Absorption and Translocation of Some Organic Compounds by Plants

John W. Mitchell[1]

Abstract

A variety of organic compounds are known to be readily translocated upward through the stems and into the leaves of plants. In contrast, relatively few are readily translocated downward from the leaves to the stems and roots. From a practical standpoint, translocation of compounds in a downward direction in plants represents a major problem in utilizing the systemic effects of organic compounds for weed control and other types of crop protection.

In basic research some effort has been directed toward learning how the downward translocation of some organic compounds such as 2,4-D by plants can be controlled or increased. Since 1945 we have learned that the downward movement of such compounds as 2,4-D in plants is associated with the downward transport of sugars and possibly other products of photosynthesis. Recently it was discovered by Gauch and Dugger[2] at the University of Maryland that boron accelerated the rate at which plants translocated sugar from their leaves to their stems. It has since been shown experimentally that this direct effect of boron on sugar transport can influence indirectly the rate of translocation of 2,4-D and some other growth-modifying compounds from the leaves to the stems of bean plants.

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2/ Gauch, H. G., and W. M. Dugger, Jr. The role of boron in the translocation of sucrose. Plant Phys. 28:457-466. 1953.

In recent experiments of another kind some compounds of the indole and benzoic acid types have been used experimentally to control to some extend the direction of transport of such growth-modifying substances as 2,4-D. Accumulation of 2,4-D in different parts of the stems of bean plants has been controlled by this means but the amount translocated from leaves or stems to roots has not been greatly increased.

The ability of a plant to absorb and translocate a compound downward from its leaves or stem is directly related to the molecular composition and structure of the compound. Study of this relation was recently broadened by the discovery of a new growth-modifying compound, alpha-methoxyphenylacetic acid (MOPA). Not only is this compound absorbed by leaves and translocated from them to distant parts of the plant, but it moved out of the roots of some kinds of plants whose stems were treated with it into the roots of other untreated ones growing nearby, and then up the stems of these untreated plants where it induced growth responses.

Preparation and Evaluation of Substituted Phenoxyacetyl Derivatives of Amino Acids

by

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and
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Abstract[3]

The preparation of the coupling products of 2-methyl-4-chlorophenoxyacetic acid (MCP) with the D-, L- and DL-forms of each of six amino acids is reported. The necessity for and the methods used to insure chemical and optical purity are discussed.

Preliminary screening data of these eighteen compounds and the parent acid on Pinto bean, Black Valentine bean, cucumber, sunflower, barley and corn are reported.

Indications of selectivity in growth response depending on the following factors are reported: (1) the optical isomer used, (2) the amino acid used and (3) the type of plant to which the compound is applied.

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3/ Abstract of a manuscript to be published in a forthcoming issue of "Weeds", Journal of the Association of Regional Weed Control Conferences.

STUDIES ON ENTRY OF 2,4-D INTO LEAVES

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J. D. Skoss[2], and J. R. Conover[1]

Although it is widely appreciated that in the application of 2,4-D to the foliage of plants, the rate and extent of entry of the material into the leaf may be of great importance in determining its ultimate efficacy, there has been very little study of the process of entry itself. At present there is available virtually no information concerning either the mechanism of entry or the factors which influence its rate and amount. This neglect has doubtless been due in large measure to the lack of simple and convenient techniques. The present paper is a progress report of studies touching on several aspects of the entry problem.

Methods

Three techniques, each with its limitations, are available for the measurement of entry of 2,4-D into leaves:

(1) Use of plant response as a criterion of entry. Even with the best techniques this method has relatively low precision and does not always distinguish entry from other processes such as translocation.

(2) Recovery of non-absorbed 2,4-D from the leaf and its determination spectrophotometrically. This method is subject to interference by other materials which are also washed from the leaf and is suitable only for relatively high doses of 2,4-D.

(3) Use of radioactive 2,4-D followed by removal of the non-absorbed portion and determination of either the absorbed or the non-absorbed radioactivity. This appears to be the most useful method available at present.

All of these methods have been employed in the present study.

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Influence of solvent and surfactants

It is well established that incorporation of various surfactants in aqueous solutions of 2,4-D may enhance greatly the effectiveness of the latter. The mechanism of this effect is still uncertain, however.

In the present study quantitative comparisons have been made of the effect of a number of surfactants representing anionic, cationic, and nonionic types. It was found that in the presence of optimal concentrations of the most effective surfactants, only 7 percent as much 2,4-D was required to bring about a standard degree of response as in the absence of surfactant, i.e. the enhancement was about 14-fold. Optimal concentrations of surfactant were of the order of 0.1 percent. Of the surfactants tested, anionic and nonionic types were equally effective, while the cationic compounds gave considerably less enhancement.

It was found further that Tween 20 enhanced very appreciably the activity of alcoholic solutions of 2,4-D. Inasmuch as the surface tension of an alcoholic solution is not decreased by addition of Tween up to at least 1 percent, it is apparent that the efficacy of surfactants is not solely a function of the depression of surface tension.

The rate and amount of entry of 2,4-D into bean leaves, both from aqueous and from alcoholic solutions, also were found to be markedly increased in the presence of Tween. Thus, of a 5 microgram dose of 2,4-D applied in a 0.005 ml droplet, only about 25% entered the leaf in the absence of Tween, whereas in the presence of the surfactant, entry was virtually complete.

Influence of dose on rate and amount of entry

Under the experimental conditions employed, 2,4-D, applied as solution containing Tween, entered at a nearly constant rate during the first few hours after application; during this time half to three-quarters of the applied dose was absorbed. Thereafter, entry continued at a much slower rate until virtually all the 2,4-D had penetrated. The pattern is quite reproducible and applies at least over the dosage range 0.5 to 50 micrograms.

Influence of pH

2,4-D solutions of low pH are known to be more efficacious than those of high pH. It would be expected that, if entry of the compound into leaves involves solution in a lipoidal phase, the process would be much more rapid at low pH at which the molecule exists in the undissociated form.

It was found that there was virtually no entry from solutions of initial pH greater than 5, whereas in more acid solution the entry increased with decreasing pH. In this experiment the 2,4-D solutions were unbuffered and it may be presumed that the pH values were shifted somewhat after application to the leaf.

Penetration through isolated cuticles

The cuticle, which is the outermost layer of the leaf, has been regarded generally as the principle barrier to entry of 2,4-D. Experiments with isolated cuticles therefore seemed of interest; with such material many of the complicating processes, such as translocation, metabolism, and protoplasmic injury, which might be expected to influence entry would be eliminated.

Cuticles were isolated by bacterial digestion of all the other leaf structures. To make such preparations it is necessary to employ leaves with rather thick cuticles; Hedera helix and Clivia nobilis were used in the present experiments. These were chosen also because they bear stomates only on one surface. The cuticles were mounted in a lucite cell in such manner that one side was in contact with water and the other in contact with air. Radioactive 2,4-D was placed on the dry side and the radioactivity of the water determined at intervals.

The maximal rates of penetration observed with the ventral, or stomate-bearing, Hedera and Clivia cuticles were of the same order as the rates of entry into intact bean leaves; this seems to support the view that the cuticle is the rate-limiting barrier in the intact leaf.

It was found, however, that there was relatively little penetration of 2,4-D through the cuticle from the dorsal, or stomate-free, surface of the leaf. This result was observed consistently in several experiments with both species, with water or alcohol as solvents, and regardless of the pH or the presence of surfactants.

Inasmuch as the dorsal cuticles were only 35% thicker than the ventral cuticles it is clear that the presence or absence of stomatal pores is the major factor responsible for the difference in the rate of penetration of 2,4-D through isolated cuticles.

A number of facts make it doubtful, however, that the findings with isolated cuticles should be extrapolated to intact leaves. Preliminary results indicate that in intact leaves of Senecio 2,4-D can be absorbed through the stomate-free surface as rapidly as through the stomate-bearing surface. There seem to be important differences also in the factors influencing penetration through isolated cuticles and entry into intact leaves. Thus, cuticular penetration is much less influenced by surfactants and not at all by pH of the applied solution.

Influence of age of leaf

In order to obtain information as to the possible influence of age and position of the leaf on rate of absorption of 2,4-D, beans were planted at weekly intervals for five weeks. Under the environmental conditions obtaining, approximately one week was required for the development of each successive leaf, so that at the end of six weeks plants were available with one, two, three, four, five, or six leaves. The absorption of 2,4-D into these various leaves during a 3½-hour interval was determined.

Each leaf appears to pass during its expansion, through a relatively brief stage of high absorbability following which its absorbability falls very markedly and remains relatively constant so long as the leaf retains its normal green color. There is a further drop to a very low level after yellowing has begun.

Influence of light

Evidence has been presented that the export of 2,4-D from leaves is indirectly dependent on light through its influence on photosynthesis. It has been claimed also that the process of entry is influenced by light. In order to test the effect of this factor, entry was measured either in light or in darkness following a light or dark period prior to application of the growth-regulator.

No significant differences in rate of absorption were found among any of the four treatments when the 2,4-D was aplied in alcohol solution containing Tween.

Hydration status of leaf

In order to ascertain whether the water content of the leaf is an influential factor in controlling absorption of 2,4-D one group of bean plants was kept well watered while another was deprived of water until it had reached the state of incipient wilting. 2,4-D was then applied to both groups; one hour after the application, water was supplied to a po tion of the dry group and 22 hours after application water was supplied to a second portion.

Measurement of entry showed that 2,4-D was absorbed more rapidly by the turgid plants than by the dry plants. The plants which were watered shortly after the application showed an intermediate absorbability whereas those which were given water 22 hours later did not differ from the plants kept dry throughout.

Entry into grass leaf

Restricted entry has sometimes been suggested as one of the factors responsible for the relatively low susceptibility of grasses to foliar application of 2,4-D. In order to obtain information on this point measurements were made of the absorption of 2,4-D by millet leaves.

It was found that the rates of entry into millet and into bean leaves were quite similar. Also like the bean leaf, the millet leaf in its development appears to pass through a relatively brief stage (prior to full expansion) of comparatively high absorbability following which the absorptive capacity declines markedly.

Entry into cotton

Some observations on cotton also may be germane to the general problem of entry. Numerous cases of injury to cotton by spray and vapor drift have been widely publicized and have given rise to the conception that the cotton plant is extraordinarily sensitive to 2,4-D.

Controlled experiments in which accurately known doses of 2,4-D were applied to the terminal buds showed that cotton and bean respond almost identically as measured by repression of leaf expansion.

There do seem, however, to be marked differences in the absorptive processes in the two species. Surfactants do not enhance the effectiveness of alcoholic solutions of 2,4-D on cotton although, as indicated above, they bring about a marked enhancement in bean. The evidence presently available indicates also that the rate of entry of 2,4-D applied as solution to leaves is less in cotton than in bean.

On the other hand, cotton appears to be much more responsive than bean to 2,4-D esters applied as vapors.

Entry of 2,4-D esters

The widespread use of esters of 2,4-D makes it of interest to compare the entry of such derivatives with that of the free acid. A number of technical difficulties have so far impeded progress along this line. In the first place, if one wishes to study the volatile esters, such as methyl or butyl, the above-described method of recovering and determining the non-absorbed residue cannot be employed because of the unknown losses due to volatilization; experiment has shown that such esters evaporate relatively rapidly from thin films such as are formed by their deposition on the leaf. Entry of volatile radioactive esters could be studied by determining the portion absorbed although this procedure would be quite laborious.

The most convenient technique would appear to be the use of a radioactive non-volatile ester; data obtained in this way are not yet available. An experiment was carried out, however, with a non-radioactive non-volatile ester to test whether its entry was enhanced by a surfactant. Beta-(2,4-dichlorophenoxy)-ethyl 2,'4'-dichlorophenoxyacetate was used and the determination of the nonabsorbed portion was made spectrophotometrically. This necessitated the application of very large doses (500 ug.) to the leaf and in consequence only a small fraction of the applied ester was absorbed. It was found that in 24 hours, 65 ug. entered from an ethanol solution containing 0.1% Tween 20 whereas only 32 ug. was absorbed in the absence of surfactant.

Conclusions

Although some insight has been gained into the influence of a number of biological and environmental factors on 2,4-D entry, uncertainty still exists as to the mechanism of entry. The bulk of the evidence indicates that absorption into the leaf is primarily by penetration of the cuticle although it cannot be excluded that the stomates also may serve as portals of entry.

The Relative Vapor Activity of Several Carbamates

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Abstract[2/]

Experimental Procedure

Experiments were designed to study the relative vapor activity of a group of N-phenyl and substituted N-phenylcarbamates. The experiments were conducted with germinating buckwheat exposed to the vapors of the carbamates in gastight cellophane cases approximately 3½ x 3½ x 16 inches in size. Filter paper (No. 1 Whatman - 9 cm. diameter) was impregnated with 100 mg. of the carbamate dissolved in 95% ethyl alcohol. After evaporation of the alcohol from the filter paper, it was inserted into the cellophane case containing the germinating buckwheat seeds growing in a 3 inch clay pot. In order to avoid direct contact with the pots containing the germinating seeds, the treated paper was fastened to the inside of the case 10 inches above the surface of the soil in the pots. The open end of the cellophane case was then sealed and the germinating seeds in the soil were exposed to the vapors for a period of 48 hours at a temperature ranging from 90° to 95°F. The pots containing the seedling plants were then removed from the bags and placed in a greenhouse for 5 days. The reduction in height of the plants served as a quantitative measurement of relative vapor activity.

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2/ Abstract of a manuscript to be submitted for publication in a forthcoming issue of "Weeds", Journal of the Association of Regional Weed Control Conferences.

Results

1. It was found that vapors of volatile carbamates will penetrate and injure seedlings prior to emergence. The most sensitive stage at which the greatest injury occurs is when the primary root is emerging through the broken seedcoat. Tests conducted with corn, cucumber and buckwheat indicated that this sensitive stage of growth was the same for each species but the time required for each species to reach this stage varied.
2. It was found that the relative vapor activity of the 11 carbamates studied varied from low to high. Isopropyl N-(3-chlorophenyl)carbamate had a vapor effect which caused a height reduction of 64 percent when compared with the controls. A carbamate of much lower vapor activity, 2-(1-chloropropyl) N-(3-chlorophenyl)carbamate, brought about a reduction of only 17 percent.
3. The vapor activity of 2-(1-chloropropyl) N-(3-chlorophenyl)carbamate was 74 percent less than isopropyl N-(3-chlorophenyl)carbamate. However, the herbicidal activity of 2-(1-chloropropyl) N-(3-chlorophenyl)carbamate was only 10 percent less than isopropyl N-(3-chlorophenyl)carbamate, thus requiring only slightly higher rates per acre to give equivalent initial weed control with less crop injury.
4. Pre-emergence field evaluation studies conducted during the summer of 1953 indicated that the application of carbamates of relatively low vapor activity resulted in longer residual herbicidal activity.
5. The carbamates with lower vapor activity were less injurious to certain crop plants such as soybeans, lima beans, cotton and others.

THE EFFECT OF SOIL ORGANIC MATTER LEVELS ON SEVERAL HERBICIDES

Stewart Dallyn

Workers with herbicides, especially under field conditions are well acquainted with the variability in results often obtained. In many cases this variability is limited to unsatisfactory weed control, but all too often the effect is in the opposite direction with the much more serious consequence of crop injury. A great deal of work has been conducted in the past on this problem and numerous enviromental factors have been found to play important roles, particularily with some chemicals. Among the more important of these factors is the organic matter content of the soil.

Meadows & Smith (2) studied the effect of temperature, organic matter, pH and rates of application on persistence of 2,4-D in soil; concluded that organic matter was most important. Holm & Tibbetts (1) and Ries & Sweet (3) have indicated that soil organic matter is tied in with crop tolerance to CMU. Both of these experiments were conducted on red beets. Numerous other references are present in the literature on this problem. Another well known fact is the manner in which muck soils differ from mineral soils in their response to numerous herbicide treatments.

GENERAL METHOD

An area is available on the L. I. Vegetable Research Farm which seemed particularily suited for studies involving varying levels of organic matter under field conditions. The field, known as "Block 4", was set up in permanent fertility plots in 1923 and maintained continuously through 1947, a total of 25 years. The treatments of particular interest to us at this time were those involving the addition of manure. Each year certain plots received, 0, 10, 20 and 40 tons of well rotted horse manure. Over the course of years various organic matter levels became more or less permanently established.

A series of eight plots (each plot 50' x 24') in one corner of the field was selected for the present study and pertinent information on them is given in Table 1. Organic matter levels over the past 6 years are included to indicate their relative stability at the present time. Test crops, Detroit Dark Red beets and Golden Cross sweet corn, were planted in each plot June 18. Pre emergence treatments with CMU were applied June 20; emergence treatments with 2,4-D June 22, and post emergence treatments with Crag & Sesin July 18.

At the time the 2,4-D was applied the corn was just emerging; the beets did not come through until 3-4 days later. Post emergence treatments were sprayed directly over the beets and directed towards the base of the corn. CMU was used at rates of 3/8, 3/4, 1-1/2 lbs. per acre; Crag & Sesin at 2, 4, 8 lbs. per acre; 2,4-D, amime salt, 1/2 and 1 lb. per acre.

TABLE 1. PERTINENT INFORMATION ON THE FIELD PLOTS USED IN THE PRESENT EXPERIMENT.

Plot Number	1*	2	3	4	5	6	7	8
1947	2.84	2.55	2.97	3.33	3.92	4.02	4.95	5.27
1948	3.10	2.83	2.95	3.54	3.79	3.73	5.09	4.96
1949	2.50	2.70	3.00	3.60	4.00	3.90	4.60	4.50
1950	2.31	2.65	3.03	3.23	3.33	3.53	4.30	4.49
1951	1.64	2.68	3.25	3.25	2.65	3.53	4.32	4.62
1952	2.59	2.90	3.19	3.45	3.84	3.68	4.51	4.40
6 year average	2.50	2.72	3.07	3.40	3.59	3.74	4.64	4.71
pH 1952	5.30	5.24	5.40	5.50	5.35	5.39	5.56	5.68

* The plot nos. above refer to permanent plots 67, 74, 73, 70 71, 72, 69, 68 respectively of Block 4, L.I.V.R.F., Riverhead, N. Y.

On July 3 counts on beet stand and weed population were made on the CMU, 2,4-D and check plots. Appearance ratings also were given to both the test crops and weed growth. The entire area was then hand weeded and the corn thinned to one plant per hill. Crag and Sesin were applied post emergence. All plots were rated again July 29. The fresh weight of the sweet corn was taken July 31 just as it was coming into tassel.

RESULTS AND DISCUSSION

For ease of presenting the data the 8 plots have been grouped into 4 organic matter levels namely, below 3.0%, 3.0-3.5%, 3.5-4.0% above 4%. Most of the tabulated data is given in Table 2. The only effect of the CMU and 2,4-D treatments on beets was to reduce stand in some cases. Injury suffered by corn from these materials was evidenced largely through stunting. Crag and Sesin produced similar symptons on the test crops though the effect of the former was much more severe. These symptons on beets were typically severe wilting with later development of intense pigmentation with small white necrotic spots giving the leaves a speckled

TABLE 2. THE EFFECT OF ORGANIC MATTER ON THE RESPONSE OF BEETS AND SWEET CORN TO SEVERAL HERBICIDES

Organic Matter Level[1] Treatment	Beet Stand				Fresh Weight Corn				Weed Rating[2]				Crop Appearance[3]			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. CMU 3/8 lb.	176	124	125	100	45.5	49.0	61.0	77.0	2.3	2.3	1.5	1.5	1.5, 1.0	1.5, 1.0	1.5, 1.0	1.5, 1.0
2. " 3/4 "	113	93	106	131	33.5	48.5	65.5	55.0	1.3	1.3	2.3	2.0	4.0, 1.0	3.5, 1.0	2.0, 1.0	2.0, 1.0
3. " 1-1/2 "	30	88	87	164	28.0	47.0	54.5	67.5	1.0	1.3	1.8	1.0	5.0, 2.0	3.5, 1.5	3.0, 1.0	3.0, 1.0
4. Crag 2 lb.					49.0	49.0	58.0	66.0					1.5, 1.5	1.0, 1.0	1.5, 1.0	1.1, 1.0
5. " 4 "					42.5	55.5	59.5	63.0					4.5, 1.0	4.5, 1.0	3.0, 1.0	2.5, 1.0
6. " 8 "					30.5	58.5	56.0	67.5					5.0, 1.5	3.5, 1.0	3.0, 1.0	2.5, 1.0
7. Sesin 2 lb.					42.5	45.0	58.0	67.0					2.0, 1.5	1.5, 1.0	1.0, 1.0	1.5, 1.0
8. " 4 "					37.5	57.0	60.0	71.0					1.5, 1.5	1.0, 1.0	1.0, 1.0	1.0, 1.0
9. " 8 "					32.5	59.0	59.5	64.0					2.0, 1.5	1.0, 1.0	1.0, 1.0	1.0, 1.0
10. 2,4-D 1/2 lb.	93	105	129	127	51.5	49.0	52.5	75.0	2.0	2.5	2.5	1.3	4.0, 1.0	2.5, 1.0	3.0, 1.5	3.0, 1.0
11. " 1 "	17	100	123	131	33.0	58.5	60.5	63.5	1.3	1.8	2.5	1.8	5.0, 2.5	4.0, 1.0	4.0, 1.0	3.5, 1.0
12. Check	130	92	104	139	53.0	65.0	68.5	55.5	2.8	3.0	3.0	2.5	1.0, 1.0	1.0, 1.0	1.0, 1.0	1.0, 1.0

1- 1 < 3% 2. 3.0-3.5% 3. 3.5-4.0% 4. > 4%
2- 1, clean 5, heavy infestation
3- 1, normal, 5, severe injury. Left hand figure in each column applies to beets, right to corn

<u>Note</u>: Crops planted June 18, CMU and 2,4-D applied June 20, rest July 18.
Beet stand & weed rating were made July 3 on the pre emergnce treatments.
Crop appearance rating made July 29, see text for type of injury.
Corn harvested July 31 at tasselling.

appearance. The corn suffered some tip yellowing or burning of the lower leaves.

Effect of Treatments on Fresh Weight of Corn

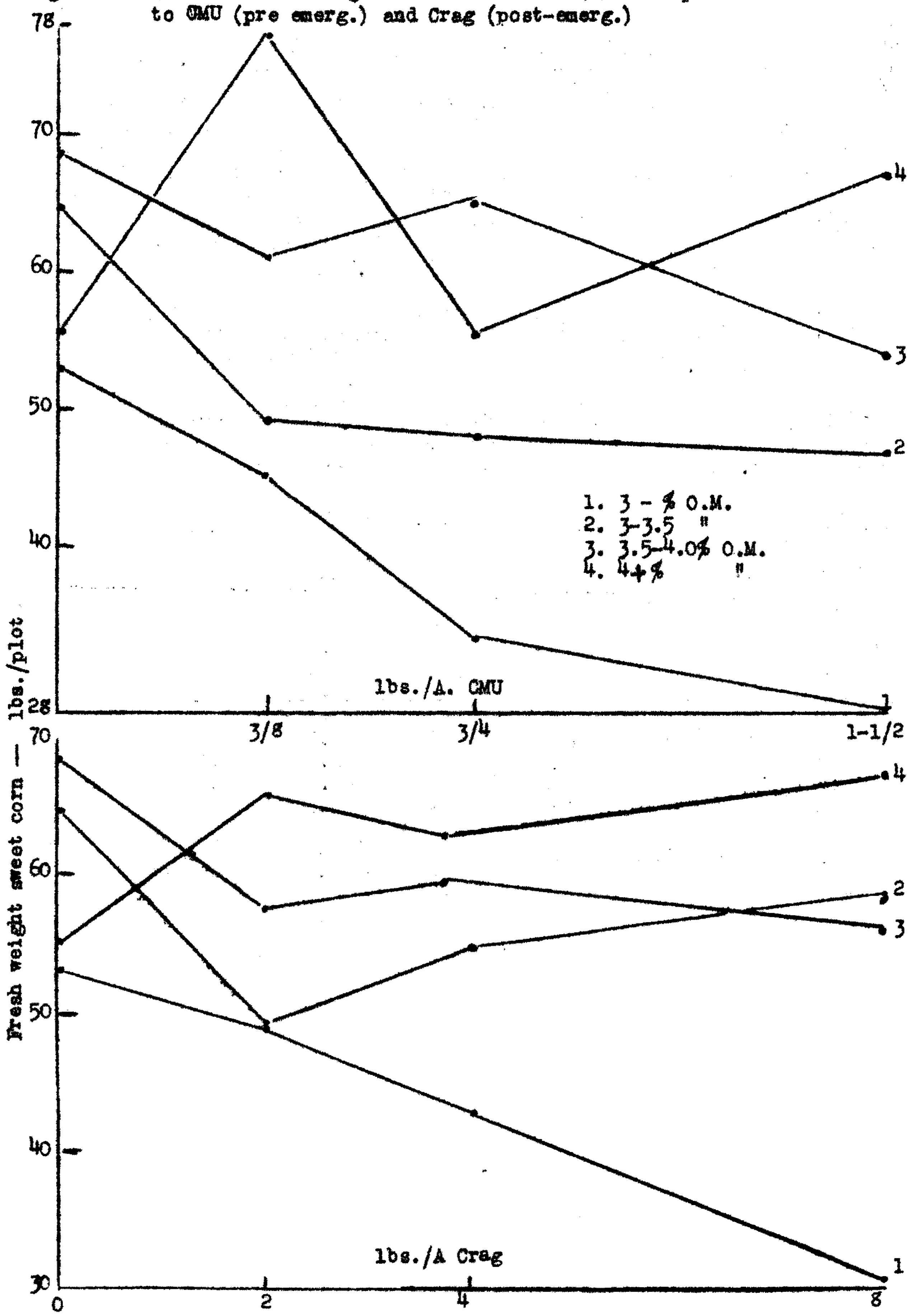
The statistical analysis of this data is presented in Table 3 and some of the significant interactions portrayed graphically in Figure 1. Of primary interest in this study are the significant treatment organic matter interactions. Crag and CMU were the only two materials which had definite effects on yield and both were markedly influenced by organic matter level. Corn growing in soil with less than 3% O.M. was severely stunted by increasing applications of CMU up to 1-1/2 lbs./A. As the organic matter content was increased, however, this stunting action of the chemical was progressively less and at contents above 3.5% even the 1.5 lb. rate had no effect. The response to Crag was in practically an identical manner.

TABLE 3. DATA ANALYSIS FOR EFFECT OF TREATMENTS ON FRESH WEIGHT OF CORN.

Source	D.F.	S.S.	Variance	F
Plot Total	15	1906.78		
Between Dup.	4	340.42	85.10	
Between Levels	3	1104.99	368.33	
" Halves	8	461.37	57.67	
Linear O.M.(CMU)	1	329.83		
" " (Crag)	1	186.17		
" " (Sesin)	1	269.10		
" " (2,4-D)	1	88.78		
Plot Treat. Total	191	3891.33		
" Total	15	1906.78	127.12	11.18**
Treat. Total	11	106.67	9.70	
Linear rate (CMU)	1	77.06		6.77*
" " (Crag)	1	22.48		
" " (Sesin)	1	12.75		
" " (2,4-D)	1	17.43		
T x L	33	376.66	11.41	
CMU' x OM'	1	61.46		5.41*
Crag x OM'	1	56.01		4.93*
Sesin' x OM'	1	34.54		
2,4-D' x OM'	1	23.89		
Error	132	1501.22	11.37	

* Exceeds required F at 5% point
** Exceeds required F at 1% point

Figure 1. Effect of soil organic matter level on the response of sweet corn to CMU (pre emerg.) and Crag (post-emerg.)



Effect of Pre Emergence Treatments on Beet Stand

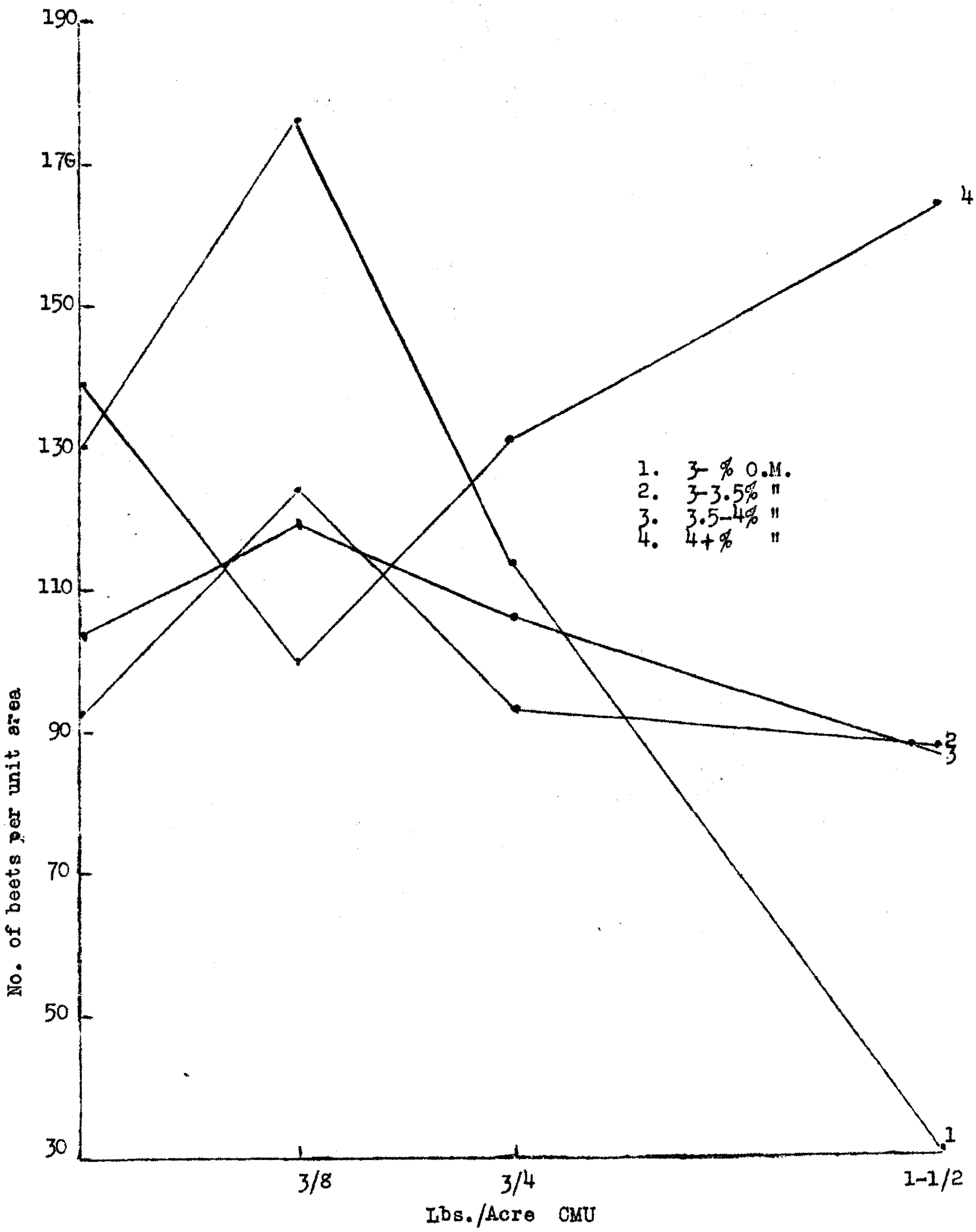
Examination of Table 4 indicates marked significance between the linear effects of CMU and organic matter. The relation between these two factors and beet stand was the most striking of the entire experiment, see Figure 2. The 3/8 lb./A was satisfactory regardless of soil organic matter level. When the rate was increased to 3/4 and up 1-1/2 lbs. on the lowest O.M. level soil the beet stand dropped very rapidly. Stands on the three higher levels were not significantly effected though there appears to be a slight downward trend, with increasing rate of CMU, in all but the highest level. This indicates that no satisfactory recommendation for the use of CMU on beets can be made without considering the organic matter of the soil involved.

TABLE 4. ANALYSIS FOR DATA ON INFLUENCE OF ORGANIC MATTER ON STAND OF BEETS TREATED PRE EMERGENCE WITH CMU AND 2,4-D.

Source	D.F	S.S.	Variance	F
Plot Total	15	4633	308.9	
Between Dup.	4	1365	341.3	
" Levels	3	1296	432.0	
" Halves	8	1972	246.5	
Linear O. M. (CMU)	1	245		
" " (2,4-D)	1	963		
Plot Treat. Total	95	20144		
" Total	15	4633	308.9	
Treatment Total	5	1122	224.4	
Linear CMU	1	507	507.0	3.09
" 2,4-D	1	282	282.0	
T x L	15	4545	303.0	
CMU' x O.M.	1	1489	1489.0	9.07**
2,4-D x O.M.	1	413	413.0	2.52
Error	60	9844	164.1	

** Exceeds required F at 1% point

Figure 2. The Effect of CMU on Stand of Beets Grown On Four Levels of Organic Matter



Effect of Pre Emergence Treatments on Weed Population

In the interest of space the data and analysis for weed counts have not been given. There was a highly significant linear effect of CMU but no interaction with O.M. level. In other words each increment of CMU consistently reduced weed population regardless of the O. M. content of the soil. The over-all control however was much better on the lower organic levels than on the high. 2,4-D treatments had no significant effects or interactions and in general weed control was unsatisfactory.

SUMMARY

(1) A marked relationship was found between the response of sweet corn and red beets to CMU and the organic matter level of the soil involved. The interaction would indicate that the organic matter content of the soil should definitely be considered when making recommendations concerning the use of CMU on such crops.

(2) A similar interaction existed with Crag but not with Sesin or 2,4-D under the conditions of this experiment.

(3) Each additional increment of CMU consistently reduced weed population regardless of the O. M. level of the soil. Any given amount of the chemical, however, gave better weed control on the lower levels. 2,4-D treatments gave unsatisfactory weed control. Data was not taken on post emergence treatments with Crag and Sesin.

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FACTORS AFFECTING THE HERBICIDAL ACTION OF DINITRO-ORTHO-SECONDARY BUTYL PHENOL[1]

W. F. Meggitt, H. A. borthwick, R. J. Aldrich and W. C. Shaw[2]

Abstract

Much of the work with the various formulations of dinitro-ortho-secondary butyl phenol has given a variety of results with respect to their herbicidal activity. The following investigations under closely controlled conditions were conducted to help explain some of these variable results obtained with DNOSBP when used as a herbicide.

Environmental conditions both before and after treatment with aqueous sprays of DNOSBP were considered to have an important bearing on the results. Experiments were designed to study the effect of temperature on the activity of DNOSBP. Most of these experiments were conducted in growth chambers where temperatures of 50, 60, 70, 80, 90, 96° F. were closely maintained. Light intensity and relative humidity were kept constant. In addition plants were subjected to a variety of growing conditions before and after treatment.

The three formulations of DNOSBP used in these studies included the ammonium, triethanolamine, and alkanolamine salts. Soybeans and cotton were used as test plants in most of the experiments.

The ammonium salt was much more active than the amine salts of DNOSBP. The triethanolamine salt was slightly more active than the alkanolamine salt. The ammonium salt as an aqueous spray showed a high degree of activity at 50° F. whereas the amine salts showed little activity until the temperature was above 70° F. The activity of all formulations increased as the temperature increased.

Volatility or vapor activity was considered to be important in affecting the herbicidal activity of DNOSBP. Vapor activity

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[1]Cooperative investigations between the Division of Weed Investigations, the Division of Fruits and Vegetable Crops & Diseases, ARS, USDA, Beltsville, Maryland and New Jersey Agricultural Experiment Station.

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of the three formulations from filter paper and from soils was studied at several temperatures.

The vapor activity of the three formulations of DNOSBP ranked in the same order as they did as aqueous sprays, ammonium salt, triethanolamine salt, alkanolamine salt. The ammonium salt showed considerable vapor activity at 70° F., and the amine salts began to show considerable vapor activity at 80° F. The vapor activity in all cases increased as temperature increased.

Vapor activity was much greater from a wet soil than from a dry soil. Liming the surface of the soil decreased the vapor activity markedly.

EFFECT OF CERTAIN HERBICIDES ON O_2 UPTAKE BY SOIL PREVIOUSLY ENRICHED WITH NITRIFIERS[1]

M. G. Hale[2], W. E. Chappell[3] and F. H. Hulcher[4]

Introduction

The manometric technique for measuring effects of chemicals on the respiration of soils previously enriched with nitrifying bacteria has been reported as a means of studying the bacteria under conditions similar to those existing in the field (Quastel and Scholefield, 1952). Previous unpublished work in this laboratory has borne out the usefulness of the method. The present paper presents information comparing the effects of several herbicides on the respiration of nitrifying bacteria using the Warburg manometer to measure the O_2 uptake.

Methods

The percolation apparatus of Lees (1947, 1949) was used to increase the population of nitrifiers in the soil. When the rate of nitrification became constant, in about two weeks, the soil was said to be "enriched" with nitrifying bacteria and was used for respiration studies. The percolating fluid was 0.01 M NH_4Cl.

Preparation of the enriched soil for use in the Warburg respirometer consisted of washing the soil until a negative qualitative test for NO_3- and NH_4- was obtained. The soil was then spread on filter paper and allowed to dry for 1/2 hour. At the end of this time it was chopped with a spatula and mixed thoroughly. One and one half grams of the resulting soil aggregates was then placed in a conventional Warburg respirometer flask and 1 ml of 0.01 M NH_4 Cl plus 1 ml of the test material was added, except that 2 ml of H_2O was added in the water blanks and 1 ml of H_2O plus 1 ml of NH_4Cl was added to the controls. Three tenths ml of 30% KOH was placed in the center well of the flask to absorb CO_2. After an equilibrium period of 15 minutes, the O_2 uptake was measured over a period of 2 1/2 hours at 37°C.

The herbicides used and their source are listed in Table I. All were commercial formulations.

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1 These studies were supported in part by the Virginia Polytechnic Institute Educational Foundation, Inc., the Virginia Agricultural Experiment Station, and a grant from the Columbia Southern Chemical Corporation.

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Table I.- Herbicides used and sources

Source	Trade name	Chemical name
DuPont	CMU	3(P Chlorophenyl) 1, 1-dimethyl urea
Monsanto Chemical Co.	PCP - Santobrite	Pentachlorophenate, Na Salt
Dow Chemical Company	Dinitro - "Premerge"	Alkanol amine salts of dinitro o sec butylphenol
U. S. Rubber Company	Alanap - 5	N-1 naphthyl phthalamic acid
Columbia Southern Chemical Corporation	3 Chloro IPC	Isoprophyl (N-3 chlorophenyl) carbamate
Dow Chemical Company	Dalapon	α,α-dichloroproprionic acid

Soils contain a mixed population of organisms, both autotrophic and heterotrophic. The O_2 uptake of a soil sample is, therefore, the sum of the O_2 uptake of the different groups of organisms. By employing the percolation technique and percolating soil with ammonium chloride solution, the population of the nitrifying organisms is increased until the surfaces of the soil particles are saturated with them. At this point a constant rate of nitrification of the sample is attained. On a theoretical basis, if the soil is then washed completely free of ammonium ions, the O_2 uptake is a measure of the endogenous respiration of the nitrifiers and a measure of the respiration of any other organisms present.

In practice it has been found that the soil must be nitrifying at a rapid rate, i.e. the population of nitrifiers must be dense and they must be actively metabolizing if significant differences in O_2 uptake are to be obtained in the various treatments.

In many experiments there has been a wide variation in the duplicate water blanks while the ammonium chloride control and the treated samples showed close agreements between duplicates. Whether this lack of consistent results from the water blanks has been because the ammonium ions have not been washed from the sample or because of some other factor has not been determined satisfactorily.

Results and Discussion

The results of a typical experiment in which consistent agreement of the water blanks was obtained are presented graphically in Figure 1. At the end of 2 1/2 hours the O_2 uptake of the water blanks was 39% of the NH_4Cl controls.

A comparison of the effects of various herbicides on the O_2 uptake in the presence of NH_4Cl is shown in Figure 2. No correction for the water blank was made. All results are plotted as the O_2 uptake in percent of the ammonium chloride control.

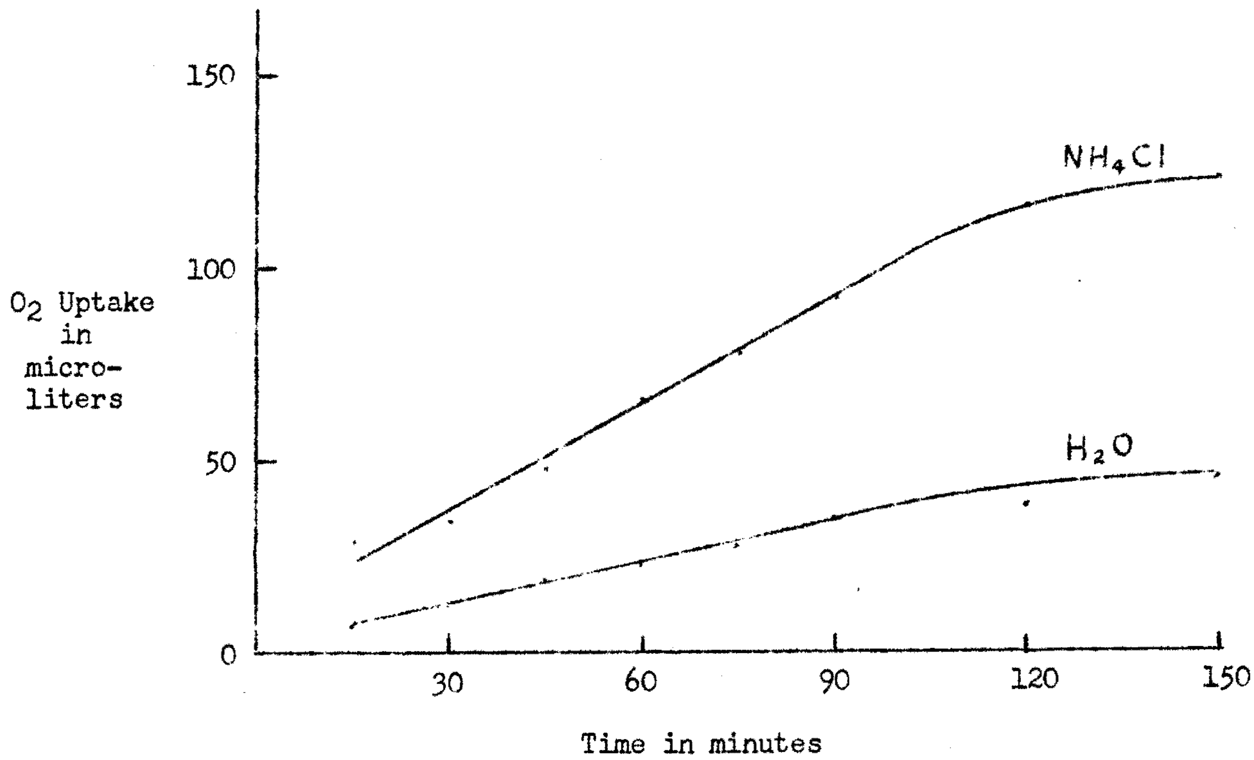

Fig. 1.- O_2 uptake of enriched soil in the presence of H_2O and NH_4Cl during a 2 1/2 hour period. Each point represents the average results from 2 manometers.

PCP, 3 Cl IPC, Dinitro, and CMU all markedly inhibited the O_2 uptake of enriched soil. Of these four herbicides, PCP was much more effective at low concentrations than the others causing 20% inhibition at 2.5 p.p.m. Alanap-5 was much less effective than these four at the concentrations used.

If inhibition of respiration continued at the rate indicated by the results at the end of 2-1/2hours, it is conceivable that the nitrifiers would die. However, unpublished data from experiments in which 3 Cl IPC was percolated through soil for two months and then replaced with a solution of NH_4Cl, showed that the nitrifiers did recover and proliferated when the herbicide was removed. Whether this is true of herbicides other than 3 Cl IPC is not known.

Dalapon at low concentrations caused an increase in O_2 uptake above that of the controls. This increase may be due to utilization of the chemical or the wetting agent, thus increasing the substrate concentration. No experiments were made to verify this, however.

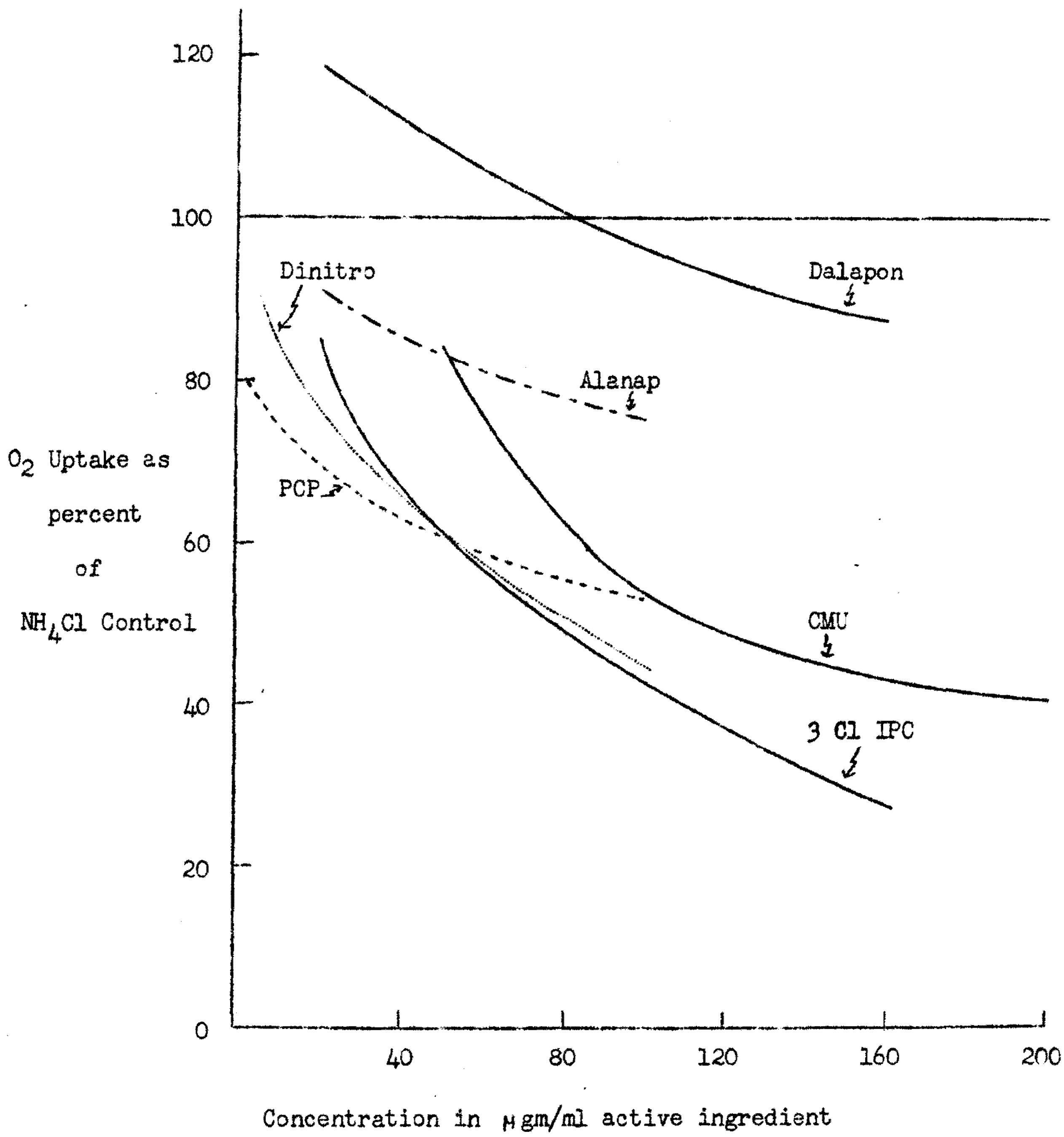

Fig. 2.- O_2 uptake of enriched soil in the presence of several herbicides and at various concentrations.

In order that the results have practical meaning they should be translated into terms of field application. The field application rates of the various herbicides have been calculated as μ gm per cm^2 of the field surface covered and are presented in Table II.

Table II.- Field application rates

Chemical	% active ingredient	Field application rate/acre	μ gm active ingredient/cm^2 surface
CMU	80	1 lb.	9
PCP	88	20 lb.	197
Dinitro	3 lbs/gal.	6 lb.	67
Alanap-5	90	6 lb.	60.5
3 Cl IPC	4 lbs/gal.	4 lb	45
Dalapon	100% Na salt	5 lb.	56

However, the amount of herbicide applied per unit of area has little correlation with effects on microorganisms. It is the concentration of the herbicide in contact with the organisms which affects them.

The concentration of herbicide in the soil which affects the microorganisms is dependent upon a number of factors. The amount applied per cm^2 of soil surface may remain on the surface, it may be dissolved in the soil solution, it may be leached by subsequent rains, it may volatilize. The effective concentration is also dependent upon the percent of moisture in the soil and whether the material is adsorbed on the soil particles or remains in the capillary water.

Nitrifying bacteria live in thin films of moisture adhering to the soil praticles. Their rate of respiration and degree of resistance to the effects of the herbicide may be greatly altered by the soil moisture conditions.

A consideration of these factors makes difficult a comparison of the effects on microorganisms in manometric studies with the effects of field application of herbicides. The results prove that some herbicides do have a definite inhibiting effect on respiration and methods for determining the effective concentrations under various field conditions should be found.

Gamble et al. (1952) using soil samples taken directly from the field found that certain herbicides reduced the number of organisms and rate of respiration of heterotrophic soil organisms for a period of at least three months. Possibly some herbicides such as sodium PCP may reduce the activity of the nitrifiers to such an extent as to reduce the soil nitrate content.

Summary and Conclusions

The relative effects of different concentrations of herbicides on respiration of nitrifying organisms in enriched soil can be determined by using the Warburg apparatus. PCP, 3 Cl IPC, Dinitro and CMU markedly inhibited the O_2 uptake of enriched soil. The usual field application rates for these herbicides may be within the range of concentrations at which inhibition of O_2 uptake occurs.

At the concentrations used Alanap-5 was much less effective in inhibiting O_2 uptake than any of the other materials used except Dalapon. Dalapon, at low concentrations caused an increase of O_2 uptake above that of the controls.

Comparison of effects of concentrations used in manometric studies with effects of concentrations which may exist under field conditions is difficult. A brief discussion of factors affecting concentration of herbicides as applied in the field is included.

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Response of Eighteen Plant Species to DPA (3,4-D), 2,4-D, and MCP

J. R. Hansen and R. E. Ogle[1]

The objective of the experiments reported here was to learn something of the selectivity and toxicity of DPA (3,4-dichlorophenoxyacetic acid) in comparison with 2,4-D (2,4-dichlorophenoxyacetic acid) and MCP (2-methyl-4-chlorophenoxyacetic acid.

Phytotoxicity of 3,4-D (DPA) was first reported by Thompson, et al.(4) Their results indicated that 3,4-D had 89 per cent of the activity of 2,4-D in a corn germination test. It had 55 per cent of 2,4-D activity in a water droplet test and 107 per cent of 2,4-D activity in an oil droplet test. In the latter two experiments, droplets were applied to growing bean plants. Leaper and Bishop(2) reported a careful laboratory study on growth effects of chloro-substituted phenoxyacetic acid compounds. Among the disubstituted compounds, 3,4-D and 2,5-D were highly active in a test of root inhibition of <u>Lupinus albus</u>, but slightly less active than 2,4-D. Ennis, et al(1) reported the effects of 3,4-D on Irish potatoes, and noted that it was less injurious than 2,4,5-trichlorophenoxyacetic acid.

<u>Experimental</u>

Herbicides were applied in pre- and post-emergence experiments. Crop species were sunflower, cotton, Irish potatoes, summer squash, snap bean, sugar beet, flax, Sudan grass, soybean, buckwheat, oats, barley, millet, rape, red clover, alfalfa, and brome grass. These were planted in well-prepared, fertile silt loam soil near Wilmington, Delaware, on May 12 and 13, 1953. Both field and sweet corn were also planted but stands were unsatisfactory. Each species was planted in three adjacent rows running the length of the field. A thick uniform stand of redroot pigweed covered the entire field. Herbicide plots were laid out across the width of the field, including three 7-foot rows of each species. The experimental plot arrangement and spray equipment was similar to that described by Shaw and Swanson(3). All herbicide treatments were duplicated. Rains fell frequently after planting and all species except corn made good stands.

Experiment I. The isooctyl ester of DPA and butoxyethanol ester of 2,4-D were applied at rates of 1,2, and 3 pounds per acre on May 16, three days after planting and prior to emergence. Soil was wet at time of application and heavy rains fell the day after application.

Experiment II. The isooctyl ester and triethanolamine salt of DPA at rates of 0.25, 0.5, 1.0, and 2.0 pounds per acre and butoxyethanol ester and alkanolamine salt of 2,4-D at rates of 0.25 and 1.0 pound per acre were applied, post-emergence, on May 27. Crop plants were well established and had 2 to 4 true leaves.

Experiment III. Triethanolamine salt of DPA and alkanolamine salts of 2,4-D and MCP at rates of 0.25, 0.5, 1.0, and 2.0 pounds per acre were applied on June 10.

1. Plant Physiologists, Hercules Powder Company, Wilmington, Delaware.

Results from treatments were taken by estimating reduction in stand and viror in comparison to untreated checks. Data were taken by two observers working independently. Tabular data presented in this paper are percentages of maximum possible injury.

An analysis of variance was run on Experiment III data converted to $\sqrt{X + 0.5}$ to indicate validity of experimental method and agreement between observers.

Results and Conclusions

DPA was relatively more effective as a foliage spray than as a pre-emergence spray in comparison with 2,4-D. Data supporting this conclusion are given in Table 1. It can be seen that difference in percentage of maximum toxicity exhibited by 2,4-D and DPA is much greater in the pre-emergence experiment than in the post-emergence experiment.

The selective toxicity of DPA was different from that of either 2,4-D or MCP. This is illustrated in Tables 2 and 3. While DPA was less toxic than 2,4-D or MCP to many species, several were more sensitive to DPA. An interesting situation occurred with leguminous species, Table 2. DPA and MCP were tolerated equally by red clover, both being less toxic than 2,4-D. On alfalfa, DPA was much less toxic than 2,4-D or MCP. DPA was highly toxic to soybean and snap bean. Table 3 illustrates differences in tolerance of five broad-leaved species to the three herbicides. DPA was more toxic to flax and squash but less toxic to buckwheat and pigweed than MCP or 2,4-D. All materials were highly toxic to sunflower. Remaining broad-leaved species were more sensitive to 2,4-D than to DPA.

Species belonging to the Gramineae family were either as tolerant or more tolerant of DPA than 2,4-D. Differences in 2,4-D and DPA tolerance of this group were not striking.

All three materials caused leaf modification to naturally occurring horse nettle but did not appear herbicidal.

An analysis of variance on Experiment III data indicated a real difference in specificity of the herbicides. The species x herbicides interaction was highly significant with an F value of 18.8. Although a highly significant difference was detected between estimates of two observers rating the experiment, variance introduced by this factor was relatively small, amounting to 1 per cent of mean squares for species or rate of herbicide application.

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Table No. 1. Comparative effect of DPA and 2,4-D applied to eighteen species in three experiments, data expressed as percentage maximum possible injury.

Herbicide	Experiment I Pre-emergence Average of 3 rates	Experiment II Post-emergence Average of 2 rates		Experiment III Post-emergence Average of 4 rates
		Ester	Amine	
DPA	38	36	29	31
2,4-D	66	53	39	43

Table No. 2. Effect of DPA, 2,4-D, and MCP applied as a foliage spray to four leguminous species, data expressed as percentage maximum possible injury at four rates of application.

Herbicide	Red Clover	Alfalfa	Soybean	Snap bean
DPA	19	26	71	74
2,4-D	49	66	62	34
MCP	20	54	80	22

Table No. 3. Effect of DPA, 2,4-D, and MCP applied as a foliage spray to five broad-leaved species, data expressed as percentage maximum possible injury at four rates of application.

Herbicide	Flax	Squash	Sunflower	Buckwheat	Pigweed
DPA	30	44	65	31	34
2,4-D	23	32	83	56	83
MCP	15	27	85	55	75

THE RELATIONSHIP BETWEEN RESEARCH AND EXTENSION IN WEED CONTROL[1]

Albin O. Kuhn[2]

Introduction

In 1862 the Congress of the United States passed the Morrill Act which provided for the establishment of a land grant college in each state. This came about as a result of a recognized need for trained personnel to serve agriculture. By 1887 it became apparent that sustained research in agriculture was needed if the purpose for which the land grant colleges were established was to be fulfilled. This culminated in the passage of the Hatch Act which provided for an agricultural experiment station in each state. Out of the growth of experimental work and teaching came the Smith-Lever Act of 1914 which provided for cooperative extension work.

These and other Acts developed in response to the needs of the people in this country. The fact that a number of years elapsed between these Acts tends to emphasize that each was well thought out and was designed to solve existing problems. That these have developed under a democratic society through the action of representatives of the people emphasizes both that a need existed and that those who work in these organizations have a mandate from the people to perform a service. Their common parentage and close association through the years both assumes and assures that there is a close relationship among these services.

The control of weeds has been an important aspect of the culture of plants throughout the history of agriculture in the United States. Earlier work was primarily along the lines of cultural practices that could help the forces of nature to work in favor of cultivated crops and to the detriment of competetive weeds. Gradually ways were developed to use chemicals for the control of weeds. Very recently in our agriculture, chemicals that can be used as selective herbicides have found their place. The development of these selective herbicides and the estimation of their potential has led to a whole new phase of work in crop production.

1/ Published with the approval of the Director of the Maryland Agricultural Experiment Station as Miscellaneous Publication No. 184, Contribution No. 2498.

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In addition to the research and extension forces that work in the Department of Agriculture and the states, there are a number of research men and company representatives in private industry who are spending their time in the development and testing of herbicides. This group has an important place in weed control that fits into the cooperative scheme that results in a good program for farm use.

Those of us who are engaged in weed control work find ourselves in a new science that is taking its place along with crop breeding and crop management. As a part of this new approach to serving agriculture, it behooves us to learn all we can from past experience with other phases and to further the relationship between research and extension.

Extension's Contribution

The cornerstone of extension work is education. Having the best available information in a form that can be readily used by farm people is essential. In crop production and in weed control mere repetition of research findings does not serve the need. The good extension man studies the research findings, makes these a part of his background of information concerning weed control, and uses this information in light of the particular problem. To be sure, the specialist and the county agent need research information but this information is of little value without their knowledge of the local situation and their observation of how research findings apply in the field. This need for "know how" in the application of research findings makes the extension job of fundamental importance in effective field control procedures.

I believe that these are the important contributions that extension men can and are making to an effective weed control program; namely:

1. Directing attention to the most pressing weed problems. Extension men who travel throughout the counties and the state, and to whose offices requests for help are made, are in position to know more about the weed problems in their areas than other workers. They are in a position to not only recognize what the farmers place foremost as weed problems but also to recognize potential problems.

2. Judging which weed control recommendations are practical for farm use. Extension workers with their broad knowledge of farm thinking and farmer acceptance of recommendations are in an excellent position to judge which practices that are developed from research findings can be put into practical use by farm people. Effective control measures have been and will be developed that are simply too expensive, too time consuming or, for some other reason, will not be accepted by farmers. Extension workers can help to eliminate these from the educational material the farmers receive.

3. Personally contacting farmers to promote better control of weeds. Confidence of farmers in the county agent and the extension specialist has an important bearing on the way in which he receives new information and adopts new practices. The procedures in selective weed control are more exact than in many other phases of work on the farm. The extension worker who has the confidence of the people can come nearer to getting weed control information into practice, and to giving the right emphasis to careful application of the information, than is possible from other sources.

4. Demonstrating new weed control practices. Good demonstrations have always been an important part of extension teaching. Most of us have to see results in order to believe them. Demonstration of weed control practices not only gives the extension worker and the farmers an opportunity to see results but also serves as applied research in learning whether the recommendations give effective field control under a given set of conditions.

5. Arousing interest in weed control. The extension worker in his daily contacts with farm people has many opportunities to call attention to the occurrence of weeds in various crops and the toll that these weeds are taking in lost production. Many farmers have come to accept weeds as a part of their farming operation and do not realize the annual loss that occurs. The extension worker is in the best position to arouse farm people to recognize the problems that exist.

6. Putting weed control in its logical place in the crop production program. The fact that the extension worker must look broadly at farm problems puts him in an excellent position to judge the importance of various activities on the farm and to place weed control in its rightful place in the educational work.

The Contribution of Research

Agriculture is not an exact science. Many of the findings of research that apply to crop production vary with the particular climatic and soil conditions that exist in various areas of the United States. This emphasizes the important use of an agricultural experiment station in each state. With an effective program each experiment station becomes the best source of information to the farm people in a given state. Just as the cornerstone of extension is education, the cornerstone of the experiment station is research; supplying sound information for educational use.

Among the important contributions that research workers can and are making to effective weed control are the following:

1. Discovering through research the most efficient way in which particular weeds can be controlled. This includes learning the tolerance of crop plants to different herbicides, the rates, dates, and methods of application which give good field control, and other information that is needed for recommendations.

2. Serving as a source of fundamental information on herbicides. The research worker who is spending a major portion of his time on weed control work is in the best position to know the fundamental information available concerning various herbicides. This is possible because the research worker is to some extent protected from the day-to-day problems of applying weed control information. He, therefore, has the time to study the available literature on herbicides and to contact other research workers to broaden his knowledge.

3. Charting new attacks on weed problems. With this background of information, and with an opportunity to determine through the help of extension workers the weed controls that are most needed in his area, the research man has an opportunity to develop entirely new approaches to effective control. He follows these new approaches with research work to determine their potential and from this comes the new recommendations for demonstrations, and eventually for farm use.

4. Evaluating new chemicals. Industrial research programs are developing new chemicals which have a place a herbicides. The research worker, in close cooperation with the Department of Agriculture and industrial research representatives, is in a position to aid in screening these chemicals and in finding the place they may fill in a rounded control program.

Cooperation

Effective cooperation between research and extension is the rule rather than the exception today. Each of these phases of work is dependent on the other if the most effective contribution is to be made. In the eyes of the farmers they serve directly or indirectly, all of these workers are from one organization; all are employed by the farmer to give him the information that will help to improve the efficiency of his operation.

In cooperating, these phases of work are serving not only the farmer but also society at large. This is an important fact and should be emphasized as the number of farm people in this country becomes a smaller part of the total population. Each person in our society contributes to the support of research and extension. Since food is used by all, improving the quality or efficiency of production is to the advantage of all.

In looking at the few problems that do arise in cooperation, I would like to make these comments toward better integration of research and extension work:

1. The extension worker should be more patient in dealing with the research worker. When the extension worker is faced with a problem that he cannot answer, he often lays it on the doorstep of the research man, and often wants the answer immediately. In a field as new as the use of selective herbicides, many of the fundamentals are not yet known and these answers often take time. The research worker is limited in the number of problems that he can actively study at any one time, and once he is embarked on a particular line of research he must see it through if he is to make any real contribution to existing knowledge. The research worker in charting new approaches to weed control problems will often find that the outlined course does not bring the answer. This can happen with the best laid plans and the best thought out procedures. If all research were to lead to productive answers and to work out just the way the worker expected, there would be little need for research. In dealing with field control problems the many soil conditions, climatic conditions, plant variations and individual seasonal variations affect the research findings. All of these must be considered in developing an adequate answer to a problem. This takes time.

2. The research man should attempt to better understand the extension worker's need for information even though complete answers are not possible. The misunderstandings that I have observed along this line have centered primarily around the fact that the research worker wants to be able to give a complete answer, and to show the data to thoroughly support this answer, before he passes any information along to the extension worker. This has its good and bad features. Recommendations made on thorough research are far less likely to lead to poor results than when they are given on a basis of few data. On the other hand, I believe that the research worker must realize that there are situations where a farmer is willing to take the risk of losing a crop through the use of a herbicide that has been only partially studied rather than to leave an area untreated for weed control. Two ways in which this problem is being solved are:

   a. The publication of annual progress reports stating the findings, the inadequacies of the data, and the limited conclusions that can be drawn, and making this available to anyone who is interested.

b. Preparation of diagrams of experiments under way so that anyone who is interested can view the work as it progresses serves to let the extension worker follow field work.

With this approach the objection is often raised by the research worker that by the time his information is in shape for a bulletin or an article, all of the information has already been made public and the article does not receive attention. I believe that the opposite is true. Often the article is received with far more interest and by far more people when they have been able to follow the progress of the study each year.

3. The extension worker should be careful to give due credit to the research worker and to explain to farmers the reason research is a slow process. In daily contacts and in meetings, it is easy for the extension worker to refer to the experiment station research and to credit the experiment station with the findings that have helped to make definite recommendations. It is equally easy to belittle research. For both the extension man and the research worker, a display of teamwork and of interdependence strengthens the respect of farm people and results in wider acceptance of information.

Summary

In summary may I point to our Northeastern Weed Control Conference as an example of the relationship between research and extension. In the start, this Conference brought together research workers in industry and in the state experiment stations to compare information and to learn about new developments in the use of herbicides. As the work of this Conference progressed, the need for greater contact with extension workers became apparent and extension workers were given a place on the programs. This year for the first time a special section is set aside for extension.

Close association of research-extension work has thus again proved worthwhile. It is a mutually beneficial association with each depending on the other if maximum profits are to be gained from agricultural research. The opportunities for increased efficiency in agriculture are great. The opportunity for selective weed control to fill an ever increasing place of importance in plant culture is here. The rapidity with which the use of herbicides reaches its potential is greatly dependent on how we as extension and research workers are willing to do our jobs well, but with an open mind, and cooperate with others who have a contribution to make.

SPONSORING AN EXTENSION WEED CONTROL PROGRAM

E. P. Sylwester[1]

I appreciate the opportunity of visiting with you at your Weed Control Conference to discuss with you some of the things which I believe enter into sponsoring a good weed control program. I want you to keep in mind that some of the things which I am going to say probably reflect my experiences in Iowa and that I am in no way trying to tell you how to run your own business. I do hope, however, that from this presentation you will be able to glean some things which may be of help to you in sponsoring weed control programs in your own areas.

In the first place, we are living in dynamic times. We are living in a changing world. This is true, not only in weed control, it is true in almost all lines of endeavor. Think of the tremendous advances that have been made in weed control, insect control, animal and human nutrition, in transportation and in the standard of living. The other day a now era in transportation was opened when an airline company announced Coast to Coast non-stip service consuming approximately 7 hours of flying time from the Atlantic to the Pacific Ocean. Internationally speaking, we find ourselves as a Nation in a strategic, responsible and awesome position of World leadership.

In weed control likewise, momentous changes have taken place. No longer are we living in Grandfather's time with the mower, the scythe, the brush hook and laborious means of weed control. As a Nation we have the best equipment, the best chemicals, the best cultural know-how, and the greatest manual ingenuity of any people on the face of the earth. We have literally a host of weed control chemicals - all designed to make the job easier and more profitable, often under very specific conditions. We find ourselves, then, in a situation comparable to the World situation where with machinery, ingenuity and chemicals at our disposal, we are in a wonderful position to assume mastery over one of man's oldest sabotaging enemies, namely, WEEDS.

We are all thoroughly familiar with the tremendous losses caused by weeds. They cause financial losses, discomfort and extra work to every single segment of our society. A recent estimate in 1952 puts losses due to weeds in the United States at 5 billion dollars. Nationally speaking, losses due to weeds are second only to the losses caused through soil erosion and are higher than those caused by insects, plant diseases and animal diseases. Whichever way you want to look at it, weeds belong in the list of the "first five" saboteurs to American agriculture. They increase the cost of production, lower the yield and quality of crops, cause animal and human poisoning, cause unsightleness and decrease land values, and above all - cause us to spend costly labor for their control.

The question arises - what can we do about this costly saboteur to American agriculture? We must do the same thing that is being done to combat soil erosion, insects, plant and animal diseases. People

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sponsoring control measures for these above named saboteurs are without exception putting most of their confidence in sound educational programs. The majority of our weed control information accumulated over the years must be concentrated in a sound educational program. That, of course, is where an active Extension educational program fits into the picture. It must, above all, be a highly cooperative program - perhaps more so than in many other phases of Extension Work. Noxious weed infestations unfortunately don't stop at fence lines. Moreover, they do not stop at county or state lines. So in this educational Extension weed control program you have to get the cooperation from the Grass Roots on up the ladder. You have to get the cooperation of the adjacent landowners. All farms, for the most part, are bordered by roads, so you have to get the cooperation of the highway and the county road groups. The people in control of lands, regardless of ownership, must be made to realize that it is to their advantage to control weeds. They must be made to realize that they, and they alone, stand to gain from a good weed control program. By following good weed and brush control programs, the farmer himself stands to gain through bigger crops. This, in turn, means more income and this again in turn, means more of the comforts of our civilization - in short, a higher standard of living.

The Board of Supervisors can improve the slightliness and safety of the roads. They can aid their constituents by a good program of weed control which aids in drying off the roads sooner, in making highways safer, in making an easier job of snow removal, in aiding in promoting well grassed shoulders free of unsightly weeds. The railroads gain in decreased upkeep and increased good will from adjacent landowners. The entire community and county gain prestige in the eyes of its neighbors becuase of increased stewardship of the land.

Let us take a bird's eye view of some of the things which can enter into a successful Extension weed control program. The function of any agricultural Extension Service is, to put it briefly, "to improve the way of life of people" - be they urban or rural. One of the primary pre-requisites to an Extension weed control program is that you must have an Extension administration that is farsighted enough to want to go ahead on a good educational program in weed control. Unless you have been able to sell the importance of weed control and unless you have the active support of the Extension administration in sponsoring a weed control program, Extension weed control activities will come to naught. In an increasing number of states, Extension administrations are becoming more sympathetic to weed control programs. They should be. After all, their function is to channel education so that it "improves the well being of the people." That can be done in different ways. Some of us can help in improving the living of people through increasing their incomes. Others can help through making better living conditions. Some can contribute to the welfare of people through sponsoring programs of relaxation, music, handiwork, hobbies, etc. Fortunately, more Extension Educators are becoming alert to the possibilities of improving people through sponsoring good programs of weed control. All Extension weed control programs should be aimed toward improving the ways of living of people. Our programs must offer the people of our state more hope, more income and above all, to make their job easier. Our programs must help improve the social outlook of our constituents. It is just as important for a farmer to raise his family in a well kept yard, where the fence row and field weeds are controlled, where the weeds and brush are not hiding the farmstead, - it is just as important to the social outlook of those children, as it is to have good fences, the buildings well painted, and the rat and insect harbors cleaned up. We lose more through weeds than we make in many other lines of work. Does that mean that unless the dollar sign is attached to everything we do that we should discard those phases of Extension Work which cannot be measured in terms of the dollar? Far from it! We need all of them - all of them improve the way of life of people. But in order to sponsor a good, active Extension weed control program, you must, by all means, have a farsighted Extension administration that gives the "green light" to a good weed control program - one that offers you the "ball of weed control" and challenges you to run with that ball. This is the first essential to a good weed control program wherever it is sponsored. Such a program must be given high clearance and priority along with other worthwhile programs.

In the second place, I believe that any good, strong educational program sponsored by the Extension Services should have a full time Extension weed control specialist. Weed control work in this age of specialized programs is a full time job. We have gone from the simple days and ways of weed control, from the laborious task that it used to be to an age where we have specific chemicals to do specific jobs. We have the best machinery and the best know-how to get the job done. In this day of rapidly developing technology, it requires the services of a specialist who is primarily interested in weed control. It is impossible in these days to "keep your eye on the ball" in weed control if you are constantly diverted by doing something else. There is enough need and there is so much to be done in any specific line that it is impossible to spread yourself so thin that you are doing a creditable job in any one of the assignments which may be given to you. Things move rapidly in this day and age. If you fit weed control into your schedule on a part time basis, one or the other suffers and most likely it is weed control. The specialist should be highly trained for his job. He must have a thorough knowledge of all phases of cultural weed control and be able to evaluate weed control by means of good seed, good rotation, smother crops, summer fallowing, prevention of weed seed production, etc. He must be thoroughly conversant with all of the chemicals imployed in the realm of weed control, their merits and disadvantages. A good Extension specialist has at his disposal a tremendous number of facilities extensively used in adult education. These would include such things as county meetings on weed control, meetings on weed control in conjunction with vocational agriculture groups, weed identification contests in conjunction with 4-H groups, Future Farmers, and vocational day schools, weed identification contest for adults, exhibits, demonstrations, leaflets, form letters, bulletins, radio and lately, television. Extension specialists in all lines of work have a host of time-tested methods of adult education at their disposal, and all of them must be used. This includes good working relationships with other specialists on the various Extension staffs. An Extension specialist, no matter in what line of work he is engaged, must feel that his own specific job is the most important in the whole Extension Service. However, at the same time, he must be tolerant and cognizant that other lines of work - forestry, landscape architecture, music, recreation, and home economics have just as important a place in the Extension program. He must know weed identification, above all, he must be able to work with all kinds of people, be a good Public Relations man, and above all, be sincere in his beliefs and recommendations. An opportunity to do Extension weed control work should be characterized by sincerity, hard work, stick-to-it-iveness and a good deal of horse sense. An educational task in Extension weed control should be looked upon as a job and not a position. The educational job is never done. There are new generations coming on - not all people learn at the same rate. Not all people adopt new ideas equally fast. At the present time, we are getting many sincere letters and questions as to how to control dandelions in lawns. Sometimes you wonder where these people have been for the last 7 or 8 years since 2,4-D came into the picture. And yet you can tell by the way that the card or letter is written that they are absolutely sincere in their questions. This means tolerance and a willingness to answer even the simplest questions, because it is coming to the specialist in all sincerity. But the best qualified Extension specialist in weed control will have an uphill fight if the Extension supervisors and Extension administration are not enthusiastic and sympathetic to the program.

Another equally important cog in any good weed control program is a good county agent or as we call them in Iowa, county extension director. It is around him that the Extension weed control activities in the county should revolve. In any Extension weed control program, education is 95 percent of the task. The county extension director is a busy man. We must help him with weed identification and we must help him in weed problem areas. He is the Extension representative out on the firing line. He must talk weed control in conjunction with his other work. He must be made weed-minded to better quality him for this task. Often he is not too well trained in weed identification and control. If possible, we should be instrumental in getting better courses in our collegiate level teaching to better fit him for his job in weed identification and control out in the counties. He is the man who must be instrumental in crystallizing the thinking of the program planning committees in working out joint programs with the county boards of supervisors and the weed commissioners. He is in a position through weekly news releases to emphasize all points in favor of cultural and chemical weed control problems. We must keep him thoroughly informal at all times.

Another important link in a good educational program on weed control are the people who have jurisdiction of the lands in the various counties. Again, they must be sympathetic to the programs of weed control. They are in charge of all lands in the county irrespective of ownership. It is their responsibility to help carry out a good weed control program, not only on the lands immediately under their jurisdiction, but also to see to it that a good regulatory program is carried out on all lands within the county irrespective of ownership. They must help plan the program. They must be made to see the savings in time and money that a good weed control program will mean to them. They should have a time schedule where they embark on certain projects for one or two years and then expand their activities to encompass more people. By cleaning up county-owned land, they can encourage people and they will encourage people to adopt good weed control programs on their lands. In many instances we have reached a state of inactivity where neither the county nor the landowners care to move ahead on a good program of weed control because they feel thatreinfestation will occur unless the owner on the other side of the fence is also undertaking a good weed control program. It is a stimulus to rural people to see roadsides and other county owned land being cleaned up. Roadsides make wonderful demonstration areas.

Another key man in a good Extension weed control program is the county weed commissioner. He, along with the county agent, is on the firing line continuously. The weed commissioner and the county agent are the two key men who will spell success or failure with any Extension weed control program. They must be well informed, willing to cooperative, conscientious, willing to extend the educational and enforcement angles of the program. A good weed commissioner will put most of his faith and trust in an educational program. At the same time, he must have recourse to a good weed law and to immediate superior officers whether that be the county board of supervisors or the State Department of Agriculture. He must have cooperation from them in order to get his job effectively done. The weed commissioner should be a man who is willing to learn, respected by his fellow citizens, should be honest and sincere and really have the welfare of the people of his area at heart. He must be well paid, his job is an important one. Unless he is willing to learn and is well liked, again the enforcement program will come to naught. I believe that most enforcement work can be kept at about a 5 percent level, most of it being educational in nature. Education and enforcement, however, go hand in hand. Education is as vital as law enforcement and law enforcement is as vital as education. In weed control work as in other activities, it is absolutely necessary to get the best man for the job. A good weed commissioner must be businesslike, well respected in his community, and must be able in many instances to temper justice with mercy.

There are many other interested groups to whom weed control is important. The utility companies such as the telephone companies, R.E.A., and gas companies, maintain distribution lines under which and over which it is important to control weed and brush growth. Local farm management companies, bankers, insurance companies, - all have a stake in the weed control program. In a program as wide flung and important as weed control, every interested person must be made to feel that his part is part and parcel of an over-all county or state program. Sometimes it is not possible to wait for all conditions to be exactly right before undertaking a good weed control program. For that reason often general county meetings, to which at least the people most interested in weed control have been invited and to which they come, may be the answer towards starting a weed control program in the area. General open county meetings or night school meetings where weed control activities by means of cultural and chemical practices are discussed sometime serve as the opening wedge toward better weed control programs in the county. Mass education by means of radio and now with television probably will make for better coverage in weed control. People who have done a good job can be recognized and complimented for their endeavors. The man on the farm stands to be the real winner in any program of weed control. All of us have much to gain by sponsoring a good weed control program. Everyone must be made to feel that it is **their** program, that is not the program of the State Department of Agriculture, of the Extension Service, or the boards of supervisors. They must be made to feel that it is <u>their</u> program. Looking at it through their eyes, it must be "our" program. They stand to gain the most. They receive the extra revenue. This, in turn, means more conveniences and a higher standard of living. It makes the job easier for them.

I hope that I am not implying that we don't have any weeds in Iowa and that they are all under control. We feel that we have been blessed by nature with good land. We feel that we owe it to future generations to take care of our heritage. Not all of our counties are sponsoring good weed control programs. However, on the other hand, if all of our counties sponsored active and agressive programs, the like of which some of our counties sponsor, we would be a long way on the road to where weeds cause very little difficulty. The very fact that we have an increasing number of counties sponsoring good weed control programs every year, that our really good weed commissioners are enjoying a longer tenure of office, that we are using more chemicals now than we ever did before - all are encouraging signs that we are making some progress. However, we have a long ways to go. We must continually strive to get greater cooperation in weed control activities with all agencies. We must never lower our guard against weeds. We must continually strive to keep high clearance for our programs on the state, county, and farm levels. If we could encourage all of our people to make weed control the No. 1 endeavor for three or four successive years, we would make terrific inroads on the weed problem in that time. We must never allow ourselves to become lackadaisical in a program which means so much to the people who conscientiously practice it. We must exhibit push and drive to get the job done. We must exhibit sincerity in the task and a firm belief in a better future for weed control. We must exhibit a firm conviction that ours is an important educational job. We must be salesmen who absolutely and thoroughly believe in our own products. The ravages of weeds are apparent everywhere. While we have made a lot of progress, much remains to be done. So much remains to be done that it is sometimes confusing just where to begin and where to end, but all progress that we can ever hope to make in the realm of weed control must be aimed at the man on the farm. He, in the last analysis, spells success or failure to the program. Weed control in all of its ramifications, with the large number of chemicals at our disposal, with the many cultural methods of weed control at our disposal, and with the many agencies that are involved and have a stake in the program, - a good weed control program is like a beautiful, simple, large child's crossword puzzle. All the pieces must be there and they must be fitted into their proper places before the picture as a whole becomes apparent. If all of us do our jobs as we see them, if we can encourage the man on the farm to become a better steward of his land, if we can give him hope and encouragement that in the future weed control will be a less burdensome and more profitable task, then all of our programs in weed control will be more successful in the future.

EXPERIENCES WITH AN EXTENSION PROGRAM FOR CHEMICAL WEED CONTROL IN MADISON COUNTY, NEW YORK 1953

Norman J. Smith 1/

Whenever relating one's experiences, it seems advisable to begin with a definite situation, so let's look back a few years. Five years ago, when this assistant county agricultural agent began an extension career in Madison County, it was understood that the chemical weed control program would be carried on. The County Farm Bureau Executive Committee recognized that chemical weed control would be something wonderful if it worked. They also recognized that it could be quite technical and assistance to farmers in every way would be necessary to make a chemical weed control program effective.

I was very fortunate in being able to spend a few days with the assistant agent I was replacing, observing the results of 2,4-D on corn. I was much impressed by the possibilities offered farmers by this new weed control tool. Although my predecessor had worked very closely with Cornell University and had applied the first 2,4-D on corn in Madison County, farmers had not accepted it as aneconomical supplement to cultivation and other good farming practices for controlling undesirable weeds. When I started work in the county there were about one dozen weed sprayers on Madison County farms and most of these were home-built rigs. A few hundred acres of corn and oats sprayed accounted for most of the chemical weed control being done. During the winter of 1949 I sought out information and tried to obtain a clearer understanding of the problems associated with chemical weed control application and results.

In 1949 the chemical and sprayer situation was very discouraging and only a few farm stores sold chemicals and the store managers weren't quite sure of what they were selling or what would happen when the container was opened. Only one store was selling sprayers and parts were available only on order. Last year in Madison County (1953) crops sprayed for weed control were - - corn, about 15,000 acres, which is about 3/4 of the county's acreage; oats, about 3,000 acres; snapbeans, about 3,000 acres, over half; seed onions, about 300 acres, over half; carrots, 150 acres, which is about 2/3 of the carrot acreage. Also a few strawberries, potatoes, and peas.

Regarding weed spraying equipment in the county to-day, there are over 250 weed sprayers on dairy, muck and upland vegetable farms. About one dozen custom operators are spraying corn and oats.

Now what happened between 1949 and 1953: In the spring of 1950 the farm machinery dealers were contacted to look at their weed sprayers. They had none and their interest was almost nil. At that time a weed sprayer realized a meager profit for a dealer compared to balers, tractors, manure spreaders, etc., which farmers were buying as fast as they were made available. As one machinery dealer

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1/ Assistant County Agent, Madison County, New York.

said, "Why should I sell these rigs to kill farmers' crops and send a man out all day to get the thing set up and only make a few bucks on the deal? I'm not getting mixed up with them."

Looking back, many of these early weed sprayers which were sold are obsolete today, so possibly Madison County farmers were fortunate in not being able to buy them. With the sprayer situation as it was, two sets of plans were drawn up for home-built weed sprayers, one for use on dairy farms and the other for muck crops. These plans were presented to the weed control commodity committee of a dozen farmers and they approved the idea.

A local GLF feed-farm store cooperated in selling all the parts for the rig as well as the chemicals. Therefore, in 1950, about forty home-made rigs were set up and used by farmers. In 1951 about fifty more were rigged up. In 1952 it looked as though farm machinery dealers were becoming more interested in chemical weed control since farmers who used 2,4-D were not keeping it a secret. By 1952 sprayers improved considerably and most farm machinery dealers in the county were handling some make of sprayer. Meetings were scheduled with the dealers in 1952 individually and as a group. Equipment, methods of application and chemicals was discussed in detail. They were given the assurance that if they sold the sprayers, I would help them get the farmer started off on the right track. So, in 1952 about sixty sprayers were sold by the machinery dealers. By this time about a dozen farm stores were selling the chemicals. The stores were kept informed of college recommendations for using the chemicals and they, in turn, answered farmers' questions.

Now you may wonder how the farmer interest was stimulated. Weed control demonstrations were set up in corn, oats, beans, peas, onions, carrots in 1950, 1951, 1952 and 1953. Meetings, county-wide and township, were held with the farmers where they could see what happened. A weed sprayer was present at most every meeting and it was dismantled, described and demonstrated thoroughly. Chemicals and sprayers cannot be separated since knowledge of both is very important. Colored slides of the weed control demonstrations were used at winter extension meetings with farmers, at grange meetings, vo-ag classes, farm veterans' classes, etc. Wherever possible a weed sprayer was present. Special meetings were arranged for the custom operators. Approximately 500 farmers a year received the latest weed control information at these meetings.

In addition to meetings and tour stops, timely circular letters and flash cards were sent to all farmers regarding chemical weed control recommendations for specific crops. Newspaper articles, although sometimes misleading, were also used. Several pages in the April, May and June issues of the County Farm Bureau News were used to give recommendations and also as important, the farm machinery dealers, custom operators and chemical handlers advertised in the special weed control issues of the Farm Bureau News. By one of these several mediums most farmers were at least exposed to some weed control information or at least a drift.

Now, since farmer interest is stimulated, something else begins to occur which should not be overlooked if you plan to build up an active weed control program. In May, the requests begin to pour into the office and they keep coming until the middle of July. The Madison County Extension Service is recognized as a reliable source of weed control information and farmers make good use of their organization during this weed spraying period. Many requests can be handled over the phone but from five to twenty-nine visits a day have been made where farmers have a specific weed control or weed sprayer problem. One begins to appreciate a good secretary when these requests are received and arranged in a schedule by areas or roads so that little time is wasted in making the calls.

As your program becomes more active, so go the requests. In Madison County this agent's program is flexible enough to give this service. The other agents in the office have cooperated considerably by adjusting their programs so a major part of this agent's time can be devoted to weed control during May, June and July. It is very likely beneficial to the county organization since many farmers who have never been reached before are using their extension service to advantage. There is always a number of farmers who farm without the help of the extension service and the county chemical weed control program is drawing them in for information which isn't generally available elsewhere. This statement applied to several of the Madison County snapbean growers. To some smaller farmers weed control is a novelty and they like to see a sprayer spray or they just like to tinker. However, it all helps to control weeds and build your program.

Cooperation by the College at Cornell University has been exceedingly helpful in developing a weed control program in Madison County. Important information regarding recommendations or specific problems can be received in a few minutes by calling the college. The extension specialists and research workers at the College have been contacted many, many times to help make decisions on specific weed problems or to furnish other information as requested. The district agricultural engineer has also been very helpful regarding spray equipment. With a weed control program where changes are rapid and mistakes costly, you must have a dependable source of information at your finger tips or you are lost.

Let's not forget cooperation with commercial companies. Area field men always have a few new angles regarding weed killers and are most cooperative in helping set up demonstrations or obtaining needed materials or sprayer parts. The agent welcomes all field men to stop by to exchange weed control experiences in any crop.

Cooperation by chemical companies in furnishing demonstration materials cannot be overlooked. In the past four years several hundred dollars worth of weed control chemicals have been supplied and used for demonstration or for special weed problems. These chemicals are appreciated just as the farmer appreciates a good demonstration, because an up-to-date weed program would be impossible without this assistance. Regardless of how complete recommendations may be, practical experience in the field is necessary to understand the variation in results on different weeds and crop plants.

By now, suppose that you are interested in building up a weed control program in your county - - here are the following suggestions:

1) Set up a weed control commodity committee and establish a plan of work.

2) Talk with your college weed workers to obtain recommendations and suggestions.

3) Work with a weed sprayer for a few hours, or better, spend some time with a custom operator.

4) Get a farmer or custom operator to set up a few demonstrations.

5) Then hold a meeting or tour stop at a demonstration. If you do not feel competent, get help from your college specialist until you gain more experience.

6) Keep the latest weed control recommendations in front of farmers all during the weed spraying season. Make recommendations simple because farmers do not read when they are busy.

7) Encourage your chemical suppliers and weed sprayer sellers to advertise their products to farmers.

8) Keep machinery dealers and chemical suppliers up-to-date.

9) Get a good set of colored slides and show them to anyone who will look at them. Sometimes you can sell a farmer on 2,4-D with one yellow streak in a field of oats.

10) Publicize a list of all sprayer owners, custom and farmer owned. Many times a farmer doesn't know what his neighbor is doing until someone else tells him.

11) Then, as always, help farmers to help themselves. With your technical assistance a farmer can operate with success, thereby attaining more confidence in himself. In the long haul this will make your work easier and more effective since confident farmers are good leaders and teachers. As you attain more experience with chemical weed control you may come up with some original ideas to kill certain weeds which are a problem in your county. This agent has been working on an effective control for yellow rocket (Barbarea vulgaris) which is a very serious weed in legumes on New York dairy farms. A report on this work was presented at this conference last year and further results will be presented at this year's conference.

When you take off on a weed control request, you can expect to do many different things. Sometimes the farmer has a new sprayer which can be about forty different parts in a box. You help him because he feels he cannot figure it out. It's a new experience for him and half the time there are no instructions in the package. You get everything set up and ready to spray and if it's the farmer's first experience he may or may not have the correct chemical. If he has the right chemical, well and good. How about the nozzle tips - - the sprayer came through with five gallon tips and he wants to use Sinox PE or Dow Premerge on beans. The beans should be sprayed today and not tomorrow. Possibly the farmer has to go twenty-five miles to get the correct tips. To meet this not unusual situation, a complete set of tips for the different makes of sprayers in the county is carried at all times. Change this farmer's tips, tell him where he can get some more, and go to the next request. You get there and the farmer is trying to spray peas, fifty gallons per acre with a two gallon per minute pump. It won't put out enough for this job, so two or three extra pumps are kept on hand to meet this situation.

One of the important secrets of low pressure weed spraying is clean water. More dirt goes in the suction hose than ever comes out through the nozzles. The rest sticks in the line and plugs the nozzle strainers. Some of the earlier sprayers sold had a twenty-five mesh line strainer with a 100-mesh nozzle strainer. This is extremely unsatisfactory. A rusty barrel is also very common and is constantly causing trouble. A few line or suction strainers to overcome this situation are always carried in the car. All repair equipment is loaned until replaced or returned by the farmer. Injury to crops caused by using incorrect amounts of weed killer or poorly adjusted sprayers also comes into the picture when your program is in its infancy. Most farmers who run into serious trouble will call which enables the agent to gain more experience. Following are a few examples of trouble calls.

1) Several hundred acres of sweet corn, 14" tall, with leaves rolled as tight as lightning rods. Reason, possibly a very heavy rain after applying one-half pound of 2,4-D.

2) One out of every four rows of onions across a thirty acre field of seed was thinned to about half. Reason, wrong nozzle size on one row using potassium cyanate.

3) Five acre field of peas burned to a crisp. Reason, seven pints Dow Selective in ten gallons water per acre instead of fifty gallons per acre, wrong size tips.

4) A four hundred gallon potato sprayer tank filled with Sinox PE to spray beans. The PE and Copper residue got together and left a thorough coating of chewing gum in the tank, lines and nozzles. This was the biggest mess the agent ever fingered into.

5) A ten-acre field of oats seeded to alfalfa, infested with lambs quarters, sprayed with one quart Sinox PE in thirty gallons of water per acre. Conditions were just right. Two days later all the mustard, ragweed, and red root were dead. The pigweed was still there. Farmer's comment "I thought you told me that the pigweed would be killed. If I had known this was going to happen, I don't think I'd have bought that ---- sprayer". What's the answer? Was the chemical contaminated? The PE was killing pigweed within two miles of the same farm. There was not an answer in sight. Three days later the farmer called. Another look at the field showed a complete kill of the pigweed. WHY? Don't try to find all the answers because there aren't enough. Try to make the farmers understand this also.

There are many other experiences like the above, so you can be assured of a very interesting day's work with a weed spraying program. Don't become discouraged; just keep going. Many difficulties can be expected in any new program, particularly in one as new as chemical weed control where developments have been rapid and the results obtained dependent on such a wide range of conditions.

GOOD SEED, A PRIME REQUISITE TO WEED CONTROL AND SUCCESSFUL FARMING

Encil Deen[1]

Weeds are the farmers great enemy. Someone has said and rightly so that "weeds are gangsters in the grass because they literally steal our livestock by cutting down the carrying capacity of our pastures and meadows". In America, weeds cause a loss of many millions of dollars every year by crowding out desirable plants, robbing them of plant food and moisture, poisoning livestock, reducing land values and causing extra labor costs. They provide a home for destructive insects and disease-producing organisms of crops.

What can the farmer expect in 1954? When we speak of crops the answer may depend largely on what he sows. If he sows good clean weed-free seed of an adapted variety, he has taken one of the essential steps to insure a good crop. If he sows impure seed, he is sure to have plenty of weeds.

It has been estimated that the annual loss due to weeds in the United States is 3,000,000,000 dollars. Comparatively speaking, it has been estimated that weed losses amount to twelve times the loss caused from animal diseases, one and two-thirds times that sustained from plant diseases, and three times as great as losses due to insects. Weeds not only reduce crop yields, but lower the quality of farm products and greatly increase cost of production. If great good is to be accomplished in coping with the weed problem, it must be done by attacking the fundamental causes of the situation, none of which is more important than the selection of clean, weed-free seed. Quality seed is fundamental in effective weed control.

Weeds, like all other plants, may be classified according to the length of time they live: as annual, surviving the winter only in the seed; as biennials, storing in fleshy root or broad green leafy rosette the food drawn from the soil and air during the first season, to perfect the fruitage in the second year; and as perennial, surviving through many seasons and springing up to spread abroad their kind and pester the land year after year, unless destroyed. Corncockle, Wild Mustard and Ragweeed are good examples of the annuals, Wild Carrot and Burdock of the biennials and Quack Grass and Canada Thistle are classified as perennial weeds.

To fight the weed menace successfully, we must understand something of the growth habits of weeds, ways of killing them and a full realization that we must sow seeds that are as free from weed seed as possible. Our Seed Laws help farmers greatly in seed selection. It is effective in aiding the prospective buyer to know in advance the quality of farm seeds that he buys. Our laws require the labeling of agricultural seed offered for sale. The tag gives the information necessary in selecting seed including kind and variety of seed, purity, germination and hard seeds, date of test, place where grown, weed percentage and the number per ounce or pound of noxious weed seed. Because of their seriousness the names of the noxious weeds are listed somewhere on the seed tag so they can be readily detected if present in the seed offered for sale.

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[1]Seed Technologist, University of Kentucky

It must be kept in mind that our laws do not prohibit the sale of inferior seeds, it merely protects the seed purchaser, who reads the labels and selects seed on a quality basis.

Weeds and good farming have never gone together. Weeds and poor farming are friends of long standing, and a menace that results in our huge National weed cost.

Buy clean seed, make your purchase on the basis of the test given on the seed tag. This takes the "guess work" out of seed selection. Buy the best or pay the penalty.

KNOW YOUR WEEDS -- THE KEY TO A SUCCESSFUL PROGRAM[1]

-- C. E. Phillips[2]

The science of weed control has made tremendous strides in the last ten years. The discovery of the weed killing properties of 2,4-D was the incentive that research workers needed. Other chemicals have been tested. New chemical combinations have been made up and tried. Every year at our annual Northeastern Weed Control Conference, we have reports on the weed killing properties of several that have not previously been used. The number of weeds that can be controlled by chemicals has been expanded year by year. Weed control recommendations are becoming more specific. We no longer can speak of weed control in general terms. We talk about the control of certain weeds with such and such a chemical. Sometimes it is necessary to go even further and say what crop a particular weed is associated with.

For instance: CIPC is recommended for the control of chickweed in alfalfa. However, if it is an alfalfa-bromegrass stand, we cannot use CIPC for that will cause serious injury to the brome. In this case we must use DN. 2,4-D is recommended as a post emergence spray for the control of weeds in corn. If horsenettle is the weed problem in the corn, 2,4-D is no good and we must use 2,4,5-T or some other chemical. KOCN and PMAS are recommended for the control of crabgrass in lawns. However, there are two species of crabgrass commonly found in lawns. Will KOCN or PMAS control both? Will they control foxtail? Which one? Will they control nimble Will? This last named weed is a very serious problem in many parts of the northeast.

When the research worker finds the solution to the chemical control of any weed in any situation, the problem then is in the hands of the workers who make the contacts where the problem exists. In most cases these workers are the State Extension Specialists and the County Agricultural Agents. They must make the recommendation that fits the problem. They are the ones who see what weeds in what crop must be controlled. What must they know if they are to do the job effectively? Suppose you are called on for the solution of a lawn weed problem. The problem may be weedy grasses such as hairy crabgrass, smooth crabgrass, nimble Will, Bermuda grass, quack grass, goose grass or several species of foxtail. If it is a broad-leaf weed problem, it may be dandelion, cinquefoil, yarrow, buckhorn plantain, broadleaved plantain, knotweed, ground ivy, or any one of several others. Where is your starting point? <u>First you must identify the weed to be controlled.</u> How do you do this? How many of you can identify most of the weeds in all the crops for which you are responsible? Very few,

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1. Published as Miscellaneous Paper No. 183 with the approval of the Director of the Delaware Agricultural Experiment Station.
2. Head, Department of Agronomy, Delaware Agricultural Experiment Station.

I'll venture to say. But before you can be sure what to recommend they must be identified. So you collect specimens and hunt up the staff botanist and ask him or her to identify them. What do you find out? Just this! That it is impossible to correctly identify plant specimens without both flowers and seed. But if it is a lawn that is regularly mowed you may never have either flowers or seed. In any case by that time it will probably be too late to do anything about control. Where do you go from there?

It appears to me that from a practical viewpoint, progress in weed identification has not kept pace with progress in weed control. All the books and bulletins that I have been able to find depend on flower and seed characters for positive identification. I am not disputing that such information is necessary if we are trying to identify positively all the weeds in any region. Muenscher in his book "Weeds" lists at least 554 different species and varieties as "the commonest weeds of the northern United States and Canada." Gleason in the 1952 revision of Britton and Brown's "Illustrated Flora of the Northeastern United States and Adjacent Canada" lists many more. But how many of these weeds do you ordinarily find as pests under conditions you deal with? Certainly not all of them.

If we are to do our job at all well we must be able to identify many common weeds before they flower. It has long seemed to me that this might be done fairly accurately in 75 to 90 percent of the cases by careful examination of the shape and other characteristics of the basal leaf. Here I must warn you that if you are to become even moderately good at weed identification, you must learn to become familiar with at least a few scientific terms. Also you must learn to see what you look at and to see it with reasonable accuracy. You will find that a pocket glass that magnifies to 3 to 4 times is indespensible. You cannot depend on the naked eye for fine points. I would recomment a magnifier at least one to one and one-half inches in diameter.

As an aid to you in the field, I have attempted to assemble some of the available information on weed identification. This effort entitled "100 Weeds -- Aids to Their Identification by Basal Leaf Characteristics" will be distributed to you in mimeographed form.

Weeding of Seedling Asparagus in a Pre-emergence Application[1]

Charles J. Noll and Martin L. Odland[2]

Experimental weeding of asparagus seedlings with chemicals has been carried on at The Pennsylvania State University for the last two years. In 1952 nine chemicals were used in a pre-emergence application two weeks after planting Noll and Odland (1). Dowicide G was the best treatment used and CMU, Premerge, and Weedar MCP offered promise.

The work during the summer of 1953 included the most promising of the chemicals used in 1952 plus other herbicides thought to offer promise in the weeding of this crop.

Procedure

In 1953 nine chemicals at two rates each and an untreated check were used in the experiment. These treatments were arranged at random together with the non-treatment control in each of ten replicated blocks. Each plot consisted of a single row 22 feet long by 2 feet wide. The herbicides were applied with a small sprayer over the seeded asparagus for a width of 1 foot. In the 1952 experiment plot rows were 20 feet long and 18 inches wide.

The land was prepared and planted April 29. All chemicals were applied May 16 after germination prior to emergence of the asparagus seedlings. Weeds between the rows were controlled through cultivation. Weed control was estimated on the basis of 1 to 10; 1 being perfect weed control and 10 no weed control. The roots were dug, counted and weighed October 20 and 21.

Results and Discussion

A summary of results of the 1953 experiment is presented in Table I. All herbicidal treatment plots had significant weed control when compared to the untreated plot.

The best chemicals in the 1953 experiment for the weeding of asparagus at the rates used taking into consideration weed control and stand and weight of asparagus are CMU, Sodium pentachlorophenate in the formulations Dowicide G and ACP-L-469, and Premerge. Two other chemicals that look good but at the rate used didn't give as good weed control are ACP 903 (Butoxy ester 4, chlorophenoxyacetic acid) and NP 1239D - (50% Chloro-

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[1]Authorized for publication on November 20, 1953, as paper No. 1843 in the journal series of the Pennsylvania Agricultural Experiment Station.

[2]Assistant Professor and Professor of Olericulture respectively. Dept. of Horticulture, School of Agriculture and Experiment Station, The Pennsylvania State University, State College, Pa.

Benzoic acid). Further work should be done to see if the rate of application of of these two chemicals could be increased to get better weed control and still maintain or increase the asparagus yield.

In table II the results of two years' experiments is compared for those chemicals used during both years. Weed control from best to poorest during both years was: Premerge, Dowicide G, CMU, and MCP. Significant increase in stand of asparagus over the control was obtained both years with CMU, Dowicide G, and Premerge. Significant increase in weight of plants was noted with all chemicals used during the two-year period except MCP in the year 1952. The data from the experiments with the chemicals used during two years indicate that three chemicals probably could be used to weed seedling asparagus prior to emergence: Premerge at 1 gal. per acre, Dowicide G at 12 lbs. per acre and CMU at 1½ lbs. per acre. CMU should be tried experimentally at rates higher than 1½ lbs. per acre as the high rates used during both years gave the greatest stand and yield of asparagus plants as compared to the lower rates used.

Conclusion

Two years' work on weeding asparagus seedlings with herbicides indicate that the following materials could be used successfully at the following rates per acre under similar conditions: CMU at 1½ lbs., Dowicide G at 12 lbs. and Premerge at 1 gal.

The best of the materials used only one year is ACP-L-469. This material is very similar to Dowicide G as the active material in both herbicides is sodium pentachlorophenate.

References

1 Noll, C. J. and Odland, M. L. Pre-emergence weeding of asparagus seedlings. Proc. of 7th Annual Meeting Northeastern Weed Control Conference p. 113-115. 1953.

Table 1. The effect of pre-emergence herbicides on weeds, stand and weight of seedling asparagus in 1953.

Herbicide	Rate per acre	*Weed Control	Asparagus No. Plants	Asparagus Weight Plants (Grams)
Nothing	--	9.6	30.0	409
ACP 903	2/3 gal.	2.3	34.0	977
" "	1 gal.	2.3	36.4	1047
Weedar MCP	1/4 gal.	5.9	34.8	759
" "	3/8 gal.	5.6	32.0	815
Dowicide G	12 lb.	1.2	37.4	1138
" "	18 lb.	1.1	34.2	1077
ACP-L-469	4 gal.	1.1	36.9	1141
" " "	6 gal.	1.0	34.8	1064
[1]LFN-904	1/2 gal.	3.6	36.6	987
" "	3/4 gal.	3.6	33.7	895
NP 1239D	4 lb.	3.9	38.7	1081
" "	6 lb.	3.7	36.8	1101
CMU	1 lb.	1.3	40.8	1326
"	1 1/2 lb.	1.3	42.9	1508
Premerge	1 gal.	1.0	37.5	1153
"	1 1/2 gal.	1.0	30.2	968
Cloro IPC	1 gal.	2.6	22.8	430
" "	1 1/2 gal.	1.6	25.8	512
L.S.D. at .05 level		0.7	6.5	305
" " .01 level		0.9	8.6	402

*Weed control (1-10) 1 - perfect weed control
10 - full weed growth

1 (2 Methyl 4-Chlorophenoxyacetic acid
2 lbs. per gal.)

Table II. The effect of pre-emergence herbicides on weeds and stand and yield of seedling asparagus during 1952 and 1953.

		1952			1953		
			Asparagus			Asparagus	
Herbicide	Rate per acre	*Weed Control	No. Plants	Weight Plants	*Weed Control	No. Plants	Weight Plants
Nothing	—	9.5	33.7	89	9.6	30.0	409
Weedar MCP	1/4 gal.	4.0	30.5	147	5.9	34.8	759
" "	3/8 gal.	2.6	22.2	176	5.6	32.0	815
Premerge	1 gal.	1.3	49.3	348	1.0	37.5	1153
"	1 1/2 gal.	1.0	48.5	544	1.0	30.2	968
Dowicide G	12 lb.	1.3	63.5	684	1.2	37.4	1138
" "	18 lb.	1.4	58.2	601	1.1	34.2	1077
CMU	2/3 lb.	4.1	46.5	314	—	—	—
"	1 lb.	2.6	69.3	534	1.3	40.8	1326
"	1 1/2 lb.	—	—	—	1.3	42.9	1508
L.S.D. at .05 level		1.0	10.0	114	0.7	6.5	305
L.S.D. at .01 level		1.4	13.2	151	0.9	8.6	402

*Weed Control 1-10 (1 perfect weed control)
(10 full weed growth)

PRELIMINARY RESULTS WITH SEVERAL NEW HERBICIDES APPLIED TO ASPARAGUS PLANTINGS

BY

E. R. Marshall and N. A. Ferrant [1]

Chemical weed control in asparagus has been practiced for many years. Common table salt was used in our forefathers time. More recently calcium cyanamid, 2,4-D and Crag Herbicide 1 have been used. WWeed control results with these materials have been variable, but on the whole, successful.

During the past four or five years, Crag Herbicide 1 has been used very successfully in the asparagus growing sections of the Northeast, particularly in southern New Jersey. Here and in other areas, calcium cyanamid and 2,4-D have also been used commercially to some extent. All three of these materials have worked very well in most instances, but each has exhibited some shortcomings. The weed control obtained with calcium cyanamid has been rather erratic at times. 2,4-D in certain instances has given distorted spears and has weakened asparagus beds in years following treatment. Crag Herbicide 1 has worked very well in most cases, but when applied to a dry soil, its efficiency is usually reduced.

One weakness of all these materials has been their general lack of long residual activity. Asparagus growers would like a chemical weed killer which would work rather uniformly under a wide range of soil moisture and environmental conditions, and at the same time give them a rather long residual effect. They would like a material that they could apply after discing in the spring, but before cutting, and which would then control weeds until after the close of the cutting season. They could then disc the beds after cutting and by one more spray treatment after the cutting season was over, hold the weeds the remainder of the season. In this way, they might completely eliminate the necessity of cultivating during the cutting and fern season.

MATERIALS AND METHODS

The recent introduction of more residual type weed control chemicals has encouraged further testing of materials which might fit this situation. In order to test the comparative effectiveness of several of the newer residual type weed killers, a test was conducted on the Tom Davis Farm at Bridgeton, New Jersey, during the spring and summer of 1953.

The treatments were applied on April 30, two days after the last discing. Some of the asparagus spears were emerged from one to three inches. The plots were 36 feet long and 12 feet wide, covering three rows of asparagus. All treatments were randomized and replicated three times.

Materials applied were CMU (3-para-chloro-phenyl-1, 1-dimethyl-urea), Natrin (2,4,5-trichlorophenoxy-ethyl sulphate), Sesin (2,4-dichlorophenoxy-ethyl benzoate), Crag Herbicide 1 (2,4-dichlorophenoxy-ethyl sulphate), PDU (phenyl-dimethyl urea), Sinox PE (alkanolamine salt formulation of dinitro ortho secondary butyl phenol, containing 3# DNOSBP per gallon), LV4 (butoxy-

[1] G.L.F. Soil Building Service, Ithaca, New York

ethanol ester of 2,4-dichlorophenoxy-acetic acid), 3,4-dichlorophenoxy-ethyl sulphate, and 2-methyl, 4-chloro phenoxy-ethyl sulphate.

The soil was a light sandy loam. The materials were applied in 25 gallons of water per acre at 25 pounds pressure, using a small plot CO_2 sprayer.

At the time of treatment there were very few germinated weeds. The soil was dry when the materials were applied, but a rain occurred several days later.

The principal weed pests were redroot (Amaranthus retroflexus), lambsquarters (Chenopodium album), chickweed (Stellaria media), crabgrass (Digitaria sanguinalis), and foxtail grasses (Setaria sp.).

The weed counts were taken approximately one month after the treatments were applied. The ratings were made three weeks and one month after the treatments were applied.

Table 1 shows the treatments and gives a summary of the data that were taken. Weed control ratings s eem to be a more satisfactory method of recording results than do actual weed counts. This is particularly true when a material tends to control weeds by stunting them. The weeds would be counted in a weed count, but this factor is taken into account when ratings are made. Counts were taken in four one square foot areas at random in each plot. Count data presented are for a four square foot area.

RESULTS AND DISCUSSION

Weed control with CMU was outstanding. Some few weeds germinated, but did not develop further. On this soil type, 2 pounds per acre gave almost perfect weed control. A lower amount could have been used. There was no evidence of asparagus injury of any type.

Natrin gave good control of weeds and excellent grass control. The data show a fairly high weed count, but these weeds were severely stunted. It was noticed that Natrin was rather selective on the weed species controlled. Lambsquarters were not controlled nearly so effectively as were the other weeds and grasses present.

Sesin showed a longer residual control than either Crag Herbicide 1 or Natrin, and although the weed counts were rather high in the plots, the weeds were severely stunted.

Crag Herbicide 1 controlled most of the early germinating weeds and grasses but the residual effect was rather short and late germinating grasses came in. These grasses were stunted somewhat, but still presented a problem later in the season.

PDU acted very similar to CMU with the exception that the late germinating grasses, particularly crabgrass, germinated after about three weeks. These grasses did not develop further, but they were counted when data were taken. Apparently the PDU has a somewhat shorter residual effect pound for pound, than has CMU. This may or may not be an advantage, depending on

WEED CONTROL OBTAINED WITH HERBICIDES APPLIED BEFORE CUTTING TO AN ESTABLISHED ASPARAGUS BED

Treatment		Weed Control Rating *		Weed Counts / 4 Sq. Ft.			Remarks
		May 19	May 26	Weeds	Grass	Total	
CMU 2#/A		9.4	10.0	0	0	0	
CMU 3#/A		10.0	10.0	0	0	0	
Natrin 3#/A		7.2	8.4	26.7	60.0	86.7	
Natrin 4#/A		4.4	8.0	29.3	18.3	47.6	Excellent Grass Control
Sesin 3#/A		8.0	7.4	28.0	98.3	126.3	
Sesin 4#/A		8.0	8.0	13.7	139.7	153.3	All Weeds and Grasses Stunted
CH 1 3#/A		6.6	7.4	16.0	146.0	162.0	Took out most broadleaves
CH 1 4#/A		7.4	7.4	10.7	114.3	125.0	All Weeds and Grasses Stunted
PDU 2#/A		10.0	10.0	0	26.0	26.0	Grass barely germinated -
PDU 3#/A		10.0	10.0	0	28.0	28.0	Did not develop
Sinox PE 6#/A		4.4	4.4	19.3	150.3	169.6	Grass came in.
Sinox PE 9#/A		7.4	7.0	3.3	87.3	90.6	
LV4 2#/A		5.0	4.6	51.7	148.3	200.0	Excellent on broadleaves,
LV4 3#/A		7.0	4.6	16.0	152.3	168.3	Poor on grass. Spears distorted
3,4-D Sulphate 4#/A		8.0	8.0	0	54.0	54.0	
MCP Sulphate 4#/A		10.0	9.0	1	135.0	136.0	Excellent control. Grass Stunted
L.S.D.	.05	1.1	1.5	N.S.	81.3	98.1	
	.01	1.5	2.0		109.1	131.6	

* 0 - No Control, 10 - Perfect Control

whether or not a shorter breakdown period is desirable.

Sinox PE gave excellent kill of all early germinating weeds and grasses, but the residual effect did not last for a month, so that the treatments were not satisfactory. In addition, some of the spears in the Sinox PE plots showed definite injury. This injury was a necrosis of the growing point, which eventually caused the spears to dry up and fail to develop.

LV4 gave good control of early germinating broadleaved weeds, but did not control grasses or late germinating broadleaved weeds. The residual action was relatively short. Many distorted spears were found in the LV4 plots, indicating that there was some injury to the spears from these rates of LV4.

3,4-dichlorophenoxy ethyl sulphate gave weed control somewhat better than Crag Herbicide 1, while 2-methyl, 4-chloro phenoxy-ethyl sulphate gave excellent control of all broadleaved weeds and good control of grasses. The grass that was present was extremely stunted and did not develop.

SUMMARY AND CONCLUSION

CMU, PDU, and 2-methyl, 4-chlorophenoxy-ethyl sulphate at the rates used gave the longest residual weed control of the materials tested.

The only treatments which gave injury to the asparagus at the rates used were Sinox PE and the LV4.

Most of the treatments controlled the early germinating broadleaved weeds and grasses, but only CMU, PDU, and 2-methyl, 4-chlorophenoxy-ethyl sulphate at the rates used controlled the later germinating weeds and grasses.

Under the conditions of this experiment, CMU, PDU, worked very similarly, with the exception that PDU at equal rates did not show quite as long a residual effect as CMU.

In conclusion it would seem that CMU, PDU, and 2-methyl, 4-chlorophenoxy-ethyl sulphate should be compared on larger plots in a concentration series and over a period of several years to see which might be the most satisfactory residual weed killer to use in established asparagus plantings.

Further comparisons should be made between Crag Herbicide 1, Natrin, Sesin, 3,4-dichlorophenoxy-ethyl sulphate and 2-methyl, 4-chlorophenoxy-ethyl sulphate. Such things as length of residual effect and selectivity on weeds and crops should be evaluated.

Sinox PE and LV4 at the rates used and on this light soil types were unsatisfactory as weed control materials because they tended to injure the asparagus spears.

CHEMICAL WEED CONTROL IN ASPARAGUS IN NEWLY SET BEDS AND OLDER ESTABLISHED BEDS - 1953

Allan H. Kates[1]

The removal of weeds from the planted row of asparagus by cultivation is quite difficult without injury to the crop. One of the most troublesome weed problems in asparagus is experienced during the first year after the setting of one year old crowns. Considerable work has been published on the use of chemicals on established fields (2 or more years old), but to the author's knowledge, there has been none on the use of chemicals during the first year of establishment.

The purpose of this investigation was twofold: (1) to determine the response of asparagus and weeds to five chemicals applied immediately after the setting of crowns in the process of establishing a producing bed and (2) to determine the response of asparagus and weeds to chemical treatments applied before and after the harvesting period in producing fields.

These tests were located on a Sassafras sandy loam soil. The weed population consisted mainly of crabgrass (*Digitaria sanquinalis*), red root (*Amaranthus retroflexus*), and lambsquarter (*Chenopodium album*).

The herbicides used, their formulations, and their source appear in Table V.

Procedure

Newly Set Crowns

After conventional asparagus bed preparation with the application of lime and super phosphate to the bottom of the 9 inch trench, one year old asparagus crowns were planted on April 2. They were covered with soil to a depth of 1 to 2 inches.

Eleven treatments (9 chemical and 2 checks) were arranged at random in each of 4 replications. Each plot was a single row, 3 feet by 70 feet long. The herbicides diluted in water at the rate of 50 gallons to an acre were applied with a hand sprayer on April 14. At this time the soil was smooth, compact, moist, and free of weeds. There had been no cultivation before applying the chemicals.

Weed counts were made of 1 square foot on May 26, six weeks after application. After these counts were made, all plots received the normal cultivations and hand weeding for the remainder of the growing season. Stand counts of the complete plots were

[1]Research and Development of Herbicides, Seabrook Farming Corp., Bridgeton, New Jersey

taken on October 12. To determine the amount of dry matter of the fern, samples were taken of 10 feet of row on November 3. These samples were dried thoroughly with forced heat circulation for five days.

Established Beds, 3 and 6 Years Old

After the usual Spring soil preparation and after asparagus emergence, CMU at 1 and 2 pounds and Crag Herbicide #1 at 3 pounds were both applied to plots on May 1 in a 3 year old and a 6 year old bed. Each treated plot was a single row 225 feet long. Each treatment was randomized in 6 replications in each field. Yield data was taken each day of commercial harvest from May 1 until June 15. It consisted of weights of the spears 7 inches long with at least 4½ inches of green. Weed counts were made of 2 square feet per plot on June 5, five weeks after application. The weeds present were the same as previously listed.

At the end of the cutting season, CMU, Crag Herbicide #1, and Urab, each at 2 rates, were applied to plots in the 6 year old bed of asparagus. The field was disked July 5 after harvest had ended and then cultivated on July 12. The fern at the time of chemical treatments on July 15 was about 2 feet tall. Weed counts were taken three weeks later on August 5.

Results and Discussion

Newly Set Crowns

The results of weed and stand counts and the dry weights of the fern appear in Table I. Very wet soil conditions (Table II) at the time of and after application of the chemicals, resulted in rather large weed population in the untreated area. All treatments resulted in significant reduction of weeds. Dowicide G at 10 and 20 pounds, Alanap #1 at 4 and 6 pounds, and CMU at ½ and 1 pound, gave the most outstanding weed control.

Alanap #1 at both rates, was observed to cause damage to the developing spears of asparagus. This injury appeared about three weeks after application. Spears were observed to be affected at the surface of the soil by a breaking down of the cells. Finally the spear would bend over and die from the soil surface to the tip. This desiccation occurred for only about ½ to 1 inch under the surface of the soil. Later new spears were observed to be developing from these crowns. Crag Herbicide #1 resulted in many slightly epinastic spears of asparagus.

Neither stand nor the dry weight of the fern were reduced below the checks (untreated or cultivated) by any of the chemical treatments. There was an increase in dry weight of fern in the treatment of CMU at 1 pound per acre. The CMU treatments were observed to have very vigorous growth throughout the growing season.

Established Beds, 3 and 6 Years Old

The results of weed counts and yield data from a 3 year old and a 6 year old bed, appears in Table III.

The Spring application of CMU on these two cutting beds, resulted in a significant reduction of weeds over both the check and Crag Herbicide #1 treatments. The time interval of the application to weed count, probably accounted for the poor results of the Crag Herbicide #1 treatments. There was no significant difference in yields due to treatment. In a taste panel conducted at Seabrook Farms on quick-frozen asparagus from these plots, no difference in flavor could be determined due to treatment.

The mid-summer application was made under relatively dry soil conditions. Table IV shows the results of weed counts made 3 weeks after treatments. CMU resulted in the most outstanding weed control, followed by Urab and Crag Herbicide #1, in that order. Observations at later dates revealed the weed control to be effective in the CMU and Urab treated plots until frost.

Conclusion

Under the conditions of this experiment CMU at 1 pound per acre gave the best results on newly set asparagus crowns considering the weed control, stand of asparagus, and the amount of dry matter of the fern.

In the producing beds of asparagus, CMU at 1 and 2 pounds per acre resulted in the best weed control of any of the treatments used. None of the chemicals used before the harvest season affected the yield or the taste qualities of the asparagus.

Acknowledgement:

Thanks are expressed to T. E. A. van Hylckama, Seabrook Farming Corp., Bridgeton, New Jersey for advice and assistance in the statistical analysis of the data.

Table I. Response of the Crop and Weeds to Various Treatments in Newly Established Asparagus.

Chemical	Rate/Acre	Broadleaf*	Grasses*	All Weeds*	Stand**	Dry Wt. of Fern*** grams
Premerge	4.5 lbs.	2.8	11.0	13.7	40.8	167
Premerge	6.0 lbs.	3.3	8.5	11.8	40.8	275
Dowicide G	10.0 lbs.	2.5	3.8	6.3	48.5	267
Dowicide G	20.0 lbs.	0.8	2.8	3.5	48.5	265
Alanap #1	4.0 lbs.	3.5	2.3	5.8	39.8	185
Alanap #1	6.0 lbs.	2.3	0.8	3.0	43.5	180
CMU	0.5 lbs.	0.5	0.8	1.3	53.3	297
CMU	1.0 lbs.	0.3	0.5	0.8	54.3	327
CH #1	3.0 lbs.	12.5	8.8	21.3	42.5	186
Check		18.3	21.8	40.0	42.5	260
Check (Normal Cultivation)		--	--	--	43.3	252
LSD 5%		4.1	3.8	9.8	12.3	128
LSD 1%		5.5	12.0	13.2	N.S.	N.S.

* means 1 Square foot - ** means 70 feet of Row - *** mean 10 feet of Row

Table II. Rainfall Data

Week Ending	Inches	Week Ending	Inches
April 8	1.77	July 6	0.66
April 15	1.40	July 14	0.64
April 22	1.26	July 22	0.57
April 29	0.27	July 29	2.63
May 6	0.32	Aug. 5	0.48
May 13	1.91	Aug. 12	0.32
May 20	1.78	Aug. 19	3.15
May 27	1.62		
June 3	1.72		

Table III. Response of Asparagus and Weeds to Spring Applications of CMU and Crag Herbicide #1.

3 Year Old Bed

Chemical	Rate/Acre	Broadleaf* Weeds	Grasses*	Yield Kilograms**	Equiv. lbs./Acre
CMU	1.0 lb.	0.2	11.3	15.98	1704
CMU	2.0 lbs.	0.0	3.8	16.17	1724
CH #1	3.0 lbs.	4.0	48.0	15.40	1642
Check	0	4.1	45.2	16.03	1709
L.S.D. 5% Level		4.5	22.2	N.S.D.	

6 Year Old Bed

Chemical	Rate/Acre	Broadleaf* Weeds	Grasses*	Yield Kilograms**	Equiv. lbs./Acre
CMU	1.0 lb.	0	0.6	25.28	2695
CMU	2.0 lbs.	0	0	27.83	2966
CH #1	3.0 lbs.	5	20.7	26.22	2795
Check	0	12.2	15.0	24.93	2658
L.S.D. 5% Level		4.1	7.9	N.S.D.	

* Mean 1 Square foot - ** Mean 225 feet of Row

Table IV. The Effect of CMU, Crag Herbicide #1, and Urab on Weeds in Asparagus When Applied under Relatively Dry Conditions.

Chemical	Rate/Acre	Broadleaf*	Grasses*	All Weeds*
CMU	1 lb.	0	1.2	1.2
CMU	2 lbs.	0	0.6	0.6
C.H. #1	3 lbs.	43.2	20.6	63.8
C.H. #1	6 lbs.	13.6	4.6	18.2
Urab	1 lb.	4.8	10.8	15.6
Urab	2 lbs.	1.4	3.8	5.2
Check	0	85.0	29.6	114.6
L.S.D. 5% Level		16.4	7.0	21.3

*Mean 1 Square foot

Table V. The Herbicides Used, their Formulations and Their Source.

Chemical	Active Ingredient	Source
Alanap #1	N-1 Naphthyl Phthalamic Acid	U. S. Rubber
CMU	3-(p-Chlorophenyl)-1, 1-Demethyl urea	duPont
Crag Herbicide #1	Sodium 2,4-Dichlorphenoxyethyl sulfate	Carbide & Carbon
Dowicide G	Sodium Pentachlorophenate	Dow
Premerge	Triethanolamine and Isopropanolamine of Dinitro Ortho secondary butyl phenol	Dow

CMU - VALUE FOR WEED CONTROL AND EFFECT ON YIELDS OF ASPARAGUS

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In a screening test of herbicides on asparagus at the Georgetown Substation in 1951, it was observed that CMU (3-p-chlorophenyl-1, 1-dimethylurea) at two pounds per acre had exceptionally good weed control value. Therefore, in 1952 and 1953 CMU was included in replicated weed control experiments wherein other treatments were first made in 1948. This paper contains information on the weed control value of CMU over a 3-year period and on the effect of CMU on yields over a 2-year period.

Experimental Procedure

Mary Washington crowns were planted in 1946 at the Georgetown Substation on Norfolk loamy sand. A randomized block arrangement was used with all treatments replicated five times in single-row plots, 5 by 50 feet. The CMU was in the form of an 80% wettable powder and was applied as a suspension in 50 gallons of water per acre. CMU was applied in April and again in late June of each year. Before each application the soil was disced and cultipacked prior to spear emergence. The entire experiment was tractor-cultivated whenever necessary to control weeds on the hoed-check plots, leaving about 15 inches over the row undisturbed. The hoed-check plots were hoed whenever necessary. About six weeks after CMU was applied, weed counts and weights were taken on a 1 by 3 foot area over each row six feet from the end of each plot. The predominant weeds were crab grass, pigweed, lamb's quarters, morning glory, and smartweed.

In order to compensate for any independent variability in plot yields after CMU treatments were first made in 1952, analysis of covariance was made comparing plot yields in the two years prior to 1952 with those of 1952 and 1953. Adjustments of individual plot yields were then made using the regression coefficient.

Results and Discussion

Weed weights (Table 1) show that the application of as little as one pound of CMU per acre gave excellent weed control except after harvest in 1953. In this instance, control was commercially satisfactory but not perfect. After CMU was applied to dry soil on June 22, 1953, there was no significant rainfall for a month. During this period, a few weed seeds germinated probably at a

[1]Published as Miscellaneous Paper No. 178 with the approval of the Director of the Delaware Agricultural Experiment Station. Contribution (No. 43) of the Department of Horticulture. November 1953.

relatively deep level where there was some moisture. These few seedlings grew through the layer of CMU on the surface which was, presumably, inactive due to lack of moisture. When rain finally came and where the 1-pound rate was used, these weeds were stunted but not killed. The 2- and 4-pound rates, however, gave excellent control.

One pound of CMU applied before harvest and the same amount applied after the harvest season, supplemented with some tractor cultivation, provided commercially satisfactory weed control for the entire season. For example, during the 1952 harvest season, on June 2--nearly seven weeks after one pound of CMU had been applied--there was an average of only one gram of weeds per square foot. The comparable 1953 figure was six grams per square foot. After harvest in 1952, on July 23, over four weeks after one pound of CMU had been applied, there was an average of only six grams of weeds (principally crab grass) per square foot. The comparable 1953 figure, 6½ weeks after application of CMU, was 34 grams per square foot.

Table 1. Effect of CMU on Yield, Stand, and Weed Weights in 1952 and 1953.

Treatment (Per Acre)	Weeds per Square Ft., Gms.[1] During Harvest 1952	During Harvest 1953	After Harvest 1952	After Harvest 1953	Av. Wt. of Mkt. Spears from 5 Plots, lbs.[2]	Av. Spear Wt., Gms.	Plant Stand in 1953 - Plants in 5 Plots
1. Check, not hoed	44	129	51	119	80.1	22	137
2. Check, hoed	0	0	0	0	77.9	20	132
3. CMU, 1 lb.	1	1	6	34	77.9	20	147
4. CMU, 2 lbs.	0.3	0	0.1	1	79.5	21	136
5. CMU, 4 lbs.	0	0	0	0	-	-	-
L.S.D. 5%	15	32	30	24	N.S.	N.S.	N.S.

[1]During the 1952 and 1953 harvest seasons, weed weights were taken 47 and 49 days, respectively, after CMU was applied. After the harvest season in 1952 and 1953, weed weights were taken 29 and 45 days, respectively, after CMU was applied.

[2]Adjusted by analysis of covariance to compensate for plot variability at the time CMU treatments were first made in 1952. Average yields for two years prior to 1952 were used as a base.

An interesting observation made in 1953 on an adjoining asparagus fertilizer experiment was that where poultry manure was applied annually for eight consecutive years and where the soil organic-matter content was much higher, the effectiveness of CMU was decreased in proportion to the amount of manure applied. Data on weeds and soil content of organic matter taken from the experiment are given in Table 2. Although poultry manure is not recommended for asparagus, these data indicate that, possibly, higher rates of CMU may be required on soils of higher organic-matter content. In this experiment, 1¼ pounds of CMU per acre were applied seven weeks before the weed data presented in Table 2 were obtained.

Table 2. Effectiveness of CMU Where Poultry Manure Was Used

Treatment[1] (Per Acre	Weeds per Sq. Ft., After 7 Weeks, Gms.	Soil O.M. Content, 9/1/53, Per Cent
800 lbs. 5-10-10 before and 800 lbs. 5-10-10 after harvest season	10	1.39
5 Tons poultry manure	64	1.82
10 Tons poultry manure	93	2.22
L.S.D. 5%	42	.42

[1]These treatments have been made every yeart starting in 1946.

Yields, average spear weights, and plant stands (Table 1) were not significantly affected when CMU was applied at the 1- and 2-pound rates. Furthermore, no plant injury was visible on the border row which received CMU at two pounds per acre in 1951 (one application), four pounds per acre in 1952 and 1953 (two applications each year) -- making a total of 18 pounds over a 3-year period.

Summary and Conclusions

CMU at one, two, and four pounds per acre gave excellent weed control in asparagus on a loamy sand soil. Two applications of CMU at 1-pound-per-acre rates -- before and after the harvest season when no spears were above ground -- along with some tractor cultivation, gave full-season control of weeds. On soils of greater organic-matter content, higher rates of CMU may be needed. This was indicated on an adjoining asparagus fertilizer experiment where CMU had been applied and where two rates of poultry manure had been used for eight years previously.

CMU at one- and two-pound-per-acre rates over a 2-year period had no injurious effect on yields, spear weight, or plant stand. On a border row which received 18 pounds of CMU over a 3-year period, there has been no visible symptoms of plant injury to date.

Weed Control in Established Asparagus Plantings with CMU (3-(p-chlorophenyl)-1, 1-dimethylurea) [1]

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Weeds are a serious problem in asparagus plantings. Many old and new chemical herbicides have been tried - some successfully and others with less favorable results. Calcium cyanamid, 2,4-D, Crag Herbicide 1, and others, have been recommended and used with erratic results, depending on age of weed, soil condition and timing of the application (2). The introduction of 3-(p-chlorophenyl)-1, 1-dimethylurea (hereafter referred to as CMU) by E. I. Du Pont de Nemours and Co., Inc. (3), provided another herbicide of possible value on asparagus and other crops. In 1952, CMU at 1.5 and 3 pounds per acre was used in a preliminary test on asparagus by Dolan (1). Noll and Odland used CMU to successfully weed asparagus seedlings (4). This report deals with the use of CMU in established asparagus beds on a Hillsdale sandy loam and on a sandy muck soil.

Materials and Methods

Two asparagus plantings on mineral soil were chosen for treating with CMU -- one for a pre-harvest application and the second for a post-harvest application. The first field was divided into six equal plots of 800 square feet each. Four rows of asparagus crossed these plots. Two of these plots were treated with 1.6 pounds per acre of actual CMU; two plots with 2.4 pounds, and two plots were left as checks. The wettable powder of CMU was applied with a 3-gallon compressed air hand sprayer at a volume of 30 gallons per acre as an over-all spray. The applications were made May 5, at which time a few of the asparagus spears were just starting to emerge. The field had been treated in the usual manner with a complete disking about a week prior to treatment.

The second field was divided in a similar way and was treated June 13, after the picking season. The field had received the usual post-harvest disking. CMU was applied here at 0.8 and 1.6 pounds per acre.

The CMU plots on muck soil were laid out in 1951. Each plot consisted of 1350 square feet. One plot received an initial application in September, at the rate of 10 pounds of CMU per acre. On May 8, 1952, CMU at 2 pounds per acre was applied to a second plot after the customary fertilization and disking operations. In 1953, applications of 1 and 2 pounds per acre were made so that one plot had received a total of 11 pounds and the other a total of 4 pounds in the 3-year period. Similar plots were left as untreated checks. The 10-pound application was made for the control of quack grass, Kentucky blue grass and smooth brome grass. The lower rates of application

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[1] Published in the Quarterly Bulletin of the Michigan Agricultural Experiment Station, Michigan State College.

were made for control of annual grasses and broad leaved weeds.

Discussion of Results

Preharvest Application

The treated areas remained nearly weed-free for four weeks following application, whereas the check areas became green with weeds, averaging well over 100 weeds per square foot. Both rates of CMU gave 90 per cent weed control (Table 1). The treated areas were neither hoed nor cultivated during the season, but the weeds were hoed from the check areas so they would not interfere seriously with asparagus growth.

Weeds controlled with CMU in these experiments were:

Broadleaved:

Curly dock (*Rumex crispus*)
Common chickweed (*Stellaria media*)
Dandelion (*Taraxacum officinale*)
Lambsquarter (*Chanopodium album*)
Mouse-ear chickweed (*Cerastium vulgatum*)
Pepper grass (*Lepidium campestre*)
Rough pigweed (*Amaranthus retroflexus*)
Shepherds purse (*Capsella bursa-pastoris*)
Smart weed (*Polygonum persicaria*)
Speedwell (*Veronica serpyllifolia*)
Wormseed mustard (*Erysimum cheiranthoides*)

Grasses:

Downy brome grass (*Bromus tectorun*)
Green foxtail (*Setaria viridis*)
Kentucky blue grass (*Poa pratence*)
Tickle grass (*Panicum cappillare*)
Quack grass (*Agropyron repens*)
Yellow foxtail (*Setaria lutescens*)

Weeds that were not completely controlled:

Butter-and-eggs (*Linaria vulgaris*)
Brome grass (*Bromus inermis*)
Crab grass (*Digitaria sanguinalis*)
Prickly lettuce (*Lactuca scariola*)

About one month following the treatments, some crab grass germinated and grew on the treated plots. A little more of this grass was evident in the areas treated with 1.6 than in areas treated with 2.4 pounds per acre. Apparently, asparagus seedlings are somewhat resistant to CMU because they germinated about 10 days after application and grew normally.

The asparagus was harvested 14 times between May 7 and June 8, and no appreciable difference in yield between treated and untreated areas was noted. (Table 1).

Table 1. Average Asparagus Yield of all Treatments of Preharvest Applications with CMU and per cent Weed Control in both Pre-harvest and Post-harvest applications.

CMU (lb./A	Asparagus Yield (lb/A) Pre-harvest treatment)	Weed Control (in per cent of check) Pre-harvest treatment	Post-harvest treatment
0.0	3267.27	00.00	00.00
0.8	- -	- -	88.10
1.6	3177.80	94.35	93.06
2.4	3400.80	97.89	- -

Several rows of asparagus adjacent to the CMU experiments were left untreated and received a post-harvest disking, whereas the experimental plots were not disked after harvest. The fern growth on the experimental plots started earlier and by mid-season was more vigorous than in the areas that had received the post-harvest disking. The disking operation evidently injured the asparagus and growth was delayed, which may have an effect on yields.

The pre-harvest application of CMU on muck soil kept the treated areas free from all weed growth through July, 1953. By the 1st of September, a few fall germinating weeds had appeared, but no grasses have yet appeared in these plots.

Yield records from these plots were equal to those from untreated plots and no abnormal growth was found. The only visible effect on asparagus was a somewhat earlier maturity of fern growth in 1952.

Post-harvest Applications

In the post-harvest test plots, treatments were made following the customary end-of-season disking.

Weed species in these plots reappeared after disking and were representative of those found in the pre-harvest experimental plots. CMU at 1.6 pounds per acre controlled more weeds than 0.8 pounds (Table 1).

The fern-growth produced following applications with CMU was vigorous, indicating that the asparagus apparently was not injured.

On the muck there were several patches of perennial grasses in the plot which received 10 pounds of CMU per acre. Quack grass and Kentucky blue grass were eliminated by the treatment, but smooth brome grass showed little or no effect from the treatment. Again in 1952 and 1953 asparagus growth was normal.

Conclusion

1. Weeds were successfully controlled in established asparagus plantings with low rates per acre of CMU, either as a pre-harvest or a post-harvest application. No cultivation or hoeing was needed during the season in the treated plots.

2. The asparagus apparently was not injured from these low rates (0.8, 1.6, and 2.4 pounds per acre) of CMU as was indicated by the yield. Fern growth in the pre-harvesting treatments was more vigorous throughout the season.

3. For commercial applications to established asparagus plantings, CMU should not be used at rates above 1.6 pounds per acre (2 pounds of the 80 per cent preparation). This amount should be applied in enough water, about 40-50 gallons per acre, to allow for uniform and complete coverage of the entire area or of the row only. For best results the spray should be applied before weed seedlings begin to emerge. The soil should have been worked down to a smooth, even surface.

4. The CMU could be applied either as a pre-harvest or post-harvest application, depending on the weed population. If it is applied both before and after harvest the rates per acre should be reduced so as not to total over 2.4 pounds per acre, which is the same as 3 pounds of the 80 per cent wettable commercial preparation.

5. Since all the conditions relative to the use of CMU in asparagus have not been completely investigated, it is suggested that growers try this chemical on a small area the first year. <u>Over-dosages of CMU may sterilize the soil for many months</u>.

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FACTORS DETERMINING THE EFFECTIVENESS OF PRE-EMERGENCE HERBICIDAL TREATMENTS

Desmond D. Dolan[1]

This experiment was designed to study the effects of the following factors in determining the incidence of weeds following pre-emergence treatment:

a. Method of soil preparation - rough, loose preparation compared to smooth, compact preparation.

b. Time of application.

c. Type of herbicide used.

d. Two soil disturbances after herbicidal treatment.

Review of Literature

It has frequently been stated that pre-emergence herbicidal treatments are most effective if the land is smoothed before the treatments are applied, evidently assuming that the chemical would be more dissipated on rough, loose soil (6). It has been demonstrated that most of the CMU applied lodges in the upper 1/8 inch of soil, and that this upper, chemical-bearing layer must be continuous to promote contact with germinating weed seeds. (1) (4).

Pre-emergence herbicides are most effective when applied at the time of maximum weed seed germination, which usually is immediately after planting. (2) (3) (5) (7). A lesser degree of weed control was obtained with some herbicides by delaying pre-emergence treatment for 3 to 5 days after planting. (2) (5).

Disturbance of the surface soil after treatment, incorporates the chemical with the soil and reduces its effectiveness (1) (4) and brings to the surface soil lacking the chemical and carrying dormant weed seeds (6).

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Materials and Methods

The experimental area was a 9-year-old asparagus planting located on Bridgehampton silt loam and fertilized with 1,000 lb. 5-10-10 per acre on April 3 . The area was thoroughly disced on April 3 and April 10, and smoothed with a spike-toothed harrow after the second discing.

A factorial split-plot design was used. The largest plots were the time of a pplication plots, there being three of these in each block to accommodate time of application as follows:

1. April 15 - Assumed to be one week before maximum weed seed germination.

2. April 22 - Assumed to be at the time of maximum weed seed germination.

3. April 29 - Assumed to be one week after maximum weed seed germination.

Each time of application plot was split lengthwise into two sub-plots,$_3$ to accommodate the two methods of land preparation as follows:

1. RL - rough and loose preparation. The upper 3-inch layer of soil was loosened with potato forks, and the lumps broken without compacting the soil.

2. SC - smooth and compact. The upper 3-inch layer of soil was loosened with potato forks, the lumps broken and the surface raked smooth. The soil was then compacted by rolling.

These sub-plots$_1$ were again split lengthwise into sub-plots$_2$ to provide for the inclusion of 2 herbicidal treatments:

1. Premerge at 2 gal. (6 lb. dinitro) per acre.

2. Chloro-IPC at 2 gal. (8 lb. ChlIPC) per acre.

An 18-inch alley was left between adjacent sub-plots$_2$. To avoid soil disturbance, the operators confined themselves to these alleys while applying the sprays. Each sub-plot$_2$ measured 45' x 4' and included a single asparagus row.

On may 12, or 13 days after the final herbicidal treatment, each sub-plot$_2$ was split transversely into three sub-plots$_3$ and these allotted at random to 3 disturbance treatments:

1. Check - No disturbance.

2. Light raking of surface

3. Deep disturbance with toothed cultivator. The disturbance plots were the smallest plots in the experiment, each measuring 15' x 4'.

Broad-leaved weeds were counted on three one-square-foot areas on each plot on June 8 and 9, or 27 after application of the disturbance treatments. The data were interpreted by analysis of variance.

Results

Effects of the Main Factors.

As indicated in Table 1, the time of land preparation and application of the pre-emergence treatments was a significant factor. Contrary to what might be expected, weeds were most prevalent where the treatments were applied at the time of maximum weed seed germination. There was no difference between treating one week earlier and treating one week later than this time.

Table 1. Broad-leaved weed count per 3 sq. ft. after pre-emergence treatment on 3 dates.

Time of application	Mean per plot
April 15	37.6
April 22	61.3*
April 29	32.5

L.S.D. 5 % = 23.7 1 % = 31.5

Type of soil disturbance was the only other factor producing a significant effect. The data in Table 2 indicate that the difference in weed count between the check (no disturbance) and light raking of the surface was not significant. Disturbance with a toothed cultivator increased the incidence of weeds to more than 4 times the count on the check plots, and this effect made the disturbance treatments the most significant factor in the experiment.

Table 2. Broad-leaved weed count per 3 sq. ft. with 3 disturbance treatments.

Type of disturbance	Mean per plot
(1) Check - No disturbance	1.8
(2) Soil surface raked lightly	22.7
(3) Deep disturbance with cultivator	106.9**

L.S.D. 5% = 23.7 1% = 31.5

Significant Interactions.

The mean weed counts for three disturbance treatments in combination with three dates of chemical application are given in Table 3.

Table 3. Broad-leaved weed count per 3 sq. ft. with three disturbances and three treatment dates.

	Disturbance Number*			
Time of application	1	2	3	Mean
April 15	2.2	31.0	79.6	37.6
April 22	2.3	25.8	155.8	61.3
April 29	0.9	11.3	85.2	32.5
Mean	1.8	22.7	106.9	43.8

L.S.D. between disturbances within time of application
5% = 41.1 1% = 54.6

* As designated in Table 2.

Comparisons of means in Table 3 indicate that light surface raking did not reduce the effectiveness of pre-emergence chemical treatment at any of the three times of application. On the other hand, deep disturbance reduced the effectiveness of the chemicals regardless of the time of treatment. Deep disturbance caused the greatest incidence of weeds when the chemical treatments were applied at the time of weed seed germination.

A second significant interaction is that between method of land preparation and disturbances. Comparisons in pairs of the means in Table 4 indicate that light surface raking did not reduce the effectiveness of pre-emergence chemical treatment regardless of whether the land preparation was rough and loose (RL) or smoothed and compacted (SC).

Table 4. Broad-leaved weed count per 3 sq. ft. with three disturbances and two preparations.

Method of preparation	Disturbance 1	2	3	Means
RL	2.4	29.4	90.1	36.1
SC	1.6	21.7	150.4	51.5
Means	1.8	22.7	106.9	43.8

L.S.D. between disturbances within method of land preparation: 5% = 35.6 1% = 47.3

Deep disturbance (D_3) caused a greater incidence of weeds than light raking (D_2) regardless of the method of land preparation. The greatest loss of chemical effectiveness and the highest weed count occurred where deep disturbance followed smooth and compact land preparation.

None of the other interactions was significant.

Discussion and Conclusions

The data on time of application of the chemicals are contrary to what might be expected. Ordinarily, one would expect the most complete weed control with herbicidal treatment at the time of maximum weed seed germination. However, the time of maximum weed seed germination is determined with difficulty and is influenced to a large extent by prevailing temperature and the soil moisture content. Weather data for 1953 indicate April rainfall was adequate for weed seed germination, but that a dry period extending from May 30 to June 13 may have affected the weed counts which followed the disturbance treatments.

Although plots lightly disturbed by raking the surface were not significantly different from check plots, those deeply disturbed by cultivation displayed a much higher incidence of weeds. These data strongly support the conclusion that chemical pre-emergence treatments are most effective when cultivation is delayed. They support the contention that most of the chemical lodges in the upper layer of soil, where it is most likely to come in contact with germinating weed seeds. Deep disturbance mixes the chemicals with the surface soil and reduces their effectiveness. Light disturbance by raking (or possibly as might occur from scuffing the feet while cutting the asparagus) would probably not reduce the effectiveness of pre-emergence chemical treatments.

Deep disturbance reduced chemical effectiveness most when the chemicals were applied at the time of maximum weed seed germination.

Deep disturbance increased the weed count most on plots that were smoothed and compacted before the chemicals were applied. It is presumed that deep disturbance incorporated the chemical with the soil and reduced its effectiveness and also brought to the surface soil lacking the chemical and containing dormant weed seeds.

Summary

(1) The effectiveness of pre-emergence chemical treatments was reduced when the soil surface was sprayed at the time of maximum weed seed germination as compared to the same treatment applied one week before or one week after this date.

(2) Deep disturbance, with a toothed cultivator 13, 20, and 27 days a fter treatment practically nullified the effect of pre-emergence chemical treatment.

(3) Cultivation should be delayed for at least 27 days in order to obtain maximum weed control from pre-emergence treatment.

(4) Light disturbance by raking the soil surface after treatment did not reduce herbicidal effectiveness.

(5) Deep disturbance reduced herbicidal effectiveness more on smooth compact plots than on rough, loose plots.

(6) Premerge and Chloro IPC were equally effective as pre-emergence herbicides.

(7) Observations made in the course of the experiment indicate that soil moisture content may greatly affect the incidence of weeds following different soil disturbances.

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ALANAP-1 AS A HERBICIDE FOR VINE CROPS IN 1953[1]

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Alanap-1 (N-1 naphthyl phthalamic acid) when applied to cantaloupes in 1952 gave good weed control with no reduction in total yields (1). Sweet and Ries (2) used the same herbicide in New York on watermelons, cucumbers, and squash as well as cantaloupes. They found Alanap-1 at four pounds per acre to be very effective for weed control without causing injury to any of these crops. They used Alanap-1 in both pre- and post-emergence applications on a fine sandy loam soil. Meador and Hemphill (3) obtained equally good results in Missouri using the same material at the same rate in pre-emergence applications to cucumbers, cantaloupes, and watermelons.

To further test Alanap-1 under extreme conditions where crop injury would most likely occur, an experiment was set up at the Georgetown Substation on a very light Norfolk loamy sand with low organic-matter content (about 1½ per cent). Four vine crops were used: cantaloupe, cucumbers, watermelons and squash.

Experimental Procedure

The varieties used were Jumbo Hale's Best cantaloupe, Congo watermelons, Marketer cucumbers, and Boston Marrow squash. All were seeded May 6, 1953. However, since the first-seeded squash showed considerable crop injury from the various rates of Alanap-1 used, a second experiment was started on June 16,on a different plot of land, using lower rates. Alanap-1, a 90 per cent wettable powder, was applied in 50 gallons of water per acre. Each treatment was replicated four times in randomized blocks using single-row plots, 50 feet long. Tractor cultivation was given whenever necessary to control weeds on the hoed-check plots, leaving a 12-15 inch band over the rows undisturbed. Weed counts and weights on a 1 by 3 foot area were taken over each row one month after seeding. Crab grass, lamb's quarters, and pigweed were the predominant weeds. Plant-stand counts were obtained at the same time as the weed data. After these data were taken, the entire area was cultivated, hoed, and plants thinned to a uniform stand. At this time too, post-emergence applications of Alanap-1 were made to certain plots. In the squash experiment, however, the only plots that were ever hoed were the "hoed-check" plots.

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[1]Published as Miscellaneous Paper No. 179 with the approval of the Director of the Delaware Agricultural Experiment Station. Contribution (No. 45) of the Department of Horticulture. Nov. 1953.

Results and Discussion

Weed counts and weights given in Table 1 indicate that Alanap-1 when applied right after seeding gave excellent control. When applied five days after seeding, however, Alanap-1 did not control weeds. The reason for this was that many weeds had already emerged five days after seeding and that Alanap-1 has little effect when applied to weeds already above ground. The day after seeding, 0.65 inches of rain fell which caused weeds to germinate quickly.

Weed data (Table 1) indicata that 2 pounds of Alanap-1 was as effective as 4 pounds when applied immediately after seeding. Weed data from the squash experiment indicate that Alanap-1 at the 1-pound rate gave considerable, though not perfect, weed control (67 per cent), and the 1/2-pound rate gave somewhat less. In the earlier squash experiment, seeded on May 6 and later discontinued, it was observed that the 2-pound rate gave excellent weed control but reduced the stand of squash by 40 per cent and caused many deformed plants.

Post-emergence applications of Alanap-1 extended the period of weed control. On cantaloupes, cucumbers, and watermelons, a 2-pound rate was used, while on squash a 1-pound rate was used. However, under the conditions of this experiment, post-emergence applications were not particularly necessary because at the time they were applied, crop plants were large enough so that any weeds in the row could be covered by tractor cultivation. Furthermore, weeds during the latter half of the growing season were not troublesome.

Total and early marketable yields and plant stands (Table 2) were not significantly affected on a statistical basis by any of the Alanap-1 treatments listed in Tables 1 and 2.

There were certain yield reductions, however, that the author feels should be noted, although due to unexplained variability among the plots, they were statistically insignificant. One of these was the 55 per cent reduction in early yield of cucumbers as compared to the hoed-check plots. Further experiments are needed to find whether early yields of cucumbers are definitely reduced by Alanap-1 at two pounds per acre on sandy soils. It was quite apparent in the field that the early growth of cucumbers was temporarily retarded by Alanap-1 at the rates used. The early growth of cantaloupes and watermelons, too, was retarded temporarily, by Alanap-1, but early yields of these crops were relatively unaffected.

Alanap-1 at the 4-pound rate as compared to the 2-pound rate gave the following yield reductions for cantaloupes, cucumbers, and watermelons: 20, 13, and 29 per cent, respectively. These reductions, although not statistically significant, indicate that no more than the 2-pound rate should be used on sandy soils lest a possible yield reduction might result.

As pointed out above, Alanap-1 at the 2-pound rate reduced squash stand appreciably and caused many deformed plants. Alanap-1 at the 1-pound rate,

Table 1. Value of Alanap-1 for Weed Control in Vine Crops in 1953 -- Weeds per Square Foot.

Treatment	Cantaloupes[1]		Cucumbers[1]		Watermelons[1]		Squash[2]	
	No.	Wt.Gms.	No.	Wt.Gms.	No.	Wt.Gms.	No.	Wt.Gms.
1. Check - Unhoed for first month	353	150	54	46	74	54	8	72
2. Check - Hoed	0	0	0	0	0	0	0	0
3. Alanap-1, ½ lb., right after seeding	-	-	-	-	-	-	3	37
4. Alanap-1, 1 lb., right after seeding	-	-	-	-	-	-	3	24
5. Alanap-1, 2 lbs., right after seeding	6	0.4	2	1	8	4	-	-
6. Alanap-1, 2 lbs., 5 days after seeding	290	125	72	41	40	17	-	-
7. Alanap-1, 4 lbs., right after seeding	7	0.5	1	0.5	3	1	-	-
8. Alanap-1, ½ lb., right after seeding + 1 lb. a month later	-	-	-	-	-	-	2	20
9. Alanap-1, 2 lbs., right after seeding + 2 lbs. a month later	17	4	2	1	2	1	-	-
L.S.D. 5%	9	16	28	28	27	39	4	41

[1]Weed counts taken on June 1, i.e., 4 weeks after seeding.

[2]Weed counts from June 16 planting taken on July 29, i.e., 6 weeks after seeding.

on the other hand, caused no crop injury as indicated by appearance of the plants in the field, by stand counts, and by yields.

Post-emergence applications of Alanap-1 applied a month after seeding, 2 pounds on cantaloupes, cucumbers, and watermelons, and 1 pound on squash were made on plots on which pre-emergence applications had previously been made; 2 pounds per acre, exept on squash where a 1/2-pound-per-acre rate was used.

Respective yields from plots receiving Alanap-1 both pre- and post-emergence, as compared with those receiving Alanap-1 pre-emergence only, were as follows: 137 and 140 cantaloupes, 278 and 271 pounds of cucumbers, 32 and 45 watermelons, and 137 and 159 pounds of squash. Differences between these

Table 2. Effect of Alanap-1 on Total and Early Yields, and Plant Stand of Vine Crops in 1953.

Treatment	Total Mkt. Yield from 4 Plots				Early Mkt. Yield from 4 Plots[1]			Plant Stand			
	Canta-loupes	Cu-cumbers	Water-melons[2]	Squash	Canta-loupes	Cu-cumbers	melons[2]	Canta-loupes[3]	Cu-cumbers[3]	Water-melons[4]	Squash[5]
	no.	lbs.	no.	lbs.	no.	lbs.	no.				
1. Check - Unhoed for first month	134	322	37	103	65	58	23	25	21	9	36
2. Check - Hoed	107	301	37	186	53	58	21	26	27	9	32
3. Alanap-1, ½ lb., right after seeding	-	-	-	159	-	-	-	-	-	-	33
4. Alanap-1, 1 lb., right after seeding	-	-	-	175	-	-	-	-	-	-	32
5. Alanap-1, 2 lbs., right after seeding	140	271	45	-	46	26	26	24	20	11	-
6. Alanap-1, 2 lbs., 5 days after seeding	131	312	30	-	49	50	18	22	22	7	-
7. Alanap-1, 4 lbs., right after seeding	112	236	32	-	40	19	17	23	25	8	-
8. Alanap-1, 1/2 lb., right after seeding + 1 lb. a month later	-	-	-	137	-	-	-	-	-	-	30
9. Alanap-1, 2 lbs., right after seeding + 2 lbs. a month later	137	278	32	-	48	21	15	21	18	9	-
L.S.D. 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

1. Yield during the first 10 days of the harvest season.
2. Average weight of watermelons for all treatments was approximately 28 lbs. and varied insignificantly.
3. Plants per 6 feet of row before thinning.
4. Plants in first 3 hills of each row before thinning.
5. Plants per plot before thinning.

yields as well as between the respective early yields of cantaloupes, cucumbers, and watermelons (Table 2) were not significantly different.

Summary and Conclusions

On a loamy sand soil with a low organic-matter content, Alanap-1 at a 2-pound-per-acre rate applied immediately after seeding gave excellent weed control in cantaloupes, cucumbers, watermelons, and squash. This treatment had no statistically significant effect on early and total yields and stand of cantaloupes, cucumbers, and watermelons. Squash seedlings, however, were severely injured by this rate of application. In another experiment, squash yields and stand were not affected significantly by a 1-pound rate applied similarly.

Post-emergence applications of Alanap-1 made a month after seeding, two pounds on cantaloupes, cucumbers, and watermelons and one pound on squash, extended the period of weed control without significantly affecting yields.

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Some Observations On The Use of Alanap-1 On Vine Crops

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During the summer of 1953 it became particularly obvious that the soil must be moist or rain was necessary following an application of Alanap-1 for this material to be effective in controlling weeds. Many disappointing results were experienced where Alanap-1 was used in Massachusetts for just this reason. Vegetable growers should expect that applications of Alanap-1 during dry weather to be of little value unless irrigation can be used in conjunction with it.

In tests with a number of vine crops it was evident that some crops were damaged by this chemical. The crops tested included cucumbers, muskmelons, squash and pumpkins. Of these it appears that cucumbers and muskmelons are relatively unharmed by recommended dosages of Alanap-1. Squash and pumpkins are harmed, however, to a considerable extent with this treatment. Varietal differences were noted in this respect and Uconn and Butternut squash were especially sensitive.

On a soil heavily infested with nutgrass (Cyperus esculentus), 4-8 pounds of Alanap-1 delayed the appearance of this pest and seriously stunted and yellowed the growth that was made later in the season.

Post-emergence applications of Alanap-1 did not kill such weeds as purslane, pigweed, ragweed, grasses or lamb's quarters on contact but in most instances gave them a wilted, twisted and somewhat dwarfed appearance. Post emergence applications on most all of the vine crops growing on very fertile soil caused their leaves to take on a very crumpled or savoyed character.

THE EFFECT OF REPEATED APPLICATIONS OF ALANAP-1 ON CUCUMBERS

Stewart Dallyn

The importance of cucumbers, and to a smaller extent muskmelons, has increased rather rapidly on Long Island during the past few years. Cucumbers are one of relatively few crops, other than potatoes, that perform satisfactorily on the low pH loams and sandy loams of this region. The greatest drawback is their high labor requirement for weeding after the vines begin to fill the row. This is a critical factor on farms primarily geared to potato production as their labor compliment is relatively low.

During the spring and summer of 1952 preliminary experiments were carried out with three (formulations 1, 2 & 5) phthalamic acid materials. In the first of these, various rates of the herbicides were applied to Delicious muskmelons about the time the plants were starting to run. The soil, sassafras sandy loam, was in a moist condition at the time of application. Weed control in general was good and no injury, in measurable amounts at least, was suffered by the crop. Later in the season additional experiments were conducted, including the effect of soil moisture on the action of this herbicide. In all cases it was found to be relatively inactive when applied to dry soil. Used in conjunction with rain or irrigation the results on cucumbers were, in general, promising. One instance of injury was noted--a six pound application to moist soil just after the cucumbers had emerged.

The objective of the 1953 experiment was to find out how much PA cucumbers could stand, and whether practical weed control could be obtained throughout the season with the use of this material.

GENERAL METHODS

Alanap was used at the rate of 6 pounds per acre, pre emergence, and 4 pounds per acre post emergence. Various treatments received either 1, 2, 3 or 4 of the latter applications as required to maintain weed control. The middles were cultivated as long as possible, and all plots were hoed whenever they required it so that weed competition was not a problem. Before each hoeing weed ratings were taken. Preceeding each treatment date the crop was irrigated so that all materials were applied to moist soil. Water soluble dinitro, 4.5 pounds per acre, was included as a pre emergence check treatment, and Crag, 4 pound rate, was applied after comeup. This latter material had previously been found quite injurious but was included for final rating. The Marketer variety was sown June 11, the pre emergence materials applied June 13 and the first post emergence June 27. Subsequent post emergence treatments were applied July 21, August 3 and August 11. Picking started August 6 and was concluded September 14.

RESULTS AND DISCUSSION

The results of the experiment are given in Table 1. Both pre emergence materials caused a temporary stunting of the plants though in the case of Alanap it was hardly noticable. Alanap was definitely superior to DN both in completeness and persistence of weed control and in addition had less harmful effects on the crop.

Crag, as in previous years, was much too injurious to the crop to warrent further attention. PA gave good weed control with the exception of crab grass. This was especially true if the grass had emerged before the herbicide was applied. The first post emergence application of PA definitely caused stunting. This injury was much more pronounced on small plants. A few recently emerged plants in hills which had been replanted due to bird damage were much more sensitive. Another factor indicating young plant sensitiviness is the fact that while both the first and second post emergence application brought about severe yield reduction the cumulative effects of the third and fourth were considerably less. There was evidence that the fourth spray, applied when the plants were in moderately heavy bloom had formative effects on fruit setting at that time.

The data, along with observations made throughout the growing season indicate that under our conditions one post emergence treatment would probably pay off provided it was not applied until the plants were well established. It is our feeling that the best program may be to use six pounds of the material soon after planting, leave as long as its effect holds and follow with hand cultivation in the row. The post emergence treatment would then be applied just as, or before the next weed crop emerged, by which time the cucumbers would be well established and injury to them would probably be negligible.

SUMMARY

1. 6 pounds per acre of Alanap applied for pre emergence weed control in Marketer cucumbers was definitely superior to 4-1/2 pounds of water soluble dinitro.
2. Post emergence application of Alanap at the rate of 4 pounds per acre reduced yield and increased the proportion of cull fruit. This adverse effect was emphasized by treatment of very small plants or plants that were in moderately heavy bloom.
3. As a result of a number of experiments with this material over the past two years we feel that the pre emergence treatment can be safely recommended. In addition it is suggested that growers use a single post emergence application on well established plants on a trial basis. This treatment would probably be most effective used after the first hand weeding following pre emergence control. By this time the plants would be 5-6 weeds old and crop damage from the Alanap at a minimum.
4. Alanap is effective only on moist soil and should be used in conjunction with rain or irrigation.

TABLE 1. EFFECT OF VARIOUS HERBICIDE TREATMENTS ON YIELD OF CUCUMBERS

TREATMENT					YIELD--BUSHELS/ACRE									
	PRE		POST		FANCY			CHOICE			CULLS		WEED CONTROL	
No.	Lbs./A.	Chem.	Lbs./A.	Chem.	Early	Total	Av.Wt.	Early	Total	Av.Wt.	Early	Total	Rate[1]	Duration[2]
1.	4.5	DN	0		75	219	.50	50	250	.49	8	112	2	18 days
2.	4.5	"	4	Crag	23	108	.47	21	112	.38	4	64	2	30
3.	"	"	4	PA	69	212	.49	50	172	.41	13	122	2	27
4.	"	"	4+4	"	41	119	.48	45	148	.39	12	97	2	46
5.	"	"	4+4+4	"	25	60	.45	54	110	.41	30	126	2	season
6.	"	"	4+4+4+4	"	24	39	.48	30	62	.40	24	104	2	"
7.	6	PA	0		81	239	.50	57	220	.42	16	125	3	24 days
8.	"	"	4	Crag	30	123	.49	34	146	.40	7	79	3	39
9.	"	"	"	PA	52	170	.48	44	163	.41	12	107	3	35
10.	"	"	4+4	"	32	84	.44	42	113	.36	14	100	3-2	48
11.	"	"	4+4+4	"	34	74	.49	43	106	.40	29	123	3-2	season
12.	"	"	4+4+4+4	"	37	70	.50	47	106	.42	31	137	3-2	"
13.	Cult.ck.				129	250	.51	81	229	.44	22	161	--------	
14.	Cult.Ck.				122	253	.51	61	191	.43	19	126	--------	
15.	Cult.		4	Crag	21	110	.50	17	102	.40	4	65	3	40
16.	"		4+4	"	26	72	.47	20	91	.36	7	63	3-2	season
17.	"		4	PA	83	217	.53	51	166	.41	15	117	3	37
18.	"		4+4		58	126	.50	47	145	.40	28	108	3-2	season
			LSD	5%	27	50		20	53		10	29		

(1) 1- not satisfactory
2- "
3- very good

(2) number of days after planting
until new weeds visible

Weeding Sweet Corn With Premerge

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During the past several years considerable evidence has been accumulated to show that DNOSBP provided an admirable pre-emergence weed killer in fields of sweet corn. Recently Watson (1) reported that this chemical might also be used in post emergence applications. He stated that corn was not injured in any way when treated in the coleoptile stage. He stated that where larger corn plants were treated slight burning of the older leaves occurred but, with the growing point protected, growth continued normally.

In order to test these methods an early sweet corn hybrid was planted on June 4, 1953 in single row plots 33 feet long. These were sprayed with 6 and 9 pounds of DNOSBP on June 8, one day before emergence of the corn. Other treatments consisted of 3 pounds of DNOSBP applied post emergence when the corn was 1 inch tall on June 11, at 3 inches tall on June 18 and at 15 inches tall on June 30. Each of the treatments were replicated four times. The month of June was warmer and drier than normal but the corn growth was excellent.

Table I. Effects of Premerge On Weed Control And Yield Of Early Sweet Corn

Treatment	Height corn when applied	DN per acre	Weed Density 1-9*	Weed Size 1-9*	Corn Vigor 1-9*	Corn Yield Lbs.
Pre-emerg	-	6 lbs.	8.7	7.5	9.0	26.6
" "	-	9 "	8.7	8.0	8.5	22.6
Post-emerg	1 in.	3 "	8.7	8.7	9.0	25.4
" "	3 in.	3 "	8.7	8.7	7.7	19.3
" "	15 in.	3 "	5.5	4.7	4.2	13.4
Check			1.0	1.0	8.5	24.8
L.S.D. at .05			1.3	2.4	1.0	3.5
L.S.D. at .01			1.9	3.4	1.3	4.8

*In the 1-9 ratings 1 is least and 9 most desirable.

No crop damage was noted as a result of the pre-emergence applications but burning was clearly apparent on the older leaves of the plants treated at the 3 inch and 15 inch post emergence stage. The results of these tests are presented in Table I and clearly demonstrate the effectiveness of Premerge in controlling weeds in pre- and early post-emergence applications. It is evident that the weeds were too far advanced for good control with 3 pounds of DNOSBP when the corn was 15 inches tall. It is also important to note that when corn was treated at this stage it was damaged to such an extent that the yield was significantly less than any of the other treatments.

Under the conditions of these tests it appears that the most effective and economical treatment was the post emergence application of Premerge at the rate of 3 pounds per acre when the corn was 1 inch tall.

LITERATURE CITED

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THE EFFECT OF CERTAIN ENVIRONMENTAL FACTORS ON THE RESPONSE OF SWEET CORN TO HERBICIDES

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6 or 7 commercially

For several years, 2,4-Dichlorophenoxyacetic acid has been used for weeding sweet corn. It has not been a perfect herbicide, however, because of its danger to other crops; its chance of contaminating equipment; its failure to control grasses, and because of its occasional damage to the crop. The purpose of this study was to re-evaluate 2,4-D as a herbicide for sweet corn and to compare it with other common herbicides as well as a few of the newer materials.

Methods

To evaluate 2,4-D and the other chemicals over as wide a variety of conditions as possible, a factorial experimental design was used which included several variables. The basis of including a given variable was usually a compromise between the likelihood of the particular factor influencing either crop response or weed control and the feasibility of studying that factor under field conditions.

primarily ideal conditions as far as #1, 0 is concerned

The major experiment as finally set up included the following:

1. Two soil types - a fine sandy loam and a silt loam confounded with location.

2. Two crop varieties - North Star, a standard for early market, and Golden Cross, a standard for main crop and processing.

3. Two stages of crop growth - spike stage and corn about 6 inches tall.

4. Irrigation - sprayed just prior to and just after 1/2" overhead irrigation.

5. Two rates of 12 chemicals - the lower rate equivalent to a usual commercial dosage, the higher rate one that might be used under some conditions. Due to space limitations, only the higher rates were used on the silt loam soil.

6. There were two replications on the sandy soil, three on the heavy soil.

The largest plot division was on the basis of varieties. One-half of each experimental area (one area for each soil type) was planted to a given variety. Each variety was divided into two parts: one received chemicals at

1. Paper No. 373 Department of Vegetable Crops
2. Part of this work was made possible by Grants-in-aid from Esso Laboratories, Dow Chemical Co., and Carbide and Carbon Chemicals Co.

the spike stage, the other when the corn was about 6 inches tall. The smallest plot division consisted of 1 single corn row 15 feet long. Two adjacent 15 foot rows received identical chemical treatments, but one was treated prior to and the other subsequent to irrigation. Guard rows and guard areas were established between varieties, between stages of growth at time of treating, and on the outer edges of the experiment.

The chemicals were applied by means of a small plot CO_2 sprayer at a pressure of 30 P.S.I. in 90 gallons of spray to the acre. An area 2 feet wide over the crop row was sprayed. Since the crop rows were 3 feet apart, a strip of each row middle was not treated.

When the crop was about 4-6 inches tall, the middles of all plots were cultivated. In addition, those plots which were to receive the sprays at the 6-inch stage were given a thorough cultivation. Soil was disturbed throughout these plots and weeds between the corn plants were covered by throwing soil to the row. At this time, these plots would have been considered by farmers to be in excellent condition from the standpoint of both weed control and tilth.

Prior to planting the crop was fertilized with about 1500 pounds per acre of a 5-10-10 fertilizer. In addition to the 1/2" of water at the time of treatment, the entire area was irrigated once in July with one inch of water to supplement the deficient rainfall. Until full silk was reached, the crop made excellent growth with prospects for a much higher than average yield. However, a severe heat wave and drought damaged the maturing ears, and crop yields, although taken, are not reported. Chemicals used and dates of performing experimental procedures are presented in Table 1.

Another experiment dealing with leaching will be reported later in this paper.

Results

Weed Control. The principal weeds were lambs-quarters (*Chenopodium album*), red root (*Amaranthus retroflexus*), purslane (*Portulaca oleracea*), stink grass (*Erogrostis cilianenesis*) and to a much lesser extent crabgrass (*Digitaria* sp.), barnyard grass (*Echinochloa crus-galli*), and nutgrass (*Cyperus esculentus*) Final weed observations were recorded by a rating method: 9 - perfect weed contril; 7 - good commercial control; 5 - possibly acceptable commercial control under severe conditions; 3 - very poor control, not acceptable commercially; and 1 - complete heavy ground cover.

In comparing weed control obtained with the different chemicals (Table 2) it will be noted that consistently poorer results were obtained with PCP and with 2,4-D wax emulsion than with the other chemicals except Dalapon. The ratings for the latter were low because it did not control the broadleaved weeds which were predominant in these experiments. NaPCP gave substantially better weed control than PCP. It was equal to the Dinitros when used at the twelve pound rate. CMU also gave excellent weed control. The 2,4-D treatments were acceptable commercially but had some grasses present. If the weed prevalence had been predominantly grasses, these plots would have been rated much lower. 3,4-D generally gave as satisfactory weed control as 2,4-D. Sesin was the most efficient of the ethyl sulfate derivatives studied.

Table 1. Experimental Materials and methods

Planted: June 8, sandy soil; June 12, silt loam soil

Treatment dates:

Corn stage	Sandy soil		Silt loam	
	North Star	Golden Cross	North Star	Golden Cross
Spike-before irrig.	June 17	June 18	June 20 a.m.	June 22
Spike-after irrig.	June 19	June 19	June 20 p.m.	June 23
6 inch-before irrig.	June 26	June 30	July 6	July 6
6 inch-after irrig.	June 27	July 1	July 7	July 7

Chemicals and designation:

Pentachlorophenol = PCP; Sodium salt of Pentachlorophenol = NaPCP; Alkanolamine salts of Dinitro ortho secondary butyl phenol = Premerge; Dinitro ortho secondary butyl phenol = DN General; 2,4-Dichlorophenoxyacetic acid, amine salt = 2,4-DA; 2,4-Dichlorophenoxyacetic acid, butoxyethanol ester = 2,4-DE; 3,4-Dichlorophenoxyacetic acid, amine salt = 3,4-DA; 3,4-Dichlorophenoxyacetic acid, isooctyl ester = 3,4-DE; 2,4-Dichlorophenoxy-acetic acid, amine salt, wax emulsion = 2,4-D wax; 2,4-Dichlorophenoxyethyl sulfate = Crag 1; 2,4-Dichlorophenoxyethyl benzoate = Sesin; 2,4,5-Trichlorophenoxyethyl sulfate = Natrin; 3-(p-chlorophenyl)-1,1-dimethylurea = CMU; a,a-Dichloroproprionic acid = Dalapon.

Data recording: Preliminary observations on weed control and crop response were made about one week and three weeks following time of treating. Final weed observations and crop height measurements were taken at full-silk. Yields are not reported, although harvest records were taken, because of severe drought conditions which prevailed during maturation of the crop.

Table 2. Weed Control Ratings. 9 - no weeds; 7 - commercial control; 5 - acceptable under severe conditions; 1 - complete heavy ground cover.

	Treatment		Sandy Soil				Silt Loam Soil			
			Early		Late		Early		Late	
No.	Lbs.	Chemical	Before Irrig.	After Irrig.	Before Irrig.	After Irrig.	Before Irrig.	After Irrig.	Before Irrig.	After Irrig.
1	3	Premerge	6.0	7.5	6.0	7.0	-	-	-	-
2	6	"	8.0	8.0	7.0	7.0	6.3	5.0	7.3	8.0
3	3	PCP	1.5	1.0	1.5	3.0	-	-	-	-
4	6	"	4.5	3.0	2.5	3.5	3.0	3.3	6.3	7.0
5A	6	NaPCP	7.5	6.5	-	-	-	-	-	-
5B	1/2	3,4-D A.	-	-	3.5	4.5	-	-	-	-
6A	12	NaPCP	7.5	8.5	-	-	6.3	7.0	-	-
6B	1	3,4-D A.	-	-	7.0	6.5	-	-	7.0	6.0
7	1/2	2,4-D A.	6.5	6.0	7.0	8.0	-	-	-	-
8	1	"	5.5	5.0	5.0	4.0	5.6	6.0	7.3	8.0
9	1/2	2,4-D Wax	3.0	2.0	3.0	3.0	-	-	-	-
10	1	"	4.0	3.5	5.5	5.0	3.3	4.6	6.3	6.0
11	1/4	2,4-D E.	5.5	4.5	5.5	6.5	-	-	-	-
12	1/2	"	6.5	4.5	8.0	7.5	5.0	5.3	8.6	8.0
13	3	Crag 1	4.5	4.0	5.0	4.5	-	-	-	-
14	6	"	7.0	5.5	7.5	7.5	5.3	5.3	8.0	8.0
15	3	Sesin	7.5	6.5	8.5	7.5	-	-	-	-
16	6	"	7.5	5.5	8.0	7.5	6.6	6.0	6.6	6.3
17	3.6	Natrin	3.0	3.0	6.5	6.5	-	-	-	-
18	7.2	"	6.0	4.0	6.0	6.0	3.0	3.6	6.0	6.0
19	0.4	CMU	4.5	6.5	7.5	7.5	-	-	-	-
20	0.8	"	8.0	7.5	6.5	7.5	5.6	4.0	6.3	8.3
21	5	Dalapon	1.5	1.5	4.0	6.0	-	-	-	-
22	10	"	1.0	1.0	3.0	4.0	3.6	4.6	7.6	7.6
23A	3	DN Gen.	6.5	5.5	-	-	-	-	-	-
23B	1/4	3,4-D E.	-	-	6.0	7.0	-	-	-	-
24A	6	DN Gen.	8.5	8.5	-	-	5.3	6.0	-	-
24B	1/2	3,4-D E.	-	-	4.5	5.5	-	-	5.3	5.0
25	None		2.5	3.0	1.0	1.0	1.6	1.6	5.3	4.6
26	None		1.0	1.0	2.0	2.0	-	-	-	-
		Total	135.0	123.0	137.5	145.5	60.5	62.3	87.9	88.8

A Treatments applied only early post-emergence
B Treatments applied only late post-emergence

Crag 1 at the 3 pound rate was not acceptable. Natrin was not effective when applied early at the 3 pound rate, perhaps because weed seeds had already sprouted.

Weed control averaged somewhat better on the sandy soil than on the silt loam soil, even though the latter had a generally lower weed population. These data may be indicative that chemicals are less effective on silt loam as compared to sandy soils. By comparing the check plots that received a thorough cultivation at both locations one can readily see that only a few "second crop" weeds appeared in the silt soil whereas a large number came in the sandy soil.

Irrigation was applied to all plots in order to eliminate possible differences in crop growth and weed population because of soil moisture differences. Since the chemicals were applied either prior to or subsequent to a 1/2" irrigation, the principal effects of this variable were therefore (1) the washing of the chemical from the foliage, and (2) the washing of the chemical slightly into the soil. At the early application on the light soil where weeds had sprouted prior to treating, there was a slight tendency for both the 2,4-D and the ethyl sulfate derivative types of chemicals to give somewhat better results when watered into the soil. Generally speaking, however, all chemicals tended to give about the same level of control whether applied before or after irrigation.

The time of applying the chemicals in relation to crop growth had no effect on weed control. This was to be expected inasmuch as thorough cultivation preceded the late treatment. In both the early and later treatments only a very small percentage of the weeds had emerged prior to treating, but most did so within a few days.

<u>Crop response</u>. Foliage symptoms were observed in those plots which received CMU, Premerge, and Dow General treatments. The symptoms gradually disappeared, however, as the crop matured. The Dinitro plots showed considerable contact damage and severe stunting for the first several weeks. The CMU plots were stunted and lighter in color than normal. By the time of silking, however, all plots had recovered so that no evidence of injury could be detected.

Irrigation had a pronounced effect on the crop symptoms in the Dinitro plots. When treated prior to irrigation, that is when the chemical was washed off, no damage could be detected, even at the higher rates.

Neither variety, soil type nor size of corn at time of treating had any effect on results with the Dinitros. Equally severe symptoms occurred in all plots irrigated prior to treating.

It is well established that results with Dinitro sprays can be profoundly influenced by the temperature prevailing at or shortly after the time of spraying. By referring to Table 3 one can see that, while some of the plots were treated during hot weather, others were treated when temperatures were at or even below normal. Since symptoms were apparent following all treatments, it is unlikely that "above normal" temperatures could be the explanation for the injury from the Dinitro sprays. Rather, it is probable that "normal" temperatures in June and July are too high in Ithaca to permit safe post-emergence use of Dinitro on sweet corn.

Table 3. Weather data for period when sprays were applied.

Date	Temperature °F Max.	Min.	Mean	Normal Mean	°F Difference from normal mean	Rainfall inches
June 17 T	80	58	69	67	+ 2	0.0
18 T	78	58	68	67	+ 1	0.0
19 T,T	85	61	73	67	+ 6	0.0
20 T,T	94	63	78	67	+ 9	0.01
21	93	70	82	68	+ 14	0.18
22 T	85	57	71	68	+ 3	0.0
23 T	74	46	60	68	- 8	0.0
24	75	41	58	68	- 10	0.0
25	88	51	70	68	+ 2	0.0
26 T	86	66	76	68	+ 8	0.0
27 T	84	54	69	69	0	0.0
28	90	55	72	69	+ 3	0.23
29	83	56	70	69	+ 1	0.0
30 T	87	53	70	69	+ 1	0.0
July 1 T	88	61	74	69	+ 3	0.28
2	88	67	78	69	+ 9	0.18
3	75	51	63	70	- 7	0.02
4	78	47	62	70	- 8	0.0
5	86	50	68	70	- 2	0.0
6 T,T	80	66	73	70	+ 3	0.0
7 T,T	83	54	68	70	- 2	0.0
8	80	52	66	70	- 4	0.0
9	69	47	58	70	- 12	0.0
10	76	42	59	70	- 11	0.0
					+ 65	
					- 64 + 1	

T - Chemical treatments applied on these days.

Leaching Study

Most research workers (1) and growers agree that 2,4-D on sandy soils can be harmful to sweet corn especially if heavy rains occur. Therefore, any evaluation of herbicides for this crop must include studies on this aspect. A leaching experiment using the higher rates of the chemicals reported in the previous experiment was laid out on an adjacent area in the same field of sandy soil. Weed populations were of similar composition, that is, predominently broadleaves. The plots were one sweet corn 1/ row 15 feet long for each chemical. There were three replications.

The soil was extremely dry at the time of planting. Two days later, before crop seeds had shown signs of swelling, chemicals were applied. Within a few minutes of applying the last treatment, irrigation was begun. Sufficient water was applied until surface run-off was imminent. The system was then shut off until the water had soaked in. This procedure was repeated so that after a 36 hour period a total of two inches of water had been applied. In the subsequent 24-hour period a series of light rains occurred which gave an additional 1.13 inches of water. Thus within a 64-hour period following treating the area received a total of 3.13 inches of water, without surface run-off.

The day of treating (July 17) the temperature reached a maximum of 93°F. However, this extreme only lasted for about one hour following the earliest applied treatments, because as soon as the irrigation was started the soil temperature fell materially. After the rain occurred, temperatures averaged in the middle 80's in the day and low 60's at night.

Preliminary notes on weed control and crop emergence were obtained on July 28 when the check plots were in the spike stage. Final observations were made September 7 when the corn was about 30 inches tall in the check plots. The results are shown in Table 4.

From the viewpoint of weed control it is interesting to note that, generally speaking, the better treatments reported in the previous experiment where conditions were nearly ideal were also the better treatments under severe leaching conditions. NaPCP was outstanding in this respect. Likewise, PCP and Dalapon were again ranked as poorer than the other chemicals. Sesin was superior to both Natrin and Crag 1. The 2,4-D materials, both ester and amine, gave only mediocre weed control. One unexpected result of this experiment was the trend toward better weed control from the Premerge than from the general type of Dinitro material. Temperature may have played a part here. Irrigation was not started for about one hour after the DN treatments were applied. Under the 90° temperature which prevailed, there may have been appreciably more volatilization of the DNOSBP than of the alkanolamine salts (2) before irrigation cooled the soil.

Crop injury was marked in several of the plots. It was especially noticeable in the 2,4-D amine and the ethyl sulfate derivative treatments. 2,4-D ester was noticeably less toxic to the corn than was the amine. This difference may not be actually as great as it first appears since only one pound of the ester was applied as compared to two pounds of the amine.

1/ Beans and peas were also included in the test but will not be reported here.

Table 4. Results from leaching experiment. Data are averages of ratings 1/.

Chemical	Lbs.	Weed control July 28	Weed control Sept. 7	Corn growth July 28	Corn growth Sept. 7	Ave.
1 PCP	6	3.6	4.3	8.3	7.6	5.95
2 NaPCP	12	9.0	9.0	8.3	9.0	8.82
3 Premerge	6	6.3	7.6	7.6	7.6	7.27
4 DN General	6	5.0	5.0	7.3	8.3	6.40
5 2,4-D A.	2	4.3	4.3	5.6	5.6	4.95
6 2,4-D E.	1	5.0	3.0	7.1	7.6	5.54
7 Crag 1	6	7.0	5.0	5.0	6.3	5.82
8 Natrin	6	5.6	5.0	3.0	3.0	4.01
9 Sesin	6	9.0	9.0	5.0	6.3	7.32
10 CMU	1	7.6	7.0	6.3	7.0	6.97
11 Dalapon	5	0.0	3.0	8.3	5.0	4.01
12 None	-	0.0	0.0	9.0	7.3	4.01

1/ See p. 2 for explanation of ratings.

In Table 4 the combined weed control and crop ratings are presented. On this basis NaPCP performed exceptionally well, but 2,4-D amine, Natrin and Dalapon were not satisfactory.

Discussion and Summary

In considering both ideal and extreme soil moisture conditions NaPCP formulation ACP195A was an outstanding material whether applied pre- or post-emergence, both for its weed killing properties and for its lack of crop damage. PCP on the other hand gave disappointing weed control. Perhaps at higher rates it would have performed more satisfactorily.

Dinitro materials, particularly the alkanolamine salts of DNOSBP were excellent for controlling weeds. They were safe when applied pre-emergence even with severe leaching. However, sweet corn foliage seemed quite sensitive to these materials. Consequently they are of doubtful value as replacements for 2,4-D as a post-emergence herbicide. Because of their safety from a leaching standpoint and their ability to control weeds, the DN's seem to offer excellent opportunities for pre-emergence use on sweet corn.

CMU gave good weed control but since it had a tendency to stunt the corn early in its growth when applied either pre- or post-emergence, more work is needed to determine adequately its value for sweet corn.

The ethyl sulfate derivatives of 2,4-D gave weed control comparable to 2,4-D when used at sufficiently high rates. These materials, however, were as harmful to the corn as 2,4-D amine when subjected to severe leaching conditions.

2,4-D amine is not a safe pre-emergence herbicide. When heavy leaching occurred, it caused appreciable stunting of the crop. Also, under these conditions, weed control was below a level acceptable commercially. When applied at low rates post-emergence, however, 2,4-D was one of the better materials, both for crop safety and weed control. Also, if current costs are considered, it was the most economical effective post-emergence herbicide used in the tests.

Dalapon was harmful to the corn and gave poor broadleaved weed control. It gave excellent control of the few grasses present.

Soil type and crop variety were relatively unimportant in influencing crop response to herbicides. Kind and rate of chemical, time of application in relation to crop growth, and soil moisture had pronounced effects on herbicidal activity and crop response. NaPCP, CMU and PCP were the least affected by these variables. Since NaPCP gave excellent weed control with no crop damage, it appears to warrant intensive further study as a sweet corn herbicide.

Literature Cited

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COMPATIBILITY OF MIXTURES OF CHEMICAL WEED-KILLERS AND INSECTICIDES APPLIED TO SWEET CORN PLANTINGS

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The trials described here were initiated as a result of a local demand by growers for information on the use of herbicides and insecticides in combination on sweet corn plantings. Such combinations applied as a single spray application on sweet corn would be a convenience and would reduce the cost of application of each material.

The data presented describe the phytotoxic effects of the herbicide and insecticide combinations. Due to the fact that the cutworm, Agrotis sp., and armyworm, Cirphis unipuncta (Haw.), did not appear in sufficiently large numbers, an evaluation of the insecticidal properties of these mixtures could not be made in the experimental area.

METHODS, MATERIALS, AND RESULTS

The chemicals used were applied with a small tractor mounted experimental sprayer in the pre-emergence applications. The post-emergence treatments were applied with a hand pack sprayer in such a manner as to give a general coverage over the plants.

Soil moisture at the time of both the pre-emergence and post-emergence treatments was at a high level and therefore ideal. Excellent weed control was obtained with all treatment mixtures containing herbicides.

Certain of the treatments retarded crop growth in both the pre-emergence and post-emergence treatments and these effects were reflected in the yield variations as shown in Table I which presents the totals of two harvests taken from these plots.

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Contribution from the Plant Physiology and Entomology Departments, Virginia Truck Experiment Station, Norfolk. Paper No. 119, Journal Series. Approved for publication November 19, 1953.

TABLE I. SUMMARY OF SWEET CORN YIELD RESULTS.

Trial Location: Norfolk Station Field. Crop Variety: Iochief
Exp. Design: Randomized block. No. Reps: Four Plot Size: 50 ft. of row.
Seeding Rate: Usual rate (1 to 2 kernels per ft.) thinned later to approximately a 15-inch spacing between plants. Planting Depth: 1 inch.
Planting Date: 4/23/53 Plant Height at Post-Emergence Treat: 4 to 8 inches.
Treatment Dates: Pre-emergence 4/23/53, post-emergence 5/21/53.
Harvest Dates: 1st harvest 7/11/53, 2nd harvest 7/13/53.
Exp. Terminated: 7/13/53
Rainfall Record: Soil moisture at planting - high.
Pre-E. 1st wk. 0.59 in. 2nd wk. 2.53 in. 3rd wk. 0.27 in.
Post-E. 1st wk. 0.28 in. 2nd wk. 0.69 in. 3rd wk. 0.91 in.
Temperature Record: Degree-Hours above 0°F. following treatment.
Pre-E. 1st wk. 10,786. 2nd wk. 11,376. 3rd wk. 11,186.
Post-E. 1st wk. 12,500. 2nd wk. 11,628. 3rd wk. 12,542.
Total for exp: 60,706°Hrs. above 40°F. 137,506°Hrs. above 0°F.

Treat. No.	Chemical (Acre Rate) 2,4-D Amine Pounds Pre-E.	Post-E.	Dow Premerge Gallons	Aldrin* Pounds	Toxaphene* Pounds	Gals. Water/A Pre-E.	Post-E.	Average Yield Per 100 Stalks Pre-E.	Post-E.
1	0	0	0	0	0	-	-	47.9	48.5
2	1.5	0.5	0	0	0	50	10	40.4	41.4
3	1.5	0.5	0	2.0	0	50	10	39.7	43.1
4	1.5	0.5	0	0	2.0	50	10	38.0	33.6
5	0		2.0	0	0	50	-	38.3	-
6	0		2.0	2.0	0	50	-	46.3	-
7	0		2.0	0	2.0	50	-	37.4	-
8	0		0	2.0	0	50	10	52.8	43.9
9	0		0	0	2.0	50	10	47.6	49.2

L. S. D. at 5% level - 14.5 pounds.
L. S. D. at 1% level - 19.3 pounds.

* Aldrin composition:
Aldrin 45%
Petroleum Distillate 21.9%
Inert Ingredients 33.1%

* Toxaphene composition:
Toxaphene 60%
Petroleum Distillate 23% with min. unsulfonated residue 80%.
Inert Ingredients 17%.

DISCUSSION

The data presented here are preliminary in nature but they give a clear indication that 2,4-D amine and Toxaphene applied in combination as a post-emergence spray on Iochief sweet corn in the early stages of growth seriously reduced yields. The 2,4-D amine alone caused some yield reduction in both the pre-emergence and post-emergence applications, whereas Toxaphene alone did not reduce yields at either date of application.

These results suggest the possibility that the solvent used in Toxaphene which was petroleum distillate (See Table I) greatly increased the phytotoxicity of 2,4-D amine applied on the foliage of the sweet corn.

The 2.0 lbs. actual of Aldrin per acre is higher than necessary for armyworm and cutworm control since 0.5 to 1.0 lb. is adequate. However, 2.0 lbs. actual per acre are necessary to control wireworms and certain other soil insects and was included here in case an occasion for its use might arise in the future.

These observations indicate the need for a continuation of this line of research and the inclusion of artificial infestation studies of armyworm and cutworm to determine the insecticidal properties of the herbicide-insecticide combinations.

CONCLUSIONS

1. The amine salt of 2,4-D applied pre- and post-emergence on Iochief sweet corn at the rate of 1.5 and 0.5 lb., respectively, per acre caused noticeable reductions in yields.
2. Dow Premerge applied pre-emergence on Iochief sweet corn at the rate of 2.0 gals. per acre caused noticeable reductions in yields.
3. Toxaphene and Aldrin applied singly at 2.0 lbs. per acre in pre- and post-emergence applications on Iochief sweet corn did not reduce yields or produce visible evidence of injury.
4. Serious reductions in yield resulted from post-emergence applications of a combination of 0.5 lb. of the amine salt of 2,4-D and 2.0 lbs. of Toxaphene per acre applied as a single spray in 10 gallons of water per acre.
5. General use of any combination of herbicide and insecticide should be preceded by a yield test for compatibility.

PRE-EMERGENCE WEED CONTROL IN MUCK GROWN SEEDED ONIONS

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Screening experiments the previous year indicated that 8 chemicals deserved intense study in 1953 in connection with pre-emergence onion weed control. These chemicals were C.M.U., Chloro-I.P.C., Endothal, P.A. 1, P.A. 5, Crag Herbicide I, Sesin, and 2,4-D Amine.

Materials and Methods

Two identical pre-emergence experiments were set up using 7 of these chemicals, the first on April 17 and the second on April 28. The first experiment was placed in a field known to be heavily infested with purslane. The muck in the area is underlain by sandstone and the pH of the test field at planting time was 5.7. Spraying was done on a very cold day with temperatures of 30°F. The onions which had been planted on April 4 had sprouted by this time but had not yet emerged. Because of the cold weather following application, they did not emerge until May 2. By this time 1.6 inches of rain had fallen.

The second experiment was placed on a field that was relatively free of weeds. The muck in this area is underlain by limestone and the pH of the field at planting time was 6.5. The day of application was cool with a low of 40°F. The following week consisted of cool nights with temperatures in the 40's, but moderate days with temperatures in the high 70's. There were 1.75 inches of rain by May 7 at which time the onions emerged.

Both experiments consisted of Randomized Blocks with 3 replications of each treatment. Individual plots were 5 rows wide by 14 feet long. All spraying was done by means of a small hand sprayer powered by a 5-pound CO_2 cylinder. Weeds were counted at the first location only. This was done in an area of 3 square feet in each plot on May 9, May 14, May 21, and June 4. The weed population was 100 per cent purslane. Yield data were obtained from both experiments. This was done by harvesting an area 3 rows wide by 12 feet long in the center of each plot. Treatments with their resulting weed counts are presented in table 1 and yields from both locations are presented in table 2.

Results

The data indicate that Chloro-I.P.C. gave good weed control at all rates of application and did not result in marked damage to the onions, even at the highest rate used. Endothal gave good weed control but resulted in damage to the onions. This damage was most marked at the first location where all three rates of this chemical resulted in decreased yields. At the second location only the highest rate did so. C.M.U. at 1 pound gave good weed control with little damage to the onions. Both P.A. 1 and P.A. 5 gave good weed control at 4 pounds per acre and resulted in no decrease in yield of the onions. Both these chemicals, however, caused a severe twisting and malformation of the onion leaves. This makes their use as pre-emergence herbicides in onions subject to question. Both Crag Herbicide I and Sesin caused severe

Table 1. The effect of pre-emergence herbicides on the stand of purslane.

Chemical treatment	Rate of application in pounds per acre (all in 100 gals.H_2O)	Stand of purslane per 3 sq. ft. of row May 9	May 14	May 21	June 4	Mean
Crag Herbicide I	2	11.33	25.00	18.00	34.67	22.25
"	4	4.00	23.33	10.00	25.33	15.67
"	6	7.33	9.33	8.33	38.00	15.75
Sesin	4	7.00	30.67	13.67	55.33	26.92
"	8	7.00	17.33	11.33	25.00	15.17
"	12	3.00	8.00	8.00	16.00	8.75
Chloro-I.P.C.	4	17.67	23.00	2.33	2.00	11.25
"	8	11.00	20.67	0.33	0.33	8.08
"	16	7.33	10.33	0.00	0.67	4.58
C.M.U.	½	17.00	39.33	32.00	38.00	31.58
"	1	14.33	14.33	8.33	9.33	11.58
Endothal	1½	11.33	15.67	10.67	25.00	15.67
"	2½	11.00	21.33	6.67	18.00	14.25
"	5	11.33	7.67	6.67	4.00	7.42
P.A. 1	2	12.66	26.00	19.67	27.00	21.33
"	4	8.33	15.33	8.67	9.67	10.50
"	6	9.33	15.33	5.00	7.33	9.25
P.A. 5	2	26.67	40.67	27.67	30.33	31.33
"	4	9.67	20.67	10.67	9.33	12.58
"	6	9.00	20.00	5.67	11.33	11.50
Ca Cyanamid	50 (as dust)	19.00	77.33	75.00	71.33	60.67
"	75 " "	15.00	70.00	62.00	48.00	48.75
Mono-Na-Cyanamid	50	13.33	58.33	46.33	64.33	45.58
"	100	14.00	53.33	40.00	81.33	47.17
Check	No treatment	39.50	87.67	75.33	71.50	68.58

Table 2. The effect of various pre-emergence herbicides on the yield of Early Yellow Globe onions.

Chemical treatment	Rate of application in pounds per acre (all in 100 gals. H_2O)	Onion yields in pounds per plot: Location 1	Location 2	Mean of both locations
Crag Herbicide I	2	36.46	41.46	38.96
"	4	38.81	44.73	41.77
"	6	32.16	37.04	34.60
Sesin	4	34.27	39.81	37.04
"	8	22.19	42.62	32.40
"	12	16.94	38.65	27.79
Chloro-I.P.C.	4	37.52	46.15	41.83
"	8	43.50	39.06	41.28
"	16	39.21	41.19	40.20
C.M.U.	½	44.06	39.85	41.96
"	1	43.88	38.00	40.94
Endothal	1½	31.46	46.69	39.07
"	2½	26.27	41.36	33.81
"	5	11.35	35.04	23.20
P.A. 1	2	43.81	42.54	43.18
"	4	37.96	43.75	40.85
"	6	41.96	40.35	41.16
P.A. 5	2	42.60	38.38	40.49
"	4	44.00	41.67	42.83
"	6	41.98	38.87	40.42
Ca Cyanamid	50 (as dust)	43.50	41.96	42.73
"	75 " "	41.25	40.58	40.92
Mono-Na-Cyanamid	50	46.27	40.02	43.15
"	100	34.12	42.58	38.35
Check	No treatment	41.95	42.60	42.28

burning of the young onions just after emergence. Again this was most noticeable at location I. Both Calcium Cyanamid dust and Mono-sodium-cyanamid resulted in good initial weed control, but their residual effectiveness was small and, therefore, their over-all weed control was poor. Chloro-I.P.C. showed the longest residual effect of all chemicals used. In this respect it should be noted in table 1 that all rates of Chloro-I.P.C. were giving almost complete control of purslane on June 4, 7 weeks after application. This was better control than the same chemical gave on May 9 and indicates a tremendous effective life for this chemical in muck soil.

Conclusion

Chloro-I.P.C. gave better control of purslane than any other chemical in this experiment. Its residual effectiveness was good, and it caused no damage to the onions. It is, therefore, the most promising of the pre-emergence herbicides tested for the control of purslane in onions. C.M.U. which gave good weed control and little damage to the onions is also promising in this respect.

POST-EMERGENCE WEED CONTROL IN MUCK GROWN SEEDED ONIONS

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Purslane is the most important weed species in western New York onion fields. Pre-emergence experiments indicated that Chloro-I.P.C. and C.M.U. were the most promising herbicides for the control of this weed in onions. However, growing onions may respond differently to weed control chemicals than onions which are just germinating. Then, too, other weed species besides purslane are important in many fields. For these reasons chemicals other than Chloro-I.P.C. and C.M.U. were included in the post-emergence experiments although these two received major emphasis.

Materials and Methods

There were 6 post-emergence experiments in all. Yield data were obtained from 5 of them in an attempt to study the effect of the various herbicides on onions throughout the growing season. Weed counts were made in all cases. All experiments were set up as randomized blocks or simple variations therefrom, and all treatments were replicated at least 4 times. Weed counts were taken from an area of 3 square feet in each plot of each experiment. Individual plots were usually 5 rows wide by 10 feet long, and the area harvested was the center 8 feet of the middle 3 rows of each plot.

The first of these experiments was made up of 2 rates of Endothal, $\frac{1}{2}$ and 1 pound per acre; 2 of C.M.U., $\frac{1}{4}$ and $\frac{1}{2}$ pounds per acre; 2 of Chloro-I.P.C., 4 and 8 pounds per acre; and 2 of Crag Herbicide I, 2 and 4 pounds per acre, sprayed over the tops of onions in three stages of growth, just emerged, first true leaf $1\frac{1}{2}$ inches long, and first true leaf 5 inches long. The second of these experiments was made up of 3 rates of Chloro-I.P.C., 2, 4 and 8 pounds; 3 of C.M.U., 1, $1\frac{1}{2}$, and 2 pounds; 3 of Endothal, $\frac{1}{2}$, 1, $1\frac{1}{2}$ pounds, 3 of Crag Herbicide I, 4, 6 and 8 pounds; 3 of P.A. I, 4, 6 and 8 pounds; and 3 of P.A. 5, 4, 6, and 8 pounds. These chemicals were sprayed over the tops of onions 7 inches high. The third of these experiments consisted of 3 rates of Chloro-I.P.C., 2, 4, and 8 pounds; 3 of C.M.U., $\frac{1}{2}$, 1, and $1\frac{1}{2}$ pounds; and 2 of Endothal, $\frac{1}{2}$ and 1 pound, sprayed over the tops of onions 9 inches tall. The fourth experiment consisted of 4 rates of Chloro-I.P.C., 2, 4, 8 and 16 pounds; 3 of C.M.U., 1, 2, and 3 pounds; 3 of Endothal 1, $1\frac{1}{2}$ and 2 pounds; 3 of P.A. I, 4, 6 and 8 pounds; and 3 of P.A. 5, 4, 6 and 8 pounds, sprayed over the tops of onions 12 inches high. The fifth experiment consisted of 5 rates of Chloro-I.P.C., 4, 6, 8, 16, and 24 pounds; 3 of C.M.U., 1, 2, and 3 pounds; 2 of Crag Herbicide I, 2 and 4 pounds; 2 of Experimental Herbicide 3, 5 gallons and 7.5 gallons; 2 of Endothal, $2\frac{1}{2}$ and 5 pounds; 3 of Herbisan, 10, 15 and 24 pounds; 1 of Sesin, 10 pounds; and combinations of C.M.U., 1 pound plus Chloro-I.P.C., 6 pounds; C.M.U., 3 pounds plus Chloro-I.P.C., 8 pounds; C.M.U., 1 pound plus Crag Herbicide I at 4 pounds; and Experimental Herbicide 3 at 5 gallons plus Crag Herbicide I at 4 pounds. These chemicals were applied to onions as stem sprays just before the onion tops began to go down. The sixth experiment included 4 rates of Chloro-I.P.C., 4, 8, 16 and 24 pounds; and 1 of Crag Herbicide I, 4 pounds. This was set up mainly to determine the effect of these two chemicals on the stand of several species of weeds.

All the chemicals were sprayed on in solution at the rate of 100 gallons of water per acre. A small hand sprayer powered by a 5-pound CO_2 cylinder was used for this. All spraying was done at 20 pounds per square inch pressure.

Results

It is impossible to include detailed data from each of these experiments, but a brief summary for each chemical will be given.

Onion Yields

There was no significant damage to the onions (as measured by their yields) in any of these experiments from the chemicals at the rates used. It must be remembered that the rates varied in the different experiments, especially as the stage of growth varied. C.M.U. at quantities above 1 pound per acre caused die-back of the leaf tips and a yellowing of the foliage. This was not reflected in the yields, however. P.A. 1 and P.A. 5 both caused a marked twisting and malformation of the onion leaves whenever used. In one experiment these two chemicals seemed to reduce yields slightly but not enough for significance. All combinations of C.M.U. with Chloro-I.P.C. resulted in severe damage to the foliage. Chloro-I.P.C. alone caused no noticeable damage to onions regardless of concentration. No other chemical caused any noticeable damage.

Weed Control

Two pounds of Chloro-I.P.C. effectively controlled purslane for a period of 3 weeks, and 8 pounds controlled all purslane from the day of application, June 13, until frost, the middle of September. Greater quantities were needed to control other weed species: 8 to 12 pounds for crab grass, 16 pounds for redroot, and 24 pounds or more for barnyard grass. One pound per acre of C.M.U. gave good control of redroot and fair control of purslane. Good control of purslane was obtained at 1½ to 2 pounds. No control of barnyard grass was obtained at any rate. Crag Herbicide I gave very little control of purslane, redroot, or barnyard grass in these experiments. Endothal gave fair control of purslane at 1½ pounds per acre and good control of redroot at 5 pounds. Its control of barnyard grass was not significant but seemed to be approaching that point at the 5 pound level. Both P.A. 1 and P.A. 5 gave poor control of purslane and no control of barnyard grass in these experiments. P.A. 1 gave good control of redroot at 4 to 6 pounds and P.A. 5 at 6 to 8 pounds. None of the other chemicals were rated on their control of individual weed species.

Discussion

Chloro-I.P.C. gave by far the best control of purslane of any chemical in these tests. A greater quantity was needed for the control of crab grass, but it still gave as good control of this weed as any other chemical studied. It was much less effective in the control of redroot and barnyard grass. It caused no noticeable damage to the onions at any concentration used.

Large-scale tests of this chemical were conducted throughout western New York by commercial growers. Most of these tests were made late in the season when the onions were large. Spraying was done on a commercial scale under widely varying environmental conditions. Applications were made both as stem sprays (sprays directed at the base of the plants) or directly over the tops of the onions. Pressures used varied from 20 pounds per square inch to 400. The quantity used was usually 6 pounds per acre. Good control of purslane resulted in each case, and in no case was any damage to onions reported.

There is one possible danger in the use of this chemical. We do not know how long it remains in muck soils under practical conditions. It is possible that its quantity in the soil can gradually be built up to a dangerously high level through continued use. This problem is being studied at the present time.

Both C.M.U. and P.A. 1 or 5 gave good control of redroot. All these chemicals, however, injured onion foliage. More work will have to be done with them to determine if they are safe to use on growing onions. Endothal gives some promise in the control of barnyard grass. Its control of this weed, however, has not been statistically significant in these experiments. It must be remembered, also that this chemical is capable of causing severe damage to small onions when used at rates much greater than those used here.

Large onions just before their tops go over are highly resistant to a wide variety of chemicals, if these are applied in the form of stem sprays. Even some damage to the foliage at this time is not reflected in large differences in yield. It should be relatively easy to control weeds in onions during the period after their tops have gone down and before they are harvested.

Conclusion

Chloro-I.P.C. is the most promising post-emergence herbicide for muck-grown onions of western New York. This is especially true as it completely controls purslane, the major weed in that area, and it causes no damage to onions at the rates used. One danger accompanies its use, however. This is the possibility that it might build up in the soil through continuous use until it reaches dangerous proportions. If weeds other than purslane are of major importance, then other chemicals may give better control.

Experimental Use of Herbicides Impregnated on Clay Granules for Control of Weeds In Certain Vegetable Crops[1,2]

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The trials discussed here were initiated to investigate the possibility of broadening the use of herbicides by studying physical selectivity as a new consideration in their use on crops. The convenience of application of dry materials as opposed to sprays was also a consideration.

Previously, the application of CIPC (Isopropyl N 3-chloro phenyl carbamate) and Sesin (2,4-Dichlorophenoxyethyl benzoate) to vegetable crops has been limited, in general, to pre-emergence spray applications on the soil. It was hoped through these trials to discover a means of applying these chemicals, and possibly others, on granular carriers and achieve a physical selectivity whereby they could be applied on growing crops either as a post-emergence application, where a crop is direct seeded, or following transplanting in other crops.

It was visualized that the practical field application would involve impregnation of the chemical on a low cost readily available granular material. This would be applied as a directed or over all treatment followed by a cloth drag to shake the material off the foliage.

Granular Fuller's earth (Attaclay) and granular tobacco pulp have been used in recent years as carriers for insecticides and were found to lend themselves very well to use in the present trials.

Materials, Methods, and Results

The results reported here cover the initial greenhouse trials and related preliminary field trials completed to date. The experimental materials and methods, and the results of these trials are presented in a series of brief standard forms for ready examination and evaluation.

Greenhouse Trials. The greenhouse trials were organized to determine the effectiveness of granular Attaclay and tobacco pulp impregnated with CIPC as weedkilling materials. This was determined by planting a CIPC tolerant crop such as spinach in combination with representative non-tolerant test plants such as oats and mustard greens. Results of this first set of trials are given in Table 1 below.

1/ Entered as Journal Paper No. 118 of the Virginia Truck Experiment Station, Norfolk, Virginia.

2/ Acknowledgement of assistance in this work is made to the Columbia-Southern Chemical Corporation for a grant-in-aid and to the Florida Agricultural Supply Company and the American Tobacco By-Products Company for generous assistance in the preparation of experimental amounts of the various granular preparations.

Table I. Greenhouse Trials - Pre-emergence Applications of CIPC Impregnated Granules on Spinach

Trial Location: Greenhouse
Crop Variety: Old Dominion Blight Resistant Spinach, Giant Curled Mustard, Victorgrain Oats. Exp. Design: Rand. Block. No. Reps.: 5. Plot Size: 1-quart containers. Seeding Rate: 10 seeds each crop per pot. Planting Depth: ¼ inch. Planting Date: 1/21/53. Treatment Date: 1/21/53. Date Exp. Terminated: 2/19/53 Soil Type: Sandy clay loam.
Watering Record: Soil Moisture at Planting Time: Medium. Moisture applied as needed to all pots in equal amounts. Approx. 3 in. for 3 weeks.
Temperature Record: Degree-Hours above 0° F. following treatment. 1st week, 19733; 2nd week, 19726; 3rd week, 19084. Total for 3 week period 58543.

Treatment No.	Treatment: Clay Lbs./A.	Treatment: Clay Mesh Size	Treatment: CIPC Lbs./A.	Av. No. Plants Per Pot: Spinach	Oats	Mustard
1	50	16-30	1	2.8	4.4	1.0
2	50	16-30	2	2.6	4.4	0.4
3	50	16-30	4	1.6	2.6	0
4	50	30-60	1	2.2	3.8	1.4
5	100	30-60	2	3.0	4.6	0.6
6	50	30-60	2	4.4	4.4	1.8
7	25	30-60	2	2.4	3.4	0.4
8	50	30-60	4	2.2	2.0	0
9	12.5	30-60	2	4.2	3.4	0.2
10	50	60-100	1	4.4	7.2	3.0
11	50	60-100	2	4.4	5.6	0
12	50	60-100	4	3.8	2.0	0
13	50	325	1	4.4	5.2	5.8
14	50	325	2	5.2	5.2	0.6
15	50	325	4	4.2	5.2	3.4
16	100	325	2	4.6	2.8	0.2
17	Control			4.1	8.6	7.6
L.S.D. 5%				2.2	2.3	1.9
1%				2.9	3.1	2.5

The phytotoxicity of CIPC applied in this way is demonstrated in these data by the severe injury indicated by the mustard stand counts. Some variability is apparent in the results and may be ascribed to uneven distribution of the small amounts of chemical involved in the individual applications. The results indicated in general that the 2-pound per acre rate of application of CIPC normally found effective in spray form was also effective when applied in granular form on a wide range of sieve sizes.

On the basis of these trials and trials in the open to determine the effect of air movement on settling of the various particle sizes, it was decided to continue this line of research using only 30-60 mesh sizes. This represented a compromise dictated by the practical limitations of time and space and does not obviate the successful use of any other particle size range.

The second series of trials in the greenhouse involved a study of the effect of 30-60 mesh granular Attaclay and of 30-60 mesh granular tobacco pulp impregnated with CIPC applied after transplanting tomato plants. The representative non-tolerant oat and mustard green seed were included as a check on phytotoxicity of the applications. Results are presented in Table II.

Table II. Greenhouse Trials - Post-Transplanting Applications of CIPC Impregnated Granules on Tomatoes

Trial Location: Greenhouse
Crop Variety: Rutgers Tomatoes, Giant Curled Mustard, Victorgrain Oats. Exp. Design: Rand. Block. No. Reps.: 5. Plot Size: 1-quart containers. Seeding Rate: 10 seeds each of mustard and oats, and one tomato plant per pot. Planting Depth: Mustard and oats ¼ inch. Planting Date: 4/21/53. Treatment Date: 4/21/53. Date Exp. Terminated: 5/25/53, Soil Type: Sandy clay loam. Watering Record: Soil moisture at Planting Time: Medium. Water 1st week, 2.0 in. 2nd week, 2.0 in. 3rd week, 2 in. Total 3 week period: 6.0 in. Temperature Record: Degree-Hours above 0° F. following treatment. 1st week, 20781, 2nd week 19588, 3rd week, 20308. Total for 3 wk. period, 60677.

Effect of Granular CIPC Treatments on Tomatoes

Treatment CIPC Lbs/A.	Carrier Lbs./A.	Av. Height - Cms. 1 wk.	2 wks.	3 wks.	4 wks. Final	Av.Wt.Per Plant-Grams Fresh	Dry
1.0	50 lbs. Attaclay	9.4	17.9	24.7	40.3	22.0	2.887
	50 lbs. Tobacco Pulp	8.2	17.9	24.7	38.7	20.0	2.526
2.0	50 lbs. Attaclay	8.5	16.9	24.4	40.2	23.0	3.127
	50 lbs. Tobacco Pulp	8.7	17.4	24.0	39.2	16.0	2.149
4.0	50 lbs. Attaclay	8.9	18.8	24.0	42.3	23.0	3.212
	50 lbs. Tobacco Pulp	7.9	17.6	27.5	38.6	22.0	2.604
0	Control	9.9	17.7	24.3	38.5	17.5	2.492
L.S.D.		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Effect of Granular CIPC Treatments on Oats and Mustard

Treatment CIPC Lbs/A	Carrier Lbs/A.	Oats Av.No. Plants per pot	Oats Av.Wt.Per Plant-Gms. Fresh	Dry	Mustard Av.No.Plants per pot	Mustard Av.Wt. Per Plant-Gms. Fresh	Dry
1.0	50 lbs. Attaclay	5.4	0.532	0.088	2.4	0.719	0.136
	50 lbs. Tobacco Pulp	4.0	0.739	0.134	5.0	0.644	0.142
2.0	50 lbs. Attaclay	4.2	0.813	0.141	1.8	0.696	0.119
	50 lbs. Tobacco Pulp	3.8	0.602	0.130	3.6	0.948	0.163
4.0	50 lbs. Attaclay	3.8	0.662	0.165	0.4	0.198	0.053
	50 lbs. Tobacco Pulp	2.8	0.738	0.151	1.6	0.594	0.212
0	Control	4.7	0.524	0.127	5.8	0.713	0.123
L.S.D	5%	3.3			1.0		
	1%	4.5			1.4		

These results show that the transplanted tomatoes were tolerant of CIPC applied in weed killing concentrations on Attaclay granules or tobacco pulp granules. Results indicate that Attaclay and tobacco pulp did not differ appreciably in effectiveness as carrying agents. These results are only indicative of the effect on vegetative growth.

Field Trials. These trials, based on the idea that CIPC impregnated on granular Attaclay might prove practical for application on a number of transplanted crops and as a post-emergence application on direct seeded crops, indicated that the materials were worthy of continuation in small scale field trials.

Results of these field trials in 1953 are presented in Tables III through VII. All applications were made directly over the crop and were not brushed off in order to determine the maximum amount of injury to the crop. Such conditions might represent a common error to be expected in commercial field application of granular materials.

The field trials were broadened to include comparison of granular applications with spray applications of other promising chemicals and to include in the case of kale the application of Sesin impregnated on granules.

Weed control results in the field trials were difficult to evaluate due to the extremely dry weather experienced at the various treatment dates. The control of weeds in the kale experiment was very evident but not measureable.

Table III. Field Trials - Effect of Post-Transplanting Applications of CIPC Impregnated Attaclay Granules on Tomatoes

Trial Location: Norfolk Station.
Crop Variety: Rutgers. Exp. Design: Rand. Block. No. Reps.: 4. Plot Size: 10 Plants. Plant Spacing: 4 X 6 ft. Plant Size at Transplanting: 8 to 10 inches. Transplanting Date: 5/12/53. Treat. Date: Sesin 5/29/53, CIPC 5/28/53. Cultivation: None following treatment. Hand Weeding: As needed. Harvest Dates: 7/24, 7/28, 7/31, 8/4, 8/11. Exp. Terminated: 8/11/53. Soil Type: Sandy clay loam.
Rainfall Record: Soil Moisture at Planting Time - Very dry. 1st week, 1.34 in.; 2nd week, 0; 3rd week, 0. Total 3 week. period 1.34.
Temperature: Degree-Hours above 0° F. following treatment. 1st week, 11823; 2nd week, 12479; 3rd week, 11054. Total for 3 week period, 35356.

Chemical	Treatment Lbs. Active Chem. per acre	Water Gals. per acre	Av. No. fruits Per 100 Plants	Av. Wt. per 100 Fruits Lbs.	Av. Fruit Wt. per 100 plants Lbs.
0	0	0	2240.8	30.8	664.8
Sesin	2	50	1794.0	32.2	552.6
Sesin	4	50	1571.0	30.7	462.8
CIPC	2	Granular	1442.7	36.4	513.7
CIPC	4	Granular	1534.0	31.5	472.1
L.S.D.			N.S.	N.S.	N.S.

The results on tomatoes presented in Table III show that weeding concentrations of Sesin sprayed on and CIPC applied impregnated on clay granules both had a tendency to reduce yields. These yield reductions were not severe in light of the fact that each of these chemicals was applied directly over the foliage and allowed to remain there.

Table IV. Field Trials - Effect of Post-Transplanting Applications of CIPC Impregnated Attaclay Granules on Peppers

Trial Location: Norfolk Station.
Crop Variety: California Wonder. Exp. Design: Rand. Block. No. Reps: 4. Plot Size: 15 plants. Plant Spacing: 2 ft. Plant Size at Transplanting: 6 to 8 inches. Transplanting Date: 5/12/53. Treat. Date: Sesin 5/29/53 CIPC 5/28/53. Cultivation: None following treatment. Hand Weeding: as needed. Harvest Dates: 7/7, 7/14, 7/20, 8/4. Exp. Terminated: 8/4/53.
Soil Type: Sandy clay loam.
Rainfall Record: Soil moisture at planting time - very dry. 1st wk., 1.34 in., 2nd wk. 0, 3rd wk., 0; Total 3 wk. period 1.34 in.
Temperature Record: Degree Hours above 0° F. following treatment. 1st wk., 11823, 2nd wk. 12479, 3rd wk. 11054. Total for 3 wk. period 35356.

Chemical	Treatment Lbs. Active Chem. per acre	Water Gals. per acre	Av. No. Fruits Per 100 Plants	Av. Wt. per 100 Fruits Lbs.	Av. Fruit Wt. Per 100 Plants Lbs.
0	0	0	454.1	24.0	90.1
Sesin	2	50	528.7	25.3	88.0
Sesin	4	50	540.0	22.7	72.0
CIPC	2	Granular	521.8	24.3	94.2
CIPC	4	Granular	535.4	23.8	80.9
L.S.D.			N.S.	N.S.	N.S.

The results on peppers presented in Table IV show that post-transplanting applications of weeding concentrations of Sesin sprayed on and CIPC applied impregnated on clay granules did not reduce yields.

Table V. Field Trials - Effect of Post-Transplanting and Post-Lay By Applications of CIPC Impregnated Attaclay Granules on Sweet Potatoes.

Trial Location: Norfolk Station.
Crop Variety: Porto Rico. Exp. Design: Rand. Block. No Reps.: 4. Plot Size: 30 Plants. Plant Spacing: One ft. in rows 6 ft. wide. Plant Size at Transplanting; Sprouts trimmed to 8 to 10 inches. Transplanting Date: 5/27/53. Treat. Dates: Each treat. applied post-planting 5/27/53 and again at post-lay by 7/2/53. Cultivation: as usual between rows to lay by. 3 cultivations. Hand Weeding: as needed. Harvest Date: 10/14/53. Exp. Terminated: 10/14/53. Soil Type: Sandy clay loam.

Table V (Continued)

Rainfall Record: Soil moisture at planting time - very dry. 1st week, 1.34 in.; 2nd week, 0; 3rd week, 0; Total for 3 week period, 1.34.
Temperature Record: Degree-hours above 0° F. following treatment.
5/27/53 Treatments: 1st week, 11656; 2nd wk., 12376; 3rd wk., 11442. Total for 3 week period, 35474.
7/2/53 Treatments: 1st week, 14295; 2nd wk., 12044; 3rd week, 13089. Total for 3 week period, 55123.

Treatment		Av. Yield Lbs. Per Plot			
Chemical	Acre-Rate Active Agent	Primes	Jumbos	Culls	Total
Control	-	53.7	23.3	8.9	85.9
3-Chloro-IPC	2 + 2 lbs. + 48 lbs. clay	52.3	13.7	9.2	75.2
3-Chloro-IPC	4 + 4 lbs. + 46 lbs. clay	53.3	14.6	8.7	76.6
Alanap 2	2 + 2 lbs. 50 gals. water	54.0	17.8	9.5	81.3
Alanap 2	4 + 4 lbs. 50 gals. water	53.1	16.6	9.1	78.8
L.S.D.		N.S.	-	-	N.S.

The results on sweet potatoes presented in Table V show that yield of prime potatoes was not affected by applications of weeding concentrations of Alanap 2 applied as a spray and CIPC applied impregnated on clay granules as post-transplanting treatments and a second time as post-lay-by treatments on the same plantings.

VI. Field Trials - Effect of Post- Emergence Applications of CIPC Impregnated Attaclay Granules on Cantaloupes.

Trial Location: Norfolk Station
Crop Variety: Pride of Wisconsin. Exp. Design: Rand. Block. No. Reps.: 4. Plot Size: 10 hills 5 seeds per hill. Hill Spacing: 3 X 6 ft. Planting Date: 7/2/53. Treat. Dates: Alanap 2 Pre-emergence 7/2/53 and Post-emergence 7/27/53. CIPC Post-emergence 7/27/53. Cultivation: As usual between rows to lay by. Hand Weeding: as needed. Exp. Terminated: 8/21/53 due to hurricane. Plant wts. obtained at this time. Soil Type: Sandy clay loam.
Rainfall Record: soil moisture at planting time - very dry. 1st wk. 0.49 in.; 2nd wk. 0.48 in.; 3rd wk. 0; Total for 3 wk. period 0.97 in.
Temperature Record: Degree- Hours above 0° F. following treatment.
7/2/53 Pre-emergence. 1st wk. 14295; 2nd wk. 12044;3rd wk. 13089; total for 3 wk. period 55123.
7/27/53 Post-emergence. 1st wk. 13532; 2nd wk. 12918; 3rd wk. 12693. total for 3 wk. period 40143.

Treatment				
Chemical	Acre-Rate Active Agent	Av. length of plants Inches	Av. No. plants per plot	Av. Wt. per 100 plants Lbs.
Control	-	73.0	30.3	132.3
Alanap 2	2 lbs. + 50 gals. water	58.8	27.8	101.5
Alanap 2	4 lbs. + 50 gals. water	59.5	25.3	115.3
CIPC Granular	2 lbs. + 48 lbs. clay	46.3	32.3	105.0
CIPC Granular	4 lbs. + 48 lbs. clay	34.8	35.5	84.5
L.S.D.		N.S.	N.S.	N.S.

The results on cantaloupes presented in Table VI are based only on plant weights due to hurricane weather which twisted the plants so severely that it was necessary to terminate the experiment without yields. Effects of the treatments were readily apparent and the results of plant length and weight measurements demonstrate the very toxic effect of CIPC applied as a post-emergence application on the foliage.

Table VII. Field Trials - Effect of Pre-emergence Plus Post-emergence applications of CIPC Granules and Post-emergence applications of Sesin Granules on Kale

Trial Location: Norfolk Station.
Crop Variety: Vates Blue Scotch. Exp. Design: Rand. Block. No. Reps.: 3
Plot Size: 16 ft. of row. Planting Depth: ¼ inch. Planting Date: 7/2/53.
Treat. Dates: Pre-emergence 7/2/53, Post-emergence 8/3/53. Cultivation: As usual between rows. Hand Weeding: As needed. Harvest Date: Series A 8/24/53 Series B and C 8/28/53. Exp. Terminated: 8/28/53. Soil Type: Sandy clay loam.
Rainfall Record: Soil moisture at planting time - very dry. 1st week, 0.49 in., 2nd week, 0.48 in., 3rd week, 0. Total for 3 week period, 0.97 in.
Temperature Record: Degree-Hours above 0°F. following treatment.
7/2/53 Pre-emergence. 1st week 14295, 2nd week 12044, 3rd week 13089. Total for 3 week period 55123.
8/3/53 Post-emergence. 1st week 12918, 2nd week 12700, 3rd week 11905. Total for 3 week period 37523.

Series No.	Treatment Chemical	Acre-Rate Chem.	Acre-Rate Carrier	Time of Application	Av. Stand Per Plot	Av. Wt. Per 100 Plants Lbs.
A	CIPC	2 lbs.	50 gals. water	Pre-E.	173	4.07
	CIPC	2 lbs.	48 lbs. clay	Pre-E.	172	5.10
	CIPC	2 lbs.	48 lbs. clay	Post-E.	122	4.37
	CIPC	2 + 2 lbs.	48 lbs. clay	Pre plus Post-E.	144	4.03
	Control				145	4.50
				L.S.D.	N.S.	N.S.
B	CIPC	2 lbs.	48 lbs. clay	Post-E.	151	5.50
	Sesin	2 lbs.	*	Post-E.	143	5.70
	CIPC + Sesin	2 + 2 lbs.	*	Post-E.	136	5.10
	CIPC + Sesin	2 + 4 lbs.	**	Post-E.	130	4.77
	Control				171	4.87
				L.S.D.	N.S.	N.S.
*	Sesin on 48 lbs. tobacco pulp, CIPC on 48 lbs. clay.					
**	Sesin on 46 lbs. tobacco pulp.					
C	CIPC	2 lbs.	48 lbs. clay	Pre-E.	107	6.10
	CIPC	4 lbs.	46 lbs. clay	Pre-E.	150	5.27
	CIPC	6 lbs.	44 lbs. clay	Pre-E.	147	4.50
	CIPC	8 lbs.	42 lbs. clay	Pre-E.	123	4.63
	Control				159	4.00
				L.S.D.	N.S.	N.S.

The results on kale presented in Table VII show that this crop is quite tolerant of weeding concentrations of both CIPC and Sesin applied singly and in combination as post-emergence treatments impregnated on Attaclay and tobacco pulp, respectively.

These results appear especially significant as they indicate the possibility of using these two chemicals in combination to control both chickweed and henbit and a wide range of warm weather weeds in kale.

Summary

Greenhouse and field trials using CIPC impregnated on granular Fuller's earth (Attaclay) and tobacco pulp on spinach, tomatoes, peppers, sweet potatoes, cantaloupes, and kale are described. The use of Sesin impregnated on tobacco pulp on kale is also described.

Conclusions

1. Granular applications of CIPC appeared to have about the same weedkilling potency as is normally obtained with spray applications.

2. Granular applications of CIPC over the foliage were tolerated quite well by such transplanted crops as tomatoes, peppers, and sweet potatoes even though the material was allowed to remain on the foliage.

3. Kale tolerated post-emergence granular applications of CIPC and Sesin singly and in combination in these preliminary trials.

4. Cantaloupes were severely injured by post-emergence granular applications of CIPC.

5. These small scale preliminary trials show that this line of approach to broadening herbicide useage holds promise of success and trials of these methods should be continued on an expanded scale.

Weeding of Cannery Peas with Herbicides[1]

Charles J. Noll and Martin L. Odland[2]

It is estimated that weeds were a serious problem in 20% of the 14000 acres of peas grown annually in Pennsylvania for processing. The yield of peas from the very weedy fields was reduced and harvesting and vining costs greatly increased. The two most serious weeds were mustard and thistle.

Several chemicals have been used successfully to control the weeds in pea fields. The most important of these are the dinitros in the form of the ammonium salt and granular cyanamid. Both have certain disadvantages. With the ammonium dinitro sprays high volum (70-100 gal. per acre) had to be used to keep from burning the pea plants. With granular cyanamid cost as well as the fact that herbicide must be applied before it is known if weeds will be troublesome limits its use.

Miller (1) found that the amine salt of DN (Premerge) was as effective as the ammonium salt of DN (Dow Selective) for weed control and that the volumn of Premerge used did not significantly affect weed control or pea yield. He successfully used Premerge at a volumn of 12 gallons per acre. The advantages of a low volumn spray for weeding peas is obvious. He suggests that a good recommendation would be 20 to 30 gallons per acre.

This experiment was set up to see if Miller's (1) experiment could be duplicated at State College and to test other herbicides as possible good chemicals for the weeding of peas.

Procedure

The land was prepared and seeded to the variety Thomas Laxton, April 17. The land, Hagerstown Silt Loam, was fertilized with a 5-10-5 fertilizer at time of seeding at the rate of 500 lbs. per acre. The plots were 30 feet long by 3 feet wide and replicated twelve times. The treatments covered the entire plot. Eight chemicals were used in a pre-emergence treatment, one chemical at emergence, 3 chemicals at the time peas were 6 inches high in comparison with an untreated check.

An estimate of stand of peas, burning of peas, hormone like damage to peas and weeds was made May 28 and 29. These estimates were on a basis of 1-10, 1 being most desirable and 10 least desirable.

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[1]Authorized for publication on November 20, 1953, as paper No. 1844 in the journal series of the Pennsylvania Agricultural Experiment Station.

[2]Assistant Professor and Professor of Olericulture respectively. Dept. of Horticulture, School of Agriculture, and Experiment Station., The Pennsylvania State University, State College, Pa.

Yield records were taken July 7 from only a portion of the experiment; stand from 4 replications and weight of peas in the pods from 7 replications.

Results and Discussion

The results are presented in table I. The predominate weed was mustard and enough was present to make the untreated plots appear yellow in color at the time the mustard was in bloom.

In the pre-emergence applications all herbicides except endothal significantly decreased weed growth. The best pre-emergence treatments taking into consideration weed control, damage to the peas and pea yield were Cloro IPC and CMU. Two other herbicides, Weedar MCP, and LFN-904 had equally as good weed control without damage to the peas and only slightly less yield per plot.

Cyanamid applied at emergence gave the highest yield of peas in the pod significantly higher than the untreated check, with good weed control and no damage to the peas.

Three herbicides were used in the post-emergence application when the peas were 6 inches high. The first of these ACP-L-423 severely damaged the peas, damage similar to 2,4-D damage, and greatly reduced the yield. Dow Selective plots at 100 gallons per acre had good weed control; slight burning of the leaves of the peas and a yield equal to the untreated check. Dow Selective plots at 25 gallons per acre had good weed control with rather severe burning of the leaves and a significant less yield as compared to the Dow Selective plot at a volumn of 100 gallons per acre. Premerge at all rates gave good weed control. Burning of the pea leaves increased from the 100 gallon rate to the 12½ gallon rate. The 12½ gallon rate had significantly more burning than with the 25 gallon or 100 gallon rate. Yields were unaffected by the treatments and not significantly different from the untreated check.

Conclusion

One year's work indicates that a number of herbicides offer promise for the weeding of peas in a pre-emergence application. The four most successfully used pre-emergence herbicides with rates per acre were: Cloro IPC at 1 gallon, CMU at 1 pound, Weedar MCP at 1/4 gallon and LFN 904 at 1/2 gallon (similar to MCP).

Cyanamid used at 400 lbs. per acre at time of pea emergence gave significantly better yield than the check with good weed control.

The volumn of the DN sprays (Dow Selective and Premerge) did not significantly effect weed control and all weed control was excellent. As the volumn of spray per acre was reduced the burning of the pea leaves increased with the ammonium salt of DN (Dow Selective) and less so with the amine salt of DN (Premerge). Dow Selective at the 25 gallon rate gave significant more burning than the Premerge at the same volumn and amount of DN per acre. Taking into consideration weed control, damage to peas, pea yield and the ease of application the best post-emergence spray was Premerge at 1/4 gallon per acre applied in 25 gallons of water. This is in agreement with the recommendation of Miller (1).

Reference

1. Miller, M. W. Preliminary investigations with dinitro and MCP sprays for weed control in legume seeded peas. Proceedings of Northeastern Weed Control Conference 1953. pp. 127-134.

Table I. The effect of pre-emergence and post-emergence herbicides on weeds and peas in 1953.

Herbicide	Rate per acre	Total Volumn per acre	No. days after planting herbicide applied	Weeds	Stand of Peas	Burning of Peas	Hormone effect on peas	Records of Harvest: Stand of peas (4 reps.)	Records of Harvest: Yield of peas in pods - lbs. (7 reps.)
Nothing	—	—	—	6.0	1.0	1.2	1.0	361	9.3
Endothal	3 gal.	12½ gal.	5 (Pre-emergence)	6.4	1.2	1.1	1.0	262	6.5
Cloro IPC	1 gal.	12½ gal.	5 (")	1.9	1.0	1.1	1.0	394	11.1
[1]ACP 903	1/3 gal.	12½ gal.	5 (")	3.3	1.0	1.0	1.0	440	10.4
[2]LFN 904	1/2 gal.	12½ gal.	5 (")	1.7	1.2	1.0	1.0	417	9.0
[3]ACP-L-423	4 gal.	12½ gal.	5 (")	1.3	5.8	1.1	1.8	197	5.7
Weedar MCP	1/4 gal.	12½ gal.	5 (")	1.7	1.0	1.1	1.0	373	9.4
[4]NP 1239D	4 lb.	25 gal.	7 (Pre-emergence)	1.5	1.4	1.0	4.8	346	6.7
CMU	1 lb.	25 gal.	7 (")	1.7	1.0	1.1	1.0	410	10.4
Cyanamid	400 lb.	—	19 (Peas emerging)	2.0	1.0	1.4	1.0	430	11.7
[3]ACP-L-423	1/2 gal.	12½ gal.	32 (Peas 6" tall)	1.6	1.0	2.9	8.2	422	1.4
Dow Selective	3/4 gal.	100 gal.	32 (" " ")	1.2	1.0	2.8	1.0	423	9.6
" "	" "	25 gal.	32 (" " ")	1.1	1.0	4.8	1.0	395	7.8
Premerge	1/4 gal.	100 gal.	32 (Peas 6" tall)	1.0	1.0	2.6	1.0	507	11.0
"	" "	25 gal.	32 (" " ")	1.1	1.0	2.9	1.0	426	10.4
"	" "	12½ gal.	32 (" " ")	1.0	1.1	3.4	1.0	475	10.1
L.S.D. at .05 level				1.1	0.6	0.5	0.4	98	1.8
L.S.D. at .01 level				1.4	0.8	0.6	0.5	131	2.4

[1] Butoxy ester of 4-chlorophenoxyacetic acid (3 lbs. per gal. acid equivalent)
[2] Ester of 2 methyl 4-chlorophenoxyacetic acid (2 lbs. MCP per gallon)
[3] Amine salt of 4 chlorophenoxyacetic acid (2 lbs. per gal. acid equivalent)
[4] 50% chloronated benzoic acid

Estimate of 12 replications (1 - most desirable) (10 - least desirable)

WEED CONTROL IN PEAS WITH VARIOUS HERBICIDES

by
E. R. Marshall and L. E. Curtis [1]

Introduction

Chemical weed control in peas has been practiced to some extent in the Northeast. The material most commonly used has been the ammonium salt of dinitro ortho secondary butyl phenol. The weed control obtained with this material was satisfactory in many cases, but frequently pea growers had rather sad experiences with it. The recommended practice was to treat the peas when they were 4 - 8 inches high with 3/4 - 1# DN as the ammonium salt per acre, using relatively large amounts of water per acre (75 - 150 gallons). If temperature and humidity were not favorable, injury in the form of foliage burning often occurred. The large amounts of water recommended was undesirable for several reasons. It was necessary to refill the tank often and in addition, the gallonage recommended made it necessary to use high gallonage equipment. Driving the heavy type sprayers over the pea vines gave a considerable amount of injury to the vines. The high pressure equipment used was a costly expense for the practice.

In order to see if we could find a more desirable practice for weed control in peas, a series of tests were begun in 1952. Some 20 compounds were screened as pre-emergence materials in 1952. As a result of this series of tests, three materials were chosen to be included in the 1953 tests. They were CMU, Crag Oxalate, and Sinox PE. In order to compare these materials further, another series of tests was conducted during the spring and summer of 1953.

Materials and Methods

The 1953 tests consisted of two different types; a large screening test and several large scale field trials, using the materials which had shown the most promise in 1952, and comparing them with some of the newer materials available in 1953. The screening test was originally planned as a pre-emergence test, but by the time the test was applied, a few of the more shallow planted peas had broken through the soil surface. The peas in this test had been planted on May 12, 1953 and the treatments were applied on May 20th and 21st. Materials applied were CMU (3 parachloro phenyl 1, 1 dimethyl urea), PDU (phenyl dimethyl urea), Sinox PE (alkanolamine salt formulation of dinitro ortho secondary butyl phenol, containing 3# of DNOSBP per gallon), Crag Oxalate (bis dichloro phenoxy ethyl oxalate), Natrin (2,4,5-trichlorophenoxyethyl sulphate), 4 Chloro (amine salt of 4 chloro phenoxyacetic acid), Hydrin, MCP Sulphate (2 methyl, 4 chlorophenoxy ethyl sulphate), 2,5-D Sulphate (2,5 dichlorophenoxy ethyl sulphate), and Amino Triazole.

All treatments were applied with a small plot CO_2 sprayer, using 25 pounds pressure in 25 gallons of spray solution per acre. The soil was a heavy loam which was moist on the day of spraying. The principal weeds present were mustard (Brassica sp.), ragweed (Amaranthus retroflexus), annual grasses

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WEED CONTROL IN PEAS FOLLOWING A PRE-EMERGENCE APPLICATION OF SEVERAL HERBICIDES

Table 1

Treatment	Weeds Per 4 Sq. Feet			Remarks
	June 9	July 3		
	Total	Broadleaves	Grass	
CMU 1#/A	13.0	2.0	4.0	Slight Injury
CMU 1½#/A	5.0	18.0	9.5	Some Injury
PDU 1#/A	6.0	9.0	14.0	
PDU 1½#/A	7.0	8.5	12.0	Some Injury
Sinox PE 1 gal/A	18.5	15.0	5.0	
Sinox PE 1½ gal/A	4.0	9.5	5.0	Excellent Weed Control, No Injury
Sinox PE 2 gal/A	1.0	2.5	5.5	Excellent Weed Control, No Injury
Crag Oxalate 2#/A	66.0	25.0	14.0	
Crag Oxalate 3#/A	35.5	7.5	19.0	Slight Injury
Natrin 3#/A	36.5	20.5	6.0	Slight Injury
Natrin 4#/A	29.0	1.5	9.0	Some Injury
Natrin 5#/A	17.0	18.0	6.0	Severe Injury
4 Chloro 2#/A	15.0	20.0	16.0	
4 Chloro 3#/A	6.5	7.5	15.0	Slight Injury
4 Chloro 4#/A	6.0	8.5	7.0	Moderate Injury
Hydrin 2½ gal/A	163.0	42.0	14.5	
Hydrin 5 gal/A	87.5	54.0	5.5	
Hydrin 10 gal/A	43.5	32.5	26.5	
MCP Sulphate 2#/A	44.0	12.5	15.0	Slight Injury
MCP Sulphate 3#/A	43.0	19.5	12.0	
2,5-D Sulphate 2#/A	82.0	48.0	4.5	
2,5-D Sulphate 3#/A	124.0	20.5	16.5	
Amino Triazole 8#/A	6.0	9.0	11.0	Peas Chlorotic - Injury
Check	141.5	62.0	12.5	
L.S.D. .05	52.8	19.1	11.3	
L.S.D. .01	70.4	25.5	15.1	

WEED CONTROL IN PEAS FOLLOWING A PRE-EMERGENCE APPLICATION OF SEVERAL HERBICIDES

Table 2

Treatment	Weed Control Rating *		Injury Rating **
	May 29	June 9	
CMU 1#/A	8.5	9.0	1
CMU 1½#/A	8.0	10.0	2
PDU 1#/A	7.5	9.0	0
PDU 1½#/A	6.0	9.5	2
Sinox PE 1 gal/A	9.0	8.5	0
Sinox PE 1½ gal/A	10.0	10.0	0
Sinox PE 2 gal/A	10.0	10.0	0
Crag Oxalate 2#/A	1.0	7.0	0
Crag Oxalate 3#/A	6.5	8.5	1
Natrin 3#/A	3.5	7.5	1
Natrin 4#/A	8.0	7.0	2
Natrin 5#/A	7.5	8.5	3
4 Chloro 2#/A	7.0	9.5	0
4 Chloro 3#/A	8.5	9.5	1
4 Chloro 4#/A	9.0	9.5	2
Hydrin 2½ gal/A	3.5	2.5	0
Hydrin 5 gal/A	4.0	5.0	0
Hydrin 10 gal/A	7.5	6.5	0
MCP Sulphate 2#/A	6.5	7.5	1
MCP Sulphate 3#/A	4.0	7.0	0
2,5-D Sulphate 2#/A	2.0	4.5	0
2,5-D Sulphate 3#/A	4.5	3.0	0
Amino Triazole [illegible]#/A	8.0	10.0	2
Check	0	1.0	
.05	4.0	3.2	
L.S.D. .01	5.4	4.3	

* 0 = No Control, 10 = Perfect Control

** 0 = No Injury, 3 = Severe Injury

(Setaria sp.), and quackgrass (Agropyron repens.).

Weed control ratings were taken on May 29th and again on June 9th. Weed counts were taken on June 9th and on July 3rd. Results of this screening test are given in Tables 1 and 2. A discussion of the large scale comparisons will be given later in the pappr. The large scale field trials were applied with a jeep sprayer using 40 gallons of spray solution per acre and 40 p.s.i. pressure.

Results and Discussion

Tables 1 and 2 give the results of the screening test. CMU and PDU gave good weed control, but slight to moderate injury at the rates used. Sinox PE was the most satisfactory chemical used. Even at the highest rate (6 lbs. DN per acre), there was no injury to the peas. Crag Oxalate gave rather erratic weed control and some injury to the peas. Natrin at 4#/A gave weed control comparable to Sinox PE at 6# DN per acre. The amine salt of 4 Chloro phenoxyacetic acid gave good weed control at 3 and 4 pounds per acre, but there was some injury to the peas. Hydrin, although giving good control of weeds that were already emerged gave little if any residual control of weeds. MCP Sulphate and 2,5-D Sulphate on this soil type gave only fair weed control. Amino Triazole at 8# per acre gave excellent weed control. This treatment injured the peas and gave the typical chlorotic effect. This effect was temporary, lasting only about three weeks. The peas on these plots showed a stunting effect for the remainder of the season.

In the large scale field trials the various materials were tried pre-emergence, at come up, and post-emergence. Weed counts taken at one pre-emergence location are shown in Table 3. The peas had been planted on April 26th and sprayed May 6th. Weed counts were taken June 1.

Table 3

Weed Counts Following Pre-Emergence Treatments on Canning Peas

Treatment		Weeds Per 1 Sq. Ft.
Sinox PE	1 gal/A	5
Sinox PE	½ gal/A	5
Crag Oxalate	2#/A	12
CMU	1#/A	5
PDU	1#/A	5
Check		22

In this test, Sinox PE at both 1½ and 3 pounds DN per acre gave very good weed control which persisted until the peas were harvested. Crag Oxalate at 2# per acre did not give satisfactory weed control, although there was no injury to the peas. Both CMU and PDU gave excellent weed control at 1# per acre, which lasted until the peas were harvested. There was no resulting injury to the peas.

At another location, the peas were sprayed just as they were emerging with three different treatments; Sinox PE at 1½ and 3 pounds DN per acre, and CMU at 1 pound per acre. At this location the 1½ pound rate of Sinox PE took out the easy to kill weeds such as mustard, but did not completely con-
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trol ragweed and other more resistant weeds. The control was good enough to be commercially practical. The 3 pound rate of Sinox PE gave excellent control of all weeds and annual grasses. The 1 pound rate of CMU gave good control but also injured the peas. The peas were yellowish in color and stunted. In other post-emergence tests on peas, Sinox PE at $1\frac{1}{2}$ quarts per acre, applied when the peas were 3 - 8" in height gave excellent weed control and little or no injury to the peas. In post-emergence tests where Sinox PE at this rate was compared with Sinox W (ammonium salt of DNOSBP), 3 quarts per acre, weed control was comparable with both treatments. In several tests less injury to the peas occurred with $1\frac{1}{2}$ quarts Sinox PE than with 3 quarts of Sinox W.

Summary and Conclusion

Several new chemicals have shown promise as selective weed killers in peas. These new chemicals have an advantage over the previously used material (ammonium salt form of DNOSBP) because they work effectively in lower gallonages of water per acre. Where ammonium salt formulations of DNOSBP were used, 75 - 100 gallons of water was recommended per acre.

Pre-emergence and emergence treatments of peas with Sinox PE have been very successful both in weed control obtained and absence of any injury to the peas.

Of the materials tested, Sinox PE has proven to be the most successful. As a pre-emergence treatment from planting up until a day before emergence, 1 and 2 gallons of Sinox PE gave excellent weed control and resulted in no injury to the peas.

As an emergence treatment made just as the peas were emerging, $\frac{1}{2}$ to 1 gallon of Sinox PE gave good to excellent weed control with no injury to the peas.

As a post-emergence treatment, Sinox PE at $1\frac{1}{2}$ quarts gave weed control equal to 3 quarts (3/4# DN) of ammonium salt formulation of DNOSBP, with as little or less injury to the peas.

A COMPARISON OF CRAG, DERIVATIVES OF CRAG, AND CMU FOR PRE-EMERGENCE WEED CONTROL IN TOMATOES[1]

Robert M. Menges and Richard J. Aldrich[2]

One problem in field tomato culture is that of maintaining weed-free rows after the last possible cultivation. The development of an herbicide which would control the weeds and still not adversely affect the tomato plant, would be of considerable value.

Very few papers have been published on the application of 2,4-dichlorophenoxyethyl derivaties on tomatoes. Ries and Sweet (5) concluded that CRAG was more toxic to tomatoes than either CRAG Benzoate or Oxalate. LeCompete (3) reported that tomato responses from CRAG were similar to that previously observed from mild doses of 2,4-dichlorophenoxyacetic acid. King and Lambrech (2) reported that reduction in growth of tomato plants was minor when CRAG was applied to the foliage. However, when the chemical was applied to the soil, its effect on the growing plant was similar to, but less pronounced than that of 2,4-D. Zimmerman and Hitchcock (7) pointed out that all ester formulations of 2,4,5-T induced less pronounced tomato plant responses than ester formulations of 2,4-D. Also, McNew and Hoffman (4) have shown that the growth regulant ability of 2,4,5-T was slightly less than that of 2,4-D. On the basis of the latter reference, it seems possible that the 2,4,5-derivative of CRAG, namely Natrin, might show even less toxic effect on tomatoes, in comparison to CRAG.

The purpose of this field experiment was to compare the relative effectiveness of the chemicals in weed control and to measure the response of tomatoes to the chemicals.

Materials and Methods

The chemicals tested were: 2,4-dichlorophenoxyethyl sulfate, 2,4-dichlorphenoxyethyl benzoate, Bis (dichloro)phenoxyethyl oxalate, 2,4,5-trichlorophenoxyethyl sulfate, and 3(p-chlorophenyl)-1, 1-dimethylurea; these materials are referred to in the remainder of this paper as CRAG, Benzoate, Oxalate, Natrin, and CMU respectively.

Rutgers variety tomatoes were transplanted May 28, 1953 to a Sassafras sandy loam soil. The plant spacing was 3.5 feet by 3.5 feet in plots 2 by 7 hills in size. Data were recorded on 2 by 6 hills in each plot. The plots were replicated four

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[1]Cooperative investigations between the New Jersey Agricultural Experiment Station and the Division of Weed Investigations, Agricultural Research Service, U. S. Dept. of Agriculture.

[2]Research Fellow in Farm Crops, Rutgers University and Agronomist, Division of Weed Investigations, ARS, USDA, respectively. Acknowledgment is made to the Carbide and Carbon Chemical Company for their support of this project.

times in a randomized block design. The tomato plants were dusted on June 9 with 3% DDT for insect control. Plots were maintained weed-free with cultivation and hand-hoeing until the date of treatment. The chemicals were applied in 40 gallons of solution per acre on July 8 at which time the plants were in the first stages of blossoming. Sprays were directed toward the lowest portions of the plants, using a belt-type hand sprayer described by Terry (6). The rates used were: 1/4, 1/2 and 1 pound per acre of CMU; $1\frac{1}{2}$, 3 and 4 pounds per acre of CRAG, Natrin and Oxalate; and $1\frac{1}{2}$, 3 and 5 pounds per acre of Benzoate. Observations were made periodically on the condition of the plants, and notes were recorded during harvests concerning the chemical effects on the fruit. Harvests were made August 12, 18, 24, 27 and 31 and September 2, 7, 11, 18 and 23.

Results and Discussion

Observations on plant condition indicated that the CRAG and especially the Natrin treatments did not affect the tomato plants as quickly or as severely as did the Benzoate and especially the Oxalate treatments. The day after chemical application, plants treated with 3 and 4 pounds of Oxalate were showing typical hormone symptoms. On the second day, Benzoate plants showed similar effects but to a lesser degree. Stems on plants treated with 3 and 4 pounds of Oxalate were twisted and split and leaves were distorted by the thirteenth day after application.

The CMU plants showed yellowing of the leaves on the sixth day after treatment but were completely recovered by the seventeenth day. The CMU plants appeared normal during the remainder of the season.

CRAG and Natrin treated plants appeared normal until July 25 or 17 days after spraying. At this time, the younger leaves of plants from the 4 pound treatments of each showed only minor leaf epinasty. CRAG appeared to cause more stem twisting. The lag in response to these treatments might be explained by low rainfall prior to July 25. There was only .06 inches of rain during July 8 to 20 and from July 21-25 there was 2.17 inches of rain. By the twenty-sixth day after application (August 3) the plants of 4 pounds Natrin showed wrinkled leaves with only minor leaf epinasty; tomatoe plants from the 4 pound treatment of CRAG had more leaf epinasty. Plants were normal in plots treated with lower rates of CRAG and Natrin.

Notations during harvests indicated that all fruits were affected by dry weather resulting in splitting at the region of the stem apex. Previous to the August 27 harvest, Natrin and CRAG fruits were normal in comparison to the check fruits. At this time, the fruits from the 4 pound application of CRAG, and especially Natrin, were showing considerable apex cracking. In the September 7 and 17 harvests, 5-16 per cent of the fruits from these treatments were seedless. The lower rate of each treatment resulted in normal fruit in all harvests. It should be pointed out that a small percentage of the check fruits were seedless.

For the most part, the fruits from the CMU treatments were excellent in quality. The only abnormality found was on September 17 when 15-20 per cent of the fruit of the 1 pound rate of CMU were seedless. The poorest quality fruit was harvested from the Oxalate and the Benzoate treatments. These treatments resulted in seedless and distorted fruits at the first harvest and the condition was carried through several harvests. During the last harvests, the medium and high rates of these Benzoate and Oxalate treatments yielded fruits which were scarred and were 30-70 per cent seedless.

The total tomato yields are presented in Figure 1 and the first three yields in each treatment are recorded in Table 1. The total Natrin and CRAG yields were approximately equal to those of the check. The total yields from the check plots were significantly higher than those from the plots of 1 pound CMU and 3 and 4 pounds of Oxalate. Total yields of plots treated with 3 and 5 pounds of Benzoate were considerably less than yields from check plots but reductions were not statistically significant.

Table 1. Total weight of tomatoes per treatment in the first three harvests, New Brunswick, N. J. 1953.

Treatment	Rate in lbs./A	Lbs. of Tomatoes/4 Plots			Total of 3 dates	Total No. of fruits for 3 dates
		Aug. 18	Aug. 24	Aug. 27		
Natrin	1½	13.2	43.6	25.7	82.5	162
	3	15.5	30.8	19.0	65.3	126
	4	6.3	32.0	20.3	58.6	95
CRAG	1½	9.4	27.7	14.7	51.8	113
	3	9.0	42.2	15.1	66.3	147
	4	10.5	30.8	16.3	57.6	122
Benzoate	1½	15.4	32.5	14.1	62.0	129
	3	17.1	42.2	27.6	86.9	165
	5	7.5	29.6	16.2	53.3	100
Oxalate	1½	9.3	40.4	13.2	62.9	121
	3	21.3	54.8	18.1	94.2	184
	4	18.5	31.3	13.8	63.6	115
CMU	1/4	7.6	21.4	17.6	46.6	81
	1/2	9.9	22.7	18.2	50.8	97
	1	4.8	15.9	10.9	31.6	60
Check		11.4	25.5	12.1	49.0	106

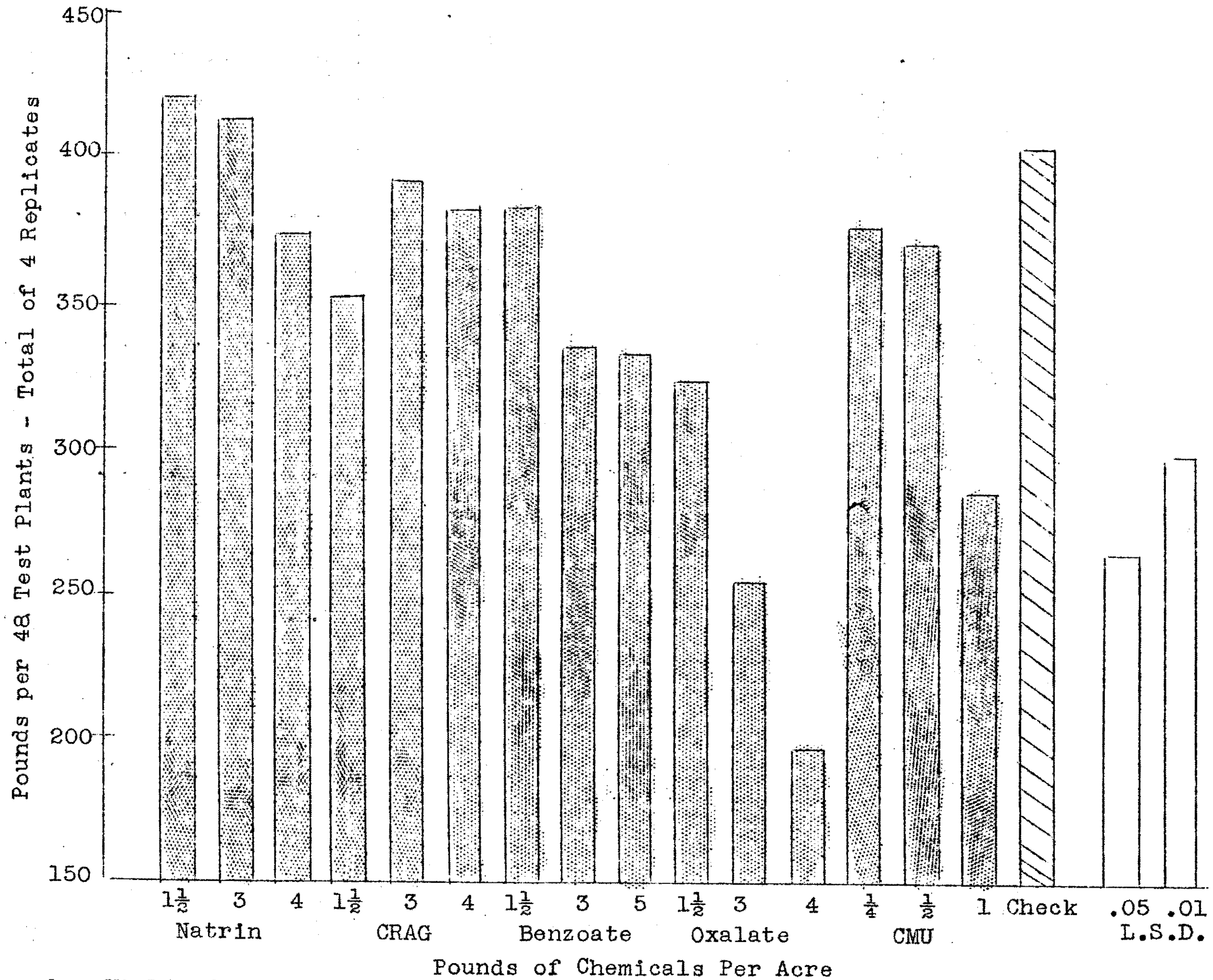

Fig. 1. Yield of tomatoes as affected by applications of CRAG, CRAG derivatives, and CMU.

It is evident from Table 1 that CMU reduced tomato yields especially at the higher rates of application. Yields on plots treated with CRAG and its derivatives tended to be higher than checks during these first three harvests. Observation of the plots in the early part of the growing season indicated a larger number of fruits in the Oxalate treatments. Examination of Table 1 indicates a close relationship between yield and number of fruits. It appears that CRAG and its derivatives resulted in heavier early fruit set. As was pointed out earlier, fruits were of poor quality in the Benzoate and Oxalate plots even in these early harvests.

Treatments did not appear to affect the size of fruit. However, the 4-pound rate of Oxalate had significantly more discard fruits than the check.

RELATIVE EFFECTIVNESS OF CRAG AND NATRIN ON PRE-EMERGENCE WEED CONTROL

There was no existing weed problem in the 1953 field tomato test due to dry weather. A separate test was initiated on August 15 to compare the relative effects of CRAG and Natrin on weed control.

Materials and Methods

CRAG and Natrin were applied to soil immediately after disking and five days after disking. The chemicals were applied in 40 gallons of solution at the rates of 1, 2, 3 and 4 pounds active material per acre. Plots were 6 by 12 feet in size and were replicated four times in a randomized block design. Broadleaf and grass weeds were counted four weeks after the first application. At the same time, visual estimates of per cent weed control on each plot were made. The percentage figures were transformed to degrees to allow a more precise analysis of variance (1).

Results and Discussion

The results given in Figure 2 reveal a pronounced difference in weed control between the two dates of treatment; both materials resulted in significantly better control when applied immediately after disking. Two and 3 pounds per acre of Natrin and 1 to 4 pounds per acre of CRAG were found significantly above the check in weed control. Refering to the graph, the lower rates of CRAG appear slightly superior to those of Natrin but the higher rates are approximately equal.

Summary

Natrin and CRAG compared favorably with the check in tomato yields; Natrin appeared somewhat superior to CRAG. Both of these chemicals yielded fruit of relatively good quality and the plants under these treatments showed no drastic hormone effects.

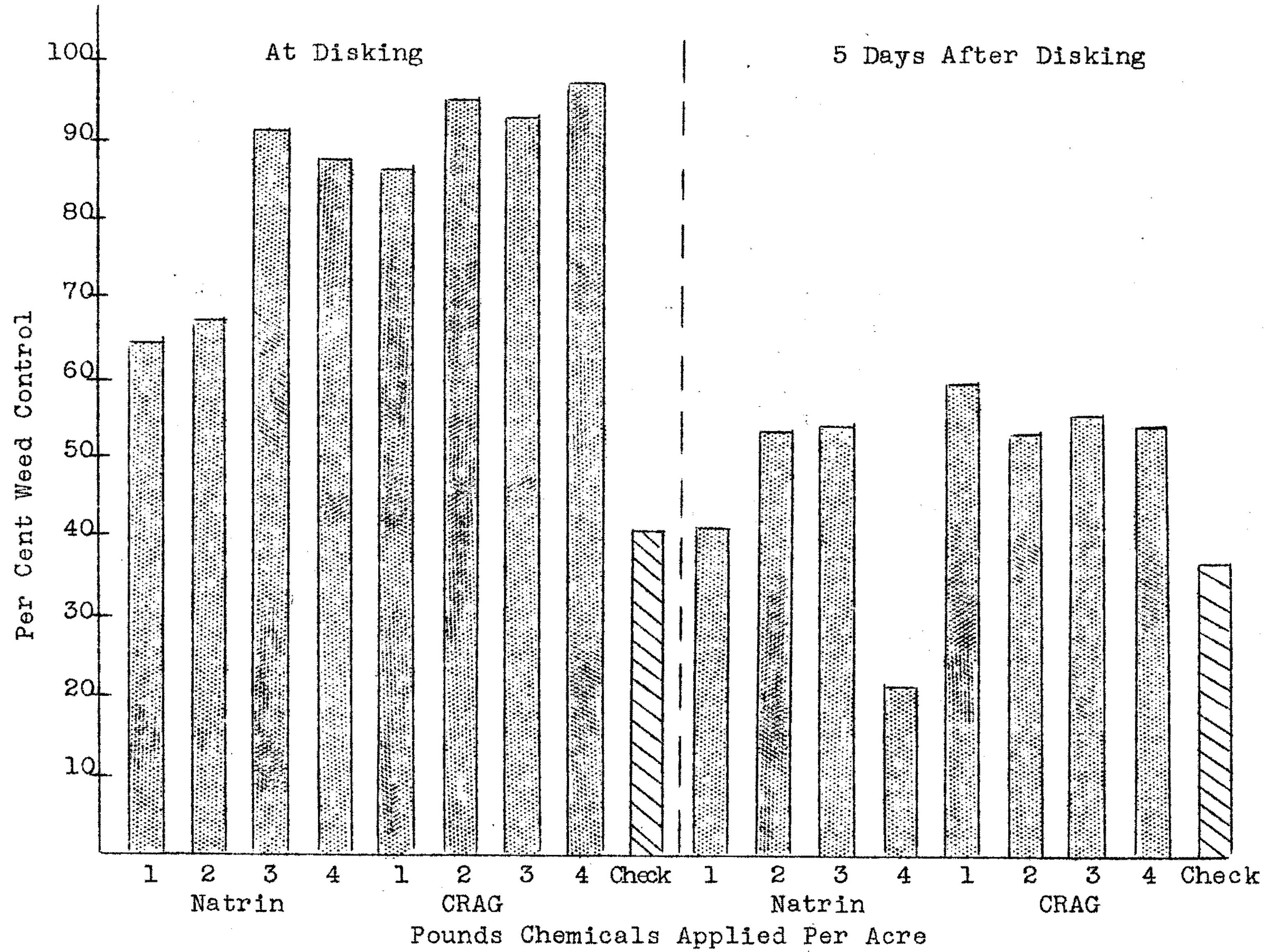

Fig. 2. Relative weed control with CRAG and Natrin applied to soil at two dates after disking.

Yields were appreciably reduced by the Benzoate and drastically reduced by the Oxalate treatments. Both of these latter materials caused generally poor quality fruit.

The 1/4 and 1/2 pound rate of CMU gave favorable yields and resulted in fruits of apparent excellent quality. However, the 1 pound rate of CMU decreased yields.

Weed control with Natrin compared favorably with that obtained with CRAG. It appeared, however, that CRAG was slightly more effective.

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PRE-EMERGENCE CONTROL OF WEEDS IN HOME VEGETABLE GARDENS

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When 2,4-D was introduced, it was for the selective control of weeds in home lawns, and for killing poison ivy. Agricultural workers were quick to realize the possibilities of such a chemical, and produced the great volume of herbicide work with which we are familiar. Excellent work in controlling weeds in various vegetable crops has been done by Chappel in West Virginia, Danielson in Virginia, LeCompte in New Jersey, Rahn in Delaware, Sweet at Cornell, Taylor in Illinois, Warren in Ohio, and many others. However, with a few exceptions, such as Sweet's report to this Conference on post-emergence control in 1952, this work has primarily been with large-scale agricultural situations.

Home owners are still faced with one of the most aggravating weed control headaches -- the home garden patch of vegetables and flowers for cutting. These usually consist of small plantings of many different species. Equipment and resources for applying present techniques are usually limited. However, several chemicals have given indication that they would be useful in such a situation, and in the summers of 1951 and 1953 tests were run in an effort to determine whether any of them would be suitable.

Methods and materials, 1951

In previously disked ground on May 28 to May 31 plots 20' x 63' were seeded to 1 row each (except corn, 2 rows) of the following representative major home garden crops: sweet corn, Narrowgrain Evergreen; squash, White Bush Scallop; lettuce, Oak Leaf; radish, Crimson Giant; snap bean, Contender; wax bean, Pencil Pod Wax; lima bean, Fordhook 242; peas, Freezonian; spinach, Longstanding Bloomsdale; beets, Perfected Detroit; carrots, Nantes Long; cucumber, Straight 8; potato, Green Mountain; onion, white sets; zinnia, Will Rogers; marigold, Mammoth Mum; gladiolus, Edith Cave Cole; aster, Giant Crego.

All chemicals were applied uniformly over the entire area as a pre-emergence treatment. On June 1, sprays of the following were applied at the indicated rates of active ingredient per acre: Crag Herbicide 1 (2,4-dichlorophenoxy ethyl sulphate), 1½ and 3 lbs.; ACP-L-195 (emulsifiable sodium pentachlorophenol formulation), 10 and 20 lbs.; diethyl phosphate, 1½ and 3 lbs.; diethyl phthalate, 1½ and 3 lbs. On June 4, dry applications of the

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following were made: iron salt of 2,4-D, 1½ lb.; copper salt of 2,4-D, 1½ lb.; Crag Herbicide 1, 1½ lb.; Weedar 64 (amine salt of 2,4-D), 1½ lb.; CMU (3-p-chlorophenyl-1,1-dimethyl urea), 1½ lb.; parachlorophenyl urea, 1½ lb.; ACP-L-162 (2,4-D derivative), 1½ lb.; ACP-472 (2,4-D derivative), 1½ lb.; ACP-472 (2,4-D derivative), 1½ lb.

One plot was left unsprayed as a check. No plots were cultivated at any time after seeding and treatment. All sprays were applied with a knapsack sprayer at the rate of 80 gallons of solution per acre. In applying this, each plot was covered twice with the second travel direction at right angles to the first. Dry applications were made with a shaker cannister. Weather was somewhat cooler than normal (only 7 days above 80° in the three weeks following treatment, and none above 90°). Principal rainfall came one week before seeding (1.28"), three days before spraying (1.02"), two days after spraying (0.89") and two weeks after spraying (0.96"). Weed population in the area consisted primarily of ragweed, pigweed, lamb's quarters, Canada thistle, northern nut-grass, quack grass and foxtail.

Results, 1953

Table I records observations made one month after treatment. Reaction of the crops to the chemicals is rated from 1 to 5, 1 indicating normal crop stand and 5, total crop kill. With regard to weed control, 1 indicates complete control and 5 indicates no control.

ACP-L-195 applied at the rate of 10 lbs. per acre appeared the most satisfactory treatment from the combined standpoint of weed control and minimum injury to crops. This was followed by ACP-L-195 at 20 lbs. per acre, and then diethyl phosphate at 1½ lbs. Although ACP-L-195 decreased emergence in some cases, those plants which did emerge grew as normally as the check plants. Crag Herbicide 1, which is used primarily for treatment after crop emergence, gave the best weed control but injured most crops severely or prevented their emergence when used immediately after seeding. The 2,4-D's all produced some degree of epinasty. Bean, spinach and aster emergence was poor in all plots, including the check. Onion sets had already begun to sprout when set out, but were not appreciably injured. No treatment produced any observable injury to gladiolus.

Weed control on the 10 lb. ACP-L-195 plot was good for six weeks after treatment, beyond the period when it is most difficult to cultivate seeded rows and seedlings. This is also usually the period of heaviest time demands on the gardener. At the time of treatment, nutgrass and quack grass sprouts had emerged, and there were a few weed seedlings, all of which were killed back to the ground.

Methods and materials, 1953

On prepared ground, demonstration plots similar to those of 1951 were seeded on July 1. Potatoes were omitted. Flowers included were zinnias, scabiosas, marigolds and annual dahlias. At weekly intervals (July 7, July 16, and July 22) tomato, pepper, cabbage, eggplant and broccoli transplants were set in the treated soil.

Chemicals used in 1953 were ACP-L-195A, sodium salt of pentachlorophenol, Sinox PE (sodium salt of dinitro-o-sec-butylphenate), Weedone Chloro IPC (isopropyl n-3-chlorophenyl carbamate), 2 methyl 4 chlorophenoxy ethyl sulphate, Crag Herbicide 1, and WPB 4 (another emulsifiable pentachlorophenate formulation). Two plots each were treated with ACP-L-195A and chloro IPC. In each pair, no further attention was given one, and the other was cultivated and retreated when weed population required it. Two control plots were provided, one to be kept clean by cultivation and the other left untouched. Time required for weed control was recorded. As in 1951, all sprays were applied with a knapsack sprayer to simulate home garden conditions. Recommended insect and disease controls were applied regularly.

Soil moisture was good at the time of treatment. Principal rainfall thereafter was at the time of spraying (0.77"; the last plot, Sinox PE, was finished in the rain) and three weeks afterward (1.14"). There were three light rains (less than 0.2") in this interval. Weeds in the area included ragweed, pigweed, purslane, Jimson weed, lamb's quarters, spotted spurge, northern nut grass and crab grass.

Single plots of ACP-L-195A, chloro IPC and Crag Herbicide 1 were cultivated and retreated on August 14. Reasonable care was taken to keep sprays from touching crop foliage. No rainfall followed for three weeks, when 1.71" fell and a period of excessive heat was broken.

Results, 1953

Table II shows the rated observation one month after the initial treatment. Weed control was rated from 1 (complete control) to 10 (no apparent control). Crop reaction was rated from 1 (complete stand) to 10 (no stand or crop killed). 1 to 3 indicates satisfactory stand; 4 was acceptable, although a bit thin. Emerged plants were normal except beans, peas, beets and corn in the MCP ethyl sulphate and 2,4-D ethyl sulphate plots, which were badly stunted. All transplants in these two plots were stunted and failed to develop normally, the degree increasing with each successive planting. It should be noted that some crops germinated poorly even in the check plots because of late seeding. Transplants also showed the effect of late planting. Emergence in the plots treated with ACP-L-195A was approximately the same as in the check plots. Weed control lasted about 6 weeks. MCP ethyl sulphate and 2,4-D ethyl sulphate gave the best weed control, but at the considerable expense of crop emergence and performance. The sneeze-producing quality of plain sodium pentachlorophenate and the staining color of Sinox PE make these two materials disagreeable for home owners to use. Check plots required approximately three times as many hours to keep clean manually as did those kept clean chemically.

Conclusions

Chemical weed control can materially reduce the amount of time needed to keep diversified home gardens weed-free. Of the 17 materials tested on 18 seeded crops and 6 transplanted ones, the most promising one for pre-emergence use was an emulsifiable formulation of sodium pentachlorophenate, ACP-L-195A. Weed control extended well beyond the crop germination period when cultivation is difficult and many other garden activities compete for time. Retreatment is feasible. Crop response to chloro IPC was also reasonably good, but weed control was not satisfactory at the time of testing. Crag Herbicide 1, useful as a post-emergence type treatment, appeared unsuitable for pre-emergence application, as did even the least soluble forms of 2,4-D.

TABLE I

Dry Applications

Crops	Fe 2,4-D 1½#	Cu 2,4-D 1½#	EH-1 1½#	CU	W64	CMU	L-162	472
Corn	1	2	1	2	1	2	2	2
Lettuce	5	5	5	2	5	3	4	5
Radishes	5	3	3	2	4	3	3	4
Squash	5	1	5	2	4	3	2	5
Snapbean	3	4	2	2	3	4	4	4
Wax beans	1	2	1	3	2	3	3	4
Lima beans	4	4	4	4	4	5	3	4
Peas	3	2	2	1	2	3	1	4
Spinach	3	4	4	4	4	4	4	5
Beets	5	3	4	1	5	4	4	5
Carrots	5	4	5	2	5	4	4	5
Onions	2	1	3	1	2	2	2	4
Cucumber	5	5	5	1	5	5	5	5
Potatoes	1	1	2	2	3	2	1	3
Zinnias	5	3	4	2	5	5	5	5
Marigolds	3	3	5	2	5	5	5	5
Asters	5	5	5	4	5	5	5	5
Gladiolus	1	1	1	1	1	1	1	1
Rating Median	3.44	2.88	3.38	2.11	3.61	3.50	3.22	4.16
Weed Control	3	4	2	4	2	2	4	2
Combined Value	3.22	3.22	2.69	3.05	2.80	2.75	3.61	3.08

TABLE I

Crops	Check	ACP-L-195 10#	ACP-L-195 20#	EH-1 1½#	EH-1 3#	Diethyl Phthalate 1½#	Diethyl Phthalate 3#	Diethyl Phosphate 1½#	Diethyl Phosphate 3#
Corn	1	1	1	3	2	2	1	1	1
Lettuce	1	4	5	5	5	3	3	5	5
Radishes	2	3	5	5	4	2	3	2	4
Squash	1	1	1	5	3	5	2	1	2
Snapbean	2	2	2	4	4	3	4	2	3
Wax beans	1	1	1	3	3	2	3	2	3
Lima beans	3	4	4	5	5	3	4	4	4
Peas	2	1	3	3	4	1	1	1	1
Spinach	2	4	5	4	4	3	4	3	3
Beets	1	3	5	5	5	4	5	4	5
Carrots	1	2	5	5	5	4	5	5	5
Onions	1	1	1	3	4	-	3	1	1
Cucumber	1	1	3	5	5	4	5	2	3
Potatoes	1	1	1	1	2	1	1	2	2
Zinnias	1	2	2	4	5	1	2	4	4
Marigolds	1	2	3	5	5	1	4	5	5
Asters	3	5	4	5	5	5	5	5	5
Gladiolus	1	1	1	1	1	1	1	1	1
Rating Median	1.44	2.16	2.88	3.94	3.94	2.67	3.11	2.77	3.16
Weed Control	5	2	1	1	1	4	4	3	2
Combined Value	3.22	2.08	1.94	2.47	2.47	3.32	3.55	2.88	2.58

TABLE II

Crops	Check	ACP L-195	Na PCP	Sinox PE	Chloro IPC	MCP Ethyl Sulphate	Crag Herb. 1	WFB4
Corn	3	3	4	3	5	4	8	5
Squash	1	1	1	1	1	9	10	2
Radish	1	3	5	10	3	10	10	2
Green Beans	3	1	3	5	5	7	8	4
Lettuce	4	9	10	10	8	10	10	8
Wax Beans	2	2	3	5	2	6	9	3
Peas	2	2	2	2	3	8	10	3
Cucumber	2	2	5	4	8	7	10	1
Spinach	10	9	10	10	9	10	10	10
Carrots	4	10	10	10	10	10	10	5
Lima Beans	3	3	4	5	4	4	8	3
Beets	6	9	9	10	8	10	4	5
Onion Sets	1	1	1	1	1	3	9	1
Zinnias	4	2	7	8	4	7	10	3
Scabiosa	10	5	10	10	10	10	10	10
Marigolds	7	3	10	10	9	10	9	4
Dahlias	8	4	10	10	9	10	10	9
Tomatoes	1,1,1	1,1,1	1,1,1	1,9,7	1,3,5	1,5,1	1,10,9	1,9,3
Peppers	1	1	2	9	3	8	10	2
Cabbage	1,1,1	1,1,1	1,1,1	1,1,1	1,1,1	2,3,2	8,9,8	1,1,1
Eggplant	1,1,1	1,1,1	1,1,1	1,1,1	1,3,1	3,1,1	1,3,9	1,1,1
Broccoli	1,1,1	1,1,1	1,1,1	2,1,1	1,1,1	1,1,1	4,6,2	1,1,1
Rating Median	2.8	2.7	3.9	5.0	4.0	5.5	7.8	3.7
Weed Control	10	2	2	2	4	1	1	8
Combined Value	5.40	2.35	2.95	3.50	4.00	3.25	4.4	5.85

Gladiolus Weed Control Experiments 1953

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There is a large commercial acreage of gladiolus grown for corms and cut flowers in Florida, Michigan, New York, and Oregon. They are also grown commercially in practically all parts of the country. The larger corms are grown for cut flowers, and the smaller corms and cormels are grown to increase the stock of flowering size corms. Much labor is required to hand weed the young stock, especially early in the season. Chemical weeding looks very promising on gladiolus because of their culture and their tolerance to many of the herbicides.

The experiments currently in progress at the Ornamentals Research Laboratory on Long Island are designed to determine which materials will do a satisfactory weed killing job and not hurt the crop. Weeds in our field are mostly mustard, Brassica sp.; lambs quarters, Chenopodium album; pigweed, Amaranthus retroflexus; and ragweed, Ambrosia artemisiifolia. Of interest also is a study of conditions influencing the final results. Experiments are also being carried out on other ornamental crops.

Materials and Methods

Medium size gladiolus corms of the varieties Cover Girl and Snow Princess, and cormels of the varieties Spic and Span and Snow Princess were planted April 23. One thousand #3 Cover Girl and 1000 #4 Snow Princess were planted in lots of 25 with 10 replicates of each variety in each of 4 rows. Another 4 rows were planted with the cormels 10 replicates of each variety in each row. The variety Snow Princess was planted in lots of 500 and Spic and Span 300. All lots of corms and cormels of a variety were adjusted to nearly equal weights. Twenty days after planting, the soil over the corms and cormels was raked level and the herbicides applied with a one gallon hand sprayer in one foot wide strips over the rows. Each herbicide was applied to one lot of each variety in each row. The treatments were randomized among plots in the rows.

The materials were used at the following rates in 100 gallons of water per acre: Alanap #1 4 lbs., Crag herbicide #1 3 lbs., 47% chloro IPC miscible 6 qts., Premerge at 6 qts. followed by 3 lbs. of Crag #1, Sesin at 3 lbs., TAT-GW (2,4-D plus Nphenylmercuriethylenediamine) at 6 qts., 2,4-D at 2 lbs., and 1 lb. of 2,4-D plus 10 lbs. of NaTCA. Untreated, unweeded "check" and the hand weeded and cultivated "cult" plots were included in each row.

On May 14 a second planting was made in another section of the field. One thousand #3 Elizabeth the Queen, 1000 #4 Cover Girl, and cormels of Spotlight in lots of 500 and Elizabeth the Queen in lots of 500 were planted as in the earlier planting. On May 23 this planting was treated with the same materials as the April planting except Natrin at 5 lbs. and Premerge at 6 qts. replaced Alanap and Sesin.

Observations were made on weed control in the different plots, and cut flower and corm yields were obtained to determine any adverse effects on the crop.

Results

The prolonged drought in late April and May greatly reduced the effectiveness of the early treatments. An irrigation system was working by mid-May and all the plots were watered regularly. This greatly improved the weed control and growth of the gladiolus in the later planting. Table 1 shows the effectiveness of the dinitros, chloro IPC, and 2,4 D plus TCA as a pre-emergence treatment even under adverse conditions. The weed seed/ germination inhibitors were less effective as seeds germinated at lower levels of soil and pushed through the dry treated layer on the surface. The cultivated plots had not yet been hand weeded. Table 2 shows the more effective weed control later in the season with irrigation and possibly also the higher temperatures. The 2,4-D materials were quite effective in the later treatment. Crag #1 did not show up too well in these experiments, but in another experiment this season and last season's results show it can do quite well. At the concentration employed in the experiments, all materials failed to give any noticeable control of nut grass, _Cyperus esculentus_, which came in patches in many spots in the field. In general chloro IPC was very effective for a short period of time. However, when its potency was expended, all the plots treated with this material produced a most vigorous stand of ragweed. Grasses grew in all the plots later in the season. The early plantings rapidly became weedy while some treated plots in the later planting never became full of weeds and the gladiolus grew well.

Tables 3 and 4 show the effect of the treatments on the size of the flower spike. There does not appear to be any consistent difference between chemical treatments although both with Cover Girl and Elizabeth the Queen the cultivated plots did very well and the unweeded checks were poorer. The checks should tend to be poorer especially with the smaller plants where competition with weeds is more of a factor.

Tables 5 and 6 show the time to flower from date of planting for the various herbicides. The figures shown in the tables represent the number of days from planting to flowering. The treatments had no significant effects on the time of flowering.

The effects of the materials on yield in the corm and cormel plots are shown in Tables 7 and 8. Notice the great variability between the cormel plots even in the same treatment as in the DN/Crag which varied from 38 to 396. Part of this may be due to disease but the cormel material is extremely variable. In future experiments the size of the cormel plots will have to be increased to 100 cormels. In the experiments with cormels, the lush weed growth in the check plots markedly cut down the yields. Part of the reduction may have been due to pulling some larger weeds but this was balanced by less competition resulting from the partial weed removal.

Discussion and Summary

Good early weed control can be secured by post planting pre-emergence sprays with dinitros, chloro IPC, and 2,4-D plus TCA, even if the soil conditions are not too favorable. Crag #1, 2,4-D, TAT-GW, and Alanap #1 probably do better if the soil is moist and slightly packed rather than loose on the surface. The treatments applied to the larger corms caused no measurable injury to flowers or reduction in corm production. Some injury may occur on the smaller stock from applications of Natrin or the 2,4-D plus TCA. However, some injury is preferable to letting the weeds grow in younger stock.

Table 1. Summary of May 20th observations on weed control in April planting. Relative number of weeds one month after treatment.

Treatment	A	B	C	D	E	F	G	H	I	Total	Average
					Row						
Check	4	2	3	3	5	5	5	5	5	37	4.1
Cultivated	3	3	3	2	3	5	5	5	3	32	3.6
Sesin	2	3	2	2	4	4	2	2	3	24	2.6
CIPC	1	0	1	0	0	0	1	0	2	5	0.6
Crag #1	2	1	1	1	3	4	3	1	3	19	2.1
2,4-D TCA	0	1	1	1	1	2	1	0	3	10	1.1
TAT-GW	1	2	2	1	2	2	3	1	3	17	1.9
Alanap #1	2	3	1	1	3	3	1	3	3	20	2.2
2,4-D	1	2	1	0	3	2	3	2	3	17	1.9
*DN/Cr	0	0	0	0	0	0	0	0	0	0	0.0

Table 2. Weed stand 1 month after planting on corms and cormels planted May 14, 1953, weed count June 28

Treatment	A	B	C	D	E	F	G	H	I	Total	Average
				Row							
Check	4	2	5	5	5	5	5	5	5	41	4.6
Cultivated	0	0	0	0	0	0	0	0	0	0	0.0
Natrin	2	5	3	5	5	5	5	5	5	40	4.4
CIPC	0	0	0	0	3	0	4	0	0	7	0.8
Crag #1	0	1	5	2	5	2	5	0	3	23	2.7
2,4-D TCA	0	0	3	0	0	0	0	0	0	3	0.3
TAT-GW	0	1	0	0	0	0	5	0	5	11	1.3
DN	0	0	0	0	0	0	0	0	0	0	0.0
2,4-D	0	1	0	0	1	2	5	3	4	16	1.9
*DN/Cr	0	0	0	0	0	0	0	0	0	0	0.0

0 no weeds
1 very few weeds
2 few weeds
3 some weeds
4 many weeds
5 very many weeds
* Dinitro followed by Crag #1

Table 3. Effect of treatment on weight of flower spikes, variety Cover Girl planted April 23. Average weight per spike in each plot in ounces

Treatment	Row B	Row C	Row D	Row E	Average
TAT-GW	1.61	1.44	1.54	2.31	1.73
CIPC	1.43	2.20	2.06	1.77	1.87
Alanap #1	1.41	1.73	0.63	2.04	1.45
2,4-D	1.99	2.08	1.84	2.45	2.06
Crag	2.06	2.09	1.56	1.56	1.81
2,4-D TCA	2.05	1.56	1.68	1.69	1.75
Check	1.25	1.73	1.82	1.31	1.40
DN/Cr	1.95	2.00	1.83	1.81	1.90
Sesin	1.75	1.93	1.70	1.59	1.74
Cult	2.03	2.05	2.14	2.49	2.18

Table 4. Effect of treatments on weight of flower spikes, variety Elizabeth the Queen planted May 14. Average weight per spike in each plot in ounces

Treatment	Row B	Row C	Row D	Row E	Average
TAT-GW	2.70	2.39	2.67	3.04	2.70
CIPC	2.58	2.94	2.50	2.41	2.61
Crag	2.29	2.65	2.68	2.50	2.53
2,4-D	2.80	2.59	2.91	2.82	2.78
Natrin	2.27	2.73	2.28	2.64	2.48
2,4-D TCA	1.66	2.02	2.28	2.52	2.12
Check	2.67	2.62	2.44	2.21	2.49
DN/Cr	1.64	2.95	2.77	2.38	2.44
DN	2.44	2.67	2.64	2.63	2.60
Cult	2.73	2.67	2.80	2.57	2.69

Table 5. Effect of treatment on time of flowering, variety Cover Girl planted May 14, 1953. Average number of days to flower from date of planting

Treatment	Row B	Row C	Row D	Row E	Average
TAT-GW	104.5	99.8	100.5	108.5	103.3
CIPC	102.8	100.7	102.0	105.6	102.5
Crag	100.4	101.0	100.5	104.6	101.6
2,4-D	100.5	95.0	100.4	109.0	101.2
Natrin	97.6	104.0	98.0	99.0	99.7
2,4-D TCA	92.0	97.0	98.0	101.0	99.3
Check	100.0	100.5	100.2	107.0	101.9
DN/Cr	97.2	102.0	108.5	114.6	105.6
DN	99.3	96.5	110.0	106.7	103.1
Cult	96.0	114.0	104.9	100.0	102.7

Table 6. Effect of treatment on time of flower, variety Elizabeth the Queen planted May 14, 1953. Average number of days to flower from date of planting.

Treatment	Row B	Row C	Row D	Row E	Average
TAT-GW	91.8	94.4	100.7	99.1	96.5
CIPC	90.7	87.5	91.8	92.6	90.7
Crag	94.4	90.4	94.7	94.4	93.5
2,4-D	89.4	92.2	93.9	96.3	92.9
Natrin	91.8	91.3	101.6	91.7	94.1
2,4-D TCA	100.3	93.8	90.7	97.6	95.6
Check	89.8	92.8	102.6	95.5	95.2
DN/Cr	90.2	99.1	91.9	95.5	94.2
DN	90.1	89.3	101.4	87.8	92.2
Cult	98.1	97.3	91.9	100.0	96.8

Table 7. The effect of herbicide on gladiolus corm yield, variety Elizabeth the Queen #3 corms planted May 14. Yield in numbers and grams

	Rows									
	B		C		D		E		Average	
Treatment	No.	Grams	No.	Grams	No.	Grams	No.	Grams	No.	Grams
TAT-GW	85	323	77	209	114	382	116	257	98	293
CIPC	78	97	39	104	94	152	83	405	74	190
Crag	96	376	52	79	39	86	132	445	80	242
2,4-D	101	198	93	225	94	256	83	199	93	220
Natrin	72	180	86	123	12	19	47	55	54	94
2,4-D TCA	26	10	107	243	101	234	34	21	67	127
Check	44	18	45	55	69	74	39	36	49	46
DN/Cr	102	296	28	38	88	244	91	269	77	262
DN	102	409	121	721	*	*	97	259	107	496
Cult	92	341	113	309	42	99	89	232	84	245

* missing plot

Table 8. The effect of herbicide on gladiolus corm yield, variety Elizabeth the Queen, cormels planted May 14. Yield in numbers and grams.

	Row									
	B		C		D		E		Average	
Treatment	No.	Grams	No.	Grams	No.	Grams	No.	Grams	No.	Grams
TAT-GW	24	909	12	481	22	1041	22	1327	20	1092
CIPC	20	786	20	1254	20	1148	20	880	20	1017
Crag	23	1016	22	1194	18	781	21	1223	21	1029
2,4-D	18	1047	20	680	20	948	22	1151	20	957
Natrin	19	880	13	746	13	504	21	885	20	883
2,4-D TCA	20	675	19	854	21	1075	13	621	20	868
Check	24	1175	20	935	19	543	17	781	20	859
DN/Cr	18	841	20	866	14	754	12	444	19	854
DN	23	1466	17	1067	10	316	23	887	21	1140
Cult	19	1321	21	1043	18	1017	20	1081	19.5	1116

It is up to the grower to try out some of these treatments on a small scale under his particular soil and weather conditions. Growers report variable results with many of these materials when application is made on a large scale. Caution is urged in the use of chemical weed killers.

EFFECT OF IRRIGATION AND CULTIVATION ON PRE-EMERGENCE WEED CONTROL OF POTATOES ON LONG ISLAND

J. Howard Ellison(1) and Stewart L. Dallyn(2)

The main purpose of this experiment was to determine whether a pre-emergence herbicide could be substituted for cultivation early in the season. A second purpose was to determine the effect of rain which might come within 24 hours of herbicidal treatment.

MATERIALS AND METHODS

On April 27, 1953, Katahdin potatoes were planted on a Sassafras fine sandy loam soil, with one ton of commercial 7-7-7 fertilizer banded on either side of the seed. The ridges were harrowed flat on May 9. Herbicidal sprays were applied at 20 gallons per acre on May 20, at potato emergence time. The plots were six rows wide by 40 feet in length and were replicated four times.

The herbicides used were Premerge at 1 gallon, Sinox General at 2 quarts plus 8 gallons of kerosene, and CMU at 1½ pounds per acre. Unfortunately, at least one-third of the CMU collected on the fine screens of the low gallonage equipment, so that the CMU treatment is not really valid. On May 21 approximately one inch of irrigation was applied as a split plot treatment to one-half of the plots in each replication. Thereafter irrigation was applied uniformly to the entire experiment.

One complete series of herbicidally treated and untreated plots, with and without early irrigation, was cultivated and weeded throughout the season. This treatment is termed "normal cultivation". A similar series of herbicidally treated plots was not cultivated nor weeded until numerous small weeds appeared. This treatment is termed "delayed cultivation". Differential cultivation began May 16, when the normally cultivated plots were weeded. These plots were cultivated on May 19, cultivated and weeded on May 25, and weeded again on June 1. Differential treatment ended on June 10, when weeds started to grow on the uncultivated plots. At that time both the normally and late cultivated plots were cultivated and weeded. Thereafter all of the plots were

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The authors wish to thank Dr. R. L. Sawyer for analyzing the yield data.

handled the same, being cultivated on June 22, July 2, and 9. This schedule afforded good weed control on all plots.

The vines were roto-cut on September 3 and harvesting was carried out on September 28, 29 and 30.

RESULTS AND DISCUSSION

There were no significant differences in yield among any of the treatments (Table 1). The three herbicides, Premerge, Sinox General and CMU, effectively controlled the weeds for approximately three weeks and eliminated three weeding operations and two cultivations. Growers might consider this short term weed control to be of practical significance, especially during wet seasons when cultivation is difficult and soil compaction results from the traffic.

No harmful results came from the inch of water which was applied within 24 hours of herbicidal treatment. The senior author (1) reported in 1952 that Premerge reduced potato yields when irrigation was applied within one day of treatment. In the earlier work, Premerge was applied at 2, 3 and 4 gallons per acre, and at these rates, there might have been enough toxic material carried down to the potato roots to be harmful. In the present study, Premerge was used at only one gallon per acre, and the lower rate may account for the lack of yield reduction which was reported earlier.

SUMMARY

Premerge, Sinox General and CMU were applied to Katahdin potatoes at emergence time. All three materials gave adequate weed control for approximately three weeks, after which cultivation was employed to control weeds for the rest of the season. The herbicides eliminated three weeding operations and two cultivations.

There was no significant difference in yield between the "delayed cultivation" plots and others which received earlier cultivation.

An inch of water, applied the day after herbicidal treatment, had no effect on the weed control nor the potato yield response to any of the herbicides tested. There were no significant differences in yield among any of the treatments.

REFERENCES

1. Ellison, J. Howard. Further studies concerning chemical weed control and cultivation with potatoes on Long Island. Proc. Northeastern Weed Control Conference, 1952. pp. 195-197.

Table 1

Yield of U. S. No. 1 Tubers Per Acre Associated With Various Treatments

Herbicides	Bu. U.S. No. 1 per A.
0. Untreated	341
1. Premerge 1 gal./A	338
2. Sinox Gen. 2 qts. plus 8 gal. kerosene/A	329
3. CMU $1\frac{1}{2}$ lb./A active(1)	335
	N.S.
Cultivation(2)	
1. Normal cult. of treated plots	338
2. Delayed cult. of treated plots	330
	N.S.
Irrigation(3)	
1. One inch of water within 24 hrs. of herbicidal treatment	328
2. No irrigation within 24 hrs. of herbicidal treatment	339
	N.S.

(1) At least one-third of the CMU remained on the screens in the low gallonage equipment.

(2) Normal cultivation plots were weeded three times and cultivated twice before the delayed cultivation plots were cultivated.

(3) Uniform irrigation was used on all plots after the initial differential application.

CULTIVATION STUDIES IN POTATOES[1]

Richard J. Aldrich, George R. Blake and
John C. Campbell[2]

Abstract[3]

Results of an initial study of this problem were reported in the 1952 Proceedings of the Northeastern Weed Control Conference. The present report deals with studies conducted during 1952 and 1953.

Similar tests were conducted on each of four farms and at the Experiment Station in 1952. The effects of zero, one, and normal cultivations on potato yields and soil physical properties were studied where 4½ pounds of DNOSBP acid were applied pre-emergence for weed control. The 1953 tests were conducted on four farms and they differed from the 1952 tests only in that two and three cultivations were added to zero, one and normal.

Three years results suggest that one or two cultivations are sufficient for maximum potato yields providing weeds are controlled by chemicals. Excellent control of annual weeds was obtained with DNOSBP in all tests. The relationship between yields and soil physical properties is not clear.

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[1]Cooperative investigations between the New Jersey Agricultural Experiment Station and the Division of Weed Investigations, Agricultural Research Service, USDA.

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[3]Abstract of material to be presented as a New Jersey Agricultural Experiment Station Circular.

Pennsylvania Agricultural Experiment Station
State College, Pennsylvania

Weed Control in Potatoes
1953 Treatments

	Treatments	Av. Yield Bu./Acre. Katahdins	Russets	Weed Count Dicots	Monocots
1.	Cyanamid 800 lbs. Pre.	249.20	211.00	20	36
2.	Natrin 5 lbs. Pre., 5 lbs. Post	175.20	202.50	25	46
3.	CH1 5 lbs. Pre., 5 lbs. Post	206.75	195.30	25	39
4.	Sesin 5 lbs. Pre.	199.30	224.10	30	56
5.	CMU 2 lbs. Pre.	203.10	216.10	8	18
6.	Sinox General 2 qts. Oct., 10 gal. Pre.	210.50	213.40	8	23
7.	Premerge 2 qts. Pre.	181.00	216.40	7	21
8.	Dow G. 20 lbs. Pre.	253.60	220.00	7	41
9.	Natrin 10 lbs. Pre.	223.20	217.70	25	37
10.	CH1 10 lbs. Pre.	210.50	190.00	17	42
11.	Weedar MCP 2 qts. Pre.	218.20	211.40	11	55
12.	Check No treatment	231.00	232.70	50	63

Plots were two fifty-foot rows, each row treated in a one-foot width across the row one day before the tops pushed through the ground surface. The weather was dry for a week following treatment.

Potatoes were planted on June 2, 1953, and treatments were applied on June 16, 1953. Two post emergence treatments were applied after the last cultivation on July 22, 1953.

Weed counts were made just before harvest on October 12, 1953 and represent the total number of weeds per plot.

Weeds between the rows were kept down by three cultivations.

THE EFFECT OF HERBICIDES UPON POTATOES USED FOR CHIPPING

By Tom Eastwood, Wise Potato Chip Company, and
J. S. Cobb, The Pennsylvania State University

A continuation of the research reported previously (1, 3, 4, 5) was carried on in 1952 at State College, Penna. The pre-emergence herbicidal treatments, Table 6, were applied when about 10 percent of the potato plants were coming up. All materials, except the $CaCN_2$ which was applied dry, were applied in water at the rate of about 50 gallons per acre.

Both the Katahdin and the Russet Rural varieties were grown. They were planted 4-5 June, 1952. Herbicidal treatments were put on 18-19 June, 1952. These potatoes were dug 16-18 October, 1952.

Yield data and weed counts were reported previously (2).

The potatoes were graded on 23-24 October, 1952, and the first chipping tests were started on 27 October, 1952, in the factory at Berwick. This delay of 10 days between digging and the first chipping was unfortunate, but uncontrollable. It is best to have the first experimental chipping as soon as possible after digging. Each lot of potatoes was divided into three groups. The first group received no cold storage treatment. The second group was placed into cold storage for a period of 9 weeks at an average temperature of 40°F. The third group was held in the cold storage conditions for a period of 18 weeks, the second 9 week period being held at an average temperature of 38°F.

All these potatoes received a curing storage of 8 weeks duration following their respective periods of cold storage. The first lot (A series) which had no previous cold storage (used as freshly dug), was held in curing storage conditions at an average of 72°F. The second lot (B series) was held in curing storage at an average of 75°F. The third lot (C series) was held in curing storage at an average of 75°F.

The original weight of each sample of potatoes from the various herbicide treatments was 150 pounds, except in a few cases of short supply wherein a minimum of at least 120 pounds was collected. These samples were a composite from the four field replicates. (Current research is justifying the use of composite field samples for chipping work, rather than carry the field replicates through all chipping tests.)

The weight of all the samples which went into curing storage was 25 pounds. During the several 8 week periods of curing storage of the several groups of potatoes, weekly chipping tests were conducted, making a total of 9 observations, the initial test plus 8 weekly tests. Thus, for the entire 3 series a total of 27 observations were represented. These chipping tests included specific gravity, percent reducing sugar, fry or chip color test, and whenever possible, flavor evaluation. Because of the general poor quality of potatoes grown during the 1952 season, it was difficult to secure a satisfactory supply of samples for use by the taste panel. Sufficient samples were obtained only from the first group, that is, the lot which received no cold storage, for taste test work. No data is presented for taste from the second and third lot of potatoes because the chips were colored too darkly to justify taste tests.

Table 1 presents the effect of the various herbicidal treatments upon the specific gravity of the tubers. As can be expected, the specific gravity of the Russet Rural potatoes was greater than that for the Katahdin potatoes.

SUMMARY

The several herbicides, used as delayed pre-emergence agents, caused significant changes in the specific gravity of the potatoes from the treated plants. However, there was no general reduction with all the materials as was reported the previous year (3). Pronounced interactions, including herbicide x variety, herbicide x cold storage, and cold storage x variety, were evident. These factors altered the reaction of the herbicides considerably. This was well illustrated by the fact that in the freshly dug group, four materials significantly reduced specific gravity. In the group which had had 9 weeks of cold storage, eight materials reduced the specific gravity of the tubers. Conversely, in the group which received 19 weeks of cold storage, eight materials increased the specific gravity. Further, apparently weather conditions in particular influenced the results between the 1951 and the 1952 crops.

The herbicidal applications had no influence upon the color of the potato chips. Both 1951 and 1952 crop data agreed.

Similarly, no herbicidal influence was noted upon the percentage of reducing sugar in the tubers. This held for both years.

The flavor of the potato chips was significantly altered by the use of the pre-emergence applications of the herbicides. But no general reduction in quality of flavor was observed as was done with the 1951 crop (3). Only three of the materials caused any significant reduction in taste, but several of the other chemicals caused a decrease in flavor which closely

Table 1.

Mean Specific Gravity Values of Potatoes From Plants Which Had Received Delayed Pre-Emergence Herbicidal Treatments-1952

Herbicides		Previous Cold Storage Treatments-Weeks											
		0			9			18			0-18		
Mat.	Amt/A	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.
Cyanamid	1200 lbs	1.0662	1.0700	1.0681	1.0640	1.0656	1.0648	1.0646	1.0650	1.0648	1.0649	1.0669	1.0658
Cyanamid	800 lbs	1.0628	1.0672	1.0650	1.0650	1.0649	1.0649	1.0667	1.0642	1.0654	1.0648	1.0654	1.0651
CMU	2 lbs	1.0653	1.0698	1.0676	1.0649	1.0679	1.0664	1.0624	1.0681	1.0653	1.0642	1.0686	1.0664
MCP	1-2 qts	1.0697	1.0700	1.0698	1.0643	1.0663	1.0653	1.0623	1.0641	1.0632	1.0654	1.0686	1.0661
CH-L	5 lbs	1.0640	1.0694	1.0667	1.0642	1.0654	1.0648	1.0639	1.0687	1.0663	1.0640	1.0679	1.0659
Sinox Gen.	2 qts	1.0667	1.0704	1.0686	1.0638	1.0696	1.0667	1.0637	1.0680	1.0658	1.0647	1.0693	1.0670
NaTCA	25 lbs	1.0646	1.0688	1.0667	1.0653	1.0663	1.0658	1.0642	1.0681	1.0662	1.0647	1.0677	1.0662
Pre-Emerge	2 qts	1.0676	1.0686	1.0681	1.0694	1.0666	1.0680	1.0687	1.0656	1.0671	1.0686	1.0669	1.0677
Dow G	20 lbs	1.0674	1.0693	1.0684	1.0668	1.0663	1.0666	1.0648	1.0642	1.0645	1.0663	1.0666	1.0665
$NaAsO_3$	2 gal	1.0650	1.0686	1.0668	1.0688	1.0673	1.0681	1.0664	1.0667	1.0666	1.0667	1.0675	1.0671
Cl-IPC	2 gal	1.0677	1.0679	1.0678	1.0647	1.0649	1.0648	1.0668	1.0653	1.0661	1.0664	1.0660	1.0662
Check		1.0668	1.0703	1.0686	1.0676	1.0683	1.0679	1.0624	1.0638	1.0631	1.0656	1.0675	1.0665
Var. $\bar{x}$		1.0661	1.0692		1.0657	1.0666		1.0647	1.0660		1.0655	1.0673	
Pd. $\bar{x}$				1.0677			1.0662			1.0654			1.0664
LSD		5%		1%	5%		1%	5%		1%	5%		1%
Between Treatments		0.0016		0.0021	0.0018		0.0024	0.0016		0.0021	0.0019		0.0025
Herb.		0.0012		0.0015	0.0013		0.0017	0.0012		0.0015	0.0008		0.0010
Var.		0.0005		0.0006	0.0005		0.0007	0.0005		0.0006	0.0003		0.0004
Var. x Herb.		0.0016		0.0021	0.0018		0.0024	0.0016		0.0021	0.0011		0.0015
Var. x Cold Stg.											0.0006		0.0007
Herb. x Cold Stg.											0.0013		0.0018

Table 2.

Mean Chip Color Values of Potatoes From Plants Which Had Received Delayed Pre-Emergence Herbicidal Treatments-1952

Herbicides		Previous Cold Storage Treatments-Weeks											
		0			9			18			0-18		
Mat.	Amt/A	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.
Cyanamid	1200 lbs	5.4	5.9	5.7	8.2	6.1	7.2	7.7	6.7	7.2	7.1	6.2	6.7
Cyanamid	800 lbs	4.9	5.9	5.4	7.4	6.0	6.7	7.3	6.3	6.8	6.6	6.1	6.3
CMU	2 lbs	5.2	5.7	5.4	8.2	6.3	7.3	7.9	6.8	7.3	7.1	6.3	6.7
MCP	1-2 qts	5.1	5.7	5.4	7.8	6.6	7.2	7.3	6.9	7.1	6.7	6.4	6.6
CH-1	5 lbs	4.9	5.3	5.1	7.9	6.4	7.2	7.3	7.4	7.4	6.7	6.4	6.6
Sinox General	2 qts	5.0	5.9	5.4	7.7	6.3	7.0	7.7	6.4	7.1	6.8	6.2	6.5
NATCA	25 lbs	4.8	5.2	5.0	8.6	5.7	7.1	7.9	5.9	6.9	7.1	5.6	6.3
Pre-Emerge	2 qts	5.2	5.6	5.4	7.4	6.4	6.9	7.0	6.7	6.8	6.6	6.2	6.4
Dow G	20 lbs	4.4	5.7	5.1	7.3	6.2	6.8	7.7	6.0	6.8	6.5	6.0	6.2
$NaAsO_3$	2 gal	5.2	5.4	5.3	7.3	6.0	6.7	7.7	6.3	7.0	6.7	5.9	6.3
Cl-IPC	2 gal	5.4	5.6	5.5	7.8	6.7	7.2	7.6	7.2	7.4	6.9	6.5	6.7
Check		5.3	5.4	5.4	7.8	6.7	7.2	7.7	6.4	7.1	6.9	6.2	6.6
Var. $\bar{x}$		5.1	5.6		7.8	6.3		7.6	6.6		6.8	6.2	
Pd. $\bar{x}$				5.3			7.0			7.1			6.5
LSD		5%		1%	5%		1%	5%		1%	5%		1%
Between Treatments					1.0		1.3	0.8		1.1	1.2		1.6
Var.		0.2		0.3	0.3		0.4	0.2		0.3	0.2		0.3
Var. x Herb.								0.8		1.1			
Var. x Cold Stg.											0.4		0.5
Cold Stg.											0.3		0.3

Table 3.

Mean % Reducing Sugar Values of Potatoes From Plants Which Had Received Delayed Pre-Emergence Herbicidal Treatments-1952

Herbicides		Previous Cold Storage Treatments-Weeks											
		0			9			18			0-18		
Mat.	Amt/A	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.
Cyanamid	1200 lbs	0.10	0.09	0.10	0.19	0.12	0.16	0.17	0.13	0.15	0.16	0.12	0.14
Cyanamid	800 lbs	0.09	0.10	0.10	0.17	0.12	0.15	0.19	0.11	0.15	0.15	0.11	0.13
CMU	2 lbs	0.09	0.10	0.10	0.22	0.12	0.17	0.22	0.13	0.18	0.18	0.12	0.15
MCP	1-2 qts	0.10	0.09	0.09	0.18	0.13	0.16	0.18	0.12	0.15	0.15	0.11	0.13
CH-1	5 lbs	0.09	0.08	0.09	0.18	0.12	0.15	0.16	0.12	0.14	0.14	0.11	0.13
Sinox Gen.	2 qts	0.08	0.10	0.09	0.18	0.13	0.15	0.17	0.13	0.15	0.14	0.12	0.13
NATCA	25 lbs	0.11	0.08	0.09	0.21	0.11	0.16	0.18	0.10	0.14	0.17	0.10	0.13
Pre-Emerge	2 qts	0.09	0.09	0.09	0.10	0.13	0.16	0.15	0.12	0.13	0.14	0.11	0.13
Dow G	20 lbs	0.08	0.09	0.08	0.18	0.12	0.15	0.17	0.12	0.15	0.14	0.11	0.13
$NaAsO_3$	2 gal	0.10	0.10	0.10	0.17	0.12	0.14	0.17	0.12	0.15	0.15	0.11	0.13
Cl-IPC	2 gal	0.09	0.10	0.10	0.19	0.14	0.16	0.18	0.13	0.16	0.15	0.12	0.14
Check		0.09	0.09	0.09	0.20	0.12	0.16	0.17	0.12	0.15	0.16	0.11	0.13
Var. $\bar{x}$		0.09	0.09		0.19	0.12		0.18	0.12		0.15	0.11	
Pd. $\bar{x}$				0.09			0.16			0.15			0.13
LSD		5%		1%	5%		1%	5%		1%	5%		1%
Between Treatments					0.04		0.05	0.06		0.07	0.05		0.07
Var.					0.01		0.02	0.02		0.02	0.01		0.01
Var. x Herb.		0.02		0.03	0.04		0.05						
Var. x Cold Stg.											0.02		0.02
Cold Stg.											0.01		0.01

Table 4.

Mean Chip Taste Values of Potatoes From Plants Which Had Received Delayed Pre-Emergence Herbicidal Treatments-1952

Herbicides		Varieties		Herb.
Mat.	Amt/A	Kat.	R.R.	Means
Cyanamid	1200 lbs	1.68	1.93	1.80
Cyanamid	800 lbs	1.65	2.51	2.09
CMU	2 lbs	1.85	2.20	2.02
MCP	1-2 qts	1.93	2.15	2.04
CH-1	5 lbs	1.76	2.29	2.02
Sinox General	2 qts	2.02	1.93	1.98
NATCA	25 lbs	1.78	1.59	1.68
Pre-Emerge	2 qts	1.83	2.02	1.93
Dow G	20 lbs	1.85	2.51	2.18
$NaAsO_3$	2 gal	1.90	2.78	2.34
Cl-IPC	2 gal	2.27	2.17	2.22
Check		1.65	1.93	1.79
Var. Means		1.85	2.17	2.00

LSD	5%	1%
Between Treatments	0.55	0.72
Var.	0.05	0.07
Herb.	0.39	0.51

Table 5.

Mean % Curing Loss Values of Potatoes From Plants Which Had Received Delayed Pre-Emergence Herbicidal Treatments-1952

Herbicides		Previous Cold Storage Treatments-Weeks											
		0			9			18			0-18		
Mat.	Amt/A	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.	Kat.	R.R.	Tot.
Cyanamid	1200 lbs	10.0	23.2	16.6	8.4	11.6	10.0	11.5	12.5	12.0	10.0	15.8	12.9
Cyanamid	800 lbs	6.8	20.8	13.8	4.0	11.2	7.6	10.7	13.5	12.1	7.2	15.2	11.2
CMU	2 lbs	9.6	20.8	15.2	8.0	14.0	11.0	17.5	15.2	16.4	11.7	16.7	14.2
MCP	1-2 qts	12.0	21.2	16.6	11.2	12.8	12.0	9.5	12.7	11.1	10.9	15.7	13.2
CH-1	5 lbs	10.4	21.6	16.0	11.2	14.0	12.6	10.7	18.7	14.7	10.8	18.1	14.4
Sinox General	2 qts	10.0	17.6	13.8	5.2	11.2	8.2	8.2	16.2	12.2	7.8	15.0	11.4
NaTCA	25 lbs	8.8	16.0	12.4	9.2	16.8	13.0	9.7	13.5	11.6	9.2	15.4	12.3
Pre-Emerge	2 qts	12.0	25.2	18.6	8.0	12.8	10.4	11.2	13.7	12.5	10.4	17.2	13.8
Dow G	20 lbs	11.2	24.4	17.8	8.4	12.0	10.2	9.5	11.8	10.7	9.7	16.1	12.9
$NaAsO_3$	2 gal	8.0	18.4	13.2	8.8	14.0	11.4	10.2	19.0	14.6	9.0	17.1	13.1
Cl-IPC	2 gal	9.6	16.0	12.8	7.2	16.4	11.8	9.2	15.2	12.2	8.7	15.9	12.3
Check		8.8	23.6	16.2	8.8	12.0	10.4	11.2	12.5	11.8	9.5	16.0	12.8
Var. $\bar{x}$		9.7	20.7		8.2	13.2		11.9	16.2		9.6	16.2	
Pd. x				15.3			10.7			12.6			12.9

LSD	5%	1%
Between Treatments	6.7	9.1
Var.	1.1	1.5
Cold Stg.	1.4	1.9
Var. x Herb.	3.9	5.2
Var. x Cold Stg.	1.9	2.6

Table 6.

Mean % Cold Storage Loss Values of Potatoes From Plants Which Had Received Delayed Pre-Emergence Herbicidal Treatments-1952

Herbicides		Varieties		Herb.
Mat.	Amt/A	Kat.	R.R.	Means
Cyanamid	1200 lbs	3.9	5.3	4.6
Cyanamid	800 lbs	3.3	3.4	3.4
CMU	2 lbs	3.3	4.3	3.8
MCP	1-2 qts	3.1	3.1	3.1
CH-1	5 lbs	3.1	3.8	3.5
Sinox General	2 qts	2.8	6.3	4.6
NaTCA	25 lbs	2.1	3.5	2.8
Pre-Emerge	2 qts	4.3	4.4	4.4
Dow G	20 lbs	7.5	3.2	5.4
$NaAsO_3$	2 gal	2.8	4.8	3.8
Cl-IPC	2 gal	2.9	4.9	3.9
Check		3.0	5.0	4.0
Var. Means		3.5	4.3	3.9

Notes: a. Cyanamid-$CaCN_2$ (Actual lbs/A one third rate/A because only apply on one-third area-one foot band-across rows)

CMU- 3-p-chlorophenyl-1-1-dimethylurea, 80%

MCP- 2-methyl-4-chlorophenoxyacetic acid (used Weedar MCP at rate 1 qt per A rate for Katahdins and 2 qt rate for Russet Rural)

CH-1-Sodium 2, 4, -dichlorophenoxy ethyl sulfate.

Sinox General-dinitro-o-sec.-butyl phenol, 50%; and dinitro-o-sec.-amyl phenol, 10%; (Equivalent 5.1 lbs per gal) (used 10 gals diesel oil per acre in 40 gals water with DN material)

NaTCA-Sodium Trichloroacetate, 90%

Pre-Emerge-Alkanolamine Salt (Ethanol and Isopropanol Series) of dinitro-o-sec-butyl phenol, 53% (Equivalent 3 lbs DNOSBP per gal)

Dow G-Sodium pentachlorophenate, 85%

$NaAsO_3$-Goulard and Olena, Inc., Potato Vine and Weed Eradicator.

Cl-IPC-chloro isopropyl-n-phenyl carbamate.

approached statistical significance. However, sufficient effect was caused in general to produce an over-all significant reduction in flavor. Although no interaction developed between herbicide and variety, it was noticed that the herbicides tended to reduce the flavor quality of the potato chips from the variety Russet Rural more than from the variety Katahdin. As was reported in the previous year, any off-flavor picked up was not distinctive in relation to material. Either flavor intensity was lowered or in some cases bitter flavor was imparted.

The herbicidal chemicals did not influence the percentage of losses in curing storage. However, it was noted that Katahdin kept better than Russet Rural.

No differences developed in percentage losses in cold storage, either as a result of variety or herbicide.

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CHEMICAL WEED CONTROL IN POTATOES

C. E. Cunningham and M. F. Trevett[1]

Pre-emergence application of the amine salts of dinitro ortho secondary butylphenol (DNOSBP) has become an established weed control practice on a large portion of the commercial potato acreage in Maine. This paper presents the results of tests in which various herbicides have been compared with DNOSBP for the control of annual broadleaved weeds.

Materials and Methods

All herbicides were applied in 50 gallons of water per acre. Application was made with a two-row hand spray boom; to insure uniform coverage two passes were made over each plot.

Plots were two rows wide by 38.5 feet. Each treatment was replicated four times.

The Katahdin variety was used in all tests.

Rainfall was below normal for the months of June, July, and August 1953:

June - 2.40 inches, -1.30 inches departure from normal
July - 3.08 " , -.64 " " " "
August - 2.24 inches, -.86 inches departure from normal

Emergence Treatments

The herbicides listed in Table 1 were applied June 16. At this date approximately 5% of the crop plants had emerged; broadleaved weeds (principally mustard, *Brassica* spp.) were germinating but had not emerged. Weeds that had emerged previously had been destroyed by a June 12 cultivation. This block was not cultivated again until June 29, and thereafter received normal cultivation practice.

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TABLE 1. EFFECT OF EMERGENCE TREATMENTS ON YIELD AND WEED CONTROL IN KATAHDIN POTATOES

Treatment	Acre Rates	Yield, Bu./A	Weed Control Rating (Broad-leaved Weeds)1/
Crag Herbicide 1 2/	2 lbs.	259	1
Crag Herbicide 1	4 "	254	1
Natrin 3/	2 "	264	1
Natrin	4 "	223	1
Chloro IPC 4/	4 " 7/	231	1
CMU 5/	½ "	264	1
CMU	1 "	276	2
DNOSBP 6/	1½ " 8/	293	4
DNOSBP	3 " 8/	269	5
Check		246	0
LSD 5%		NS	

1/ Rating from 0 to 5. Four or above considered to be very acceptable field control.

2/ "Crag Herbicide 1", 90% Sodium 2,4-Dichlorophenoxyethyl sulfate, 10% inert ingredients. Carbide and Carbon Chemicals Company.

3/ "Experimental Herbicide Natrin", Sodium 2,4,5-Trichlorophenoxyethyl sulfate. Carbide and Carbon Chemicals Company.

4/ "Weedone Chloro IPC", 45.8% Isopropyl N(3 Chlorophenyl) carbamate. American Chemical Paint Company.

5/ "CMU", 80% 3-(P-Chlorophenyl)-1,1-dimethylurea. DuPont Chemical Company.

6/ "Premerge", 53% Alkanolamine salts (of the Ethanol and Isopropanol series of Dinitro-o-sec-Butylphenol). Dow Chemical Company.

7/ Active ingredient.

8/ Acid equivalent.

The herbicides listed in Table 2 were applied during crop emergence to a block that received normal cultivation throughout the season. Weeds that survived cultivation were hand pulled to insure that any effect on yield would be the result of chemical treatment and not of weed competition. Specific gravity of tubers was determined at harvest by the air-water method.

TABLE 2. EFFECT OF EMERGENCE TREATMENTS ON YIELD AND SPECIFIC GRAVITY OF KATAHDIN POTATOES

Treatment1/	Acre Rates	Yield, Bu./A	Specific Gravity of Tubers
Crag Herbicide 1	4 lbs.	267	1.085
Natrin	4 "	276	1.085
Chloro IPC	4 " 2/	261	1.083
CMU	½ "	295	1.084
CMU	1 "	306	1.083
DNOSBP	3 " 3/	290	1.084
Check		289	1.086
LSD 5%		NS	NS

1/ Legend for herbicides at bottom of Table 1.

2/ Active ingredient.

3/ Acid equivalent.

Post-Emergence Treatments

In a post-emergence block a 1.5 pound per acre rate of DNOSBP was applied at crop emergence to all plots except "check". All plots were cultivated and hilled three times during the season. The post-emergence treatments given in Table 3 were applied following the final ("layby") hilling.

"Overall" spraying was compared with a directional spray applied between the crop rows. Overall spraying resulted in maximum wetting of potato foliage, between row spraying resulted in minimum wetting of foliage.

TABLE 3. EFFECT OF POST-EMERGENCE TREATMENTS ON YIELD AND WEED CONTROL IN KATAHDIN POTATOES

Treatment	Acre Rates	Yield, Bu./A	Weed Control Rating (Broad-leaved Weeds) 1/
Natrin applied overall	4 lbs.	279	1
CMU applied between rows only	1 "	259	2
DNOSBP applied between rows only	3 " 4/	265	5
Crag Herbicide 1 applied between rows only	4 "	294	3
Natrin applied between rows only	4 "	296	1
Granular Crag Herbicide 1 2/ applied overall	4 " 5/	278	2
Dalapon 3/ applied overall	2 " 4/	271	0
Dalapon applied overall	4 " 4/	237	0
Dalapon applied between rows only	4 " 4/	291	0
Check		278	0
LSD 5%		NS	

1/ Rating from 0 to 5. Four or above considered to be very acceptable control.

2/ "Granular Crag Herbicide." A granular preparation containing 10% Crag Herbicide 1. Carbide and Carbon Chemicals Company.

3/ "Dalapon", sodium salt, 64 to 68% a,a-Dichloropropionic acid. Dow Chemical Company.

4/ Acid equivalent.

5/ Crag Herbicide 1.

Granular Crag Herbicide 1 was mixed with dry sand and hand broadcast.

Results and Discussion

DNOSBP was the only herbicide tested that gave satisfactory broadleaved weed control. The ineffectiveness of Crag Herbicide 1, Natrin, Chloro IPC, and CMU, in the emergence blocks at least, may have been due to a period of drought subsequent to treatment. For the period June 16, 1953 to June 30, 1953 total rainfall was 0.64 inches. Low temperature may have been a contributing factor leading to the ineffectiveness of Crag Herbicide 1. Average daily temperature for June 1953 at Presque Isle, Maine, where the tests reported were made, was 61.6°F. (2.8°F. higher than normal). Vlitos[2] has reported that "The herbicidal form of Crag Herbicide 1 is found in soil more readily at high temperatures" -- 75°F. to 86°F.

Compared to check, yields were not significantly affected by any of the herbicides tested (Tables 1,2,3). There were, however, trends for significant reductions in yield for 4 pounds Dalapon applied "overall" (Table 3), 4 pounds Natrin at emergence (Table 1), and 4 pounds Chloro IPC at emergence (Tables 1 and 2). The relatively low average yields for all blocks can be attributed in part to subnormal rainfall throughout the season, but more particularly to an early harvest.

Total solid content of potato tubers, as determined by specific gravity (Table 2), was not significantly affected by any of the herbicides tested.

Dalapon was included in the post-emergence test (Table 3) primarily to detect effects on yield and plant growth. Apparently, potatoes will tolerate Dalapon at 2 pounds acid equivalent per acre as an overall spray and 4 pounds acid equivalent per acre as a directional spray between the rows without adverse effects on plant growth and yield. In other tests Dalapon at 2 pounds acid equivalent per acre effectively controlled Japanese millet used as a test "grass". This rate was effective whether applied pre-emergence to the millet, or post-emergence when millet was in the seedling stage.

2/ Vlitos, A. J. The Influence of Environmental Factors on the Activity of Crag Herbicide 1 (Sodium 2,4-Dichlorophenoxyethyl sulfate). Proceeding of the Sixth Annual Meeting, Northeastern Weed Control Conference: 57-62. 1952.

Conclusions

1. DNOSBP at 1.5 and 3 pounds per acre effectively controlled annual broadleaved weeds whether applied at emergence of potatoes, or post-emergence.

2. At the rates tested Crag Herbicide 1, Natrin, Chloro IPC, and CMU did not effectively control broadleaved weeds, probably because of adverse moisture relationships.

3. Yields and total solid content of potato tubers were not significantly affected by any of the herbicides tested, although trends were apparent for significant reductions in yields at the 4-pound per acre rate of Dalapon (overall), Natrin (emergence), and Chloro IPC (emergence).

Chemical Weeding of Lima Beans[1]

Charles J. Noll and Martin L. Odland[2]

Pennsylvania farmers grow over 4000 acres of lima beans for processing. Most of this acerage is on general farms where lack of labor precludes any hand weeding of this crop. Conventional cultivation equipment is adequate to control weeds between the lima bean rows but usually not good enough to give adequate weed control in the row if the season is on the wet side.

This report is a continuation of work started in 1948 and is a comparison of new herbicides with the most successfully used older chemicals.

Procedure

Fifteen chemicals each used at two rates together with an untreated check were tested in the experiment. The treatments were arranged at random in each of twelve replicated blocks. Each plot consisted of a single row 22 feet long by 3 feet wide. The herbicides were applied with a small sprayer over the row for a width of one foot.

The land was prepared June 16 and planted June 17 to the variety Fordhook 242. Chemicals were applied at various dates, dates estimated to give maximum weed kill with minimum damage to the bean plants. Weeds between the rows were controlled through cultivation. No serious weed problem developed due to the hot-dry growing season. In September bean plants were pulled, and counted, and beans in the pods pulled off the plants and weighed.

Results

A summary of results is presented in Table I. Two materials gave significant increases in yield and weed control as compared with the untreated plot. Cloro IPC at 1 1/2 gallons per acre and Oktone at 1/4 gallon per acre carried in Stoddard Solvent. Other materials that gave significant increase in weed control without injury to lima bean stand or yield are: Sodium Pentachlorophenate in the materials ACP-L-469 and Dowidice G.: Dinitros in the material Premerge; and Monosodium cyanamid in the material Aero Cyanamid Soluble. Probably greater differences in yield would have been found if the weed

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[1]Authorized for publication on November 20, 1953, as paper No. 1840 in the journal series of the Pennsylvania Agricultural Experiment Station.

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population had been great enough to reduce the yield of beans in the plots where weeds were not controlled by herbicides.

Conclusion

A number of herbicides offer possibilities for the weeding of lima beans in a pre-emergence application. These herbicides are Cloro IPC, Oktone, Dowicide G, ACP-L-469, Premerge and Aero Cyanamid Soluble. Under the conditions of this experiment all gave significant increase in weed control without a reduction in either stand or yield of lima beans. The first two herbicides, Cloro IPC, and Oktone gave significant increases in yield at one rate of application.

Table I. Effect of herbicides on weeds and stand and yield of lima beans

Herbicide	Rate per acre	Application days after planting	*Weed Control	Beans per Plot Stand	Beans per Plot Yield-fruit lbs.
Nothing	—	—	4.50	43.3	6.42
Premerge	2 gal.	5	1.67	44.8	7.86
"	3 gal.	5	1.42	40.8	6.18
Dowicide G	16 lb.	2	1.17	40.8	5.93
" "	24 lb.	2	1.17	43.8	6.54
[1]ACP-L-469	5 gal.	2	1.25	41.2	6.68
" " "	7 1/2 gal.	2	1.25	43.2	6.86
2,4-Dow Weed Killer	1/4 gal.	2	4.25	37.6	7.12
" " "	3/8 gal.	2	2.42	29.6	5.09
CMU	1 lb.	2	2.92	45.0	6.43
"	1 1/2 lb.	2	2.50	44.7	5.74
Cloro IPC	1 gal.	1	2.75	36.8	5.08
" "	1 1/2 gal.	1	1.33	41.8	8.99
Weedar MCP	1/2 gal.	2	2.92	38.0	5.13
" "	3/4 gal.	2	2.42	35.9	5.20
[2]ACP 903	1/2 gal.	2	2.25	35.8	6.01
" "	3/4 gal.	2	2.00	32.4	5.31
[3]LFN 904	1/2 gal.	2	3.50	38.4	5.82
" "	3/4 gal.	2	1.75	34.8	5.93
Endothal	3 gal.	2	4.50	40.6	5.13
"	4 1/2 gal.	2	4.08	37.5	5.78
Oktone (Stoddard Sol. carrier)	1/4 gal.	5	1.58	43.3	8.28
" "	3/8 gal.	5	1.67	41.9	6.22
[4]NP 1239D	4 lb.	2	1.25	21.3	1.06
" "	6 lb.	2	1.17	18.8	.76
Aero Cyanamid Soluble	30 lb.	5	1.92	42.5	5.80
" " "	45 lb.	5	2.25	43.5	7.16
[5]ACP-L-601	1/2 gal.	2	2.83	26.2	4.32
" " "	3/4 gal.	2	3.42	23.2	4.64
Sesin	6 lb.	12 after	2.83	36.1	6.15
"	9 lb.	12 emergence	2.50	32.83	5.32
		L.S.D. .05 level	1.29	6.5	1.82
		L.S.D. .01 level	1.70	8.6	2.40

1 Sodium pentachlorophenate (2.92 lb. per gal.)
2 Butoxy ester 4-chlorophenoxyacetic acid (3 lb. per gal. acid equivalent)
3 Low volatile ester of MCP (2 lb. per gal.)
4 Chlorinated benzoic acid (50%)
5 3,4 Dichlorophenoxy acetic acid (4 lb. per gal.)

*Weed control (1-10) 1 - perfect weed control
10 - full weed growth

Weeding of Seeded Onions With Chemicals[1]

Charles J. Noll and Martin L. Odland[2]

To produce a good crop of onions it is essential that weeds be kept under control. Weeding can be very expensive to remove if hand weeding of the rows is needed in addition to cultivation between the rows. Even where the onion weeder is used weeds may not be adequately controlled in the onion row.

Potassium cyanate in a post-emergence application has been used successfully for weeding onions. This material is applied after the onion has passed the flag stage of growth. If the weeds get much beyond the seedling stage at the time of the potassium cyanate application weed control is inadequate.

An experiment was set up to find a pre-emergence herbicide to use alone or in combination with a post-emergence application of potassium cyanate for the weeding of onions.

Procedure

Nine chemicals applied in a pre-emergence application at the rate indicated (Table I) per acre were used in this experiment: Endothal at 2 gal.; Cloro IPC at 1 gal.; CMU at 1 lb.; Premerge at 1 gal.; NIX at 8 lbs.; Sesin at 6 lbs.; ACP 903 at 1/2 gal.; (Butoxy ester 4 chlorophenoxy acetic acid 1 1/2 lbs.); NP 1239D at 4 lbs. (50% Chlorinated benzoic acid); and Stoddard Solvent at 70 gallons. Each treatment covered two rows.

Potassium cyanate at the rate of 6 lbs. per acre of 91% material was applied after the flag stage on the first row of each pre-emergence treated plot in all replications.

The land was prepared and seeded to the variety Sweet Spanish April 29, and all pre-emergence herbicides except Stoddard Solvent were applied one or two days after seeding. Stoddard Solvent was applied the 8th day after seeding. Twenty-eight days after seeding and after the seedling onions were past the flag stage potassium cyanate was applied.

Individual plots were 22 feet long and 2 feet wide. Treatments were randomized in each of 10 replicated blocks. The herbicides were applied with a small sprayer over the row for a width of 1 foot; potassium cynate at a volumn of 100 gallons per acre, Stoddard Solvent at 70 gallons per acre and all other herbicides at 35 gallons per acre. Weeds between the rows were

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[1]Authorized for publication on November 20, 1953, as paper No. 1841 in the journal series of the Pennsylvania Agricultural Experiment Station.

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controlled through cultivation.

Results and Discussion

The results are presented in Table I. Weed control was estimated on the basis of 1 to 10 - 1 being perfect weed control and 10 no weed control. Records are presented of weed control, onion stand and total weight of onions per plot.

In all comparisons potassium cyanate increased the weed control. Many of the pre-emergence chemicals caused a reduction of onion stand and yield. The best results taking into consideration weed control, onion stand and onion yield were: CMU used in a pre-emergence application at 1 lb. per acre and the combination spray of Cloro IPC in a pre-emergence application at 1 gallon per acre followed by potassium cyanate in a post-emergence application at 6 lbs. per acre.

Conclusion

CMU offers possibilities for herbicidal weeding of onions if used in a pre-emergence application. Cloro IPC in a pre-emergence application in combination with potassium cyanate in a post-emergence application also is worthy of trial for the weeding of onions.

Potassium cyanate used as a post-emergence herbicide materially reduces the weed population and could be used if no pre-emergence herbicide adequately controls the weeds or if no pre-emergence herbicide is used.

Table I. - The effect of pre-emergence and post-emergence herbicides on weeds and stand and yield of onions in 1953.

Pre-emergence Herbicide			Post-emergence Herbicide				Onion	
Herbicide	Rate per acre	Application days after planting	Herbicide	Rate per Acre	Application days after planting	*Weed Control	Stand	Wt. Grams
Endothal	2 gal.	1	Potassium Cyanate	6 lbs.	28	3.6	71.2	573
"	"	1	Nothing	—		5.2	75.8	499
Cloro IPC	1 gal.	1	Potassium Cyanate	6 lbs.	28	1.9	97.4	1049
" "	"	1	Nothing	—		2.2	77.8	857
CMU	1 lb.	1	Potassium Cyanate	6 lbs.	28	2.1	63.2	855
"	"	1	Nothing	—		2.7	84.0	1141
Premerge	1 gal.	1	Potassium Cyanate	6 lbs.	28	2.4	1.0	4
"	"	1	Nothing	—		3.2	0.6	4
NIX	8 lbs.	1	Potassium Cyanate	6 lbs.	28	5.3	78.2	426
"	"	1	Nothing	—		8.5	74.5	349
Sesin	6 lbs.	2	Potassium Cyanate	6 lbs.	28	1.8	7.1	126
"	"	2	Nothing	—		2.2	7.5	136
ACP 1239D	1/2 gal.	1	Potassium Cyanate	6 lbs.	28	2.1	2.1	15
" "	"	1	Nothing	—		3.4	2.2	16
NP 1239D	4 lbs.	1	Potassium Cyanate	6 lbs.	28	1.4	21.4	299
" "			Nothing	—		1.8	33.8	387
Stoddard Solvent	70 gal.	8	Potassium Cyanate	6 lbs.	28	3.3	79.2	710
" "	"	8	Nothing	—		4.9	118.8	753
L.S.D. at .05 level						.9	37.5	295
L.S.D. at .01 level						1.2	49.5	389

*Weed control (1-10) - (1 perfect weed control) (10 full weed growth)

Chemical Herbicides as They Effect Yield of Tomatoes[1]

Charles J. Noll and Martin L. Odland[2]

The weeding of transplanted crops is usually not difficult by mechanical means. If the field is free of weeds when the crop is planted, early cultivation destroys the weeds between the rows and throws enough soil around the crop plant to control the weeds in the crop row. As the season advances the crop plants shade the ground in the row and thus eliminates the weeds in the row while cultivation continues to control the weeds between the rows.

This is not always the case with tomatoes. Under certain weather conitions, dry spring and wet summer and fall, weeds develop after the tomato plants have covered the ground. The weeds in the row cannot be removed mechanically; they compete with the tomato plant and make picking of the fruit difficult. In an effort to solve this weed problem an experiment was set up to compare what were thought to be the most promising herbicides at rates strong enough to give weed control.

Procedure

Five chemicals at the rate indicated per acre were used in this experiment: Sesin at 4 lbs., Alanap 5 at 8 lbs., Crag #1 at 4 lbs., ACP-L-423 at 1 gal. (Amine salt 4 chlorophenoxyacetic acid - 2 lbs. per gallon) and Natrin at 6 lbs.

The land was prepared June 15 and planted to the tomato variety Rutgers on June 17. Herbicides were applied directly over the tomato plants on June 24. Individual plots consisted of six plants spaced 3 feet apart in rows 6 feet apart. Treatments were arranged at random together with the non-treatment control in six replicated blocks. The weather was extremely dry throughout the growing season and weeds were not a problem.

Results and Discussion

The results are presented in Table I. Records are presented of tomato yield consisting of the average number and total weight of tomatoes per plot.

[1]Authorized for publication on November 20, 1953, as paper No. 1842 in the journal series of the Pennsylvania Agricultural Experiment Station.

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Table I. Chemical herbicides as they effect yield of tomatoes in a post-planting application.

Herbicide	Rate per Acre	Tomato Yield No.	Tomato Yield Weight lbs.
Nothing	--	141.0	32.2
Sesin	4 lbs.	105.8	22.9
Alanap 5	8 lbs.	3.8	0.8
Crag #1	4 lbs.	65.0	12.7
ACP-L-423	1 gal.	15.2	3.1
Natrin	6 lbs.	112.3	12.8
Least significant difference	.05 level	41.7	9.4
	.01 level	56.4	12.8

All chemicals used produced visible injury to the tomato plants. Two chemicals Sesin and Natrin did not significantly reduce the number of fruit and one chemical Natrin did not significantly reduce the total yield.

Conclusion

Under the conditions of this experiment and at the rates used only Natrin offers possibilities as an herbicide to use in a post-planting spray on tomatoes. Even this material produced visible injury to the tomato.

PRE-EMERGENCE WEEDING SWEET CORN WITH 2,4-D, DINITRO, AND ISOPROPYL TRICHLOROBENZOIC ACID

M. F. Trevett, H. J. Murphy, and H. E. Bradbury[1]

The ideal pre-emergence, or emergence, herbicide for sweet corn should possess these characteristics: It should be noninjurious to the crop under adverse climatic conditions; it should provide effective control of the common broadleaved weeds and annual grasses; and finally it should be sufficiently versatile to insure consistently satisfactory use under a variety of soil, climatic, and weed relationships.

One of the potential sources of crop injury following pre-emergence treatments lies in the possibility that subsequent moderate to heavy rains may leach the herbicide to the crop seed zone. This paper is a report of an evaluation of four herbicides with respect to their relative safety and herbicidal effectiveness under a controlled moisture regime.

The herbicides tested included a 2,4-D ester, a 2,4-D amine, a water soluble dinitro, and isopropyl trichlorobenzoic acid.

Experimental Procedure

Katahdin Gold sweet corn was planted at an average depth of 1.5 inches June 15 in a sandy loam soil. Herbicide treatments were laid out in a randomized block with 16 replicates of single row plots. Herbicides were applied with a single nozzle spray boom over a strip two feet wide centering on the crop row using Tee Jet nozzle 8004 E at 40 pounds pressure and 50 gallons per acre volume.

The acre rates of herbicides applied were: one pound 2,4-D acid equivalent from an ester formulation ("Esteron Ten Ten", Dow Chemical Co.); one pound 2,4-D acid equivalent from an amine formulation ("Dow 40", Dow Chemical Co.); three pounds

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Acknowledgment is made for a grant in aid from the B.F. Goodrich Chemical Co., and for herbicides supplied by the Dow Chemical Co.

dinitro ortho secondary butyl phenol from an alkanolamine salt ("Premerge", Dow Chemical Co.); five and ten pounds isopropyl trichlorobenzoic acid (B.F. Goodrich Chemical Co.), emulsified with "Joy".

The herbicides were applied June 20 when approximately 25% of the corn had emerged and was 1/4 to 3/8 of an inch tall. On this date the only weeds visible in quantity were mustards in the cotyledonary stage.

Three hours after the herbicides were applied one half of the block was irrigated (Section A) sufficiently to wet the soil to an average depth of three inches. The remaining half block (Section B) did not receive water until June 26 when 0.4 inch of rain fell, thereafter the entire block was irrigated as needed. Table 1 contains rainfall and irrigation data. The irrigation system was of the overhead type.

TABLE 1. RAINFALL AND IRRIGATION DATA, JUNE 20, 1953 TO JULY 20, 1953

Date	Inches of Rain	Irrigation
June 20	---	Section A only
26	.40	
27	.07	
29	.15	
30	---	Entire block
July 7	---	Entire block
9	.22	
13	.82	
15	.02	
20	.28	

The principal weeds present were: wild mustard (<u>Brassica</u> spp.), lamb's-quarters (<u>Chenopodium</u> spp.), and barnyard grass (<u>Echinochloa</u> spp.). Weed counts were made 24 days after treatment. Prior to making the weed counts an uncultivated strip six inches wide was left on each side of the crop row, thereafter normal close cultivation was practiced. The corn was harvested at the soft dough stage.

Results

This experiment was not designed to test the interaction between rates of water applied and herbicide treatment. However, because of an inadequacy of the irrigation system one half inch of water was applied at each date to the outer six columns of plots of Section A, while one inch of water was applied to the center twelve columns. Since statistical analysis did not indicate a significant interaction of rates of water and herbicides on corn performance, data for the two rates are combined in Table 2. A trend towards significance was indicated for an interaction between rates of water applied the day of treatment and herbicides on broadleaved weed control (Table 4). However, for evaluation of the various herbicides with respect to weed control differential watering, and the comparison irrigated vs. non-irrigated the day of treatment, was ignored and all plots were combined for the analysis given in Table 3.

Table 2 contains data on the effect of the various herbicides on stand of corn, height, date of 50% silk, and yield. In Section A, irrigated the day of treatment, both 2,4-D ester and amine significantly reduced stand of corn; 5 and 10 pounds XTB, and 3 pounds DNOSBP did not differ significantly from check. In Section B, not irrigated the day of chemical treatment, 10 pounds XTB significantly reduce stand compared to check; the remaining treatments had no significant effect.

In both Section A and Section B 2,4-D ester and 2,4-D amine were the only herbicides that significantly reduced corn height.

Date of 50% silk was significantly influenced by 2,4-D amine in Section A.

Yields were affected by chemical treatment. Covariance analysis in which yields were adjusted for stand did not significantly change mean yields. Yields in tons of snapped ears per acre given in Table 2 are unadjusted yields. In Section A yield for the 2,4-D amine treatment was significantly lower than all other treatments; in Section B 2,4-D ester was significantly lower than all others. In both sections 2,4-D ester and 2,4-D amine treatments produced significantly lower yields than check. Considering both sections an arbitrary grouping can be made of treatments with respect to affect on yield: Group 1 - check, 5 pounds XTB, 3 pounds DNOSBP; Group 2 - 10 pounds XTB; Group 3 - 2,4-D ester and amine. Statistically, 10 pounds XTB did not differ significantly from check.

Formative or other effects were observed for all chemical treatments. Three pounds DNOSBP caused a transient marginal and tip "burn" which persisted until the corn plants were five to six inches tall. This effect was apparent whether water had been applied the day of chemical treatment or not.

TABLE 2. EFFECT PRE-EMERGENCE TREATMENTS OF 2,4-D, XTB, DN ON YIELD, PLANT HEIGHT, SILKING DATE AND STAND OF SWEET CORN

Treatment and Acre Rates	Tons Snapped Ears/Acre	Height Corn Inches	Date 50% Silked	Stand of Corn Per 25' Row
Section A. Irrigated Day of Treatment				
5# XTB 1/	4.55	76.4	Aug. 27	49.8
Check	4.36	77.7	" 29	49.1
3# DNOSBP 2/	4.19	75.0	" 28	45.7
10# XTB 3/	3.64	74.4	" 27	47.8
1# 2,4-D ester 4/	3.01	71.5	" 28	41.6
1# 2,4-D amine 5/	1.96	69.4	36.1% silked Aug. 29	39.2
LSD 5%	0.77	2.8	Highly sign.	6.9
Section B. Not Irrigated Day of Treatment				
3# DNOSBP	6.00	79.6	Aug. 21	42.6
5# XTB	5.59	79.3	" 23	42.6
Check	5.40	79.9	" 24	41.5
10# XTB	4.86	78.2	" 23	35.4
1# 2,4-D amine	4.00	74.9	" 21	36.1
1# 2,4-D ester	3.67	74.0	" 24	39.3
LSD 5%	1.20	2.3	NS	5.7

1/ Five pounds isopropyl trichlorobenzoic acid, B.F. Goodrich Chemical Co.

2/ Three pounds dinitro ortho secondary butyl phenol from "Premerge", Dow Chemical Co.

3/ Ten pounds isopropyl trichlorobenzoic acid.

4/ One pound 2,4-D acid, ester, from "Esteron Ten Ten", Dow Chemical Co.

5/ One pound 2,4-D acid, amine, from "Dow 40", Dow Chemical Co.

Both 2,4-D amine and ester caused a bending of seedling corn during the spike and two-leaf stage. The extent of this effect varied with watering treatment. In Section A 57% of the amine treated corn and 64% of the ester treated corn showed this effect. In Section B, which was not irrigated the day of chemical treatment, the percentages were 21 and 47, respectively.

Frequency of occurrence of "onion leaf" in the 2,4-D plots varied also with watering treatment. On the 24 of July in Section A 3% of amine treated corn and 10% of ester treated were "onion-leafed". In Section B the percentages were 22 and 28, respectively.

Neither the 5 nor the 10-pound rate of XTB caused "onion leaf". However, during the early seedling stage in Section A the 5-pound rate caused bending of 1% of the corn, and the 10-pound rate 7%. In Section B both rates of XTB caused less than 1% bending.

"Rat-tailing" at tasseling occurred only in the 2,4-D treated plots. This type of injury, as for "onion leaf", was expressed to a greater degree in Section B.

TABLE 3. BROADLEAVED WEED AND ANNUAL GRASS CONTROL

Herbicide and Acre Rates[1]	Broadleaved Weeds		Annual Grasses		Percent Reduction of Weeds	
	No./Sq. Ft.[2]	Means of Transformed Data[3]	No./Sq. Ft.[2]	Means of Transformed Data[3]	Broad-leaved	Annual Grass
Check	25.2	1.419	10.2	1.048	---	---
5# XTB	9.6	1.024	6.9	0.896	61.9	32.3
3# DNOSBP	4.8	0.766	3.6	0.667	80.9	64.7
10# XTB	4.1	0.706	4.1	0.706	83.7	59.8
1# 2,4-D amine	0.72	0.236	2.9	0.592	97.1	71.5
1# 2,4-D ester	0.26	0.099	1.8	0.440	98.5	82.3
LSD 5%		0.088		0.127		

1/ Legend for herbicides in Table 2.

2/ Reconverted means of transformed data.

3/ Means of transformed data. Original data transformed using log. $\sqrt{n+1}$.

Data on the effect of the various herbicides on the control of annual broadleaved weeds and annual grasses are found in Table 3. The ester and amine of 2,4-D gave significantly better broadleaved weed control than all other treatments: 3 pounds DNOSBP and 10 pounds XTB were significantly better than 5 pounds XTB; 5 pounds XTB was significantly better than check. The ester of 2,4-D gave significantly better annual grass control than all other treatments: 2,4-D amine, 3 pounds DNOSBP, and 10 pounds XTB were significantly better than 5 pounds XTB; 5 pounds XTB was significantly better than check.

Data in Table 4 indicate a trend towards an interaction between herbicide treatment and differential watering on broad-leaved weed control.

TABLE 4. EFFECT OF IRRIGATION ON PERCENT REDUCTION OF BROAD-LEAVED WEEDS1/

Herbicide and Acre Rates2/	Irrigation Treatment Day Herbicides Were Applied		
	Not Irrigated	One Half Inch Water	One Inch Water
5# XTB	53.1	75.9	62.4
3# DNOSBP	70.0	93.9	80.7
10# XTB	78.1	89.6	87.4
1# 2,4-D amine	93.5	99.5	99.3
1# 2,4-D ester	98.1	99.5	99.9

1/ Percent reduction based on the mean number of weeds for "check" in each irrigation treatment.

2/ Legend for herbicides in Table 2.

Discussion

A companion study indicated that DNOSBP leached to the rooting zone of seedling corn resulted in a reduction in lateral root development. Both 2,4-D amine and ester caused a somewhat similar type of injury. Within ten days of treatment recovery was noted in all cases, but the type of root growth made during this period varied with herbicide. The DN injured roots produced new laterals not macroscopically different from those of untreated corn, but with a diminished frequency. In 2,4-D treated plots, on the other hand, the numerous new laterals, occurring in clusters along the main root, were club-like in appearance, unbranched, shorter and of greater diameter than normal. Later observations indicated that DN injured roots recovered more quickly and more completely than 2,4-D injured. It might be conjectured that this difference in recovery is a consequence of the mode of action of the two herbicides: DNOSBP, a contact herbicide, destroys fine laterals without impairing the ability of the central root to subsequently regenerate laterals normally; 2,4-D, a growth regulator, causes morphological effects (as well as other). XTB was not included in this companion test.

The temporary impairment of the root system caused by DNOSBP might under certain rainfall combinations result in subsequent prolonged subnormal growth. For example, if a leaching rain were followed by a prolonged period of drought, accompanied by low humidity, a water deficit (and nutrient deficiencies) might occur in the seedling plant. This effect would be aggravated if DNOSBP is absorbed from the soil solution and moved in the transpiration stream throughout the plant. Stimulation of respiration by DNOSBP[2/] might proceed to the point where complete, or rapid regeneration, of lateral roots would be impossible because of a carbohydrate deficit.

For the rates of herbicides used in this experiment it would appear that DNOSBP and XTB are safer chemicals for preemergence weeding of sweet corn than 2,4-D. Different rates of herbicides, however, particularly with respect to 2,4-D ester, would undoubtedly alter this rating. Comparisons should be made on the basis of phytotoxic equivalents. Observations have indicated that 3 pounds of DNOSBP and 1 pound 2,4-D amine, under ideal conditions, are about equal in effect on broadleaved weeds and annual grasses. Data in the present test indicate that for preemergence application 10 pounds XTB is equivalent to 3 pounds DNOSBP. However, on the basis of phytotoxic equivalents the safety rating of XTB is somewhat obscure. The consistent numerically higher yields from DNOSBP and check treatments over 10 pounds XTB (Table 2) lead to the suspicion that further testing might result in a statistical advantage for DNOSBP.

On the basis of the present experiment the herbicides tested may be rated for over-all weed control effectiveness in the following order: 1 pound 2,4-D ester and amine most effective; 3 pounds DNOSBP and 10 pounds XTB intermediate; 5 pounds XTB least effective.

2/ Robbins, Crafts, and Raynor. 1952. "Weed Control", Second Edition, page 173. McGraw-Hill Book Co., Inc., New York.

Comparisons of 3 pounds DNOSBP and 1 pound 2,4-D amine over a five-year period do not, however, indicate superiority for 2,4-D amine (Table 5). The percent reduction in broadleaved weeds during this period was 76.7 for 3 pounds DNOSBP and 73.4 for 1 pound 2,4-D amine. These figures are the averages of treatments applied at various times, from five days before crop emergence to the day of crop emergence.

TABLE 5. PERCENT REDUCTION OF WEEDS FOLLOWING PRE-EMERGENCE TREATMENT WITH 2,4-D AMINE AND ALKANOLAMINE SALTS OF DNOSBP, 1949-1953

Herbicide and Acre Rates1/	All Blocks Included		For Only Those Blocks in Which Control Was Obtained
	Broad-leaved	Annual Grass	Grass
6# DNOSBP	77.0	56.1	65.1
3# DNOSBP	76.7	47.8	56.2
1# 2,4-D amine	73.4	+2.4 2/	49.5
LSD 5%	NS	38.8	NS

1/ Legend for herbicides in Table 2.

2/ An increase compared to check.

Data for annual grass control with 3 pounds DNOSBP and 1 pound 2,4-D amine apparently reflect inherent differences that exist between the two herbicides. When all blocks were included for comparison (Table 5), 3 pounds DNOSBP gave significantly better annual grass control than 1 pound 2,4-D amine. When only those blocks in which annual grass control was obtained are included in a comparison, no significant difference was found to exist between the two herbicides. DNOSBP in these tests was more dependable than 2,4-D amine: 2,4-D amine gave control in 44% of the total number of trials; DNOSBP gave control in 92.5% of the trials.

Generally, 2,4-D amine failed to give control when applied after grass emergence. Control ordinarily was obtained if 2,4-D amine was applied as the grass emerged or during germination. DNOSBP at the 3-pound rate, on the other hand, ordinarily gave satisfactory control when applied when the grass was in the one to two-leaf stage as well as during germination and emerging stages.

XTB, apparently, is an effective herbicide only if it is applied before weed emergence. In other tests ten pounds XTB applied to annual grasses and broadleaved weeds in the cotyledonary and one to three-leaf stage did not give measurable control.

Summary

Acre rates of one pound 2,4-D acid from an ester formulation, one pound 2,4-D acid from an amine formulation, five and ten pounds of isopropyl trichlorobenzoic acid, and three pounds of dinitro ortho secondary butyl phenol from an alkanolamine salt were applied to Katahdin Gold sweet corn at emergence. Three hours after herbicides were applied one half the block was irrigated sufficiently to wet the soil to a depth of three inches; the second half received 0.4 inch of rain six days after treatment.

The ester and amine of 2,4-D gave significantly better broadleaved weed control than all other treatments: 3 pounds DNOSBP and 10 pounds XTB were significantly better than 5 pounds XTB; 5 pounds XTB was significantly better than check. The ester of 2,4-D gave significantly better annual grass control than all other treatments: 2,4-D amine, 3 pounds DNOSBP, and 10 pounds XTB were significantly better than 5 pounds XTB; 5 pounds XTB was significantly better than check.

Yields from 2,4-D ester and 2,4-D amine plots were significantly lower than for check plots. Five and ten pounds isopropyl trichlorobenzoic acid and three pounds DNOSBP did not significantly reduce yields.

A COMPARISON OF VARIOUS HERBICIDES ON SWEET CORN GROWN UNDER BOTH IRRIGATED AND NON-IRRIGATED CONDITIONS - 1953

Allan H. Kates[1]

The success or failure of many herbicides has been attributed to moisture conditions of the soil at the time of and immediately after their application. The purpose of this investigation was to obtain information on the effects of various chemical treatments on the stand, yield of sweet corn and weed control, when two different moisture conditions were maintained during the period of application.

Procedure

The tests were made on a Sassafras sandy loam, containing about 1.2 per cent organic matter. After conventional seed bed preparation with final fitting immediately before planting, Golden Cross variety of sweet corn was planted on June 15.

Three replications in randomized blocks were treated in both irrigated and non-irrigated areas. Plots were 4 rows wide by 36.3 feet long, each 0.01 acre in size. Herbicides were applied with a Hudson knapsack sprayer fitted with a #8004 Tee-jet nozzle. All chemicals were applied in water at the rate of 20 gallons per planted acre in a band 12-14 inches over the row.

The rainfall data as collected at Seabrook, N. J., dates and rates of applying additional water by overhead irrigation, appear in Table I.

The check (hand weeded and cultivated) received these treatments twice before weed and stand counts were made. All plots received two cultivations after the counts were made.

Weed and stand counts were made on July 15. Weed counts were of 2 strips on the 2 center rows, each strip 2 feet by 6 inches. Stand counts were of 100 feet of row. Yield data collected on September 1 consisted of snapped ears from 25 feet of row from the 2 center rows.

The broadleaf weed population consisted of lambsquarter (*Chenopodium album*), red root (*Amaranthus retroflexus*), rag weed (*Ambrosia* spp.) a few annual morning glory (*Ipomea* spp.)., Crabgrass (*Digitaria sanquinalis*), and few barnyard grasses (*Echinochloa crusgalli*).

[1]Research and Development of Herbicides, Seabrook Farming Corp., Bridgeton, New Jersey

Discussion of Results

A summary of results from the twenty-five chemical treatments and checks, both weeded and non-weeded, appears in Tables II and III, irrigated and non-irrigated areas, respectively.

Analysis of variance indicated that the results of all counts due to treatment are highly significant, except the broadleaf weed counts from the irrigated section.

All pre-emergence treatments resulted in better weed control when the soil moisture conditions were conducive to rapid seed germination. In the irrigated area, more weeds per unit area resulted with the grasses in dominance. In the dry area the broadleaf weeds were in dominance.

The treatments of Premerge at both $4\frac{1}{2}$ and 6 pounds resulted in good weed control when applied between planting and emergence of the corn. There is a trend towards better weed control under dry conditions by the heavier rate of the dinitro. At both rates a reduction in stand and a corresponding reduction in yield resulted from post-emergence application, 16 days after planting. Severe burning of the plant foliage was observed shortly after the application was made.

Dowicide G at 15 pounds at both pre- and post-emergence applications, under both wet and dry soil conditions, resulted in very good weed control without a detrimental effect to the sweet corn.

Of the pre-emergence 2,4-D treatments, the 2,4-D Amine-Wax emulsion at $1\frac{1}{2}$ pounds resulted in a stand and yield reduction in sweet corn when irrigation followed the treatment. During the growing season observations revealed some hormone type injury to all 2,4-D treated plots. By harvest these had largely disappeared without an adverse effect occurring to stand or yield. The low volatile ester of 2,4-D appeared to be safer to use on sweet corn under the conditions of this experiment.

With the post-emergence treatments of 2,4-D using 1/8 and $\frac{1}{4}$ pound of the amine and 1/8 pound of the low volatile ester, the degree of effective weed control is reflected in the yield. In both areas the yield is comparable to the weedy check and significantly lower than the hand-weeded and cultivated check.

The CMU treatments of $\frac{1}{2}$ and 1 pound resulted in more effective weed control when followed by irrigation. The higher rate caused a chlorotic condition to the sweet corn in both areas, which was visible throughout most of the growing season. The yields on these plots were also adversely affected.

The weed control, due to the application of Crag Herbicide #1 and Sesin each at 3 pounds per acre, was accentuated by the addition of water after application. In comparing these two treatments, Crag Herbicide #1 showed a trend toward better weed control and more adverse effect to the yield of sweet corn.

Chloro I.P.C. at both 4 and 6 pound rates under both soil moisture conditions resulted in severe yield reductions.

Conclusion

The Premerge treatments at 4½ and 6 lbs. applied at the day of planting, at 3 days after planting, and at emergence of sweet corn effectively controlled both broadleaf and grass weeds without a detrimental effect to the corn. When applied under dry soil conditions at the earlier stages of growth of the sweet corn, the higher rate resulted in a trend toward better weed control.

Dowicide G at 15 pounds per acre, although very disagreeable to handle, resulted in effective weed control with no damage to the sweet corn at both times of treatment, day of planting, and post emergence.

Of the 2,4-D treatments, the low volatile ester treatments appears to be safer to use on sweet corn grown on a sandy loam soil. Various degrees of injury were apparent on all 2,4-D treated plots.

The tolerance range of sweet corn to CMU was very narrow under the conditions of this experiment.

Acknowledgement:

Thanks are expressed to T.E.A. van Hylckama, Seabrook Farming Corp., Bridgeton, New Jersey for advice and assistance in the statistical analysis of the data.

Table I. Showing the Rainfall Data as Collected at Seabrook, N. J. and the Water Added by Irrigation.

	Rainfall Inches	Irrigation Inches
6-13	0.05	
6-14	0.51	
6-15*		0.50
6-18*		0.50
6-23*	Trace	0.50
6-26		0.50
6-29	0.06	
6-30	0.03	
7-1 *		0.50
7-3	0.14	
7-5		0.50
7-7	0.50	
7-9	0.66	

* Treatment Date - 0, 3, 8, 16 days after planting.

The Herbicides Used, Their Formulations and Their Source

Chemical	Active Ingredient	Source
Chloro I.P.C.	Isopropyl N 3-chlorophenyl carbamate	California Spray Chemical
CMU	3-(p-Chlorophenyl)-1,1-Dimethyl Urea	DuPont
Crag Herbicide #1	Sodium 2,4-Dichlorophenoxyethyl sulfate	Carbide & Carbon
Dowicide G	Sodium Penta chlorophenate	Dow
Premerge	Alkanolamine and Propanolamine of Dinitro Ortho secondary butyl phenyl	Dow
Soluble Cyanamid	Monosodium cyanamide	American Cyanamid
Sesin	2,4-Dichlorophenoxyethyl benzoate	Carbide & Carbon
2,4-D Amine	Triethanolamine salt of 2,4-D	American Chem. Paint
2,4-D Amine Wax	Emulsion of above 2,4-D Amine and W 5709 (Water Emulsion Wax)	Johnson Wax
2,4-D LV Ester	2,4-D Acid, Butoxy Ethanol Ester	American Chemical

Table II. The Effect of 27 Treatments on Weeds and Stand and Yield of Sweet Corn when Wet Soil Conditions Followed their Application.

	Chemical	Rate/Acre	Treatment Day After Pltg.	Broadleaf* Weeds	Grasses*	Stand**	Yield***
1	Premerge	4.5 lbs.	0	0	6.0	46.0	7.70
2	Premerge	4.5 lbs.	3	0	6.6	45.6	9.00
3	Premerge	4.5 lbs.	8	0	3.6	52.6	7.53
4	Premerge	4.5 lbs.	16	0	9.3	49.3	6.66
5	Premerge	6.0 lbs.	0	0	5.3	56.6	9.16
6	Premerge	6.0 lbs.	3	0	2.0	50.3	8.73
7	Premerge	6.0 lbs.	8	0	1.3	57.0	10.80
8	Premerge	6.0 lbs.	16	0.3	5.3	36.6	6.10
9	Dowicide G	15.0 lbs.	0	0.3	4.0	51.3	10.00
10	Dowicide G	15.0 lbs.	16	0	6.0	56.0	9.00
11	2,4D Amine Wax	.75 lbs.	0	0.3	1.6	50.6	9.20
12	2,4D Amine Wax	1.5 lbs.	0	0	4.0	33.0	5.86
13	2,4D LV	.75 lbs.	0	0	3.6	51.6	9.36
14	2,4D LV	1.5 lbs.	0	0.6	7.3	46.0	11.03
15	2,4D LV	1/8 lb.	16	0	10.0	56.3	5.76
16	2,4D Amine	1/8 lb.	16	4.3	17.6	52.0	5.63
17	2,4D Amine	1/4 lb.	16	1.0	8.3	60.6	4.76
18	CMU	.5 lb.	0	0	4.0	45.0	9.13
19	CMU	1.0 lbs.	0	0	1.0	43.0	5.20
20	C.H. #1	3.0 lbs.	0	0	1.0	36.3	8.30
21	Sesin	3.0 lbs.	0	0.3	5.6	52.6	9.33
22	C.I.P.C.	4.0 lbs.	0	0.3	1.3	34.3	5.03
23	C.I.P.C.	6.0 lbs.	0	0	0	23.6	3.00
24	Soluble Cyanamid	10.0 lbs.	8	1.0	14.6	50.0	6.83
25	Soluble Cyanamid	20.0 lbs.	8	1.3	6.3	49.0	8.30
26	Check	(Cultivated and Handweeded)		0	0	55.3	13.43
27	Check			9.3	30.0	53.3	3.96
	L.S.D. 5% Level			5.4	10.5	18.2	3.99
	L.S.D. 1% Level			N.S.	13.9	24.2	5.32

* 2 Square feet - ** 100 feet of Row - *** 25 feet of Row.

Table III. The Effect of 27 Treatments on Weeds and Stand and Yield of Sweet Corn when Dry Soil Conditions Followed Their Application.

	Chemical	Rate/Acre	Treatment Days After Pltg.	Broadleaf* Weeds	Grasses*	Stand**	Yield***
1	Premerge	4.5 lbs.	0	2.6	3.3	43.6	9.03
2	Premerge	4.5 lbs.	3	1.3	1.3	49.3	10.03
3	Premerge	4.5 lbs.	8	1.0	1.3	41.3	9.53
4	Premerge	4.5 lbs.	16	0.6	2.6	33.0	8.97
5	Premerge	6.0 lbs.	0	0.6	3.6	40.6	11.73
6	Premerge	6.0 lbs.	3	0	1.3	49.3	10.43
7	Premerge	6.0 lbs.	8	0.3	2.6	43.6	9.93
8	Premerge	6.0 lbs.	16	1.0	1.0	9.3	2.33
9	Dowicide G	15.0 lbs.	0	2.3	2.0	50.3	10.43
10	Dowicide G	15.0 lbs.	16	2.0	3.6	41.6	9.63
11	2,4D Amine Wax	.75 lbs.	0	4.6	5.0	42.6	9.16
12	2,4D Amine Wax	1.5 lbs.	0	3.6	6.0	48.6	11.06
13	2,4D LV	.75 lbs.	0	4.6	6.0	49.3	8.73
14	2,4D LV	1.5 lbs.	0	1.3	3.3	39.0	9.23
15	2,4D LV	1/8 lb.	16	1.0	5.6	52.0	8.66
16	2,4D Amine	1/8 lb.	16	2.6	8.0	47.3	8.53
17	2,4D Amine	1/4 lb.	16	2.6	3.0	43.6	9.43
18	CMU	1/2 lb.	0	2.3	6.3	46.0	7.87
19	CMU	1.0 lbs.	0	1.3	7.6	46.6	5.16
20	CH #1	3.0 lbs.	0	1.6	5.0	43.0	7.96
21	Sesin	3.0 lbs.	0	3.6	6.0	46.3	9.80
22	CIPC	4.0 lbs.	0	2.3	6.6	43.3	5.40
23	CIP	6.0 lbs.	0	5.6	2.6	45.0	6.10
24	Soluble Cyanamid	10.0 lbs.	8	2.0	12.6	46.0	9.07
25	Soluble Cyanamid	20.0 lbs.	8	1.6	6.3	41.3	9.07
26	Check	(Cultivated and Handweeded)		0	0	46.6	12.00
27	Check			19.0	10.6	47.3	8.80
L.S.D.	5% level			8.4	6.5	12.4	2.95
	1% level			11.2	8.6	16.5	3.94

* 2 Square feet - ** 100 feet of Row - *** 25 feet of Row

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RESULTS WITH POST EMERGENCE APPLICATIONS OF DNOSBP IN SWEET CORN[1]

Richard J. Aldrich[2]

Applications of DNOSBP shortly after corn has emerged may provide advantages in weed control over pre-emergence applications. Since many of the weeds emerge at about the same time as the corn, the chemical would be applied contact to many of the weeds. This would avoid part of the hazard associated with heavy rains immediately following a pre-emergence treatment which can result in poor weed control.

The present test was initiated to evaluate the weed control potentialities and effects on sweet corn of post-emergence aplications of a DNOSBP amine salt.

EXPERIMENTAL

Methods

One and one-half and three pounds of a DNOSBP amine salt were applied to Carmelcross sweet corn in the following stages of growth: emergence (90%), 2 to 3 leaf, 3 to 5 leaf, and 5 to 7 leaf. Applications were made in 20 gallons of water per acre; the first treatment was made May 19. Plots were 2 hills wide and 13 hills long with a hill spacing of 42 x 21 inches.

Observations were made of effects of the treatments on the corn plants; total yield, number of ears, and maturity were recorded. Weed counts were made June 12. Immediately after the weed counts were recorded the area was cultivated and hand-hoed and normal cultivation practices were followed during the remainder of the growing season.

Results

Observations of the sweet corn seedlings immediately after treating indicated that the degree of leaf burning increased as the size of the plant at treating increased. Plants treated at emergence showed little evidence of burning. The effects of the treatments on sweet corn yields are given in table 1. Differences in yield between rates of DNOSBP were not significant. Records of maturity did not show any adverse affects from treatment. It appears that the initial burning on seedlings had no affect on yield.

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[1]Cooperative study between the New Jersey Agricultural Experiment Station and the Division of Weed Investigations, ARS, USDA.

[2]Agronomist, Division of Weed Investigations, ARS, USDA.

Weed control data are given in table 2. The primary weeds in the test area were crabgrass (Digitaria sp.), pigweed (Amaranthus retroflexus), and lambsquarters (Chenopodium album). The weed counts indicate that time of treatment had little effect on control of broadleaved weeds; effective control was obtained with both rates although it is apparent that 3 pounds provided consistently better control. Crabgrass was effectively controlled only by treatment at emergence of the sweet corn.

SUMMARY

Results of one year's test of post-emergence applications of DNOSBP in sweet corn indicate that the method warrants further investigation. Considering injury to the corn seedlings and total weed control it appeared that treatment at emergence of the corn was more promising than later treatments.

Table 1. Tons of Sweet Corn Ears Per Acre, New Brunswick, N. J. 1953.

Stage of sweet corn when treated	Check	1½ lbs. DNOSBP amine	3 lbs. DNOSBP amine	Average all rates
Emergence	5.28	5.38	5.18	5.28
2-3 leaf	6.85	6.97	5.73	6.52
3-5 leaf	4.84	5.80	5.02	5.22
5-7 leaf	5.04	5.23	5.14	5.14
L.S.D. .05				.75
Ave. all stages	5.50	5.84	5.27	

Table 2. Weeds Per Square Foot, New Brunswick, N. J., 1953.

Stage of sweet corn when treated	Check		1½ lbs. DNOSBP amine		3 lbs. DNOSBP amine	
	Broad-leaves	Grasses	Broad-leaves	Grasses	Broad-leaves	Grasses
Emergence	89.3	27.3	5.3	6.0	2.5	1.6
2-3 leaf	80.1	26.8	7.6	27.5	0.5	11.7
3-5 leaf	88.2	22.5	12.9	33.3	3.4	37.0
5-7 leaf	74.8	29.6	8.5	23.6	1.6	25.7
Ave. all stages	83.1	26.6	8.6	22.6	2.0	19.0

Further Studies with CRAG Herbicide 1 (SES)[1] on Ornamentals and Nursery Stock

J. A. Kramer, Jr. and L. J. King[2]

It has been demonstrated that aqueous applications of CRAG Herbicide 1 (sodium 2-(2,4-dichlorophenoxyethyl sulfate), SES, to the aerial parts of the plants at dosages that will kill germinating weed seeds are non-phytotoxic and physiologically inactive[3]. The herbicide is converted to its active form upon contact with the soil, suggesting a microbial breakdown[4].

CRAG Herbicide 1 (SES) is being widely evaluated on nursery stock, shrubs and flowers[5]. It is also commercially recommended for weed control in established plantings such as strawberries, asparagus, sweet and field corn.

This paper is a continuation of the earlier work on ornamentals and nursery stock carried on in the past years by commercial nurserymen and points out the savings both in hand labor and money to be achieved by using CRAG Herbicide 1 (SES) in controlling weeds.

Results and Discussions

In addition to including the results of cooperators, reports of work done by the authors at the Boyce Thompson Institute during the summer of 1953 are also included.

The management of Dugan Nurseries[6] has been using CRAG Herbicide 1 (SES) for three years. The plants they treated (Table 1) were rooted cuttings and one year old stock. The rooted cuttings were set out in the field on June 1 and CRAG Herbicide 1 (SES) at 2 lbs. per acre was applied on the following dates: June 10, July 10, and August 10. There was no apparent injury to

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[1]SES is the new designated name for CRAG Herbicide 1

[2]Fellows, Boyce Thompson Institute for Plant Research, Inc. and the Carbide and Carbon Chemicals Company, Yonkers, New York.

[3]Herbicidal Properties of Sodium 2,4-Dichlorophenoxyethyl Sulphate. L. J. King, J. A. Lambrech, and T. P. Finn. Contrib. Boyce Thompson Inst., (16/4): 191-208, October-December 1950.

[4]Biological Activation of Sodium 2-(2,4-Dichlorophenoxy)Ethyl Sulfate by Bacillus Cereus Var. Mycoides. A. J. Vlitos. Contrib. Boyce Thompson Inst., (16/9): 435-438, January-March 1952.

[5]CRAG Herbicide 1 (Sodium 2-(2,4-dichlorophenoxyethyl sulfate) for Preventing Weeds in Flowers, Shrubs and Nursery Stock. T. P. Finn, L. J. King, A. J. Vlitos. Presented at the 1953 Northeastern Weed Conf., published in Proceedings of the Northeastern Weed Conf. 1954.

[6]Dugan Nurseries, Perry, Ohio.

any of the plants and good weed control was obtained. The same applications were applied to the one year old stock and the results were the same as those obtained in the rooted cuttings. A heavy weed population plus the problem of voluntary grape seedlings had existed at the nursery but CRAG Herbicide 1 (SES) controlled these two problems. It took 400 hours of hand labor last year to weed one-quarter acre of rooted cuttings, while this year only 40 hours of hand labor were required after three applications of CRAG Herbicide 1 (SES).

At the Nagel Bulb Farm[1], CRAG Herbicide 1 (SES) was applied both as pre-emergence and post-emergence sprays to 50 acres of gladioli. The chemical was applied with a tractor mounted sprayer of a 100 gallon capacity and applied at the rate of 3 lbs. of the herbicide to 40 gals. of water per acre. The first application was applied eight days after planting as pre-emergence spray. The second application was applied four weeks later after the plants had emerged. The entire acreage was sprayed with no attempt to avoid the gladioli. While areas planted to bulblets were sprayed three times, only two applications were needed in the large bulbs since they soon outgrew the weeds that appeared later in the season.

CRAG Herbicide 1 (SES) eliminated at least 95% of the weeds. It was estimated that this saved the Nagel Farm at least $2,000 in weeding wages plus the grief of getting the weeds pulled by hand labor.

The Conner and Amos[2] nursery obtained good results with CRAG Herbicide 1 (SES) even under conditions of high soil moisture and excessive crab grass population. The liners including Ilex, Juniper and Taxus were set out and then irrigated. The fields were then allowed to drain sufficiently to permit spray equipment in to apply the herbicide. Applications up to 3½ lbs. per acre were applied once a month. The fields were irrigated once a week when necessary with a little less than an inch of water. They obtained satisfactory results and no visible injury to the plants was observed. The plant varieties that were grown in the test areas are listed in Table 2.

Test plots were set up at the Institute rose garden in beds containing well established rose plants. The plots were cultivated prior to treatment and CRAG Herbicide 1 (SES) was applied at the rate of 3 lbs. per acre at two different times during the summer. Excellent weed control was obtained and no injury was observed to the plants or to the flowers.

Petunia transplants and gladioli bulbs were planted in the field on June 8. The plots were cultivated and CRAG Herbicide 1 (SES) was applied on June 27 and July 29 at the rate of 3 lbs. per acre. When the herbicide was applied, the spray was directed over the entire plots including the plants and no injury to the petunias or gladioli resulted from the treatment. The CRAG Herbicide 1 (SES) plots were weed-free during the entire period of the tests (Table 3).

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[1]Nagel Bulb Farm, Rural Route 2, Kalamazoo, Michigan.

[2]Conner and Amos, Inc., Charleston, West Virginia.

In the above experiments the herbicide was applied at the rate of about 100 gallons per acre using a 1 gal. hand operated sprayer.

When applied to newly cultivated weed free soil, CRAG Herbicide 1 (SES) has proven to be an effective and a safe herbicide for the prevention of both weed seed germination and seedling growth in established plantings of a large number of species and varieties of bulbs, ornamentals, and nursery stock.

Table 1

Nursery Stock Treated at Dugan Nursery

Holly	Ilex crenata rotundifolia
	Ilex crenata convexa
	Juniper hiburnica
	Juniper pfitzeriana
	Arborvitae pyrimidalas
	Taxus cuspidata
	Taxus media hicksii
	Euonymous rudicans colorota
	Euonymous patens

Table 2

Nursery Stock Treated at Connor & Amos, Inc.

Holly	Ilex crenata convexa
	Ilex crenata rotundifolia
	Ilex crenata microphylla
	Ilex crenata helleri
	Ilex crenata burfordi
	Ilex crenata glas
Juniper	Juniper chinensis pfitzeriana
	Juniper horizontalis plumosa
Yew	Taxus cuspidata
	Taxus hunnewelliana

Table 3

Weed Control in Roses, Petunias (var. Giant Lavendar) and Gladioli (mixed) with CRAG Herbicide 1 (SES)

	Rate lbs./acre	Weed Rating[1]	Toxicity Rating to Plant[2]
Series I			
Roses	3	1	A
Control	-	3	A
Series II			
Petunias	3	1	A
Control	-	3	A
Gladiolus	3	1	A
Control	-	3	A

[1]Weed Rating: 1 = excellent weed control
2 = fair weed control
3 = no weed control

[2]Toxicity Rating:
A = no injury

Series I: Treated 6/11/53 and 7/15/53, Reading 9/17/53

Series II: Planted 6/8/53, Treated 6/29/53 and 7/30/53, Reading 9/22/53

Defoliation of Nursery Stock with Copper Salts and Endothal

A. M. S. Pridham and Robert Hsu, Cornell University

Defoliation as a harvest aid must not injure buds, twigs or stems since quality of nursery stock would be seriously impaired.

Roses and California Privet represent two important nursery crops. There are, however, many other species and varieties grown. Many species do not ripen and go through a dormant period as native woody plants do. Growth slows down but the leaves continue green and intact till killed by frost. Satisfactory defoliation is not a simple matter of killing foliage or inducing leaf fall.

Nursery stock in New York State is largely dug in October to December. At these times temperatures are usually below 60°F and often in the low 50s or 40s. In our experience many defoliants are of limited value at temperatures below 60°F.

Present work is based on a suggestion from the nursery industry that copper sulfate has been used on occasion for defoliating roses and that copper is more active in cold than in warm weather.

The experimental procedure used was to screen chemicals over a range of concentrations and temperatures under laboratory conditions. A second series of screening tests was done outdoors in August or September and a third and final test run under similated or actual commercial conditions with field equipment.

Table 1. Percent of leaflet defoliation at 50°F in Rose Better Times 3 and 7 days after treatment in the laboratory.

Date of test	Control		Defoliant and reaction time in days: 4069 1:50		$CuSO_4$ ½%		4069 and $CuSO_4$	
	3	7	3	7	3	7	3	7
3/30	0	0	35	45	60	90	85	100
4/8	0	0	0	35	0	0	0	50
5/4	0	5	0	0	30	30	60	80
7/30	0	0	0	0	0	85	0	45
Mean	0	1.3	8.7	20	22.5	51.3	36.3	68.7

Laboratory tests were run with four samples per treatment. Sprayed foliage was placed in pint bottles which were sealed with paraffin. Defoliation was permitted to proceed in the dark at constant temperatures over a range from 40° to 80°F. Records were made daily once defoliation began. The bottles were tapped vigorously to encourage leaf fall.

The data presented follow preliminary screening to establish likely concentration levels. The temperatures of 50° and 80°F were chosen to determine response at lower and upper limits that are likely to be met in the field. Humidity in the bottles is high and constant. This differs from field conditions.

Each treatment is the average of four individual samples. Mean values (Table 1) are thus based on four runs of four samples. Endothal (4069) 1:500 is below the commercial recommendation. Copper sulfate ½% in preliminary tests could be increased two or three fold before foliage injury would be serious. Copper sulfate used at ½% appears to have definite properties as a defoliant for Rose Better Times. The combination of endothal with copper sulfate gave on the average earlier and more defoliation than either defoliant alone. The combination did not produce injury to buds or twigs and no immediate injury of visible type to leaves.

Table 2. Per cent defoliation in outdoor Roses "Better Times" and "Cavalcade" 7 days after spraying foliage to drip stage, August 12, 1953.

Control	4069 1:100	4069 1:500	$CuSO_4$ ½%	$CuCl_2$ ½%	Iodoacetic acid 500 ppm	Combination 4069 and additive
Rose Better Times						
2	96		81			100
		37	81			43
	96			100		100
		37		100		98
	96				93	100
		37			93	100
Rose Cavalcade						
0	14		22			81
		8	22			30
	14			16		25
		8		16		63
	14				31	73
		8			31	56

Four samples were included in each average used to indicate response to treatment. Percentages were based on rating rather than on leaflet or foliage counts.

In addition to copper sulfate, copper chloride and also iodoacetic acid show defoliant properties under warm weather conditions of 70-80°F prevailing outdoors in August 1953.

Two Rose varieties show improved defoliation when copper salts or iodoacetic acid was used with endothal.

In September 1953 commercial defoliation of roses was undertaken at Tyler, Texas in cooperation with Dr. Elton Lyle of the Texas Rose Research

Foundation and Mr. Donald Vanderbrook of the C. W. Stuart Nurseries of Newark, N. Y. Applications were based on 2 pounds of active ingredient of endothal per acre applied by gear pump at 50 psi driven by tractor power take off. Copper sulfate was used at 1% ($CuSO_4$ $5H_2O_4$).

Defoliation began two days after treatment. Plants were dug the third day after treatment. The majority of varieties responded satisfactorily and after being cut back and bundled for shipment 90% or more of the foliage had dropped.

Samples of the Rose "Red Jacket" both hand defoliated and chemically defoliated were followed through to the consumer. Greenhouse grown samples have survived equally well from hand as from chemical defoliation.

At least 1,000 plants of each of the following varieties were sprayed with endothal 1:20 in September: Amie Quinard, Baby Chateau, Blaze, Cavalcade, Charlotte Armstrong, Countess Vandal, Doubloons, Dr. Nicholas, Golden Salmon, Improved Lafayette, Mrs. Finch, Peace, Pinocchio, Red Jacket and World's Fair. The use of copper sulfate with the endothal speeded up defoliation and found favor with the nurserymen concerned in growing and preparing the plants for market. The balance of the crop is to be defoliated before digging. Early reports indicate equally good results in November at Tyler as in September.

Ligustrum ovalifolium. In addition to Roses, California Privet is grown in large amounts. This plant, like the rose, tends to continue to hold its foliage till actually killed by frost. Ligustrum ovalifolium has been used as a test crop for screening defoliants. Its response to copper salts, iodoacetic acid and other chemicals is given in the following tables.

The effectiveness of copper salts used with endothal at 50°F is evident in the response of Ligustrum ovalifolium as it was in the case of Rose Better Times and Cavalcade. Iodoacetic acid as used with Ligustrum ovalifolium is a poor defoliant in its own right and of value only at low levels of endothal as an additive.

For most of the shrubs tested the use of copper salts has been effective in bringing about defoliation and in making endothal more effective. Hibiscus is an exception and Weigela failed to respond to defoliants alone or in combination in these tests. Iodoacetic acid did not show defoliant properties under field conditions.

Discussion

When copper sulfate was added to endothal and defoliation proceeded at low temperature (50°F) improved defoliation resulted in Rose Better Times and Cavalcade; also in Ligustrum ovalifolium and several other species of shrubs except Hibiscus.

Table 3. Per cent defoliation in *Ligustrum ovalifolium* 7 days after spraying till foliage drips. Four twig samples of 10 leaves held in the dark in pint bottles at 50^{o}F.

Control	4069 1:100	4069 1:500	$CuSO_4$ ½%	$CuCl_2$ ½%	Iodoacetic acid 500 ppm	Combination 4069-additive
a. 0	36.6		6.6			70.6
b. 0		13.3	9.5			23.8
c. 0		10.0		20.0		30.0
d. 0	86.5				0.0	81.5
e. 0		10.0			0.0	22.0

a. Average of 3 runs of 4 samples per treatment.

b. Average of 4 runs of 4 samples per treatment.

c. Average for 1 run of 4 samples per treatment.

d. Average of 2 runs of 4 samples per treatment.

e. Average of 2 runs of 4 samples per treatment.

During August and again in late September the addition of copper sulfate to endothal did not interfere with the effectiveness of endothal and rather consistently speeded up defoliation of roses under field conditions at Tyler, Texas in September 1953.

In addition to copper sulfate, copper chloride also showed defoliant properties and increased the effectiveness of endothal.

Iodoacetic acid was found to increase the effectiveness of endothal at 50^{o}F under field conditions for roses but iodoacetic acid as used in these tests did not in itself evidence as marked defoliant properties as did the copper salts.

Table 4. Percent defoliation in outdoor plantings of deciduous shrubs under warm weather of August 1953. Twigs sprayed till foliage dripped.

Plant tested outdoors	Control	4069 1:100	$CuSO_4$ ½%	$CuCl_2$ ½%	Iodoacetic acid 500ppm	Combination 4069 and additive
Berberis Thunbergii	0	75	5			100
		75		5		100
		75			0	100
Forsythia spectabilis	0	7	0			37
		7		45		83
Hibiscus syriacus	0	80	0			60
		80		5		75
Ligustrum amurensis	0	100			4	100
		100	100			100
		100		100		100
Ligustrum ibolium Regelianum	0	95	87			62
		95		95		100
		95			0	8
Ligustrum ovalifolium	0	3	5			8
	0	75	100			100
		75		100		100
		75			0	100
Spiraea Bumalda	0	100	75			75
		100		75		75
		100			8	75
Syringa vulgaris	0	100	100			100
		100		0		100
		100			0	100

Weigela floribunda - no defoliation with any treatment

Screening Tests of Defoliants for Nursery Stock

A. M. S. Pridham and Robert Hsu, Cornell University

It has recently been demonstrated by Hall (1) that leaves on twigs cut from cotton plants can be induced to defoliate by ethylene chlorohydrin application under laboratory conditions. Hall (1) also demonstrated that by application of growth regulators the amount of defoliation per unit of time was reduced from that found with ethylene chlorohydrin alone. Hall suggested that defoliation may be related to the ethylene auxin balance in the abscission zone.

Ethylene has been shown by many workers to induce abscission of leaves. Ethylene is often reported as one of the constituents of illuminating gas. Goodspeed, McGee and Hodgson (2) studied the effect of the individual constituents of the illuminating gas used in their laboratories. *Nicotiana Tabacum* varieties and *Citrus sinensis* varieties were used as experimental plants. The criteria of induced abscission was a reduction in the time from treatment to fall of first blossoms as compared with untreated controls.

Goodspeed et al. reported induction of flower drop by CO_2 10%, carbon monoxide 10%, and ethylene 5%. No induction of abscission was brought about by hydrogen 10% or 20% nor by methane 10%. Acetylene was not studied by Goodspeed. The presently useful defoliant endothal has a characteristic odor somewhat like acetylene or like ammonia; hence both gases were included in the present screening tests.

The purpose of the present tests was to explore the possibilities of induced abscission of leaves by the use of acetylene, ammonia, methane, carbon dioxide, carbon monoxide, and nitrogen. A second purpose was to determine the effect of additions of growth regulator to the foliage immediately prior to treating the foliage with the defoliant.

Wetmore and Jacob (3) have reported a relation between auxin content and leaf age in Coleus. They have also indicated that when the leaf blade, as a source of auxin, is removed growth regulators applied to the cut petiole retard its abscission.

Present tests began with examination of the interval of time taken for abscission of Coleus petioles after deblading. Explants (Tables 1 and 2) were used for this purpose and the performance of the petioles of each node from the youngest to the oldest was noted separately. In addition to deblading, the explants were dipped momentarily in the growth regulator alpha naphthalene acetic acid prepared in a range of concentrations to parallel and exceed natural auxin levels reported by Wetmore and Jacob (3).

The next step (Tables 2, 3 and 4) was to treat debladed Coleus petioles with ethylene by using distilled water saturated with C.P. ethylene gas from a "lecture bottle" source. Specific volumes of ethylene saturated water were transferred to pint culture bottles in which test explants had been placed. The bottles were capped and immediately sealed with paraffin. They were then placed in an 80°F chamber in the dark and examined periodically by vigorously shaking the culture bottle to encourage abscission.

Table 1. Abscission of petioles from debladed shoots of Coleus. Time in 12 hour units taken for defoliation of 8 petioles per treatment for Coleus petioles of different ages (node, 1-7 oldest). Shoots sprayed with alpha naphthalene acetic acid. The experiment ran for 5½ days or 11 intervals, hence total time = 88 maximum.

Treatment	1st node	2nd node	3rd node	4th node	5th node	6th node	7th node	Total
Control	D	D	44*	54	40	41	37	216
NAA 1/10 ppm	D	D	70	66	61	49	38	284
NAA 1 ppm	D	D	70	49	46	47	39	251
NAA 5 ppm	D	D	81	76	72	57	51	337
NAA 10 ppm	D	D	88	76	81	74	62	381
NAA 25 ppm	D	D	88	88	88	62	74	400
NAA 100 ppm	D	D	D	D	D	88	88	--

D indicates petioles died during the experiment and did not absciss. These petioles were less than ¼ inch in length for nodes 1 and 2.
* indicates total time in half days for 8 petioles to absciss, i.e. an average of 2½ days from time of treatment.

Table 2. Abscission of petioles from debladed shoots of *Coleus Blumei*. Data in total number of 12 hour units taken for defoliation of 4 petioles per treatment for each node from young (1) to old (7). Time from spraying to conclusion of test was 10 days or 20 total units per node per treatment = 80. One leaf only of each pair was removed.

Treatment	1st node	2nd node	3rd node	4th node	5th node	6th node	7th node	Mean time per petiole
Control	D	33	32	24	23	21	24	6.33
*Ethylene-H_2O 1 drop	10	8	7	6	15	12	14	2.57
" 2 "	8	5	5	7	10	10	14	2.11
" 10 "	10	5	4	4	4	4	4	1.25
Indole AA 10 ppm	D	58	26	30	25	24	31	8.09
E 1 drop + IAA 10 ppm	16	14	18	15	13	16	15	3.83
E 2 " "	12	9	7	11	14	13	11	2.75
E 10 " "	12	10	10	12	10	12	13	2.82

D position 1 for control had 2 dead petioles and for IAA 10 ppm 4 dead petioles at position 1
* Ethylene-H2O - distilled water was saturated with ethylene by forcing minute bubbles of ethylene through the water in a stoppered flask. This reservoir was held at 70°F and samples taken by forcing the saturated water into a 2 way burette from which samples of ethylene saturated water were measured rapidly into cultures that were immediately sealed.

Table 3. Abscission of leaves from shoots of Coleus Blumei. Data stated in half days for defoliation of 4 leaves per treatment for each node from young (1) to old (7). Time from spraying to conclusion of test was 10 days or total units per node per treatment = 80.

Treatment	1st node	2nd node	3rd node	4th node	5th node	6th node	7th node	Mean time per leaf blade
Control	--	--	80	--	78	68	58	17.75
Ethylene-H_2O 1 drop	--	--	--	72	66	50	42	14.37
" 2 "	--	--	70	60	41	50	26	12.35
" 10 "	--	--	-	70	54	42	26	12.10
IAA 10 ppm	--	--	--	80	80	58	54	15.75
E 1 drop + IAA 10 ppm	--	--	--	78	66	50	39	14.50
E 2 " "	--	--	78	74	72	52	52	16.40
E 10 " "	--	70	--	72	56	56	29	14.15

Table 4. Mean abscission time in 12 hour units per petiole or leaf blade of Coleus Blumei for nodes 3, 4, 5 and 6. Defoliant treatment extended over a period of $3\frac{1}{2}$ days or 7 units at 80°F in darkness.

Treatment	Mean time units Petiole drop	Leaf abscission per cent	Leaf abscission Mean time units
Control	4.13	25	5.50
Ethylene-water 1 cc	1.00	56	4.50
" 2 cc	1.06	50	5.12
" 4 cc	1.25	70	4.81
Indole AA 10 ppm	5.86	0	(7+)
E 1 cc + IAA 10 ppm	2.44	38	5.66
E 2 cc "	2.20	38	7.00
E 4 cc "	1.88	100	7.00

The procedure noted was modified for the other gases tested. Gases insoluble in water were measured by "displacement method." The volume of test gas introduced was thus roughly gauged from bubble counts. The explant was inserted in the bottle and compressed air used to displace the remainder of the water before closing and sealing the bottle.

Results are given in the following series of tables (5, 6, 7, and 8).

Table 5. Percentage defoliation and mean time in 12 hour units per leaf of Ligustrum ovalifolium, 10 leaves per twig, 4 twigs per treatment, March 10, 1953. Duration of treatment $5\frac{1}{2}$ days or 11 units at 60°F in darkness.

Treatment	Defoliation Per cent	Defoliation Mean time units
Control	0	11+
Ethylene-H_2O $\frac{1}{2}$ cc	100	1.95
Indole acetic acid 10 ppm	0	11+
Ethylene $\frac{1}{2}$ cc + IAA 10 ppm	100	2.90
Maleic hydrazide 500 ppm	0	11+
Ethylene $\frac{1}{2}$ cc + Maleic hydrazide 500 ppm	100	2.80

Table 6. Per cent defoliation in Ligustrum ovalifolium after 3 days treatment with acetylene at 80°F in darkness. Table in 4 parts.

Part 1. Concentration of indoleacetic acid spray/prior to defoliant

Defoliant	0	10 ppm	100 ppm	500 ppm
None	0	0	0	0
Acetylene	100	80	57	3
Acetylene added 7 days after growth regulator	100	100	40	48

Part 2. Concentration of maleic hydrazide spray prior to defoliant.

Defoliant	0	1 ppm	100 ppm	10,000 ppm
None	0	0	0	0
Acetylene	100	100	97	60
Acetylene added 7 days after growth regulator	100	100	100	75

Part 3. Concentration of indoleacetic acid sprayed prior to applying defoliant.

Defoliant	0	10 ppm	100 ppm
None	0	0	0
Ethylene-H_2O 1 drop	50	51	25
" 1 cc	100	80	100
" 10 cc	100	100	100

Part 4. Concentration of maleic hydrazide sprayed prior to applying defoliant.

Defoliant	0	1000 ppm	10,000 ppm
None	0	0	0
Ethylene-H_2O 1 drop	50	45	78
" 1 cc	98	100	100
" 10 cc	100	100	100

Table 7. Per cent defoliation after 19 and 25 hours of exposure to acetylene, ethylene and methane by <u>Ligustrum</u> <u>ovalifolium</u> sprayed with indoleacetic acid.

Defoliant	Exposure time hours	Indoleacetic acid used prior to defoliant treatment, in ppm 0	50
None	19	0	0
	25	0	0
Acetylene	19	0	0
	25	80	5
Ethylene-H_2O 1 cc	19	67	27
	25	95	95
*Methane 50 cc	19	5	0
	25	17	0

* Methane used from lecture bottle and reported to contain traces of carbon monoxide and .4% ethane.

Table 8. Per cent defoliation after 3 days exposure to ethylene or carbon monoxide by <u>Ligustrum</u> <u>ovalifolium</u> previously sprayed with indoleacetic acid.

Defoliant	Concentration indoleacetic acid spray prior to defoliant 0	10 ppm	100 ppm
Control	0	0	0
Ethylene H_2O 0.5 cc	100	100	63
1.0 cc	100	100	37
CO 4.5 cc	52	0	8
9.0 cc	90	43	26
18.0 cc	95	25	15

Ammonia (4), carbon dioxide and nitrogen did not cause defoliation. Ammonia was toxic in the amounts employed, 1 ppm to 10,000 ppm, though some defoliation did follow the use of 10 drops of 10,000 ppm solution in a pint bottle. Ethylene (Tables 2, 3 and 4) rather consistently resulted in abscission of petioles and leaves. Young debladed petioles of <u>Coleus</u> <u>Blumei</u> were slower in abscission than older petioles. The young petioles responded proportionally more than older petioles to ethylene. Treating petioles with auxin delayed abscission. The delay was of the same relative order (approximately 30%) in both ethylene-auxin combination and in auxin treated petioles versus control petioles.

The majority of later work was done with Ligustrum ovalifolium twigs. Ten young leaves were present on each twig. Old leaves or those not of normal healthy green color were discarded. Foliage of similar leaf area was employed as far as possible from matching the twigs and leaves by eye. The course of abscission began in the older leaves of the 10 leaf sample and in many cases the leaves that were still immature in size or were in the process of unfolding remained after the ten full-sized leaves of the sample had defoliated. The relation of age of leaf to abscission was therefore similar in both Coleus Blumei and in Ligustrum ovalifolium.

The results (Tables 5, 6, 7, and 8) with ethylene, acetylene and with carbon monoxide indicate induction of defoliation at 80°F in Ligustrum ovalifolium. Results with methane may be due to impurities in C.P. "lecture bottle" samples. The growth regulators indoleacetic acid and maleic hydrazide,applied prior to using the defoliant,retarded leaf fall in comparison with the use of the defoliant alone. The delay in the abscission was somewhat greater at higher level of growth regulator than at the lower level.

The results of this series of tests would appear to the authors to indicate:

1. That in addition to ethylene, other unsaturated hydrocarbons may be effective defoliants. Carbon monoxide as well as acetylene resulted in abscission of privet leaves.

2. When growth regulators were sprayed on privet foliage prior to defoliant treatment a delay in abscission resulted.

3. The extent of the delay in abscission is related to both the amount of growth regulator and to the amount of defoliant.

4. When a small or marginal amount of defoliant is used the growth regulator level of the leaf either natural (young) or modified by artificial means often retards or may prevent abscission.

5. When a large amount of defoliant is applied the growth regulator level of the leaf tissue from natural or artificial sources often becomes inadequate to prevent abscission though abscission may be delayed.

6. If environmental conditions result in modifications of auxin level in the abscission zone, it is possible that such changes may partially account for some of the variability obtained under field conditions in defoliating nursery stock. This is particularly important since action of endothal and sodium chlorate-pentaborate have been shown by Hall to be reduced in Coleus Blumei when 1% IAA was applied prior to the defoliant.

References

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3. Wetmore, R. H. and Wm. P. Jacob. Studies on abscission; The inhibiting effect of auxin. Am. Jour. Bot. 40 (4): 272. 1953.
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Fall Application of Herbicides in Nurseries

Effect on Nursery Stock

A. M. S. Pridham, Cornell University

Lot 1. Twigs of Forsythia intermedia and of Ligustrum ovalifolium were cut to 6 inch lengths and grouped in samples of 10 for spraying with herbicides to determine their effect on the buds and wood of the leafless cuttings. Spraying was done November 17, 1952. After spraying, twigs were allowed to dry rapidly at 80°F or were kept under outdoor weather of late November 20° to 50°F in relatively moist air. The twigs were kept in open quart bottles. After two weeks exposure the cuttings were taken from storage and placed in propagating sand in a greenhouse. Mortality in the cuttings as of January 1, 1953 is given in Table 1.

Table 1. Percentage of mortality in twigs of Forsythia intermedia and of Ligustrum ovalifolium January 1, 1953 after treatment with herbicides November 17, 1952.

	Forsythia intermedia		Ligustrum ovalifolium	
Herbicide applied	Twigs dried quickly 85°F	Twigs dried slowly 50°F	Twigs dried quickly 85°F	Twigs dried slowly 50°F
Control	0.0	0.0	8.0	0.0
Chloro IPC 1:12	5.0	5.0	0.0	0.0
1:50	0.0	0.0	0.0	0.0
Endothal 1:12	0.0	7.5	5.0	2.5
1:50	0.0	0.0	10.0	0.0
Sinox PE 1:12	12.5	2.5	100.0	0.0
1:50	2.5	0.0	100.0	0.0
Sinox W 1:12	0.0	0.0	0.0	0.0
1:50	0.0	0.0	0.0	0.0
Dow Premerge 1:12	2.5	5.0	100.0	7.5
1:50	5.0	0.0	50.0	0.0

When twigs were sprayed with herbicide at rates recommended by manufacturers and the twigs allowed to dry outdoors in mid-November, no mortality occurred in the twigs during a month's period in propagating sand in the greenhouse. The twigs were taken out of the sand for examination at that time, thus concluding the test.

Lot 2. Twigs of Juniperus chinensis were received for test February 12, 1953 and after treatment with herbicide were placed to dry for one day at 85°F and for the remainder of 10 days at -10°F. A second lot was allowed to dry slowly at 50°F. All twigs were placed in propagating sand in the greenhouse February 24.

After 1 week all twigs treated with dinitro herbicides and dried at 85°F were dead. Controls were uninjured but all other treated cuttings were injured and were dead by March 26.

Twigs placed in 50°F after treatment were injured less than those at 85°F. The controls, NIX and chloro IPC at recommended concentrations were uninjured at the end of a week in the greenhouse.

Lot 3. Twigs of Malus baccata and of Platanus orientalis were received and sprayed with herbicides February 24. After spraying the twigs were placed in quart bottles to keep the several treatments separate. The twigs were kept outdoors till March 3 when they were brought indoors and after a day at 50°F were placed in propagating sand in the greenhouse. The mortality of the twigs two weeks later is given in Table 2. The twigs of Malus were tips of vigorous shoots and seldom averaged $\frac{1}{4}$ inch in diameter.

Table 2. Percent mortality in twigs of Malus baccata and of Platanus orientalis four weeks after spraying with herbicides as indicated by greenhouse tests.

Herbicide applied	% mortality in 40 twigs	
	Malus baccata	Platanus orientalis
Control	52.0	0.0
Chloro IPC 1:12	97.5	7.5
1:50	50.0	0.0
NIX 1:1000	80.0	7.5
Sinox PE 1:12	100.0	17.5
1:50	100.0	0.0
Dow Premerge 1:12	100.0	45.0
1:50	100.0	0.0
Endothal 4069 1:25	100.0	100.0
1:100	100.0	100.0

The twigs of Malus baccata may have been injured in some other manner than by herbicides since over 50% of the control twigs failed to grow in propagating sand. Twigs of Platanus orientalis were over a quarter inch in diameter and with a distinct bark. No injury resulted from following the manufacturer's recommendation for concentration of herbicide for normal use except for NIX and for endothal.

Summary

Twigs of Forsythia intermedia, Ligustrum ovalifolium, Malus baccata, Platanus orientalis and Juniperus chinensis were gathered during the fall and winter of 1952-53 for treatment with herbicides at normal rates recommended by manufacturers for control of annual weeds. in farm crops.

After treatment twigs were dried quickly or kept in low temperature, highly humid air for slower drying. Twigs were set in propagating sand four weeks after treatment. The condition of the twigs four weeks after planting was taken to be indicative of the effect of the herbicide upon the twigs when sprays were applied during fall or winter.

Applications made at manufacturer's recommended rates did not result in damage to the twigs except where drying took place rapidly at high temperatures. Juniperus chinensis and Malus baccata are both exceptions in this experiment. Forsythia intermedia was injured least.

From the results of these tests the dinitro herbicides were most likely to result in injury to "dormant" twigs. Chloro IPC was the least likely to injure twigs. Injury from endothal was serious only with Platanus orientalis if species characteristics are recognized as associated with injury in Juniperus chinensis and Malus baccata.

Field tests with the herbicides used in these experiments indicate that more injury was evident in the tests than under field conditions.

Fall Applications of Herbicides in Nurseries

Residual Effect in Soils

A. M. S. Pridham, Cornell University

Two soils were used to study the residual effects of herbicides. Both soils were loamy, one a Dunkirk silty clay loam, the second a sassafras loam. Eight samples of 160 grams each were placed in specimen dishes and 20 cc. of water added, which brought up the moisture content to near field capacity. The soils were then sprayed for 9 seconds with an air brush to deliver .8 cc of herbicide over the 12 square inches of exposed soil surface. This ammount approximates 100 gallons of spray per acre. Ten cucumber seed were then placed on the soil surface and the dish covered and stored at 65°F for 7 days time. Notes were made of the number of seeds germinating and of any abnormalities in the early growth of the primary root. The seedlings were then removed and the culture resprayed ready for replanting.

A series of 8 spray applications were made between December 12, 1952 and March 16, 1953. Soils were thus subjected to an intense series of spray applications without the benefit of leaching rains or of high summer temperatures for evaporation. Soil moisture was moderate and after the first addition of water no more was added.

At the end of the series of spray applications the soils were transferred from specimen dishes to clay pots. Well rooted cuttings of Taxus cuspidata and of Ligustrum ovalifolium were planted in the soils. This phase lasted from March 16 to May 4.

The herbicidal sprays did not seriously injure cucumber seed laid on the soil surface for germination. The character of growth was modified in the first and subsequent cultures of chloro IPC. Swollen roots were present uniformly in all cultures at both concentration levels of chloro IPC. Small short roots were uniformly present from the first spraying of all dinitro formulations and concentration levels.

The growth of both the Taxus and the Privet was rated as good, meaning that the plants were alive and healthy. Plants remained healthy in the chloro IPC, endothal and NIX cultures. Privet plants were injured in CMU treated soil. All plants in soils treated with dinitros were dead by the end of 6 weeks time.

It is not to be concluded that dinitros are to be avoided but it would seem advisable to repeat tests of this type under actual field conditions where a wide range of soil types might be included and the maximum number of applications likely per year, 4 or 5, could be made in combinations with normal cultivation practices.

Crafts' work would indicate that soil sterility from dinitros would be unlikely in clay loams with which he experimented.

Table 1. Percent germination of cucumber seed and the condition of rooted cuttings of Taxus cuspidata and Ligustrum ovalifolium after planting in soils receiving 8 spray treatments in 3 months

Treatment and rate	Mean germination cucumber seed 8 runs	Mean germination cucumber seed 7 reps	Condition of plants March 16 to May 4 Taxus	Condition of plants March 16 to May 4 Ligustrum
Control	86.7	85.6	Healthy	Healthy
Chloro IPC 1:12	88.6	91.9	Healthy	Healthy
1:50	86.9	82.9	Healthy	Healthy
Sinox PE 1:12	85.3	87.0	Dead	Dead
1:50	87.0	91.9	Dead	Dead
Sinox W 1:3	81.1	80.6	Dead	Dead
1:12	82.3	87.8	Dead	Dead
Dow Premerge 1:50	92.5	83.8	Dead	Dead
Endothal 1:170	83.3	89.6	Healthy	Healthy
(3000) 1:680	90.0	89.4	Healthy	Healthy
CMU 1:40	85.6	90.8	Injured	Dead
NIX 1:1000	93.3	88.3	Healthy	Healthy

The present tests would point to chloro IPC, endothal and NIX as leaving relatively less toxic residues than the dinitro group on the basis of normal rates of application and at as much as four times the normal rates.

Reference

Crafts, A. S. Toxicity of Ammonium Dinitro-o-sec-butyl phenolate in California Soils. Hilgardia 19, No. 5, pp 161-169.

Artemisia vulgaris - Control in Nursery Plantings

A. M. S. Pridham, Cornell University

Artemisia vulgaris was planted in pots and permitted to grow for one summer till the plants were well established. Treatments were then applied to the tops of the plants only.

Two tests were run. The first set up December 15 included control, Sinox PE, chloro IPC, endothal and CMU. The second test was begun January 29 and confined to chloro IPC in comparison to cutting off the tops of the plants.

Chloro IPC at 1:12 sprayed on the foliage at the equivalent of 200 gallons per acre resulted in severe injury of most Artemisia roots. CMU at 1:40 was also effective and regrowth following Sinox PE 1:12 was slow in appearing.

Potted plants of *Ligustrum ovalifolium* were sprayed April 21 with the three herbicides noted and the concentration of CMU lowered by steps from 1:40, 1:80, 1:800. Plants sprayed on the exposed roots were killed with all three herbicides as was Artemisia. CMU sprayed on the tops also killed over half the plants so treated.

Field tests were begun in July in a field of Rhododendrons at Callicoon, N. Y. Chloro IPC was used at 1:50 and at 3:50. Dow Premerge and Sinox PE were used at 1:50. Spray was applied directionally among the Rhododendron plants in a recently invaded area. Solid blocks of spraying was done in a well established growth of Artemisia. The sprays were repeated again in August and samples of 1 square foot area were dug in October from control and treated plots. The roots were shaken free of soil and the samples weighed.

A similar procedure was followed in a second nursery at Eastview, N. Y. after a single application of herbicide in August.

The results are given in the following table.

Table 1. Reduction in stand of *Artemisia vulgaris* at two locations following foliage spray application of herbicides. Weight of plants per square foot for control taken as 100.

	Location	
Treatment	Callicoon, N. Y. after 2 sprayings	Eastview, N. Y. after 1 spraying
Control	100	100
Chloro IPC	48	63
Sinox PE	83	90

In both locations the population of Artemisia roots has declined. This agrees with results from screening tests. The more marked decline resulted from chloro IPC rather than from application of dinitro. This, too, agrees with screening tests.

These results are reported at this time largely to stimulate interest in the possibility of controlling a weed that is a serious problem in many nurseries in the northeast. The control of Artemisia by foliage application to weeds growing in nursery stock will likely require a series of applications to be effective. Since chloro IPC does not injure mature bark and wood or seriously interfere with soil conditions, it may prove to be an effective aid in controlling Artemisia in established plantings.

Recent Developments with the Two Contact Herbicides, Good-rite N.I.X. and Good-rite Oktone in Greenhouse, Nursery, and Truck Crop Work

by

Dr. J. H. Standen, B. F. Goodrich Chemical Company

By way of quick review on these two products, N.I.X. (sodium isopropyl xanthate) is applied in a water solution. It is a mild herbicide requiring a warm and dry period of 2-5 hours to do its work. It is really effective only on small, tender weeds, and has no hormone action nor residual.

Oktone is, chemically, octachlorocyclohexenone. It is applied in oil. At present it is distributed as a 40% oil solution, although it looks as though we may have to go to a sand form of the pure material. It kills all vegetation wet with it to the soil level. Weather does not affect its action. It has very little soil residual at recommended rates.

Because most hardened stems are not significantly injured by N.I.X., it is being used at present to weed, as a directed spray, gladiolus, cabbage and its relatives, roses, all shrubs, conifer seedlings, (yew and a couple others are somewhat sensitive), and a long series of plants, including carnations, dormant poinsettias, hydrangeas, callas, hard stemmed chrysanthemums, peonies, etc. In fact, in a recent test on young hardy perennials, Platycodon was the only plant of 18 species in the trial significantly injured by N.I.X.

Dr. O. W. Davidson of Rutgers University has devised what he calls a chemical hoe. This is merely a 6 inch funnel soldered over a Teejet nozzle on the end of a spray wand. The mouth of the funnel can be held within an inch or less of the soil surface, and essentially 100 per cent of the foliage of shrubby plants such as roses, azaleas, and hydrangeas can thus be protected from spray injury. One grower working under Dr. Davidson's direction says that two men working with chemical hoes did a better job in a day and a half than 4 men previously did in 4 days by regular chopping methods.

The use of N.I.X. pre-emergent to field drilled peppers is now standard practice in both the Pompano and the Ft. Myers areas in Florida.

N.I.X. has two rather serious qualifications along with its virtues. Weeds must be small and tender, and weather must be right. Of course, these two qualifications cancel out entirely under glass.

We've found some new points too on Oktone. One is what appears to be a considerable extension of the number of crops that will take pre-emergent Oktone. We have known for a couple years that Oktone can be used without injury at ten times the recommended concentration pre-emergent to gladiolus, set onions, beets, sugar beets, and all Brassica oleracea forms. Apparently peppers are also safe by a wide margin. We are not quite sure yet if we can continue to use Oktone in Diesel #2 pre-emergent to certain other vegetable crops. We may have to use it in mineral spirit to avoid oil injury. We are using Oktone in mineral spirit pre-emergent to practically any vegetable crop you can name. We are also using Oktone pre-setting to peppers, tomatoes, and any other set plants where weeds need to be knocked down before setting. This technique should be of particular value with sweet potatoes that are set with a dibber, as the weeds could be allowed to sprout, and then be sprayed out in the rows prior to setting. The dibbers would bring up very few new weeds.

Before I come to the most interesting part of my paper, I want to tell you of two interesting techniques we have developed in connection with Oktone in nurseries. The one has to do with the fact that in some parts of the country weeds such as chickweed, certain mints, shepherd's purse, mustards, and Poa annua form a considerable mat by the time herbaceous perennials break dormancy in the spring. Often this mat is so heavy that delphiniums and others of like habit have trouble breaking through. Because Oktone is indifferent to weather, it can be used to kill such mats prior to emergence of the herbaceous perennials. In this connection, we suggest two or three successive light applications rather one heavy one, and better to work with mineral spirit rather than Diesel #2. Also, care should be taken that the crowns of the perennials have at least 1/4 inch of soil over them. This, of course, can be easily arranged by throwing a little dirt to them late in the fall.

The second Oktone technique is quite simple. If, in lined out stock, roses, and such, the weeds are really bad, a plywood shield placed so that the lower edge is on the ground next to the base of the stems may be used. The top is drawn back exposing the weeds. A second operator gives them a shot of Oktone spray. I showed this to one rose grower, and he was able to dismiss 60% of his field crew two days later. The remaining crew was still able to do the job better than it had been done.

Now, for this new technique I mentioned before. Supposing we weld on the front wheel of a regular seeder, a hoop, wedge shaped in cross section, with a knife edge, about 5/8 inch deep and 1/2 inch wide at the base. Now remove the opening plow and the covering devise leaving only the seed shoot. The firming wheel may need a bit of extra weight, say 10 lbs. to close the V-shaped furrow we roll into the soil with that hoop. Now, let's fit the soil, and let the weeds sprout. It is important that we keep the soil surface moist and get the surface weeds through. A sprinkling system helps a lot here, and may mean the success or failure of the technique. When the weeds are well sprouted we roll a V-shaped opening in the soil surface, drop the seed, and roll the same soil back in the same position, bringing up no new weed seeds. Depending on conditions, we may spray with N.I.X. plus wetting agent or Oktone in the same operation, or delay until just prior to seedling emergence. The results in our trials in Florida sand are startling, as I'll show you in a moment with some photos.

I anticipate an objection. Someone is going to say that lettuce seed, for example, must be planted too shallow to permit such a practice. The grower with whom I worked shallowed two units of his seeder with strips of linoleum. The seeds planted at 5/8 inch depth gave the best germination. The same technique should be possible with larger seeds using larger hoops.

This technique is brand new, and I'm not presenting it as a finished thing, but it certainly looks most promising. My Florida cooperator is going to eliminate at least 90% of his hand work in the row, and by that I mean well over 95% of the weeds.

CRAG Herbicide-I (Sodium 2-(2,4-dichlorophenoxyethyl sulfate) for Preventing Weeds in Flowers, Shrubs and Nursery Stock.

T. P. Finn, L. J. King, and A. J. Vlitos[1]

INTRODUCTION

It has been demonstrated that aqueous applications of CRAG Herbicide-I to the aerial parts of plants at dosages that will kill germinating weed seeds are non-phytotoxic and physiologically inactive.[2] However, this herbicide is converted to its "active form" upon contact with soil, suggesting a microbial breakdown.[3]

Because of these unique properties CRAG Herbicide-I has been widely tested both as a pre-emergence and post-emergence selective herbicide. It is commercially recommended for pre-emergence use when flowers such as gladioli, dahlias, daffodils, lilies and iris are planted as well as a selective herbicide after emergence. As a post-emergence selective herbicide, CRAG Herbicide-I is also commercially recommended for weed control in established plantings such as strawberries, asparagus, sweet and field corn and a large variety of nursery stock.

The purpose of this paper is to present in abstract form the results obtained when CRAG Herbicide-I is employed as a selective spray for preventing weeds in established plantings of ornamental evergreen and deciduous trees and shrubs, tree and bush fruits and annual and perennial flowers. These data are taken from reports of Agricultural Experiment Stations and commercial nurserymen who have tested CRAG Herbicide-I during the 1952 growing season.

RESULTS AND DISCUSSION

The results obtained with CRAG Herbicide-I for preventing weeds in plantings of ornamental evergreen trees and shrubs, deciduous trees and shrubs, tree and bush fruits and annual and perennial flowers are abstracted in Tables I, II, III, and IV respectively. A number under the heading "source" in each table designates the institution, company or individual contributing the indicated data (see list of cooperators).

1/Fellows, Boyce Thompson Institute for Plant Research, Inc., and the Carbide Carbon Chemicals Company, 30 East 42nd Street, New York 17, N. Y.

2/Herbicidal Properties of Sodium 2,4-Dichlorophenoxyethyl Sulfate. Lawrence J. King, J. A. Lambrech, and Thomas P. Finn. Contrib. Boyce Thompson Inst., 16(4): 191-208, October-December 1950.

3/Biological Activation of Sodium 2-(2,4-dichlorophenoxy)Ethyl Sulfate by <u>Bacillus Cereus</u> Var. <u>Mycoides</u>. A. J. Vlitos. Contrib. Boyce Thompson Inst., 16(9): 435-438. January-March, 1952.

It is noted that observations pertaining to weed control were not recorded in some instances. In such cases the applications were made principally to determine the effects upon the cultivated plant since weed control efficiency had already been established.

It is interesting to note that no injurious effects due to phytotoxicity were reported by any of the cooperators substantiating the safety of CRAG Herbicide-I on plant foliage. The instances where CRAG Herbicide-I was injurious to plants, for example, injury observed on holly, juniper and yew by the Conner and Amos Nursery can be attributed to the abnormal condition of water collecting in low areas in the field. No doubt the water collecting in these low spots containing the herbicide in solution resulted in application of the chemical at much greater pounds per acre than initially calculated. In the remainder of the field that was well drained no such injury was observed.

A similar case of over-concentration causing injury was noted by the Stark Brothers Nurseries and Orchards Co. on peach seedlings. While cleaning nozzles in the field, drip from other nozzles caused excessive dosage to some of the plants. Observing that coverage was uneven due to this nozzle clogging the same area was sprayed two more times. Consequently the injured seedlings received three times the normal concentration in addition to excessive nozzle dripping. However, where CRAG Herbicide-I was applied normally at the rate of 3 lbs./A. on May 23 and June 18 no such injury occurred.

There are, of course, instances where injury may be attributed to the extreme sensitivity or growth habit of the plant. The pine and oak seedlings that were affected may be due to plant sensitivity at that particular stage of growth. A similar case of boxwood injury occurred at the Koster Nursery. Mr. James Wells, manager of this nursery, pointed out that boxwood by the nature of their method of growth rapidly produce adventitious roots from the stem of the plant just below the soil surface after transplanting. Such roots may have absorbed the herbicide that is concentrated in this upper layer of soil resulting in injury. This condition may also account for the injury noted on pine and oak seedlings since both were young liners recently set in the field. Delaying the application of CRAG Herbicide-I until such liners or surface rooting plants in general are older and better established may eliminate sensitivity and injury. Boxwood treated at a later stage of growth (source 14) was not injured by a similar application substantiating this reasoning. The cases of injury on very young stock may well be remedied by paying particular attention to the growth habit of such species and applying CRAG Herbicide-I when the plants have become better established.

When most plant species were well established no instances of injury were reported. Note that species of arborvitae, camellia, gardenia, hemlock, holly, juniper, rhododendron and yews ranging from rooted cuttings to four year old stock were successfully weeded with CRAG Herbicide-I. Similarly, well established ornamental deciduous trees and shrubs such as barberry, crabapple, cypress, dogwood, euonymous, firethorn, heather, honeysuckle, hydrangea, lilac, mock orange, privet and roses were weeded with CRAG Herbicide-I without injury.

Where correct dosages were applied no injurious effects were reported in weeding fruit plants such as apple, boysenberry, cherry, citrus, peach, pear, plum, quince and raspberry.

Many annual and perennial flowers may also be weeded with CRAG Herbicide-I but again growth habit and the development of the plant at the time of application will be important factors to consider for maximum safety.

The consistency of effective weed control with CRAG Herbicide-I is evident. Good weed control was obtained for three or more weeks depending upon the rate per acre under normal growing conditions. Where adverse weather conditions prevented normal weed populations, weed control could not be determined. Also of interest are reports of effective weed control under high soil moisture conditions. Frequent irrigation needed in the Conner and Amos tests did not adversely affect weed control.

(Paper presented orally at NEWCC, Hotel New Yorker, N. Y., January 1953)

LIST OF COOPERATORS

Source	
1	Conner & Amos, Inc., Charleston, West Virginia
2	Ravizza Nursery, New Britain, Connecticut
3	Dugan Nurseries, Perry, Ohio
4	Jackson & Perkins Co., Newark, New York
5	Koster Nursery, Div. of Seabrook Farms, Bridgeton, New Jersey
6	(Authors' data)
7	C. R. Ure, Canadian Dept. of Agric. Exp. Sta., Morden, Manitoba, Canada
8	E. Dudley, Deputy Agricultural Commission, Santa Ana, California
9	V. H. Freed, Dept. of Farm Crops, Oregon State College, Corvallis, Oregon
10	Florida Agricultural Supply Co., Jacksonville, Florida
11	J. P. Mahlstede, Hort. Dept., Iowa State College, Ames, Iowa. (Data published in Research Report, Eighth Annual North Central Weed Control Conference, 1951.
12	Stark Brothers Nurseries, Louisiana, Missouri
13	E. L. Denisen, Hort. Dept., Iowa State College, Ames, Iowa. (Data published in Research Report, Eighth Annual NEWCC, Dec. 1951)
14	F. S.Gooch, Southwestern Louisiana Institute, Lafayette, Louisiana

TABLE 1. ORNAMENTAL EVERGREEN TREES AND SHRUBS WEEDED WITH CRAG HERBICIDE-I

Common Name	Genus, Species, Variety	Source	Weed Control and Crop Response Data
ARBORVITAE	1) Thuja orientalis	5	3 lb./A applied to 2 yr. old grafts 8 to 10" in ht., fair to good weed control, no injury.
	2) Thuja occidentalis	5	3 lb./A applied to 2 yr. old grafts 12" in ht., no injury, insufficient weeds for weed control determination.
	3) Thuja occidentalis	2	2 lb./A applied between rows, excellent control of all weeds except wild mint, no injury.
	4) Thuja spp.	3	Applied at 2 lb./A to stock ranging from rooted cuttings to 4 yr. old plants, good weed suppression for 2 to 3 weeks, no injury.
	5) Thuja orientalis	11	Two app. of 4 lb./A on 3 yr. old transplanted seedlings, 97.3% control of chickweed, peppergrass, purslane, no injury.
BOXWOOD	1) Buxus sempervirens	5	3 lb./A applied to 1 yr. old rooted cuttings, excellent weed control, mod. suppression of growth and chlorosis, slow recovery.
	2) Buxus sp.	9	1 and 2 lb./A app., 50 to 96.7% weed control, no injury.
	3) Buxus sp.	14	Well established rooted cuttings treated with 2½ to 3 lbs./A, no injury, no weed data taken.
BULL BAY	1) Magnolia grandiflora	14	Four mo. old cuttings 2-3" in ht. treated with 2½-3 lbs./A. no injury, no weed data taken.
CAMELLIA	1) Camellia japonica	6	3 lbs./A applied to young stock 4-5' in ht., no deleterious effects observed 1 mo. after application.
	2) Camellia sasanqua	14	Well established rooted cuttings treated with 2½-3 lb./A, no injury, no weed data taken.
GARDENIA	1) Gardenia dwarf	14	Well established rooted cuttings treated with 2½-3 lb./A, no injury, no weed data taken.
HEMLOCK	1) Tsuga canadensis	2	2 lb./A applied between rows, excellent control of all weeds except wild mint, no injury.
HOLLY	1) Ilex crenata convexa	1	Holly species 1) to 6) were 1951-52 greenhouse cuttings set in field as 6" liners. CRAG-I was applied 3 times during summer at rate of 3½ lb./A, 90% weeds that come from seed were killed. Overhead irrigation applied frequently and injury noted where water drained and collected in low areas. Similar app. on larger and older holly resulted in 90% or better weed control with no injury.
	2) Ilex crenata rotundifolia	1	
	3) Ilex crenata microphylla	1	
	4) Ilex crenata helleri	1	
	5) Ilex crenata burfordi	1	
	6) Ilex crenata glas	1	
	7) Ilex spp.	13	Applied at 2 lbs./A to stock ranging from rooted cuttings to 4 yr. old plants, good weed suppression for 2-3 wks. no injury.

Table 1 (cont.)

Common Name	Genus, Species, Variety	Source	Weed Control and Crop Response Data
JUNIPER	1) Juniperus chinensis pfitzeriana	1	Juniper species 1) and 2) were 1951-52 greenhouse cuttings set in field at 6" liners. CRAG-I applied 3 times during growing season at rate of 3.5 lb./A, 90% weed control obtained. Injury noted when irrigation water collected in low areas of field whereas no injury noted in well drained areas. Similar app. on larger and older stock resulted in excellent weed control with no injury.
	2) Juniperus horizontalis plumosa	1	
	3) Juniperus spp.	3	Applied 2 lb./A to stock ranging from rooted cuttings to 4 yr. old plants, good weed control for 2-3 wks., no injury.
	4) Juniperus communis stricta	5	3 lb./A applied to 2 yr. old rooted cuttings, excellent weed control, no injury.
	5) Juniperus communis compressa	6	3 lbs./A applied to young stock 4-5' in ht. of Juniperus species 5) and 6), no deleterious effects observed 1 mo. after app.
	6) Juniperus foetidissima squarrosa	6	
	7) Juniperus virginiana	11	Two app. at 4 and 6 lb./A on 3 and 4 yr. old stock of Juniperus species 7) and 8) gave 90% weed control 1 mo. after 1st. app. and 79% at 4 lb./A rate after 2nd app. Hand labor was reduced ½ where CRAG-I was used at 6 lb./A, no injury reported on either species.
	8) Juniperus procumbens	11	
MAHONIA	1) Mahonia sp.	6	3 lb./A applied to young stock, no deleterious effects observed 1 mo. after application.
PINE	1) Pinus caribaea	14	4 mo. old cuttings 2-5" in ht. treated with 2½ to 3 lb./A, stem curvature and leaf injury noted, no weed data taken.
RHODODENDRON	1) R. var. roseum	5	3 lb./A applied to 1 yr. old rooted cuttings, no injury, insufficient weeds for weed control determination.
	2) Rhododendron sp.	9	1 to 2 lb./Aapp., 50 to 96.7% weed control, no injury.
ROSE (CHRISTMAS)	1) Helleborus niger		2 lb./A applied to established plants, good control of small weed seedlings, no apparent injury.
ROSEMARY	1) Rosmarinus officinalis	6	3 lb./A applied to young stock, no deleterious effects observed 1 mo. after application.
YEW	1) Taxus cuspidata	1	Taxus species 1) and 2) were 1951-52 greenhouse cuttings set in field as 6" liners. CRAG-I applied 3 times during season at 3.5 lb./A, 90% weed control obtained. Injury noted when irrigation water collected in low areas in field whereas no injury noted in well drained areas. Similar app. on larger and older stock resulted in excellent weed control, no injury.
	2) Taxus hunnewelliana	1	

Table 1 (cont.)

Common Name	Genus, Species, Variety	Source	Weed Control and Crop Response Data
YEW	3) Taxus spp.	3	Applied 2 lb./A to stock ranging from rooted cuttings to 4 yr. old plants, good weed control for 2-3 wks., no injury.
	4) Taxus media hicksii	5	3 lb./A applied to 1 yr. old liners 8-10" in ht., excellent weed control, no injury.
	5) Podocarpus macrophylla	14	Well established rooted cuttings treated with 2½ to 3 lb./A, no injury, no weed data taken.

TABLE II. ORNAMENTAL DECIDUOUS TREES AND SHRUBS WEEDED WITH CRAG HERBICIDE-I

Common Name	Genus, Species, Variety	Source	Weed Control and Crop Response Data
BARBERRY	1) Berberis thunbergii	4	CRAG-I applied at 4 lb./A between rows, no injury seen. Dry weather prevented weed control determination.
	2) Berberis red	12	CRAG-I applied at 2½-3 lb./A, no injury, weed control undetermined because of dry weather.
CRABAPPLE	1) Malus sp.	7	Spring transplanted 1 yr., root stock seedlings treated with CRAG-I at 2,4,6,8 lb./A, good control of all weeds obtained at 4 lb./A and higher. Slight resistance of wild millet at the 2 lb./A rate. Slight injury at the 8 lb./A rate but rate of growth not seriously impaired. A trace of injury on a few plants at 6 lb./A, no injury at 4 and 2 lb./A.
CYPRESS	1) Taxodium distichum	14	Sprayed with CRAG-I at 2½-3 lb./A as the seedings were emerging and at 3, 4½, 8 and 10 wks. after emergence. No injury observed on any seedlings treated 3 wks. after emergence or thereafter. Epinasty and growth suppression seen on seedlings treated at emergence, weed data not taken.
DOGWOOD	1) Cornus florida rubra	5	3 lb./A applied to 1 yr. old grafts, no injury, excellent weed control.
EUONYMOUS	1) Euonymous japonica	6	3 lb./A applied to young stock. No deleterious effects observed 1 mo. after application.
	2) Euonymous patens	1	1951-52 cuttings set in field as 6" liners received 3 app. of CRAG-I at 3½ lb./A throughout the growing season. No injury noted except in low areas in field where irrigation water collected. Good weed control. Similar app. on larger and older plants have shown no injury and good weed control.
FIRETHORN	1) Pyracantha duvalii	6	3 lb./A applied to young stock. No deleterious effects observed 1 mo. after application.
HEATHER	1) Erica tetralix	6	" " " "
HONEYSUCKLE	1) Lonicera implexa	6	" " " "
HYDRANGEA	1) Hydrangea anomala	6	" " " "
LILAC	1) Syringa French hybrid	5	Lilac on privet rootstock grafts 4-6" in ht. set in field 1952 treated with CRAG-I at 3 lb./A, excellent weed control, no injury.
	2) Syringa sp.	9	1 and 2 lb./A. app., 50 to 96.7% weed control, no injury.
	3) Syringa sp.	11	Two app. at 4 and 6 lb./A on 3 and 4 yr. old stock gave 90% weed control 1 mo. after the first app. and 79% control after second app. Hand labor reduced ½ at 6 lb./A, no injury.

Table II (cont.)

Common Name	Genus, Species, Variety	Source	Weed Control and Crop Response Data
MOCK ORANGE	1) Philadelphus sp.	11	Two app. at 4 and 6 lb./A on 3 and 4 yr. old stock gave 90% weed control 1 mo. after 1st. app. and 79% control after 2nd app., no injury. Hand labor reduced ½ where CRAG-I used at 6 lb./A.
	2) Philadelphus sp.	12	CRAG-I applied at 2½-3 lb./A, no injury, weed control undetermined because of dry weather.
OAK	1) Quercus virginiana	14	Four mo. old cuttings 4-8" in ht. treated with CRAG-I at 2½ to 3 lb./A. stem curvature and leaf injury noted, no weed data taken.
PRIVET	1) Ligustrum ovalifolium	4	4 lb./A applied between rows, no injury, weed control nil due to dry weather.
	2) Ligustrum sp.	6	3 lb./A applied to young stock 3-4' in ht., no deleterious effects observed 1 mo. after application.
	3) Ligustrum sp.	9	1 and 2 lb./A applied to young stock resulted in 50 to 96.7% weed control, no injury.
ROSES	1) Rosa chinensis viridiflora	6	3 lb./A applied to rose species 1), 2), and 3), no deleterious effects observed 1 mo. after application.
	2) Rosa rouletti	6	
	3) Rosa rugosa	6	
	4) Rosa rouletti	4	2 lb./A app. of CRAG-I resulted good control of small weed seedlings and no apparent injury.
	5) Rosa ver. aloha	4	4 lb./A applied between rows, no injury, weed control nil due to dry weather.
	6) Rosa sp.	8	Two app. of 3 lb./A applied to field grown roses resulted in good weed control for 6-8 wks. with no injury noted immediately after the app. or the following year.
	7) Rosa sp.	9	1 and 2 lb./A app. results in 50 to 96.7% weed control with no injury.

TABLE III. TREE AND BUSH FRUITS WEEDED WITH CRAG HERBICIDE-I

Common Name	Genus, Species, Variety	Source	Weed Control and Crop Response Data
APPLE	1) Malus sylvestris	7	One yr. old seedlings treated with 2,4, and 8 lb./A resulted in 75, 80 and 80% weed control respectively with no observable injury from any of the concentrations.
BOYSENBERRY	1) Rubus ursinus Loganbaccus	9	1 and 2 lb./A app. on established stock gave 50 and 96.7% weed control with no injury.
CHERRY	1) Prunus cerasus	7	1 yr. old seedlings treated with 2, 4 and 8 lb./A resulted in 75, 80 and 80% weed control respectively with no observable injury from any of the concentrations.
	2) Prunus cerasus	12	Seedlings set in the field during spring of 1952 were treated 1 mo. after setting with two app. of CRAG 1 at rate 2.5 lb./A. Dry season prevented weed control determinations, however, no injury was observed.
CITRUS	1) Citrus spp.	8	App. of 1, 2,3,4, and 5 lb./A applied around trees resulted in excellent weed control at 3 lb./A and higher rates for two months after applying with no indication of injury.
	2) Citrus sinensis	8	Three app. totalling 18 lb./A applied to establish orange trees resulted in excellent weed control and no injury noted shortly thereafter or the following season.
PEACH	1) Prunus persica	12	Seedling 7" in ht. set in field spring of 1952, were treated 1 mo. after transplanting with 2 app. of CRAG 1 at 2.5 lb./A. Injury noted where drip from nozzles and 3 times or more the normal app. rate was applied.
PEAR	1) Pyrus communis	12	Seedlings set in the field during spring of 1952 received 2 app. at rate of 2.5 lb./A 1 mo. after transplanting. Dry season prevented weed control determinations, no injury.
PLUM	1) Prunus domestica	7	1 yr. old seedlings treated with 2,4 and 8 lb./A resulted in 75, 80 and 80% weed control respectively, no observable injury from any of the concentrations.
	2) Prunus domestica	12	Seedlings set in the field during spring of 1952 received 2 app. at rate of 2.5 lb./A 1 mo. after transplanting. Dry season prevented weed control observations, no injury observed.
QUINCE	1) Chaenomeles lagenaria	12	Quince seedlings received 1 app. at 2.5 lb./A, weather conditions prevented weed control evaluation, no injury noted.

Table III (cont.)

Common Name	Genus, Species, Variety	Source	Weed Control and Crop Response Data
RASPBERRY	1) Rubus idaeus latham	13	New plantings of species 1) and 2) received 2, 4, and 6 lb./A app. CRAG-I resulting in very effective weed control at the 4 and 6 lb./A rates. No noticeable injury to either the sucker plants of the red variety or the new shoots of the black variety.
	2) Rubus occidentalis bristol	13	
	3) Rubus sp.	9	1 and 2 lb./A app. on established stock gave 50 and 96.7% weed control with no injury.

TABLE IV. ANNUAL AND PERENNIAL FLOWERS WEEDED WITH CRAG HERBICIDE-I

SNAPDRAGON MARYGOLD (SMALL) MARYGOLD (LARGE) ASTER	Snapdragons, large marigolds, small marigolds and asters were chosen as representative plants found in home gardens and commercial cut flower and flower seed producers' fields. There were very few weeds present in the field when CRAG Herbicide-I was applied before blooming at rates of 1½ and 3 lb./A since the area had just been cultivated. The entire plot area, however, was undersown with mustard before the chemical applications. A strip 1' wide was sprayed down each row of flowers with the nozzles arranged so that the spray pattern would hit only on the lower portion of the flower stems. Two weeks after application, all plots were virtually free of weeds. After 5 weeks some grasses, primarily sudan grass from a nearby field and some lamb's quarters, were growing back into the plots. At this time there were about half as many weeds in each of the treated plots as there were in the check area. In all cases the mustard was controlled. No treatment caused damage to the flowers. (Weed Control in Garden Flowers, E. F. Laning, Jr. and V. H. Freed, Oregon State College). Research Progress Report, Thirteenth Western Weed Control Conference, 1952. Reno, Nevada, February 5,6,7.
PETUNIA MARIGOLD VERBENA	Seedlings of petunia, marigold and verbena were set in a garden that had previously received two applications of CRAG Herbicide-I at the rate of 2 lbs./A. Two weeks after the seedlings were transplanted, the garden received another 2 lb./A application. Results of this test have shown excellent weed control following the herbicidal application with no injury to the flowers. (Author's data).

Table IV. (cont.)

ASPARAGUS FERNS

An established planting of (Asparagus plumosus) ferns that were mowed on June 19, 1952, were treated with CRAG Herbicide-I as a dust plus fertilizer application on June 24. At the time of application weeds one to two inches high were visable in some areas and other weeds at various stages of germination throughout the entire field. The soil surface was visable in some areas, while a mulch covered the soil to ½" in other sections. The following weed control observations were made 2 weeks after the applications:

CRAG Herbicide-I + Fertilizer Plots

CH-I at 3 lb./A + Fert. at 35 lb./500 sq. ft.	- Reduction of weeds throughout plot, perhaps 50% of check. Wandering Jew reduced.
CH-I at 6 lb./A + Fert. at 35 lb./500 sq. ft.	- Similar to 3 lb./A application.
Control (Fert. at 35 lb./500 sq. ft.)	- Dense weed growth - perennial grass, Wandering Jew, nut grass, nightshade.

No injury to the ferns was reported. (Data courtesy Florida Agric. Supply Co., Jacksonville, Fla.)

CRAG Herbicide-I was applied at the rate of 2 lb./A in 60 gal. H_2O/A as a blanket spray to an area in which the following flowering plants were established:

Crop	Crop Response
Delphinium	No apparent injury
Chrysanthemum	Decided injury
Vinca minor	No apparent injury
Lily of the Valley	No apparent injury
Gypsophilia Rosy Veil	No apparent injury
Rudbeckia	No apparent injury
Sedum spectable	Decided injury

The injury referred to in all cases included slight swelling of stems and turning of the leaves. However, no plants died as a result of the application. Weed control was good as far as small weed seedlings were concerned, but no practical control of established weeds was reported. (Data courtesy Jackson & Perkins Co., Nurseryman, Newark, New York)

PROGRESS REPORT ON AGRICULTURAL USES OF DALAPON

By
Lawrence Southwick[1]

DALAPON is a common name for 2,2-dichloropropionic acid (α,α-dichloropropionic acid) which has shown activity as a grass herbicide[2]. Research samples of DALAPON (sodium salt) were distributed to experiment station workers in 1953 and information on herbicidal activity and use suggestions were provided in a technical bulletin[3]. A gratifying amount of experiment station work has been carried out with DALAPON (sodium salt) in 1953 and thanks are due to many individuals for supplying information for DALAPON Bulletin Number 2. This bulletin will be available to experimenters interested in further investigations with this compound. It will summarize most of the DALAPON research results which were available up to November 1, including work done by research workers of The Dow Chemical Company and that conducted by the agricultural experiment stations. This paper will present a summary of some of the more promising uses of DALAPON (sodium salt) for agricultural grass control problems.

Controlled laboratory investigations have established that DALAPON is actively absorbed and translocated by living grass foliage and also by foliage of broadleaved plants. It is also absorbed by roots following soil application. New growth of grasses is often malformed following application and there is frequently proliferation of tissues. At lethal rates, old foliage gradually yellows and dies. The chemical appears to induce dormancy of crown and rhizome buds for varying lengths of time, depending on the dosage used and on environmental conditions. At suitable rates of application, dormant buds fail to recover and a high degree of grass kill results. At lower rates of application, dormant buds tend to recover. Thus, for example, with applications to quack grass it is possible to stunt and to delay the growth with rather low amounts of chemical. Adequate dosages give satisfactory control for one season although 100% kill may not be expected from the normally used dosage rates.

[1]Agricultural Chemical Development, The Dow Chemical Company, Midland, Michigan

[2]U.S. Patent No. 2,642,354

[3]DALAPON Bulletin Number 1. Published by The Dow Chemical Company, May 1953.

The physiological response of plants to DALAPON is similar in certain respects to the response from TCA, except that there is little foliar transport to growing points from foliage applications of TCA. The broadleaved species which tend to be tolerant to TCA are also among the more tolerant to DALAPON. However, DALAPON produces growth retarding effects even on certain of the more tolerant species. In applications to single leaves of bean plants it has been actively translocated to the growing points.

Laboratory tests have shown that DALAPON does not translocate efficiently through dead tissue and any spray which contains a quick burning contact agent may reduce the effectiveness of DALAPON since it is taken in through the foliage and is most effective when so absorbed. At high concentrations of DALAPON (sodium salt) there is sometimes evidence of foliage burn. This is physiologically distinct from the systemic growth regulator effect, which is normally expected.

Greenhouse pot trials have shown that ten pounds DALAPON per acre applied as a sodium salt on a loam soil and watered heavily was not detectable after four weeks as determined by successive plantings of susceptible plants. Forty pounds per acre was still detectable after eight weeks but not after twelve weeks. Field plots have shown that toxic amounts of chemical are still in treated plots after six weeks as determined by action on susceptible species planted at weekly intervals. Rainfall during this period was 2.8 inches. When the soil was transferred to the greenhouse 81 days after treatment and corn planted, it grew well in the samples which had been treated with two pounds of DALAPON per acre but was not completely normal in soils treated with eight pounds of DALAPON or forty pounds of TCA (each applied as the sodium salt). DALAPON (sodium salt) cannot be considered to be persistent in most soils under average conditions.

In quack grass control studies some twelve reports from experiment stations indicated that DALAPON is considerably more effective than TCA even under conditions favorable for TCA action. DALAPON will prove effective where TCA will be almost completely ineffective, that is, under conditions of no rainfall or excessive rainfall. Since DALAPON is absorbed by the foliage, the subsequent weather conditions do not play the important part that they do with the use of Sodium TCA which is absorbed primarily by roots. In general, twenty pounds of DALAPON (sodium salt) per acre may be considered a minimum dosage for effective kill of quack grass while thirty pounds often have given better results. Early applications of five pounds of DALAPON (sodium salt) to spring growth of quack grass have resulted in excellent suppression for a few weeks but there has been almost complete recovery later on.

Promising results have been obtained with the use of DALAPON to reduce quack grass stands to manageable levels in preparation of crop land. Tillage soon after treatment appears to limit maximum effect, however, plowing six to eight weeks after application has been promising.

The application of DALAPON on recently plowed and cultivated soil containing roots and rhizomes of quack grass has shown promising control. In one test applied in August 1952, where DALAPON was used for quack grass control, immediately after plowing and cultivation, at rates of 10, 20, 40 and 80 pounds of DALAPON per acre as the sodium salt no quack grass was present on plots receiving more than 10 pounds per acre. When applied to soil, favorable soil moisture conditions are required for efficient action.

On Johnson grass there have been about a dozen reports which, in general, show promising results. The results of Dow experiments indicated that best control of Johnson grass in land not amenable to cultivation can be obtained with double application. For example, in Mississippi twenty pounds DALAPON as the sodium salt in April followed by twenty pounds in July gave 75% control. Forty pounds in April followed by twenty pounds in July gave 87% control. With regard to Johnson grass treatment it is important to remember that within ten weeks following application in a high rainfall area, the ground may be pretty well covered by new seedlings. This seedling reinfestation is a factor that needs considerable experimental work to determine just how best to cope with it. It is evident that a repeated application may often be needed. Seedlings of Johnson grass species are relatively easy to kill with DALAPON.

It has been noted that Johnson grass growing under drought conditions is not as readily killed by DALAPON application as grass that is growing vigorously in moist soil.

Interesting results have been obtained in the killing of undesirable pasture grass sod in preparation for establishing new seedings. Good results have been secured with as little as five pounds of DALAPON per acre as the sodium salt to kill blue grass and brome grass sod. There is apparently less danger to subsequent grass seedings from DALAPON usage than from TCA.

Quack grass is often a problem in fruit plantings. Several tests were undertaken this year by Dow experimenters in which applications were made close to the fruit plants to determine what hazard might be involved. It was found that apple and pear trees showed no response at twenty pounds per acre as the sodium salt and only slight response at forty pounds as the sodium salt. On the other hand, the stone fruits seemed more sensitive to DALAPON and it is suggested that work with the stone fruits should be undertaken with the knowledge that injury may be serious, particularly with fairly high dosages. Plums and sour cherries were particularly sensitive. Possibly, low growth-suppressing dosages could be used without seriously hurting such crops as peaches and grapes. The injury included marginal necrosis and chlorosis which had a tendency to persist throughout the growing season.

Grasses are often a problem in alfalfa plantings. Work in Michigan with downy brome grass (bromus tectorum) showed very promising results. Application was made in late March and early April using three, six and nine pounds DALAPON per acre as the sodium salt with the six and nine pound dosages giving complete control. No injury to the alfalfa was evident from the three and six pound rates but early growth on occasional plants in the nine pound plots showed slight chlorosis and formative effects on the foliage. This injury was temporary and was outgrown. It is interesting that in these experiments the development of quack grass was greatly suppressed in the six and nine pound plots until after the first cutting when it seemed to recover almost completely.

In another test, alfalfa was treated in June one week after cutting and at the time of spraying the alfalfa was several inches tall. Using five and ten pounds of DALAPON (sodium salt) no observable effects were noted on the alfalfa and the grass seedlings were controlled. This work indicates that alfalfa has considerable tolerance to DALAPON and in fact adequate tolerance for rates sufficient to control seedling grasses.

Excellent results in controlling water grass (Echinochloa crusgalli) in sugar beet plantings for the past two years have shown that beets are relatively tolerant to DALAPON. In California tests, maximum effect was evident in six to eight weeks. Sugar beet top growth seemed to be suppressed for about two weeks after treatment but at harvest no growth differences were apparent. Any spray volume between 12 and 100 gallons per acre seemed to give equivalent results. From four to six pounds of DALAPON as the sodium salt is adequate to give good control of the grass, particularly when a wetting agent is used in the spray.

Sometimes grass seedlings become a problem in corn rather late in the season at about lay-by time. An experiment was undertaken in Michigan to determine the effectiveness of DALAPON as a directed spray using five pounds per acre as the sodium salt. In this case, the main grass was old witch grass (Panicum capillare) and its development varied from seedlings in the one-leaf stage to plants which had begun to stool out and had seven or eight leaves. Practical grass control was achieved. Seedling plants were stopped and the larger plants were fairly well controlled. The corn yield was not impaired by the treatment.

This experiment indicates that even in a susceptible crop species like corn, good grass control can be obtained by directed sprays after the crop plants have become well established.

In Michigan, potatoes were sprayed directly after emergence with four and eight pounds per acre of DALAPON as the sodium salt. The high rate caused chlorosis and some stunting which was not observed in the four pound plots. No yields were taken in this experiment but it is believed that no differences resulted. In another test, potato land was sprayed ten days before planting with five, ten and fifteen pounds DALAPON to control quack grass. The land was reworked just prior to planting and no effects from the DALAPON were noted during the season, either on growth or yield. Thus, it can be said that potatoes belong in the more tolerant group of crops and probably DALAPON can be used efficiently in certain ways to control grass weed problems.

In a Michigan experiment cattail three to five feet high was sprayed with DALAPON in such a way as to wet all foliage. Concentrations as low as ten pounds per 100 gallons had a definite effect. Twenty pounds was more effective and there was little difference between 20 and 30 pounds. Excellent top kill was obtained in the 1953 experiments and it remains to be seen what recovery will be made next year.

1953 experiments on Phragmites control in New Jersey show that this species is sensitive to DALAPON. Root kill data will not be available until the spring of 1954. However, rates of 20 and 40 pounds of DALAPON per acre as the sodium salt applied as a wetting spray after the grass had grown from one and one-half to three feet tall in the spring killed the above ground shoots and prevented regrowth throughout the season. Even ten pounds per acre gave very promising results. DALAPON was much more successful than Sodium TCA except at very high dosages of the latter. Of interest also are some results on para grass in Florida. Apparently rates as low as ten pounds per acre gave control for several weeks and 40 pounds gave a high degree of kill to this very vigorous grass.

Tests in California indicate that very young alfalfa and birdsfoot trefoil can withstand up to four pounds per acre of DALAPON plus a wetting agent. On the other hand, Ladino clover is very sensitive and easily killed with low dosages. In additional tests, alfalfa showed exceptional tolerance, whereas red clover showed high susceptibility.

It is of interest that DALAPON appears promising for the control of seedling grasses, including wild oats, in flax. Although flax is not highly tolerant to DALAPON, the first results indicate that it may be found useful to retard the grass growth. Directed basal sprays have given good annual grass control in cotton. Apparently, cotton, like corn, can be treated with a directed spray without injuring the plant.

Discussion

The following observations may suggest variables that should be considered in the conduct of future field experiments.

1. The sensitivity of grasses to DALAPON appears to decrease with increasing age of the plant.

2. In some instances DALAPON appears to be less effective when applied to grass growing under dry soil conditions.

3. Northern or cool weather grasses such as blue grass and quack grass have been effectively controlled by spring application when the weather is still cool.

4. Early application to warm season species such as Bermuda grass and Johnson grass before much foliage has developed has not proved as effective as application made after considerable growth has occurred.

5. Seed stalk development has been arrested or prevented by application in the early boot stage or before. The stalks may continue to elongate if application is delayed.

6. In general, best results have been achieved with sprays that adequately wet grass foliage.

It may be concluded from the many favorable results reported to date that DALAPON (sodium salt) is a promising new herbicide. Certainly, extensive field and laboratory investigations are warranted.

DALAPON (sodium salt) will be commercially available only for application to railroads and other industrial lands in 1954[1]. However, experimental quantities will be available for investigators interested in its possible agricultural applications.

[1] For a discussion of the use of DALAPON (sodium salt) for railroad use see "Experiments with DALAPON in Controlling Several Grass Problems of Railroads" by L. L. Coulter, published elsewhere in these Proceedings.

Some Factors Involved in the Chemical Control of Quackgrass

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Quackgrass (Agropyron repens) has proven to be a difficult weed to control by either cultural or chemical means.

Cultural control methods have recently been discussed by Lowe and Buchholtz (2). Working infested areas with a field cultivator for several weeks during the dryer part of the summer so as to expose the rhizomes to dessication gave good control in Wisconsin. The authors question that this method would be satisfactory during seasons of heavy rainfall.

Among the chemicals which have been used for quackgrass control, maleic hydrazide has recently been shown to be effective by Hoffman and Slywester (1). A new compound, Dalapon, dichloropropionic acid, which was released in 1953, offers promise as an herbicide for grassy weeds. At present, sodium trichloroacetate is the most widely recommended chemical for chemical control of quackgrass.

Objectives

A series of quackgrass control experiments were carried out using sodium TCA in an attempt to clarify the apparently inconsistent results frequently obtained from the use of this chemical.

Included in the study was an experiment comparing the effect of plowing a quackgrass sod before applying the chemicals as opposed to applications made on undisturbed sod. Another objective was to evaluate the division of sodium TCA into two separate applications by applying half of a given rate several weeks apart. Parallel applications were made in which the entire dosage was applied at one time.

In an attempt to correlate the results obtained, rainfall data from the Storrs Station was summarized and analyzed as it related to the degree of quackgrass control. An exploratory experiment was carried out in 1953 to compare Dalapon and sodium TCA for controlling quackgrass.

Procedure

The experiments were conducted at the Storrs Agricultural Experiment Station at Storrs, Connecticut, from November, 1951 to November, 1953. The experimental area was on a Charlton fine sandy loam in a field which had been in alfalfa for seven years prior to the time of the initial treatment. The area had become heavily and uniformly infested with quackgrass.

Rates of 10, 20 and 40 pounds acid equivalent of the 90% salt of sodium TCA[1] applied in 40 gallons of water solution per acre were used for all treatments. The chemical was applied on plots 14 by 14 feet, replicated four times. In some cases, a randomized block design was used, while in other cases a split-plot design was used. Unless otherwise indicated, all plots were plowed just prior to treatment. In the case of the divided applications, there was no further tillage between the first and second application on the same plot.

Times of Treatment with Sodium TCA

Each experiment was designated as a Stage.

Stage A - Single application - November 23, 1951.
Divided application - November 23, 1951 and April 10, 1952.

Stage B - Single application - April 10, 1952.
Divided application - April 10, 1952 and July 8, 1952.

Stage C - Single application - May 15, 1952.
Divided application - May 15, 1952 and August 30, 1952.

Stage D - Single application - September 9, 1952.

Stage E - Single application - April 1, 1952.

The results from the treatments were evaluated by making visual ratings of top growth on one or more dates and by sampling the weight of living quackgrass rhizomes by digging to a depth of eight inches in quadrats measuring one-ten thousandth of an acre. The reduction of rhizome weight is considered to give the most accurate indication of quackgrass control since top-kill is frequently followed in a few months by new growth from rhizomes only partially injured by the sodium TCA.

As is often the case in sampling underground parts of plants, the plot to plot variation for the same treatment was often quite high. Differences due to treatment were great enough however, to be significant in most cases.

Results and Discussion

The quackgrass top growth density ratings are given in Table I. Table II gives the weight of rhizomes remaining in the treated plots several months after treatment.

[1] Sodium TCA and Dalapon supplied by Dow Chemical Company, Midland, Michigan

Table I.
Stand Density of Quackgrass Topgrowth Following Treatment with Sodium TCA.

0 - no stand; 10 - complete cover
Each rating is an average of 4 replications

Treatment	Date of Rating	Lbs./Acre Acid Equivalent of TCA 0	10	20	40	Av.	Av. of Treated Plots
Not Plowed Treated July 8, 1952	July 1, 1953	6.0	5.5	4.3	3.3	4.8	4.4
Plowed Treated July 8, 1952	July 1, 1953	5.0	3.0	1.0	0.0	2.2	0.8
				STAGE A			
Single application November 23, 1951	Nov. 5, 1952	10.0	7.0	7.0	3.0	6.8	5.7
	July 1, 1953	8.3	5.5	7.3	3.5	6.2	5.4
Divided application November 23, 1951	Nov. 5, 1952	9.5	3.3	2.1	1.0	4.0	2.1
April 10, 1952	July 1, 1953	9.5	2.3	2.3	1.8	4.0	2.1
				STAGE B			
Single application April 10, 1952	Nov. 5, 1952	9.8	5.0	1.3	1.3	4.4	3.5
	July 1, 1953	10.0	4.3	3.9	1.0	4.8	3.0
Divided application April 10, 1952	Nov. 1952	9.0	7.7	4.9	1.7	5.8	4.8
July 8, 1952	July 1, 1953	8.0	7.5	5.0	1.3	5.5	5.0
				STAGE C			
Single application May 15, 1952	July 1, 1953	9.8	4.3	3.5	1.5	4.8	3.1
Divided application May 15, 1952 August 30, 1952	July 1, 1953	9.3	7.3	6.5	1.7	6.2	5.2
				STAGE D			
Single application September 9, 1952	July 1, 1953	6.5	2.8	1.7	1.5	3.1	2.0

Table II.
Air-dry Weight of Living Quackgrass Rhizomes in Pounds Per Acre Following Treatment with Sodium TCA. Rhizomes Were Sampled on July 14, 1953.

A. Effect of Plowing Prior to Treatment
Plots Treated July 8, 1952

Cultural Treatment	Lbs. Acid Equivalent Per Acre of Sodium TCA					Average of Treated Plots
	0	10	20	40	Av.	
Plowed prior to treatment	566	126	269	0	240	131
Not plowed prior to treatment	680	611	577	451	580	547

B. Effect of a Single Application of Sodium TCA versus a Divided Application of a Given Rate.

Time of Treatment	Lbs. Acid Equivalent Per Acre of Sodium TCA					Av. of Treated Plots
	0	10	20	40	Av.	
			STAGE A			
Single application November 23, 1951	2034	3540	1057	1646	2069	2081
Divided application November 23, 1951 April 10, 1952	1834	426	451	194	727	358
			STAGE B			
Single application April 10, 1952	1480	640	937	120	794	566
Divided application April 10, 1952 July 8, 1952	1480	869	520	360	807	583
			STAGE D			
Single application September 9, 1952	2222	1640	411	463	1840	838

The trends shown by the ratings of top growth and quackgrass rhizome weight are in general agreement. In Stage A, there was a marked advantage in divided application of the sodium TCA. However, in Stages B and C there was a slight advantage, if any, in a single application. The reason for this will be discussed in connection with rainfall.

The marked increase in quackgrass control obtained by plowing prior to treatment was shown by the data in Table II. The average rhizome weight in the treated plots was less than one-half as great when the plots were plowed prior to treatment. Forty pounds following plowing gave complete control while the weight in the non-plowed plots at 40 pounds was only one-fourth less than the check. The advantage of tillage prior to treatment of quackgrass with sodium TCA has been consistently shown by the experiments reported here and elsewhere. The lack of any control from plowing alone is further evidence that plowing alone has little efficacy in quackgrass control.

In fact, in most cases the check plots which were plowed had more quackgrass in them than the unplowed checks. Since sodium TCA is known to be a contact rather than a translocated herbicide, it is necessary for it to enter the soil and come into direct contact with the rhizomes if kill is to be obtained. Sodium TCA moves readily into and through the soil because of its high solubility. The Dow Chemical Company lists the solubility of sodium TCA at 152 g./100 gm H_2O. Therefore, while it is necessary to have sufficient rainfall to carry the sodium TCA into the rhizome area, excessive rainfall may readily carry the chemical beyond the rhizome level. There is no evidence that sodium TCA is fixed by soil colloids.

Rainfall amount and distribution in an arbitarily chosen period of four weeks following each chemical treatment was analyzed in relation to the quackgrass control obtained.

Table III.

Correlation Between Quackgrass Control and Rainfall

Date and Method Of Chemical Application	Average pounds per acre of rhizomes in treated plots.	Rainfall amount in each of 4 weeks following treatment
Stage A - November 23, 1951 single and divided application	2081	1.0-0.8-0.8-3.0
Stage A - April 10, 1952 divided application	358	1.5- 0 -3.1- 0
Stage B - April 10, 1952 single and divided application	566	1.5- 0 -3.1- 0
Stage B - July 8, 1952 divided application	583	3.1- 0 - 0 -1.1
Stage D - September 9, 1952 single application	838	0.4-1.1-0.1-1.0
Stage E - April 1, 1953 single application	---	1.7-2.0-1.4-4.4

A study of the rainfall data indicated that a rainfall of 1.5 inches to 3 inches, followed by several days of little or no rainfall, resulted in good control. If rainfall was so frequent that the sodium TCA was leached out before it had a chance to remain in contact with the rhizomes for several days, the amount of kill was low.

The rainfall pattern also clarified the results obtained from the divided applications. In Stage A, neither the half-rate nor the single application of sodium TCA was efficient when applied in November because of the uniform rainfall distribution. The half-rate applied on Aoril 10 was more effective. At least seven days of rainless weather followed each of two rainy spells during the four weeks following treatment. The rainfall pattern was somewhat less favorable for the second half-rate applied on July 8, 1952, because of the excessive rainfall in the first week. In this case, as in the case of the May 10 applications, the single application was somewhat more effective.

It may be concluded that the principal advantage of a split application is to increase the chances of having the chemical on the soil during a period of favorable rainfall. The obvious disadvantage is the prolonged period of soil toxicity.

The correlation between rainfall and rhizome kill was well demonstrated by a comparison of the November 1951, and the September 1952 treatments. Following the 1951 treatment, the rhizome weight in the treated plots averaged 2081 pounds per acre, however, the 1952 treatments reduced the rhizome weight to 838 pounds per acre. Since the rhizome samples were dug on the same date, there was a full year in which the quackgrass treated in 1951 was allowed to recover. This may have biased the results to some extent. The more favorable rainfall pattern shown in Table III offers the best explanation for the differences between the two dates.

Virtually no top-kill was obtained from the Stage E, April 1, 1953, application of sodium TCA. The heavy, frequent rainfall indicated by the data in Table III is again cited as evidence of the importance of rainfall.

The variation in quackgrass control on different dates of chemical treatment raises the question as to the influence of the physiological status of the quackgrass at the time of treatment. While such status is probably a factor, the relatively greater influence of rainfall is shown by a comparison of the April 10, 1952, and the April 1, 1953, applications. While it can be assumed that the stage of growth was about the same in both cases, chemical treatment reduced the rhizome weight by 80 percent in 1952, while virtually no kill was obtained in 1953, even at the 40 pound rate when applied during a period of heavy rains.

Comparison of Dalapon and Sodium TCA

Applications of both Dalapon and sodium TCA were made at rates of 20 and 40 pounds acid on June 17, and July 20, 1953, on both spaded and non-spaded plots. Rainfall was moderate following the first application, with 2.51 inches falling in the four weeks following treatment. Rainfall was excessive following the July application, with 5.43 inches falling in the four week period.

Good control of quackgrass as judged by amount of top growth recovery on November 3, 1953, was obtained with both TCA and Dalapon from the June applications. TCA was applied on spaded plots only while Dalapon was applied on non-plowed as well as plowed plots. The quackgrass was in full bloom when the Dalapon was applied. The entire foliar portion of the quackgrass became brown within a few days after treatment and the spikes characteristically assumed an angle perpendicular to the axis of the plant.

Following the July applications the TCA was ineffective. Treated plots had the same percentage recovery as the check on both spaded or non-spaded plots. Excessive rainfall following soon after treatment was very unfavorable for the use of sodium TCA. Dalapon, however, reduced top growth recovery as compared to the check by 90% when applied to the foliage. It did not show a marked advantage over the sodium TCA when applied on the spaded plots.

The following trend was evident. Dalapon was superior to sodium TCA when applied on quackgrass foliage. When applied to spaded plots it did not show a marked advantage over sodium TCA. Both of these observations are in line with the evidence that Dalapon is translocated within the plant.

Dalapon, therefore, offers promise of being superior to sodium TCA as an herbicide for the control of quackgrass and other perennial grasses since it is less affected by the rainfall pattern following treatment.

Conclusions and Summary

Factors affecting the effectiveness of sodium TCA for quackgrass control were studied from November, 1951 to November, 1953. Plowing prior to sodium TCA application was found to markedly increase the amount of kill. The rainfall pattern following application of the chemical on plowed ground was found to be very important. The best control was obtained following sufficient rainfall to leach the sodium TCA into contact with the rhizomes followed by several days of scant rainfall. By dividing a given rate of chemical into two applications several weeks apart, the chances were increased of experiencing a period with a favorable rainfall pattern.

Dalapon was compared with sodium TCA in preliminary tests and was found to offer promise as an herbicide for quackgrass which would be relatively independent of rainfall conditions since it is absorbed by the foliage and translocated to the rhizomes.

References

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A COMPARISON OF DIFFERENT HERBICIDES APPLIED AT PLANTING, AT EMERGENCE, AND POST-EMERGENCE ON FIELD CORN

by
E. R. Marshall & G. Loeffler [1]

The problem of perennial weed and grass control in corn has become an increasingly more important problem each year as the use of 2,4-D for broadleaf weed and annual grass control has increased. Such troublesome pests as quackgrass (Agropyron repens), horsenettle (Solanum carolinense), canada thistle (Cirsium arvense), nutgrass (Cyperus esculentus) and others, are becoming very serious problems in cornfields in the Northeast. In many cornfields these weeds present a more serious problem than do annual weeds and grasses. Most perennial weeds do not emerge until some time after the corn has been planted. Therefore, planting and pre-emergence applications of herbicides have not been too effective in their control. Post-emergence herbicidal applications have helped to some extent but usually rates necessary for control of these pests have resulted in rather serious corn injury. In order to compare several of the herbicides now being marketed with some of the newer materials which have shown promise, the following tests were conducted.

Materials and Methods

The first test was designed to study the weed control obtained with the various materials when applied to field corn. The materials were applied at three dates; at planting on June 3, when the corn was emerging on June 12, and again as a post-emergence application when the corn was 8 - 10" high on June 22. All materials were applied at the same rate at planting and at emergence, but this rate was reduced one-half with certain chemicals on the post-emergence plots.

Types of 2,4-D applied were Butoxy ethanol ester (LV4), Butoxy ethanol propanol ester (BEPD), Ethoxy ethoxy propanal (EEPD), and Triethanolamine salt (G.L.F. "66"). Other materials tested were; Alkanolamine salt of DNOSBP (Sinox PE), 3-parachlorophenyl-1, 1-dimethyl urea (CMU), Phenyl dimethylurea (PDU), 2,4-dichlorophenoxy ethyl sulphate (CH1), 2,4-dichloro phenoxy ethyl benzoate (Sesin), 2,4-dichloro phenoxy ethyl oxalate (6036), 2-methyl, 4-chlorophenoxy ethyl sulphate (L474), and the N butyl ester of MCP (Butyl MCP).

These materials were applied as an over-all spray to plots 12' wide and 36' long, covering 4 rows of corn, on June 3, 12, and 22. There were two replicates at each date of treatment making a total of 6 replicates in all. A small plot CO_2 sprayer, delivering 25 gallons of solution per acre at 25 lbs. pressure was used to apply the material. The soil type was a medium loam. The principal weed problems were; mustard (Brassica arvensis), ragweed (Ambrosia retroflexus), milkweed (Asclepias syriaca), thistle (Cirsium arvense), quackgrass (Agropyron repens), nutgrass (Cyperus esculentus), horsetail (Equisetum arvense).

[1] G.L.F. Soil Building Service, Ithaca, New York

The second experiment was a post-emergence grass control test. Materials which had previously shown promise as grass control materials were applied with a directional spray to a corn field heavily infested with quackgrass, nutgrass, and annual grass species. The corn was 24 - 26" in height when the treatments were applied. A jeep mounted sprayer was used to apply the materials. Drop pipes were used and directional nozzles were used on the bottom of the drop pipes. Materials applied were 3,6 endoxo-hexahydro phthalate liquid (Endothal), and a powder form containing 38% active ingredient (Niagarathal), sodium trichloroacetate (TCA), trichloroacetanilide (2025), trichloroacetylurea (2015), a,a dichloroproprionic acid (Dalapon), phthalamic acid (PA), and amino triazole.

Results and Discussion

Tables 1 and 2 give the results of the weed counts taken on July 8; 35, 26, and 16 days respectively after planting, emergence, and post-emergence treatments were made. These data have been divided into broadleaved and perennial weeds for a clearer understanding of the results. Table 1 shows the counts on broadleaved and perennial weeds, while Table 2 gives the means of broadleaved and perennial counts and the mean for combined broadleaved and perennial weed counts.

No attempt will be made here to go into detail on the various results. Materials which gave the best broadleaved weed control results at planting were LV4, BEPD, CMU, PDU, Sinox PE, Sesin, and 6036. LV4, BEPD, EEPD, CMU, PDU, CH 1, and Butyl MCP gave the best broadleaved weed control when applied as the corn was emerging. As a post-emergence treatment, LV4, BEPD, EEPD, CMU, PDU, Sinox PE, and G.L.F. "66" gave good broadleaved weed control.

Most of the materials were less effective in perennial weed control. The most promising materials at planting were BEPD, EEPD, CMU, and Natrin. At emergence, LV4, CH 1, Natrin, L474, and Butyl MCP looked good. As a post-emergence treatment, EEPD and PDU looked the most promising.

The means for date of treatment show that the most effective control was obtained by the emergence treatment. This was the case for both broadleaved and perennial weed control. The planting application was second in control, while the post-emergence application resulted in the poorest over-all weed control. It must be remembered, however, that the amount of chemical applied was reduced in the post-emergence treatments and this would affect the weed control obtained. The rates used were in the range necessary for adequate weed control and a minimum of injury to the corn. The LV4, BEPD and EEPD when applied at emergence and post-emergence, showed some suppression of nutgrass and gave good control of horsetail. Results with CMU and PDU were nearly identical. The higher rates stunted the corn and caused it to have a yellow color. Sinox PE at the higher rates gave good control of annual grasses and broadleaved weeds and also suppressed quackgrass and nutgrass. As a post-emergence treatment this material injured the corn at all rates of application. Sesin and L474 at the higher rate, when applied at planting and at emergence stunted grasses and perennial weeds.

TABLE 1. WEED CONTROL IN CORN FOLLOWING HERBICIDAL TREATMENT AT THREE STAGES OF GROWTH

Treatment	Broadleaved Weeds/Unit Area			Perennial Weeds/Unit Area		
	Planting	Emergence	Post-Emergence	Planting	Emergence	Post-Emergence
* LV4 1#	23.0	3.5	16.5	56.5	44.5	88.5
* LV4 1½#	9.5	2.5	17.5	52.5	22.0	52.5
* BEPD 1#	52.0	4.5	12.0	67.5	61.0	81.0
* BEPD 1½#	9.0	5.0	3.5	38.0	59.5	60.5
* EEPD 1#	36.0	5.5	5.0	60.5	41.5	82.0
* EEPD 1½#	19.0	0.0	5.5	32.5	40.5	36.0
CMU 1#	42.0	8.5	22.0	98.5	55.5	74.0
CMU 1½#	4.0	2.5	6.0	32.5	41.0	57.5
PDU 1#	13.5	4.0	30.0	73.0	36.5	55.5
PDU 1½#	4.0	6.5	12.0	47.5	31.0	40.0
* Sinox PE 3#	76.0	10.0	50.0	57.0	52.0	79.0
* Sinox PE 6#	23.5	7.5	12.0	54.0	45.0	77.0
* Sinox PE 9#	8.0	5.5	6.0	48.0	42.5	74.0
CH 1 3#	16.5	8.5		69.0	35.0	
CH 1 4#	26.5	2.5		42.5	26.0	
Sesin	17.5	27.5	82.0	59.0	43.5	73.0
Sesin 4#	13.0	12.0	79.5	41.0	44.0	55.5
6036 3#	24.5	21.0	99.5	61.5	52.0	87.0
6036 4#	11.5	16.0	68.5	42.0	43.5	75.5
Natrin 3#	88.5	33.0	103.0	74.0	61.0	100.5
Natrin 4#	18.0	13.0	88.0	37.5	25.5	73.0
L474 3#	28.0	11.5	98.5	43.5	40.0	50.0
L474 4#	18.5	10.0	68.0	40.0	27.5	48.0
* Butyl MCP 1#	96.0	3.0	41.5	88.0	49.5	75.0
* Butyl MCP 1½#	22.5	0.0	13.5	45.5	26.5	52.5
G.L.F. "66" ½#			15.0			70.5
G.D.F. "66" 3/4#			5.0			52.0
Check	88.5	79.0	130.0	51.5	43.5	98.0
MEAN	30.2	12.4	43.5	52.3	42.9	70.0

* These materials applied ½ strength in the post-emergence applications

TABLE 2. MEANS OF BROADLEAF AND PERENNIAL WEED COUNTS AT THREE DATES OF APPLICATION

Treatment	Combined Means of Dates of Application		
	Broadleaves	Perennial	Broadleaves and Perennial
* LV4 1#	14.3	63.2	38.8
* LV4 1½#	9.8	42.3	26.1
* BEPD 1#	22.8	69.8	46.3
* BEPD 1½#	5.8	52.7	29.2
* EEPD 1#	15.5	61.3	38.3
* EEPD 1½#	8.2	36.3	22.2
CMU 1#	24.2	76.0	50.0
CMU 1½#	4.2	43.6	23.9
PDU 1#	15.8	55.5	35.4
PDU 1½#	7.5	39.6	23.5
* Sinox PE 3#	45.3	62.7	54.0
* Sinox PE 6#	14.3	58.7	36.5
* Sinox PE 9#	6.5	54.8	30.7
Sesin 3#	42.3	58.5	50.4
Sesin 4#	34.8	46.8	40.8
6036 3#	48.3	66.8	57.6
6036 4#	28.6	53.7	42.8
Natrin 3#	74.8	78.5	76.7
Natrin 4#	39.7	45.3	42.5
L474 3#	46.0	44.5	45.2
L474 4#	32.2	39.1	35.3
* Butyl MCP 1#	46.8	70.8	58.8
* Butyl MCP 1½#	12.0	41.5	26.8
Check	99.2	64.3	81.8

* These materials applied ½ strength in the post-emergence applications.

TABLE 3. WEED CONTROL IN CORN FOLLOWING HERBICIDAL TREATMENT AT THREE STAGES OF GROWTH

Treatment	Weed Control Rating *			
	At Planting	At Emergence	Post-Emergence	Mean
+ LV4 1#	4.0	10.0	9.0	7.7
+ LV4 1½#	7.5	9.0	8.5	8.3
+ BEPD 1#	2.0	8.5	6.5	5.7
+ BEPD 1½#	7.5	7.5	10.0	8.3
+ EEPD 1#	2.0	8.0	8.5	6.2
+ EEPD 1½#	6.0	8.5	10.0	7.7
CMU 1#	3.0	2.0	5.0	3.3
CMU 1½#	9.5	8.5	7.5	8.5
PDU 1#	8.0	9.5	6.5	8.0
PDU 1½#	9.5	9.0	7.0	8.5
+ Sinox PE 3#	3.0	5.0	4.0	4.0
+ Sinox PE 6#	3.0	6.0	6.0	5.0
+ Sinox PE 9#	9.0	8.0	10.0	9.0
CH 1 3#	3.0	7.5		
CH 1 4#	7.5	9.0		
Sesin 3#	6.0	6.0	0	4.0
Sesin 4#	5.5	7.0	0	4.2
6036 3#	6.0	4.0	0	3.3
6036 4#	6.0	8.0	0	4.7
Natrin 3#	1.0	3.5	0	1.5
Natrin 4#	6.0	8.0	0	4.7
L474 3#	4.0	7.0	0	3.7
L474 4#	5.0	2.0	0	2.3
+ Butyl MCP 1#	1.0	9.5	4.5	5.0
+ Butyl MCP 1½#	4.0	9.5	9.0	7.5
G.L.F. "66" ½#			5.5	
G.L.F. "66" 3/4#			7.0	
Check	0	0	0	0
Mean	5.0	6.9	4.8	

* 0 = No Control, 10 = Perfect Control

\+ These materials applied at ½ strength in post-emergence applications.

TABLE 4. RESULTS OF DIRECTIONAL SPRAYED GRASS CONTROL TEST ON CORN

Material	Lbs. Active/Acre	Corn Injury	Grass Control
Endothal 3003	1	Slight	Poor
Endothal 3003	2	Moderate	Fair
Endothal 3003	4	Severe	Good
Niagarathal	1	Moderate	Fair
Niagarathal	2	Severe	Good
Niagarathal	4	Severe	Good
TCA	4	None	None
TCA	8	None	None
TCA	16	None	Poor
2025	4	None	None
2025	8	None	None
2025	16	None	Poor
2015	4	None	None
2015	8	None	Poor
2015	16	None	Fair
Dalapon	4	None	Fair
Dalapon	8	Slight	Good
PA	2	None	None
PA	4	None	None
PA	8	Slight	None
Amino Triazole	4	Moderate	Fair
Amino Triazole	8	Severe	Good

The most effective materials for broadleaved weed control at all dates were LV4, BEPD, EEPD, CMU, PDU, and Sinox PE at the higher rates used as shown in Table 2. For perennial weed control at all three dates, LV4, EEPD, CMU, PDU, L474, and Butyl MCP at the higher rates gave the most satisfactory control. For combined broadleaf and perennial weed control, LV4, EEPD, CMU, PDU, Sinox PE, and Butyl MCP at the higher rates gave the best control.

Table 3 gives the weed control ratings which are in general agreement with the weed counts. Where variances do occur, the authors feel that more weight should be given to the ratings. Ratings tend to give a better general over-all picture of the plot results than do weed counts, which fail to take into account weed and grass suppression, and other factors, which are considered when ratings are made. The ratings also show that of the three times applied, emergence applications were the most effective means of weed and grass control.

Table 4 lists the chemicals used as post-emergence directional sprays for grass control in corn. The Endothal and Niagarathal treatments, even though applied directionally, injured the corn. TCA, 2015 and 2025 at the rates used did not give the grass control desired. 2015 appeared to be somewhat more active than TCA or 2025. Dalapon gave good grass control but injured the corn somewhat. Phthalamic acid was ineffective at the rates used. Amino triazole at both rates gave good grass control but seriously injured the corn. This injury first appeared as a chlorosis of the leaves which prevented the corn from developing normally. It was also noticed that the tassels on the corn which had been treated with amino triazole were sterile. Amino triazole and Dalapon were the most effective grass control materials. At the rates used, amino triazole gave the most effective control of quackgrass, nutgrass, and annual grasses, but seriously injured the corn. Dalapon gave good grass control with a minimum of injury to the corn.

Summary and Conclusions

Applications of various herbicides were made to corn at planting, at emergence, and when the corn was 8 - 10" in height. Data were taken on annual, broadleaved, and perennial weed and grass control.

The data show that an emergence application is more effective in controlling the weed species encountered than either a planting or a post-emergence application. The most effective materials tested were the low volatile esters of 2,4-D, Sinox PE, Crag Herbicide 1, and Butyl MCP. CMU and PDU gave good weed control but injured the corn. Post-emergence applications of Sinox PE $1\frac{1}{2}$ - 3 and $4\frac{1}{2}$ lbs. DN per acre gave injury to the corn. Injury at the $4\frac{1}{2}$ lb. rate was severe.

No consistent differences were found between the three low volatile forms of 2,4-D.

A post-emergence grass control test was conducted using various herbicides applied as a directional spray. None of the materials tested were entirely satisfactory for grass control in corn.

Materials which showed the most promise for post-emergence directional sprays on corn for grass control were amino triazole and Dalapon. Amino triazole gave the better grass control, but seriously injured the corn. Dalapon gave good grass control but resulted in some corn injury.

Effect of some Chemicals on Weed Growth and Corn Production[1]

Collins Veatch[2]

Weed control experiments in corn were started in West Virginia in 1948 using 2,4-D at various rates (1). These experiments have been extended to compare the effectiveness of various chemicals on weed control and corn production (2, 3).

Procedure

The plot areas, at each location, were tilled, fertilized and check planted as uniformly as possible. Plots were laid off 4 hills x 12 hills which gave a center plot of 2 hills x 10 hills with surrounding border hills. Yields and percentage stands were calculated on the basis of the center 2 hill x 10 hill plots. The treated plots were randomized with occasional cultivated and untreated checks. Four replications were used in these experiments with the exception of the pre-emergence at Point Pleasant where 8 replications were used in 1953. Pre-emergence applications were made within 2 or 3 days after planting and the post-emergence, when the corn was 6 to 10 inches high. The sprayer used was a compressed air plot model mounted on a Planet Jr. garden tractor, equipped with a special tractor speedometer. The 2,4-D compounds were applied with nozzles delivering 5.24 gallons of water per acre at 3 m.p.h. under 20 lbs. pressure per square inch. The other compounds were applied with nozzles delivering 38.28 gallons per acre at 3 m.p.h.

These experiments were conducted at three locations: 1. the Ohio Valley Experiment Station near Point Pleasant on Wheeling sandy loam (1), 2. the Reedsville Experiment Farm near Reedsville in the north central part of the State on Mongahela silt loam and 3. the Reymann Memorial Farms near Wardensville in the eastern part of the State on Monongahela fine sandy loam.

The percent stand is based on 3 stalks per hill, sixty stalks per plot being a perfect stand. In correcting yields for stand, records were taken of the missing and single stalk hills. Hills containing 2 stalks were not counted against the stand or yield. The weed index is relative, 0 indicating no weeds present in the area, 9 indicating complete weed coverage without any relationship to the weed present on untreated plots.

Discussion

Pre-emergence 1952

The influence of pre-emergence weed control treatments on yield, percent stand and weed growth at Wardensville in 1952 are shown in Table I. This area

[1]Scientific Paper No. 481, West Virginia Agriculture Experiment Station.
[2]Associate Agronomist, West Virginia Agriculture Experiment Station.

was rather poorly drained and stayed too wet thru June and July for effective weed control. Cultivation was not effective. Treatment No. 14, an application of Premerge at a rate of 6 lbs. per acre, gave the best weed control and a yield which was 100 bu. per acre. Sodium T.C.A. applied at the rate of 4 lbs. per acre apparently held the weeds in check and resulted in a yield of 98 bu. per acre. Four hundred lbs. of Ca Cyanate per acre followed by a post-emergence cultivation gave a plot yield of 80 bu. per acre. The other treatments could hardly be considered satisfactory although many of them were as effective as the cultivation under these wet conditions.

The pre-emergence treatments listed in Table II at Point Pleasant were applied on May 19th. A rainfall of .60 inches was recorded on that date followed the next day with 1.53 inches. As a consequence none of the treatments controlled the weeds as well as cultivation. Treatment No. 16, four lbs. of T.C.A. was the only treatment that seriously reduced the stand. Post-emergence spraying with 2,4-D after the pre-emergence treatments with 2,4-D (No. 5), C.M.U. (No. 10) and Calcium Cyanamide (No. 10 & 11) apparently reduced the weed growth resulting in increased yields.

At Reedsville (Table II) all of the treatments resulted in good yields except possibly Calcium Cyanate No. 14 which should have received a late cultivation or post-emergence spray. The Weed Index was rather high on some of the plots but apparently the treatments held the weeds in check until the corn was well started, then there were sufficient nutrients and moisture present to develop both corn and weeds.

Pre-emergence 1953

In 1953 the pre-emergence experiments at Wardensville were abandoned due to adverse conditions. During the two weeks following pre-emergence treatment the rainfall totaled 4.2 inches. When the corn emerged the stand was very irregular and this irregularity could not be attributed to the treatments since some of the untreated plots had stands of only 5 percent.

In the experiments at Point Pleasant in 1953 (Table III) cultivation (No. 5, 10 & 15) gave outstanding results in yield and weed control. In this case the rainfall was not excessive but was persistent. The plots were treated May 7th. Percipitation records show a rainfall May 7th - .49 inches, May 8th - .36 inches and May 9th - .35. Apparently this was sufficient to leach the chemicals in treatments No. 9 (T.C.A. 4 lbs.) No. 11 (T.C.A. 8 lbs.) and No. 13 (C.M.U. 2 lbs.) into the soil greatly reducing the stand of corn and allowing weeds to take over, especially on the T.C.A. treated plots. The Dinitro treatments No. 7 and 8 gave fair results controlling the broad-leaved weeds but not the grass. Most of these plots indicate the need of some post-emergence treatment or cultivation.

The pre-emergence treatments at Reedsville in 1953 (Table III) were grown under very favorable conditions. The weed population was rather low as indicated by a Weed Index of 2.25 on the no treatment plots which gave a yield of 118 bu. per acre. Treatment No. 7 four lbs. of Chloro I.P.C. was the only treatment that was apparently too severe, reducing the stand and yield. The 2,4-D and Dinitro treatments were at least equal to cultivation under these conditions.

Post-emergence 1952

Cutlivation gave outstanding results in the post-emergence treatments at Point Pleasant in 1952 (Table IV). An abundant rainfall during the latter part of June was probably an important factor in these results. Some treatment or cultivation was needed either in late June or early July. Where grass was present cultivation would be indicated.

At Reedsville in 1952 no significant distinction could be made between the treatments and cultivation except that the yield in treatment No. 69 would indicate that the 1 lb. of 2,4-D injured the corn. It controlled the broad-leaved weeds but not the grass.

At Wardensville the 2,4-D applications apparently did a good job of controlling the broad-leaved weeds allowing annual grasses to predominate. These plots were all relatively weedy as indicated by the Weed Indexes.

Post-emergence 1953

The post-emergence plots at Wardensville were abandoned since the corn failed to develop as a result of dry weather.

The post-emergence treatments at Point-Pleasant (Table V) show excellent control of weeds with 2,4-D but little control of annual grasses.

In the second section of Table V where the area was cultivated before treatment excellent control of annual grasses was secured but some smartweed survived.

In the post-emergence experiments at Reedsville (Table IV) little distinction could be made between treatments. As previously mentioned weeds were not too much of a problem in this area as indicated by the yield of 122 bu. per acre on the untreated plots giving a Weed Index of one.

Summary

Weather conditions with special emphasis on the amount and distribution of rainfall play a vital part in the success or failure of any weed control program in weed infested areas.

Broad-leaved weeds, such as ragweed, predominated on the plots where control was poor on weed infested areas used at Point Pleasant. When the ragweed was controlled annual grasses took over. Little grass was found growing on the ragweed shaded plots.

Under West Virginia conditions it is not recommended that one application or treatment be relied on to control weeds for the season. Under favorable weather conditions or in the absence of a heavy weed infestation a pre- or even a post-emergence treatment may be effective throughout the season. In general, one should be prepared to follow pre-emergence treatments with a post-emergence treatment or cultivation.

Some of the results indicate the possibility of cultivating the corn when emerging or up to 6 inches in height with a rotary hoe or other implement to destroy grass and following with a post-emergence spray.

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3. Veatch, Collins, Four Years of Weed Control in Corn in West Virginia, Proceedings of the Sixth Annual Meeting of the Northeastern Weed Control Conference, January 1952, pg. 217.

Acknowledgment is made to the following Companies who supplied the chemicals used in these experiments: American Chemical Paint Company, Dow Chemical Company, American Cyanamid Company, Carbide and Carbon Chemicals Company, E. I. du Pont de Nemours and Company.

Table I

Influence of Pre-emergence Weed Control Treatments on Yield, Stand and Weed Growth at Wardensville in 1952

	Treatment	Rate Per A. lbs.	Post-emerg. or cult.	Yield bu. per A.	% Stand	Weed Index (0-9)	Predominant Weeds
1.	Cultivated			50	89	4.5	Lambs quarters, pigweed,galinsoga
2.	2,4-D *	1.5		50	88	4.25	Smart & pigweed Lambs quarters
3.	2,4-D amine	1.5		52	97	5.25	Pig & smartweed, foxtail
4.	2,4-D amine	1.5	Cult.	64	88	4.5	Pig & smartweed, Lambs quarters
5.	Ca Cyanamide	400	Cult.	80	93	5.5	Grass
6.	C.M.U.	1		64	92	4.75	Pig,Rag & Smart Weed,Grass
7.	C.M.U.	1.5		73	95	3.5	Rag & Smartweed, Grass
8.	T.C.A.	2		59	92	4.25	Grass,Smartweed
9.	T.C.A.	4		98	93	3.25	Grass,Smartweed
10.	Crag #1	2		48	88	6.00	Pig & Smartweed
11.	Crag #1	2	2 lbs.	42	92	6.75	Pigweed,Lambs quarters,grass
12.	Crag #1	4		61	91	4.5	Smart & pigweed
13.	Crag #2	2		42	91	7.	Grass,Ragweed Galinsoga
14.	Premerge	6		100	92	.5	
15.	Shell #130	6.25 Gal.		69	95	6.	Grass
16.	K Cyanate	16		30	93	7.75	Grass,pigweed
*Butoxy ester		L.S.D.	.05	24.3			

Table II

Influence of Pre-emergence Weed Control Treatments on Yield, Stand and Weed Growth at Point Pleasant and Reedsville in 1952.

Point Pleasant

	Treatment	Rate Per A. lbs.	Post-emerg. 2,4-D per A. lbs.	Yields bu. per A.	% Stand	Weed Index (0-9)	Predominant Weeds
1.	Cultivated			94	100	0	
2.	2,4-D amine	2		42	100	6	Ragweed
3.	2,4-D amine	1.5		46	99	4.25	Pig & Ragweed
4.	2,4-D amine	3		60	98	4.75	Ragweed
5.	2,4-D amine	1.5	.5	76	100	.75	
6.	2,4-D amine	1.0		25	98	7	Ragweed
7.	2,4-D *	1.5		53	98	4	Rag & Pigweed
8.	2,4-D *	1.0		51	100	6.25	Ragweed
9.	Cultivated			99	98	0	
10.	C.M.U.	1	.5	81	99	1.75	Grass
11.	C.M.U.	1.5		51	98	3.75	Rag & Pigweed
12.	Ca Cyanamide	600	.5	74	98	1.75	Grass
13.	Ca Cyanamide	400	.5	74	100	2.25	Grass
14.	K Cyanate	16	.5	51	99	3.	Grass
15.	Sodium T.C.A.	2	.5	57	83	3.5	Grass
16.	Sodium T.C.A.	4	.5	53	68	4.5	Grass
17.	Cultivated			95	100	0	
18.	Crag #1	2		39	99	4.75	Rag & Pigweed
19.	Crag #1	2	2 Crag #1	49	100	4.75	Rag & Pigweed
20.	Crag #1	4		43	99	3.75	Pig & Ragweed, grass
21.	Premerge	4		11	98	6.25	Ragweed, Grass
22.	Premerge	6		20	99	7	Rag & Pigweed
23.	No treatment			25	99	7	Ragweed
24.	Shell #130			19	100	6.75	Ragweed
25.	Cultivated			88	100	0	

*Butoxy ester L.S.D. .05 21.6

Reedsville

	Treatment	Rate Per A. lbs.	Post-emerg. 2,4-D per A. lbs.	Yields bu. per A.	% Stand	Weed Index (0-9)	Predominant Weeds
1.	Cultivated			90	97	3.5	Ragweed
2.	2,4-D *	1.5		101	98	1.25	Ragweed, foxtail
3.	2,4-D amine	1.5		97	98	2.	Foxtail
4.	2,4-D amine	1.5	.5	96	94	1.75	Foxtail
5.	2,4-D amine	1.5	Cult.	104	97	2.25	Ragweed, foxtail
6.	C.M.U.	1		104	98	.75	Foxtail
7.	C.M.U.	1.5		97	90	0	
8.	T.C.A.	2		90	97	4.5	Ragweed
9.	T.C.A.	4		79	93	4.75	Ragweed
10.	Crag #1	2		96	91	3.75	Ragweed, foxtail
11.	Premerge	4		95	85	.25	
12.	2,4-D amine	1.5		86	93	1.5	Foxtail
13.	Shell #130			82	94	6.25	Ragweed
14.	Ca Cyanamide	600		67	89	6.5	Ragweed
15.	K Cyanate	16		92	97	3.5	Ragweed

*Butoxy ester L.S.D. .05

Table III

Influence of Pre-emergence Weed Control Treatments on the Yield, Stand and Weed Growth at Point Pleasant and Reedsville in 1953.

Point Pleasant

	Treatment	Rate Per A. lbs.	Yield bu. per A.	% Stand	Weed Index (0-9)	Prevailing Weeds
1.	No control		53.	84	6	Ragweed
2.	2,4-D amine	1	89.	96	2.6	Grass
3.	2,4-D amine	1.5	88.	90	4	Grass
4.	2,4-D amine	2.0	79.	84	3	Grass, smartweed
5.	Cultivated		128.	99	0.5	
6.	M.C.P.	1.5	95.	80	4	Smartweed & grass
7.	Dinitro	6	106.	92	3	Grass
8.	Dinitro	9	96.	90	3.3	Grass
9.	T.C.A.	4	-	5	9.	Ragweed
10.	Cultivated		125.	93	1.	
11.	T.C.A.	8	-	2	9.	Ragweed
12.	C.M.U.	1.5	66.	72	5.1	Ragweed
13.	C.M.U.	2	-	17	3.5	Grass & bullnettle
14.	Dinitro-2,4-D	3-1	101.	92	3.	Grass
15.	Cultivated		124.	92	1.	

*Butoxy ester L.S.D..05 18.11

Reedsville

	Treatment	Rate Per A. lbs.	Yield bu. per A.	% Stand	Weed Index (0-9)
1.	T.C.A.	8	111	97	2
2.	2,4-D amine	1.0	118	97	1.5
3.	2,4-D amine	1.5	122	98	1
4.	2,4-D amine	2	125	96	.5
5.	Cultivated		122	98	2.25
6.	2,4-D *	1.5	122	97	.75
7.	Chloro IPC	4	98	79	1.5
8.	Dinitro	6	122	100	.75
9.	Dinitro	9	122	100	.25
10.	Cultivated		121	99	1.75
11.	T.C.A.	4	119	99	1.25
12.	No treatment		118	95	2.25
13.	C.M.U.	1.5	117	92	.75
14.	C.M.U.	2	111	98	.5
15.	Cultivated		119	99	2.5
16.	Alanap	4	116	96	1.75
17.	Alanap	6	104	94	1.5

*Butoxy ester L.S.D..05 11.48

Table IV

Influence of Post-emergence Weed Control Treatments on Yield, Stand and Weed Growth at the Locations Indicated in 1952.

Point Pleasant

	Treatment	Rate Per A. lbs.	Cult. or late spray	Yield bu. per A.	% Stand	Weed Index (0-9)	Predominant Weeds
101.	2,4-D *	.5		49	100	2.75	Grass
102.	2,4-D amine	.5		41	100	3.25	Grass
103.	2,4-D amine	.5	Cult.	55	99	2.25	Grass
104.	2,4-D amine	.5	Cult. & .5	38	100	4.	Grass, ragweed
105.	2,4-D amine	1.0		.7	100	7.75	Ragweed
106.	K Cyanate	10.		3.3	99	7.5	Ragweed
107.	Crag #1	4.		9.6	98	7.0	Ragweed
	Cultivated			88	100	0	
*Butoxy ester		L.S.D.	.05	19.9			

Reedsville

	Treatment	Rate Per A. lbs.	Cult. or late spray	Yield bu. per A.	% Stand	Weed Index (0-9)	Predominant Weeds
65.	Cultivated			97	95	5.	Ragweed
66.	2,4-D *	.5		85	92	2.75	Foxtail
67.	2,4-D amine	.5		95	93	5.25	Quackgrass, foxtail
68.	2,4-D amine	.5	Cult.	83	98	2.5	Foxtail
69.	2,4-D amine	.5	Cult. & .5	85	94	3.75	Quackgrass, foxtail
70.	2,4-D amine	1.0		76	93	2.5	Grass
71.	K Cyanate	10.		92	93	5.5	Ragweed
72.	Crag #1	2.		92	98	3.5	Quackgrass, ragweed
*Butoxy ester		L.S.D.	.05	20.5			

Wardensville

	Treatment	Rate Per A. lbs.	Cult. or late spray	Yield bu. per A.	% Stand	Weed Index (0-9)	Predominant Weeds
65.	Cultivated			75	90	4.75	Pigweed, Galinsoga
66.	2,4-D *	.5		64	87	4.25	Grass
67.	2,4-D amine	.5		73	88	3.5	Grass
68.	2,4-D amine	.5	Cult.	76	88	5.0	Grass
69.	2,4-D amine	1.0		78	87	4.5	Grass
70.	K Cyanate	10.0		68	87	6.25	Grass, pigweed
71.	Crag #1	2.		41	85	7.25	Smart, pig, & velvet-weed
*Butoxy ester		L.S.D.	.05	27.8			

Table V

Influence of Post-emergence Weed Control Treatments on the Yield, Stand and Weed Growth at Point Pleasant and Reedsville in 1953.

Point Pleasant

	Treatment	Rate Per A. lbs.	Yield bu. per A.	% Stand	Weed Index (0-9)	Prevailing Weeds
1.	Cultivated		117	88	.5	
2.	2,4-D amine	.5	83	94	4.7	Grass
3.	2,4-D amine	1.0	86	97	4.5	Grass
4.	2,4-D *	.5	81	98	4.7	Grass
5.	2,4-D *	1.0	90	88	4.7	Grass
6.	Cultivated		104	99	1.2	

*Butoxy ester L.S.D..05 20.00

Cultivated before spraying

	Treatment	Rate	Yield	% Stand	Weed Index	Prevailing Weeds
	Check		102	100	0.5	-
25.	Crag #1 4 lb.		110	98	1.25	Smartweed
26.	Crag #1 6 lb.		102	99	2.25	Smartweed
27.	Alanap 4		101	99	2.25	Smartweed

L.S.D..05 13.03

Reedsville

	Treatment	Rate	Yield	% Stand	Weed Index
1.	Alanap	4	109	100	.75
2.	Sessin	4	114	93	1.25
3.	Crag #1	4	125	97	1.25
4.	Crag #1	6	118	97	.75
5.	Cultivated		123	99	1.00
6.	2,4-D amine	.5	116	98	1.00
7.	2,4-D amine	1.0	110	95	0
8.	2,4-D amine	1.5	109	93	.25
9.	No treatment		122	97	1.00
10.	Cultivated		119	97	1.00
11.	LV-4 ,2,4-D*	.5	118	99	.75
12.	LV-4 ,2,4-D*	1.0	104	96	.50
13.	Dinitro	1	122	94	0
14.	Dinitro	2	125	87	.1

*Butoxy ester L.S.D..05 12.18

FIELD TRIALS OF PLANTING APPLICATIONS OF HERBICIDES TO CORN

by

L. E. Curtis, W. Baran, N. A. Ferrant, M. J. Papai, & C. V. Flagg [1]

As the use of herbicides increases on corn, growers are becoming more and more concerned with the problem of grass control. Post-emergence sprays of 2,4-D have given splendid control of broadleaf weeds. This has resulted in reduced competition by broadleaved weeds, and the annual grass, quack grass, and nut grass problem has become more serious.

We have observed a trend toward pre-emergence sprays using larger amounts of 2,4-D. This has been done in an effort to obtain better annual grass control. This approach has helped for annual grasses, but has emphasized the seriousness of quack grass and nut grass in many fields.

It is generally agreed that 2,4-D is of tremendous value for chemically weeding corn. However, it has several objectionable features. We are observing growth responses and injury under certain climatic conditions. These responses occur at all recommended rates of application. However, they are usually greater at the higher levels recommended for any one stage of growth. Corn grown on sandy and lighter textured soils lower in organic matter has shown greater injury. 2,4-D application is largely ruled out for corn grown on such locations. This is particularly true for sweet corn. There are marked differences in susceptibility between the various field and sweet corn varieties.

Small plot work has been carried on in 1951 and 1952 in an attempt to find possible materials for suppression of the serious perennial grasses as well as for control of annual grasses and broadleaf weeds. Some of the results of these screening trials have been repoŋted previously at this conference (1), (2). This work indicated that marked suppression of quack and nut grass could be obtained along with control of all other weeds. Furthermore, certain pre-emergence materials such as water soluble dinitros and CMU held promise of much longer residual action than could be obtained with 2,4-D. The higher rates of application necessary and the resulting higher cost per acre suggested application in rather narrow bands over the corn row. These could be followed later by conventional cultivation handled in such a manner as to eliminate weeds from between rows. In order to obtain accurate application of reasonably narrow bands (8" - 10" in width), it was thought desirable to mount the weed sprayer nozzles on the corn planter. Such equipment is inexpensive and with present high labor costs, it would appear that growers might welcome the combining of planting and spraying into one operation.

Methods and Materials

A number of cooperators located in New Jersey, Pennsylvania, and New York were selected in order to explore the practical aspects of grower application. Results from 13 of these cooperators are reported in this paper. Each of

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these growers indicated an interest in working with us on the adaptation of weed spray equipment to the corn planter. Their interest was prompted by a serious grass and weed problem. The mounting and adjustment of equipment was done in advance so that a whole field could be band sprayed at planting. Each of the three chemicals selected were band sprayed on a part of the field. Appropriate untreated check areas were included. Assistance was given each cooperator in adapting his own weed spray equipment to the corn planter. The conventional "power take-off" mounted weed sprayer pump was used with the supply tank or drum in most cases being mounted behind the tractor seat well above the draw-bar. The discharge hose from the pump, instead of leading to the boom of a conventional weed sprayer, was attached to hoses leading to one weed sprayer nozzle located behind each seed shoe or packer wheel and above the planted row of corn. Brackets or attachments were used to hold the nozzle 8 to 10 inches above the soil surface and about 10 inches to the rear of the packer wheel or shoe. The two and four-row brackets as supplied by the Engine Parts Manufacturing Co., were found to be very helpful for planter attachment.

The materials selected for grower trial were CMU (3-para-chloro-phenyl-1, 1-dimethyl urea), Sinox PE (alkanolamine salt formulation of dinitro ortho secondary butyl phenol, containing 3 pounds DNOSBP per gallon), and LV4 (butyloxyethanol ester of 2,4-dichlorophenoxy acetic acid, containing 4 lbs. 2,4-D acid equivalent per gallon). The rates selected were CMU 1 to 1½ lbs. actual per acre over-all coverage, dinitro 4½ to 6 lbs. and LV4 1 to 1½ lbs. These rates are per acre of ground actually covered. These were applied in 30 to 40 gallons of water per acre. For example, in a 10" band over rows spaced 40" apart, the 40 gallon rate would require 10 gallons per acre of corn planted.

Results and Discussion

All three chemicals included, Sinox PE, CMU, and LV4 gave splendid control of broadleaf weeds in all locations with but three exceptions. One cooperator in Chautauqua County, New York, obtained no appreciable control with any of the three materials. In the two days immediately following application 3½ inches of rain fell. The soil is light in texture and well drained.

Another cooperator in Erie County, Pennsylvania, obtained inferior weed control with all three chemicals. Considerable pump and pressure gauge trouble at time of application resulted in faulty and inaccurate application. LV4 in Onandaga County, New York, gave inferior broad leaf control on dry soil where weeds started slowly.

The difference in the performance of the materials was apparent in the amount of grass control obtained. Sinox PE gave evidence of superior annual grass control and the best suppression of quack and nut grass. This is probably due in a large part to the longer residual effect obtained at the 6 lb. level. This was apparently longer than the residual of LV4 at 1½ lbs. per acre.

Most of the cooperators are planning much greater use of Sinox PE for planter banding in 1954. These growers feel that they would prefer Sinox PE where grasses are a particular problem in spite of the higher cost per acre. LV4 performed well for broadleaf weed control in most cases. For this type of extremely early pre-emergence application, where the chemical is applied at planting, the shorter length of residual obtained with LV4 even at the high rate used, gave variable and in some cases unsatisfactory control of annual grasses. At one location in Wayne County, New York, where ideal moisture conditions started all weeds promptly, LV4 appeared a close second to Sinox PE, until midseason. It gave some suppression of quackgrass and nutgrass. However, in summarizing all observations in every location, LV4 gave substantially less annual grass control and perennial grass suppression than Sinox PE at the rates used.

CMU, being a wettable powder formulation, proved difficult to maintain in suspension in practically all locations. Consequently there was a general lack of uniformity in rate of application in almost every field. Injury appeared in places. There is evidence that with uniform rates of application over a field it might well equal Sinox PE both in annual grass control and suppression of the more serious perennial grasses.

Our cooperators who were properly equipped in advance, reacted enthusiastically to planter banding without exception. They plan to continue use of the practice in 1954 with expanded acreage. They point out that when planting is finished, spraying is done. This has been accomplished with a minimum of interference with the planting operation. There is a saving in labor and equipment costs. Unfavorable weather which often greatly increases the need for chemical weed control can not prevent spraying. It should, However, be borne in mind that these cooperators were above average as farm operators. They were well qualified to cope with any problems of calibration, adjustment, and operation of the weed spray equipment when these tasks are superimposed, on the regular planting operation.

The equipment as set up and as previously discussed, proved entirely satisfactory and in most cases gave continued trouble-free operation where good clean water and adequate filters were used. It should be pointed out that relatively narrow planter bands strongly suggest certain modifications in the technique of cultivation. For the first cultivation it will be found distinctly advantageous to equip the cultivator with a disc operating on either side of the row at about the margin of the band of chemical. The discs should be adjusted to throw soil away from the row. This is to avoid throwing weed seeds into the row where they may germinate and become a problem later. If desirable, or necessary, a lay-by cultivation could return some dirt to the row.

Summary and Conclusions

Planter banding of herbicides for weed control and grass suppression in corn appears most promising when careful attention is paid to planter and sprayer calibration and operation. Some growers will probably choose to continue older established methods of chemical weed control. This will be true in some cases because of increased cost of chemicals even when banded, and because of the type of worker needed to handle the combined job of planting and spraying.

Of the materials tested, Sinox PE, because of its long residual at the rates applied will probably deserve first consideration for any locations which have a serious grass problem. LV4 will find a place in planter banding in moderate infestations of annual grass with broadleaf weeds being the primary problem. Before CMU can be satisfactorily applied, we must have equipment and methods better adapted to the handling of wettable powders.

Planter banding offers another timing for weed control, and can if need arises, be followed with a later spray. In areas where large acreages of 2,4-D sensitive crops are grown near corn fields, growers welcome a non-hormone type of material such as Sinox PE. This chemical will fit in applications on lighter soils where 2,4-D injury is common.

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Weed Control in Corn in Pennsylvania

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The amine, ester, low volitale ester of 2,4-D and MCP were applied at 1, 2, and 3 pounds per acre; Cyanamid at 400, 600, and 800 pounds; CMU one half, 1, and 2 pounds; Chloro IPC 2, 4, and 6 pounds; and amine salt of dinitro-o-sec-butylphenol 3, 6, and 9 pounds per acre. The applications were made on the day of planting, June 11, 1953, on soil which had been puddled because of the frequent rains.

The 2,4-D and MCP controlled 84 percent of the monocots and 87 percent of the dicots. There was very little difference between the 1 and 3 pound rates. Chloro IPC at 6 pounds gave good control of grasses and fair control of dicots. Cyanamid averaged a little lower than 2,4-D. CMU and dinitro at the two higher rates gave about the same control as 2,4-D.

There was no apparent injury on any treatment until the corn was about three inches tall. Then the two heaviest rates of dinitro started to show injury on the tip of the leaves. The 9 pound rate killed about 60 percent and the 6 pound rate about 40 percent of the corn plants. There was little rain after planting and the temperatures were relatively high.

The plant disease corn breeding inbred lines and crosses were sprayed with one half pound of low volitale ester when the plants were about 14 inches tall. Very few lines were injured by this post emergence treatment.

A number of directional contact sprays were applied to the base of the corn plant and annual grasses. The treatments were applied when the grass was heading. This is on the late side for ease of control. Endothal 3003 with NH_4SO_4 at 2 pounds per acre did a satisfactory job and at 4 and 8 pounds gave complete kill of grasses. The amine salt of dinitro at 1 and 2 gallons per acre and sodium cyanamids at 20 and 40 pounds per acre gave fair control of the grasses. It rained shortly after spraying so some of the herbicides were probably washed off. In general, the directional spray injured only the two lower leaves.

In our opinion, directional spraying (applying 2,4-D while cultivating) of 2,4-D is the safest, gives the best results, and is the most economical way of applying 2,4-D on weeds in corn.

THE EFFECT OF A HIGH AND A LOW VOLATILE ESTER OF 2,4-D ON SEVEN VARIETIES OF FIELD CORN AS DETERMINED BY INJURY AND YIELD

W. P. Anderson, C. C. Jack[1], J. D. VanGeluwe and E. R. Marshall[2]

Introduction

The North Central Weed Control Conference recommends, and has been recommending for the past few years, 2,4-D as a chemical weed killer on field corn. The form of 2,4-D suggested is either amines or esters. The only specification is that the esters be used at lower rates than the amines.

Here in the Northeast there has always been a controversy over the use of 2,4-D ester formulations as a herbicide in field corn. The vapor activity, or so-called volatility, of the ester formulations has probably been the major reason for this controversy. Here in the Northeast, as contrasted to the Northcentral area, the agriculture is quite intensive and diversified. Plants that are highly susceptible to 2,4-D and have shown to be injured by the vapors of 2,4-D are often grown adjacent to fields devoted to corn crops. Since the introduction of the low volatile esters, the hazard from the vapors or so-called volatility has been considerably reduced.

The work presented in this paper was conducted to determine, by comparison, the effect of a high and low volatile ester of 2,4-D on field corn regarding injury and yield.

Procedure

This test was conducted on the American Chemical Paint Company's Research Farm in Ambler, Pennsylvania. Seven varieties of field corn, Ohio M-15 hybrid, Ohio K-24 hybrid, Cornell M-1 hybrid, Cornell M-4 hybrid, Wisconsin 235 hybrid, Wisconsin 275 hybrid and New Jersey 7 hybrid. These varieties were selected for this test because it was felt that they were most commonly grown in the Northeast.

The corn was planted with a corn planter in rows 3 feet apart, 800 feet long. Each of the seven varieties were planted in four rows side by side. Plots were planted in May and the

1 American Chemical Paint Company
2 G. L. F. Soil Building Service

materials were applied as a post-emergence spray in July. All plots received one cultivation before spray. At the time of spraying, the corn was about 10 to 12 inches tall. In order to subject the corn plants to a critical test the application was made as an over-all spray directing the spray completely over the tops and whirl of the plants. The plot size was 16 feet wide and 88 feet long, replicated three times. Each plot had all seven varieties included and the spray pattern was across the different varieties. Application was made at a rate of 60 gallons of water per acre and applied by a hand sprayer.

Materials used were Weedone LV-4 (butoxy ethanol ester of 2,4-D), Weedone 48 (ethyl ester of 2,4-D), Weedar 64 (alkanolamine salt of 2,4-D), and Weedone 2,4,5-T (butoxy ethanol ester of 2,4,5-T). All materials were applied at 1/4, 1/2 and 1 pound per acre.

Results

Injury readings for all materials and varieties were made 2 weeks after application. All materials applied at the 1/4 pound rate produced no visual injury to any variety except the New Jersey 7. The New Jersey 7 variety showed slight bending and some slight curling of the bracer roots.

At the 1/2 pound rate, the New Jersey 7 variety showed more injury than the other varieties. This injury was in the form of stunting and severe bracer root distortion. Only slight distortion of the bracer roots and bending of the stalk were evident on the Wisconsin 235 and 275 varieties. Four varieties, Ohio M-15, Ohio 24, Cornell M-1 and Cornell M-4, showed consistent distortion of bracer roots to the Weedone LV-4 treatments whereas only a few plants in each of these varieties showed similar injury to the other three treatments. From visual observations there did not seem to be any difference in degree of injury between the amine or ester formulations of 2,4-D used in this test.

At the one pound rate all materials used gave moderate to severe root injury with some bending of the corn plants of all varieties except New Jersey 7 which showed severe bracer root injury, stunting and some twisting of the corn leaves.

Table 1 - Average Yields of Seven Varieties of Field Corn Treated Post-emergence

	Average Yield (lbs./plot) 3 Replicates							Yield (lbs)	
	N.J.-7	Wisc. 275	Wisc. 235	Cornell M-4	Cornell M-1	Ohio K-24	Ohio M-15	Total	Average
1/4 lb/Acre									
Weeone LV-4	15.5	7.6	9.0	7.7	13.3	14.7	12.0	79.8	11.4
Weedone 48	17.0	10.1	13.5	9.8	15.8	15.9	12.0	94.1	12.0
Weedone 2,4,5-T	19.3	8.0	8.8	7.2	13.8	15.4	13.2	85.7	12.2
Weedar 64	13.6	9.2	11.7	7.8	13.5	14.1	13.2	83.1	11.9
Control	8.7	6.9	8.1	6.2	12.6	13.6	11.0	67.1	9.6
1/2 lb/Acre									
Weedone LV-4	13.9	8.6	9.0	7.3	12.3	14.1	12.7	77.9	11.1
Weedone 48	12.9	8.3	7.8	7.9	13.2	16.3	13.2	79.6	11.4
Weedone 2,4,5-T	10.2	8.1	10.9	8.1	13.4	15.4	14.1	80.2	11.5
Weedar 64	14.0	10.2	9.7	8.3	12.5	16.1	13.7	84.5	12.1
Control	12.4	9.6	10.0	7.3	15.2	15.0	11.7	81.2	11.6
1 lb/Acre									
Weedone LV-4	10.9	5.8	7.6	8.0	11.9	14.4	11.7	70.3	10.0
Weedone 48	13.4	6.6	8.2	7.3	13.9	13.9	12.6	75.9	10.9
Weedone 2,4,5-T	12.0	8.5	7.6	7.2	12.2	14.1	12.1	73.7	10.5
Weedar 64	12.3	6.5	7.6	5.9	12.2	13.3	11.9	69.7	10.0
Control	8.7	5.0	7.8	5.3	10.8	12.2	11.0	60.8	8.7

Under the conditions of this test, regardless of the injury observed, there was little difference in the total yield of corn between materials tried on any specific variety. In most cases treated plots gave higher yields than check plots. This was probably due to weed control since check plots did not receive any additional cultivation before harvest. Weed control was satisfactory in all plots but no counts were made. It is interesting to note that although New Jersey 7 showed more injury than other varieties, the yield was not affected proportionately.

Conclusions

1. New Jersey 7 was the only variety that showed effects of 2,4-D at the 1/4 pound rate of Weedone LV-4, Weedone 2,4,5-T, Weedar 64 and Weedone 48. The injury on New Jersey 7 was in the form of slight curling of the bracer roots and some slight bending of the stalks.

2. Wisconsin 235 and 275 showed slight curling of the bracer roots with some bending of the stalks at the 1/2 pound rate of all materials tried.

3. Ohio M-15, Ohio 24, Cornell M-1 and Cornell M-4 had only a few plants with slight bracer root injury at the 1/2 pound rate of Weedar 64, Weedone 2,4,5-T and Weedone 48. Where 1/2 pound of Weedone LV-4 was used these same varieties showed a consistent slight curling of bracer root injury. New Jersey 7 at the 1/2 pound rate of all materials showed severe bracer root injury with some stunting.

4. At the one pound rate all materials produced some bending of the stalks and moderate to severe bracer root injury to all varieties except New Jersey 7 which produced severe bracer root injury, stunting of the corn and some twisting of corn leaves.

5. Under the conditions of this test there was little difference in injury or yield following treatment with either the "low volatile" ester (butoxy ethanol ester of 2,4-D) or the "high volatile" ester (ethyl ester of 2,4-D).

THE INFLUENCE OF WETTING AGENTS ON THE PHYTOTOXICITY OF SEVERAL HERBICIDES[1]

C. R. Skogley[2]

Surface active agents are often classified according to the purpose for which they are used. Wetting agents, detergents, emulsifying agents, and stickers are a few of the terms used in classifying these synthetic products; however, one surface active agent might fulfill several or all of these uses. In agricultural use these terms are often used interchangeably and when used in conjunction with herbicides a surface active agent perhaps fulfills more than one function. In water-insoluble liquids a surface active agent can serve as an emulsifier. With insoluble powders these agents may be useful in improving suspension and dispersion in aqueous solutions. It is also possible that a surface active agent may alter the physical and chemical characteristics of a spray solution. Wetting, sticking, and penetration are often listed as the criteria upon which the value of a wetting agent is determined.

Bryan, Staniforth and Loomis (2) working with 2,4-D spray solutions on soybean leaves concluded that wetting agents which gave good visible wetting of the leaves caused greater injury to the plants than those which wet poorly. Ennis et al. (3) in working with 2,4-D solutions accounted for the increased effectiveness of a spray containing a wetting agent as being entirely due to increased adherence. Blackman (1) in considering the principles of herbicidal spray applications suggests that the addition of a surface active agent will result in greater wetting and may also increase retention on leaves with a well-developed, waxy cuticle. Mitchell and Linder (4) report that the rate of absorption and translocation of 2,4-dichloro 5-iode phenoxyacetic acid was greatly increased when certain surface active agents were added. They attributed this increased effectiveness to reduced surface tension and also to the agents acting chemically as co-solvents and preventing the 2,4-DI acid from crystalizing out on the leaf surface. Staniforth and Loomis (6) reported that the toxicity of sodium and amine salts of 2,4-D to corn, flax and soybeans was increased five or more times when one per cent of wetting agent was added. They concluded that it was not just the relationship of surface tension and penetration but perhaps involved the chemistry of the combined materials.

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[1]This work was made possible by support from the Atlantic Refining Company. The assistance of Dr. E. W. Clark and John Campbell of the Atlantic Refining Company in conducting some of the tests and for doing the photographic work is acknowledged.

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Price (5) stated that there is no such thing as a detergent that does not to some extent promote wetting and penetration, emulsify oil, disperse dirt particles, and produce foam. In increasing the effectiveness of herbicides certain of these properties are important but perhaps there are other characteristics of wetting agents that are of equal importance. Variable plant responses may be obtained with any one herbicide when different types of wetting agents are added. The anionic type of surface active agent may be more or less effective than the non-ionic type depending on the plant and the herbicide involved. There is much to be learned regarding the chemical and physiological aspects of wetting agents as they effect phytotoxicity.

Studies have been underway at the New Jersey Agricultural Experiment Station for several years in an attempt to ascertain the value of surface active agents in combination with several phytotoxicants. The present study was conducted on the basis of the favorable results obtained in earlier tests.

Methods

A. Plot size in all cases, except in the test with ammonium sulphamate (Ammate) on poison ivy, was 10 feet by 4½ feet. The poison ivy test was conducted on a fence row and the foliage was wet thoroughly.

B. The spray was applied to the 4½ x 10 foot plots with a 3 nozzle milk bottle type hand sprayer operated at 30 pounds pressure. The pressure was supplied by CO_2 from a small cylinder.

C. All treatments on the 4½ x 10 foot plots were in duplicate.

D. The chemicals used, rates and dates of application, amount of water used, crop treated, and the designation and amount of wetting agent added is given in table 1. The surface active agents used were of the anionic alkyl aryl sulfonate type, designated as Ultrawet.

E. All plots were rated visually for per cent top kill and averages of the two replicas were obtained. In most cases recovery data, where applicable, has not been obtained as the tests were mainly conducted late in the 1953 growing season.

F. Throughout most of the testing period the temperatures were unusually high for the area and the soils were extremely dry. This should be kept in mind when analyzing the results.

Results

A. New Jersey No. 7 hybrid corn was planted on July 16 for the purpose of these tests. The corn was about 2 inches high when it was treated. All rates of the isopropyl ester of

Table 1. Chemicals employed, rates and dates of application, gallonage applied, crops treated, and designation and rate of wetting agents used during the 1953 trials.

Chemical	Lb. rates per acre*	Water Gals./A	Ultrawet used	Lb. rates per acre	Crop treated	Application date
2,4-D isopropyl ester	0, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2	10	Exp. 82	0, 1/20, 1/10, 1/5, 2/5	Corn 2" high	7/21
2,4-D TEA salt	0, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2	10	DS	0, $\frac{1}{4}$, $\frac{1}{2}$, 1	" " "	7/22
DNOSBP amine salt	0, 2, 4	40	Exp. 82	0, 1, 2	" " "	7/21
CIPC	0, 1$\frac{1}{2}$, 3	40	DS	0, 1, 2, 3	Soybeans-Pre-emerg.	7/22
Maleic hydrazide	0, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2	100	DS	0, 1, 2	Fine turf	7/17
" "	0, 1, 2, 4, 6	100	DS	0, 1, 2, 4	Weedy grasses[1]	7/16
Monoethanolamine arsenite	0, 2$\frac{1}{2}$, 5, 10	40	TEA-E-4 ovhd	0, 2, 4	Annual weeds[2]	7/17
Atlacide + 2,4-D TEA salt	20 + 1/4	40	Exp. 82	0, 2, 4	Weedy hay field[3]	8/13
Ammate + 2,4-D TEA salt	10 + 1/4	40	Exp. 82	0, 2, 4	Weedy hay field	8/13
MEA arsenite + 2,4-D TEA salt	5 + 1/4	50	Exp. 82	0, 2, 4	Weedy hay field	8/13
2,4,5-T butyl ether esters	2$\frac{1}{2}$, 5	30, 60, 120	Exp. 82	0, $\frac{1}{4}$, $\frac{1}{2}$, 1, 1$\frac{1}{4}$, 2	Heavy brush[4]	8/5
MEA arsenite	0, 5	50	Exp. 82 & 60L	0, 2, 4, 6	Weedy hay field	8/26
Butyl ether esters of 2,4-D & 2,4,5-T	0, $\frac{1}{2}$, 1	10	Exp. 82	0, 1, 2	" " "	8/26
CMU	0, 2, 4	50	Exp. 82 & 60L	0, 2, 4, 6	" " "	8/26
Carbex (100% Petroleum oil)**	0, 400, 800	--	Exp. 82	0, 4	" " "	8/26
Ammate	0, 20, 40, 80, 120	150	60L	0, 6	" " "	9/4
"	200, 400	Wet foliage	60L	0, 4	Poison ivy	8/13

*Based on acid equivalent, active ingredient, or total solid depending on usual practice

**Diluted by 10% with kerosene to reduce viscosity

[1]Bluegrass, creeping bent, ragweed, plantain, dandelion.

[2]Pigweed, ragweed, morning glory, & lambsquarters

[3]Red clover, timothy, curly dock, broad leaf plantain, crabgrass, foxtail, ragweed, lambsq., daisy, nutgrass

2,4-D gave some weed control. Only at the 1/4 pound per acre rate did the addition of an ultrawet increase the efficiency of the 2,4-D. At the 2 pound rate of 2,4-D combined with the high rate of ultrawet the corn was slightly injured and stunted.

B. All rates of the triethanolamine salt of 2,4-D with or without wetting agents gave some weed control. The addition of an ultrawet to the 1/4 and 1/2 pound rates of 2,4-D did not improve the weed control. However, at the 1 and 2 pound per acre rates, the addition of from 1/4 to 1 pound of an ultrawet increased weed kill from 50 per cent to 90 per cent. There was no corn injury.

C. From the standpoint of weed control no benefit was derived from adding a wetting agent to the amine salt of dinitro-o-sec-butyl phenol in this test. The lowest rate used, 2 pounds per acre, gave excellent weed control. An excellent picture of the increased action of a dinitro plus a wetting agent compared with dinitro alone was obtained as a result of this test. Table 2 shows the effect of adding a wetting agent as measured by corn height.

Table 2. The effect of adding experimental Ultrawet 82 to an amine salt of DNOSBP as measured by corn height three weeks after application.

Pounds per Acre		Height as % of check
DNOSBP	Ultrawet 82	
0	0	100 (check)
2	0	71
	1	68
	2	37
4	0	77
	1	31
	2	28

D. No benefit was obtained in these tests as a result of adding a wetting agent to Chloro IPC for pre-emergence weed control in soybeans. Only a slight amount of weed control was obtained at the highest rate regardless of the amount of wetting agent added.

E. An interesting observation was made, both on the fine turf, and on the weedy grasses, when Maleic hydrazide was used in conjunction with an ultrawet. No data could be obtained as to growth inhibition resulting from the use of this chemical but it was observed that with the higher rates of maleic hydrazide the wetting agent prevented browning of the grass.

Without the ultrawet the grass turned brown at the 1 and 2 pound rates.

F. Monoethanolamine arsenite, a contact or non-selective herbicide, when applied to annual weeds gave considerably better results when a wetting agent was added. A 25 to 50 per cent increase in kill was obtained when as little as 2 pounds of an ultrawet were added to the arsenical. When 5 pounds of monoethanolamine arsenite plus 2 pounds of ultrawet per acre were sprayed on a stand of annual grasses, clovers, and weeds the per cent top kill was 80 to 90 per cent. The same rate of the arsenical alone gave an average top kill of 50 per cent. This same chemical at 5 pounds per acre plus 1/4 pound of an amine salt of 2,4-D was made from 60 to 80 per cent more effective when 2 pounds of ultrawet per acre was added.

G. Atlacide (58% $NaClO_3$) at 20 pounds per acre with 1/4 pound 2,4-D amine, although not too effective at this low rate, was benefited considerably by the addition of an ultrawet. Without the wetting agent only a 10 to 20 per cent top kill was obtained while a 40 per cent top kill was obtained by the addition of 2 pounds of experimental Ultrawet 82.

H. Two pounds of Experimental Ultrawet 82 increased the top kill obtained by the use of 10 pounds of Ammate (ammonium sulfamate) plus 1/4 pound of 2,4-D amine per acre by 25 to 35 per cent. This rate of herbicide also gave poor results in this test. Both the Ammate and Atlacide tests were conducted on established sods of perennial grasses, clover and weeds.

I. A test employing Esteron 245 (butyl ether esters of 2,4,5-T) on brush with and without a wetting agent and in varying concentrations failed to show any benefits derived from the addition of the Ultrawet. Perhaps the amount of recovery observed in the spring of 1954 will indicate the validity of this preliminary data.

J. A slight increase in phytotoxicity on perennial grasses, clover, and weeds was obtained with Esteron Brush Killer (butyl ether esters of 2,4-D and 2,4,5-T) when 1 pound per acre of an ultrawet was added to either 1/2 or 1 pound rates of the brush killer. The over-all kill in this test was poor, however.

K. CMU (3-para chloro phenyl 1, 1-dimethyl urea) at 2 and 4 pounds per acre was used with 0, 2, 4 and 6 pound rates of two different ultrawets--60L and Experimental 82. In all cases the use of an ultrawet improved the immediate toxicity of the CMU. No benefit was observed by the addition of more than 2 pounds of ultrawet, however. There was no apparent difference in the reaction of the ultrawets tested.

L. Carbex, an aromatic petroleum fraction, which was diluted by 10 per cent with kerosene gave a better kill at both 400 and 800 pounds per acre when 4 pounds of ultrawet were added.

M. A test conducted in September using 0, 20, 40, 80 and 120 pound per acre rates of Ammate showed an improved kill of perennial grasses at the two highest rates when 6 pounds of ultrawet were added. At the lower rates the kill was poor with or without the ultrawet.

N. A 200 pound per acre rate of Ammate plus 4 pounds of Ultrawet 60L was compared with an application of 400 pounds of Ammate alone on a very rank growth of poison ivy. These rates are approximations as the exact areas sprayed could not be measured accurately; however, the ratio holds true. The amount and rate of defoliation was similar on both spray areas and no recovery growth started during the remainder of the season.

Summary and Conclusions

During July, August and September a series of small scale, preliminary tests were conducted to determine the value of adding certain types of wetting agents to a number of known weed killers. The wetting agents were of the anionic, alkyl aryl sulfonate type. The herbicides included in the trials were: amine and ester forms of 2,4-D, Ammate, CMU, Carbex, Esteron Brush Killer, Esteron 245, Monoethanolamine arsenite, DNOSBP amine salt, Atlacide, CIPC, Maleic hydrazide and combinations of 2,4-D with several of these materials.

These tests were not conducted at the time considered optimum for weed control nor were the weather conditions normal throughout most of the testing period. However, in most cases the addition of an ultrawet increased the herbicidal activity of the material. In the case of maleic hydrazide the grass was injured less at the higher rates when a wetting agent was added.

The results obtained from these tests should indicate that much more work can be done in checking the role of wetting agents in herbicidal work. The rates and types of wetting agent best suited for each individual herbicide may vary and it may vary according to the type of plant being sprayed.

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Chemical vs. Cultural Control of Weeds in Soybeans[1]

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Introduction

Previous work at this station (1,2) has shown that certain herbicides applied as a pre emergence spray will effectively control most annual weeds in soybeans for a period of two to four weeks. It was observed in earlier experiments that if application of the herbicides was delayed until just before the soybeans came up, more effective weed control resulted. Also, an earlier report (1) suggested that some cultivation resulted in larger yields regardless of weed control. Reported herein are the results of an experiment involving three herbicides, three application levels, and three levels of cultivation, as they effect the weed control and yield of soybeans.

Methods

On May 6, 1953, soybeans of the variety S 100 were planted near Warsaw, Va in Sassafras silt loam soil. They were planted in rows 40 inches wide with a two row planter. Individual plots of four rows by 30 feet were used. Three replicates of all possible combinations of the following treatments were applied:

A.- 1. Chloro IPC - 6 lbs.
   2. Dinitro-sec-butylphenol (amino salt) - $6\frac{1}{2}$ lbs.
   3. Sodium pentochlorophenotel (PCP) - 18 lbs.

B.- 1. Applied at 0 rate (check)
   2. Applied at planting
   3. Applied at 4 days after planting

C.- 1. Cultivated late only.
   2. Cultivated medium and late.
   3. Cultivated early, medium and late.

All chemicals were applied in water at 40 gallons per acre with a knapsack sparyer.

Approximately one half inch of rain fell the day after planting. Rainfall was normal for the first six weeks of growth after which time practically no rain fell until harvest.

Weed control ratings were given three weeks after planting and weed counts were made just before harvest. Yield records were taken from the two center rows in each plot on October 13, 1953.

[1] These studies were supported by the Virginia Polytechnic Institute Educational Foundation, Incorporated.

Results and Discussion

The average rank of the treatments in respect to weed control and crop injury three weeks after planting are shown in table I.

Table I.- Weed control and crop injury at 3 weeks

Treatment	Rank*	Crop injury
CIPC 6 lb. at planting	2.45	None
CIPC 6 lb. 4 days after planting	1.89	Slight stunting
Dinitro 6 lb. at planting	1.33	Slight leaf burn
Dinitro 4 days after planting	1.00	Slight leaf burn
PCP 18 lb. at planting	1.38	None
PCP 18 lb. 4 days after planting	1.00	Slight leaf burn
Check	9.00	

* 1 = no weeds 9 = no control

All treatments resulted in satisfactory weed control with Chloro IPC being slightly less effective than dinitro or PCP. Applications made four days after planting resulted in more effective weed control in all cases than those made at planting time. This was probably due to the fact that weed seed had begun to germinate and the seedlings were in a rapid state of growth at the time of the last application. The differences continued throughout the growing season except in the case of Chloro IPC which evidently did not have as long a residual effect as did PCP and dinitro.

Delayed applications made at four days after planting resulted in some injury to the soybeans by all chemicals used. This injury caused no permanent damage and was not evident after six weeks.

Large weeds interfere with combining operations and consequently are of major importance Weed counts were taken on the various plots about three weeks before harvest to determine if control early in the season was beneficial. A summary of the analysis of variance of weed counts and soybean yields is presented in table II. The principal sources of variance shown in this table are due to the main effects of time of application, level of cultivation, and chemicals. First order interactions of cultivation X chemical and time of application X chemical are also significant.

Average weed counts and yields for each treatment are presented in table III. Two way comparisons are shown in figures 1, 2 and 3.

In figure 1, weed counts just before harvest indicate a slight advantage for delaying application of PCP and dinitro over Chloro IPC. This is possibly due to a longer residual effect of these chemicals especially in hot weather. Yields were higher from applications of dinitro at planting than from delayed applications. The beans were beginning to emerge at the late application and may have suffered permanent injury, although it was not observable from field notes taken during the season. Delaying application increased the yield in the PCP plots as shown in figure 4. These results agree in general with other reported work (3).

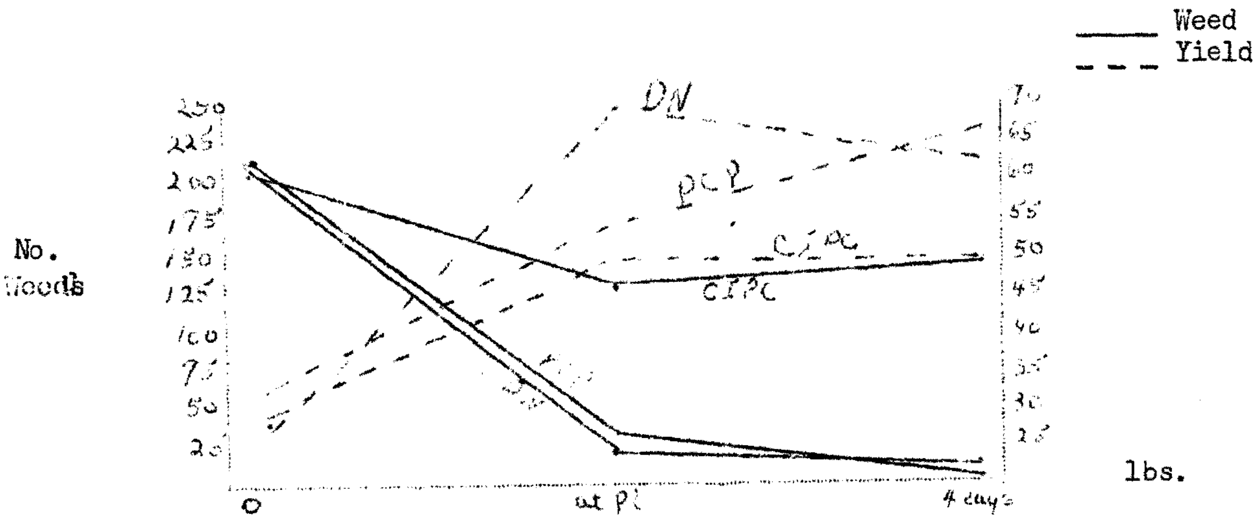

Fig. 1 - Chemical/time effects on told counts
and yields.

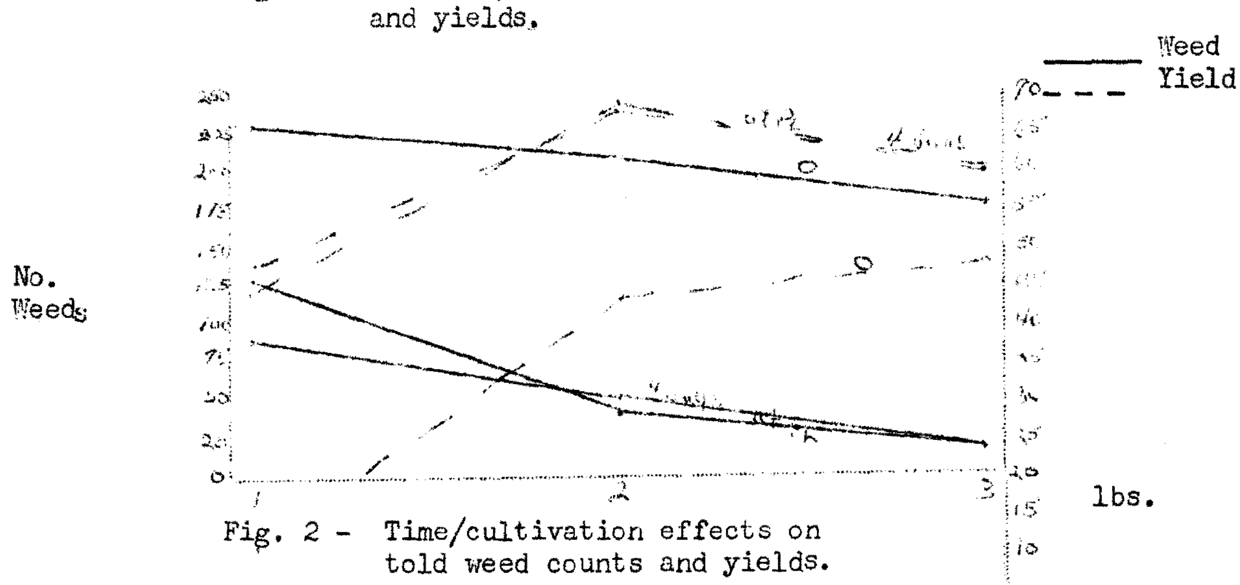

Fig. 2 - Time/cultivation effects on
told weed counts and yields.

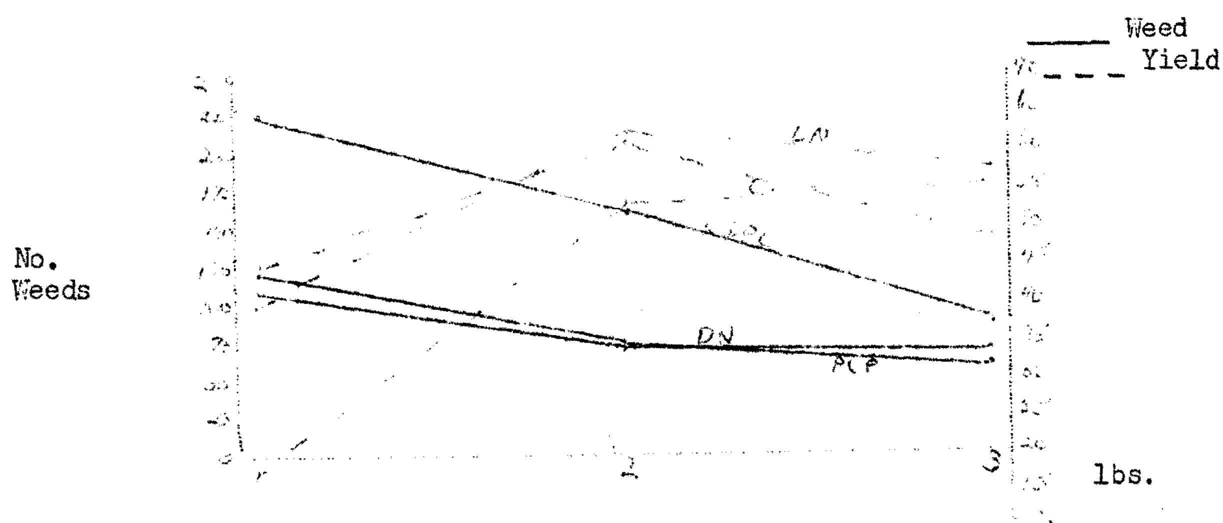

Fig. 3 - Chemical/cultivation effect on
total weed counts and yields.

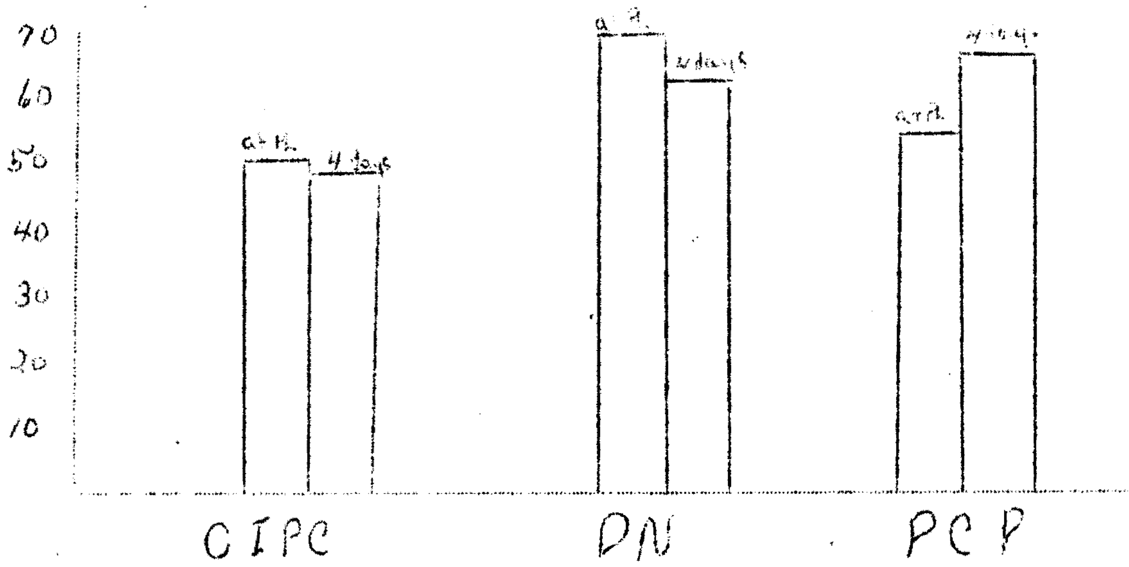

Fig. 4 - Yield in pounds for treated plots only.

Table II.- Analysis of Variance for Weed Counts and Soybean Yields

Source	DF	Weed Counts M^2	Weed Counts F	Yield M^2	Yield F
Between Treat.	26	317.8700	14.2967**	15.0801	11.31**
Chemicals	2	611.2650	27.5188**	11.8952	7.79**
Time of appl.	2	2366.8250	106.6567**	84.7229	55.46**
Cultivation	2	495.6800	22.3420**	57.8132	38.50**
Cult X Time	4	34.2950	1.5458	1.7407	1.14
Cult X chem.	4	82.6925	3.7272**	7.7452	5.07**
Time X chem.	4	170.5925	7.6892**	5.4441	3.56
T X C X c	8	18.7613	0.8456	2.9390	1.92
Within Treat. (Error)	54	22.186		1.5276	

** F value significant at the 1% level

Table III.- Master table for average yield and weed counts

Chem.	Time	Cult.	Av. yield lbs/plot	Av. weeds/ 60'row
Dinitro	At planting	2	8.82	0.0
PCP	4 days	2	8.56	0.0
Dinitro	At planting	3	7.98	0.0
Dinitro	4 days	2	7.68	0.0
CIPC	4 days	3	7.40	5.3
PCP	4 days	1	7.32	1.7
CIPC	At planting	2	7.16	13.0
PCP	At planting	2	7.10	0.7
CIPC	At planting	3	6.90	3.7
DN	4 days	3	6.84	0.0
Dinitro	4 days	1	6.34	3.3
PCP	4 days	3	6.29	0.0
Dinitro	At planting	1	6.18	5.7
PCP	At planting	1	6.00	10.7
PCP	At planting	3	5.22	1.0
PCP	0	2	4.95	23.3
PCP	0	3	4.72	17.7
DN	0	2	4.48	21.7
CIPC	0	2	4.37	23.3
DN	0	3	4.32	21.3
CIPC	0	3	4.16	18.3
CIPC	At planting	1	2.53	25.0
CIPC	4 days	1	2.12	23.3
PCP	0	1	1.52	25.0
CIPC	0	1	1.43	25.0
DN	0	1	.86	25.0
L.S.D. .05			2.00	7.64

Cultivations had no effect on weed counts or yield as shown in figure 2. This could be expected since the chemicals had probably disappeared before cultivation began. Yields were greatly increased by a medium and late cultivation over a single late cultivation. In contrast, yields were lowered in the treated plots by giving an early cultivation in addition to two later cultivations. Some unknown factor, possibly cultivation when the soil was too wet, could have been the cause. No explanation is offered as to why the early cultivation increased, rather than decreased yield in the untreated plots.

Figure 3 shows that more than two cultivations did not reduce weeds when treated with PCP and dinitro but did reduce yields. The opposite was true with Chloro IPC. Cultivation evidently aided in the destruction of weeds that were not killed by the Chloro IPC. Very few weeds were evident at any time in the DN and PCP plots, indicating that if early weeds are controlled, there is no great weed problem at harvest.

Summary

The results of an experiment involving three chemicals, three times of application and three cultivation levels in soybeans is reported.

Under the conditions of this experiment it appears that dinitro and PCP were superior to Cl IPC in controlling weeds. Delaying application of the herbicide seems to favor weed control with dinitro and PCP, but not with Cl IPC. One late cultivation was not as effective as a medium and late cultivation or an early, medium and late cultivation.

Yield increase was almost directly proportional to weed control. Dinitro and PCP resulted in higher yields than did Cl IPC. Delaying application four days after planting did not greatly increase yield with any of the chemicals used. A medium and late cultivation resulted in higher yield than did an early, medium and late cultivation with PCP and dinitro, but not with Cl IPC.

Literature:

1. Chappell, W. E. 1952. Pre-emergence weed control studies with soybeans. Southern Weed Conference Fifth Proceedings, 127-128.

2. ____________ 1953. Weed control studies in soybeans. Southern Weed Conference Sixth Proceedings, 122-125.

3. Hansen, J. R., and J. F. Freeman, 1952. Comparison of Cl IPC and DNOSBP for control of weeds in soybeans. North Central Weed Control Conference Research Report, 102 (abstract).

THE EFFECT OF SIX HERBICIDES ON ALFALFA AND CLOVERS UNDERSEEDED TO SPRING OATS

A. J. Tafuro, R. H. Beatty and C. C. Jack [1]

In the Northeastern part of the United States a large proportion of grains are seeded with legumes, mostly mixed legumes. Weeds in seeded grains are a serious pest to the Northeast farmer, since not only do they effect normal growth of grains, but they also compete with the legume seedings. Chemical weed control in seeded grains has been practiced by farmers in this area, to some extent, for the past few years. Dinitros, MCP and 2,4-D all have been used as selective weed killers in seeded grains.

Although 2,4-D and MCP can both be used selectively at low gallonage rates on grains, the legumes, especially alfalfa, are rather susceptible to injury when these chemicals come in contact with the legume at rates needed for weed control. To overcome this, applications of 2,4-D and MCP are applied at low gallonage (5 to 10 gallons per acre) when weed infestations are serious and grain is at least 8 to 10 inches tall to protect the legume seeding from the chemical. In many cases this application gives a good control of mustard but does not always control weeds such as ragweed and smartweed. Dinitros have also been used with some success but under certain environmental conditions injury to grain and legumes has been observed.

This experiment was conducted to test the selectivity of six herbicides on alfalfa and clovers (alsike, ladino, and medium red). Application was made at a relatively high volume of water per acre (35 gallons) when grain was only 6 to 8 inches tall to insure thorough wetting of the legumes and grain with each spray.

Procedure

A test comparing six (6) herbicides applied at three (3) rates, 1/4, 1/2 and 1 pound of active ingredient per acre was conducted on American Chemical Paint Company's Research Farm in Ambler, Pennsylvania. The treatments were applied to a field of Clinton oats underseeded with a legume mixture of alfalfa, ladino, alsike and medium red clover. The clinton oats were seeded in May and the legumes were seeded when oats were in the two leaf stage. The rate of legume seeding was six (6) pounds of alfalfa per acre, one (1) pound of ladino, one (1) pound of alsike and one (1) pound of medium red clover per acre. Materials were applied by a hand sprayer operating at 20 pounds pressure by compressed air. Application was at a rate of thirty-five (35) gallons of water per acre.

(1) American Chemical Paint Company, Ambler, Pennsylvania

The plot size was five (5) feet wide and twenty (20) feet long and were replicated four (4) times. At the time of spraying the oats were about eight (8) inches tall, completely tillered, and the underseeded legumes were in the first leaf stage. The weather was clear and the temperature was 75°F when materials were applied. On the day after spraying, counts were made on the alfalfa and clover stand in each plot. Two (2) two (2) square foot areas were counted in each plot and these areas were staked permanently for further counts made four (4) weeks later. Weed readings were also made at both times that the legumes were counted. Weeds present in the plots were mustard, ragweed and smartweed.

The data obtained on alfalfa and clover stands was analyzed statistically using the analysis of covariance technique. Stands reported for 4 weeks after spray treatments are adjusted averages.

Table I - Results of Statistical Analysis (F Values) (Covariance).

Source of Variation	D.F.	Alfalfa	Clover
Materials	5/50	N.S.	2.46*
Rates	2/50	5.39*	1.61
M x R	10/50	N.S.	N.S.
C.V.	---	61.80%	67.53%

Table II - Average Counts Taken at Time of Spray and 4 Weeks After Spray.

		Alfalfa		Clover	
Material	Rate	Before	After	Before	After
MCP 60 (amine)	1/4#/A	13.50	15.55	12.50	15.60
MCP 60 (amine)	1/2#/A	11.50	8.31	7.00	8.61
MCP 60 (amine)	1#/A	10.00	7.01	3.25	8.38
MCP 90 (amine)	1/4#/A	13.75	12.90	11.00	13.85
MCP 90 (amine)	1/2#/A	22.25	10.05	11.50	13.35
MCP 90 (amine)	1#/A	6.75	5.80	2.25	10.14
4 Chloro (amine)	1/4#/A	24.75	7.23	10.00	9.86
4 Chloro (amine)	1/2#/A	15.50	13.80	9.50	10.36
4 Chloro (amine)	1#/A	14.25	9.83	10.50	5.85

Table II (Continued) - Average Counts Taken at Time of Spray and 4 Weeks After Spray.

Material	Rate	Alfalfa Before	Alfalfa After	Clover Before	Clover After
4 Chloro (ester)	1/4#/A	13.00	10.87	13.25	2.09
4 Chloro (ester)	1/2#/A	6.75	11.05	4.25	10.13
4 Chloro (ester)	1#/A	20.00	3.47	13.00	1.84
2,4-D (amine)	1/4#/A	17.75	11.13	13.75	11.84
2,4-D (amine)	1/2#/A	18.75	13.00	11.00	13.85
2,4-D (amine)	1#/A	19.75	2.87	6.00	13.87
3,4-D (amine)	1/4#/A	7.50	13.33	5.00	17.12
3,4-D (amine)	1/2#/A	8.00	14.27	4.75	10.13
3,4-D (amine)	1#/A	22.25	11.05	11.00	9.35
Check		12.50	15.68	8.50	13.36
Average (excluding check)		14.78	10.08	8.86	10.35

Table III - Rate Averages for Counts Taken at Time of Spray and 4 Weeks After Spray. Averages Based on All Materials and Four Replications.

Rate	Alfalfa Before	Alfalfa After	Clover Before	Clover After
1/4#/A	15.04	11.83	10.92	11.72
1/2#/A	13.79	11.74	8.00	11.06
1#/A	15.50	6.66	7.67	- 8.23
L.S.D. Values		.05 = 3.62 .01 = 4.82	Difference is not significant	

Table I gives the average alfalfa and clover plants counted at the time of spray and 4 weeks after spray. The figures for 4 weeks after spray have been adjusted to a common initial stand level on the basis of the regression relationship established by covariance analysis.

Table IV

Material	Alfalfa Before	Alfalfa After	Clovers Before	Clovers After
MCP 60	11.66	10.29	7.58	10.86
MCP 90	14.24	9.59	8.25	12.44
4 Chloro Amine	18.16	10.28	10.00	8.69
4 Chloro Ester	13.24	8.47	10.16	4.70
2,4-D Amine	18.74	9.00	10.25	13.18
3,4-D Amine	12.58	12.87	6.91	12.21
Check	12.50	15.68	8.50	13.36

LSD Values for comparing material averages with check average. .05 = 7.22 .01 = 9.62

LSD Values for comparing materials. .05 = 5.73 .01 = 7.64

LSD Values for comparing materials with check. .05 = 8.12 .01 = 10.83

Results

Table IV shows the average counts, with all 3 rates combined, of the various materials used. The after spray figures have been adjusted to a common initial stand level on the basis of the regression relationship established by covariance analysis to adjust for variability in the intial stand counts among treatments.

Table IV shows that for alfalfa, the check is on the borderline of being significantly better than the ester of 4-chloro phenoxyacetic acid. The other materials do not differ significantly from the check nor do they differ significantly from each other. However, it is interesting to note that all materials, except 3,4-D, gave consistent decrease in the final stand counts after spray. In all replications 3,4-D counts were consistent in that it was not as detrimental to the alfalfa plants as the other materials used. The MCP both 60 and 90, 4-chloro amine and ester and the 2,4-D amine all gave a higher injury factor than 3,4-D at all rates, although the difference was not significant at the 5% probability level.

It is interesting to note that the clovers were also effected more seriously by the 4-chloro formulation than the MCP, 2,4-D or 3,4-D. MCP 60 and 90, 4-chloro amine, 2,4-D amine and 3,4-D amine do not significantly differ from each other or the check, but MCP 60, MCP 90, 2,4-D amine and 3,4-D amine and the chedk all have significantly higher adjusted stands than the 4-chloro ester.

For alfalfa (see Table III) the 1 pound rate had significantly lower adjusted stand than the 1/4 and 1/2 pound rate but there was no difference between the 1/4 and 1/2 pound rates.

The 4-chloro ester at the 1/2 and 1 pound rates delayed oat maturity for about 2 weeks whereas the 4-chloro amine formulation at the one pound rate delayed maturity for about one week.

Conclusions

Under the conditions of this test:

1. All chemicals used were somewhat detrimental although stands were significantly lower than the check for alfalfa. With alfalfa the one pound rate had significantly lower stands than the 1/4 and 1/2 pound rates but there was no difference between the 1/4 and 1/2 pound rates.

2. On alfalfa the check was on the borderline of being significantly better than the ester of 4-chloro phenoxyacetic acid. The MCP 60, MCP 90, 4-chloro amine, 2,4-D amine and 3,4-D amine did not differ significantly from the check.

3. 3,4-D amine in all replications was consistently less injurious to alfalfa plants and in this test seemed to be the safest to use on alfalfa of any of the materials tried. 3,4-D should be tested more thoroughly in the future.

4. On clover MCP 60, MCP 90, 4-chloro amine, 2,4-D amine, 3,4-D amine did not differ significantly from each other or the check, but MCP 60, MCP 90, 2,4-D amine, and 3,4-D amine and the check all had significantly higher stands than the 4-chloro ester.

5. 4-chloro ester and amine formulations delayed maturity of clinton oats as much as 2 weeks.

PRELIMINARY RESULTS OF PRE-AND POST-EMERGENCE SCREENING EXPERIMENTS ON LEGUMES.

Marvin M. Schreiber and Stanford N. Fertig 1/

Introduction

The use of the screening procedure for rapid evaluation of numerous herbicides has increased greatly in the past few years. The specific method used at a particular place is more or less dictated by the type of facilities available and the particular information desired.

The problem of weed control in legumes is as yet unresolved. From the herbicidal view, this is primarily due to two reasons:

1) Either we have not determined the most effective method of using the herbicides now available without legume injury, or

2) New herbicides which are less injurious to legumes are drastically needed. Both of these points were upper most in mind when these screening tests were initiated.

This is a preliminary report of a screening program started in the summer of 1953 in the Department of Agronomy, Cornell University. Its main objectives were to observe the effect of both pre- and post-emergence spraying of chemicals now in wide use and new experimental herbicides on leguminous crops. Many combinations of both types of chemicals were included.

Materials and Methods

Alfalfa, birdsfoot trefoil, ladino clover and medium red clover were the legumes used in all these tests. Two rows of each legume were seeded in greenhouse flats (12" x 18" x 3") filled with a Shagrin silt loam soil that had previously been limed and fertilized. Weed seeds of mustard (Brassica arvensis), yellow rocket (Barbarea vulgaris), lambs-quarters (Chenopodium album) and pigweed (Amaranthus retroflexus) were also seeded along with the legumes. The flats were then sprayed at specified times with various herbicides using an experimental sprayer built by C. W. Terry, Professor of Agricultural Engineering, Cornell University (Northeastern Weed Control Conference Proceedings, 1952). After spraying the flats were placed outside on a level, cindered area.

The screening method used was as follows: 21 chemicals and various combinations of these chemicals at 3 to 6 different concentrations were sprayed pre- and post- emergence without replication. Upon favorable observations as to its relative effect on the legumes involved a second screening test of the herbicide was made over a wider range of concentrations and was replicated twice. This method allowed for rapid observation of many herbicides to start with.

The following is a list of treatments applied pre-emergence four days after seedings were made and post-emergence when the crops were 3 to 4 inches tall:

1/ Graduate Assistant and Professor of Agronomy, respectively, Department of Agronomy, Cornell University, Ithaca, New York.

Chemical	Pre-Emergence Conc. (Lbs./A.)	Post-Emergence Conc. (Lbs./A.)
2,4-D, Dow	1/4, 1/2, 1	1/8, 1/4, 1/2
MCP 60%, Chip.	1/4, 1/2, 1	1/8, 1/4, 1/2
MCP 60%, ACP	1/4, 1/2, 1	1/8, 1/4, 1/2
MCP 90%, Dow	1/4, 1/2, 1	1/8, 1/4, 1/2
4-Chloro (ester) ACP	1/2, 1, 1-1/2, 2	1/8, 1/4, 1/2, 1
4-Chloro (amine) Dow	1/2, 1, 1-1/2, 2	1/8, 1/4, 1/2, 1
2-Methyl 6-Chloro, ACP		1/8
2,4,5-T	1/4, 1/2, 1	1/8, 1/4, 1/2
3,4-D (amine), Hercules	1/4, 1/2, 1	1/8, 1/4, 1/2
3,4-D (ester), Hercules	1/4, 1/2, 1	1/8, 1/4, 1/2
Sinox P.E.	2,3,4,5,6,10	1/2, 1, 2, 3, 4
TCA, Dow	4,6,8,10,20	2, 4, 6
EH T515, U.S.I.	8,12,16	2, 4, 6
EH T516, U.S.I.	8,12,16	2, 4, 6
EH T517, U.S.I.	8,12,16	2, 4, 6
EH T518, U.S.I.	8,12,16	2, 4, 6
EH 654-20-37, U.S.I.	8	
EH 654-27-32, U.S.I.	8	
Natrin, Carbide & Carbon	4,5,6,7	
Parasin, Carbide & Carbon	4,5,6,7	
NP 745, Penn Salt	5,10,15	

Combinations Pre-Emergence
(Lbs./A.)

Sinox P.E.	4 + T515 12
Sinox P.E.	4 + T516 12
Sinox P.E.	4 + T517 12
Sinox P.E.	4 + T518 12
Sinox P.E.	4 + 2,4-D 1/2
Sinox P.E.	4 + MCP 60%, Chip., 1/2
Sinox P.E.	4 + MCP 60%, ACP, 1/2
Sinox P.E.	4 + MCP 90%, Dow, 1/2
Sinox P.E.	4 + 4-Chloro (amine), 1-1/2
Sinox P.E.	4 + 4-Chloro (ester), 1-1/2
Sinox P.E.	4 + 2,4,5-T, 1/2
Sinox P.E.	4 + 3,4-D (amine), 1/2
Sinox P.E.	4 + 3,4-D (ester), 1/2
Sinox P.E.	4 + TCA, 8

Combinations Post-Emergence (Lbs./A.)	
Sinox P.E.	1 + T515, 4
Sinox P.E.	1 + T516, 4
Sinox P.E.	1 + T517, 4
Sinox P.E.	1 + T518, 4
Sinox P.E.	2 + T515, 4
Sinox P.E.	2 + T516, 4
Sinox P.E.	2 + T517, 4
Sinox P.E.	2 + T518, 4
Sinox P.E.	1 + 2,4-D, 1/4
Sinox P.E.	1 + MCP 60%, Chip., 1/4
Sinox P.E.	1 + MCP 60%, ACP, 1/4
Sinox P.E.	1 + MCP 90%, Dow, 1/4
Sinox P.E.	1 + 4-Chloro (ester) ACP, 1/2
Sinox P.E.	1 + 4-Chloro (amine), Dow, 1/2
Sinox P.E.	1 + 3,4-D (ester), 1/4
Sinox P.E.	1 + 3,4-D (amine), 1/4
Sinox P.E.	1 + 2,4,5-T, 1/4
Sinox P.E.	1 + TCA, 4

Results and Discussion

In reporting the results of the above treatments only those that showed favorable effects will be discussed unless pertinent points concerning the others were observed.

Pre-Emergence

Sinox P.E. showed the best weed control with the least injury to the legume even up to 6 pounds per acre. 4-Chloro, whether amine or ester, retarded legume emergence and caused chlorosis of those plants that did emerge. TCA treatments showed no weed control and progressively less germination of legume from 4 lbs. to 20 lbs. per acre. NP 745 showed no retarding effect on legume emergence even up to 15 lbs. per acre but no weed control.

All the experimental carbamates, T515. T516, T517, T518, 654-20-37 and 654-27 32 seemed to produce abnormally long, flat cotelydons which appeared to delay the first unifoliate leaf. None of the carbamates tested gave any weed control. T-518 was the best of all the carbamates tested.

Sinox P.E. at 4 lbs./A. plus TCA at 8 lbs./A. gave a good stand of all legumes with good weed control.

3,4-D treatments showed definite promise in the initial test and a second screening test was made using both the amine and ester at a greater range of concentrations (0.1 lbs./A. - 1.0 lbs./A. by tenths). No reduction in legume stands were noted by any of these treatments. Below 0.3 lbs./A. of 3,4-D weed control was not evident. Between 1/2 and 1 lb./A. weed control was good but legume growth appeared to be slightly stunted.

Post-Emergence

None of the translocated herbicides when used alone at 1/8 lb./A. showed reduction of stand of either the legumes or weeds. The most promising chemicals on the basis of the initial screening test were 3,4-D (amine and ester) and Sinox P.E. Sinox P.E. showed increased burning with an increase of concentration but with no reduction of the legume stand. Burning on birdsfoot trefoil initially looked the worse but after a few weeks no difference could be noted when compared to the check.

A second screening test was made on the 3,4-D products using both seedling legumes and what would be considered established legumes (seeding made early in the spring, crop clipped once and sprayed two weeks later after some regrowth).

Replicated sprayings of 3,4-D amine was made on seedling legumes with concentrations ranging from 0.1 lbs/A. to 0.5 lbs./A (by .05 lbs./A.). Most plants were at the first trifoliate leaf stage of growth. None of the concentrations showed stand reduction although initially epinasty was evident. Weed control increased with concentration, particularly for yellow rocket (Barbarea vulgaris).

The second screening test on established legumes was made using 3,4-D (ester and amine) with 4-Chloro amine and ester, 2,4-D, MCP 90% Dow, and Sinox P.E. included primarily for comparison. The concentrations ranged from 1/8 lb. per acre to 2 lbs./A for 2,4-D, 3,4-D, MCP 90% and 1/4 lb. to 3 lbs./A. for 4-Chloro. 3,4-D showed definite reduction of injury to legumes, particularly alfalfa when compared with MCP, 2,4-D and 4-Chloro; thus, verifying the initial observation. This was true for both the amine and ester.

The activity of 4-Chlorophenoxyacetic acid was observed to be much lower than that of 2,4-D, MCP and 3,4-D. However, 4-Chloro is as injurious to legumes as 2,4-D and MCP at equal activity concentrations. This is most striking on its effect on medium red and ladino clover which are considered to be the most resistant of the legumes. Leaf curl on medium red clover was more pronounced due to treatment with 4-Chloro than with MCP and equal to that brought about by 2,4-D. Ladino clover showed profound abnormalities, particularly in fusion of leaflets and stems and increasing the number of leaflets from three to a maximum of eight. This effect was noted only at concentrations of 1/4 and 1/2 lb./A whether the chemical was used alone or in combination.

Summary

1) MCP was as injurious to legumes as 2,4-D at the same concentration..

2) 3,4-D was less injurious to legumes than 2,4-D or MCP at the same concentration.

3) 4-Chloro showed less activity than 2,4-D or MCP.

4) The concentration of 4-Chloro required to give the same degree of weed control as 2,4-D or MCP resulted in equal injury to the legume.

5) Sinox P.E. caused the least injury to legumes and gave the best weed control of all herbicides tested whether pre-emergence or post-emergence.

6) The experimental carbamate T518 showed the least injury to legumes of all the carbamates tested.

Acknowledgement is made to the following companies for supplying the chemicals used in this experiment:

American Chemical Paint Co., Ambler, Penna.
Carbide and Carbon Chemicals Co., New York, N. Y.
Dow Chemical Co., Midland, Michigan.
Chipman Chemical Co., Boundbrook, N. J.
Hercules Powder Co., Wilmington, Dela.
Pennsylvania Salt Manufacturing Co., Wyndmoor, Penna.
U. S. Industrial Chemicals Co., Baltimore, Md.

CHEMICAL WEED CONTROL IN SMALL GRAINS UNDERSEEDED TO LEGUMES

M. F. Trevett and C. E. Cunningham[1]

Recommendations for the treatment of underseeded small grains with 2,4-D- or MCP-type herbicides usually stipulate that spraying be deferred until a protective canopy of grain and weed foliage has formed. To insure that the receptive and retentive capacity of the canopy is not exceeded, low acre volumes of spray are also suggested. These, generally, are the only positive measures taken to aid in the establishment of an adequate legume stand.

Although experimental confirmation is lacking, there are other practices that might increase the certainty of obtaining an adequate stand. For example, compared to low rates of companion crop seeding, relatively high rates should result in more protection for legume seedlings by increasing the density of stand of the companion crop per unit area. The density of the canopy, of course, should not be increased to the point where it will become a factor in limiting legume establishment. Increased protection due to the small grain would be of most importance in fields with a sparse weed population. Variations in the rate of companion crop seeding may account for much of the conflicting data in the literature, particularly, as in the case of oats, when seeding rates range from one half to two or more bushels per acre.

For any given rate of companion crop seeding the method of sowing may have a bearing on the amount of protection provided. Broadcast grains, because of greater seed dispersion, might give greater total coverage of the soil floor than drilled grain, especially during the early stages of companion crop development. From the standpoint of weed control, an increased canopy effect on the part of the small grain may be undesirable. The shielding action that protects legume seedlings would also protect weed seedlings. If, however, the objective of weed control is not the complete elimination of all weeds, but rather the removal from competition of those weeds that germinated prior to clover emergence, then the enhanced canopy effect would not be objectionable. Tall, early emerged weeds would themselves be a part of the canopy and hence subject to adequate spray coverage.

Aside from the conjectured benefits of increased seeding rates of the companion crop, or of the method of companion crop sowing, an adequate stand of legume might be assured if

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legumes were seeded at higher than normal rates. For a given density of canopy, high seeding rates of the legume should, compared to lower rates, increase the number of legume seedlings shielded by the canopy. Other effects of higher rates of seeding might include, in the case of species with a high percentage of hard seeds, a significant amount of germination after sprays have been applied. Even at normal seeding rates post-spraying germination of both hard and soft seeds may be of practical importance.

Table 1 contains preliminary observations on the interaction between herbicide treatment and rates of seeding Ladino clover. Plantings were made in mid-May. Sprays were applied when the clover was not more than 2 inches tall, and when oats were 4 to 6 inches tall. Clover counts were made during the first week in September of the seeding year.

TABLE 1

INTERACTION BETWEEN RATE OF SEEDING AND HERBICIDES ON STAND OF LADINO CLOVER

Herbicide and Acre Rates	Number of Ladino Clover Plants Per Square Foot September of Year of Seeding		
	1950	1951	
	5# Ladino/Acre	3# Ladino/Acre	1# Ladino/Acre
Check	26.8	14.2	6.2
1/4# MCP 1/ acid	19.4	---	---
1/2# MCP 1/ acid	---	12.8	4.8
1/2# 2,4-D 2/ acid	---	12.9	4.4
3 qts. Dow Sel. 3/	13.1	11.2	3.4
LSD 5%	6.1	NS, but a trend for check to be higher	1.7

1/ "Weedar MCP", 30.5% Diethanolamine salt of 2-methyl 4-chlorophenoxyacetic acid. American Chemical Paint Co.

2/ "2,4-Dow Weed Killer", 65% Alkanolamine salts (of the Ethanol and Isopropanol series) of 2,4-Dichlorophenoxyacetic acid. Dow Chemical Co.

3/ "Dow Selective Weed Killer", 13.7% Ammonium dinitro secondary butyl phenate. Dow Chemical Co.

The data in Table 1 conform to the principle that the more adverse conditions are for legume establishment the higher should be the rate of legume seeding. However, by and of itself, this data is not meaningful. The fact that, compared to check, an excessive rate of dinitro reduced clover stand by 51.2% in 1950, and by 45.2% in 1951 (one pound per acre rate of seeding), is not of much assistance in evaluating this treatment for farmer use. To properly evaluate this data the number of surviving, vigorous legume plants should be compared to a norm. The norm will represent the minimum number of legume plants per square foot, the fall of the seeding year, that experience or experiment has indicated as required for a full stand the year following associated grasses or legumes, the use to which the sod is to be put, and will further depend upon the expected loss of seedlings due to winterkilling, or to other causes. If, for example, in a certain mixed forage seeding two Ladino plants per square foot are required for a full legume stand the year following seeding, any of the treatments for the one-pound rate of seeding in Table 1 would have resulted in an adequate stand, even assuming a one third loss of plants over winter. On the other hand, if, for another grass-legume mixture, five Ladino plants per square foot were deemed a full stand the year following seeding, and assuming a one third loss of plants over winter, a one-pound seeding rate of Ladino would have been inadequate.

Norms based on measurements other than of number of plants per square foot would make satisfactory standards. For example, evaluation could be made on the basis of percent legume in the first cut of hay the year following seeding. Thus, for certain grass-legume mixtures, an acceptable norm would be 60% legume:40% grass. In any case, for whatever the type of data employed, the norm should conform to the rule that in mixed grass-legume seedings each component should attain a proportion of the mixture that will insure maximum longevity and productivity of the sod.

Summary

It is suggested that, insofar as effect on legume stand is concerned, herbicides applied to underseeded small grains be evaluated on the basis of vigor and number of legumes surviving chemical treatment in relation to a norm representing the minimum number of legume plants per square foot required for a full stand in a given situation; increasing legume seeding rates to above normal may assist in establishing an adequate stand.

CHICKWEED CONTROL IN PASTURE SEEDINGS[1]

W. H. Mitchell and C. E. Phillips[2]

For the successful establishment of pasture and hay crops it is essential that competition from weeds be eliminated as nearly as possible. The importance of chickweed (Stellaria media) in reducing the first cutting yields of newly-established alfalfa has been shown by Aldrich and Baylor (1), Morris and Kuhn (2) and others. There is much less evidence to indicate the extent of injury to pasture seedings from chickweed competition. Experiences and investigations in Delaware and elsewhere indicate that chickweed is most severe on low ground where there is ample moisture for its growth. The pasture acreage in Delaware is far greater than the acreage devoted to the growing of alfalfa and much of the pasture acreage is on low ground. Since this ground provides good conditions for the growth of chickweed as well as pasture plants it would seem desirable to determine to what extent the chickweed is competing with and reducing the stand of pasture plants and the possibilities of an effective control program.

The objectives of this study were to determine the effectiveness of several chemicals in controlling chickweed and to find to what extent presence of chickweed is decreasing the yield of pastures.

Materials and Methods

This study was conducted at the College Farm on a Sassafras Silt Loam soil. A seedbed was prepared and a seeding made in late August using a cultipacker-type seeder. The seed mixture consisted of 7 pounds Orchard grass, 10 pounds bromegrass, 3 pounds alsike clover, and 1 pound Ladino clover.

One year previous to this seeding the middle section of this field was disced heavily in an attempt to renovate it. This proved unsuccessful and the following summer the entire field was plowed, planted to Sudan grass, and plowed again in September in preparation for the seeding used in this study. The middle section of the field became heavily infested with chickweed following closely the area that was disced in an attempt at renovation. This 8 acre field was divided into 8 one-acre lots for intensive grazing by 30 - 35 mature dairy animals. The middle 4 lots had a heavy growth of chickweed and a series of plots were laid out across this area.

The plot layout consisted of a completely randomized design with all treatments replicated 3 times. The plot size was 6' x 50'. A check plot was located beside each treated plot in an attempt to remove some of the differences due to variable weed growth over the experimental area.

Six treatments were made consisting of the following:

Ammonium and alkanolamine salts, each at 1 pound of DNOSBP per acre; IPC at 4 pounds and 8 pounds of active ingredient per acre; and CIPC at 1 pound and 2 pounds of active ingredient per acre.

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1. Published as Miscellaneous Paper No. 180 with the approval of the Director of the Delaware Agricultural Experiment Station.
2. Assistant Research Professor and Head, respectively, Department of Agronomy, Delaware Agricultural Experiment Station.

All materials were applied in 50 gallons of water per acre with a pressure of 80 pounds per square inch. At the time of application the temperature was 45° - 48° F. Treatments were made on December 18 and at this time chickweed on the plot area was from 1" - 5" deep.

In April square yard samples were cut from each plot, hand separated into grass, clover, and chickweed components and later oven dried. In September, 1953, the plots were rated as to their relative stands of pasture species. Somewhat incidental to this study, grazing records were kept to give an approximation of the quantity of pasture being produced.

Experimental Results and Discussion

Table 1 shows the results of the hand separations made on the April cuttings.

Table 1. Effect of Chemical Treatments on Dry Matter Yields of Clover, Grass, and Chickweed

Treatment No.	Treatment	Rate lbs./Acre[1]	Yield of Dry Matter in Grams per Sq. Yd. Clover	Grass	Chickweed
1	Chloro IPC	1	2.3	26	13
2	Check	-	3.0	22	144
3	Chloro IPC	2	7.3	9.0	1.3
4	Check	-	9.0	22	89
5	IPC	4	8.0	12	81
6	Check	-	1.0	4	100
7	IPC	8	15.0	3	20
8	Check	-	6.0	23	192
9	Sinox W	1	7.0	42	76
10	Check	-	11.0	52	150
11	Sinox PE	1	5.0	49	8
12	Check	-	3.0	16	79

1/ All rates of the dinitros expressed as DNOSBP equivalent and the carbamates as active ingredients.

The dinitro treatments produced a surface kill of the chickweed but there was considerable regrowth by the time the plots were sampled in April.

In the plots treated with IPC both at the 4 pound and 8 pound rates, there was no noticeable reduction in the chickweed stand until late February and March. At the 4 pound level there was very little weed control, however, at 8 pounds per acre the IPC gave very good control. At this level there was a reduction in the stand of orchard grass and bromegrass.

Chloro IPC both at the 1 pound and 2 pound levels had a very delayed effect on the chickweed although control at both levels was good. There appeared to be a slight reduction in growth of the grasses at the 2 pound level.

There was considerable variation in the stand of weeds when data was collected in April. It was noted, especially with the IPC and CIPC, that even where good control resulted from the treatment there was no more grass or clover present than in the untreated checks. In areas nearby where little or no chickweed was present, the stand of grass and clover was noticeably better. This suggests that injury to the stand resulting from the competition of the chickweed occurs early in the life of the stand and in this case before December 18.

Table 2. Production of Seeded Area as Measured by Cow Days of Grazing

Lot No.	1	2	3	4	5	6	7	8
Cow Days of Grazing	238	236	202	204	204	186	170	188

Table 2 is included to show that the production in all of the lots was very satisfactory, even though, as previously stated, there was a marked variation in the stand of chickweed.

In September of 1953 observations were made of the plot area and there were no significant differences showing between the treated and untreated areas. This suggests that where as the original stand of grass and clover may have been reduced by the weed competition, the spreading nature of Ladino clover may largely overcome this loss.

Summary

The objective of this study was to investigate the extent of injury to a fall pasture seeding by chickweed and to study the effectiveness of four chemical controls.

The ammonium and alkanolanime salts of DNOSBP at the 1 pound rate gave an effective top kill of the chickweed but considerable regrowth was made by April.

IPC at 4 pounds per acre did not effectively control chickweed but at the 8 pound rate produced a nearly complete control. At the 8 pound rate there was considerable reduction in the growth of orchard grass and bromegrass.

CIPC gave good control at the 1 pound and 2 pound levels with some retardation in the growth of the grasses at the higher rate.

It appears that injury to the stand of pasture plants resulting from the competition of chickweed occurs in the early stages of seeding establishment.

The entire seeded area produced an average of over 200 cow days of grazing per acre per season indicating that Ladino clover-grass mixtures will overcome to a considerable extent severe chickweed competition.

Literature Cited

1. Aldrich, Richard J. and Baylor, John E. Chickweed Control in Alfalfa. Northeastern Weed Control Conference Proceedings, 7:221-229, 1953.

2. Morris, Lindsay F. and Kuhn, Albin O. A Field Study of Rates and Dates of Applying Certain Chemicals for Control of Chickweed in Alfalfa. Northeastern Weed Control Conference Proceedings 7:213-219, 1953.

CONTINUED STUDIES OF CHICKWEED CONTROL IN ALFALFA[1]

Richard J. Aldrich[2]

Investigations at the New Jersey Station during 1950-51 and 1951-52 clearly showed that chickweed could be satisfactorily controlled with DNOSBP and Chloro-IPC. It was found that Chloro-IPC effectively controlled chickweed regardless of date of treatment and amount of water used for the treatment. Control with a single application of DNOSBP was consistently better with treatments made prior to matting of the chickweed. The value of repeat treatment for most effective control was also pointed out. The amount of water used had negligible affect with single applications of DNOSBP prior to matting or where two treatments were made.

The 1952-53 work was devoted to continued study of gallonage and date of DNOSBP application, a comparison of DNOSBP formulations and evaluation of split treatments of low rates. Chloro-IPC and IPC were also compared.

EXPERIMENTAL

DNOSBP

Methods: Tests were conducted on pure seedings of alfalfa seeded in late summer of 1952. Plots were 6 feet wide and 25 feet long in a randomized block design.

The gallonage and date of application test was identical to the 1951-52 test. One pound of an ammonium salt of DNOSBP was applied in 10, 20, 40, and 100 gallons in the following months: December, January, February, December plus January, December plus February, and January plus February.

DNOSBP ammonium and amine salts with and without a wetting agent and DNOSBP acid were compared. One pound of the active ingredient was applied in 40 gallons of water per acre December 19, February 5, and December 19 plus February 5.

In the test of rates of DNOSBP, 3/4, 1, and 1½ pounds of an ammonium salt were applied in 40 gallons as single treatments December 19 and February 5, 3/8, 1/2, and 3/4 pound were applied December 19 and again February 5, giving a total application equal to single treatments on each date. The first treatment was made when chickweed was in the seedling stage (1/4-1/2 inch).

[1]Cooperative study between the New Jersey Agricultural Experiment Station and the Division of Weed Investigations, ARS, USDA.

[2]Agronomist, Division of Weed Investigations, ARS, USDA.

Results: Results of the gallonage test were in general agreement with results of the 1951-52 test. Satisfactory control was obtained with the October treatment and all combination treatments. It was noted that, even on the optimum dates for control, application in 10 gallons did not provide as effective control as application in 20, 40, and 100 gallons. Gallonage had no affect in the 1951-52 test providing treatments were made in the optimum periods for control. This may have been due to a relatively larger and denser growth of alfalfa in the 1952-53 test area. Field peppergrass (Lepidium campestre) was effectively controlled in 1952-53 test with treatments in December and January and with all combination treatments.

DNOSBP ammonium salt with and without wetting agent, DNOSBP amine salt with wetting agent, and DNOSBP acid provided equal and effective control as single treatments in December and in the combination treatments. DNOSBP amine salt without wetting agent provided slightly less control as a single treatment on either date.

In the comparison of rates of ammonium DNOSBP, 3/4 pound as a single treatment to seedling chickweed in December provided effective control. It was observed that 1/2 pound in December provided control comparable to 3/4 pound so that the repeat treatment was not needed. Effective control was not obtained with any rate applied in February.

Carbamates

Methods: The test was conducted in a pure seeding of alfalfa seeded in late summer of 1952. Plots were 6 feet wide and 25 feet long in a randomized block design with four replications.

Chloro-IPC was applied at rates of 1/2, 1, and 2 pounds and IPC at rates of 1, 2, and 4 pounds in 40 gallons of water per acre. Applications were made December 19 to chickweed 3 to 5 inches high.

Results: Chickweed was completely eliminated by 1 and 2 pounds of Chloro-IPC and by 2 and 4 pounds of IPC. Although chickweed was not killed by 1/2 pound of Chloro-IPC its growth was very much restricted and flowering was largely prevented.

SUMMARY

It is clear that effective control with DNOSBP is associated with time of treatment whereas date of treatment has relatively little effect with the carbamates tested. Single treatments of DNOSBP have never controlled chickweed when applied after the chickweed is heavily matted; control of matted chickweed has been obtained with repeat treatments. The 1953 results suggest that DNOSBP rates as low as 1/2 pound per acre may control chickweed if it is treated while in the seedling stage. There would not appear to be pronounced differences in control obtained with the DNOSBP formulations; control with the amine salt was slightly, but measurably, less than with the other formulations.

IPC appears to be satisfactory for control although more chemical is required than with Chloro-IPC.

Chickweed Control in Alfalfa in Pennsylvania

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Two seasons have passed since I reported on chickweed (Stillaria media) at the 1952 Northeastern Weed Control Conference. The two falls were very different. In 1951 chickweed grew very rapidly, having a thick mat six to eight inches thick. In 1952 the fall was much drier so the mat was two to three inches thick.

In both years the applications were made in water using a four-nozzle fan boom with thirty-five pound pressure. Forty-five gallons per acre were applied to randomized plots which were six by twenty feet with two föot borders between plots.

In 1951 the treatments were 1, 2, and 4 pounds chloro IPC; 4, 8, and 12 pounds dinitro (amine salt of dinitro-ortho secondary butyl phenol) and sodium chlorate at 5, 10, and 15 pounds per acre.

All rates of chloro IPC gave good control, no rate of IPC gave satisfactory control, and the dinitro killed only about three to four inches of top. The 3 pound rate was about as effective as the nine pound rate.

In 1952 on the relatively thin mat, two formulations of chloro IPC were applied at one half, 1, and 2 pounds; 4, 8, and 12 pounds of IPC; 1, 2, and 3 pounds of dinitro; and 5, 10, and 15 pounds of sodium chlorate.

With one formulation of chloro IPC we got a white precipitate on all treatments and IPC clogged the nozzles. With both treatments the control of chickweed was poor. Upon checking with the manufacturers, they discovered the supplier of the wetting agent changed the formula without notifying them of the change. The 1 and 2 pound rate of the other formulation of chloro IPC gave excellent control. The one half pound rate stunted all plants but did not kill.

The dinitro killed 40 to 60 percent of the chickweed and badly stunted the rest. They recovered later in the winter.

Sodium chlorate at 10 and 15 pounds killed the chickweed and badly injured the alfalfa.

Chloro IPC eliminated the grasses seeded in the alfalfa.

Preliminary Report of the Effect of Weed Control Chemicals on New Forage Seedings.

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The following is a preliminary report on a series of experiments conducted at the Storrs Agricultural Experiment Station on post-emergent application of several herbicides on new seedings of alfalfa, Ladino clover, orchard grass and timothy. Since most weeds are more readily controlled and since competition is most serious in the seedling stage, application of herbicides as soon after emergence as possible is desirable.

Some information is available on the response of forage species to herbicides. Hauser et. al. (3) have given a detailed account of the effect of 2,4-D on Ladino clover-orchard grass mixtures. Fertig (1) has given a preliminary report on the use of MCP and several dinitros on new seedings underseeded in oats. V. Geluwe (2) and Marshall have reported on the use of MCP and 2,4-D on underseeded legumes. More information, however, is needed concerning other chemicals and of the effect of environmental variation upon response.

Procedure

Four herbicides which have given promise for weed control in forages were applied on four species commonly used in the Northeast. They were used on a summer seeding without a companion crop, and on a seeding made in oats. The seedings were all band seedings in alternate strips seeded with a grain drill. Seeding rates were as follows: alfalfa, 15 pounds per acre, Ladino clover, 2-3/4 pounds per acre, timothy and alfalfa, 15 and 3 pounds per acre, orchard and Ladino, 4 and 15 pounds per acre. The spring seedings were made in Clinton oats seeded at 6 pecks per acre.

The seedings were designated as stages and are summarized below.

Stage	Time of Seeding	Method of Seeding	Time of Chemical Treatment	Stage of Growth of Treated Species
A	Aug. 14, 1952	No companion crop.	Sept. 6, 1953	Alfalfa 2-3 trifoliate leaves. 2-3" tall. Ladino 2 trifoliate leaves. 2-3" tall. Orchard and timothy 2" tall.
B	April 30, 1953	Seeded in oats.	June 1, 1953	Oats fully tillered. averaged 4-6" tall. Legumes 2 trifoliate leaves.
C	April 30, 1953	Seeded in oats.	June 23, 1953	Oats in late boot stage, 10% of panicles emerged, 22-24" tall. Alfalfa 6 trifoliate leaves. 4-8" tall. Ladino 4 trifoliate leaves. 4-6" tall.

Each treatment was replicated four times and analyzed as a randomized block design. The plot size was 7 by 8 feet.

Ratings were made of the effect of the chemical treatments on the stand density of each species and in the case of the Stage A, summer, 1952, treatment yield data was obtained from the second cutting the summer of 1953. A cutter bar type mower was used for harvesting the plots. A swath 15 inches wide was removed from both ends of each plot and area 60 inches by 66 inches harvested. The component yields of the Ladino-orchard grass mixture were determined from hand separated sub-samples taken at the time of harvest. The alfalfa timothy mixture was not harvested because of the slight recovery of timothy in the second cutting.

The chemicals used were as follows:

1. Alkanol amine of dinitro ortho-secondary phenol (DN)
   2, 4 and 8 pounds active ingredient per acre.

2. Chloro-isopropyl phenyl-carbamate (C-IPC)
   2, 4 and 8 pounds active ingredient per acre.

3. Sodium trichloroacetate (Sodium TCA)
   5, 10 and 20 pounds acid equivalent per acre.

4. Triethonal amine of 2,4-dichlorophenoxy acetic acid at 1/8, 1/4 and 1/2 pound acid equivalent plus sodium TCA at 10 pounds per acre.

All the chemicals were applied in 40 gallons of water solution per acre. The TCA-2,4-D was chosen as a possible combination for controlling both grassy weeds and broadleaf weeds since each component tends to be selective.

Results and Discussion

Alfalfa yields were not markedly reduced by any of the chemicals other than 2,4-D. Ladino yields were significantly reduced at the .01 level by both the sodium TCA alone and by sodium TCA plus 2,4-D. A linear trend occurred for each increment of chemical. A decreased yield from the dinitro occurred only from the highest rate of 8 pounds per acre.

Orchard grass yields were erratic. There was a rather definite trend toward reduction of stand from dinitro. The Ladino in the mixture responded essentially as it did in pure stand with reduction occurring from the sodium TCA and sodium plus TCA treatments. The yields of Ladino were lower in mixture than in a pure stand presumably because of the competition of the orchard grass component. Total yields of the mixture varied less between chemicals than the pure stand yield since the orchard grass component filled in when Ladino was reduced by treatment.

Results and Discussion

Table I.
Yield of Alfalfa and Ladino Clover in Pure Stand and of a Ladino Clover-grass Mixture Treated Post-emergent with Several Herbicides.

Forages seeded August 14, 1952, and sprayed on September 7, 1952. Ladino harvested on July 22, 1953, and alfalfa harvested on August 17, 1953.

	Lbs. per acre oven dry weight				
			Ladino-Orchard Grass Mixture		
	Alfalfa (pure stand)	Ladino clover (pure stand)	Ladino Separate	Orchard grass Separate	Mixture Total
(All rates in lb. active ingredients)					
DN - 2 lb/A	2020	735	420	182	602
DN - 4 lb/A	1946	496	508	133	641
DN - 8 lb/A	2153	462	357	105	462
C-IPC - 2 lb/A	1920	760	697	238	935
C-IPC - 4 lb/A	2006	810	438	256	694
C-IPC - 8 lb/A	2182	875	529	242	771
Sodium TCA - 5 lb/A	2017	462	284	210	494
Sodium TCA - 10 lb/A	1883	292	112	110	222
Sodium TCA - 20 lb/A	1876	126	137	224	361
Sodium TCA - 10 lb/A + 2,4-D - 1/8 lb/A	1123	102	88	208	296
Sodium TCA - 10 lb/A + 2,4-D - 1/4 lb/A	710	38	14	186	200
Sodium TCA - 10 lb/A + 2,4-D - 1/2 lb/A	660	11	11	315	326
Check	1960	800	669	186	855
Average of all rates of each chemical					
DN	2040	567	430	140	589
C-IPC	2036	816	554	245	799
Sodium TCA	1925	293	179	181	360
Sodium TCA + 2,4-D	831	62	37	238	275

Table II.

Stand Density of Ladino Clover as Affected by Post-emergent applications of Several Herbicides on Pure Stand and on an Underseeding in Oats.

0 - no stand; 10 - complete cover. Each figure is an average of 4 replications in Stage A, and of 3 replications for Stage B and C.

Chemical Treatment	Stage A (Pure stand) Rated Sept. 30 1952	Stage A (Pure stand) Rated June 17 1953	Stage B under-seeded Rated Sept. 2 1953	Stage C under-seeded Rated Sept. 7 1953
(All rates in lb. active ingredients)				
1. DN - 2 lb/A	7.7	9.3	6.7	9.2
2. DN - 4 lb/A	7.3	8.0	8.0	9.2
3. DN - 8 lb/A	4.0	4.7	4.2	9.5
4. C-IPC - 2 lb/A	9.0	10.0	8.7	9.2
5. C-IPC - 4 lb/A	9.0	10.0	8.7	9.5
6. C-IPC - 8 lb/A	8.7	9.5	8.2	8.7
7. Sodium TCA - 5 lb/A	9.3	5.0	5.8	5.8
8. Sodium TCA - 10 lb/A	7.0	2.7	4.0	4.0
9. Sodium TCA - 20 lb/A	7.0	3.2	1.2	2.3
10. Sodium TCA - 10 lb/A plus 1/8 lb. 2,4-D	7.3	1.7	3.1	3.7
11. Sodium TCA - 10 lb/A plus 1/4 lb. 2,4-D	5.3	1.3	2.1	4.2
12. Sodium TCA - 10 lb/A plus 1/2 lb. 2,4-D	6.0	1.0	2.1	5.8
13. Check	9.9	9.8	7.3	8.9
Average of all rates of each chemical				
DN	6.3	7.3	6.2	9.3
C-IPC	8.9	9.8	8.5	9.1
Sodium TCA	7.8	3.6	3.7	4.0
Sodium TCA + 2,4-D	6.2	1.3	2.5	4.6

Table III.

Stand Density of Alfalfa as Affected by Application of Several Herbicides on Pure Stands and on an Underseeding in Oats.

Chemical Treatment	Stage A (pure stand) Rated Sept. 30 1952	Stage A (pure stand) Rated June 17 1953	Stage B (under seeded) Rated Sept. 2 1953	Stage C (under seeded) Rated Sept. 7 1953
	0 - no stand; 10 - complete cover. Each figure is an average of 4 replications in Stage A, and of 3 replications for Stages B and C.			
(All rates in lb. active ingredients)				
1. DN - 2 lb/A	7.4	7.3	6.8	8.0
2. DN - 4 lb/A	7.4	8.7	7.3	8.1
3. DN - 8 lb/A	5.0	5.0	8.0	9.2
4. C-IPC - 2 lb/A	7.4	8.7	6.5	5.7
5. C-IPC - 4 lb/A	7.0	9.0	5.7	6.2
6. C-IPC - 8 lb/A	6.5	8.5	6.7	7.3
7. Sodium TCA - 5 lb/A	7.2	5.5	3.7	6.1
8. Sodium TCA - 10 lb/A	6.5	6.5	3.3	7.2
9. Sodium TCA - 20 lb/A	6.8	4.3	4.3	3.2
10. Sodium TCA - 10 lb/A plus 1/8 lb. 2,4-D	5.5	2.3	5.0	5.0
11. Sodium TCA - 10 lb/A plus 1/4 lb. 2,4-D	4.8	1.5	2.2	5.7
12. Sodium TCA - 10 lb/A plus 1/2 lb. 2,4-D	5.7	1.0	2.3	7.5
13. Check	7.5	9.0	6.0	5.3
Average of all rates of each chemical				
DN	6.6	7.0	7.4	8.5
C-IPC	7.0	8.7	6.3	6.4
Sodium TCA	6.8	5.4	3.8	5.7
Sodium TCA + 2,4-D	5.3	1.6	3.2	6.1

Table IV

Stand Density of Orchard grass, Timothy and Broadleaf Weeds as Affected by Several Herbicides.

0-no stand; 10 - complete cover. Each figure is an average of 4 replications in Stage A, and of 3 replications for Stages B and C.

Chemical Treatment	Forage grass stand Stage A				Broadleaf stand	
	Rated Sept. 30, 1952		Rated June 17, 1953		Stage B under-seeded Rated Sept. 2, 1953	Stage C under-seeded Rated Sept. 7, 1953
(All rates in lb. active ingredients)	Orchard grass	Timothy	Orchard grass	Timothy		
1. DN - 2 lb/A	2.0	5.0	1.9	10.0	2.3	2.5
2. DN - 4 lb/A	2.8	2.2	0.8	10.0	2.0	1.8
3. DN - 8 lb/A	0.8	2.0	0.5	8.7	1.0	2.2
4. C-IPC - 2 lb/A	7.0	8.3	7.5	8.5	5.3	5.0
5. C-IPC - 4 lb/A	7.0	5.7	6.8	7.5	2.8	3.3
6. C-IPC - 8 lb/A	5.5	6.3	3.5	5.3	4.2	4.2
7. Sodium TCA - 5 lb/A	7.0	5.7	7.0	9.5	4.4	4.7
8. Sodium TCA - 10 lb/A	7.0	5.7	7.5	9.7	3.8	4.5
9. Sodium TCA - 20 lb/A	6.5	3.5	6.2	7.7	3.1	5.0
10. Sodium TCA - 10 lb/A plus 1/8 lb. 2,4-D	7.0	4.3	6.7	10.0	3.2	4.7
11. Sodium TCA - 10 lb/A plus 1/4 lb. 2,4-D	7.0	4.3	7.0	9.0	1.9	4.7
12. Sodium TCA - 10 lb/A plus 1/2 lb. 2,4-D	7.0	6.0	7.0	10.0	2.8	3.8
13. Check	6.8	6.1	7.2	9.6	4.8	4.4
Average of all rates of each chemical						
DN	1.9	3.1	1.0	9.7	1.8	2.2
C-IPC	6.5	6.8	5.8	7.1	4.1	4.2
Sodium TCA	6.8	5.0	6.9	9.0	3.8	4.7
Sodium TCA plus 2,4-D	7.0	4.9	6.9	9.7	2.6	4.4

Density ratings are given in Tables II, III and IV of the various components of the treated plots. Ratings of the forage grass stand in Stages B and C were not made since the stand was poor in all plots.

Ratings made of Stage A, given in Tables II and III, indicate a marked difference in stand between the rating made three weeks after treatments and that made just prior to harvest. Death of many of the plants treated with sodium TCA and sodium TCA plus 2,4-D was not apparent until the next season. In contrast, ratings of the grass stand given in Table IV indicated a marked reduction three weeks after treatment from dinitro. The following season the orchard grass stand was still less than in the check. The timothy stand density had increased considerably on all plots by harvest, presumably due to tillering. The reduction from dinitro was no longer evident except at the 8 pound rate.

The effect of a protective canopy of the oat companion crop is evident from the stand densities of alfalfa and Ladino clover given for Stages B and C in Tables II and III. While sodium TCA and sodium TCA plus 2,4-D decreased the stand density of alfalfa when applied at the fully tillered stage, there was no evidence of injury from either chemical when applied at the late boot stage (Stage C.) This relationship was not as evident with Ladino clover with over a 50% reduction of stand occurring in both stages. This can probably be attributed to the greater sensitivity of Ladino clover to sodium TCA which is plainly shown by the yield data from Stage A.

Effect of chemicals on oats

Effects of chemicals on oats were evident from dinitro and from C-IPC. Sodium TCA and 2,4-D had no apparent effect. The dinitro caused some delay in maturity and a reduction in density of stand. The lower density was traceable mainly to restricted tiller development. The C-IPC had the most drastic effect. When the oats were sprayed in the late boot stage (Stage C) many of the panicles failed to emerge. At the 8 pound rate fully half of the panicles remained in the boot after treatment. About 20 per cent of the panicles failed to emerge at the 2 pound rate. The color of the leaves and stems of the oats were altered in Stage C by the 4 and 8 pound rates to a blue-green shade, the intensity being in proportion to the rate. The principal effect on Stage B, fully tillered, was a restriction in tiller development which caused a reduction in stand density.

Effect of chemicals on weeds

Distribution of weeds in Stage A was quite erratic, therefore, density ratings were not made. Lambsquarter and wild mustard were the principal annual soecies present. The dinitro compound was the most effective chemical used for the control of these weeds.

Dinitro was also the most effective material on Stages B and C as shown in Table IV. This material was effective on broad leaves on both the fully tillered and the late boot stages. 2,4-D, however, was effective only on the younger stage when less of a canopy was present.

Discussion

Of the chemicals used C-IPC was the least herbicidal. There was no consistent effect from this material on any of the species involved on any date of application which is in contrast to some published data.

Since chloro-IPC has been shown to be relatively voliatile (Shaw and Swanson (4), weather data were studied. Following the Stage A application there was no rain for six days. Following the Stage B application there was only 0.2 inches of rainfall in 20 days. Temperatures did not exceed 76° F. in either case for a three day period following treatment. The absence of rainfall to carry the C-IPC into the soil may have resulted in a considerable loss by voliatilization. Following treatment of Stage C, rainfall was 1.15 inches in the week following treatment, but the temperature maximums were 82, 76 and 79° F. on the first, second and third days following treatment. Again conditions were favorable for loss by voliatilization. Some direct absorption of the C-IPC by the oats was indicated by the systemic reaction.

Sodium TCA is also considered to be primarily a soil sterilant, but since it is non-voliatile its effects became evident after sufficient rain occurred to leach it into the soil.

The sodium TCA plus 2,4-D combination showed promise only for use on alfalfa. Ladino clover is too sensitive to sodium TCA to permit its use on seedling stands.

Dinitro proved to be the best of the materials used considering both weed control and effect on the forage species. There was an indication of sensitivity of orchard grass and timothy in the seedling stage, which should be considered, however, when using this material on mixtures.

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A FIELD STUDY OF RATES AND DATES OF APPLYING CERTAIN CHEMICALS FOR CONTROL OF WEEDS IN ALFALFA 1/

Merrill Wilcox and A. O. Kuhn 2/

INTRODUCTION

Alfalfa is making an important contribution to pasture and hay production in Maryland. When grown primarily for production of hay, alfalfa is grown alone or in combination with orchard grass, brome grass, or timothy. When grown primarily for pasture or as a combination pasture and hay crop, it is usually used in mixture with ladino clover, red clover, and orchard grass. Some of the acreage is established in the spring of the year with small grain as a companion crop but the major acreage is established in late summer on seed beds that are prepared for this seeding and without the use of a small grain crop. Observations in Maryland have shown that when alfalfa is first used in the cropping system, late summer seedings have resulted in better stands than can be expected with the seeding made in small grain in the spring. The principal competition when alfalfa is first seeded on a farm in late summer is usually from summer annual weeds that are killed by frost. Observations have shown that as alfalfa becomes a regular part of the cropping system and adequate lime and fertilizer is used to maintain good yields, establishment in late summer becomes more difficult because of an increase in winter annual weeds.

Previous work at the Maryland Agricultural Experiment Station (5) has shown that chickweed, Stellaria media (L) Cyrillo, and winter cress, Barbarea vulgaris R. Br., are important in the competition that reduces alfalfa stands. It was observed in this work that while control of chickweed helped to secure better alfalfa yields, control of winter cress appeared to be equally important if stands were to be maintained and if the first cutting for hay was to be reasonably free of weeds.

In undertaking the research here reported a seeding of alfalfa, ladino clover, and brome grass was selected on a farm on which alfalfa had been grown for several years, and on which heavy weed infestations had been noted in the establishment of late summer seedings. With the ladino clover seeded at a light rate, and with the characteristic of brome grass to become established slowly, the study became primarily one of the value of weed control in alfalfa establishment; however some observations were possible concerning the effect of the herbicides on ladino clover.

1/ Published with the approval of the Director of the Maryland Agricultural Experiment Station as Miscellaneous Publication No. 187, Contribution No. 2503.

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In this study thick stands of chickweed and winter cress were present and in addition field pepper grass, Lapidium campestre R. Br., was abundant.

REVIEW OF LITERATURE

A number of workers have reported that the ammonium salt and the alkanolamine salt of DNOSBP, when used as a post-emergence spray, result in temporary chickweed control in mixed grass-alfalfa seedings (1, 4, 5). It has been generally found that rates of 1 to 4 pounds of active ingredient per acre give good control if the spray contacts the chickweed leaves. No adverse effect on the alfalfa or associated grass has been reported within these rates. Aldrich and Baylor (1) found that 10 gallons of liquid per acre was not adequate for best control of chickweed with DNOSBP, but found no significant increases in control with 40 and 100 as compared to 20 gallons per acre.

CIPC, used at rates of 2 to 8 pounds of active ingredient per acre as post-emergence spray has been reported as an effective control of chickweed (2, 5, 6). No injury was noted to the alfalfa in these studies.

Smith et al (7) reported 1/2 pound of MCP applied in April as effective in controlling winter cress in red clover and alfalfa without injury to the legumes.

Shaw and his co-workers (6) found that 4-Chloro PA, when used as a post-emergence herbicide at 1/2 pound per acre, damaged alfalfa less than many other crop plants.

OBJECTIVES

This work was divided into two phases, referred to as Experiment I and Experiment II.

The objectives of Experiment I were to measure the effect of post-emergence application of several herbicides at selected rates and dates on:

1. Control of common chickweed, winter cress, and field pepper grass.
2. Maintenance of alfalfa stands and the yield of alfalfa.

Experiment II was to gain preliminary information concerning the rates at which MCP could be used on different dates to give control of winter cress and field pepper grass, and the effect on the alfalfa.

MATERIALS AND METHODS

These experiments were conducted near Ellicott City, Maryland on a farm known as Doughoregan Manor, and with the cooperation of the county agricultural agent and the farm manager. Plots were established on well fertilized, well drained Chester loam soil which had been seeded in August 1952 with 15 pounds of Buffalo alfalfa, 1 pound of ladino clover, and 15 pounds of Elsberry brome grass per acre. This seeding was made with a Brillion seeder. The actual site for each experiment was selected the early part of October 1952, attempting to get a uniform stand of the seeded mixture and competing weeds.

Experiment I

Treatments. The chemicals used were ammonium salt of 4,6 dinitro-ortho-secondary-butyl phenol (ammonium salt of DNOSBP); isopropyl N-(3-chlorophenyl) carbamate (CIPC); 3-(para-chlorophenyl)-1,1-dimethyl urea (CMU); alkanolamine salt of 4-chlorophenoxyacetic acid (4-Chloro PA); and alkanolamine salt of 2-methyl, 4-chlorophenoxyacetic acid (MCP). Individual plots were treated only once during this study. The following summary shows the rates used at each time of treatment:

Chemical	Rates Expressed As	Rates Used in Pounds Per Acre 10/31/52	11/29/52 & 1/31/53
Ammonium salt of DNOSBP	Act. Ing.	1, 2, 4	1, 2, 4
CIPC	Act. Ing.	1, 2, 4	2, 4, 8
CMU	Act. Ing.	1/8, 1/4, 1/2	1/4, 1/2, 1
4-Chloro PA	Acid Eq.	1/4, 1/2, 1	1/2, 1, 2
(CIPC +	Act. Ing.	1, 2, 4	2, 4, 8)
(MCP	Acid Eq.	1/4, 1/4, 1/4	1/2, 1/2, 1/2)

A total of 16 plots were located in each replicate with the 15 chemical-rate combination treatments and with an untreated plot for each date. The alfalfa was in active growth at the first date of treatment, did not appear to be growing but was still green at the second date of treatment, and the foliage was brown by the third date of treatment.

Individual plots 7 x 20 feet were used. A randomized block design, split for dates, with three replications was used.

Procedure. The chemicals were applied with a wheel-mounted, hand-pushed sprayer which had been calibrated to deliver 18.5 gallons per acre of water. This spray covered a width of 80 inches and the entire length of the plots was sprayed. A strip 2.8' x 17.2' was harvested from each plot on June 1, July 11, and August 20, 1953. A representative sample from the first harvest was refrigerated until separated into alfalfa, ladino clover, grass, winter cress, and field pepper grass. These separations were dried in a forced draft oven. Later harvests were relatively free of weeds and no separations were made.

Alfalfa plant counts were made on June 24 after the first harvest. A frame 1 foot square was placed at random 3 times in each plot to make these determinations.

Experiment II

In this experiment MCP was used without replication at 1/8, 1/4, 1/2, 1, and 2 pounds per acre, following the same procedures and dates as in Experiment I.

EXPERIMENTAL RESULTS

Experiment I

Plant Separations of the First Cutting. The effect of various chemicals on the plants growing in the field is best shown from the plant separations of the first cutting. These data are shown in Tables 1 and 2.

Table 1. Percentages of several plant species in total yield of the first cutting of an alfalfa-ladino mixture seeded in August 1952 and treated with several herbicides, each applied at three selected rates on each date.

Chemical Applied	Alfalfa	Ladino Clover	Grass[1/]	Winter Cress	Field Pepper Grass	Av. Yield of Three Rates
	%	%	%	%	%	T/A, 12%M
	Herbicide Applied on October 31, 1952					
DNOSBP	43.5	18.2	22.2	10.8	5.3	1.61
CIPC	45.8	19.4	19.0	8.0	7.8	1.67
CMU	52.8	8.6	21.9	9.1	7.6	1.74
4-Chloro PA	29.9	33.1	37.0	0.0	0.0	1.27
CIPC + MCP	45.6	23.5	30.9	0.0	0.0	1.50
Untreated	42.0	19.1	25.7	4.1	9.1	1.61
	Herbicide Applied on November 29, 1952					
DNOSBP	63.2	9.2	22.1	2.0	3.5	1.54
CIPC	84.2	6.2	1.4	6.3	1.9	1.25
CMU	64.8	5.1	16.5	6.8	6.8	1.73
4-Chloro PA	27.9	38.4	30.3	3.4	0.0	1.34
CIPC + MCP	89.1	8.2	0.0	2.7	0.0	1.11
Untreated	59.9	14.7	17.2	3.0	5.2	1.67
	Herbicide Applied on January 31, 1953					
DNOSBP	62.2	11.9	17.2	5.2	3.5	1.47
CIPC	70.1	19.7	1.8	6.7	1.7	1.51
CMU	62.6	4.2	23.8	4.9	4.5	1.47
4-Chloro PA	35.6	38.3	25.0	1.1	0.0	1.24
CIPC + MCP	77.4	17.8	1.7	3.1	0.0	1.12
Untreated	61.1	13.3	17.5	6.6	1.5	1.22

1/ Although brome grass was seeded, not enough was found to make a separation. The grass percentage indicated is primarily volunteer oats, *Avena sativa*, and annual brome species, *Bromus* sp.

With the exception of 4-Chloro PA treatments on the first date, the major differences in the data were in relation to the chemical used rather than the rate applied. Therefore, the data for the three rates of each chemical for each date have been combined in Table 1. The data for the three rates of 4-Chloro PA applied on the first date is shown in Table 2. In this case there was a marked decrease in the percentage of alfalfa as the rate increased.

Table 2. Percentages of several plant species in total yield of the first cutting of an alfalfa-ladino mixture seeded in August 1952 and treated with 4-Chloro PA October 31, 1952.

Rate 4-Chloro PA	Alfalfa	Ladino Clover	Grass[1]	Winter Cress	Field Pepper Grass	Total Yield
#/A	%	%	%	%	%	T/A, 12%M
1/4	51.2	21.2	27.6	0	0	1.26
1/2	22.1	37.7	40.2	0	0	1.77
1	10.7	42.9	46.4	0	0	.77

[1] Although brome grass was seeded, not enough was found to make a separation. The grass percentage indicated is primarily volunteer oats, *Avena sativa*, and annual brome species, *Bromus sp*.

Although a thick chickweed stand was found throughout the plots, the chickweed did not make vigorous growth during this study and not enough chickweed was found in the first harvest to include this as a separate.

Field observations showed that only those treatments involving CIPC gave sustained control of chickweed. DNOSBP treatments gave temporary kill but there was regrowth of chickweed in all cases. The combination of CIPC and MCP gave complete control of winter cress and field pepper grass on the first date, and did not reduce the alfalfa or grass. Later applications gave complete control of the field pepper grass, reduced the winter cress and practically eliminated the grass. Treatments using CIPC alone had the same effect on grass, but little effect on winter cress and field pepper grass. Treatments with 4-Chloro PA gave complete control of winter cress and field pepper grass on the first date only, and gave a marked reduction in alfalfa percentages on all dates. CMU had no apparent effect on any of the weeds, and was the only herbicide more damaging to the ladino clover than to alfalfa.

Effect of Treatments on Alfalfa Stand Counts. Reference to Table 3 shows that the principal effects on stand counts were from the use of CMU and 4-Chloro PA at the first date of treatment. The stand of alfalfa was significantly higher than the check for each rate of CMU applied this first date. This was true also for the 1/4 and 1/2 pound rates of CMU on the second date of treatment.

The 4-Chloro PA gave highly significant decreases in stand at the heaviest rate of treatment on each date.

Table 3. Number of alfalfa plants per square foot on July 24, 1953 from a stand seeded in August 1952 and treated with certain chemicals at selected rates and at three dates.

	Date of Application					
	10/31/52		11/29/52		1/31/53	
Chemical	Rate #/A	Alfalfa	Rate #/A	Alfalfa	Rate #/A	Alfalfa
DNOSBP	1	9.6	1	10.9	1	10.0
DNOSBP	2	8.4	2	12.1	2	11.0
DNOSBP	4	10.1	4	11.2	4	12.0
CIPC	1	10.9	2	10.9	2	8.9
CIPC	2	8.9	4	11.8	4	11.0
CIPC	4	8.1	8	11.3	8	9.7
CMU	1/8	12.6	1/4	12.1	1/4	10.7
CMU	1/4	11.9	1/2	12.1	1/2	9.8
CMU	1/2	12.7	1	9.6	1	10.6
4-Chloro PA	1/4	7.8	1/2	9.9	1/2	8.0
4-Chloro PA	1/2	5.1	1	6.2	1	8.7
4-Chloro PA	1	2.8	2	5.3	2	6.2
CIPC +	1	9.0	2	11.9	2	11.0
MCP	1/4		1/2		1/2	
CIPC +	2	6.6	4	11.3	4	9.7
MCP	1/4		1/2		1/2	
CIPC +	4	10.8	8	11.3	8	12.7
MCP	1/4		1/2		1/2	
Untreated	0	8.3	0	9.9	0	10.1
L.S.D. 5%		3.0		2.0		2.2
L.S.D. 1%		4.0		2.7		3.0

Effect of Treatments on Total Alfalfa Yields. Total alfalfa yields for 1953 are compiled in Table 4. DNOSBP at 4 pounds and CMU at 1/8 pound gave highly significant increases over the untreated plots when applied October 31. Some of the other rates of these same chemicals, and a combination of CIPC and MCP gave significant increases for the same date. These yield increases may be taken as an index of the control of competing species within the plots. Most rates of 4-Chloro PA gave significant reductions in yield on all dates. None of the treatments made on November 29, 1952 or January 31, 1953 gave significant yield increases.

Table 4. Total alfalfa yields from three cuttings made in 1953 of a seeding made in August 1952 and treated with certain herbicides at selected rates on three dates.

Chemical Applied	Date of Application 10/31/52 Rate #/A	Yield T/A	11/29/52 Rate #/A	Yield T/A	1/31/53 Rate #/A	Yield T/A
DNOSBP	1	2.94	1	3.28	1	2.93
DNOSBP	2	2.52	2	3.08	2	3.07
DNOSBP	4	3.12	4	3.07	4	2.99
CIPC	1	2.70	2	3.18	2	3.03
CIPC	2	2.54	4	3.28	4	3.03
CIPC	4	2.73	8	3.07	8	2.97
CMU	1/8	3.03	1/4	3.02	1/4	3.01
CMU	1/4	2.90	1/2	3.20	1/2	2.55
CMU	1/2	2.81	1	2.78	1	2.83
4-Chloro PA	1/4	2.65	1/2	2.33	1/2	2.47
4-Chloro PA	1/2	1.99	1	2.10	1	2.32
4-Chloro PA	1	1.68	2	2.01	2	2.25
CIPC + MCP	1 1/4	2.37	2 1/2	3.28	2 1/2	2.99
CIPC + MCP	2 1/4	2.22	4 1/2	3.12	4 1/2	3.06
CIPC + MCP	4 1/4	2.94	8 1/2	3.19	8 1/2	2.61
Untreated	0	2.39	0	3.01	0	2.82
L.S.D. 5%		.47		.66		.37
L.S.D. 1%		.64		.87		.50

Experiment II

Plant Separations of the First Cutting. Botanical composition of the herbage from the first hay cutting following MCP treatments is given in Table 5. This secondary experiment was designed to observe a wider range of rates of MCP than was practical in the first experiment. The field pepper grass was completely controlled with all rates of application of MCP on all dates. The 1/4 pound rate of MCP gave complete control of winter cress on the first date and reasonably good control on the last date. None of the rates of MCP were as effective on the second date of treatment in controlling winter cress as with the first or third date of treatment. The higher rates of MCP reduced the percentage of alfalfa in the first cutting at each date of application.

Table 5. Percentages of several plant species in total yield of the first hay cutting of an alfalfa-ladino mixture seeded August 1952 and treated with MCP.

MCP Rate #/A	Alfalfa	Ladino Clover	Grass[1/]	Winter Cress	Field Pepper Grass	Total Yield All Species
	%	%	%	%	%	T/A, 12% M
		MCP Applied on October 31, 1952				
1/8	54.7	22.9	19.9	3.5	0	2.02
1/4	62.3	18.3	19.4	0.0	0	1.85
1/2	28.9	31.6	39.5	0.0	0	1.73
1	7.0	24.6	68.4	0.0	0	1.84
2	17.5	6.3	76.2	0.0	0	1.78
		MCP Applied on November 29, 1952				
1/8	72.4	11.0	11.7	4.9	0	1.63
1/4	43.5	17.3	27.9	11.3	0	1.58
1/2	66.2	10.0	19.9	3.9	0	1.23
1	60.7	15.9	19.3	4.1	0	1.02
2	44.0	10.0	43.6	2.4	0	1.35
		MCP Applied on January 31, 1953				
1/8	84.0	11.2	4.8	0.0	0	1.95
1/4	77.0	14.8	7.0	1.2	0	1.81
1/2	67.9	16.5	14.2	1.4	0	1.60
1	48.5	18.5	33.0	0.0	0	1.35
2	34.5	17.7	47.8	0.0	0	1.63

1/ Although brome grass was seeded, not enough was found to make a separation. The grass percentage indicated is primarily volunteer oats, Avena sativa, and annual brome species, Bromus sp.

DISCUSSION

The fact that chickweed occurs in an alfalfa stand does not necessarily indicate the need for control measures. The results reported in this paper, as well as those in previous studies at the Maryland Agricultural Experiment Station, indicate that thin stands of chickweed, or thick stands of chickweed that make limited growth, do not greatly reduce the alfalfa stands or the hay yields. Observations of the field in which this study was made showed that there were small areas of one-fourth of an acre or less where the chickweed made a very heavy growth and became matted over the alfalfa. Under these conditions there was heavy reduction in the alfalfa stand. Results of this study show that DNOSBP or CIPC can be used to effectively reduce this chickweed growth. From the point of view of practical farm use, it appears logical to recommend these herbicides only in the cases of chickweed stands that outgrow the alfalfa and have a tendency to form a matted growth.

The control of field pepper grass on all dates of application with 1/8 pound of MCP, and the fact that this application did not injure the alfalfa, indicates that this is a practical application for recommendation wherever field pepper grass is a problem.

Field observations of the plots showed that alfalfa hay practically free of weeds could be produced through the use of a combination of CIPC and MCP. These plots were striking in their freedom from weeds in the field study. This raises the question as to whether this combination may be useful from the standpoint of improving the quality of the alfalfa for feeding purposes and perhaps improving the curing of the hay crop. It may be possible on some farms that even though the weed infestations are not heavy enough to seriously reduce the stand or yield of alfalfa, the improvement in hay quality may make treatment worthwhile.

The varying control of winter cress with rate and date indicates a need for further study of rate and date interaction with MCP.

The fact that CMU treatments at the first date gave higher alfalfa yields appears to be associated with the effect of CMU in reducing competition from ladino clover. This raises the question of whether to include ladino clover in mixtures where alfalfa is the principal plant desired.

SUMMARY

A mixture of alfalfa, ladino clover, and brome grass, seeded in August 1952 on a well drained, Chester loam soil in central Maryland, was used to evaluate several herbicides for the control of chickweed, winter cress, field pepper grass, and volunteer grasses. Treatments were applied on separate areas on each of three dates: October 31, 1952, November 29, 1952 and January 31, 1953. The principal findings in this study were:

1. An ammonium salt of DNOSBP, applied at the rates of 1, 2, and 4 pounds per acre, gave temporary control of chickweed and had no apparent effect on other plants growing in the plots. Significant alfalfa yield increases were found for the total yields in 1953 for the first date of treatment.

2. CIPC, at the rates of 1 to 4 pounds, controlled chickweed growth beginning about 4 to 5 weeks after treatment and continuing for the remainder of the winter and spring period. CIPC did not affect the winter cress, the field pepper grass, or the alfalfa. One and two pound rates of CIPC did not reduce the grasses at the first date of treatment. Most of the grass was removed by the later treatments.

3. CMU, at rates of 1/8 to 1 pound, had no apparent effect on the weeds studied but reduced the stand of ladino clover. Alfalfa stand and yield increases were noted on the first date of treatment.

4. Treatments with 4-Chloro PA at 1/4 to 2 pounds per acre had no apparent effect on chickweed but reduced the alfalfa stands as well as the winter cress and field pepper grass.

5. MCP at 1/8 pound per acre gave complete control of field pepper grass on all dates of treatment. The 1/4 pound per acre rate of MCP gave effective control of winter cress at the first and last dates of treatment but was not effective when applied at the second date.

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1953 OBSERVATIONS ON YELLOW ROCKET CONTROL IN ESTABLISHED CLOVER AND ALFALFA FIELDS.

Norman J. Smith1/, Stanford N. Fertig2/ and Lloyd E. Curtis3/

Observations from early spring treatment of legumes for yellow rocket control showed considerable promise in 1952. A preliminary report to this effect appeared in last year's Proceedings.

The important consideration appeared to be one of timing, since treatments applied while the legumes were semi-dormant resulted in good weed control with no reduction in total forage yields. This was true with alfalfa as well as red clover.

To further observe the relationship of earliness of treatment to control of yellow rocket and legume susceptibility, it was decided to start earlier in the spring of 1953 and continue treatments over a longer period of time. For the practice to be widely used at this time of year, a fairly wide range over which the farmer could spray would be desirable. Also, due to seasonal variations, the stage of dormancy or growth of the legume which resulted in legume injury or stand reduction must be known.

Methods and Procedure

Twenty fields representing a wide range of soil type, drainage, fertility and legume-grass composition were located throughout Madison County. The fields were first-year seedings having a good infestation of yellow rocket (Barbarea vulgaris). The seeding mixture at the different locations varied. Some were predominately alfalfa; others about 50 per cent alfalfa and 50 per cent clovers; the remainder predominately red clover.

The materials used were MCP "60" amine, L-423 (the amine salt of 4-chlorophenoxyacetic acid), and L-135 (an amine formulation of 4-chlorophenoxyacetic acid). All materials were not applied at all locations. A range of concentrations from 1/8 to 1.0 per acre was used.

Single plots 20 feet wide and averaging 400 feet long were sprayed using a jeep mounted sprayer. All treatments were applied in 40 gallons of water per acre. Treatments were not replicated.

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Treatments were applied on eleven dates covering the period from March 18 to April 17. Temperatures at the time of treatment ranged from a low of 35° F. to a high of 70°. The highest temperature occurred on March 23 and the lowest on April 17.

Some of the fields were very wet at the time of spraying. Others, particularly the alfalfa soils, were dry enough to carry farm machinery without damage.

The growth of the legume varied at different locations, depending on soil type, and date of treatment. The growth ranged from semi-dormant on the early treatments up to 6 to 8 inches at the later dates.

The growth of yellow rocket ranged from the rosette stage to early bud, again depending on date of treatment. The stand of yellow rocket averaged 6 to 10 per square foot and was consistently uniform at most locations. At no date of treatment did the yellow rocket offer appreciable canopy to the legumes.

Results and Discussion

Yellow Rocket

MCP at 1/4 pound or more per acre gave 100 per cent control of yellow rocket in the rosette stage. The percentage control decreased at subsequent stages of treatment up to early bud stage. In many cases the yellow rocket plants were not killed but the injury was sufficient to prevent formation of any seeder stalk.

L-423 and L-135 gave less than 50 per cent control of yellow rocket at the same stage of growth and concentration.

Effect on Legumes

MCP at 1/4 and 1/2 pound per acre showed no apparent injury to the legume stand up to the April 2 date of treatment. The alfalfa and red clover by this date had started some growth. Shoots were 1 to 2 inches tall and showing several trifoliate leaves. The degree of injury showing at time of harvest increased with treatments applied after April 2, with severe injury showing on those applied April 17. The injury showed up as a difference in height, reduced leaf size, leaf and stem epinasty and fewer stems per crown on alfalfa. The number of shoots per crown decreased with later date of treatment and with increased concentration.

Differences in legume stand of 15 to 20 per cent are not detectable by visual observation. Where yield data were taken and botanical separations made, the actual effect of treatment could be observed. There was no difference in total yield between the early treatments and the check. However, from separation studies, the alfalfa content of the mixture was reduced by 50 per cent for the early treatments and 75 per cent for the late treatments when compared to the check (Fig. 1). The graphs indicate that as the percentage of alfalfa is reduced, the red clover and grass increase.

L-423 and L-135 even though much less effective on the yellow rocket, showed increased damage to the legume compared to MCP at the same concentration.

Summary and Conclusions

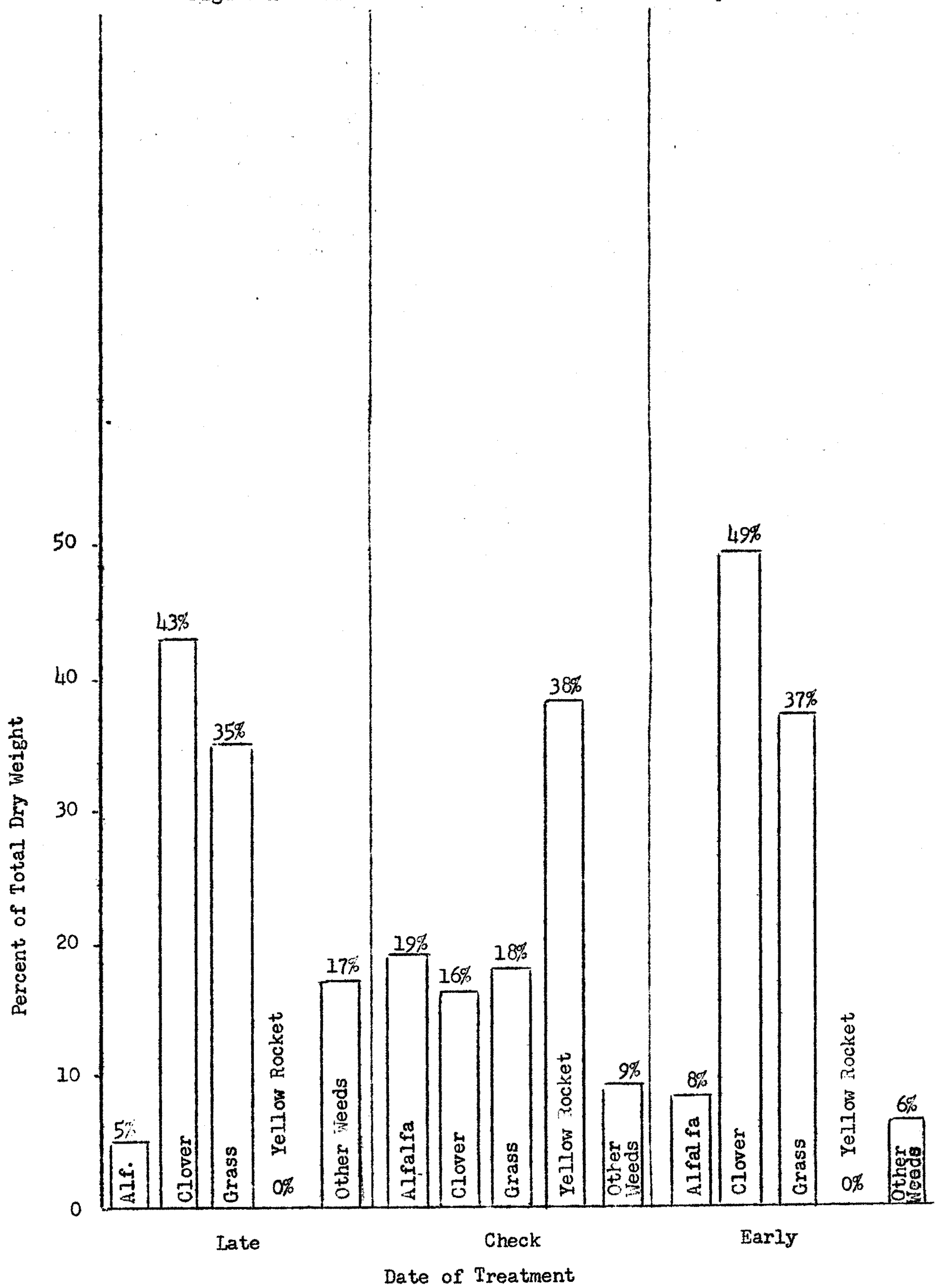
In 1953 as in 1952, control of yellow rocket was achieved from early spring treatments of MCP at 1/4 to 1/2 pound per acre. Excellent control was obtained in the rosette stage but decreased with later stages of growth.

The injury to legume increased with advanced stages of growth. Alfalfa was more easily injured than red clover. Even from early treatments, some reduction in stand occurred. Where alfalfa is an important component of the seeding mixture, appreciable reduction in stand may be expected the year of treatment.

Where red clover is the main legume and/or where the amount of alfalfa is of little concern, early spring treatment using 1/4 pound of MCP will control yellow rocket without reducing stand or yield of red clover.

Calendar date is of no significance in determining when spring treatments can be safely be applied. March 18 in 1953 compared to April 9 in 1952. The earlier treatments can be applied the better regardless of the legume present. The wide variation in temperature had no measurable effect on control. Results were just as good at 35 degrees as at 70 degrees.

Figure 1. Effect of Treatment on Botanical Composition.



PRELIMINARY REPORT ON CONTROL OF BEDSTRAW IN BIRDSFOOT TREFOIL SEEDINGS.

E. Kinne and S. N. Fertig1/

Bedstraw (Galium spp.) can be found on roadsides, along hedge rows and in old meadows throughout New York State and most of the Northeastern part of the United States. Some species occur mostly on moist, rich, sandy or alluvial soils, while others are most common on rocky or gravelly soils.

Bedstraw is a member of the Rubiaceae (Madder Family). Gray (1) lists 25 species that are found in the central and northeastern United States and Canada. Weigand and Eames (2) lists 14 species in "Flora of the Cayuga Lake Basin, New York". Muenscher (3) lists 5 species which are probably the most common in the Northeast. The species found most frequently in New York have been Galium mollugo, Galium Aparine, and Galium verum.

Until recently, bedstraw was considered as just another weed because it could be controlled through the use of a normal rotation on productive soils and did not spread rapidly where its growth was limited by poor soils.

Within recent years the occurrence of some species of this weed have increased markedly, particularly in fields of birdsfoot trefoil (Lotus corniculatus). The widespread use of trefoil has provided an ideal situation for this spread:

1) The seeds are of the same size and shape.

2) Birdsfoot trefoil once established is usually left down for several years, which gives the bedstraw an opportunity to become established.

3) Birdsfoot trefoil is often seeded on areas which are steep, rough or for other reason not included in the rotation and where bedstraw is already present.

4) Both plants produce seed at the same time of year.

5) Bedstraw starts growth from two to three weeks earlier in the spring, giving it an advantage in growth over birdsfoot.

The species of bedstraw commonly found in birdsfoot seedings is Galium mollugo. This species is a perennial reproducing by seeds and rootstocks. The stems are usually decumbent and spreading branched, wiry, 4-angled, usually in dense clumps from rootstocks, glabrous or nearly so. The leaves are mostly 8 in a whorl on the main stem and 6 in a whorl on the branches. The flowers are in terminal panicles; corolla white; ovary glabrous. The seed is oval in outline, varying somewhat in shape from kidney shaped to globular. The surface is very rough and uneven, color brown to dark brown with a lighter area around the scar.

The seed closely resembles that of birdsfoot in size, making it extremely difficult to separate. The following table shows the relationship in size and

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weight between Ladies' bedstraw (Galium mollugo) and two strains of (Lotus corniculatus), French Commercial (var. vulgaris) and New York Common (var. vulgaris).

Author	Length mm.	Bredth mm.	Thickness mm.	Weight per 1000 seeds gm.
Korsmo 1935 (Galium mollugo)	1.22	0.9	1.7*	0.43
MacDonald 1940 (Lotus corniculatus)				
French Commercial	1.43	1.20	0.95	1.161
New York Common	1.42	1.19	0.99	1.108

*Author determination

Methods and Procedure

A 12-year old stand of Certified Empire Trefoil was located in Seneca County, New York, which was badly infested with Galium mollugo. The bedstraw was discovered in this field as isolated plants two years after the seeding was made. In the spring of 1953, an average of 17 clumps per square yard covered the entire 10-acre seeding. The field had been used for hay and sheep pasture during most of this period.

On April 3, 1953, twenty-one treatments were applied in a simple randomized block experiment with 4 replications (Table 1). On April 22, twenty-six additional treatments were applied in a similar randomized block design (Table II).

Plots were 6 feet wide by 50 feet long with a two-foot border between plots and a 10-foot alleyway between replicates.

Treatments were applied using an Allis Chalmers "G" tractor. The volume of water varied depending on whether the chemicals were considered to be translocated or contact. Where a contact herbicide was used, the rate was 30 gallons per acre. Those considered as primarily translocated were applied at 10 gallons per acre (Tables I and II).

To evaluate the effectiveness of the various treatments, the following data were obtained:

1) Botanical separations of bedstraw, birdsfoot trefoil, grass and other weeds.

2) Dry matter yields from all plots.

3) Effect on seed production of birdsfoot trefoil (difficult to evaluate).

Four quadrat samples 1-1/2 x 1-1/2 feet were taken from each plot just before the first cutting (July 2). A botanical separation was made and the various

TABLE I. PERCENTAGE OF TOTAL YIELD FOR EACH SEPARATE CALCULATED FROM DRY MATTER PER ACRE YIELDS - APRIL 4, TREATMENTS (AVERAGE OF 4 REPLICATES).

	Chemical	Concentration	Gallons/A.	Percentage of each separate: Bedstraw	Birdsfoot Trefoil	Grasses	Other Weeds
1.	MCP "60" Amine Salt	1/4 pound	10	50.9	18.7	29.1	1.3
2.	MCP "60" " "	1/2 "	10	59.9	21.5	13.3	5.3
3.	MCP "60" " "	1.0 "	10	53.1	17.8	27.4	1.7
4.	MCP "90" " "	1/4 "	10	42.1	22.2	29.5	6.2
5.	MCP "90" " "	1/2 "	10	60.8	15.8	21.9	1.5
6.	MCP "90" " "	1.0 "	10	60.9	15.7	19.2	4.2
7.	2,4-D Amine Salt	1/4 "	10	65.2	15.5	16.9	2.4
8.	2,4-D " "	1/2 "	10	49.9	31.7	12.3	6.1
9.	2,4-D " "	1.0 "	10	54.4	20.2	23.8	1.6
10.	TCA	2.0 "	30	58.3	18.3	13.2	10.2
11.	TCA	4.0 "	30	33.3	36.7	27.2	2.8
12.	TCA	6.0 "	30	42.0	33.9	13.8	10.3
13.	Sinox + TCA	2 qts. + 10	30	10.2	59.5	25.2	5.1
14.	" P.E.	4 "	30	28.3	27.7	40.5	3.5
15.	" " "	6 "	30	14.9	16.0	67.2	1.9
16.	MCP + Dinitro	1/2 pound + 4 qts	30	18.6	29.1	51.9	0.4
17.	LV-4	1/4 "	10	63.5	11.4	21.3	3.8
18.	LV-4	1/2 "	10	62.6	11.6	21.3	4.5
19.	Sinox P.E.	12 qts.	30 Applied Apr. 22, 1953	7.1	33.1	54.8	5.0
20.	TCA + MCP	4 pounds + 1/2 pound	30	36.0	21.0	39.3	3.7
21.	Check			67.3	19.9	5.9	6.9

TABLE II. PERCENTAGE OF TOTAL YIELD FOR EACH SEPARATE CALCULATED FROM DRY MATTER PER ACRE YIELDS APRIL 22, TREATMENTS (Average of 4 Replications).

Chemical	Concentration	Gallons/A.	Percentage of each separate: Bedstraw	Birdsfoot Trefoil	Grasses	Other Weeds
1. MCP "90" + Sinox P.E.	1/4 lb. + 6 qts.	30	21.7	29.1	43.5	5.7
2. MCP "90" + Sinox P.E.	1/2 lb. + 6 qts.	30	24.7	27.7	40.4	7.2
3. MCP "90" + Sinox P.E.	1/8 lb. + 4 qts.*	30	12.3	30.4	50.8	6.5
4. MCP "90" + Sinox P.E.	1/4 lb. + 4 qts.*	30	27.2	25.8	40.1	6.9
5. MCP "90" + TCA	1/4 lb. + 6 lbs.	30	48.8	29.2	13.3	8.7
6. MCP "90" + TCA	1/8 lb. +10 lbs.	30	38.2	51.6	5.7	4.5
7. MCP "90" + TCA	1/4 lb. +10 lbs.	30	35.6	28.4	27.3	8.7
8. MCP "90" + TCA	1/8 lb. +16 lbs.	30	51.2	35.9	4.6	8.3
9. MCP "90" + CMU	1/4 lb. + 1/2 lb.	30	52.7	16.6	23.8	6.9
10. MCP "90" + CMU	1/4 lb + 1.0 lb.	30	47.8	24.2	20.5	7.5
11. MCP "90" + 3-Chloro IPC	1/4 lb. + 6 lbs.	30	79.5	11.0	4.2	5.3
12. MCP "90" + 3-Chloro IPC	1/4 lb. + 12 lbs.	30	62.2	10.2	0.2	27.4
13. MCP "90" + Endothal	1/4 lb.+ 4 lbs.	30	43.0	22.2	30.2	4.6
14. MCP "90" + Endothal	1/4 lb. + 8 lbs.	30	40.5	14.9	31.6	13.0
15. MCP "90" + Endothal	1/2 lb + 4 lbs.	30	39.4	18.7	33.3	8.6
16. Sinox P.E.	4 qts. - 2*treatments	30	19.4	44.5	30.5	5.6
17. Sinox P.E.	6 qts. - 2*treatments	30	15.4	29.3	49.6	5.7
18. Sinox P.E.	8 qts.	30	5.0	29.6	59.0	6.4
19. Sinox P.E.	12 qts.	30	10.1	25.1	55.2	9.6
20. Check			64.3	15.6	16.6	3.5
21. Chipman MCP	1/2 lb.	30	54.3	20.8	21.1	3.8
22. TCA	16 lbs.	30	36.4	46.2	5.8	11.6
23. CMU + Sinox P.E.	1/4 lb. + 4 qts.	30	25.7	22.7	46.3	5.3
24. CMU + TCA	1/4 lb + 6 lbs.	30	45.7	33.7	8.4	12.2
25. 2,4,5-T	1/4 lb	30	22.8	26.4	40.7	10.1
26. Check			65.4	17.1	8.6	8.9
27. 2,4-D + Sinox P.E.	1/4 lb. + 4 qts.	30	23.2	35.8	33.9	7.1
28. Check			63.5	16.9	11.2	8.4

* 2 weeks apart

Note; Treatments applied April 22, 1953. Slight rain around 4:00 P.M. Treatments 20 and 26 not put on.

separates were oven dried for 24 hours at 170° F. for dry matter determinations. Yield per acre was calculated for each separate and is reported as a percentage of total yield (Tables I and II).

To evaluate the effect of treatment on total yield, a strip 20 feet long and 3-1/3 feet wide was harvested from the center of each plot using a Gravely power mower. Total green weight was recorded and a 500 gram composite sample chopped for dry matter determination. This sample was oven dried in the same manner as the separates.

The remainder of each plot was retained to study the effect of treatment on flower set, seed yields and germination of birdsfoot trefoil seed. 1953 was a poor seed year and the information from this phase of the study is nil.

In addition to the chemical treatments (Tables I and II), grazing experiments with sheep and geese feeding trials with cattle and frequent clipping were investigated.

Results and Discussion

The translocated herbicides at the concentrations used in the April 4 treatments (Table I) showed no promise for the control of bedstraw. The average per cent bedstraw in these treatments compare favorably with the check treatment.

TCA at all rates resulted in the characteristic bleaching or chlorophyll destruction. This condition lasted for 6 to 8 weeks, gradually fading to normal. The higher the concentration of TCA, the lighter the color and the longer it persisted. TCA at the 4- and 6-pound rate resulted in a stunting of the bedstraw plants, shortening of the internodes in the terminal infloresence and delayed flowering. The birdsfoot exhibited little or no change in color, growth was normal and flowering hastened.

The dinitro treatments resulted in complete top kill of bedstraw for a period of 3 to 4 weeks. One month after treatment the average length of bedstraw shoots was 12 inches on the check compared to 2 inches on the dinitro treated plots. There was no injury to the birdsfoot from the dinitro treatments applied April 4.

From early observations, the most promising treatments appeared to be the mixtures, Dinitro plus TCA and Dinitro plus MCP. As a result, the April 22 treatments were almost entirely combinations (Table II).

Based on separation studies from the April 22 treatments, TCA, CMU, 3-chloro IPC and Endothal alone or in combination with a translocated herbicide were not effective at the concentrations used.

The greatest reduction in the percentage of bedstraw occurred where dinitro was used in combination or alone. Actually, the value of the translocated herbicides in combination with dinitro is questionable.

Sheep, cattle, geese and frequent clipping

On May 11 a flock of 94 sheep was turned on approximately 3 acres adjoining the area in plots. There was no evidence of them eating the bedstraw until the birdsfoot and grass was completely pastured off and nothing left but bedstraw. When forced, they did eat the bedstraw and by the first of June the field was uniformily pastured to a short stubble and the sheep removed.

To check the palatability at different growth stages, the sheep were turned on the same area July 7. At this time the bedstraw was at about three-quarters bloom. The same pattern was followed as before, the bedstraw left until last.

On June 25, approximately 500 pounds of fresh cut material, taken from plots that averaged over 50 per cent bedstraw by separation studies, was placed in a feed rack where 9 head of heifers and dry stock had access to it. Overnight all green material was completely consumed. This preference for bedstraw may not, however, reflect conditions under grazing or continuous diet. Permanent pastures have been observed in New York where though stocked to capacity, bedstraw was flourishing. Contrary to this last statement, the majority of reports in the literature indicated cattle relish bedstraw.

Since geese have become popular for weeding some crops, it was decided to determine their preference. They do not like bedstraw. Although placed in luxuriant growth of bedstraw at different growth stages, they were skin and bones in 2 weeks and had to be removed.

A check on chemical composition at different growth stages indicates the following:

Chemical Composition of Bedstraw at Various Growth Stages*

	Stage of Growth	% H_2O	% Fat	% Protein	% Fibre	% Ash	% Ca	% K	% P	N Free Extract
1.	Vegetative	3.8	5.0	19.0	23.7	9.1	.67	2.03	.31	39.4
2.	Vegetative-Treated with TCA	3.4	5.0	26.4	21.1	10.7	.68	4.12	.31	33.4
3.	Early bloom	5.3	2.5	11.1	34.7	7.5	1.06	2.50	.23	38.9
4.	Early seed	5.9	2.5	10.6	32.0	7.8	1.23	1.88	.19	41.2
5.	Vegetative-2nd cut	4.4	7.5	21.9	15.1	10.4	1.06	1.74	.36	40.7
6.	Bloom-2nd cut	5.5	5.0	11.9	25.1	8.7	1.35	2.26	.25	43.8

*Determinations made by the Analytical Laboratory, Department of Agronomy, Cornell University, 1953.

Conclusions

None of the chemicals or combination of chemicals used in this study have to date shown outstanding promise for the control of bedstraw in birdsfoot trefoil seedings.

The concentration of a translocated herbicide such as 2,4-D or MCP required to control bedstraw will unquestionably kill birdsfoot trefoil.

A reduction in stand of bedstraw is possible using dinitro. Dinitro alone or in combination with other herbicides offers a possible method of complete eradication by repeated treatments.

Fields of birdsfoot trefoil infested with bedstraw and intended for seed production should be used for rotational pasture or plowed and planted to clean cultivated crops and kept in a shorter rotation.

This study is being continued to determine whether repeated or a combination of herbicides, applied at different growth stages, will give control of bedstraw.

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THE EFFECTS OF VARIOUS HERBICIDES ON THE YIELD AND BOTANICAL COMPOSITION OF LEGUMES.

Marvin M. Schreiber and Stanford N. Fertig[1]

Introduction

Forage legumes are the only important agronomic crops for which no satisfactory weed control recommendations have yet been made. The reasons are many, the most important of which are the relative susceptibility of the legume to the various herbicides now available and the persistent nature of the weed species that commonly infest hay fields. With such common usage of alfalfa, birdsfoot trefoil and other leguminous forage plants, one can readily see the necessity of resolving these difficult problems.

With the advent of new chemicals it becomes more and more important that they be evaluated not only in their specific effects but in their relative effects. That is to say, the selectivity of a herbicide for specific crops is of great importance in itself, but its relative selectivity in comparisons to other herbicides must be critically evaluated. It is not always possible to draw such conclusions from greenhouse experiments; hence, one must move to the field for final decisions on these various products.

Yield data and weed stand counts have been the basis of most of the determinations in the field. This type of information is of great interest but unfortunately it can at the same time be misleading, especially in grass-legume mixtures. It is possible to get excellent weed control by the use of a specific herbicide and to show equal or even superior yields compared to the untreated plots. However, the composition of a grass-legume hay may be completely altered due to treatment. This is of prime importance, especially to the farmer whose seeding mixture is so calculated to furnish him with the most productive quality feed for a number of years.

The question of MCP versus 2,4-D is, of course, not new. By a quick review of the history of MCP, one can readily find that its most important initial quality was its greater selectivity on legumes. This single point has been the basis for a number of experiments in recent years. The results of most of these experiments have suggested the importance of stage of growth or, as most often reported, time of application.

This has likewise been reported with the other herbicides suggested for legume weed control. The old adage, "An ounce of prevention is worth a pound of cure", is applicable to weed control in legumes. If herbicides are the answer to weed control in legumes, certainly controlling them in the first year (seedling year) would appear to be much easier than established legumes. This idea has led us to work on new seedings.

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Objective

The main purpose of this experiment was to determine the effectiveness of fall application of herbicides for the control of weeds in established grass-legume seedings.

Three specific objectives are as follows:

1) The effect of fall applied herbicides on the control of yellow rocket (Barbarea vulgaris).

2) The effect on the yield of grass-legume hay.

3) The effect on the botanical composition of grass-legume hay.

Materials and Methods

This test was initiated in the fall of 1952 in five counties in the State of New York: Tioga, Allegany, Madison, Albany, and Jefferson. These locations were chosen as representative areas of the five leading seeding mixtures used in the state; Tioga and Jefferson representing the General Purpose Mixture - alfalfa, red clover, alsike and timothy with red clover predominating; Madison representing also the General Purpose Mixture with a higher percentage of alfalfa; Allegany representing a general alfalfa-timothy mixture; and Albany representing predominately the birdsfoot trefoil-timothy mixture. In all locations, uniform stands of yellow rocket (Barbarea vulgaris) were present.

After the oats were harvested, the stubble was clipped and removed, and therefore there was no canopy of weeds or trash to protect the legume. Treatments were made over the period September 11 to September 17. The design and treatments were the same at all locations. The plot design was a randomized block with six replications. The chemicals and concentrations used are listed in Table I. The plots were 6 feet wide and 50 feet long with a 2-foot border between plots and a 10-foot alleyway between replicates. The plots were sprayed with a 6-foot boom mounted on an Allis Chalmers "G" tractor rigged for plot spraying. The translocated herbicides were all put on at the rate of 10 gallons of water per acre. Sinox P.E. and Chloro IPC were applied at the rate of 30 gallons of water while Dow Selective was at 60 gallons of water per acre. The average temperature at time of application was 80° F.

Composition studies were made by taking 4 one-foot square quadrat samples at random from each plot and separating by hand alfalfa, clover, grass, yellow rocket and other weeds. The first cuttings were made in the middle of June. Yield data was obtained by taking a three-foot swath through the middle full length of the plot. Total green weight and dry weight were determined.

Results and Discussions

In the case of Albany County, no yield or composition studies were obtained due to the extremely wet and cold spring. However, visual observations were made particularly concerning weed control. The discussion of the results of this experiment will cover all locations.

Weed Control

Observations on weed control at the various locations were made in the fall, several weeks after treatment, and again in the spring. Fall observations showed no apparent adverse effects on the crops with very little indication of actual weed control. However, the spring observations showed without question the degree of weed control and composition changes that become more apparent when separations were made. These latter effects will be discussed in more detail.

All the translocated herbicides, 2,4-D, MCP 60% amine, MCP 60% sodium salt and MCP 90% amine showed increased yellow rocket (Barbarea vulgaris) control as concentrations increased. Very little difference could be seen between 1/4 and 1/2 pound of acid equivalent per acre. No differences were visible between the various MCP products used and between 2,4-D as far as weed control was concerned; however, the 1/2 pound rates of MCP's and 2,4-D were easily distinguishable primarily on the basis of legume content of the hay.

The contact herbicides as a whole gave less than 25% weed control even at the highest levels of concentrations. Dow Selective in general appeared to show slight reductions in legume composition. The reaction of Chloro IPC was the same except in Albany County where marked reduction in grasses were obvious.

Yield data given in Tables 1 and 2 represents the first and second cuttings at Tioga County, respectively. Table 3 represents the first cutting in Madison County. This data is representative of all counties harvested. All counties showed significant differences due to treatment and in most cases the significance was due to chemicals.

The mean yields shown in Table 1, 2, and 3 clearly indicates that only in the 2,4-D treatments is there a significant difference. No differences were obtained between the various MCP products used. This is quite evident as one compares the total means expressed as chemicals. However, in the first cutting at Tioga County, there was significance in levels and in the interaction of chemicals and levels as well as chemicals. This can be attributed to the 2,4-D treatments. No significant differences, are shown between the 1/2 and 1/4 pound rates of any of the translocated herbicides used.

The contact herbicides employed showed no significant differences in yield from those of the translocated, discounting 2,4-D at a half pound. The results of the contact herbicides in the first cutting at Madison County (Table 3) showed consistently higher yields as measured by chemicals.

Botanical Composition

From the data presented so far, one could be led to surmise: (1) that the translocated herbicides gave far greater weed control than the contact herbicides, (2) that all the herbicides used except for 2,4-D gave no reduction in yield of grass-legume hay. These two assumptions are true. However, another important factor must be considered - - what has happened to the botanical composition of the grass-legume hay.

Table 1. Effect of Herbicides on the Yield of Hay (Yield Lbs. Dry Matter/A.)
Mean of 6 Replications.
Tioga County, First Cutting, 1953.

No.	Treatment	Mean	Means by Chemicals	Means by Levels
1	2,4-D, 1/8#, G.L.F.	4065		1) 28451
2	2,4-D, 1/4#, G.L.F.	3115		2) 27133
3	2,4-D, 1/2#, G.L.F.	1772	8952	3) 24647
4	MCP 60%, 1/8#, ACP	3777		
5	MCP 60%, 1/4#, ACP	4175		
6	MCP 60%, 1/2#, ACP	4048	12000	
7	MCP 60%, 1/8#, Chip.	4123		
8	MCP 60%, 1/4#, Chip.	3625		
9	MCP 60%, 1/2#, Chip.	3665	11413	
10	MCP 90%, 1/8#, Dow	3967		
11	MCP 90%, 1/4#, Dow	4625		
12	MCP 90%, 1/2#, Dow	3652	12244	
13	Sinox P.E., 1 qt.	4077		
14	Sinox P.E., 2 qts.	3925		
15	Sinox P.E., 3 qts.	4162	12164	
16	Dow Selective, 5 pts.	4270		
17	Dow Selective, 7 pts.	3738		
18	Dow Selective, 9 pts.	3468	11476	
19	Cl. IPC 2#	4172		
20	Cl. IPC 4#	3930		
21	Cl. IPC 6#	3880	11982	
22	Check	4463		

Source	DF	SS	MS	F	.05	.01
Total	131	1,013,962				
Replicates	5	210,177	42,035			
Treatment	21	410,873	19,565	5.23	1.63	*2.06
Chemicals	6	159,801	26,633	7.12	2.19	*2.99
Levels	2	64,100	32,050	8.56	3.09	*4.82
Chem. x levels	12	163,361	13,613	3.64	1.85	*2.36
Check x rest	1	23,610	23,610	6.31	*3.94	6.90
Error	105	392,912	3,742			

Table 2. Effect of Herbicides on the Yield of Hay (Yield Lbs. Dry Matter/A.)
Mean of 6 Replications.
Tioga County, Second Cutting, 1953.

No.	Treatment	Mean	Means by Chemicals	Means by Levels
1.	2,4-D, 1/8#, G.L.F.	1267		1) 8462
2.	2,4-D, 1/4#, G.L.F.	897		2) 8133
3.	2,4-D, 1/2#, G.L.F.	582	2746	3) 7606
4.	MCP 60%, 1/8#, ACP	1353		
5.	MCP 60%, 1/4#, ACP	1285		
6.	MCP 60%, 1/2#, ACP	1122	3760	
7.	MCP 60%, 1/8#, Chip.	1015		
8.	MCP 60%, 1/4#, Chip.	1153		
9.	MCP 60%, 1/2#, Chip.	1207	3375	
10.	MCP 90%, 1/8#, Dow	1367		
11.	MCP 90%, 1/4#, Dow	1468		
12.	MCP 90%, 1/2#, Dow	1213	4048	
13.	Sinox P.E., 1 qt.	1140		
14.	Sinox P.E., 2 qts.	1210		
15.	Sinox P. E., 3 qts.	1228	3578	
16.	Dow Selective, 5 pts.	1205		
17.	Dow Selective, 7 pts.	1037		
18.	Dow Selective, 9 pts.	1102	3344	
19.	Cl. IPC, 2#	1115		
20.	Cl. IPC, 4#	1083		
21.	Cl. IPC, 6#	1152	3350	
22.	Check	1283		

	DF	SS	MS	F	.05	.01
Total	131	157,940				
Replicates	5	17,766	3,553			
Treatments	21	41,093	1,957	2.07	1.63	*2.06
Chemicals	6	19,885	3,314	3.51	2.19	*2.99
Levels	2	3,202	1,601	1.70	3.09	4.82
Chem. x levels	12	17,023	1,418	1.50	1.85	2.36
Check x rest	1	982	982	1.04	3.94	6.90
Error	105	99,081	944			

Table 3. Effect of Herbicides on the Yield of Hay (Yield lbs. Dry Matter/A.)
Means of 6 Replications
Madison County, First Cutting, 1953.

No.	Treatment	Mean	Mean by Chemicals	Means by Levels
1.	2,4-D, 1/8#, G.L.F.	4103		1) 29793
2.	2,4-D, 1/4#, G.L.F.	4162		2) 28975
3.	2,4-D, 1/2#, G.L.F.	3237	11504	3) 29146
4.	MCP 60%, 1/8#, ACP	4355		
5.	MCP 60%, 1/4#, ACP	3803		
6.	MCP 60%, 1/2#, ACP	3545	11703	
7.	MCP 60%, 1/8#, Chip.	4227		
8.	MCP 60%, 1/4#, Chip.	3803		
9.	MCP 60%, 1/2#, Chip.	3540	11570	
10.	MCP 90%, 1/8#, Dow.	4173		
11.	MCP 90%, 1/4#, Dow.	4075		
12.	MCP 90%, 1/2#, Dow.	3680	11928	
13.	Sinox P.E. 1 qt.	4803		
14.	Sinox P.E. 2 qts.	4342		
15.	Sinox P.E. 3 qts.	4667	13812	
16.	Dow Selective, 5 pts.	4553		
17.	Dow Selective, 7 pts.	4830		
18.	Dow Selective, 9 pts.	4482	13865	
19.	Cl. IPC, 2#	4445		
20.	Cl. IPC, 4#	3960		
21.	Cl. IPC, 6#	5127	13532	
22.	Check	4333		

Source	DF	SS	MS	F	.05	.01
Total	131	807,760				
Replicates	5	170,135				
Treatments	21	277,516	13,215	3.53	1.63	*2.06
Chemicals	6	148,867	24,811	6.63	2.19	*2.99
Levels	2	3,197	1,598	0.43	3.09	4.82
Chem. x levels	12	124,215	10,351	2.77	1.85	2.36
Check x rest	1	1,237	1,237	0.33	3.94	6.90
Error	105	360,109	3,742			

Figure 1. The Effect of Herbicides on the Botanical Composition of Hay
1st Cutting, 1953, Tioga County
Translocated Herbicides

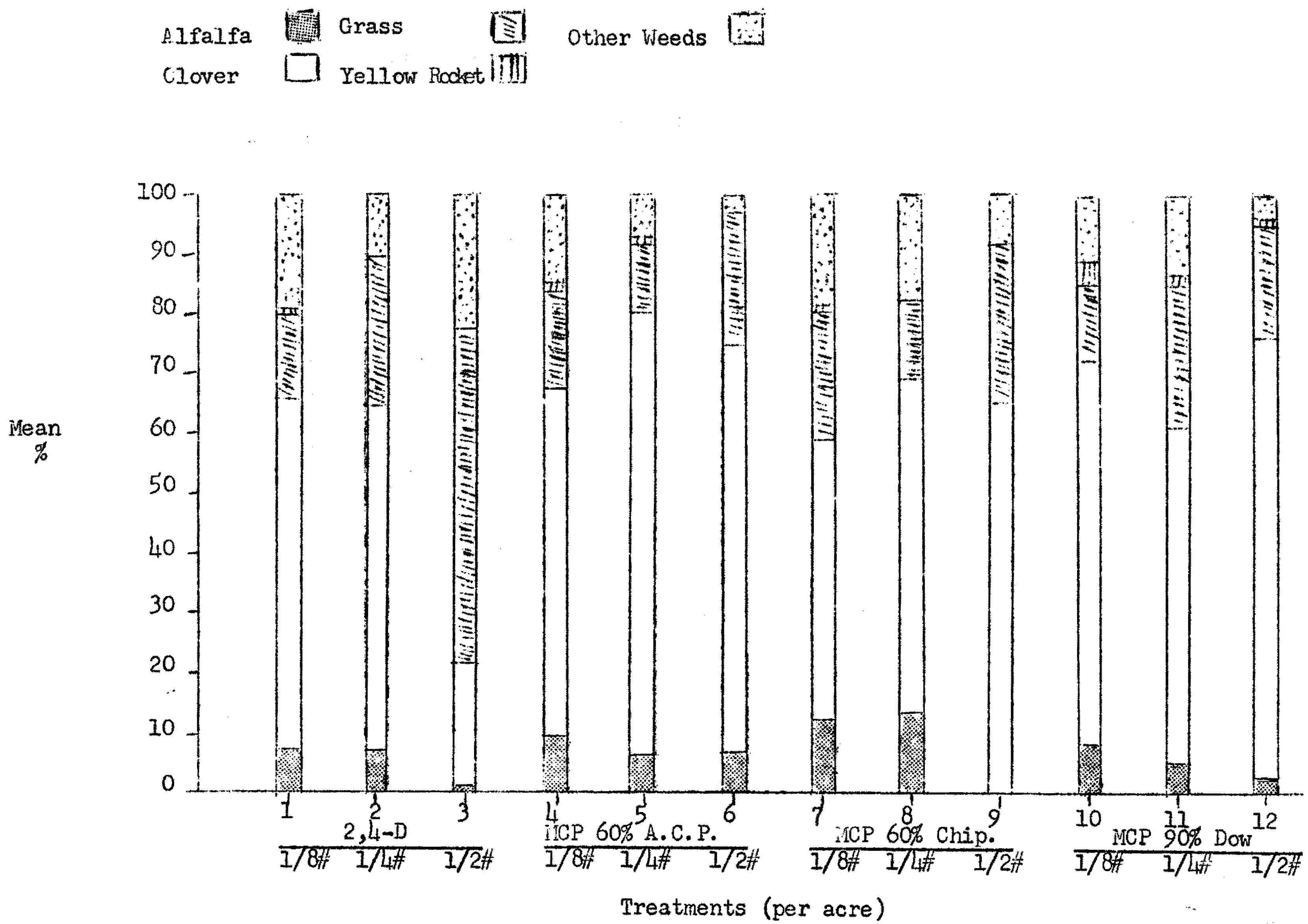


Figure 2. The Effect of Herbicides on the Botanical Composition of Hay
1st Cutting, 1953, Tioga County
Contact Herbicides

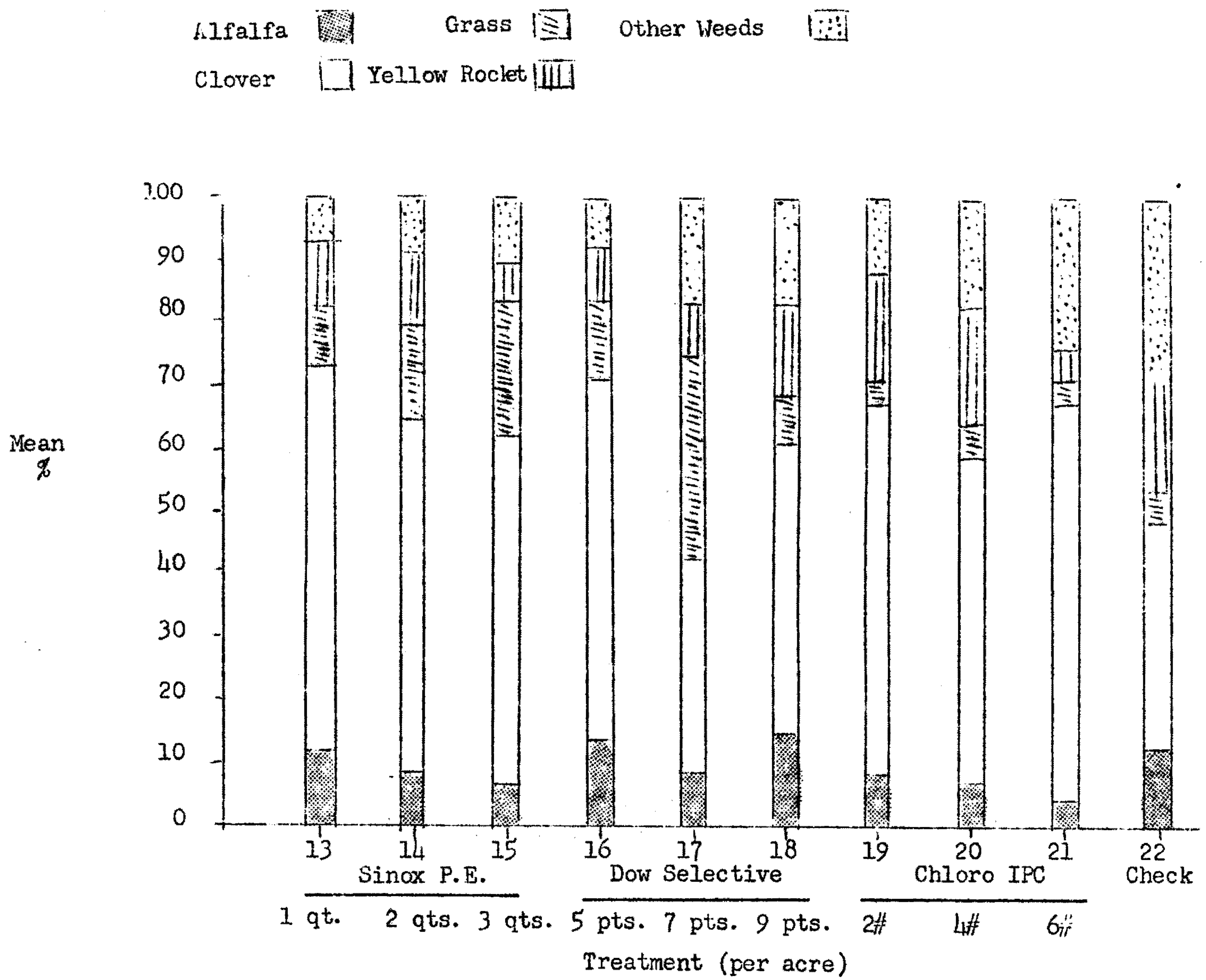


Figure 3. The Effect of Herbicides on the Botanical Composition of Hay
2nd Cutting, 1953, Tioga County
Translocated Herbicides

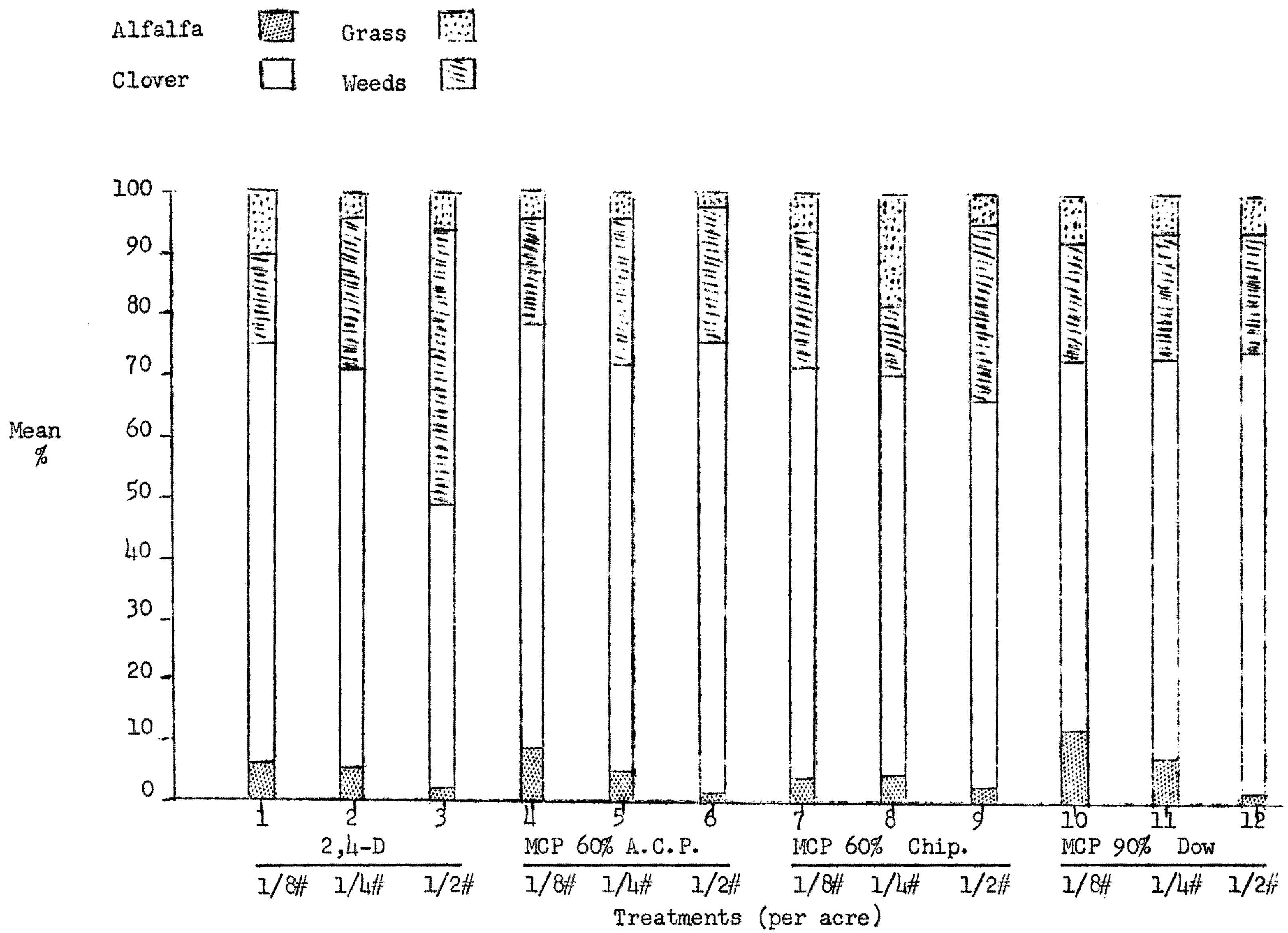


Figure 5. The Effect of Herbicides on the Botanical Composition of Hay
2nd Cutting, 1953, Madison County
Translocated Herbicides

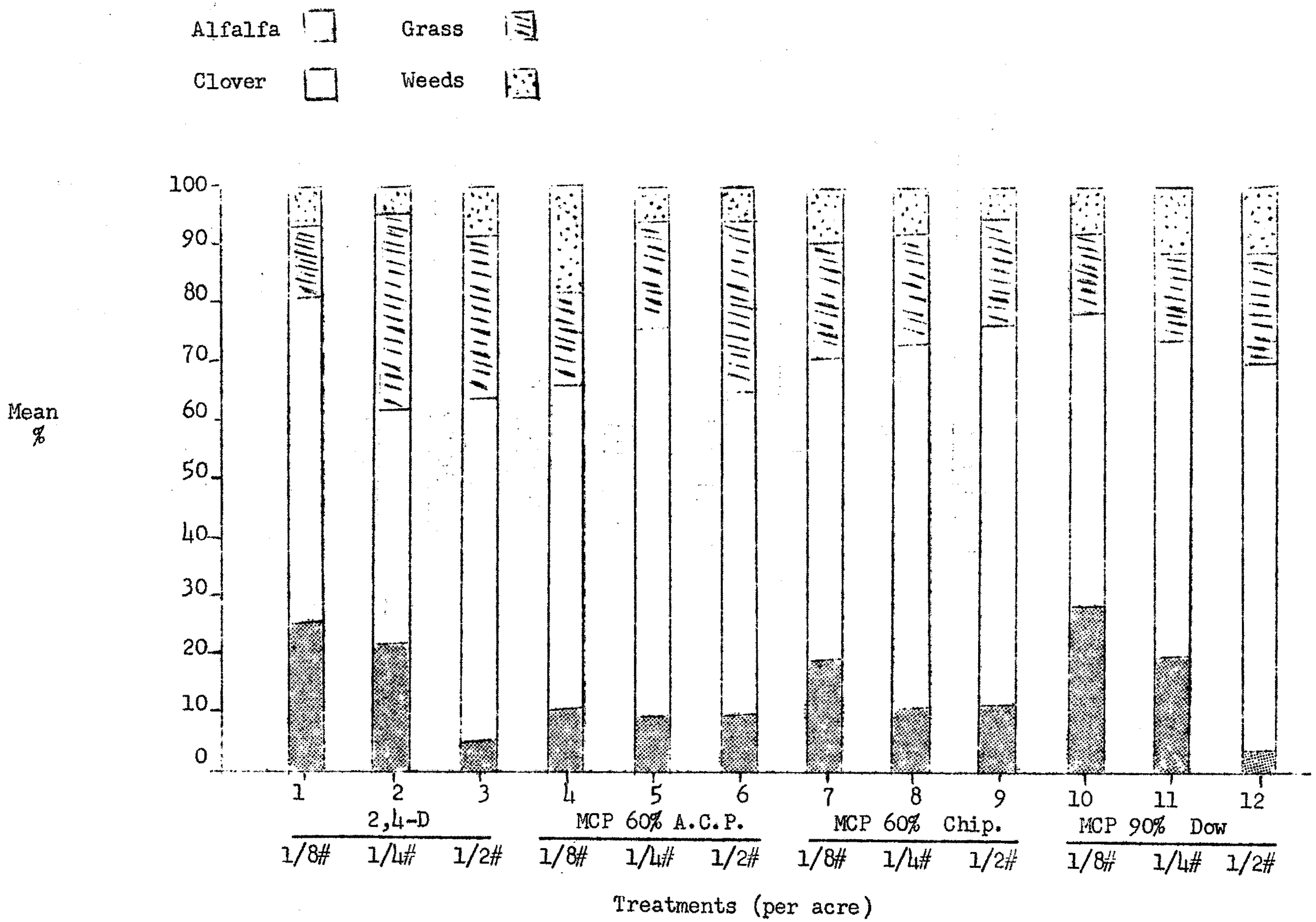
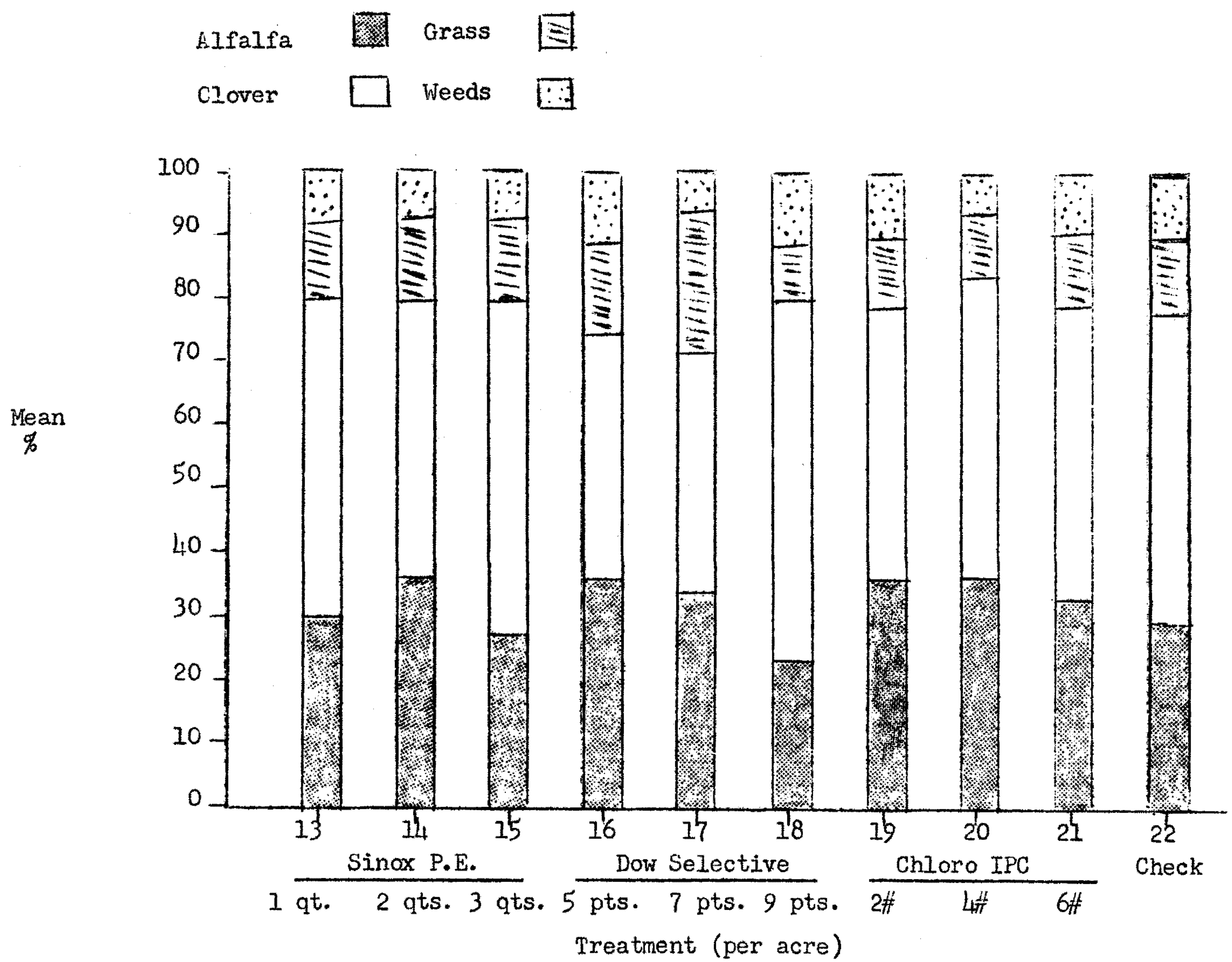


Figure 6. The Effect of Herbicides on the Botanical Composition of Hay
2nd Cutting, 1953, Madison County
Contact Herbicides



Figures 1 through 6 represent the botanical composition studies made in Tioga and Madison Counties. These again are representative of all the locations. Figures 1 and 2 represent the mean percentages of the various separates in the first cutting at Tioga County. By noting the percentage of yellow rocket in the translocated and contact herbicide plots, one can see that the original observations on the effectiveness of weed control are well founded. This was shown in all first cuttings.

The most striking points of these figures are the effect of the herbicides on the percentage of the legumes present, especially alfalfa. First, there is a distinct difference between the contacts and the translocated herbicides. In general, the contact herbicides showed less reduction of alfalfa in both cuttings than the translocated herbicides. Secondly, there is a definite reduction of alfalfa as the concentration of the translocated herbicides increased. The effects appear to be permanent since the trend is observed in the second cutting (Tables 3,4,5, and 6); however, these percentages may change in succeeding years. The magnitude of reduction appears to be the same regardless of the initial percentage of alfalfa. In Tioga County the check plots were around 15 percent alfalfa while in Madison County the percentage was around 30. Nevertheless, the reductions were of the same magnitude. In general, the 1/8 and 1/4 pound rates of 2,4-D and the MCP's did not vary in their alfalfa percentages. This may have some implications as to the relative merits of the MCP's in their selectivity on legumes.

Some increases can be noted. This may be explained on the basis of reduced weed competition.

Summary and Conclusions

1) Sinox PE, Dow Selective, and Chloro IPC were ineffective as fall applications in the control of yellow rocket (Barbarea vulgaris).

2) 2,4-D and MCP, whether amine or sodium salt at 1/4 to 1/2# per acre, gave 95% to 100% control of yellow rocket (Barbarea vulgaris) as fall applications.

3) 2,4-D at 1/2#/A. significantly reduced the yield of grass-legume hay when applied as a fall application.

4) No significant reduction in yields were obtained by the fall application of MCP products...Sinox PE, Dow Selective or Chloro IPC.

5) Marked changes in the botanical composition of grass-legume hay were obtained by the fall application of translocated herbicides- 2,4-D and MCP.

6) Alfalfa was equally sensitive to MCP and 2,4-D at the same concentrations by fall applications.

7) The reduction of alfalfa percentage carried over through the second cutting and may be considered as permanent.

8) Medium red clover was not adversely affected by fall applied contact or translocated herbicides.

In conclusion it should be stated that the percentages given in this paper are not specific and may not be obtained with subsequent spraying. This may be attributed to differences at time of fall treatments in respect to growth of legume, canopy of weeds, seasonal variations, and weather conditions before and after spraying. They do, however, show a definite trend which can be expected from the various herbicides used in this experiment. It is also the authors' opinion that only through botanical composition studies as well as yield and weed control observations can practical recommendations be safely made concerning the use of herbicides for weed control in leguminous crops.

Acknowledgements

The herbicides used in this experiment were supplied by: The American Chemical Paint Company, Ambler, Penna., Chipman Chemical Company, Boundbrook, N. J., Dow Chemical Company, Midland, Mich., and The Standard Agricultural Chemicals Company, Hoboken, N. J.

FURTHER INVESTIGATIONS WITH CHEMICALS IN PASTURE RENOVATION

M. A. Sprague[1]

The initial studies with this subject were particularly encouraging with respect to the use of chemicals to aid in preparing a seedbed for small seeded grasses and legumes. The principle of seedbed preparation appeared to have merit particularly on areas too steep or stony to plow safely and had contributory benefits of water and soil erosion control, and reduced tillage requirements.

The preliminary trials, however, were narrow in scope and were conducted during 1951 and 1952 seasons which were especially favorable with respect to rainfall. Versatility in adaptation needed to be developed, i.e., treatments, tillage and seeding over a wide range of conditions and of seasons of the year, more effective and less expensive chemicals than TCA needed to be tested, and a chemical or combination of chemicals which is cheap, easy to use, suitable for fall, winter and spring seasons, and which have little residual effects on the soils are required.

The procedure as initially established has been to reduce an overgrazed, live sod, made up primarily of indiginous grasses, to a dead mulch by treatment during mid-summer with low rates of TCA. This was followed in 30 days with about two times over the area with a disk, fertilization and seeding all in the same day.

During the wet seasons of 1950, 1951, and 1952 in New Jersey this has worked very well. The dry season of 1953 presented entirely new problems and different results though not opposite nor discouraging results. The TCA at 27 pounds active acid per acre was not adequate to kill the sods quickly when the soil was dry. When rains came a delayed kill was evident but the water moved only a short distance in the dry soil so that residual effects of the chemical were evident on seedings made 30 days after spraying. Later rains carried the chemical beyond the reach of the new seeding.

TCA to be effective at low rates must be applied to close grazed sods. An accumulation of ungrazed top growth greatly lessens the effect of the chemical at low rates.

Other chemicals show promise for specific variations in the technique. Chemicals of long duration in the soil like CMU and to a lesser extent, PDU, show promise for use in the fall season to be followed by spring seeding. One small trial plot with CMU at 4 pounds per acre responded with an excellent stand of ladino clover-orchardgrass established in this manner. Another field study with CMU at 2 pounds gave an encouraging kill but less complete establishment.

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Further trials with PDU, CMU and CIPC each at 4 pounds per acre were put out on an undergrazed sod of bluegrass and orchardgrass on September 18. Dalapon at 5 pounds per acre was also included in this series. By October 14 the areas treated with PDU and CMU were an estimated 70 per cent killed. CIPC had no observable effect. The forage on the Dalapon treated plots was only slightly discolored. On October 26, the plots treated with Dalapon were 90 per cent dead and the remainder badly affected. The remainder showed no change.

Dalapon put on a bluegrass-bromegrass sod on July 10 required fully 3 weeks to show any appreciable effect. However, by August 10 the grass in plots treated with $2\frac{1}{2}$ pounds Dalapon per acre was 50 to 60 per cent dead. Plots treated with 5, $7\frac{1}{2}$, 10, 15 and 20 pounds per acre were completely dead. There was no observable difference between the effects of the chemical when applied with 10 or 20 gallons of solution per acre. Seedings of rye and bromegrass on this area on September 15 showed good establishment on all but the 20 pound per acre plots. From these initial trials it looks like Dalapon is very promising as a chemical for this purpose. It remains to determine the costs per acre to fix the extent of its use.

Versatility in adaptation is one means of making this procedure attractive on farms. On October 1, 1952 rye and orchardgrass were sown on a dead sod disked twice and also on a plowed and prepared seedbed which had not been sprayed. TCA at 27 pounds per acre on August 15 had been used to kill the bluegrass sod. Ladino clover sown broadcast in February, 1952 caught well on the killed and disked area where there was a surface mulch to protect the seedlings. The plowed seedbed gave a poor catch.

The small grains were grazed twice in spring and the new grass-legume seeding was ready for grazing by July 15. In 1953 the total production on the chemically renovated area was 8800 pounds; on the plowed area 9,000 pounds of dry weight per acre. Further, the Kentucky bluegrass population in the former was 2.0 and the latter 2.4 per cent by weight. Essentially, no difference the 1st year after establishment.

Further years' data are required to determine how rapidly the climax vegetation will return.

In another trial seeded in September, 1950, the area sprayed and disked twice had 4 per cent Kentucky bluegrass 3 years later whereas the area disked seven times at the time of seeding had 28 per cent bluegrass in 1953. Another season and the area tillage renovated only would need to be renovated over again. Chemicals in renovation promise a more complete kill of unwanted indiginous grass weeds.

A 10 acre trial at Annandale initiated last year yielded a total of 5472, 5375 and 5969 pounds dry forage during 1953 from the chemical renovated areas, disk renovation and plowed areas respectively. These were all over 400 per cent increases over the untreated areas (1323 pounds). In a similar trial at New Brunswick, disk renovated plots yielded a total of 5024 pounds and chemically renovated plots yielded 5032 pounds dry weight per acre during 1953. However, the disk renovated plots contained 12 per cent bluegrass and the chemically renovated areas 4 per cent. This may mean renovation with chemicals will last longer.

One phase of this study which has not received warranted attention as yet is a measure of the merits of the dead mulch from the standpoint of soil erosion control and water loss. Two items in particular require more research attention: (1) search for the proper chemical to fit the requirements of the season, weeds and crops and (2) a study of the soils and fertilizer aspects of the method to foster good production of newly established crops.

CHEMICAL CONTROL OF MATURE, SMOOTH CRABGRASS IN LAWNS[1/]

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Introduction

The comparative effectiveness of several chemicals for the control of mature, smooth crabgrass was studied during the summer of 1953. Previous work (2), (3), (4), (5), (6) and (7) indicated phenyl mercurials were effective control agents for crabgrass; (1), (5), (6), (7) and (8) reported good control with potassium cyanate both in solution and as a dust; and (6) reported favorable results with boronium compounds. The chemicals reported in this paper include some of those materials that have shown promise for crabgrass control in turf.

Materials and Methods

The tests were conducted during the summer of 1953 on a portion of the athletic field of the University of Rhode Island. The turf, composed of Kentucky bluegrass, Chewings' fescue and Astoria Colonial bent, was representative of lawns and fairways in New England, and was mowed at a height of approximately one inch. Crabgrass infestation was fairly heavy and uniform throughout the test area. The crabgrass population consisted mostly of smooth crabgrass, *Digitaria ischaemum*, combined with a small amount of hairy crabgrass, *D. sanguinalis*.

The experimental design consisted of four blocks, each containing 13 plots of 100 square feet each. There were 12 treatments and one check randomized in each block.

The materials used, the percent active ingredient in each material, and the amounts applied were as follows:

1. PMAS (10% phenyl mercuric acetate) at 2 and 3 ounces per 1,000 square feet.

2. Sowa S-1998, a 75% solution of bis(lauryl, di-2-hydroxyethylammino) boronium fluoride, at 25 and 35 pounds per acre.

3. Sesin (50% 2,4-dichlorophenoxyethyl benzoate) at 3 and 6 pounds per acre.

4. Potassium cyanate (91% potassium cyanate) at 8 and 12 pounds per acre.

5. Potassium cyanate dust (4% potassium cyanate) at 10 and 15 pounds per 1,000 square feet.

6. Milcyanate (4% potassium cyanate and 96% Milorganite) at 10 and 15 pounds per 1,000 square feet.

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2/Agronomist and Research Assistant in Agronomy, respectively.

The PMAS, Sowa S-1998, Sesin and potassium cyanate (91%) were mixed with water. The solutions were applied at the rate of 10 gallons per 1,000 square feet with a 15-gallon power sprayer. Because of the very fine powdery form of the Milcyanate and potassium cyanate dust (4%), these materials were broadcast by hand.

By the time of the first treatment, crabgrass was quite advanced in growth and beginning to set seed.

Dates of application and environmental conditions at the time of treatment were as follows: First treatment August 13, a clear day, soil fairly moist, temperature 76 degrees F.; second treatment August 21, soil fairly moist, temperature 75 degrees F.; third treatment August 27, clear, soil moist, temperature 86 degrees F.

Notes on the percent of crabgrass were taken before the first treatment was applied and again on September 24, four weeks after the last treatment. The notes were recorded as estimates of the percent of area covered by crabgrass. The figures given in table 1 are averages determined from the 4 replicates of each treatment. The percent control figures for each treatment are based on the differences between the amount of crabgrass before and after treatment. Turf discoloration and injury notes were taken September 3, 10 and 17 which were one, two and three weeks after the last treatment.

Results and Discussion

The figures presented in table 1 show the comparative effects of the various chemical treatments and the amount of turf discoloration or injury caused by them.

PMAS at the 2- and 3-ounce rate per 1,000 square feet gave 92 and 95 percent control. Turf discoloration from this chemical was very slight.

Sowa S-1998 at the rate of 25 and 35 pounds per acre gave 95 and 99 percent control, respectively. Slight turf discoloration resulted from both rates of treatment.

Potassium cyanate solution at 8 and 12 pounds per acre provided 97 percent control of crabgrass but turf discoloration was quite evident. The potassium cyanate dust at 10 and 15 pounds per 1,000 square feet gave excellent control, 99 and 100 percent respectively, and turf discoloration was slight.

Milcyanate at 10 and 15 pounds per 1,000 square feet provided plots entirely free from crabgrass and thus produced 100 percent control. Turf discoloration was very slight at both application rates.

Sesin at the rates used did not control the mature crabgrass.

Summary and Conclusions

Tests for the control of crabgrass were conducted during the summer of 1953 on a portion of the athletic field of the University of Rhode Island. Chemicals used were PMAS (10% formulation of phenyl mercuric acetate; Sowa S-1998, a 75% solution of bis(lauryl, di-2-hydroxyethylammino) boronium fluoride; Sesin (50% 2,4-dichlorophenoxyethyl benzoate); Milcyanate (4% potassium cyanate and 96% Milorganite); potassium cyanate (91%) used in solution and potassium cyanate (4%) used as a dust.

PMAS, Sowa S-1998, potassium cyanate solution and dust, and Milcyanate provided control of crabgrass averaging from 92.3 to 100 percent. Sesin was not effective in this test on mature smooth crabgrass plants. Turf discoloration from some of the chemicals was noticeable but there was no discoloration from the use of Sesin. There was no permanent injury to the basic grasses from any of the treatments. Discoloration ranked from least to greatest in the following order: Milcyanate, PMAS, Sowa S-1998, potassium cyanate dust, and potassium cyanate solution.

Acknowledgements

The authors wish to express their appreciation to the following for their contributions to this study: American Cyanamid Company, Carbide and Carbon Chemicals Corp., Sowa Chemical Company, and W. A. Cleary Corp.

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Table 1. Control of Mature, Smooth Crabgrass in Lawn Turf with Various Chemicals. R. I. Agricultural Experiment Station 1953.

Material	Rate	Method of Application	% Crab before Trt.	% Crab after 3 Trts.	% Control	Discoloration* after 1 wk.	2 wks.	3 wks.
PMAS (10%)	2 oz/M**	10 Gal. H_2O	13.25	1.03	92.3	0.03	1.0	1.0
PMAS (10%)	3 oz/M	10 Gal. H_2O	13.5	0.55	95.9	0.33	1.5	1.0
Sowa S-1998	25 lbs/A	10 Gal. H_2O	13.0	0.55	95.8	0.3	0.2	1.0
Sowa S-1998	35 lbs/A	10 Gal. H_2O	14.0	0.03	99.8	2.0	0.6	1.0
Sesin	3 lbs/A	10 Gal. H_2O	12.75	34.75	0.0	0.0	0.0	0.0
Sesin	6 lbs/A	10 Gal. H_2O	11.75	34.75	0.0	0.0	0.0	0.0
Potassium cyanate (91%)	8 lbs/A	10 Gal. H_2O	11.75	0.28	97.7	2.3	1.8	1.0
Potassium cyanate (91%)	12 lbs/A	10 Gal. H_2O	11.25	0.03	97.8	2.3	2.8	2.0
Potassium cyanate (4%)	10 lbs/M	Broadcast by hand	11.75	0.03	99.8	1.0	1.0	1.0
Potassium cyanate (4%)	15 lbs/M	Broadcast by hand	11.5	0.0	100.0	1.0	1.8	1.5
Milcyanate	10 lbs/M	Broadcast by hand	12.5	0.0	100.0	0.8	0.7	0.0
Milcyanate	15 lbs/M	Broadcast by hand	12.25	0.0	100.0	0.8	0.3	0.0
Check			10.75	35.0	-	0.0	0.0	0.0

* Discoloration index - 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = turf injury.

** M refers to rate per 1,000 square feet and A refers to rate per acre. Three treatments were applied at weekly intervals as follows: August 13, 21 and 27.

Crabgrass Control with Phenyl Mercuric Acetate on Various Strains of Colonial Bentgrass Turf at Two Levels of Fertility[1,2]

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Introduction

Early in the summer of 1952 it was observed that crabgrass had invaded the Colonial bentgrass comparison plots at the Rhode Island Agricultural Experiment Station. Since these plots were set up to compare various strains of Colonial bentgrass fertilized at two levels, it offered an excellent opportunity to determine the effect of a phenyl mercury herbicide for crabgrass control under these conditions.

In 1947 phenyl mercuric acetate was reported (1) to be effective as a selective treatment for crabgrass in bentgrass turf. Subsequent findings (2) and (3) revealed that phenyl mercurials were very satisfactory for the control of immature crabgrass. The work reported in this paper is the result of experiments conducted during the summers of 1952 and 1953 at the Rhode Island Agricultural Experiment Station.

Methods and Materials

The experimental area consisted of 4,000 square feet of planted in 1951 in duplicate plots of 10 feet by 20 feet. The plots were seeded at the rate of 2 pounds per 1000 square feet with various strains of Colonial bentgrass from different sources as follows: Astoria and Highland bent from Associated Seed Growers Inc.; Astoria, Colonial, and Highland bent from O. M. Scott and Sons Co.; Astoria, Cascade and Highland bent from F. H. Woodruff and Sons; and Rhode Island Colonial and Rhode Island 84 Colonial bent from seed produced at the Rhode Island Agricultural Experiment Station.

A split plot design was used with one-half of each plot receiving Scott's 9-7-4 Turf Builder to provide 1 pound of nitrogen per 1000 square feet in April and 1 pound of nitrogen in September. The other half of the plot received 1 pound of nitrogen in April, June, August and September. Thus one-half of each plot received 2 pounds of nitrogen each year while the other half of the plot received 4 pounds of nitrogen.

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[1]Contribution No. 834 of the R.I. Agr. Exp. Sta., Kingston, R.I.
[2]This work was made possible in part by the grant and materials given by O. M. Scott and Sons Co.; and by the contribution of materials from Associated Seed Growers, Inc. and F. H. Woodruff and Sons.
[3]Agronomist and Research Assistant in Agronomy, respectively.

The formulation used for crabgrass control was a 0.75 phenyl mercury acetate impregnated in a dry carrier and designated as Scutl. The center 10-foot section of each plot was treated with Scutl, providing a treated area and a check area on both the light and heavy fertilized section of each plot. The Scutl was applied with a 3-foot Scott's spreader at setting Number 7 which delivered the "normal rate" or approximately 3.3 pounds per thousand square feet.

The crabgrass population consisted mostly of smooth crabgrass, Digitaria ischaemum, combined with a small amount of hairy crabgrass, D. sanguinalis. The crabgrass plants were in the early stages of growth and were quite immature at the time of the treatments.

During the 1952 season, three applications of Scutl were made on dew covered grass as follows: first treatment July 7, a clear day, soil dry, temperature 90°F; second treatment July 14, a clear day, soil dry, temperature 90°F; third treatment July 21, a clear day, soil dry, temperature 86°F.

During the 1953 season three applications of Scutl were made on dew covered grass as follows: first treatment July 9, a clear day, soil fairly moist, temperature 75°F; second treatment July 17, a clear day, soil dry, temperature 90°F; third treatment July 27, a clear day, soil moist, temperature 80°F.

Crabgrass notes were taken before the first treatments and after the last treatments were applied. Discoloration notes were taken in 1952 following each treatment. In 1953 no discoloration worthy of mention was observed.

Results and Discussion

1952 Experiment

Results obtained during the 1952 season are reported in table 1. Crabgrass control with Scutl on the various plots of Colonial bentgrass was very satisfactory. Control varied somewhat among the plots ranging from 88 to 99 percent.

Discoloration of the turf was evident after the first treatment. The figures for discoloration are listed in table 1. From the data it appears that discoloration was greater on the high fertility plots, and that Highland bent was less susceptible to discoloration than the other strains of Colonial bentgrass.

1953 Experiment

Excellent crabgrass control resulted in 1953 with Scutl (table 2) on the various strains of Colonial bentgrass turf. Control ranged from 99.0 to 100 percent.

Discoloration of turf from the chemical was not noticeable on any of the plots during the 1953 season.

In 1953 the amount of crabgrass on the plots without Scutl was greater on those receiving the lower level of fertilization than on the plots receiving the higher level. This can be noted in table 3 and is the reverse of the 1952 results. The fertility level of the soil and consequent density of the turf had been increased during the period and undoubtedly accounts for the decrease in the amount of crabgrass on the untreated plots.

The most effective control of crabgrass was obtained by the use of the high fertility level and the normal rate of Scutl. Low fertility in conjunction with Scutl gave good control but not as good as with the high rate of fertilization. In general, the percentages of control were better during the 1953 than in 1952, especially on those plots receiving the high rate of nitrogen fertilization.

Summary and Conclusions

Crabgrass control experiments with phenyl mercury acetate were conducted during the summers of 1952 and 1953 at the Rhode Island Agricultural Experiment Station, on various strains of Colonial bentgrass turf fertilized with two levels of fertility based on the rates of 2 and 4 pounds of nitrogen per 1000 square feet per season. This was provided by a 9-7-4 turf fertilizer. The phenyl mercury acetate formulation used was Scutl, a 0.75 percent phenyl mercuric acetate impregnated in vermiculite. This was applied on plots of Astoria, Highland, Cascade and R. I. Colonial bentgrass turf from various sources.

Phenyl mercuric acetate in the form of Scutl was very effective in the control of crabgrass in Colonial bentgrass turf. Control ranged from 99 to 100 percent.

Phenyl mercuric acetate in conjunction with the higher fertility level was the most effective treatment and resulted in 100 percent crabgrass control.

Feeding the turf with 9-7-4 turf fertilizer in amounts sufficient to supply 4 pounds of nitrogen per season resulted in a turf that was quite resistant to weed invasion. There was considerably less crabgrass in the untreated plots that received high rate of fertilization than in the plots that received the low rate.

Literature Cited

1. DeFrance, J. A. Water-soluble Mercurials for Crabgrass Control in Turf. The Greenkeepers' Reporter. January-February, 1947.

2. ______________, and Simmons, J. A. A Comparison of Chemicals for Crabgrass Control and a Study of Some Factors Related to the Control of Crabgrass with Phenyl Mercury Compounds. Proc. 6th Annual Meeting Supplement, N.E.W.C.C., NYC, pp. 67-75. Jan. 1952.

3. Schery, Robert W. Evaluation of a Selective Crabgrass Killer. Missouri Botanical Garden Bulletin. Vol. 39, No. 4. April 1951.

Table 1. Control of crabgrass by application of Scutl on various strains of Colonial bentgrass lawn turf fertilized with two levels of fertility. Rhode Island Agricultural Experiment Station 1952.

Grass	Nitrogen[a] Level lbs./1000 sq. ft.	Rate of Scutl*	% Crab before trt.	% Crab after 3 trt.	% Control	Discoloration after** 1st trt.	2nd trt.	3rd trt.
Astoria W/	2	Normal	3	0.3	90	1	2	2
"	4	Normal	4	0.5	88	2	2	2
"	2	None	3	9.0	0	0	0	0
"	4	None	4	12.0	0	0	0	0
Highland W	2	Normal	5	0.3	94	1	1	0
"	4	Normal	5	0.3	94	2	2	1
"	2	None	4	9.0	0	0	0	0
"	4	None	8	13.0	0	0	0	0
R. I. Colonial L	2	Normal	6	Trace	99	1	1	1
"	4	Normal	5	0.5	90	2	2	2
"	2	None	4	14.0	0	0	0	0
"	4	None	4	14.0	0	0	0	0
Cascade W	2	Normal	3	Trace	97	1	1	1
"	4	Normal	1	Trace	91	2	2	2
"	2	None	2	8.0	0	0	0	0
"	4	None	2	8.0	0	0	0	0
Astoria A	2	Normal	2	Trace	96	1	1	1
"	4	Normal	1	Trace	91	2	3	3
"	2	None	2	7.0	0	0	0	0
"	4	None	2	10.0	0	0	0	0
Astoria S	2	Normal	2	Trace	96	1	1	1
"	4	Normal	3	Trace	97	2	2	2
"	2	None	3	12.0	0	0	0	0
"	4	None	3	10.0	0	0	0	0
Highland S	2	Normal	3	Trace	97	1	1	0
"	4	Normal	5	Trace	98	2	2	2
"	2	None	3	7.0	0	0	0	0
"	4	None	5	10.0	0	0	0	0
R. I. 84 L	2	Normal	2	Trace	96	1	2	2
"	4	Normal	3	Trace	97	2	3	3
"	2	None	2	6.0	0	0	0	0
"	4	None	6	14.0	0	0	0	0
Colonial S	2	Normal	1	Trace	91	1	2	2
"	4	Normal	1	Trace	91	2	3	3
"	2	None	1	4.0	0	0	0	0
"	4	None	2	8.0	0	0	0	0
Highland A	2	Normal	3	Trace	97	1	0	0
"	4	Normal	3	Trace	97	2	1	0
"	2	None	3	10.0	0	0	0	0
"	4	None	3	9.0	0	0	0	0

*Rate of Scutl - Normal rate as amount specified by manufacturer. Approximately 3.3 pounds per 1,000 sq. ft. as delivered by Scott's spreader at setting No. 7.

**Discoloration index: 0 = none, 1 = slight, 2 = medium, 3 = severe.

/Source of seed: S = O. M. Scott & Sons Co.
W = F. H. Woodruff and Sons
A = Associated Seed Growers Inc.
L = Rhode Island Agricultural Experiment Station

Date of Treatments = July 7, 14 and 21

[a]Nitrogen Level = Amount of nitrogen supplied by a 9-7-4 turf fertilizer.

Table 2. Control of crabgrass by application of Scutl on various strains of Colonial bentgrass lawn turf fertilized with two levels of Nitrogen. Rhode Island Agricultural Experiment Station 1953.

Grass	Level of Nitrogen[a] lbs./1,000 sq. ft.	Rate of Scutl*	% Crab before trt.	% Crab after 3 trts.	% Control
Astoria W**	2	Normal	1.5	Trace‡	99.0
"	4	Normal	1.5	0.0	100.0
"	2	None	4.0	15.0	0.0
"	4	None	4.0	6.5	0.0
Highland W	2	Normal	2.25	Trace	99.0
"	4	Normal	1.05	Trace	99.9
"	2	None	10.0	27.5	0.0
"	4	None	4.0	4.0	0.0
R.I. Colonial L	2	Normal	1.75	Trace	99.0
"	4	Normal	0.5	0.0	100.0
"	2	None	5.0	25.0	0.0
"	4	None	4.0	7.5	0.0
Cascade W	2	Normal	0.5	Trace	99.0
"	4	Normal	Trace	0.0	100.0
"	2	None	4.0	15.5	0.0
"	4	None	1.25	5.0	0.0
Astoria A	2	Normal	1.0	Trace	99.0
"	4	Normal	0.75	0.0	100.0
"	2	None	5.5	21.0	0.0
"	4	None	3.5	8.5	0.0
Astoria S	2	Normal	0.75	Trace	99.0
"	4	Normal	1.0	Trace	99.0
"	2	None	4.5	18.0	0.0
"	4	None	2.5	6.0	0.0
Highland S	2	Normal	2.0	Trace	99.0
"	4	Normal	0.75	0.0	100.0
"	2	None	7.0	25.0	0.0
"	4	None	5.0	6.0	0.0
R.I. 84 L	2	Normal	1.0	Trace	99.0
"	4	Normal	0.75	0.0	100.0
"	2	None	6.0	22.0	0.0
"	4	None	3.0	8.0	0.0
Colonial S	2	Normal	0.25	Trace	99.0
"	4	Normal	0.5	0.0	100.0
"	2	None	2.0	13.0	0.0
"	4	None	2.0	2.5	0.0
Highland A	2	Normal	1.5	Trace	99.0
"	4	Normal	0.75	Trace	99.5
"	2	None	8.0	29.5	0.0
"	4	None	3.5	5.2	0.0

*Rate of Scutl = Normal rate as amount specified by manufacturer. Approximately 3.3 lbs. per 1000 sq. ft. as delivered by Scott's spreader at setting No. 7.

**Source of Seed: S = O. M. Scott and Sons Co.
W = F. H. Woodruff and Sons
A = Associated Seed Growers, Inc.
L = Rhode Island Agricultural Experiment Station

Date of treatments = July 9, 17 and 27

‡Trace = Less than 0.1 percent.

[a]Nitrogen level = Amount of nitrogen supplied by a 9-7-4 turf fertilizer.

Table 3. The effect of two levels of Nitrogen fertilization on crabgrass population in various strains of Colonial bentgrass for the years 1952 and 1953 at the Rhode Island Agricultural Experiment Station.

Grass	Nitrogen[a] Level lbs./1000 sq. ft.	Rate of Scutl**	% Crab after 3 trts. 1952	% Crab after 3 trts. 1953	% Control 1952	% Control 1953
Astoria W*	2	Normal	0.3	Trace/	90.0	99.0
"	2	None	9.0	15.0	0.0	0.0
"	4	Normal	0.5	0.0	88.0	100.0
"	4	None	12.0	6.5	0.0	0.0
Highland W	2	Normal	0.3	Trace	94.0	99.9
"	2	None	9.0	27.5	0.0	0.0
"	4	Normal	0.3	Trace	94.0	99.9
"	4	None	13.0	4.0	0.0	0.0
R. I. Colonial L	2	Normal	Trace	Trace	99.0	99.0
"	2	None	14.0	25.0	0.0	0.0
"	4	Normal	0.5	0.0	90.0	100.0
"	4	None	14.0	7.5	0.0	0.0
Cascade W	2	Normal	Trace	Trace	97.0	99.0
"	2	None	8.0	15.5	0.0	0.0
"	4	Normal	Trace	0.0	91.0	100.0
"	4	None	8.0	5.0	0.0	0.0
Astoria A	2	Normal	Trace	Trace	96.0	99.0
"	2	None	7.0	21.0	0.0	0.0
"	4	Normal	Trace	0.0	91.0	100.0
"	4	None	10.0	8.5	0.0	0.0
Astoria S	2	Normal	Trace	Trace	96.0	99.0
"	2	None	12.0	18.0	0.0	0.0
"	4	Normal	Trace	Trace	97.0	100.0
"	4	None	10.0	6.0	0.0	0.0
Highland S	2	Normal	Trace	Trace	97.0	99.0
"	2	None	7.0	25.0	0.0	0.0
"	4	Normal	Trace	0.0	98.0	100.0
"	4	None	10.0	6.0	0.0	0.0
R. I. 84 L	2	Normal	Trace	Trace	96.0	99.0
"	2	None	6.0	22.0	0.0	0.0
"	4	Normal	Trace	0.0	97.0	100.0
"	4	None	14.0	8.0	0.0	0.0
Colonial S	2	Normal	Trace	Trace	91.0	99.0
"	2	None	4.0	13.0	0.0	0.0
"	4	Normal	Trace	0.0	91.0	100.0
"	4	None	8.0	2.5	0.0	0.0
Highland A	2	Normal	Trace	Trace	97.0	99.0
"	2	None	10.0	29.5	0.0	0.0
"	4	Normal	Trace	Trace	97.0	99.5
"	4	None	9.0	5.2	0.0	0.0

*Source of seed: A = Associated Seed Growers, Inc.
W = F. H. Woodruff and Sons
S = O. M. Scott and Sons Co.
L = Rhode Island Agricultural Experiment Station

**Rate of Scutl = Normal rate as amount specified by manufacturer. Approximately 3.3 lbs. per 1,000 sq. ft. as delivered by Scott's spreader at setting No. 7.

/Trace = Less than 0.1 per cent.

Date of treatments = July 7, 14 and 21, 1952
July 9, 17 and 27, 1953

[illegible] = Amount of nitrogen supplied by a 9-7-4 turf fertilizer.

Duration of Clover Control with Endothal and with 2,4,5-T in Turf Mowed at Lawn and Fairway Height

John A. Jagschitz and John F. Cornman[1]

After the end of the 1952 growing season we reported on a rather extensive series of experiments where endothal formulations (1) and 2,4,5-T (2, 3) were used for selective clover control in lawn and fairway turf. Such conclusions as we drew from these trials were tentative; our clover counts were made during the season of application whereas the practical merits of the different treatments would not be evident until the end of the season following. We are now able to complete the record by reporting the clover control evident in these same plots in 1953. As a matter of convenience the several experiments are enumerated here in the same order as in the previous paper, with a repetition here of the 1952 clover counts for comparison. For details of the 1952 trials see the previous papers (1, 2).

Dairy Building Tests

Table 1. Persistence of clover control after July 1952 treatments with endothal.

Lb. endothal/A ME-3003	Percent clover control (Average of 4 gallonages) at 6½ weeks*	at 11½ months
½	76	22
1	91**	55
1½	92**	52
Ave. % clover in checks	49	42

* Summarized from Table 1, Cornman and Jagschitz (1)
** Objectionable turf discoloration following application
Application date: July 11, 1952
Clover control estimates: August 25, 1952 and July 3, 1953

The 1953 follow-up observations tabulated in Table 1 indicate that clover control from July 1952 applications of endothal in formulation ME-3003 did not remain satisfactory by July 1953.

Stewart Park Tests

It was evident from superficial observations in July 1953 of the experimental area treated in July 1952 that the results would be similar to those of the Dairy Building Test reported above, but since the plots had been injured severely by skunks in the fall of 1952, no actual clover counts were made.

[1] Turf Research Assistant, and Associate Professor Ornamental Horticulture, Cornell University, Ithaca, New York, respectively.

Clara Dickson Tests

Table 2. Persistence of clover control after August 1952 treatments of fairway turf with one and two applications of endothal

A. One Application

Formulation	Lb. endothal per acre	Percent clover control (Average of 2 gallonages) at 1 month*	at $10\frac{1}{2}$ months
ME-3003	$\frac{1}{2}$	94	83
	1	98	92
	$1\frac{1}{2}$	98	89
EC-4069	$\frac{1}{4}$	91	85
	$\frac{1}{2}$	97	91
	1	98	90
Ave. % clover in checks		15	31

* Summarized in Table 3, Cornman and Jagschitz (1)
Application date: August 18, 1952
Clover control estimates: September 19, 1952 and July 3, 1953

B. Two successive applications

Formulation	Lb. endothal per acre	Percent clover control (Average of 2 gallonages) at 1 month*	at 10 months
ME-3003	$\frac{1}{2}$	99	94
	1	99	98
	$1\frac{1}{2}$	99	95
EC-4069	$\frac{1}{4}$	99	95
	$\frac{1}{2}$	99	95
	1	99**	96
Ave. % clover in checks		23	55

* Summarized from Table 4, Cornman and Jagschitz (1)
** Objectionable turf discoloration following application
Application dates: August 18 and August 27, 1952
Clover control estimates: September 26, 1952 and July 3, 1953

The data in Table 2-A indicates that single applications of ME-3003 and EC-4069 produced clover control that remained satisfactory for at least 10 months, and without objectionable turf discoloration. Two successive applications (Table 2-B) produced even better results. The complete data, not included here, show no consistent differences between gallonages or formulations at equivalent rates. The differences in clover control between gallonages at a specific rate of either chemical varied less than 3% from the average.

James Baird Park Experiments

Unreplicated plots similar to the replicated ones reported above were established at James Baird State Park near Poughkeepsie, New York. Treatments were made on August 19 and August 25, 1952. Data about the condition of these plots on June 8, 1953, 11 months after treatment, are enumerated in Table 3-A and Table 3-B.

Table 3. Persistence of clover control after August treatments on fairway turf with one and two applications of endothal (Unreplicated plots at James Baird State Park)

A. One application

Formulation	Lb. endothal per acre	Percent clover control at 3 weeks	Percent clover control at 9 3/4 months
ME-3003	½	68	14
	1	85	38
	1½	95	74
	2	97*	85
EC-4069	½	79	37
	1	92	63
	1½	97*	87
	2	99*	99
%clover in checks		55	82

*Objectionable turf discoloration following application
Application date: August 19, 1952
Clover estimates: September 11, 1952 and June 8, 1953

B. Two applications

Formulation	Lb. endothal per acre	Percent clover control at 2½ weeks	Percent clover control at 9½ months
ME-3003	½	93	87
	1	99	91
	1½	99	98
EC-4069	½	98	86
	1	99	96
%clover in checks		55	82

Application date: August 19 and August 24, 1952
Clover estimates: September 11, 1952 and June 8, 1953

These data indicate that under these circumstances a single August application of ME-3003 or EC-4069 did not produce clover control that was satisfactory 11 months later except at rates which procued objectionable initial turf discoloration. Lasting clover control without objectionable turf discoloration was produced by two successive applications of endothal rates that were inadequate as single applications.

Taughannock Park Experiments

Table 4. Persistence of clover control after October treatments of fairway turf with various endothal formulations.

Formulation	Lb. endothal per acre	Percent clover control at 5 weeks*	Percent clover control at 11 months	Average for formulation 11 months
ME-3001	$\frac{1}{4}$	96	64	
	$\frac{1}{2}$	98	89	87
	1	100**	96**	
	2	100**	99**	
ME-3001 in sand	$\frac{1}{4}$	96	63	
	$\frac{1}{2}$	97	88	87
	1	99	98	
	2	100	99	
EC-4069	$\frac{1}{4}$	79	29	
	$\frac{1}{2}$	96	82	68
	1	94	64	
	2	98**	96**	
ME-3000	$\frac{1}{4}$	86	36	
	$\frac{1}{2}$	95	55	65
	1	97	76	
	2	98	92	
ME-3000 in sand	$\frac{1}{4}$	81	18	
	$\frac{1}{2}$	91	35	50
	1	95	82	
	2	94	66	
ME-3003	$\frac{1}{4}$	88	29	
	$\frac{1}{2}$	86	16	45
	1	91	41	
	2	98	94	
Ave % clover in checks		29	65	
LSD 5%		8	32	17
1%		11	43	23

* Summarized from Table 5, Cornman and Jagschitz (1)
** Objectionable turf discoloration following application
Application date: October 11, 12, 1952
Clover estimates: November 16, 1952 and September 26, 1953

From these data in Table 4 it is evident that clover control readings made 5 weeks after treatment did not provide an accurate gauge of the clover control to be anticipated at the end of 11 months. The high initial control provided by the lower rates of each chemical proved only temporary. With the liquid applications of ME-3000, EC-4069 and ME-3003 only the 2 pound rate of endothal gave good control for a period of 11 months. With formulation ME-3001 lasting control was produced with $\frac{1}{2}$, 1, and 2 pound rates in spray or in sand, with the dry applications the more desirable because of the relatively minor turf discoloration after the applications were made.

Relative Effectiveness of Endothal Formulations

The degree of clover control was higher in all cases with ME-3001 as a spray or in sand than with any of the other endothal formulations at equivalent rates. At rates of 2 pounds endothal per acre these differences are obscured. The clover control was almost identical when ME-3001 was applied as a spray and in sand, but there was significantly less turf discoloration following the dry application. The powder formulations of endothal at some of the lower rates produced better control of clover than did the comparable liquid formulations. The inclusion of ammonium sulfate in the powder or liquid formulations increased the herbicidal activity markedly at some of the low rates. Considering the degree of clover control, amount of actual endothal required, and the intensity of turf discoloration, ME-3001 applied in sand at the 1 pound rate proved to be the most satisfactory treatment.

For the October 1952 applications at Taughannock Park we made clover counts in July 1953 and can compare these with the late September counts presented here (Table 5). In general, the July figures for the plots receiving the lower rates of chemicals show much more complete clover control in July than two months later. Unlike the Taughannock Park area, the sites of the Clara Dickson and James Baird Park tests were not favored by adequate moisture during the summer drought of 1953, and by September all vegetation was so parched that clover counts were impossible. However, the striking resurgence of clover at Taughannock Park during the two summer months casts doubt upon the validity of any conclusions that might be drawn from our June control estimates at the James Baird Park plots (Table 3) and our July control estimates at the Clara Dickson trials (Table 2). This resurgence also suggests that clover counts in other experiments should be considered as only tentative until counts for the autumn of the following growing season are available.

Satisfactory control of clover, at least for 11 months, was obtained with 1 pound of 2,4,5-T alone. For the low degree of control recorded with the treatment of $1\frac{1}{2}$ pounds of 2,4,5-T plus $\frac{1}{2}$ pound of 2,4-D we have no explanation to offer.

Conclusions

From these trials it appears that the results to be anticipated from the use of endothal formulations on lawn and fairway turf can not now be anticipated accurately. If our single set of trials with 2,4,5-T can be considered typical, we can only conclude that on the basis of work thus far a single autumn application of 2,4,5-T butyl ester at the rate of 1 pound acid equivalent per acre will provide practical clover control in lawn and fairway turf, and that this treatment is more desirable than any with endothal from the standpoint of clover control, of turf injury, and of current costs.

Table 5. Persistence of clover control after October 1952.
Treatments with 2,4,5-T and mixture of 2,4,5-T and 2,4-D

A. 2,4,5-T

2,4,5-T ester* lbs. per acre	Percent clover control at 5 weeks**	at 11 months
½	86	73
1	96	94
1½	96	95
% clover in checks	29	65
LSD 5%	8	32
1%	11	43

* Propylene glycol butyl ether ester
** Summarized from Table 1, Cornman and Jagschitz (2)
Application date: October 11, 1952
Clover estimates: November 16, 1952 and September 26, 1953

B. 2,4,5-T + 2,4-D

Lbs. 2,4,5-T ester* added to ½ lb. 2,4-D**	Percent clover control at 5 weeks***	at 11 months
½	86	76
1	92	90
1½	86	62
% clover in checks	29	65
LSD 5%	8	32
1%	11	43

* Propylene glycol butyl ether ester
** Triethanolamine salt
*** Summarized from Table 1, Cornman and Jagschitz (2)
Application date: October 11, 1952
Clover estimates: November 16, 1952 and September 26, 1953

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Selective Clover Control in Putting Green Turf with Endothal and 2,4,5-T Formulations

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Endothal (disodium 3,6-endoxahexahydrophthalate) has shown some promise as a selective herbicide for clover control in lawn and fairway types of turf, as reported in a series of papers beginning in 1951 (1, 4, 5, 7). In 1952 Daniel (3) reported good control of clover in Indiana lawns and putting greens with 2,4,5-T and his trials were repeated with similar results on New York lawns (2).

Since clover is one of the more serious weeds of golf course putting greens, the effects of endothal and of 2,4,5-T on this type of turf needed detailed investigation. We needed more information on the effectiveness of the various formulations of endothal and of formulations of 2,4,5-T, as well as the effects of gallonage on the results from these two materials. On putting greens we needed to know what modifications, if any, could be expected from mowing practices, the time of day of application, season of application, and the presence and absence of thatch. This paper reports the results of six replicated experiments on putting green turf in 1953.

Constants in Terminology and Experimental Conditions

Abbreviation	Formulation
ME-3001	16% endothal (disodium 3,6-endoxahexahydro-phthalate) and 84% ammonium sulfate (a powder)
ME-3003	2 pounds endothal per gallon
EC-4069	2/3 pound endothal and 3 1/3 pounds ammonium sulfate per gallon
2,4,5-T	
Amine	Triethylamine salt, 4 pounds acid per gallon
Butyl ester	Propylene glycol butyl ether esters, 4 pounds acid per gallon
Pentyl ester	Pentyl ester, 313 pounds acid per gallon
Isopropyl ester	Isopropyl ester 32.3% and amyl ester 11.7%, 3.34 pounds acid per gallon

All rates of chemicals used are expressed in pounds of endothal per acre or pounds of 2,4,5-T acid per acre.

Turf Components

On all greens treated there were some patches of velvet bent of varying size and frequency, but most of the grass appeared to be creeping bent.

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Method of application

Sprays were applied with a small-plot sprayer (6) with four fan-type Tee Jet nozzles on a hand boom. Constant pressure was supplied by CO_2 between 25 and 30 psi. Nozzles were changed for different gallonages. Two timed passes were made over each plot for uniform coverage. ME-3001, when applied as a dry mixture, was mixed with dry builder's sand which passed a 64-mesh screen and was spread by hand at the rate of 726 pounds per acre.

Turf discoloration

The turf discoloration scale used was: 0 - None, 1 - Light, 2- Moderate or Objectionable, 3 - Severe and 4 - Complete Kill. Three gradations were distinguished between each of these readings. The check plots at the time of reading were considered as 0 (none).

Clover control

Percent clover control was estimated as the reduction in area covered by clover leaflets from the amount in each plot before treatment. Before clover control was calculated in terms of percent the base figure for the amount originally present in each plot was adjusted in proportion to the seasonal variations observed in the check plots. A ½ foot strip just inside each plot boundary served as a border strip.

Experiment 1 - Gallonage and Endothal

Purpose: To determine the influence of gallonage on clover control with endothal on putting green turf.

Materials and methods

The experiment was located on the 7th green of the Dinsmore Golf Course at Staatsburg, N. Y. The green as a whole contained 15% clover. The experimental design was complete randomized blocks with three replications. Six plots served as checks. Individual plots were 4 x 12 feet.

Each of the three endothal formulations was applied in water at rates of 50, 200, and 800 gallons per acre. The chemical treatments were ME-3003 at the rate of 3/4 pound endothal per acre, EC-4069 at 3/8 pound per acre, and ME-3001 at 1/8 pound per acre. Treatments were applied on June 15, 1953. The experimental area had been mowed a few hours prior to the applications. The soil was slightly moist and it was a hot, clear day. The weather following was hot and dry. The green was watered two days after treatment and as normally required thereafter. Turf discoloration estimates were made on June 25, and clover estimates on September 28.

Results and discussion

The data in Table 1-A show that, while the degree of clover control was not correlated with changes in gallonage, the amount of turf discoloration decreased significantly as gallonage increased.

At the rates used here the three endothal formulations did not differ significantly in clover control or turf discoloration produced, nor could the degree of clover control in any instance be considered satisfactory.

Table 1. Clover control on putting green turf with endothal formulations applied in 3 volumes of water.

A. Clover control and turf discoloration (scale 0-4)

Formulation	lb. endothal per acre	% Clover Control Gallons/Acre 50	200	800	Ave.	Turf Discoloration Gallons/Acre 50	200	800	Ave.
ME-3001	1/8	62	34	41	45	1.7	1.0	0.7	1.1
EC-4069	3/8	29	59	52	47	1.8	1.1	0.4	1.1
ME-3003	3/4	47	47	72	55	2.0	1.5	0.5	1.3
Average		46	47	55		1.8	1.2	0.5	
LSD 5%			NSD				0.6		NSD
1%					NSD		1.0		

B. Turf killed by endothal formulations

Formulation	lb. endothal per acre	Dead patches, as % of plot area Gallons per Acre 50	200	800	Average
ME-3001	1/8	3.8	0.6	0.0	1.5
EC-4069	3/8	4.5	0.6	0.0	1.7
ME-3003	3/4	4.4	2.4	0.0	2.3
Average		4.2	1.2	0.0	

Treatment date: June 15, 1953
Turf discoloration estimates: June 25, 1953
Dead patches estimated: July 24, 1953
Clover control estimates: September 28, 1953

On July 24, about 5 weeks after treatment, the scattered areas of dead turf that had appeared were estimated, as tabulated in Table 1-B.

From these data it is evident that the turf areas killed by the chemical treatments decreased as gallonage increased. In the plot most seriously injured (ME-3003) about 8.3% of the treated turf was completely killed, while in none of the 800 gallon treatments was any truf damaged in this fashion.

In summary, in this trial of endothal formulations on putting green turf the use of the higher gallonages resulted in significantly less turf injury without decreasing clover control.

Experiment 2 - Mowing

Purpose: To determine the effect of mowing putting green turf prior to the application of endothal and 2,4,5-T for clover control.

Materials and methods

The experiment was located on the 6th green of the Dinsmore Golf Course at Staatsburg, N. Y. The green as a whole contained 6% clover. The experimental design was split-plot, in triplicate. In each of the 64 x 15 foot blocks, the half to be mowed just prior to the treatment was chosen by chance, and in each of the resultant 6 half-blocks the locations of the various treatments were also chosen at random. Twelve plots served as checks. Individual plots were 4 x 15 feet.

The complete green was mowed on June 6, 1953. Half of each block was mowed about one hour before the treatments were applied on June 9. The entire green was not mowed for another 2 days, on June 11.

Five chemicals were applied in water at the rate of 50 gallons per acre; these were ME-3003 at the rate of 3/4 pound endothal per acre; EC-4069 at ½ pound endothal per acre; ME-3001 at 1/8 pound endothal per acre; 2,4,5-T butyl ester and 2,4,5-T amine, each at the rate of ½ pound 2,4,5-T per acre. The sixth treatment was ME-3001 in sand, at the rate of ¼ pound endothal per acre. The day of the treatment was clear, the temperature in the 80's, and the soil moist. Cloudy and cool weather followed for the next four days, followed by drought. The green was watered as would normally be required, beginning at least 3 days after the treatments were applied.

Turf discoloration readings were made on June 17, eight days after treatment. Clover estimates were made on September 28, about 15 weeks after treatment.

Results and discussion

The data in Table 2 indicate that mowing just prior to treatment made no significant difference in regard to either turf discoloration or clover control. Both 2,4,5-T formulations produced significantly less turf discoloration than any of the endothal formulations, and there was little to choose between the formulations of endothal. Except for the amine form of 2,4,5-T, each chemical treatment produced over 90% clover control as observed after 15 weeks.

Table 2. Clover control and turf discoloration on putting green turf with endothal and 2,4,5-T, with and without mowing prior to chemical application

Chemical	lb./acre	% clover control Mowed	Not mowed	Ave.	Turf discoloration Mowed	Not mowed	Ave.
ME-3001	1/8	91	98	94	1.3	0.7	1.0
ME-3001 in sand	1/4	97	95	96	0.9	1.0	1.0
EC-4069	1/2	99	95	97	1.2	1.2	1.2
ME-3003	3/4	93	96	94	0.9	1.2	1.1
2,4,5-T butyl ester	1/2	93	89	91	0.1	0.3	0.2
2,4,5-T amine	1/2	76	88	82	0.2	0.1	0.2
LSD 5%		NSD		8	NSD		.3
1%				11			.4

Treatment date: June 9, 1953
Turf discoloration estimates: June 17, 1953
Clover control estimates: September 28, 1953

When the turf discoloration readings were made on June 17, it was noted that in some of the plots there were irregular areas where the turf was severely burned. This severe localized injury appeared predominantly on velvet bent turf, although in each injured plot there was also velvet bent that was not burned. Some replications of each of these treatments contained no burned areas. On July 24, about 5 weeks later, some of the burned spots noted in June had recovered, while others had not. There were no dead areas on any of the plots where ME-3001 had been applied in sand or where 2,4,5-T ester had been applied. At that time not more than a total of 3 square feet out of the 2500 square feet involved was dead.

From the practical standpoint we can summarize this experiment by noting that under our conditions (1) mowing putting green turf just prior to treatment had no effect on clover control or turf discoloration produced by any treatment; (2) the butyl ester form of 2,4,5-T was outstanding, producing significantly better clover control than the amine form and producing significantly less turf discoloration than any of the endothal treatments.

Experiment 3 - Time of Day

Purpose: To determine the effect of time of application during a day on clover control with endothal and 2,4,5-T on putting green turf.

Materials and methods

The experiment was located on the 5th green of the Dinsmore Golf Course in Staatsburg, N. Y. The green as a whole contained 29% clover. The experimental design was complete randomized blocks with four replications. Eight plots served as checks. Individual plots were 4 x 12 feet.

Four chemical treatments were applied at each of three time intervals. The four chemical treatments were ME-3003, 2,4,5-T (amine) and 2, 4,5-T (butyl esters) applied at $\frac{1}{2}$ pound active ingredient per acre and EC-4069 at $\frac{1}{4}$ pound endothal per acre, each in water at the rate of 50 gallons per acre. The time intervals and conditions for spraying were as follows:

June 16, 1953. 1:30 p.m.
Soil moist, grass dry, temperature hot, day clear, clover in diurnal position

June 16, 1953. 9 p.m.
Soil moist, grass starting to dew, clover in nocturnal position, temperature warm

June 17, 1953. 6:30 a.m.
Soil moist, grass wet, clover partially recovered from nocturnal position, day clear, temperature warm, followed by hot day

The green had been mowed on June 15 and was not mowed again until June 18. Turf discoloration estimates were made on June 26. On July 24 patches of dead turf were observed and data taken. Clover control estimates were made on September 28, 1953.

Results and discussion

The data in Table 3-A indicate that somewhat better results were achieved from each chemical when the application was made at 1:30 p.m. than from the same chemical applied earlier or later in the day, although the superiority of the 1:30 treatments did not attain statistical significance.

Table 3. Clover control on putting green turf with endothal and 2,4,5-T formulations applied at different times of the day

A. Clover control

Chemical	lbs./ acre	Per cent clover control — Time of Application: 1:30 p.m.	9:00 p.m.	6:30 a.m.	Average
EC-4069	1/4	71	58	58	62
ME-3003	1/2	79	75	74	76
2,4,5-T amine	1/2	84	68	70	74
2,4,5-T butyl ester	1/2	92	83	82	85
Average each time		81	71	71	
LSD 5%			NSD		14
1%					20

B. Turf discoloration (scale 0 - 4)

Chemical	Turf discoloration — Time of Application: 1:30 p.m.	9:00 p.m.	6:30 a.m.	Average
EC-4069	.7	.7	.3	.6
ME-3003	1.0	.6	.7	.8
2,4,5-T amine	.5	.4	.3	.4
2,4,5-T butyl ester	.5	.3	.6	.5
Average	.7	.5	.5	
F values: NSD				

C. Turf killed by the chemical treatments

Chemical	Dead patches, as % of plot area — Time of Application: 1:30 p.m.	9:00 p.m.	6:30 a.m.	Average
EC-4069	.3	.3	.3	.3
ME-3003	1.6	.0	1.0	.9
2,4,5-T amine	.0	.8	.3	.4
2,4,5-T butyl ester	.8	1.0	1.6	1.1
Average	.7	.5	.8	

Treatment date: June 16, 17, 1953
Turf discoloration estimates: June 26, 1953
Dead patches estimated: July 24, 1953
Clover control estimates: September 28, 1953

The four materials did not differ significantly in the degree of turf discoloration produced, nor did any produce discoloration that was considered objectionable (Table 3-B). Each material produced some dead areas of turf, with the ester form of 2,4,5-T the most severe in this regard (Table 3-C).

The same two formulations of 2,4,5-T were used in this experiment as in the previous trials concerning the effects of mowing (Table 2). The degree of clover control obtained with each was approximately the same in both trials. In both trials the 2,4,5-T ester was superior to the amine form so far as clover control was concerned and both forms produced scattered areas of dead turf.

Experiment 4 - Gallonage and 2,4,5-T

Purpose: To determine the effect of gallonage on clover control with 2,4,5-T amine and butyl ester formulations on putting green turf.

Materials and methods

The experiment was located on the 9th green of the Dinsmore Golf Course at Staatsburg, N. Y. The green as a whole contained 11% clover. The experimental design was complete randomized blocks with six replications. Individual plots were 4 x 20 feet. Six plots served as checks.

2,4,5-T amine and 2,4,5-T buytl ester were applied at the rate of 1 pound 2,4,5-T per acre in 25, 100, and 400 gallons of water per acre. The treatments were applied September 29, 1953. The soil was dry and the temperature was warm. A drought period was in progress. The green had not been mowed at least three days before application of the treatments, and two days after treatment it was mowed and watered. Clover control estimates and turf injury observations were made on November 12.

Results and discussion

The data in Table 4 indicate no significant differences in clover control between the ester and amine forms of 2,4,5-T nor between the amounts of water used. We have no acceptable theory as to why the amine form of 2,4,5-T in 100 gallons of water produced poorer clover control than any of the other treatments.

Table 4. Clover control on putting green turf with 1 pound per acre 2,4,5-T in two formulations, in 3 volumes of water.

	Per cent clover control			
	Gallons per acre			
Formulation	25	100	400	Average
Amine	93	81	89	87
Butyl ester	92	93	92	92
Average	92	87	91	
Formulation and gallonage LSD 5%				8.5

Treatment date: September 29, 1953
Clover control estimates: November 12, 1953

Casual visitors to these plots during October have reported to us that some treated plots were lighter green in color than others, but the specific treatments involved have not been identified, so it is not known whether the differences in color were due to different amounts of water or to the different formulations. On November 12, our first opportunity to revisit the plots, there were no noticeable differences between the treated and the check plots nor among the treated plots, although the spots where the clover had been killed appeared as noticeable bare patches.

Experiment 5 - Thatch Removal and Gallonage

Purpose: To determine the effect of thatch removal and gallonage on clover control with ME-3003 and 2,4,5-T amine on putting green turf.

Materials and methods

The experiment was located on the 8th green of the Willowbrook Golf Course near Cortland, N. Y. The green as a whole contained 27% clover. The green had developed thatch, a heavy surface layer of stolons, stems and undecomposed organic matter. Half of the green was heavily raked and mowed, at two different times, prior to the applications of the chemical treatments. To each half of the green 6 treatments were randomized in each of 4 blocks. Individual plots were 4 x 10 feet, with four plots serving as checks for the entire experiment.

The two chemicals used were ME-3003 at the rate of 3/4 pound endothal per acre and 2,4,5-T (amine) at 1 pound 2,4,5-T per acre, each being applied in 25, 50 and 400 gallons of water per acre. Treatments were made on September 18, 1953.

At the time of treatment the soil was moist, the temperature warm, and there was a slight dew on the grass. There was a heavy frost the night before the treatments were applied and cold nights followed. There was an all-day rain two days after treatment, followed by dry weather. The green was fertilized, composted, and spot seeded in early October. Turf discoloration estimates were made on October 8 and clover control estimates on November 17.

Results and discussion

The data in Table 5-A indicate that the degree of clover control was not affected particularly by varying the amount of water used in the application of a particular chemical nor were results particularly different whether or not the thatch was removed. Superifically ME-3003 appears to have produced greater clover control when the thatch was removed while with 2,4,5-T better control was obtained when the thatch was not removed, but in neither case were the differences statistically significant.

In none of the treated plots was there more than light turf discoloration, and variables in treatments had no particular effect on the degree of general turf discoloration.

The endothal formulation ME-3003 produced significantly greater clover control than the amine form of 2,4,5-T.

In general ME-3003 produced slightly greater general turf discoloration than the 2,4,5-T. The appearance of completely dead spots differed greatly depending upon whether 2,4,5-T or endothal had been applied. The 2,4,5-T produced no dead areas on the half of the green where the thatch had been removed; on the other half only two plots contained dead spots and these were relatively small. The ME-3003 produced numerous dead spots as recorded in Table 5-B. While there are no significant differences between the various treatments with ME-3003, the general trend was for increased dead spots with decreased gallonage and for more dead spots when the thatch was removed.

On the most seriously injured plot, the dead areas approached 5% of the area. Velvet bent appeared to suffer more in this regard than the creeping bent.

Table 5. Clover control on putting green turf with endothal ME-3003 and with 2,4,5-T (amine), with and without thatch removal and with 3 gallonages.

A. Clover control

	Per cent clover control							
Formulation	ME-3003 (3/4 lb./A)				2,4,5-T amine (1 lb./A)			
Gallons per acre	25	50	400	Average	25	50	400	Average
Thatch removed	87	91	90	89	70	68	59	65
Thatch not removed	84	86	77	82	72	78	65	72
Average (F value Sig. 1%)		86				68		

B. Turf killed by endothal (ME-3003) at 3/4 lb./A

	Dead patches, as % of plot area		
Gallons/A	Thatch removed	Thatch not removed	Average
25	3.8	2.5	3.1
50	2.6	1.9	2.2
400	1.8	2.0	1.7
Average	2.7	2.0	
F values: NSD			

Treatment date: September 18, 1953
Clover control estimates: November 17, 1953
Estimate of dead patches: October 8, 1953

Experiment 6 - 2,4,5-T Formulations

Purpose: To determine the relative effectiveness of 4 formulations of 2,4,5-T for clover control on putting green turf.

Materials and methods

The experiment was located on the 4th green at the Willowbrook Golf Course near Cortland, N. Y. The green as a whole contained 11% clover. The turf was composed of creeping and velvet bent that had developed a heavy thatch. Half of the green was raked heavily and mowed, at two different times, prior to the application of the chemicals.

On each half of the green, 4 treatments were randomized in each of 3 blocks. Individual plots were 4 x 20 feet. Three plots served as checks.

The four chemicals, each applied at the rate of 1 pound 2,4,5-T acid in 25 gallons of water per acre, were the amine, butyl ester, pentyl ester, and isopropyl ester formulations of 2,4,5-T.

The treatments were applied on September 18, 1953. At the time of the treatments the soil was moist, the temperature was warm, and there was a slight dew on the grass. There had been a heavy frost the night before the treatments, and cold nights followed. A heavy rain fell two days after the treatments were applied, and dry weather followed. The green was fertilized, composted, and spot-seeded in early October. Turf observations were made on October 8; clover control estimates on November 17, along with observations on turf conditions and growth.

Results and discussion

The data in Table 6 indicate that the isopropyl and butyl ester formulations of 2,4,5-T produced significantly greater clover control than the amine or pentyl ester forms. There were no significant differences in clover control due to thatch removal.

Table 6. Clover control on putting green turf with four 2,4,5-T formulations at 1 lb. 2,4,5-T per acre with and without thatch removal.

2,4,5-T Formulation	Per cent clover control		Average
	Thatch removed	Thatch not removed	
Butyl ester	83	89	86
Isopropyl ester	90	83	87
Amine	80	74	77
Pentyl ester	81	73	77
LSD 5%	NSD		7
1%			10

Treatment date: September 18, 1953
Clover control estimates: November 17, 1953

None of the treatments in this experiment caused turf discoloration or the appearance of dead patches. There were some differences in appearance in the plots, though none of these differences could be considered as turf discoloration. On October 8 it was noted that the plots treated with isopropyl ester were lighter green than the others, and the velvet bent in these plots was the more conspicuously so. On November 17, it was apparent that growth had been somewhat retarded by the isopropyl ester formulation, especially on the plots where the thatch had been removed. The plots where the pentyl ester and amine formulations had been applied were not different from the checks in growth or appearance.

The maximum growth took place where the butyl ester had been applied. It appears, then, that the butyl ester formulation was the most desirable of the four. While no real "burning" injury was caused by any of the treatments, the butyl ester was significantly better than the amine and pentyl ester formulations so far as clover control was concerned and it appeared to stimulate rather than retard the growth of the grass as did the isopropyl ester.

Summary

Considering the endothal formulations alone as used in these experiments it appears that their effectiveness as to clover control and turf injury was not modified by mowing just prior to treatment, by the time of day when the treatments were made, or by the removal of thatch prior to treatment. Increased gallonage with endothal formulations decreased turf injury without altering clover control. As anticipated from previous experiments, formulation ME-3001 was the most effective per pound of endothal used, followed by EC-4069 and then by ME-3003. It is clear that at least at certain seasons, the results from the use of endothal formulations on putting greens cannot be anticipated accurately. Experiments 1, 2, and 3 were all made in June on similar greens on the same golf course and over a relatively short period. In Experiment 1 there was rather conspicuous turf injury with relatively poor clover control (50% ±); in experiment 2, there was very good clover control (94%+), with less turf injury; and in experiment 3 the clover control was mediocre (70% ±), with the least injury of the 3 trials.

As with the endothal formulations, the effectiveness of the 2,4,5-T as to clover control and turf injury was not modified by mowing just prior to treatment, by the time of day when the treatments were made, or by the removal of thatch prior to treatment and, in the case of 2,4,5-T, we found that changes in gallonage did not alter results. Of the four formulations of 2,4,5-T used, the butyl ester seems the most desirable, for it usually produced the best clover control per pound of active ingredient, the turf injury was usually about the same, and at least in September treatments it appeared to stimulate growth of the grasses rather than having a neutral or retarding effect as did the others. In general, 2,4,5-T has not produced the degree of clover control we would have expected from the same applications to fairway and lawn turf.

After considering the results of these six experiments, we feel that we have not demonstrated that a single application of either endothal or of 2,4,5-T is a sure and effective measure for clover control in putting greens. Under the best circumstances either may produced a marked reduction in clover during the current season, but clover control has not been nearly complete in any instance, and we have no way of forecasting the durability of clover control during the next year. Whenever either material is applied to putting greens at our rates some turf injury is likely to follow, with the damage from endothal usually more serious than that from 2,4,5-T. While the risks involved might be acceptable on lawns and fairways, they seem too grave for putting greens in active use during the golfing season.

We have not investigated the possibilities of small amounts of 2,4,5-T (say $\frac{1}{4}$ lb. acid per acre) in several successive applications, but on the basis of what we have seen thus far we would suggest that for serious infestations of clover in putting greens the first effort should be several seasons of adequate maintenance, with particular emphasis on adequate turf fertilization. Only if such measures prove inadequate would chemical treatments seem justified. Of these, a late fall application of 2,4,5-T butyl ester at the rate of 1 pound 2,4,5-T per acre would seem the best choice so far as possible clover control, minimum turf injury, and the opportunity for turf repair are concerned.

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THE USE OF OIL SPRAY TO CONTROL WEEDS IN CONIFEROUS SEEDBEDS

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The use of a naphthalic oil to control the weeds in coniferous seedbeds has become an established practice. The practice stems from the use of a similar oil product in controlling weeds in the carrot fields of California. One channel to the present use went first from the carrot fields to the guayule culture in California during the war years. The Federal foresters working on this project, carried the idea later to their own coniferous seedbeds. The writer's contact came through an idea received directly from the use of oil in the carrot field, when in the early post war period a problem of weed control was critical due to conditions created during the war period. Namely, an accumulation of billions of weed seed in the established nursery areas caused by the abandonment of these areas during the war. Trees could not be grown without the almost prohibitive task of hand weeding. This problem was met and solved by the use of oil sprays.

The effectiveness of this use and practice is basically due to the selective action of the oil. Practically all troublesome weeds including the grasses are readily killed by the oil, while the conifers at all ages are highly resistant. The oil when applied correctly and lightly will not damage germinating seedlings, but will readily kill those germinating weed and grass seedlings. The resistance of the conifers continues throughout their lives in the nursery, with the exception of some burning when the new growth is present. At this period lighter applications become necessary.

This resistance is evident in all conifers. The larch species, which are deciduous conifers show the least resistance and great care must be exercised in the use of oil on them. Where hand labor is available the oil is not used with this species.

The oil kills most all deciduous plants, this includes the so-called hardwood trees and shrubs. Therefore, the oil cannot be applied to the stems and foliage of these species. It is used, however, as a pre-emergence spray with favorable results.

The oil used, is chemically a naphthalic aromatic hydrocarbon, which is known by such various names as Stoddart solvent, dry cleaning solution and mineral spirits; and by such trade names as Sovasol, Varsol, Stanisol, Ohio Weed Killer, etc. The effectiveness of this material is that it makes rapid penetration into the tissues of non-resistant plants, but evaporates rapidly, leaving little residue. It has been used now for at least eight years without showing any accumulated effects in the soil. The oil is applied in the pure state. Tests with water emulsion did not prove effective and damage was noted where the materials were carried into the soil making contact with the tree roots. The pressure used in the application is held below 100 pounds per sq. in. to keep at a minimum the evaporation of the material.

The variations among these products is due mainly to its crude oil source, in that this effects the aromatic content. This may range in the normal product from 15 to 30 percent.

There has been some question as to the relation of this content to the kill of weed species. Tests made by the writer this past summer with two products, with three different aromatic contents, indicate a good correlation between the percentage of aromatics and the kill of several weed species. For instance in practice, it would appear that it would take one half again as much oil to obtain the same effect in using a 17% content, as it would a 27% product.

There is evidence to the effect that these products deteriorate in storage and become more toxic to coniferous seedlings.

The rate of application would depend upon the aromatic content, along with the age and growth stage of the trees. The rate used for a 27% aromatic content product varies from 20 to 40 gallons per acre. The lower rate for germinating seedlings and when tender new growth is evident. The high rate is used later in the growing season in each case.

Of equal importance to the rate itself is the method of application. The material must be applied mechanically and with the proper adjustment of the booms of the sprayer, so that the rate wanted is actually applied evenly.

The number of applications may vary, but during the weed growing period from early spring to late summer application should be made by the calendar every two weeks. This is based upon the writer's experience. When the weed crop is evident, it is then generally too late for effective spraying. The greatest damage occurs on the weeds that are unseen or nearly so.

When the weeds have developed to that stage that they are very evident and as large as the trees themselves, the rate of spray needed is usually too much to avoid tree injury.

Fortunately, weather conditions do not effect greatly the application of these oils. There is a plus or minus in the effectiveness with various weather conditions but they are not critical, so the application can be made at most any convenient time. The greatest handicap in weather is the wind, which prevents application being made at times. A curtain protection over the spray boom is partly effective against the wind.

This is one venture in weed control that really works, as attested to by its use for many years in coniferous nurseries throughout this and other countries. Its real success comes with its bold application, with certain fundamental practices adherred to. Those for emphasis and summary are, the proper rate regularly applied, with a controlled application of a known product.

Nov. 18, 1953

(For presentation at the Northeastern Weed Control Conference, Jan. 5-7, 1954, in New York City.)

The Use of Silvicides to Establish White Pine by Natural Reproduction

by

Clifford H. Foster

Forestry began in this country a little over half a century ago, as a crusade to reforest cut over, burned over, and abandoned agricultural lands. The first foresters were trained in Europe. They quite naturally brought to this country many European ideas as well as trees. The idea of planting trees was transplanted into the American public mind as the solution of the forestry problem. Furthermore, the old crusaders stressed the point that it was the patriotic duty of all good citizens to plant trees. They promised that trees would grow literally anywhere, with little or no care, especially on poor farm land. In 25 years or so, and with little effort or expense, a substantial crop of timber would be produced at the very time when wild timber would be consumed.

For fifty years we have been reaping the crop of ideas sown in those early days. The public still thinks that tree planting is the solution of the forestry problem. In spite of all the plantation failures, it is difficult for foresters today to interest landowners in cultivating natural reproduction.

White Pine is the finest conifer of Northeastern North America, and at its best, possibly the finest, most useful and most beautiful softwood lumber of the world. Yet, in spite of its having been planted on a great many thousands of acres, year after year, over a very wide range of sites and conditions, there are relatively few acres of good, promising 20 year old plantations of this fine tree today. We may yet learn how to consistantly grow White Pine by planting. Certainly we have learned the hard way that it is both difficult and expensive to grow White Pine of fine quality in plantations.

Relatively little high quality White Pine has been grown in pure stands originating from natural reproduction. The reason for this is that very few such stands have been cultivated. When permitted to grow in a wild, unt ded condition, the large coarse limbed trees dominate and crowdout the potentially fine quality, straight, small limbed individuals. Where proper selective cutting has been practiced, fine White Pine trees can be grown to large size in a relatively short time. Average annual growth of 1000 board feet per acre of the finest quality White Pine can be expected on good sites over a long rotation of 125 to 150 years. Such timber crops demand serious financial consideration. The Gross stumpage value of 1000 board feet of high quality White Pine in a good location at present prices may well exceed $50.00 per acre annually. Long term investments in such a crop cannot long be ignored in a timber hungry country.

Twenty-five years experience at the Pack Forest at Warrensburg, N.Y. has convinced me that White Pine can be successfully grown from natural reproduction, if seedlings can be established and be kept free from domination by hardwood weeds for 10 years. The most common causes of death, deformation and poor development, so prevalent in White Pine plantations, can be avoided or greatly minimized in properly managed stands originating from natural reproduction.

White Pine is a prolific seeder. Trees with good crowns bear cones every third year. Seed are scattered several hundred feet by the wind, mostly to the south and east. Experience shows that under reasonably favorable forest conditions, a substantial proportion of these seed germinate. Weakened by excessive shade, root competition, and other factors, however, most of this natural reproduction dies out the first or second winter. Broad leafed seedlings and saplings on the forest floor are usually the immediate cause of death of the young pine reproduction. Their easy and cheap elimination is the key to successful establishment of a dense new crop of White Pine.

Hardwood weed destruction by mechanical methods has been practically impossible, except on the driest sites where growth is poorest for both pines and hardwoods. Grazing has been successfully applied by farmers in Maine and New Hampshire to keep the hardwood weeds in check until the pine is finally established. There are so many practical difficulties entailed in grazing that there seems to be little hope that this means will be widely applied. Therefore, when chemicals were developed capable of completely killing both the stems and root systems of most hardwoods, it became clear that a new means of cultivating the forests had come into existence.

Although the Pack Forest is primarily a demonstration forest, some experimenting and research work is undertaken to test new methods, to improve their efficiency, to learn how to do those things which can only be learned by trial and error. We operate according to our best understanding of what should be done, and how to do it. The idea is that others will be able to learn from us what to do and how to do it. Only those methods are applied which are considered to be practical and economical. If and when timber growing becomes a feasible and desirable undertaking, which seems inevitable, it is our purpose to be a number of years ahead of the demand for know how. Thus our experience should facilitate the applications of effective forestry in this country.

We started experimenting with silvicides in the fall of 1948. The first extensive field test was made in June, 1949, on an area of about six acres of White Pine reproduction, averaging about knee high, partly suppressed by a light cover of the common Northern and Central hardwood species. A foliage spray of 24D Esterone, 4 ounces in 5 gal. of water, was applied to the point of run off, using an Indian pump can equipped with a spray nozzle. By fall, the results were definitely not encouraging. One year later, the general aspect was better, and, two years later, still better. Many of the hardwoods had been killed. Some had been stunted while some had not been appreciably effected. No significant permanent damage was done to the pine seedlings, although it was thought at first that they had been damaged, because of the temporary distortion of the new growth. The significant fact was that after treatment the growth of the White Pine reproduction quickly accelerated--while that of the hardwoods declined. The spraying had turned the tide, and made the situation manageable.

In the fall of 1950, with a ripe crop of cones on the trees, another study area of some 15 acres was selected for testing the use of chemicals in securing White Pine reproduction. This area was typical of many thousands of acres of poorly stocked mixed second growth in the Northeast, There were, in fact, so few trees of good species, of good form and in a healthy condition, that, literally, no kind of silvicultural practice or conservative management could conveivably have resulted in the production of more than a negligible amount of reasonably good lumber on this area in more than 50 years. There were, however, enough White Pine seed trees, even though of poor form and quality, to seed the area. It was decided to proceed to treat half the area, and to retain the other half for a later test, using different timing in the next seed year to come.

The first step was a basal stem treatment of all hardwoods from small seedlings to pulpwood size, using a mixture of 1 part 245T, and 38 parts of fuel oil, applied in October. All saw timber trees, other than those desired for shade and protection, were cut during the winter of 1950 and spring of 1951. Early in June of 1951, the smaller hardwood pulpwood was girdled and treated with Sodium Arsenite as a test of chemical debarking.

The White Pine seedlings germinated in June in sufficient abundance to stock the entire area. These developed very well during the summer of 1951. By August, certain groups were being overtopped and dominated by raspberry, blackberry, fire cherry, and many of the light loving species which follow heavy cutting. By the latter part of June 1952, this over topping vegetation was causing alarming suppression of the pine seedlings in groups representing perhaps half of the area. It was decided to apply a foliage spray of 245T in water (1 part to 200) at ance. This was done with an Indian pump can, spraying lightly those groups where the pine seedlings were completely buried.

This operation was accomplished quickly and inexpensively, at a cost of less than $2.00 per acre. Within 2 weeks practically all the broadleaf foliage--woody, annual and perennial, was curling up and dying. The White Pine seedlings stood out where they could be seen once more. The spraying had no appreciable adverse effect on these 2 year seedlings, then 4" - 6" in height. By fall these released seedlings had had a chance to harden, to better resist the freezing winter. The unsprayed portions had thickened up with vegetation by fall.

During the fall the Arsenite treated pulpwood was cut and removed. The tops of these trees were mostly dead, but the stumps had sprouted. The removal of the pulpwood caused some damage, some reproduction was buried up with brush, and, later, more weeds germinated where the soil had been disturbed. It was therefore decided that on the other half of the study area, to remove all merchantable material before germination took place.

During the summer of 1953, the area again became heavily covered with weeds--tree, shrub and herbaceous. The unsprayed portions of the area were supporting 3 year old woody weeds as well as White Pine seedlings. On some of the very lightly sprayed spots, raspberry and blackberry had sprouted from the roots, and were becoming quite large. It was therefore decided to give the area a general spraying in early August, and retain an unsprayed area as a check. This was done, using a home made gasoline powered spraying unit mounted on a Jeep puck-up truck. The spray was applied in this case at the rate of 50-75 gal.(1 part 245T in 200 Parts of water) per acre, in the belief that the pine could take it. The result as viewed in the fall appeared to be very satisfactory. The pine seedlings showed very little effect from the 245T. The hardwoods had been killed or severely damaged. It should here be noted that as the result of this and other experiments, the middle of August appears to be the most favorable time for selective killing of hardwood weeds, with the least damage to White Pine. It is not yet known how soon another treatment will be necessary.

It can be said with confidence that without chemical treatment, there would be few pine seedlings alive and thrifty on the area today. It seems quite likely at this time that these two selective sprayings will be sufficient to permit the pine seedlings to reach a height of two or three feet in the next three years. The next weeding will probably be a basal stem treatment, exactly when, is not yet predictable.

This experiment covers but one typical case of the use of silvicides in securing White Pine reproduction. Every site class, soil type and forest type presents a somewhat different problem, calling for different timing and a different sequence of treatments. The treating of moist sites will be different from that of dry sites, since the woody weed species and their aggressiveness will differ. Much experimenting must be done to determine the most effective and economical applications to cover the conditions likely to be met with on one forest. Throughout the range of a species like White Pine, a great deal of experimenting is indicated.

There are several related studies in progress, or in prospect, at the Pack Forest, employing the use of silvicides in connection with the establishment of natural White Pine reproduction, all of which have broad application. On certain lots, cut in seed years, there are often groups of one to many acres of over topped pine seedlings, which could be saved if released in time. Especially where suppression has been severe, and where mechanical weeding would be futile, the use of chemicals seems highly promising. We have several such areas under treatment. In these situations, mechanical releasing would give only one growing season of partial relief, followed by even more severe suppression than if no cutting were done. Basal treatment with chemicals, by reason of complete killing of the root systems, as well as the tops of the hardwood weeds, gradually and completely releases the White Pine.

Another study is in progress, aimed at determining the best method of securing natural reproduction under White Pine stands which have been intensively managed for twenty years or more. Previous selective cuttings and thinnings have intensified the development of advance growth hardwoods. The dense understory of small hardwoods is effective in preventing the development of White Pine reproduction, especially on the heavier soils and moist sites. It appears to be the low shade and root competition of the hardwood understory, rather than the high shade of the overwood, which discourages or prevents the establishment of White Pine reproduction. White Pine seedlings are known to be quite shade tolerant during the first years. This series of experiments is to determine the effects of chemical elimination of the advance growth hardwood, testing the use of 245T, both as a foliage spray in water, and basal application in fuel oil. In these experiments it is planned to retain the overwood as it is, with varying degrees of density, in order to find out the effect of the overwood alone upon the establishment and development of the reproduction. There is much evidence at hand to indicate that, in spots where hardwoods are not present, White Pine reproduction develops well under a fairly heavy overwood. These experiments will furnish a comparison with the conventional shelterwood methods. The more gradual treatment will not excite the germination of the light loving species which are so aggressive when 50% or more of the overwood is suddenly removed. It is quite possible that this method may be especially desirable where the overwood is made up of a substantial number of good trees.

Only by intensive cultivation can we produce for future use relatively cheap, high quality timber--especially White Pine. Long experience discloses marked advantages of growing this tree from natural reproduction, rather than in plantations, especially where fine quality timber is desired. The success of growing White Pine from natural reproduction is fundamentally dependent upon the effective elimination of hardwood weeds which develop in large numbers under nearly all stands where White Pine grows. Until chemicals were developed, which have lately proved to be highly effective in completely killing nearly all hardwood weeds, there was literally no practical method of destroying them. Now it appears possible to secure natural reproduction in most situations where White Pine seed trees are growing on favorable sites. Silvicides seem destined to play a critical part in converting vast areas of forest land from a wild to a cultivated condition. How soon this may happen, only time will tell. Much will depend upon the imagination, skill and perseverance of our silviculturists and chemists, and the success of their efforts.

PROGRESS REPORT ON THE CHEMICAL CONTROL OF HARDWOODS AT THE HARVARD FOREST 1/

Mechanical weeding or cleaning to favor selected trees by cutting back others has been used for many years to regulate the composition, form, and growth of young forest stands. The results of this silvicultural technique on hardwoods, however, have been discouraging. The natural sprouting capacity of most of our hardwood trees lowers the feasibility of mechanical weeding because such weeding is costly and must be done repeatedly.

In 1950, as a part of a cooperative research program within the Department of Biology of Harvard University, David P. Hackett 2/ began some chemical weeding experiments at the Harvard Forest. These experiments were designed primarily to investigate the following: the effectiveness of hormone-like chemical compounds for inhibiting the growth of specific local hardwood trees; the effectiveness of different carriers for the compounds; the amount and concentrations of the chemical required; and the method of application.

The information derived from the experiments indicated that it was possible to kill the stems of the common hardwoods of this region with basal sprays of either 2,4,5-T or a mixture of 2,4,5-T and 2,4,-D in solution with kerosene. Furthermore, effective kill could be attained with concentrations as low as 1 and 2 percent 3/ if the basal spray were applied properly.

When Dr. Hackett made his report to the Weed Control Conference in December, 1951, he had seen his experiments through two growing seasons after treatment. Single stems and clumps of sprouts sprayed in the early spring of 1950 had not put out new shoots. Dr. Hackett again checked his original plots in the late summer of 1952, after a third growing season. His figures for kill remained essentially the same as those of his report to the Conference. At the present writing, after a fourth growing season, the percentages are still unchanged, and the sprout clumps sprayed early in the 1950 season still have not resprouted.

With this information at hand or accumulating, further investigations were undertaken at the Harvard Forest in 1952 to determine the feasibility of using a basal spray of 2,4,5-T more extensively and under a variety of forest conditions. These experiments were designed to compare the costs and effectiveness

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1/ The present paper was prepared by those members of the staff of the Harvard Forest who were most concerned with follow-up experiments begun in 1952. The layout and conduct of the work were in charge of Mr. Earl P. Stephens, Research Associate, and Dr. Ernest M. Gould, Jr., Forest Economist and Lecturer on Economics. Mr. Herschel G. Abbott assisted with the field work.

2/ Hackett, David P. Experiments on Chemical Control of Hardwoods in Northeastern Forests. (Proceedings of Northeastern Weed Control Conference, New York, N. Y. 1951.)

3/ Total acid equivalent (TAE) by weight.

of mechanical and chemical weedings when both were applied by regular woods workers to similar areas under comparable conditions and with the same objectives. The present paper is a progress report on these experiments.

Equipment

The chemical weedings were done with commercial spraying equipment which consisted of the Myers New Idea Sprayer 4/, capacity 4 gallons, fitted with neoprene spray-resistant washers and hoses. Straight brass extension pipes or wands 34 inches long were attached to the pump hose. Graduating-type spray nozzles, Myers No. 6690A, were used. A 2.05 percent solution of Esteron 245 5/ and kerosene was the spray applied. This was trucked to the job in a 55-gallon drum and put in a convenient place for refilling the backpack pumps. Three-pound single-bitted axes were used for the mechanical weedings.

Labor

The weedings were applied by three members of the Harvard Forest woods crew. The oldest of these, 62 years of age, had had many years of woods experience. Each of the younger men, age 30, had worked in the woods for three years. All had had experience in mechanical weeding, but none of them had done any chemical weeding. The experiments were explained to the men who then did one day's practice work under supervision. During this time they became familiar with the equipment and learned what was expected of them.

Weeding Procedure

The weedings were conducted from May 5 through May 29, 1952. At the beginning the hardwoods were bare of foliage, the leaf buds just starting to elongate; toward the end, the trees were in full leaf. The chemical weedings were done by basal spraying. The men were instructed to wet thoroughly the entire surface of the lower 8 to 10 inches of each bole so that the spray would run down around the root collar. In the mechanical weeding the trees were cut off completely at a convenient height, usually 2 feet or less above the ground.

Simple instructions, requiring a minimum of interpretation, as to the kinds of trees to be treated were issued for each area. In general, the men moved across the areas three abreast, working at intervals that would give complete coverage. Since there was not available a method for marking the multitude of small trees as they were sprayed, the men used any physical features of the land that would serve for orientation: stone walls, roads, topography, and transect lines which had been established for the purpose of sampling.

4/ The F. E. Myers and Bros. Co., Ashland, Ohio. New Idea Knapsack Sprayer (No. 1330AX). Cost in Worcester, Mass. -- $32.45.

5/ Esteron 245, Dow Chemical Co., Midland, Mich. Solution was prepared by mixing 2-1/2 gallons of 2,4,5-T in 50 gallons of kerosene.

Input and Cost Factors

The labor input recorded for each area treated is the number of man-hours actually spent working on each lot. Travel time to and from the area, lunch stops, and work losses due to accidents are not included because these factors will be different for each crew and locality operated. These factors should be allowed for in converting man-hour labor figures to equivalent man-days of work.

The amounts of spray used on each area were measured in two ways. A record was kept of the quantity taken to the job each day and the amount brought back at the end of the day. A running record of the amounts drawn off by each man was also kept as a check against total consumption.

Labor and spray inputs were converted to costs by multiplying these quantities by the current wage rate or the prices paid for spray materials. Labor cost $1.20 per man-hour, Esteron 245 cost $12.90 per gallon, and kerosene 15.3 cents per gallon, so that the spray mixture put on the trees cost 76 cents per gallon.

Treatment of the Stands

Three wooded areas including about 33 acres were weeded, 21 chemically and 12 mechanically. One area consisted of a 14-year-old plantation of white pine competing with hardwoods. Another area supported a 9-year-old stand of seedling and sprout hardwoods. The third area was characterized by a 14-year-old mixed stand of natural white pine and hardwood seedlings and sprouts.

Each of the stands was divided into two parts as similar as possible in every respect except acreage. Both parts of each stand were weeded, one chemically and the other mechanically. The silvicultural objectives of the treatments, and the instructions for them, were the same within each stand but different for each of the three stands.

14-year-old White Pine Plantation

On this area of about 7 acres, a 50- to 60-year-old stand of old-field white pine and hardwoods had been clear-cut in 1935. The area was planted in 1938 with white pine at a spacing of 4 x 5 feet. Immediately before planting the most vigorous hardwoods were cut back. By 1944 the pines were being suppressed severely by hardwoods. A mechanical weeding was applied which released all of the pines from overtopping hardwoods.

By 1952, the hardwoods were competing again with the pines and in many instances overtopping them. The principal hardwood species were red maple, black oak, and gray birch. There were approximately 5,700 stems per acre 1/2 inch and larger in diameter at breast height, about 2,000 of which were white pine. About 1,200 of the hardwoods were in sprout clumps, each consisting of three or more stems. There were approximately 280 such clumps per acre. The hardwoods ranged in d.b.h. from 1/2 to 5 inches, the majority being in the 1/2 and 1 inch classes. Their heights were from 5 to 15 feet, with an average of about 8 feet. The pines ranged in d.b.h. from 1/2 to 5 inches, the

2-4 inch classes being the most numerous. Their heights were from 5 to 15 feet, with an average of about 12 feet. The plantation was densely stocked and had never been pruned. As a result, it was very difficult to move about in the area, especially with a knapsack pump.

The silvicultural objective on this area was to release the crowns of the pines from the competition of the hardwoods. The men were told to cut or spray all hardwoods 1/2 inch d.b.h. and larger.

The inputs and costs of the weedings per acre were as follows:

Mechanical weeding:		
14.32 man-hours input @ $1.20		$17.18
Chemical weeding:		
4.88 man-hours input @ $1.20	$5.86	
8.3 gals. solution input @ $0.76	6.31	
		$12.17

<u>14-year-old Mixed Stand of Natural White Pine and Hardwoods</u>

This stand of about 9 acres had followed the clear-cutting of an 80-year-old mixed stand of old-field white pine and hardwoods that had been severely damaged by the hurricane of 1938. In 1952 the stand had about 2,800 stems per acre of which approximately 800 were white pine. The most common species of hardwoods were red maple, gray birch, red oak, white oak, and fire cherry. The pines were generally distributed over the area with a small group occurring occasionally. Many of them were being overtopped by hardwoods. The hardwoods were from 1 to 6 inches d.b.h., the 1 and 2 inch trees being the most numerous; their heights ranged from 5 to 20 feet, averaging about 10 feet. The white pines were mostly 1 and 2 inches d.b.h. but ranged up to 5 inches, while their heights ran from 5 to 20 feet, with an average of about 8 feet. The stand was open enough to permit the men to move about easily as they chopped or sprayed.

The objective was to release the crowns of the white pines from hardwood competion. The men were instructed to cut or spray those hardwoods that were overtopping the pines and also those that were at least as tall as the pines and in immediate contact with the crowns of the latter. The hardwoods in this class numbered about 860 stems per acre. About three acres were mechanically weeded and almost six acres chemically weeded.

The inputs and costs of the weedings on an acre basis were as follows:

Mechanical weeding:		
4.27 man-hours input @ $1.20		$5.12
Chemical weeding:		
2.21 man-hours input @ $1.20	$2.65	
3.36 gals. solution input @ $0.76	2.55	
		$5.20

9-year-old Stand of Seedling and Sprout Hardwoods

This area of about 17.5 acres had a stand of seedling and sprout hardwoods which followed the clear-cutting in 1943-44 of a 40- to 50-year-old mixed stand of hardwoods and white pine. This stand had been severely damaged by the hurricane of 1938. The principal species were red maple, red oak, gray birch, and paper birch. There were approximately 5,700 stems per acre ranging in size from 1/2 to 5 inches d.b.h. and 5 to 20 feet tall. Most of the trees were 2 inches and less in d.b.h. Half of the stems were members of sprout clumps of three or more stems each. There were about 500 such clumps per acre. The trees of seedling origin were generally smaller than those of sprout origin. The large number of sprouts in some of the clumps made the latter difficult to treat.

The objective was to up-grade the quality of the stand by eliminating the coarse sprout clumps. The men were told to cut or spray every sprout clump that had three or more stems. Mechanical weeding was applied to about 5.5 acres, and the remainder of the stand, about 12 acres, was weeded chemically.

The inputs and costs of the weedings per acre were as follows:

Mechanical weeding:

4.96 man-hours input @ $1.20		$5.95

Chemical weeding:

2.01 man-hours input @ $1.20	$2.41	
5.49 gals. solution input @ $0.76	4.17	
		$6.58

Table 1. Characteristics of the Stands Treated

Stand	Area acres	No. of Stems per Acre: White Pine	Hard-woods	Total	Basal Area per Acre sq. ft.: White Pine	Hard-woods	Total	Area Weeded acres: Mechan-ically	Chemi-cally
14-yr.-old white pine plantation	6.74	2,016	3,679	5,695	50	21	71	3.31	3.43
14-yr.-old mixed stand of natural white pine & hardwoods	9.12	815	1,991	2,806	9	25	34	3.16	5.96
9-yr.-old stand of seedling & sprout hardwoods	17.42	—	5,689	5,689	—	37	37	5.59	11.83

Discussion of Inputs and Costs

With these three cases in mind, what can we say about how the inputs and costs of basal spraying compare with those of mechanical axe weeding? We must agree that these three cases alone do not provide any solid final measures of relative cost. However, we can draw some tentative conclusions or working hypotheses that will serve as a basis for further work.

First, let it be said that the axe weeding, serving here as a datum plane for comparison, was done with somewhat better than average efficiency and dispatch. In our experience it would be very difficult greatly to reduce the amount of labor used per acre. This is not necessarily true of the chemical weeding. It seems likely that fairly substantial savings could be made by improving spray techniques, or greater efficiency could be achieved with about the same input of labor and materials per acre.

With the techniques used, basal spray weeding took about one-third to one-half as much labor per acre as axe weeding. Working time per acre spraying varied from 2 to 5 man-hours. The fact that spraying requires less work may be significant in areas with relatively high wage rates or on lands with a limited amount of labor. It should be possible for the same crew to cover more ground spray weeding than they could in the same time with axe weeding.

From about 3 to 5 gallons of spray mixture were used to weed an acre of the natural stands. About 8 gallons per acre were used in the plantation. At the price paid for Esterone 245, kerosene, and labor, spraying materials made up about half the cost of chemical weeding.

In general, the total dollar cost per acre of chemical weeding was about the same as that of axe weeding. This fact, of course, could be changed through the reduction of inputs by developing a faster spray technique, or lowering the percentage of Esterone 245 used in the spray mixture, or by reducing unit costs with a cheaper carrier, or by less expensive labor or chemicals

Finally, we must qualify the relative costs per acre of chemical and axe weeding by the effectiveness of each method in reaching the silvicultural objectives.

Discussion of Silvicultural Effectiveness

The extent to which the mechanical and chemical weedings achieved the stated silvicultural objectives can be only partially assessed at this time. The two methods were applied with approximately the same efficiency of coverage. The mechanical weedings on the three areas resulted in 100 percent, 63 percent, and 100 percent coverages, while the chemical counterparts resulted in coverages of 96 percent, 73 percent, and 96 percent.

On the other hand, the effects of the treatments varied greatly. The mechanical weedings brought the immediate release of the crowns of the trees favored. In contrast, the chemical weedings caused a gradual release of the favored trees. This release appeared to be slight during the first growing season. However, many of the smaller trees favored by the mechanical weedings were overtopped by new sprouts during the first and second growing seasons following treatment. This was especially true on the areas of the 14-year-old natural stand and the 9-year-old hardwood stand. Thus the results of the chemical weedings could not be assessed after the first growing season. After the second season, on the other hand, the crowns of 40 to 60 percent of the trees sprayed were apparently dead, while 8 or 9 percent had one-third live crown remaining, and 30 to 50 percent two-thirds. Even though about 29 percent of these trees had sprouted since being sprayed, the sprouts were extremely low in vigor and did not seem capable of competing seriously for crown space with the selected trees.

In spite of lower percentages of kill than those attained in Dr. Hackett's experiments, our more recent and extensive treatments show results that are very promising indeed. The effectiveness of mechanical weeding, though immediately pronounced, disappears quickly as it has long been known to do in our region. The basal spray treatments, on the other hand, in light of Dr. Hackett's and our more recent work, though a little slower to take effect, bid fair to remain effective for several years — long enough for the favored trees to get ahead of their undesirable neighbors. We are inclined to credit the lower percentages of kill in our recent experiments not so much to lack of effectiveness in the chemical as to lack of efficiency in its application.

Suggestions for Further Development

One fact seems clear from this second set of experiments with basal sprays at the Harvard Forest. The greatest opportunity for improvement in chemical weeding efficiency and cost seems to be by insuring that each stem is treated properly and completely. This should greatly increase the silvicultural effectiveness of chemical sprays as a tool for weeding. Using the present techniques, we got about as good coverage with sprays as with axes, but only about half of the sprayed stems were completely killed. It seems likely that this kill could be increased by a series of coordinated developments.

Something can be accomplished by better training and instruction for the men, but before this can be effective better spraying equipment and techniques for applying the spray should be developed. The men ran into several problems and difficulties in the field that could be eliminated to make basal spraying easier and more effective. Several improvements could be made in the equipment:

1. Four gallons make too heavy a load for all-day work. A two- or three-gallon load is probably better.

2. The back-pack pump should be tight so that it will not spill over the top when the men duck around through the brush.

3. A more comfortable back-pack carrier would be a great help. The tank could be mounted on a canvas-covered pack board or on an aluminum rucksac frame to prevent its digging into the back.

4. There should be a minimum of protrusions from the tank that can catch on brush and limbs. The pump mechanism was particularly troublesome. A tank that did not

require constant pumping would be desirable. One that could be completely emptied after one charge of compressed air would perhaps be best.

5. A trigger release mechanism that did not clog easily would lead to less dribbling, better maintenance, and a greater economy of spray.

6. A spray nozzle attached to the brass extension pipe at a 90° angle would make it easier to wet the stem all the way around.

With the above equipment changes, a means of coloring the spray so that it would stain the bark some bright color would speed up the work. This would serve several purposes; it would make it easier to tell what had been treated, how thoroughly it had been covered, and would give the men a feeling of accomplishment that is lacking with a simple kerosene spray. After a hard day's work a man cannot see that he has done anything because there is not a mark to show what he has sprayed. If the color lasted, it would also help later in assessing the efficiency of coverage and the thoroughness of the treatment of individual trees.

A closely related need is to find efficient methods for laying out an area for treatment. Strings or painted lines might be used to divide it into convenient work units for individual men or for the crew. This would save time, provide a feeling of accomplishment, and promote better coverage.

The men should be thoroughly trained in the use of these improvements in equipment and technique. It would also help to explain how the sprays work. If woods workers think of these chemicals as "poisons," they are likely to overrate their effectiveness. They may feel that even a little bit is enough to kill a tree.

With the above developments it seems reasonable to anticipate about as good a coverage by basal spraying as with axe weeding, and a very high percentage of spraying kill. It also seems likely that comparable weeding could be done with about three-fourths as much labor as we experienced in these experiments. However, this saving may be offset by using more spray to get proper treatment, so that the relative costs of chemical and axe weeding would remain unchanged. With a technique that insured proper treatment of each stem, however, it might be feasible to reduce the percentage of Esterone 245 to 1 percent. At present prices this might lead to savings of about 20 percent in the cost of chemical weeding.

The two sets of experiments carried out at the Harvard Forest seem to indicate that basal sprays with 2,4,5,-T or mixtures of this with 2,4,-D in oil form an exceedingly promising silvicultural tool. We have only begun to explore the ways in which this tool can be incorporated into our thinking about forest production. It is difficult to assess the importance of the innovation, but the preliminary results seem well worth following up vigorously.

Table 2.

Comparison of Effectiveness

Hardwood Stems

Acre Basis

			1952		1953			
			Mechanical	Chemical	Mechanical	Chemical--Percent of treated stems		
Stand	No. of stems	No. of stems to be treated	Percent cut	Percent sprayed	Percent of stems sprouting	Apparently dead *	1/3 live crown remaining	2/3 live crown remaining
14 yr.-old white pine plantation	5,695	3,679	100	96	100	60	8	32
14 yr.-old natural white pine and hardwoods	2,806	860	63	73	100	60	8	32
9 yr.-old hardwoods	5,689	2,850	100	96	100	44	9	47

A PROGRESS REPORT ON THE CONTROL OF HAWTHORN

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A practical method for the control of hawthorn (Crataegus spp.) would be of great value in many areas of Ontario. The results attained by the use of certain hormone-like chemicals suggest that a chemical method of eradication would often assure worthwhile savings in capital investment and greater efficiency in the use of labour. Investigations have therefore been conducted each year since 1946 by members of the department to devise more efficient methods of chemical control.

Previous reports have described work on stage of growth and its influence on the success of foliage applications, (1) & (2) and also on basal bark treatments applied during the growing season, on the relative value of oil and water as carriers for basal bark and stump treatments, and on a series of rates ranging from 1 percent to 10 percent acid using 2,4-D esters, 2,4-D/2,4,5-T ester mixtures, and 2,4,5-T esters (3). These earlier studies did not consider the effectiveness of applications made during the fall, winter, and early spring and included relatively few trees per treatment. A more comprehensive study was started in the spring of 1952 which included applications at monthly intervals through one year and used a larger number of trees for each treatment.

The area used for the main part of the experiment consisted of an alluvial flat along the Nith River south of Haysville (near Kitchener, Ontario). The open areas were used by the farmer as "permanent" pasture. The hawthorn cover was comparatively uniform and a sufficiently large number of trees was available. The treatments consisted of (1) fuel oil alone, (2) 2,4-D butyl ester at both 2 and 4 percent, (3) 2,4-D/2,4,5-T butyl esters at 2 percent, and (4) 2,4,5-T propylene glycol esters at 2 percent in fuel oil. Treatments were applied as basal bark sprays to the lower 12 inches of each trunk to the point of "run-off". This required 2 Imperial gallons (2.4 U.S. gallons) of oil or mixture for each group of fifty trees. At each date fifty trees were treated and tagged for each treatment. The treatments were made during the last few days in each month.

At the end of September 1953 all the trees were examined and the data recorded. The results are shown in Table I. On the trees listed as dead there were no buds and no green cambium layer could be found. A large number of trees had from 2 to 7 trunks which appeared to come from a common root. Each of these clumps was considered as one tree. The diameter of the largest trunk in each of these clusters was measured at the ground line and the number of trunks was recorded. Where the tree had only one trunk its diameter at the ground line was recorded.

Table I. Results of basal bark treatments of hawthorn, Haysville, 1952-53.

Time	B.E. 4 Size* in.	B.E. 4 % kill	B.E. 2 Size* in.	B.E. 2 % kill	B.K. 2 Size* in.	B.K. 2 % kill	2,4,5-T Size* in.	2,4,5-T % kill	F.O. % kill	Ave. % kill
May	1.98	66	1.84	52	2.36	49	2.29	39	0	51.5
June	2.49	84	2.45	78	2.52	71	2.61	57	0	72.8
July	2.53	94	2.00	76	2.50	62	2.16	40	1	68.0
Aug.	1.45	100	2.16	58	2.16	54	1.87	54	0	66.7
Sept.	2.18	98	2.06	41	2.29	54	2.36	46	0	59.2
Oct.	2.39	98	1.77	94	1.92	86	2.12	80	0	89.5
Nov.	2.18	100	1.90	94	2.10	84	2.24	80	2	89.5
Dec.-Jan.	2.08	98	2.26	58	2.17	96	2.07	70	0	80.5
Feb.	2.17	90	1.97	86	1.66	86	2.30	48	0	77.5
Mar.	1.89	100	2.06	96	2.02	90	2.01	82	0	92.0
Apr.	2.40	78	1.89	82	2.09	60	1.95	52	0	68.0
Ave.	2.14	91.4	2.03	74.3	2.07	72.1	2.09	59.0	-1	

* Each figure represents average of 50 trees.
Ave. - average
B.E. 4 = 2,4-D butyl ester 4 pereent, B.E. 2 = 2,4-D butyl ester 2 percent, B.K. 2 = 2,4-D/2,4,5-T butyl esters, 2,4,5-T = 2,4,5-T propylene glycol ester, F.O. = fuel oil

The results on approximately 2750 trees treated and tagged show that 2,4-D butyl ester was as effective as the 2,4-D/2,4,5-T butyl ester mixture at 2 percent. Both were more effective than the 2,4,5-T propylene glycol esters applied at the same rate. 2,4-D butyl ester at 4 percent was the most successful treatment with better than a 90 percent kill. Less than 1 percent of the trees treated with fuel oil were dead. The size of the trees did not influence the results as the average diameter was nearly the same for all treatment groups with a range of from 2.03 to 2.14 inches.

Almost half of the trees were from 1 to 2 inches in diameter. The data concerning these was tabulated separately. The percent kill was higher for all treatments but the order was not changed. The results were as follows:

4% 2,4-D butyl ester	- 95.1
2% 2,4-D butyl ester	- 83.7
2% 2,4-D/2,4,5-T butyl ester	- 82.1
2% 2,4,5-T propylene glycol ester	- 71.6

Satisfactory results were obtained in every month of the year. The most successful results were those from the treatments applied from October through to March.

The treatments were repeated in July 1952 at a location near Guelph where the previous work had been carried out, and also at Arkona (near Sarnia) where the hawthorn stand consists of a greater variety of species. The most common species at Guelph and Haysville is C. punctata but many of the trees at Arkona closely resemble the description of C. crus-galli. In mid-November 1953 the results at each of the three locations were recorded. These are shown in Table II.

Table II. Results of basal bark treatments of hawthorn at three locations, July, 1952.

Treatment	Location Arkona		Guelph^x		Haysville	
	Size* in.	% kill	Size* in.	% kill	Size* in.	% kill
2,4-D B.E. 4%	2.08+	100	2.04	96	2.53	97
2,4-D B.E. 2%	2.17+	100+	2.59	75	2.00	78
B.K. 2%	2.09	92	2.24	36	2.50	66
2,4,5-T 2%	1.99	98	2.82	20	2.16	46
Fuel oil	sim.	6	sim.	8	sim.	2

* Recorded November 1953. Each figure is the average for 50 trees unless otherwise indicated.
x Average 25 trees
\+ Average 31 trees
sim. - trunks not measured but average size would have been within the range recorded for other treatments.

Summary

1. In a test involving approximately 3100 hawthorn trees basal bark applications of 2,4-D butyl ester in fuel oil proved to be as effective as the 2,4-D/2,4,5-T mixture and more effective than 2,4,5-T propylene glycol ester when used at the same concentration.

2. Using complete kill as the criteria 4 percent 2,4-D butyl ester in oil applied at the rate of 2 gallons for 50 trees was the most successful treatment and gave a kill of over 90 percent at all locations. (2 Imperial gallons = 2.4 U.S. gallons)

3. While satisfactory kills were obtained for all treatment periods, the treatments made from October through to March were most satisfactory.

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RELATIONSHIP BETWEEN CONCENTRATION OF BASAL SPRAYS AND MORTALITY OF RED MAPLE SPROUT CLUMPS

David M. Smith, Russell J. Hutnik, and Harold A. Paulsen, Jr.[1]

One of the most difficult problems involved in the use of 2,4,5-T and related compounds is the determination of appropriate concentrations. The chemicals are sufficiently expensive that it is desirable to use them in the lowest concentrations which will give satisfactory results. This objective could be achieved more expeditiously if a well-defined mathematical relationship could be established between the percentage of mortality and the concentration of silvicidal sprays.

In research with medicinal drugs, insecticides, and fungicides, it has been found that the probit of an all-or-none response like death is very often a straight-line function of the logarithm of dosage (Bliss, 1935). The transformation of percentages to probits is a mathematical device for converting the normal, bell-shaped distribution curve to a straight line. Tables for making this transformation may be found in Fisher and Yates (1948) and some of the more recent textbooks on statistical methods.

The main objective of this investigation was to determine whether the mortality of red maple sprout clumps resulting from basal spraying with different concentrations of 2,4,5-T in oil would follow this kind of straight-line relationship.

The study was conducted in an 11-year old stand of sprout hardwoods in the Cockaponset State Forest, 14 miles east of New Haven, Connecticut. The stand had originated in 1940 following the clearcutting of a stand of sprout hardwoods about 60 years old. The soil was derived from a coarse glacial till and was capable of supporting only a mediocre stand of hardwoods. The State acquired the land shortly after the clearcutting and planted a number of different conifers over the area as an experiment in the rehabilitation of such areas. However, the investigation of basal spraying was conducted without particular reference to the release of any of the planted trees.

The scattered sprout clumps of red maple (Acer rubrum L.) were chosen for the test largely because they constitute the most aggressive type of undesirable vegetation in the forests of the locality. This choice was a poor one from the

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[1]This study was initiated as a student research project by Mr. Paulsen, now of the Southwestern Forest & Range Experiment Station. Mr. Hutnik, now of the Northeastern Forest Experiment Station, continued the study and, under the guidance of Prof. Chester I. Bliss, developed the methods of statistical analysis. The project was directed and carried to completion by Prof. Smith. The 2,4,5-T was donated by the American Chemical Paint Company.

standpoint of the experiment because each clump was a heterogeneous collection of connected stems of different sizes. Closer insight into the relationship between mortality and concentration of 2,4,5-T would have been gained if single-stemmed, straight trees had been treated.

The total heights of the clumps varied from 10 to 35 feet; the majority were about 20 feet tall. The number of stems per clump varied from one to 22, although the average number was about 6 stems per clump. The D. B. H. of individual stems ranged from 0.3 to 6.0 inches, but only a small number of clumps included stems larger than 2.5 inches D. B. H.

The treatments were carried out late in March 1951, shortly before the red maple buds broke dormancy. No. 2 fuel oil was used as a carrier for the butoxy ethanol ester of 2,4,5-trichlorophenoxyacetic acid used in the experiment. Six different concentrations, ranging from 0.25 to 3% by weight, were tested; one treatment consisted of basal spraying with No. 2 fuel oil only. The materials were applied under pressure from a knapsack sprayer equipped with a nozzle which delivered a cone-shaped spray. Each stem was encircled with spray from the ground-line up to a height of 8 inches; treatment was continued until the solution started to run off onto the ground. Each concentration was tested on 45 sprout clumps. The final results were assessed in July 1953, two and one-half growing seasons after treatment.

In testing the hypothesis that the probit of mortality would bear a straight-line relationship to the logarithm of concentration, the following steps were necessary. The various concentrations of 2,4,5-T were converted to pounds of acid equivalent per gallon of spray. These values were then transformed to logarithms; the characteristics of the logarithmic values were increased by 2 in order to make them all positive. Results for the treatment with pure fuel oil were omitted from the test because no logarthmic value could be assigned to a concentration of zero. Mortality was evaluated in terms of the percentage of the 45 clumps in each treatment which were completely killed above ground and also failed to sprout. These percentages were converted to probits and plotted over the log + 2 of concentration, as shown in Figure 1.

Visual inspection of Figure 1 is sufficient to demonstrate good agreement with the hypothesis. This impression is supported by the special methods of statistical analysis, outlined by Fisher and Yates (1948), which must be applied to data which has been transformed to probits. The straight line shown in the graph is based on the equation:

$$\text{Probit of mortality} = 3.16 + 2.189\ (\text{log of conc.} + 2)$$

derived by the method of curve-fitting appropriate to such data. Testing with chi-square, it was found that the data fitted the straight line with a probability of about 0.85.

It must be noted that the probit transformation has characteristics such that ordinary methods of curve-fitting are invalid. In other words, one cannot balance a straight line through such an array of points by eye or by the method of least squares without risk of error. The simpler methods would be reliable only if the points happened to fit a straight line almost exactly.

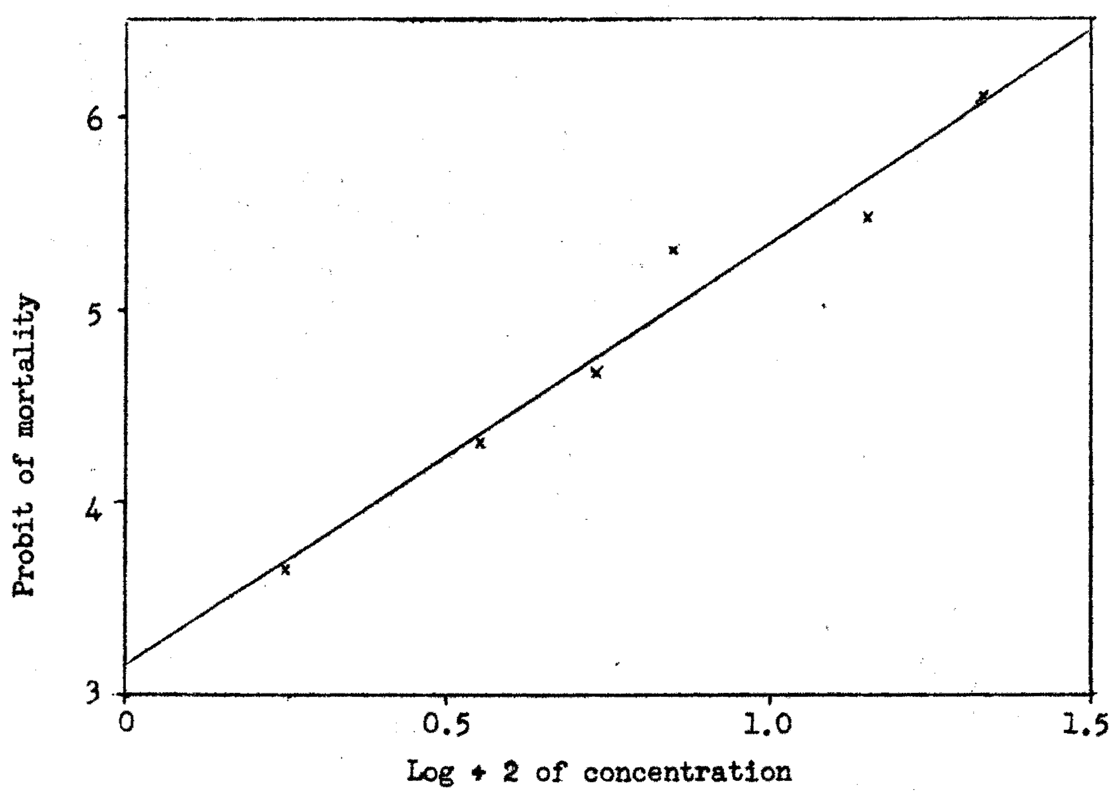

Figure 1. Log-probit transformation of relationship between concentration of 2,4,5-T in basal spray and mortality of red maple sprout clumps.

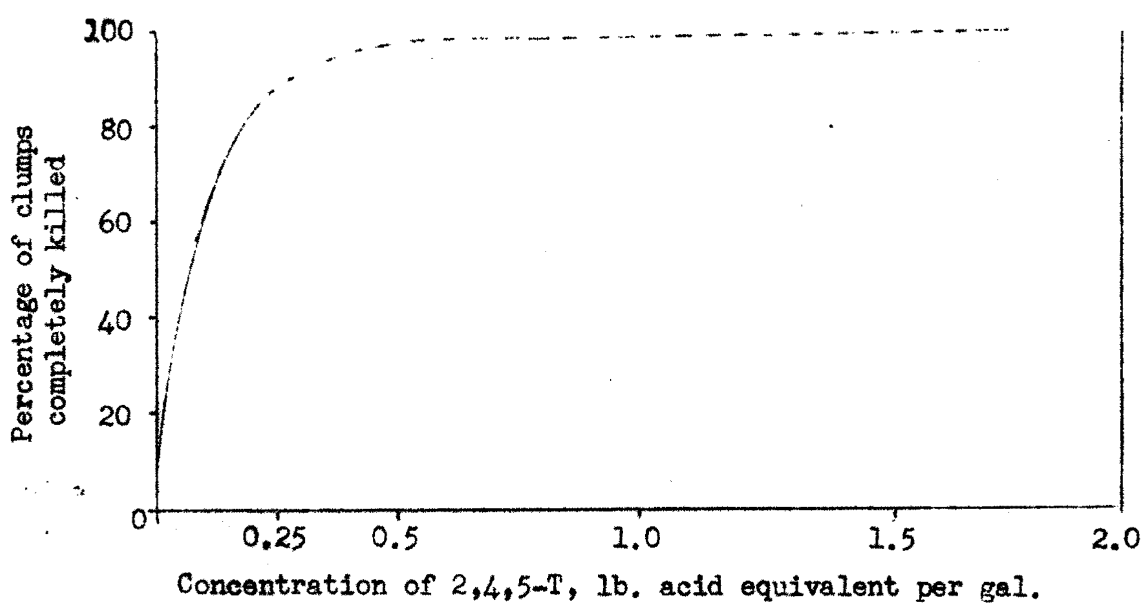

Figure 2. The straight-line relationship shown in Figure 1 extended and and replotted on arithmetical axes. The dashed portion of the curve is the part which represents an extension of the straight line.

If the log-probit transformation will convert the relationship between concentration of 2,4,5-T and mortality to a straight line in one case, it is not illogical to suppose that it might do so in other situations. Therefore, it is desirable to examine the implications of this relationship.

In the first place, if one extends the straight line shown in Figure 1 to higher dosages, it becomes apparent that one would reach the point of diminishing returns, as far as cost is concerned, long before a complete kill was achieved. If the straight line shown in Figure 1 is extended and replotted on arithmetical axes, as shown in Figure 2, it appears that one would have to increase the concentration 6.5 times to increase the theoretical mortality from 90 to 99.9%. This indicates that it may be wiser, as a general practice, to select concentrations which will give a kill of 90-95% than to attempt a complete kill.

The log-probit transformation is at least potentially capable of providing a precise means of determining the concentration of spray necessary to give a certain percentage of mortality. By determining the mortality resulting from application of a few different concentrations, the effects of the whole range of possible concentrations can be evaluated. For example, from the equation defining the straight line shown in Figure 1, it can be predicted that a concentration of 0.269 pounds of 2,4,5-T acid equivalent per gallon would give a kill of 90%. A concentration of 0.389 pounds per gallon would give a theoretical kill of 95%. However, the relationship derived in this particular case can apply at best only to red maple sprout clumps consisting of individual stems with the same distribution of diameters as those tested. Precise determination of concentrations required to achieve stated objectives under all conditions can be made only if trials are arranged in such manner as to allow for the effects of variation in diameter, time of year, species, age of stand, and similar factors.

When the results of the trial were considered on the basis of mortality of individual stems, it became very obvious that the concentration of 2,4,5-T required to give a satisfactory kill increased very rapidly with diameter. The values given in Table 1 illustrate this variation, which is probably the result of the close correlation between D. B. H. and bark thickness at the point of application. The desirability of confining basal sprays to small stems and treating stands while they are still young are clearly indicated. It is also apparent that much money can be wasted by using concentrations of 2,4,5-T which are high enough to kill the largest sprouts in a stand but unnecessarily high as far as the smaller stems are concerned.

An attempt was made to use these data to determine the precise concentrations necessary to give stated percentages of mortality in the different diameter classes. However, the heterogeneity of diameters and the interrelationships between stems within clumps caused somewhat too much variation to allow straight lines to be fitted to the data readily. It is probable that much more satisfactory computations could have been made if single stems originating from seedlings or seedling-sprouts had been used as test material.

Table 1. Mortality among different diameter classes of individual stems 2 1/2 growing seasons after application of basal sprays consisting of various concentrations of 2,4,5-T in No. 2 fuel oil.

Concentration of 2,4,5-T acid equivalent		Percentage of mortality by 1/2-inch D.B.H. classes				
Lb./gal.	% (by wt.)	<1.0"	1.0-1.49	1.5-1.99	2.0-2.49	<2.49"
0.2142	3.0	100	100	100	100	100
0.1428	2.0	100	100	97.6	96.3	78.7
0.0714	1.0	100	100	97.7	94.5	88.9
0.0536	0.75	98.2	97.6	91.1	57.1	55.5
0.0357	0.5	100	89.0	85.0	53.9	40.0
0.0179	0.25	81.3	60.2	44.7	23.0	29.4
No. 2 fuel oil only		83.9	45.7	35.0	28.6	19.4

Conclusions

1. It has been demonstrated that, at least in one case, the probit of mortality resulting from basal spraying with 2,4,5-T bears a straight-line relationship to the logarithm of the concentration of the spray. If it can be established that this relationship has wide application, systematic tests of different concentrations could be vastly expedited.

2. Where a relationship of this kind applies, the economic wisdon of seeking kills greater than 90 or 95% is open to serious question.

3. The concentration of 2,4,5-T required for a satisfactory kill, when applied in basal sprays, increases very rapidly with stem diameter. Costs for material can be held to a minimum only if undesirable woody vegetation is treated when it is young and small.

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USE OF 245T TO CONTROL HARDWOODS IN CUT-OVER PINE FORESTS

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In January 1951, while attending the N.E.W.C.C., the author had the pleasure of hearing a report by L.E.Chaiken on "The Chemical Control of Brush In Forest Management". A subsequent talk with him on the use of 245T to control inferior species in loblolly pine and later, his Station Paper No.10 further stimulated interest in applying this silvicide on the Del-Mar-Va Peninsula.

Through the years, logging operations here on the shore have left a vast amount of unproductive land in their wake. These areas are dominated by unmarketable hardwoods which have completely taken over or suppressed the development of new pine. Little has been done to rectify the situation. Mechanical means for reclaiming the cut-over areas have proved costly and limited. It appears that 245T might be an inexpensive chemical tool to help restore loblolly pine. Our chief concern with this chemical has been in determining its practical value for large scale conservation. Investigation of its use has been conducted in two phases; basal bark spraying and the frill method of application.

With the cooperation of the Maryland Department of Forests and Parks, a basal spray project for this region was undertaken. On March 16,1951, the Forestry department established four plots in three Maryland counties to study the effects of this control method on hardwoods. The plots were one-half acre each and typical of our commercially logged forests. Data were compiled on d.b.h. and species and inspection reports were made on the resulting kill.

Since the labor cost was considered to be of prime importance, it was decided to treat the areas as quickly as possible. In following this procedure, we regret to say, the volume of solution per tree was sacrificed for the time element.

Materials

5 gal. Knap-sack Pressure Sprayer-diaphram type, 30" play pipe attached.
A solid cone nozzle for directing spray.
Esteron 245 (propylene glycol butyl ether esters of trichloro-phenoxyacetic acid) - 4 lbs. 245T acid per gallon.
No.1 Fuel Oil.

Procedure and Results

A 4% solution by volume or 1 pint Esteron 245T in 3 gallons fuel oil was sprayed on the base of stems from the root collar up about 18", completely encircling same. As mentioned above, in an attempt to reduce spray time to the minimum, we chose not to wet the bark to the point of run-off. There were four one-half acre plots; each, a one-man operation.

Plot No.	No. Hardwoods	D.B.H.	Spray Time	Solution Used
1	179	3"-12"	1hr-20 min.	$8\frac{1}{4}$ gal.
2	148	3"-22"	1hr-	6 gal.
3	43	3"-13"	20 min.	$2\frac{1}{4}$ gal.
4	137	3"-14"	45 min.	$5\frac{1}{2}$ gal.

Basal Spray Plots 1 to 4 (Consolidated)

Hardwood Stocking - March 1951

D.B.H.	White Oak	Red Oak	Red Gum	Red Maple	Hickory	Black Gum	Holly	Beech	Tot.
3"	31	12	14	37	10	5	10	12	131
4"	22	21	9	26	6	1	7	6	98
5"	18	15	5	14	4	1	5	1	63
6"	13	25	7	12	6	1	2	-	66
7"	18	11	6	8	5	2	1	3	54
8"	9	7	2	2	1	4	-	2	27
9"	10	7	2	6	2	-	-	-	27
10"	5	6	2	4	-	-	-	1	21
11"	1	4	-	2	-	1	-	-	8
12"	-	2	-	-	-	-	-	1	3
13"	1	2	-	-	-	-	-	-	3
14"	-	3	1	-	-	-	-	1	5
15"	-	-	-	-	-	-	-	-	-
16"	1	-	-	-	-	-	-	-	1

22"	-	-	-	-	-	-	-	1	1
Total	129	115	48	111	34	15	27	28	507

Dead Trees - July 1952

D.B.H.	White Oak	Red Oak	Red Gum	Red Maple	Hickory	Black Gum	Holly	Beech	Tot.
3"	12	5	3	27	9	-	1	3	60
4"	8	11	2	14	3	-	1	3	42
5"	4	2	-	1	2	1	-	-	10
6"	2	6	2	3	5	-	-	-	18
7"	1	2	-	-	1	-	-	-	4
8"	-	-	1	1	-	-	-	-	2
9"	1	1	-	-	1	-	-	-	3
10"	-	1	-	1	-	-	1	-	4

12"	-	1	-	-	-	-	-	-	1

16"	1	-	-	-	-	-	-	-	1
Total	29	29	8	47	21	1	3	7	145

Dying Trees - July 1952

D.B.H.	White Oak	Red Oak	Red Gum	Red Maple	Hickory	Black Gum	Holly	Beech	Tot.
3"	5	1	-	-	-	1	-	3	10
4"	6	6	1	3	1	-	-	2	19
5"	2	5	-	4	2	-	-	1	14
6"	2	12	-	3	1	-	-	-	18
7"	2	1	-	5	2	-	-	1	11
8"	2	1	-	1	-	1	-	-	5
9"	-	3	1	4	-	-	-	1	9
10"	-	-	-	1	-	-	-	-	1

12"	-	1	-	-	-	-	-	-	1
Total	19	30	2	21	6	2	-	8	88

Summary July 1952 Inspection

46% stems treated were dead or dying;

Hickory 79%
Red maple 61%
Beech 54%
Red oak 51%
White oak 37%
Red gum 21%
Black gum 20%
Holly 11%

The smooth bark trees such as: hickory, red maple, and beech were most susceptible. Among the thick bark trees, gums were most resistant. Most of the trees killed were in the 3"-6" d.b.h. group.

Inspection Aug. 1953

Approximately 75% of the trees considered in a dying condition in 1952 appeared to be dead. Resprouting from the trees partially dead was low in vigor and number. Most of the large thick bark species remained unaffected. Generally, the overstory on these plots was opened up but not sufficiently to provide a healthy pine environment.

Discussion

Failure to wet stems thoroughly to the point of run-off produced erratic results. This was evidenced by the fact that all of the trees of the same species and d.b.h. were not killed. Although basal spraying is not the complete answer to our forestry problems on the shore, it should prove invaluable in eliminating stems in the 1" to 3" group when applied in adequate volume.

Additional Basal Spray Test Sept.1952

The author selected a two acre pine-hardwood stand to test the effectiveness of basal control with greater volumes of solution per tree and lower concentration of 245T. The area had a hardwood reproduction of ninety three stems per acre and was stocked with red oak, white oak, red maple, black gum, wild cherry, laurel, and dogwood. Stem size varied from 2"-7" d.b.h., with an average d.b.h. of 3".

A 2% by volume solution, or 1 pint Esteron 245T in 6 gallons of fuel oil was sprayed with knap-sack equipment on basal stems from root collar upward about 18", completely encircling the stems. A sufficient volume of solution was used to thoroughly wet the bark to the point of run-off.

I inspected the plot in May 1953 and found that 58% of the treated stems had not developed buds. Examination of the cambium layer above the sprayed area and below to the root crown revealed them dead. The remaining 42% had produced buds.

In July 1953, the 42% remaining trees had put out full or partial foliage and were dead or dying.

The area was again inspected in Sept. 1953; all the trees were dead with the exception of 2% - black gum. On these, there was bark proliferation to such an extent that recovery seemed unlikely. There was no evidence of sprouting on the trees presumed to be dead but there was some on the gum.

The 2% solution and high volume application proved more effective than the 4% solution and low volume. Excellent control of overstory was observed but it will remain to be seen if sprouting will appear in future growing seasons.

The results obtained with this basal bark treatment are in agreement with the authorities that volume is more important than high per cent solutions.

Commercial Application of 245T by Del-Mar-Va Forest Improvements, Inc.

In January 1953, the D.M.V. Forest Improvements, Inc. began commercial use of 245T to control hardwoods on cut-over land. A four man crew was trained on fifty-eight acres in basal spraying and frill girdling techniques in accordance with Chaiken. By volume a 2% solution of Esteron 245 in fuel oil was chosen as a standard mixture for both operations. The Maryland Department of Forests and Parks surveyed and supervised the selection of the areas contracted for with owners of cut-over land. Since the land owners received Federal assistance under the U.S. Dept. of Agriculture Production and Marketing Administration 1953 Conservation Program, the Forestry Dept. inspected our work at the completion of each contract to determine whether or not proper methods had been employed.

The following have been selected as typical examples of contracts engaged in by the company in 1953.

Contract A - Basal Spray, May 1953

The area consisted of eight acres, dense with hardwood reproduction. A three man crew with knap-sack equipment applied a sufficient amount of 2% solution by volume to the stems from 1" to 3" d.b.h. to wet them to the point of run-off. Stocking by species included red and black gum, red and white oak, red maple, hickory, beech, and holly. The job required seven and three-quarters man-hours per acre and twenty eight and one-fourth gallons of 2% solution per acre.

By the end of the summer, 90% of all the stems were dead. No sprouting was observed.

Contracts B,C,D - Frill Method, 1953

A four man crew worked all the contracts; three men used overlapping ax cuts to frill trees approximately waist high; one man poured the chemical solution in frills from a knap-sack sprayer. One pound National Oil Red O dye was mixed in all frill solutions to identify poured trees. Most all areas under contract were mixed hardwood stands with little pine reproduction left after logging. On contracts B and C, all hardwoods from 5" d.b.h. up were frill treated. Contract B was a mixed hardwood-pine stand easily worked. Contract C was a total hardwood stand dominated by beech and oaks ranging in size from 5" to 44" d.b.h. This area was difficult to supply with chemical due to inaccessibility. Contract D was mixed hardwood-pine and all stems from 3" d.b.h. up were frilled. (Note increase in man-hours and chemical used for Contracts C and D.)

Contract	Date	No.Acres	No.Trees	Av. D.B.H.	Median D.B.H.	Man Hrs. Per Acre	Solution Per Acre
B	Mar.	38	130	6.53"	6"	2.5	3.5 gal.
C	May	18	62	15.29"	16"	5.5	4.3 gal.
D	Nov.	9	450	6.07"	5"	5.0	5.5 gal.

Observations on Commercial Contracts

To use the basal spray method for general elimination of larger trees would not be feasible because of relatively high cost - even with lower concentrations of 245T solution. It is of value in removing scattered clumps of hardwoods on cut-over pine land.

In Sept.1953, top kill was noticed on 40% of the trees frilled in the spring. From an examination of the bark on the remaining 60% that retained foliage throughout the summer, it is apparent that the tops will also die. Approximately 50% of the red oaks have sprouted. Approximately 75% of the red maples have also sprouted at the root crown. Some sprouting has been observed on other species but all sprouts are low in number and vigor as compared to a cut stump.

Having completed 386 acres of frill contracts, we believe that this type of work can be attractive to all owners of cut-over woodland here on the Shore. Removal of hardwood overstory in cut-over pine land is economical for this region. Our contract prices for the frill method ranged from $12-$20 per acre. Dormant season treatment is preferred for ease of operation. An adequate amount of salary on a per acre basis per man instead of hourly rates lends to a minimum of field supervision and keeps cost down. This is accomplished with small crews. On man can frill and pour two acres per day on difficult woods and three acres per day on an average woods.

Acknowledgements

Acknowledgement is gratefully made to Mr. L. E. Chaiken, to the Maryland Dept. of Forests and Parks for cooperation and supervision, and to the DOW Chemical Co., Midland, Michigan, for supplying materials used in initial basal spray tests.

EFFECT OF SEASONAL BASAL SPRAYS ON ROOT SUCKERING OF ASPEN

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INTRODUCTION

Aspen is a short-lived tree widely distributed on this continent. It is characterized in early life by vigorous root suckering, resulting in dense pure stands of from 3000 to 11000 stems per acre. At age 20 to 30 years, excessive competition between plants greatly reduces this number and the aspen gradually die and are replaced by other species till by age 60 to 70 years most of the aspen has passed out of the stand. It is considered a pioneer tree species in plant succession, invading abandoned fields or forest areas which have been denuded by cutting and fire, and spreads rapidly by root suckering. It is because of this root suckering habit that it is extremely hard to control by chemical sprays during it's youth.

BASAL SPRAY TESTS IN THE DORMANT SEASON, 1950-52

In 1950 it was decided to attempt aspen control through a series of consecutive dormant basal sprays. The area chosen for these tests had been burned several times in the past 15 years, the last fire being in 1946. It was covered with a dense stand of aspen of which 95 to 100% were under 2 inches in basal diameter and 10 to 15 feet tall. White and red pine had been planted immediately after the fire and these were severely suppressed by the aspen. The dormant season was selected as being the time when injury to planted conifers was least apt to occur.

The progress of these dormant treatments was reported in 1952(2). Some of these plots have now been treated three times. The four year results shown in Table 1 and in Figure 1 are intended to supplement the original report and as a background for spray tests made at various seasons of the year. All sprays were applied to the basal 12 inches of the stems.

TABLE 1

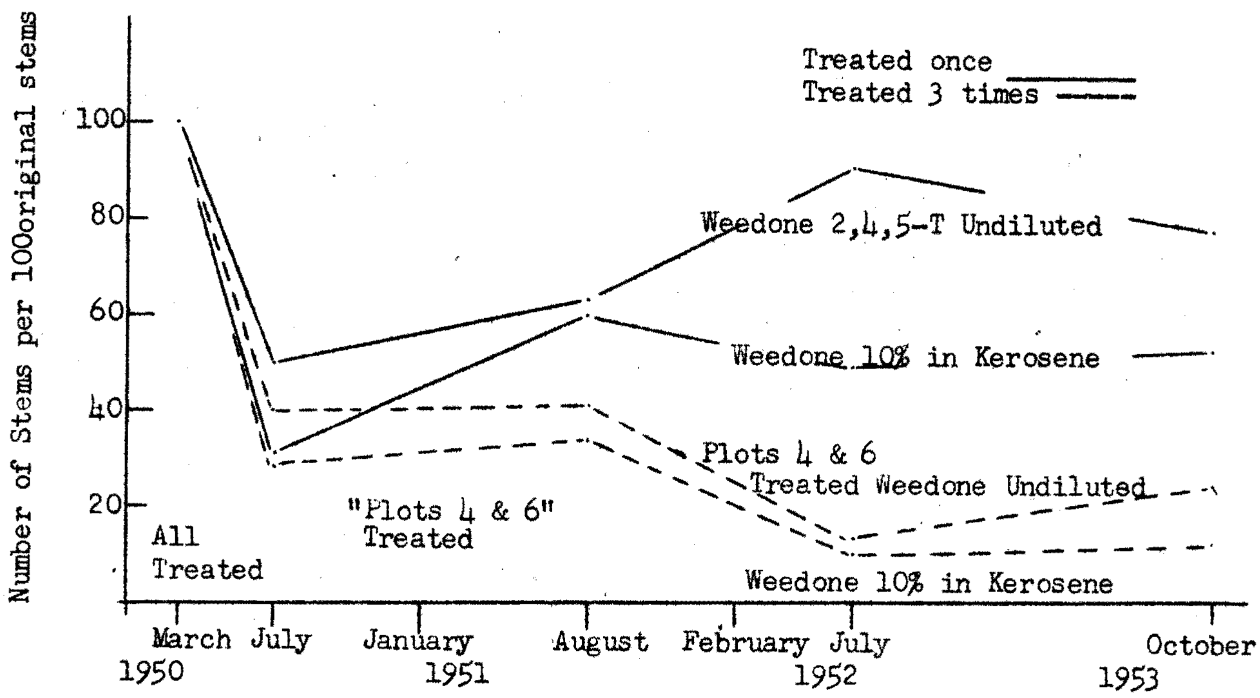
Effect of 2,4,5-T Dormant Basal Spray on Aspen. The Formulation Used Contained 4 lbs. of Acid Per Gallon

Plot No.	Type of Basal Application	Original Tally* March'50	Date Treated	First Retally July'50	Date Treated	Second Retally Aug.'51	Date Treated	Third Retally July'52	Fourth Retally Oct.'53
1	Weedone	312	March	155	None	198	None	284	239
	2,4,5-T								
6	Undiluted	1104	1950	307	Jan.'51	458	Feb.'52	153	268
3	10% Weedone	680	March	639	None	598	Original Stems not		
	2,4,5-T in								
5	Water	503	1950	416	Jan.'51	431	killed - Discontinued		
2	10% Weedone	783	March	241	None	467	None	386	422
	2,4,5-T in								
4	Kerosene	393	1950	155	Jan'51	133	Feb.'52	37	48

* "Tally for 0.1 Acre plot."

FIGURE 1

Effect of Dormant Basal Treatments on Aspen



As shown in Table 1 none of the dormant treatments were successful in eradicating aspen. Certain conclusions can be drawn from the data however:

1. Winter is not the season to basal spray young aspen for complete eradication.
2. In basal treatments the sprayed solution (10% Weedone 2,4,5-T in kerosene on plots 2 and 4) is consistently superior to pure Weedone 2,4,5-T (plots 1 and 6) painted on the basal stems.
3. Repeated treatments (plot 4) are necessary to effect a reasonable control.
4. The retreatment in the second winter does not seem effective probably because many root suckers do not appear till the second growing season.

SEASONAL BASAL SPRAY TESTS, 1952-53

The area chosen for these tests was adjacent to the dormant spray test area and had a similar fire history. The purpose in treating was to release white pine, planted in 1946, a practical problem often encountered in Christmas tree production and in other situations where conifers are in competition with aspen.

Six plots were laid out in March of 1952 and another added in July of 1953 so as to fall in different seasons identified by various phenological characteristics as follows:

Season	Months	Phenological Characteristic	Date of Application
Spring	April-May	Beginning of growth	May 10, 1952
Early Summer	June-July	Active growth	June 16, 1952 July 31, 1953
Late Summer	August-Sept.	Growth terminating	Sept. 8, 1952
Fall	Oct-Nov.	Beginning of Dormancy	Oct. 31, 1952
Early Winter	Dec.-Jan.	Dormancy	Jan. 1, 1953
Late Winter	Feb.-March	Beginning of Activity	March 30, 1952

The July 31, 1953 plot was added as an additional comparison with results obtained by Arend (1), who worked with larger aspen and reported no sprouting after spraying during the period of full leaf development.

The basal spray technique used consisted of spraying the bottom 12 inches of each stem till ample rundown was obtained. Weedone 2,4,5-T butoxy ethanol ester, was used in a 4% solution by volume in kerosene giving 16 pounds of active acid equivalent per 100 gallons of solution. The 1/40 acre plots were staked out; the original stems were counted and measured. During the spraying process a careful record was kept as to the time required and volume of solution used. In subsequent retallys the original stems and suckers were kept separate. Tabular results are found in Table 2 and figure 2.

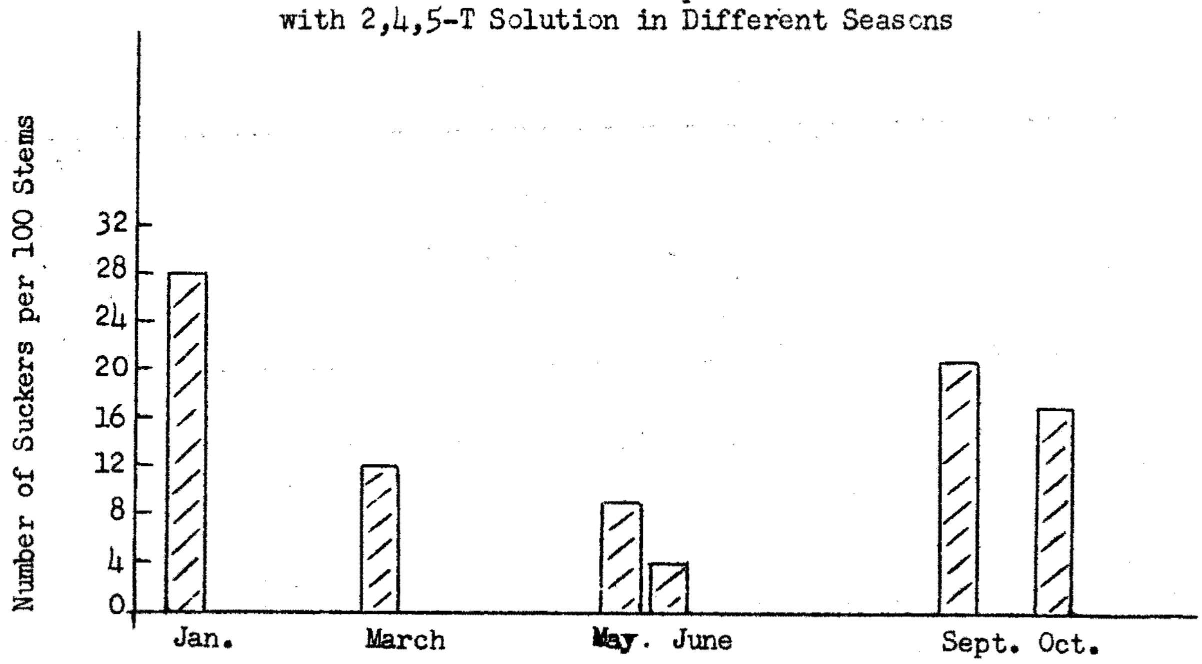
TABLE 2

Effect of Season of Basal Spraying on Root Suckering on Young Aspen

Date Sprayed	Soln. per stem oz.	Spray per Acre Gal.	Total orig. stems on 1/40 Acre	Dec. 1952 % orig. Stems killed	Retally 1952 Suckers No.	July 1953 % orig. Stems killed	Retally 1952 and 1953 Suckers No.
3/21/52	0.89	63.36	229	97.1	16	100	28
5/10/52	1.58	58.08	118	100.0	6	100	11
6/16/52	0.83	52.80	204	94.2	3	100	9
9/8/52	1.32	79.20	192	-----	--	100	42
10/31/52	1.43	142.56	319	-----	--	99.7	55
1/8/52	1.70	155.76	294	-----	--	93.5	84
7/31/53	4.62	168.96	117	-----	--	-----	--

FIGURE 2

Number of Suckers Obtained per 100 Stems Treated with 2,4,5-T Solution in Different Seasons



The effects of the spray in different seasons on the first year suckering of aspen are distinct. Three to six times more suckers were found after dormant season spray than after sprays in the seasons of active growth. It remains to be seen if suckering can be entirely eliminated by a basal spray later in the growing season. From the evidence in the preliminary tests, we can conclude that suckers will continue to increase in the dormant plots; whether this will be the case with the growing season plots or not will require retallying for another year at least.

The response of white pine to release from aspen was marked. Before treatment the pine were 2 to 6 feet high growing at the average rate of 0.7 feet in height per year. The first season after release the height growth was 0.8 feet and the second season they grew at the average of 1.2 feet per year. Similar white pines not released grew 0.7 feet per year for the same periods. All seasons gave effective release of the pine so that for this purpose any season of application will yield effective results. Those pines on plots sprayed in May and June showed slight twisting in the current years growth pointing up the need for particularly careful spraying at that time to avoid serious effects from the spray.

EFFECT OF BASAL SPRAYS ON ROOTS

In order to determine the origin of suckes arising in the spray plots, root excavations were carried out in July and September, 1953. The first plot examined was that sprayed on May 10, 1952. Of the 13 root suckers arising on the plot, 2 were from trees off the plot while 11 were from sprayed aspen on the plot with dead stems and tops. A second plot, sprayed on June 16, 1952, was excavated and of the 19 root suckers on the plot, 9 were from sprayed aspen with dead stems on the plot, 10 suckers were from trees off the plot.

These root excavations revealed some interesting facts regarding the effect of basal spraying on roots. First, above-ground portions, including the root collar area of aspen may be readily killed by basal sprays and not kill the roots which then proceed to produce root suckers. In these tests, portions of roots have been killed extending from the root collar as far as 4.3 feet, and these same roots have still produced suckers 7 feet farther out along the root. This killing of the stem and partial killing of the roots has occurred in all seasons under test, although most effective suppression of root suckering was obtained in the active growing season (Table 2).

DISCUSSION

Arend (1) finds that using a 3% (12 lb./100 gals.) solution of 2,4,5-T ester in diesel oil during full leaf development offers promise of controlling aspen without subsequent sprouting for at least three years. Morrow (3) in dealing with aspen and beech reports that none of the aspen receiving treatments (most of them were dormant treatments) sprouted. These two investigators worked with large aspen. Arend's treatments were apparently made on 4-5 inch basal diameter trees while Morrow's tree sizes ranged from 4-12 inches d.b.h.

Our results (obtained on 1-2 inch basal diameter aspen, 10-15 feet tall) parallel the conclusions drawn by Arend. The small aspen, respond better to the growing season treatments than to dormant treatments, though complete elimination of root suckering was not had.

The practical conclusion seems to be, where possible, to let aspen grow to at least 3-4 inches d.b.h. before treating. At maturity sprouting can be eliminated by treatment with 2,4,5-T in oil at any season; while at middle age suckering can be controlled by summer basal treatments; and if aspen must be treated while very young, summer basal treatment will yield the least root suckering.

SUMMARY OF RESULTS

A study of basal spraying of young aspen over-topping pine has been made over the past 4 years in central Pennsylvania. Basal spraying the bottom 12 inches of stems at any season of the year effected a release of 6 to 7 year-old pines planted under an aspen canopy. The most effective season to reduce root suckering of sprayed aspen proved to be the growing season (June-August). When winter basal spraying was used, it was necessary to repeat the spray in 3 consecutive years to get adequate control of root suckers. Extremely high concentration of 2,4,5-T up to 400 lb. per 100 gal. of solution was not as effective as 16-40 lb. per 100 gal. solutions. Finally, it was possible to kill aspen tops in any season and still not kill the roots of all trees, so that a drastic 100% eradication by one spray does not seem likely to occur when young vigorous aspen are treated.

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REPORT ON TWO YEARS RESULTS OF DORMANT BASAL SPRAYS ON MIXED BRUSH

W. A. Meyers, R. H. Beatty and W. W. Allen [1]

Basal sprays using oil as the carrier are now standard procedure in controlling many species of woody plants and successful application has been reported by numerous workers in the field. (1)

Since the esters of the 2,4,5-T formulation are soluble in oil you can study the effectiveness of 2,4,5-T esters in oil versus oil plus water emulsion. The oil portion of each hundred gallons of spray material would contain the 2,4,5-T. It is obvious that the concentration of ester in oil would vary greatly from the material containing ten gallons of oil per hundred gallons to the one containing all oil and no water. Perhaps it would be of value to note just what the percent by weight would be of the 2,4,5-T in each mixture. Keeping the 2,4,5-T constant at 12 pounds per hundred gallons of mixture, the following percentages are obtained in the oil phase:

10 gallons of oil plus 90 gallons of water	- 16.7%
20 gallons of oil plus 80 gallons of water	- 8.4%
30 gallons of oil plus 70 gallons of water	- 5.6%
40 gallons of oil plus 60 gallons of water	- 4.2%
100 gallons of oil	- 1.7%

The substitution of water for a portion of the oil would reduce the cost of the carrier. Previous results using all water as a carrier for dormant basal sprays have not proven satisfactory.

The purpose of the work was to determine the minimum amount of oil in an oil-water mixture which can be used effectively for dormant basal sprays on mixed brush. Since no published data was available on oil-water basal sprays, the project was set up with the idea of varying both the concentrations of the spray material and the oil-water ratio.

Root suckering species have been very difficult to control with basal sprays because of their tendency to resprout from dormant buds occuring along the widespread laterals. (2) These dormant buds on the lateral rhizomes are induced to sprout when the parent stem is cut or chemically killed. It was thought that perhaps by varying the concentration of the oil-water ratio, some clue might be brought to light as to the best type of basal treatment to use where these plants occur in mixed brush. In many cases, locust has responded to chemical treatment by sending up enough of these root suckers to actually increase the number of living stems present on the treated area a year following the initial spray. (3)

1 American Chemical Paint Company, Ambler, Pennsylvania

Procedure:

The area selected for the test was chosen because of the uniformity of the major species occuring on the plots. It is a typical area in that several species of oaks are present along with red maple and the root suckering species, locust and sassafras. It was decided that the area should have both the root suckering plants and those that sprout at the root collar in order that the test plots would satisfactorily represent a typical right-of-way. The location of the plots was on the American Telephone and Telegraph Harrisburg-Lewistown Cable Line near Mifflintown, Pennsylvania.

The plots measured one tenth acre in size and were formed by dividing the right-of-way in half parallel to the wires in order to make a pair of adjacent test areas. There were eight treatments in the series. Sample areas one fiftieth of an acre in size were laid out in each test area. It was on these sample areas that the stem counts were made over the two year study period.

Weather conditions at the time of application, March 24, 25, and 26, 1952 were cloudy and remained below freezing while the material was applied. A pressure of 80 pounds per square inch was used and enough material was applied to cause considerable run down to ground line. Rate of application varied from 80 to 100 gallons of spray material per acre. Brush density on the area averaged about 10,000 stems per acre. 2,4,5-T ester formulation was the herbicide used in each of the spray plots.

By the evaluation of "kill" in the following tables, we mean that the plant is completely defoliated and shows no resprouting. The term "kill" as referred to in the paper may not be the best word to use, but it must suffice until a term is agreed upon by everyone in the brush field covering this problem.

Regrowth, as used in this paper, means resprouting either from canes not completely killed, root crown sprouts, or in the case of root suckering species, sprouts occuring from buds along the lateral rhizomes.

Table 1 Effects of Various Oil and Oil-Water Basal Sprays on Dormant Mixed Brush

Plot No.	Treatment	Species	First Year Results on sample plots* Regrowth	Kill	%Kill	Second Year Results on sample plots* Regrowth	Kill	%Kill
1	12 lbs. acid equiv. 2,4,5-T in oil	White Oak	7	53	90	11	48	81
		Black Oak	-	6	100	2	5	71
		Red Maple	1	14	93	5	13	72
		Locust	17	7	29	21	3	12
		Sassafras	12	10	45	16	8	33
2	12 lbs. acid equiv. 2,4,5-T in 10 gal. oil plus 90 gal. water	White Oak	2	2	50	5	1	17
		Black Oak	6	11	65	8	9	53
		Red Maple	1	19	95	6	12	66
		Locust	4	6	60	4	7	63
		Sassafras	-	6	100	3	5	62
3	12 lbs. acid equiv. 2,4,5-T in 20 gal. oil plus 80 gal. water	White Oak	-	-	-	-	-	-
		Black Oak	1	19	95	3	15	83
		Red Maple	-	9	100	3	5	62
		Locust	2	2	50	4	2	33
		Sassafras	3	8	73	22	9	29
4	12 lbs. acid equiv. 2,4,5-T in 30 gal. oil plus 70 gal. water	White Oak	1	11	92	4	7	64
		Black Oak	1	5	83	2	5	71
		Red Maple	1	12	93	3	7	70
		Locust	1	4	80	4	2	33
		Sassafras	14	30	68	8	28	37
5	12 lbs. acid equiv. 2,4,5-T in 40 gal. oil plus 60 gal. water	White Oak	13	61	82	15	54	78
		Balck Oak	5	14	74	6	11	65
		Red Maple	1	15	94	-	12	100
		Locust	2	12	81	9	8	47
		Sassafras	1	21	95	11	19	63
6	16 lbs. acid equiv. 2,4,5-T in 20 gal. oil plus 80 gal. water	White Oak	26	70	73	31	52	63
		Black Oak	4	7	63	7	4	36
		Red Maple	2	13	86	6	6	50
		Locust	27	19	41	21	18	46
		Sassafras	4	8	66	14	9	39

Table 1 (Continued) - Effect of Various Oil and Oil-Water Basal Sprays on Dormant Mixed Brush.

Plot No.	Treatment	Species	First Year Results on sample plots* Regrowth	Kill	%Kill	Second Year Results on sample plots* Regrowth	Kill	%Kill
7	8 lbs. acid equiv. 2,4,5-T in 20 gal. oil plus 80 gal. water	White Oak	28	64	70	36	52	59
		Black Oak	1	13	93	8	4	33
		Red Maple	1	13	93	4	6	60
		Locust	14	10	42	21	9	30
		Sassafras	6	18	75	17	15	47
8	24 lbs. acid equiv. 2,4,5-T in 20 gal. oil plus 80 gal. water	White Oak	18	52	71	21	42	66
		Black Oak	1	18	95	5	9	65
		Red Maple	-	17	100	3	14	82
		Locust	15	7	32	22	5	19
		Sassafras	2	29	94	58	24	29

*Stems counted on an area 1/50 acre in size located in each test plot.

Discussion: The effects of the various treatments in the test series show a well established pattern. First year results show a trend of increasing degree of kill on oak and red maple as the concentration of oil per hundred gallons of material was varied from 10 to 40 to 100 gallons. This is shown to a more marked degree in the second year results on oaks and red maple. However, both first and second year results on sassafras and locust show the best kills to be on the plot having the lowest amount of oil per 100 gallons and the poorest kill on the plot using all oil as the carrier.

Table II - Comparison of Two Year Results Using All Oil as a Carrier Versus Ten Gallons of Oil Plus Ninety Gallons of Water.

Plot No.	Treatment	Species	% Kill 1st Year Results	% Kill 2nd Year Results
1	12 lbs. acid equiv. 2,4,5-T in oil.	White Oak	90	81
		Black Oak	100	71
		Red Maple	93	72
		Locust	29	12
		Sassafras	45	33

Plot No.	Treatment	Species	% Kill 1st Year Results	% Kill 2nd Year Results
2	12 lbs. acid equiv. 2,4,5-T in 10 gal. oil plus 90 gal. water	White Oak	50	17
		Black Oak	65	53
		Red Maple	95	66
		Locust	60	63
		Sassafras	100	62

Increasing the concentration of 2,4,5-T to 24 pounds per 100 gallons had the same effect as increasing the concentration of oil. Kill was increased on oak and red maple but was decreased on locust and sassafras. (See table III.)

Table III - Comparison of Second Year Results Using Varying Amounts of 2,4,5-T in 20 gallons of oil plus 80 gallons of Water

Plot No.	Treatment	Species	Result % Kill
7	8 lbs. acid equiv. 2,4,5-T in 20 gal. oil plus 80 gal. water	White Oak	59
		Black Oak	33
		Red Maple	60
		Locust	30
		Sassafras	47
8	24 lbs. acid equiv. 2,4,5-T in 20 gal. oil plus 80 gal. water	White Oak	66
		Black Oak	65
		Red Maple	82
		Locust	19
		Sassafras	29

Therefore, we can see that by increasing either the oil to water ratio or increasing the acid content increases the effectiveness of the material on oaks and red maple but decreases its effect on locust and sassafras.

It is interesting to note the number of plants which showed no resprouting the first year but which put out new growth the second year following treatment. This should point out to us the advisability of waiting two or perhaps three years following treatment before stating that a plant will not resprout.

Summary:

A basal spray was applied during the dormant season on mixed brush. Both the concentration of the material and the oil-water ratio was varied. Approximately the same amount of spray material was applied in each treatment, ranging from 80 to 100 gallons per acre. 2,4,5-T was the material used in each case. The right-of-way consisted principally of oak and red maple with sassafras and locust occuring abundantly on all plots.

Results have indicated that on species such as oak and red maple which sprout from the root collar, best kills were obtained where high rates of oil and high concentrations of 2,4,5-T were applied. For the root suckering species, just the opposite held true, best kills resulting from the treatments where lowered concentrations of 2,4,5-T and lower ratio of oil to water were used. These facts would tend to point out to us the possibility of fitting the concentration and treatment to the areas to be treated. This trend of thought is justified by the fact that although a good kill of the parent stem of locust and sassafras resulted from the high concentration and high oil to water ratio, subsequent resprouting from lateral rhizomes resulted in an increase in number of stems over the original count.

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THE BALD EAGLE STATE FOREST RIGHTOFWAY, PENNSYLVANIA: PLANTS TAKE OVER FUTURE BRUSH CONTROL

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American Museum of Natural History, New York 24.

The botanical research described herein was initiated in 1951 under a cooperative agreement between the Pennsylvania Power and Light Company, the Pennsylvania Department of Forests and Waters, and the American Museum of Natural History. The studies are part of a 200-acre treatment which was the first fullscale commercial application of the American Museum System of Rightofway Vegetation Management, and which has now completed its third growing season.

Location. That part of the Bald Eagle State Forest involved lies in Clinton County (Green Township), Centre County (Miles Township), and Union County (Hartley and Lewis Townships) in central Pennsylvania. Physiographically the region is part of the Folded Appalachians.

Nature of the Line. The rightofway is part of the Sunbury-LockHaven 66 KV transmission line operated by the Pennsylvania Power and Light Co. It is 100 ft. wide, and extends 44,900 feet through the State Forest.

History of the Line. Brush had originally been hand-cut, and in the fall of 1950 averaged 6-10 feet in height. Although it varied greatly in quantity and abundance, the overall situation was one of "average density".

In February-March 1951, the vegetation was treated for the elimination of unwanted woody plants according to the American Museum System of leaving that permissible vegetation which most successfully resists re-invasion in subsequent years. By a standard commercial contract with the R/W Maintenance Corp., undesired species were selectively basal-sprayed, using knapsack sprayers and a mixture of 2,4-D and 2,4,5-T in oil. A follow-up spray (part of the original contract) was applied after two growing seasons, in October-December, 1952. (Such second sprays are now being deferred to a later year.)

It is not the purpose of this report to evaluate the effects of that botanical Conversion. The costs were on a competitive basis with other types of herbicide treatment, and basal spraying is now an established commercial procedure. The field applications require care and precision. They can be interrupted by weather irregularities, and there are sometimes unpredictable and local inferior results. Almost the entire line was investigated this summer, and rootkill throughout appears to have been obtained on over 95% of the plants treated. Other sections of the line were expectably reported to have living sprouts, since it was too early for the second spraying

[1]Chairman, Committee for Chemical Brush Control Recommendations for Rightofways, American Museum of Natural History.

to have taken effect. The extension northward of this transmission line has received a first treatment, and is now at the end of its second growing season. Brush was originally very dense in some parts, yet apparently over 90% of the unwanted growth in many parts has been rootkilled by this single treatment. Rootsuckering species (as opposed to stump-sprouting species) continue to be a problem with all types of herbicidal treatment.

Data Obtained. Five experimental plots have been established by the Pennsylvania Dept. of Forests and Waters. These are each 1/15 acre in extent. Complete floristic inventories have been made, and trees have been tallied and data tabulated. Two such summer studies have been made, in 1951 and 1953. Although these data have influenced the writing of this report, they are not here included.

The author has spent about 8 days on the area in observation and study. One of these days was mainly in the valley of White Deer Creek, Miles Township, the results of which support the interpretations which follow.

1. Site Types

Locally the streams and ridges extend approximately east and west, so that the slopes tend to be north-facing and south-facing, thus providing maximum site-differences for the vegetation. The power line crosses the creek at an elevation of 1440 feet, and the ridges on each side rise to about 1900 feet, providing a relief of over 600 feet. Elsewhere in the State Forest, the relief is as great as 1200 feet. Increase in elevation is here such as to favor the development of more xeric "southern" types of vegetation, and not a more "northern" vegetation.

The local conformation of the Valley and Ridge Province is such that two types of topographic cross-sections can be idealized. The first is a saw-tooth type, composed of deep cove-like valleys and sharp crests, forming a sequence of crest-midslope-cove sites. The second includes broad flat-bottomed valleys, and relatively flat high-level plateaus.

The parent material of the soils varies considerably in relation to topography, and is of great significance for vegetation. The high plateaus are thin-soiled, with frequent exposures of bedrock. The broad valleys are deep-soiled, and of various textures. Lower slopes are generally stony or rocky. They grade gradually into steep upper slopes which can be little more than stone piles.

The various combinations of topography, soil, and directional exposure produce a delicately adjusted mosaic of site-types, each of which has its own vegetational potentialities, and which must be recognized in any rational Vegetation Management program.

Certain otherwise-anomalous irregularities in the distributions of several species and plant-communities are not to be explained in terms of the factors mentioned above. At the present time - and for reasons beyond the scope of this paper for discussion - the local situation becomes comprehensible on the hypothesis that there were extensive and repeated fires in Indian days (started by the Indians themselves andor by lightning), which markedly affected the original so-called virgin conditions. These light and frequent fires would tend to be restricted to the flat-lands, either on the plateaus or the valleys. In the deep-soiled valleys, they would tend to favor grassland, and all sites might show an increase of such xeric species as pitch pine and scrub oak.

2. Forest Types

The existing forest types are a reflection of this complicated past history, in relation to the contemporary environments, and as modified by recent lumbering operations. In its simpler expressions, a pitchpine-scruboak type occupies the high rocky plateaus, and the sharp crests. In the latter case it extends over the south-facing side, but not onto the north-facing side. A chestnut oak type occurs on much of the upper two-thirds of the south-facing slope. A blackoak-whiteoak type is on the lower third of the south-facing slope. There is a hemlock-beech-yellowbirch-sugarmaple type in the coves, with tulip-tree and a Rhododendron understory, which extends up the north-facing slopes of the sawedge topography. In the broad valleys however, a red maple swamp occupies the wettest sites, and the potential beech-birch-maple-hemlock forest, presumably because of its fire history, is mixed with almost all tree species of the region. Only on the highest rockiest, north-facing slopes (where the effects of the light fires would have been at a minimum) does the northern type emerge as a hemlock-paperbirch forest.

All these forest types have their respective complexes of understories which must be separately considered in the handling of non-forest rightofway vegetation.

3. Rightofway Vegetation Types

The number of vegetationally important herbs and shrubs in this area is about forty. Of these, only about ten become important vegetational dominants. This paucity is fortunate in simplifying the rough picture of rightofway vegetation to a state less complicated than that of their corresponding forest types. The following summaries only deal with the more abundant plant communities.

A. The Scirpus cyperinus type is a relatively pure community of a swamp sedge, growing in patches up to fifty feet across. The site is under shallow water at certain seasons. There is no evidence of invasion by tree seedlings.

B. The Panicum clandestinum and P. latifolium grassland occurs on the lower soils, but small patches may be found high up on the rubble slopes. This rank grassland is knee-high, is not easy to walk through, and the accumulation of a mat of mulch is apparently a strong deterrent to invasion by other plants.

C. The Danthonia spicata (poverty grass) type is a dry thin open grassland, the most widespread and abundant of the grasslands in the region, but of local occurrence on the rightofway. As with all grasslands, it needs deep soil, and does not occur on stony lands or rubble slopes. It is typical of so-called "worn-out" soils in nearby agricultural areas. In the event that there is a suitable source of tree-seed, this grassland is open to invasion, especially by pines.

D. A Pteridium latiusculum (bracken fern) type is common on deep soils, where it may form an overstory above poverty grass, or even over low blueberries and huckleberries. The type is widely known to foresters as being detrimental to reforestation, and thus where it occurs, it should be considered relatively stable.

E. A Dennstaedtia punctilobula (hay-scented fern) type is sporadic in its occurrence, replacing Danthonia on deep soils, or existing high up on the rubble slopes. At least the denser growth on the lower slopes appears to be a deterrent to the development of new tree seedlings.

F. The low-blueberry-huckleberry type, of Vaccinium angustifolium, V. vacillans, and Gaylussacia baccata mainly, is the most abundant single type, one of the easiest to walk through, one of the most valuable for wildlife, one of the most easily destroyed by indiscriminate spraying, and one of the most resistant to forest re-invasion. It is found on almost all sites, from the high rocky plateaus and rubble slopes, to the deep-soiled lower slopes. On these deepsoiled areas however, it often appears to have been replaced by grassland types.

G. Kalmia latifolia (mountain laurel) as a type is sporadically distributed, very locally forming a 4-6 foot high community, but usually scattered among the blueberries and huckleberries. Where it occurs solidly, it is probably an all but perfect seal against reforestation.

The territories occupied by all these communities appear to be stabilized. There is no evidence at this time of any marked peripheral advance or recession in any instance. This phenomenon is of very considerable importance in a program of Vegetation Management, for it means that the mosaic of these non-forest types can be predicted in advance of chemical treatment, even when the land is relatively densely covered with tree sprouts.

H. The Comptonia peregrina (sweetfern) type is all but non-existent in the adjacent forest. It has become abundant in certain parts of the rightofway, and gives evidence of still increasing in abundance. It is found in conjunction with blueberries and huckleberries, with poverty grass, and with hay-scented fern, although it is absent from the steep rubble slopes. Its ultimate destination is still unknown.

The Jeep Road Cross-section. A Jeep road has been bulldozed along the entire rightofway. Especially on the steep upper slopes, this bulldozing has given rise to a series of linear sites that are showing interesting and indicative vegetational relationships. Four "belts" are readily recognized in terms of the dominant plants upon them. 1. The hay-scented fern belt is restricted to the "cut" margins of the trail edge, of exposed but in situ rock and soil. 2. The "cut" half of the road bed has no dominant vegetation as yet, but there are large numbers of black birch seedlings. 3. The "fill" half of the road bed is covered with Agrostis alba, and occasional tree seedlings. The entire road bed is subject to trampling, and on steep slopes it funnels the movements of deer upon it. 4. The "fill" margin of the trail edge is distinguished by sweetfern, which does not seem to invade belt 3.

Role of Deer in Brush Control. The deer population is heavy on the Bald Eagle State Forest, and now has a vital and important role in the browsing of tree sprouts which would otherwise grow up. There is a fairly large population of "young" oaks on some sites, especially on the high plateaus. These plants, rarely over 12 inches high, have root systems that may be 20, 40, or more years old, and thus are not "seedlings" even though the above-ground parts are but 1-6 years old. They are plants that have been kept down by "animal pressure", by mice in their younger stages, and by deer when larger. As long as the animal pressure remains fairly strong, these plants will give no trouble. If for some reason in the future the animal populations decline, these plants may mature. The mistake must not be made to assume that such brush is then "invading" the site. Such brush was part of the initial floristic composition, and had invaded the land at a time antecedent to the present chemical treatment.

ROLE OF PLANTS IN BRUSH CONTROL. The most important phase of this entire study was in field observations and data upon the stability of the various non-forest types. By stability is meant the resistance of the community to invasion by trees, as by germination of tree seeds and development of the seedlings. In the areas investigated, all communities except the grasslands appear to be "closed" to tree invasion except for such sporadic individuals as are not of economic importance. Birch seedlings were abundant on bare soil, but such bare soil occurred only on the jeep trail, and since the trail concentrated wildlife trampling and browsing (an important factor in trail-maintenance on rightofways), it is not thought that they will cause future trouble. The two grassland types however, Agrostis alba (redtop) and Danthonia spicata (poverty grass), although more stable than bare soil, are showing themselves incapable of resisting an invasion by trees. These two types (commonly produced by indiscriminate spraying in unplanned brush control) are present on the Bald Eagle line only in small quantities, where other plants are coincidentally absent. Aside from these grasslands however, the post-selective-spraying vegetation of the Bald Eagle rightofway - itself largely spray-sensitive - gives every evidence of being "closed" to invasion by additional tree seedlings. In other words, the plants that have been saved by selective spraying are now those which are acting as the most important single factor in future brush control.

PROGRESS REPORT ON THE EFFECT OF CERTAIN COMMON BRUSH CONTROL TECHNIQUES AND MATERIALS ON GAME FOOD AND COVER ON A POWER LINE RIGHT-OF-WAY*

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In the spring of 1953, a large-scale test of commonly-used spray techniques and chemicals was set up on a three-mile section of a new power line right-of-way of the Pennsylvania Electric Company. This section of line lies on State Game Lands between Philipsburg and Port Matilda in Centre County, Pennsylvania, and is located on the eastern edge of the Allegheny escarpment at an elevation of 2,000 to 2,100 feet. The forest cover is dominated by mixed oaks, commonly referred to as the oak-hickory forest type in Pennsylvania, which had been cleared in the winter of 1951-52 so that one growing season had elapsed between cutting and initiation of the test.

The major objective of this five-year study is to compare the effects of several common commercial spray techniques and materials on game food and cover produced on the right-of-way. A distinctive feature of this particular study is the use of large replicated treatment areas for the comparison of spray techniques which have been applied under commercial conditions. A second objective of this study is to follow the ecological changes in the plant community present on the right-of-way as a result of spraying, with a view towards comparing the types of stable covers developed. Other valuable information such as a comparison of effectiveness of sprays on various species of plants, the aesthetic desirability of the cover types developed, and the cost of maintaining the right-of-way in an acceptable vegetative cover by the various techniques and chemicals, will be obtained.

While the results of these tests will apply specifically to the extensive upland oak-hickory forests of central Pennsylvania, there are many similar forest types in the oak-chestnut regions of the eastern United States to which the results will apply in a general way. Moreover, as most of the common species present on the test area are found throughout the eastern oak forest, application of species reactions to the sprays may be made to a much wider range than the forest type involved.

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*This project is sponsored by the Asplundh Tree Expert Company, the American Chemical Paint Company, and the DuPont Chemical Company and has been carried out with the approval of the Pennsylvania Electric Company on a section of their right-of-way. Cooperating in research on the project are the Pennsylvania Game Commission and the Pennsylvania Cooperative Wildlife Research Unit.

TREATMENTS AND DESIGN OF THE TEST

The six treatments used in the study may be described as follows:

A - No spray. To be compared as a control to sprayed areas and not to be treated in any way until in need of cutting to maintain the right-of-way. Original clearance of the right-of-way was completed in the winter of 1951-52.

B - Broadcast foliage spray (D + T) in water carrier. In this treatment Weedone Industrial Brush Killer, four pounds per gallon of the butoxy ethanol esters of 2,4D and 2,4,5T, half and half, was mixed at the rate of one gallon per 100 gallons of water. The spray was applied at 300 pounds pressure using a number eight nozzle tip. This tip size and the high spraying pressure are necessary to secure thorough coverage of all stems and foliage, especially the dense brush clumps. Spray was also broadcast on all existing ground cover.

C - Summer basal spray (D + T), oil and water carrier. For this treatment formula L-182A of the American Chemical Paint Company was used containing two pounds per gallon of the emulsifiable acid of 2,4D and 2,4,5T, half and half. Three gallons of L-128A, 10 gallons of number two household fuel oil and 87 gallons of water were mixed to obtain 100 gallons of spray material. This spray was also applied at 300 pounds pressure using a number eight nozzle tip for good penetration. The spray was applied at the stumps, bases, and lower two-thirds of stems and foliage of woody brush. Complete encirclement of each stem and run down to the root crown was secured. Only woody brush was sprayed.

D - General summer basal spray (D + T), in an oil carrier. For this treatment 6 gallons of L-182A was mixed with number two household fuel oil at the rate of six gallons to 94 gallons of oil to obtain a hundred gallons of spray material. The application was a combination stump and basal treatment. Number five nozzle tips were used and the spray was applied with approximately 50 pounds of pressure to the basal twelve inches of each stem and to the exposed bark area of each stump. Sufficient material was applied to completely encircle the base of each stem and to run down to the root crown. All the brush species which attain a mature height of over six feet were sprayed. The low shrub and herbaceous ground cover was not sprayed.

E - Selective winter basal spray (T) in oil carrier. This treatment is to follow the recommendations of Dr. Frank E. Egler as a selective type of spray designed to remove only trees and shrubs that threaten to interfere with line maintenance and to create a stable cover of which shrubs will form a prominent part. The spray will be applied in February to March of 1954. Further details on this technique will be given in a later report after application has been made.

F - Broadcast foliage spray (Ammate) in a water carrier. For this treatment 80 per cent of ammonium sulphamate was mixed with water at the rate of three-quarters pounds per gallon. DuPont sticker spreader was added to this mixture, 4 oz. per 100 gallon. The Ammate spray was applied with 300 pounds pressure using number eight nozzle tips to insure thorough coverage of all stems and foliage of the existing brush.

The treatments described above were applied commercially between June 9 and July 1, 1953, by the Asplundh Tree Expert Company, with the exception of Treatment E which as noted will be applied later by the R/W Maintenance Corporation.

Although cost comparisons of spray techniques using materials and labor, only, do not give the entire picture of the cost of a spray operation, they are given here for comparative purposes so that some relative evaluation of the treatments may be made (Table 1).

TABLE 1. Summary of treatments applied June 9 to July 1, 1953 on the Penelec R/W.

Treatment	Number replications	Total acreage treated	Average gallons per acre	Average man hours per acre	Average spray truck hours per acre
A – No spray	4	8.6	–	–	–
B – Broadcast foliage spray (D + T), water	4	8.43	460	7.23	2.41
C – Summer basal spray (D + T), oil and water	4	10.08	345	7.11	2.37
D – General summer basal spray (D + T), oil	4	9.82	140	11.61	3.87
E – Selective winter basal spray (T), oil	4	10.50	–	–	–
F – Broadcast foliage spray, Ammate	4	12.65	415	7.05	2.35

The general design of the tests was kept as simple as possible. Each treatment was repeated in each of four randomized blocks, thus giving four replications per treatment. The blocks were selected so as to include a uniform plant community within each block, while blocks were allowed to vary somewhat from each other in plant community composition. The treatment areas varied from 1.9 acres to 3.9 acres in area, covering from 460 to 940 feet of a 180 foot-wide right-of-way.

Within each treatment area, two types of sample plots were taken for detailed analysis of the vegetation. One type of sample plot consisted of one randomly-located plot per treatment area, each plot being 33 feet wide by 165 feet long extending perpendicular to the right-of-way and subdivided into five, 33 foot by 33 foot subplots. The entire plot is a transverse belt transect while the subplots were taken in case it becomes desirable later to analyze edges and centers separately. Data were taken on the belt transect using the combined estimate of Braun-Blanquet (1) for community analysis. In addition, counts were made of all stumps and stump sprouts on the plots for purpose of determining the effect of sprays on tree and shrub species.

An additional set of 33 foot by 165 foot belt transects were placed in the forest adjacent to the right-of-way at several points to get information on the species composition of the various layers of the uncut forest in the area.

The second type of plot in each treatment area were five, 100-foot line transects mechanically spaced to divide the treatment area in equal parts, each extending from the edge of the right-of-way past the center. The method of Canfield (2) was followed in taking data on the cover value of species by layers on these line transects and consisted essentially of measuring the ground space occupied by each plant on the line.

ANALYSIS OF THE PLANT COMMUNITY ON TREATMENT AREAS BEFORE SPRAYING

The plant community present on the area studied was a typical sample of upland oak-hickory forest common to a large section of the oak-chestnut forest region. It has been separated for analysis into three layers, a tree layer (above 8'), a shrub layer (2' - 8'), and a ground layer (below 2').

In the forest before the right-of-way was cleared, the tree layer was dominated by white oak, red oak, black oak, and chestnut oak. Red maple and sassafras were abundant. Hickory, black gum, black cherry, Juneberry, flowering dogwood, aspen, and scarlet oak were constantly present but sparse.

The shrub layer was dominated by witch hazel and sassafras. Bear oak, mountain laurel, maple leaf viburnum, and chestnut sprouts were characteristically present, along with saplings of the species in the tree layer.

The sparse ground layer was composed of numerous tree seedlings, shrubs, herbs, sedges and grasses. The common shrubs were blueberries, huckleberry, deerberry, and wintergreen. Blackberry, dewberry, azalea were also constantly present along with seedlings of species common in the shrub and tree layers. Common herbaceous and grasslike plants present were bracken fern, vernal sedge, wild sarsaparilla, loosestrife, and panic grasses.

The right-of-way, in the second growing season after its original cutting, possessed the same species as the former forest, with a few new additions representing plants that invade forest openings and clearings such as sweetfern and fireweed. The common plants, which dominated the shrub and ground layers on the right-of-way at the time of spraying, formed a plant community that was highly constant in species composition on all treatment areas.

The shrub layer on the right-of-way was dominated by the clumps of tree sprouts that arose following cutting. Five oaks (white, red, black, chestnut and bear oaks) were present on all treatment areas. Also present were red maple, sassafras, witch hazel and chestnut. Certain other species such as Juneberry, aspen, wild cherry, blackberry, hickory, flowering dogwood, scrub chestnut oak, black gum, scarlet oak, mountain laurel, chokeberry while not present on all plots were found in at least one replication of each treatment.

The ground layer on the right-of-way was dominated by vernal sedge and bracken fern along with the low shrubs; blueberries, huckleberries, deerberry and wintergreen. This dense layer covered 80 to 100 per cent of the ground area. Panic grasses, loosestrife and wild sarsaparilla were abundant but of small cover value on all treatment areas. Tree seedlings of red maple, sassafras and witch hazel were common, while the various oaks were sparse but constantly present in ground layers on all treatment areas.

EARLY EFFECTS OF SPRAYS ON THE PLANT COVER

All sprays caused an 80 to 100 per cent foliage kill of all species combined (Table 2). In fact, only three out of seventeen common species had less than 90 per cent kill; the most resistant being mountain laurel with an 80 to 90 per cent kill.

TABLE 2. Summary of the early effect of sprays on common trees and arborescent shrubs; spray applied in June, 1953, and data taken in September, 1953.

	T O P K I L L					
	Per cent of foliage killed per sprout clump		Per cent of stem killed per sprout clump			
Treatment	Average	Range	1/4 stem	2/4 stem	3/4 stem	4/4 stem
A – No spray	–	–	–	–	–	–
B – Foliage (D + T) water	98	80–100	36	8	11	45
C – Summer basal (D + T) oil and water	98	80–100	14	13	19	54
D – General summer basal (D + T) oil	97	80–100	3	1	5	91
E – Selective Basal (T) oil	–	–	–	–	–	–
F – Foliage (Ammate) water	98	80–100	24	31	12	33

Although there was little difference between sprays in respect to their effect on the foliage of sprout clumps, when stem kill was considered a marked difference between sprays showed up. Observations on stem kill were obtained by examining the stem of each species and taking brown discoloration of the inner bark as "kill". In Table 2, 1/4 stem kill indicates that 1/4 of the total stem at the top was killed, 4/4 means the entire stem was dead. It may be noted that Treatment D, summer basal with oil as a carrier, caused the most complete stem kill of all species combined. However, it is expected that there may be some further stem kill over the next year as a delayed effect of the sprays.

SUMMARY

A replicated series of treatments have been set up on a three-mile section of a power line right-of-way designed to compare the effects of the spray application on game food and cover of an upland oak-hickory forest cover type. These treatments include a summer foliage spray with 2,4D + 2,4,5T, a foliage spray with Ammate, a summer basal spray with D + T in oil and in oil-water carriers, and a selective winter basal spray. A uniform plant community has been described covering the right-of-way at the time of spraying. All sprays caused a foliage kill of from 80 to 100 per cent, but stem kill varied. The highest per cent of stem kill was obtained from the general summer basal spray of D + T in an oil carrier.

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THE GRASSY RIGHTOFWAY: INVITATION TO COSTLY RESPRAYING

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The Problem. Determination of the most suitable vegetation cover for rightofways in eastern forested regions is an item of considerable importance to the land owner and the land manager. Although secondary values, such as those of wildlife, ornamental plants, and fire hazards, are often significant, consideration in this paper will be restricted to the primary needs of the utility corporation - those of physical suitability, and actual costs.

As in all operational procedures, materials and methods determine the choice of results. With the chemicals now available, and with the opposing techniques of (a) blanket spraying, whether or not followed by selective spraying, and (b) selective spraying alone, two contrasting vegetation types are obtainable by standard commercial procedures: the so-called "grassland", and the so-called "shrubland". Natural and seminatural vegetation varies tremendously from region to region and from site to site, and consequently generalizations must be accepted with their limitations. The grassland (of grasses or grass-like plants) is generally a sod one to two feet high, but it may vary from dense masses seven feet high and more, to low swards less than two inches in height. In some instances, as on certain steep and acid slopes, no grasses at all will grow, and the land would be bared by the treatment elsewhere producing grassland. The shrubland is composed not only of shrubs of varying height down to two feet and less, but with varying admixtures of broad-leaved herbs, and patches of grasses wherever other plants do not occur. Obviously, many shrubs are too tall and rank to be permitted in the central part of the rightofway, and consequently the designing of such a shrubland includes their removal where necessary, and the creation of a practicable foot- or truck-trail.

The majority of recommendations from manufacturers and contractors have favored the side-to-side grassland. This is understandable because of its photogenic advantages, and for the operational facility of using relatively unskilled labor already available. To my knowledge, these recommendations have not been based on the advice of botanists, the botanical literature has not been consulted, their botanical observations have been restricted to the few years of such commercial treatment, and no botanical analysis has ever been made and published of such an herbicide-induced grassland.

In view of the fact that the problem is a botanical one, this paper has been prepared as a summary of certain botanical data. These data have not been accumulated to support one side of a supposed controversy. They have been gathered to bear impartially upon the problem of whether grasslands or shrublands (within the physical needs of the rightofways) most successfully

[1]Chairman, Committee for Chemical Brush Control Recommendations for Rightofways, American Museum of Natural History.

retard reinvasion by tree seedlings, and thus are cheapest to maintain.

Sources of Data. It is impossible to acknowledge all the sources of information which guide me in certain generalizations. Those generalizations are related to the backgrounds developed in preparing for a textbook in vegetation science, and for a map of North American vegetation types. In addition there have been the activities of the Vegetation Bibliography of the Americas, as well as field experience in the other continents and in all 48 states. More specifically, there has been continuing field experience at an area in northwestern Connecticut since 1927. All botanical details mentioned below however stem from studies at 22 research areas in 11 states, extending from Vermont to Florida, all including chemically-induced vegetation types. These studies are being run with the cooperation of other organizations, including: a utility corporation, a spraying contractor, a radio station (oldest public demonstration project), a sand and gravel company, a state forest, a boy scout camp (with a low shrubland stable since 1936), a nature education center, an experimental watershed, and federal experimental forests.

Data. The following tree species have been investigated sufficiently to permit an estimate of their vegetational status: Pinus strobus (white pine), Pinus palustris (longleaf pine), Pinus caribaea (slash pine), Pinus taeda (loblolly pine), Pinus rigida (pitch pine), Pinus echinata (shortleaf pine), Pinus virginiana (scrub pine), Larix laricina(tamarack), Picea mariana (black spruce),Picea rubens (red spruce), Tsuga canadensis (hemlock), Abies balsamea (balsam fir), Taxodium distichum (bald cypress), Taxodium ascendens (pond cypress), Thuya occidentalis (white-cedar), Juniperus virginiana (red-cedar), Populus tremuloides (quaking aspen), Populus grandidentata (bigtooth aspen), Populus tacamahacca (balsam poplar), Populus deltoides (eastern cottonwood), Salix nigra (black willow), Juglans cinerea (butternut), Juglans nigra (black walnut), Carya cordiformis (bitternut), Carya ovata (shagbark hickory), Carya glabra (pignut hickory), Carpinus caroliniana (blue-beech), Ostrya virginiana (hop hornbeam), Betula lenta (black birch), Betula lutea (yellow birch), Betula nigra (river birch), Betula populifolia (gray birch), Betula papyrifera (paper birch), Fagus grandifolia (beech), Quercus borealis (northern red oak), Quercus coccinea (scarlet oak), Quercus velutina (black oak), Quercus catesbaei (turkey oak), Quercus falcata (southern red oak), Quercus marilandica blackjack oak), Quercus nigra (water oak), Quercus phellos (willow oak), Quercus cinerea (bluejack oak), Quercus virginiana (live oak), Quercus stellata post oak), Quercus alba (white oak), Quercus montana (chestnut oak), Ulmus americana (American elm), Ulmus alata (winged elm), Ulmus fulva (slippery elm), Celtis occidentalis (hackberry), Morus rubra (red mulberry), Magnolia acuminata (cucumber-tree), Magnolia virginiana (sweet bay), Magnolia tripetala (umbrella tree), Liriodendron tulipifera (tulip-tree), Persea palustris (swamp bay), Sassafras officinale (sassafras), Liquidambar styraciflua (red gum), Platanus occidentalis (sycamore), Malus pumila (apple), Amelanchier spp. (tree service-berries), Crataegus spp. (hawthorns), Prunus pensylvanica (pin cherry), Prunus serotina (black cherry), Gleditsia triacanthos (honey locust), Robinia pseudoacacia (black locust), Ailanthus altissima (ailanthus), Acer saccharum (sugar maple), Acer saccharinum (silver maple), Acer rubrum (red maple), Acer negundo (box-elder), Tilia glabra (basswood), Nyssa sylvatica (black gum), Nyssa aquatica (tupelo gum), Oxydendrum arboreum (sourwood), Diospyros virginiana (persimmon), Fraxinus americana (white ash), Fraxinus pennsylvanica (red and green ashes), Fraxinus nigra (black ash).

The following common shrub species have been similarly investigated: Juniperus communis (low juniper), Serenoa repens (saw palmetto), Smilax rotundifolia (greenbrier), Smilax glauca (greenbrier), Salix cordata (willow), Salix discolor (pussy willow), Salix humilis (prairie willow), Salix bebbiana (Bebb's willow), Salix sericea (silky willow), Comptonia peregrina (sweetfern), Myrica cerifera (waxmyrtle), Corylus americana (American hazel), Corylus cornuta (beaked hazel), Alnus rugosa (northern alder), Alnus serrulata (southern alder), Castanea pumila (chinquapin), Quercus ilicifolia (scrub oak), Quercus prinoides (chinquapin-oak), Berberis canadensis (American barberry), Berberis vulgaris (common barberry), Asimina triloba (pawpaw), Lindera benzoin(spice bush), Hydrangea arborescens (wild hydrangea), Hamamelis virginiana (witch-hazel), Spiraea latifolia (meadowsweet), Spiraea tomentosa (steeple bush), Aronia arbutifolia (red chokeberry), Aronia melanocarpa (black chokeberry), Amelanchier spp. (low shadbushes), Rubus allegheniensis (blackberry), Rubus occidentalis (black raspberry), Rubus idaeus (raspberry), Rubus odoratus (flowering raspberry), Rosa spp. (wild roses), Prunus allegheniensis (Allegheny plum), Prunus americana (wild plum), Prunus virginiana (choke cherry), Crataegus spp. (hawthorns), Cercis canadensis (redbud), Rhus copallina (winged sumach), Rhus typhina (staghorn sumach), Rhus glabra (smooth sumach), Ilex opaca (American holly), Ilex verticillata (winter berry), Ilex glabra (gallberry), Euonymus americana (wahoo), Celastrus scandens (bittersweet), Staphylea trifolia (bladdernut), Ceanothus americanus (New Jersey tea), Vitis spp. (grapes), Parthenocissus quinquefolia (Virginia creeper), Hypericum spp. (shrubby hypericums), Cornus florida (flowering dogwood), Cornus stolonifera (red osier), Cornus rugosa (round-leaved dogwood), Cornus amomum (silky dogwood), Cornus racemosa (panicled dogwood), Cornus alternifolia (alternate-leaved dogwood), Clethra alnifolia (pepperbush), Clethra tomentosa (white-alder), Rhododendron maximum (rhododendron), Rhododendron nudiflorum (pink azalea), Rhododendron roseum (pink azalea), Rhododendron viscosum (white swamp azalea), Kalmia latifolia (mountain laurel), Kalmia angustifolia (sheep laurel), Lyonia ligustrina (male-berry), Gaylussacia baccata (huckleberry), Gaylussacia frondosa (dangleberry), Vaccinium stamineum (deerberry), Vaccinium vacillans (low blueberry), Vaccinium angustifolium (low blueberry), Vaccinium corymbosum (tall blueberry), Symplocos tinctoria (sweetleaf), Gelsemium sempervirens (yellow jessamine), Callicarpa americana (French-mulberry), Campsis radicans (trumpet-creeper), Bignonia capreolata (cross-vine), Cephalanthus occidentalis (buttonbush), Sambucus canadensis (elder), Sambucus pubens (elder), Viburnum alnifolium (hobblebush), Viburnum cassinoides (wild-raisin), Viburnum lentago (nannyberry), Viburnum rafinesquianum (downy arrowwood), Viburnum nudum (possum-haw), Viburnum dentatum (arrowwood), Lonicera japonica (Japanese honeysuckle), Symphoricarpus orbiculatus (coralberry), Diervilla lonicera (bush honeysuckle).

Although the number of grasses identified is large, the number of grassland communities has so far proven unexpectedly few. In the Northeast and Central East, the species which most frequently dominate (excepting those of swampy areas) are: Agrostis alba (redtop), Festuca rubra (red fescue), Anthoxanthum odoratum (June grass), Andropogon scoparius (bunch grass), Andropogon virginicus (broom sedge), Panicum clandestinum and P. latifolium (panics), Danthonia spicata (poverty grass), and Carex pensylvanica (a sedge).

In the far South, the following genera, represented by several species each, are most abundant: Aristida spp. (wire grass), Sporobolus spp. (wire grass), Andropogon spp. (broom sedges), Paspalum spp., Panicum spp. (panics), Sorghastrum spp.

Of the very large number of forbs (i.e., herbs not grasses) encountered in these areas, only the following goldenrods have been observed to form dense relatively pure stands: Solidago altissima, S. aspera, S. canadensis, S. graminifolia, S. juncea, and S. rugosa. The following ferns do likewise: Onoclea sensibilis (sensitive fern), Dennstaedtia punctilobula (hay-scented fern), Pteridium aquilinum (bracken), and Aspidium noveboracense (New York fern).

The relative stability of shrublands. To date, no shrub type has been observed to act as a nurse crop for an invading forest generation in the eastern states (though they are known elsewhere). Although mixtures of trees and shrubs are constantly found, it would appear that most such trees originated coincident with, or previous to, the shrubs. This situation has long been recognized by foresters, who consider even a low-shrub stage a deterrent to reforestation in the coastal plain. In the southern Appalachians, the Rhododendron thickets are a major silvicultural problem; while on certain summits, the "slicks" of laurels and rhododendrons have survived since Indian days. One might add that the East Anglian heaths, where the forests were destroyed in Roman times, are still heaths.

The relative stability of grasslands. Of all the shrubs listed above, and seed of which is constantly being showered on grasslands, the only shrub species which has been observed to be capable of mass invasion of any grassland is Comptonia peregrina, the sweetfern, and its invasion is possibly by underground parts. Certain other species can invade marginally by such underground parts, but there are almost no data on the rapidity of such invasions, and the present indication is that it is not rapid.

In the consideration of trees that can invade grassland, we have a markedly different picture. In the first place, many of the hardwoods (as oaks and hickories) commonly thought to be "invading" grassland and pineland are found to be not seedlings, but small sprouts from old root systems. The root systems date from long-past disturbances, and in some instances are believed to be even pre-agricultural in origin.

Most of the tree species listed above have not been observed as seedlings in grass, even though they may be abundant in the adjacent landscape. The following, and only the following, trees can invade grassland: Pinus strobus (white pine), Pinus palustris (longleaf pine), Pinus caribaea (slash pine), Pinus taeda (loblolly pine), Pinus rigida (pitch pine), Pinus echinata (shortleaf pine), Pinus virginiana (scrub pine), Betula populifolia (gray birch), Ulmus americana (American elm), Ulmus fulva (slippery elm), Liriodendron tulipifera (tulip-tree), Acer saccharum (sugar maple), Acer rubrum (red maple), Fraxinus americana (white ash). Of these fourteen trees, the pines are by far the most active. Invasion by elms, maples, ashes, birches, and tulip-tree is more sporadic, though it may be locally abundant. To some extent, this invasion depends on the apparent density of the grassy vegetation. Such density is directly correlated with the facility with which one can walk through it. The more desirable for walking, the more "open" for tree seedlings. All such tree invasion is dependent on the presence of nearby parent seed trees, and it is only relatively rarely that no individuals of such species are in the vicinity. This situation has long been recognized among botanists. Even in commercial brush control, the invasion is well established. In Virginia, for example, a rightofway program includes a respraying once every five years for invasioninto a chemically-induced broom-sedge cover of scrub pine (unfortunately resistant itself to these sprays).

CONCLUSIONS. It is impossible to compare on a statistical basis the relative stabilities of blanket-sprayed grassland and selectively sprayed shrubland, since many such shrublands (comparable to what can be produced by chemicals) have lasted 15, 50, 250, 2000 years, and are still continuing. Certainly there are other shrublands which are not that stable, and certain tropical ones are ideal nurse crops for reforestation. To the contrary, many grasslands on the uplands of the East everywhere show evidence of being short-lived. As with any vegetational phenomena, one cannot make exact predictions, for reforestation is dependent on many variables including seed production and migration, germination and seedling success.

Since commercial procedures for producing grassland and shrubland are on a cost-competitive basis, the field evidence points conclusively towards the desirability of the low shrubland type of vegetation. Furthermore, since trees rather than shrubs return into the grassland, unjustified recommendations to produce that grassland may result in the relatively permanent destruction of a valuable asset for the land owner, and in an unbreakable cycle of undesirable circumstances that otherwise would not have occurred.

EXPERIMENTS WITH DALAPON IN CONTROLLING SEVERAL GRASS PROBLEMS OF RAILROADS

By
L. L. Coulter[1]

Vegetation control in railroad ballast and berm areas is one of the major problems confronting maintenance engineers. These men are continuously combatting roadbed vegetation in an attempt to improve the drainage of ballast, reduce safety hazards, facilitate maintenance and car inspection as well as improve employee relations by giving train crews a dry place to walk and one relatively free of snakes, sandburs and greasy weeds. A successful weed control program also is valuable in regard to public relations through improvement of appearance and control of noxious weeds. While many weed control programs have been developed for control of specific problems in agricultural areas these techniques have not been completely successful in controlling the aggressive mass of heterogeneous vegetation that invades the railroad roadbed. In recent years 2,4-D has given the maintenance engineer a valuable tool for economically killing broadleaved weeds which invade the roadbed and TCA has been moderately successful in controlling grasses. The recent development of DALAPON[2] as a chemical control agent for grasses has provided the railroad industry with a potentially new tool for attacking this problem of roadbed maintenance. Early tests[3] with this compound in small-scale field plots indicated its promise and in order to properly evaluate its usefulness in the railroad field, limited tests were conducted on railroad roadbeds in 1952. These were followed by more extensive applications in a number of areas during 1953.

Test Equipment and Methods

1953 tests have been conducted in eastern and southern states including New York, Virginia, Michigan, Minnesota, Florida, Georgia and Louisiana. A special test sprayer was designed and built for this test work. The spray unit is essentially a small-scale roadbed sprayer with a sixteen and one-half foot boom. It is mounted on standard flange wheels and has a pipe frame which can be telescoped in order to save space on the one-ton truck which carries

[1]Agricultural Chemical Development, The Dow Chemical Company, Midland, Michigan.

[2]DALAPON is the common name for α,α-dichloropropionic acid.

[3]U.S. Patent No. 2,642,354.

it to the various experimental areas. In application work the speed of this unit is measured by a large automobile speedometer which is driven by a belt connection off the axle. Other features include a water meter, jet agitation, swivel joint connections in the boom and a high capacity pump. The unit is not self-propelled, however, it is light enough to be easily drawn by a small section car. Standard application in these tests was 320 gallons per two-acre mile at six miles per hour and 30 pounds pressure. The output of the centrifugal pump for that type of application is 32 gallons per minute.

Most of the tests reported in this paper were set up in such a way that each plot constituted an area 16 1/2 feet wide and 312 feet long (eight 39 foot rails). A length of one to two rails, depending on vegetation, was left between plots for a check area. Each treatment was repeated after skipping two to three plots. In this manner, for example, treatments A, B, C and D might have been applied consecutively down the track, then the series would be repeated to give a more representative sampling of the vegetation.

Results

The results of an experiment near Savannah, Georgia are typical of those obtained in other areas of the country. In this instance a test of DALAPON and DALAPON in combination with other herbicides was applied with the small test unit on April 26, 1953. This test was applied in an area of Seaboard Airline roadbed where the predominant vegetation was Bermuda grass. Data were taken on these plots on July 29 and again on October 22. The data on this experiment are presented in Table 1. The figures in this table represent mean estimates of kill by two people and include mean values for both replicates of the plots.

Table 1: Percent Kill of Bermuda Grass in Savannah, Georgia Tests Three Months and Six Months After Treatment.

Material	July 29, 1953 (3 months) Lbs.acid equiv./2 A.mile						October 22, 1953 (6 months) Lbs. acid equiv./2 A.mile					
	20	40	60	80	100	160	20	40	60	80	100	160
DALAPON (salt)	74	83	88	95			35	83	85	93		
DALAPON + 2,4-D* + penta** + oil	40	69	88	88			10	28	50	70		
DALAPON + 2,4-D	30	55	89	88	89		10	35	80	87		
TCA				15		46				12		65
TCA + penta + oil + 2,4-D				20		56						

* Where indicated the amine salt of 2,4-D was applied at 8 pounds acid equivalent per two-acre mile

** Where indicated pentachlorophenol applied at 16 pounds per two-acre mile and 40 gallons of fuel oil per two-acre mile.

These data indicate that DALAPON is an effective agent for the control of Bermuda grass in railroad ballast and berm areas. One application of the higher rates has given a high degree of actual kill and suppression throughout the growing period. It is evident that suppression may be obtained for a short time with low dosages (40 pounds per two-acre mile), however, this effect may be dissipated soon with little actual kill resulting. The optimum dosage under these conditions appears to be 60 to 80 pounds per two-acre mile. The latter rate gave good control through October, however, it is quite possible that a second application might be required to keep the roadbed completely bare of grasses, particularly in areas of heavy rainfall.

The data further indicate that the combination containing pentachlorophenol which produced a very rapid "burn" of the foliage reduced the amount of grass kill where the lower rates of DALAPON were used. This reduced action was not evident where the higher DALAPON rates were used. It has been established that DALAPON does not translocate through dead tissue and it is quite evident that contact agents which kill tissue quickly prevent the movement of DALAPON in the plant. This observation has been substantiated by results of tests in other railroad and agricultural areas where DALAPON has been used in combination with contact agents. On the other hand, the apparent reduction in activity of low DALAPON dosages by 2,4-D alone though present in one other field test, has not been adequately substantiated by field or laboratory experiments. It does not appear to be important where recommended dosages of DALAPON are used.

A similar test was applied on the Chesapeake and Ohio Railroad near Lansing, Michigan on May 25, 1953. Grasses infesting the roadbed were primarily quack and bluegrass. These plots were rated on August 1, 1953 and October 12, 1953 and the ratings are presented in Table 2.

Table 2: Percent Kill of Bluegrass and Quackgrass in Michigan Tests Two and Four and One-Half Months After Treatment

Material	August 1, 1953 (2 months) Lbs. acid equiv./2 A.mile				October 12, 1953 (4.5 months) Lbs. acid equiv./2 A. mile			
	20	40	60	80	20	40	60	80
DALAPON (salt) + 2,4-D* + penta** + oil	38	68	87	90	20	40	75	95
DALAPON + 2,4-D	55	70	77	80	20	30	45	80

* Where indicated the amine salt of 2,4-D was applied at 8 pounds acid equivalent per two-acre mile.
**Pentachlorophenol applied at 16 pounds per two-acre mile and oil at 40 gallons per two-acre mile.

In this test as in the Savannah test, sixty and even forty pounds of DALAPON gave a fair degree of control during the early part of the summer while the higher dosages gave satisfactory control of grasses throughout the season. Bluegrass appeared to be more easily controlled than quack. It is important to note that the early control of these grasses was obtained even though the local area underwent a rather severe early summer drought with less than three inches of rain during June and July. Similar results were obtained on Bermuda grass near Vicker, Virginia in 1952 where dosages of 40, 60 and 80 pounds of DALAPON per two-acre mile gave effective control though little more than a trace of rain fell over a three month period following application. These observations, when considered with those of agricultural workers, lend support to the hypothesis that while DALAPON action may be influenced by weather conditions it is not wholly dependent upon ideal conditions.

Results On Other Species

Johnson Grass:

DALAPON (sodium salt) has been applied to Johnson grass in five 10-mile tests using standard commercial sprayers. These tests were applied in cooperation with the Louisville and Nashville Railroad and Spray Services, Incorporated. In this instance DALAPON at 40 pounds per two-acre mile plus 2,4-D gave some kill of Johnson grass, good suppression of regrowth, and the surviving plants were stunted, deformed and showed the typical growth abnormalities associated with DALAPON. At 80 pounds per two-acre mile similar results were obtained, however, more Johnson grass was actually killed and suppression was more complete. While these applications were made during mid-summer and restricted regrowth the remainder of the year, it is probable that it would be necessary to make two applications a year if the first one was made earlier in the season. A test of DALAPON at 40 pounds per two-acre mile in combination with sufficient pentachlorophenol to give severe contact kill was ineffective in controlling Johnson grass.

Phragmites communis (giant reed):

An early summer application of DALAPON on phragmites growing along the Delaware, Lackawanna and Western Railroad in New Jersey showed considerable promise in controlling this specie. Good top-kill and suppression of regrowth were obtained, however, final evaluation of root-kill must be made during 1953.

General

It is not within the scope of this paper to present the results of all small-scale or semi-commercial railroad tests with DALAPON. However, the observations presented here are in general agreement with results of other tests and all have established the merit of DALAPON as a control agent for grasses. Since it usually is effective on grasses only, sprays for general vegetation control should contain another component for broadleaf weed control. 2,4-D has been used successfully for this purpose. The most effective combination appears to be 80 pounds of DALAPON and eight pounds of 2,4-D. Lower dosages of DALAPON may be useful in some areas depending upon the degree of control desired. In most southern areas two applications of the DALAPON - 2,4-D combination may be necessary, however, in the northern areas one application per year has been promising.

Tests have indicated that it is important to avoid spraying grasses too early: that is, before all new growth has emerged and has developed considerably. An example of this was noted in an experiment on the Norfolk and Western Railroad near Crewe, Virginia. Here DALAPON was applied early in the spring. At this time only a few shoots of Bermuda grass had emerged. Those that had emerged were killed and some kill of the rhizomes from which they originated was obtained. However, moisture conditions apparently were not suitable for DALAPON to act through root absorption and with inadequate top-growth for leaf absorption control in all treatments was poor.

While DALAPON now is a grass control agent of proved merit, it should be pointed out that grasses are very aggressive forms of vegetation. Complete eradication is not a matter of one or two treatments in most instances and in this respect grass control is similar to brush control. However, DALAPON appears to be the most efficient chemical available for this problem. Limited quantities of DALAPON (sodium salt) will be available for industrial grass control in 1954.

In addition to the railroad companies mentioned in the text this experimental work has been made possible through the cooperation of the Atlantic Coast Line Railroad, the Southern Railroad and the Northern Pacific Railroad and the R. H. Bogle Company. Sincere appreciation is expressed to these companies for their cooperation in this test program.

Public Health Significance of Ragweed Control

Miriam Sachs, M.D., M.P.H. [/1]

At these annual conferences, there is generally a speaker to emphasize the public health significance of ragweed control. I hope this does not mean that there is some doubt in your minds as to the importance of weed control programs. If it is justification of public health import that is needed, the case is so right and so clear-cut that no vestige of doubt should remain that the control of pollen is a problem of considerable stature in public health activities.

It is generally accepted today, that a health problem becomes a public health problem when, due to its characteristics or methods for control, it may be solved only by systematic community or social action. Our concepts of control of public water supplies, sewerage systems, communicable diseases such as tuberculosis, smallpox and syphilis fit readily into this definition; modern public health is just beginning to include other health problems into the category of official agency action.

From the many biological and sociological forces contributing to our relative feelings of wellness and illness, some selection must be made as to which is of sufficient seriousness to merit specialized attention and concerted action. Doctor Harry Mustard, in his excellent monograph Government in Public Health[1] has outlined the factors that express the seriousness of a public health problem and the factors that should determine the make-up of a public health program. Annual mortality and morbidity rates serve as a rough measure of the severity and extent of a disease problem. The mortality rate from hay-fever alone is probably not one of our leading causes of death -- in fact the mortality figures are likely to be very low but when asthma develops as a sequelae, as it has been reported to occur in 30-40% of hay-fever sufferers, (2),(3) mortality is greatly increased. Mortality among men with asthma has been found to be about 64% in excess of the Basic Mortality Table[4].

Since hay-fever is not among our reportable diseases, our morbidity figures are scant and those we have are not too recent. However, as a result of the National Health Survey conducted by the United States Public Health Service in 1935 and 1936, hay-fever and asthma were listed as fourth in prevalence among chronic diseases[5]. The most recent figures of which I have any knowledge were collected by the New Jersey State Department of Health's Air Sanitation unit in October 1952 during a small survey to determine the possible health effects of industrial air pollution. In a group of 50 families living in an area adjacent to several large industrial plants and in a control group in a far-distant community data were collected concerning hay-fever occurrence to obtain a crude differential diagnosis on symptoms of eye and nose irritation. In the two groups of approximately 180 persons each, of all ages, hay-fever was reported to occur twice in the target group, and 10 times in the control group, 1.1% and 5.5%, respectively. These figures are not very different from the ranges of prevalence reported

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in other papers (2%, 3%, 5%, 10%, etc.)(6). There seems to be little doubt that a substantial segment of our population suffers each year, with terrifying regularity, from a disease complex which causes severe and incapacitating symptoms, and an immeasurable amount of loss of time and efficiency.

Having established that our problem is serious, it still behooves us to define the criteria by which we shall determine whether or not this problem is to be included in the program of a Public Health Agency. Perhaps the two most important considerations here are:

1. The scientific knowledge available for prevention or control of the disease, and

2. the applicability of scientific knowledge.

The availability of knowledge is an essential characteristic of a successful, well-balanced public health program. Failure to consider this factor has often caused many brave and worthy efforts to limp and falter and finally fade away into distasteful oblivion. Certainly, we all are ready to admit that, for example, arthritis and certain of the mental diseases are more serious than hay-fever, but actually what can we do about them? Despite a few gaps in our knowledge of hay-fever occurrence and its control, no one can deny that we know the cause or agent, we know how the agent reaches the human host, and we know how to interpose the barriers that will intercept or dissipate the effects of the offending agent. In the literal medico-legal sense, a public health administrator might be termed "negligent" who did not put this wealth of knowledge to work.

In the ability and practicability of applying our available knowledge, we are again very fortunate. If we do our jobs properly, none of the factors that might mitigate against the application of available information, should hinder the team efforts in ragweed pollen control. These possible factors would be:

1. The offending agent might be so disseminated or masked that it would be difficult to discover foci of infection.

   This situation is true in the attempts to eradicate infected ticks in Rocky Mountain Spotted Fever, infected ground squirrels in sylvatic plague, and isolate apparently well carriers in poliomyelitis. The recognition of giant and dwarf ragweed, and the identification of ragweed pollen is in a different category. Other members of the New Jersey State Department of Health weed control unit will tell you in later papers, about this part of the problem.

2. Control might involve procedures that would infringe upon the legal rights of individuals. In the present state of our ability to quarantine or impose regulations, we cannot force a mild case of influenza to stay home, or a housewife to keep custards and mayonnaise in the refrigerator. Weed spraying can be approached with a different philosophy. Of this too, more later.

3. The cost of the investigation and control activities:

   Cost and operating budgets are very real factors in the success or failure of health department programs. Lack of hospitals and nursing personnel seriously impairs the effectiveness of control programs in tuberculosis and mental illness. The almost prohibitive cost of analytical field and laboratory equipment in air pollution work limits the number and extent of areas covered. Weed spraying operations may be fitted comfortably into health department programs "on a limited budget". The actual costs and estimates for sprayers, spraying equipment and weed-killers will be discussed by Mr. Zemlansky and other speakers as this conference moves along.

4. Indifference or opposition by the public:

   Indifference, rather than real opposition, has probably slowed the application of ragweed control activities more than any other factor. This indifference is the responsibility of all of us here today. We have not translated our interest and information into the simple terms necessary to arouse public action. If we do a good job of health education and reach those persons in the community who will assume local responsibility for action, we can put into active demonstration the beneficial results of controlling unwanted vegetation. The methods used to stimulate local interest and action need expert guidance which I am sure Mr. Benson, the next speaker, will give you.

There is one more item of tremendous importance which should be discussed when considering the public health significance of a ragweed control program. In addition to the specific benefits to the allergic segment of our population, a successful ragweed control program can improve all public health benefits in a community because it becomes a valuable tool for teaching public health methods and organization for action. Each step in the investigation is so simple and logical, each person's share in the activity is so well correlated with the actions of others, that a pattern for community action can be crystallized and used for other needs and problems. Doctor Mayhew Derryberry once said that no matter what critical war problem he wished to handle with community groups, he first had to help them organize for garbage disposal. After the garbage question had been answered, he was then able to divert and use the community teams for promotion of maternal-child health, tuberculosis control, nutrition or whatever else was a high priority need.

Professors Gordon and Leavell of the Harvard School of Public Health, in a recent paper entitled Solving a Community Health Problem(7) have developed a schema which outlines the forces at work which make the problem, and the procedures necessary to investigate and establish adequate control measures. With some slight liberty, I have adapted this schema to ragweed pollen control.

There seems to be no necessity to belabor the point -- control of ragweed by a weed-spraying operation is the only feasible and practical method we have, at the present time to alleviate the suffering of the hay-fever and asthma victim. No one really believes that persons with allergy would defer marriage because of the possibility of having an allergic child. Injections are uncertain, temporary, painful and costly. The antihistamines have unpleasant side-reactions. It becomes then, a public health duty to control hay-fever at the source -- by the eradication of the offending pollen-bearing plant.

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Solving the Problem of Hay-Fever Due to Ragweed Pollen

Epidemiology

1

I. Determination of Natural History
Who gets hay-fever?
What causes it?
How does the cause produce its effect?

A. Host Factors
1. Age, race, sex - both sexes, all races, all ages, infants to persons over 60 may get hay-fever
2. Natural resistance or susceptibility. Inherited tendency to sensitization.

B. Agent Patterns
1. Plant pollen-giant and dwarf ragweed
2. Dose necessary - unknown

C. Environmental Patterns
1. Physical
   Weather
   Climate
   Season
2. Social
   Vacant lots
   Highways
   Gardens
   Farms

II. Extent of the Problem
1. Proportion of people affected - 5-10%
2. Seriousness of effects — increased mortality when asthma supervenes.
3. Community effects — loss of time, wages, efficiency

III. Research
1. To learn more of natural history
2. To find new control measures

2

Planning the Strategy of Control

<u>Strategic Points to Protect Host</u>

1. Discourage marriage of allergic persons
2. Vaso-constrictors for nasal mucosa
3. Antihistamines
4. Acquired immunity through injections of aqueous pollen extract

<u>Strategic Points to Attack Agent</u>

1. Eradicate ragweed plant
   a. Cutting
   b. 2, 4-D

<u>Methods of Changing Environment</u>

1. Move to pollen-free area
2. Air-conditioning

<u>Estimate of the practicability and desirability</u> of applying available control measures

Health Education

Public Health Practice

3

The Tactical Control Program

The Health Department

Community Approval and Cooperation

Public Support | Official Support appropriate necessary funds | Other interested agencies

<u>Organization and Administration of the Program</u>

1. Define job to be done -- spray weeds on progressive plan
2. Determine work units

Evaluation of Results

PUBLIC HEALTH SIGNIFICANCE OF RAGWEED CONTROL DEMONSTRATED IN DETROIT

by: John H. Ruskin *

In 1950 the City of Detroit began a long-term program to eradicate ragweed, poison ivy, and other noxious weeds. Since that time over 11,000 acres of vacant or unmaintained land have been sprayed and millions of ragweed plants have been destroyed. Every known plot of poison ivy has been eradicated.

Mr. Alfred Fletcher and Mr. Clarence Velz are responsible for inspiring Detroit's attempt to duplicate the results obtained in New York City. Their paper (1) presented at a Continued Education Course in Air Pollution at the School of Public Health, University of Michigan, in February, 1950, was covered by a Detroit columnist. He pressed certain members of the Common Council into requesting that the feasibility of a ragweed control program be investigated. Mr. Fletcher was invited to Detroit to consult with a special committee representing interested departments, and advice was obtained from local members of the Michigan Association of Allergists. By June, 1950, four crews of three men each had been assigned by Mr. John J. Considine, Superintendent of the Department of Parks and Recreation, to the ragweed control program. Dr. Joseph G. Molner, Commissioner of Health, was made responsible for coordination and evaluation of the program.

The program was started in the southwest section of the city, in a narrow strip lying between the suburban communities of Dearborn, Melvindale, Lincoln Park, and River Rouge across the river from the famous Rouge plant of the Ford Motor Company. This area was found to be heavily infested with both giant and common ragweed (*Ambrosia trifida* and *A. elatior*). With the experience gained in this relatively small area, the crews worked their way around the southern, western and eastern edges of the city. Most of the vacant land and most of the ragweed was found in the periphery of the city. Since prevailing winds in the summer range from south to west, it was decided that efforts concentrated on these sections would be most beneficial to Detroit residents.

Tracts, lots, streets and parks totaling 11,084 acres, scattered over a gross area of about 64 square miles or 45 per cent of the city's area, have been sprayed for ragweed control in the first four seasons. The four crews operated in 1953 at a cost per acre of $1.87 for materials, $4.38 for labor, and an assumed $0.40 for equipment, totaling $6.65 (2). A small part of this acreage includes repeat spraying. Administrative, supervisory and equipment maintenance costs are not included because they cannot be readily determined. A cost breakdown by seasons is included in the appendix.

Detroit includes about 140 square miles of Wayne County's 607 square mile area. The Wayne County Road Commission (3) in 1951 inaugurated a program for spraying its roads and parks. In 1952 and again in 1953 they sprayed 7,460 acres of right-of-away along their system of roads and subdivision streets, and 676 acres of parks and golf courses. Their average cost per acre

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in 1952 was $4.73, including direct labor, material and equipment rental. Their experience indicated that spraying cost only half as much as mowing, and saved at least one mowing per season. They are staying in the spraying business to save money as much as to control ragweed; they are doing much to beautify the roadsides.

Equipment, Methods, and Policies

In the city program, the crews have used two converted hydraulic tree sprayers, 500 and 600 gallon sizes respectively, and two 100-gallon weed sprayers. When three additional crews are outfitted, as planned for next season, they will be equipped with the 100-gallon type. All are trailer-mounted and pulled by four-wheel drive open Jeeps. At times a pickup truck has been used to pull one of the large sprayers. No. 800-1 "Tee-Jets" (1/4-inch pipe size) were used on the sprayer booms, and 3/16-inch round nozzle orifices were used in the portable spray guns. The county has used twenty sprayers of a variety of types, from a 100-gallon sprayer mounted on the rear seat of a Jeep and operated by the driver, to 300-gallon and 500-gallon trailer or truck mounted types. Because of excessive distances from sources of water in certain sections of the county, they prefer a 300-gallon tank with 15-horse-power compressor engine.

Solution for spraying was made in Detroit's program by diluting 6 gallons of 2,4-D concentrate with water to make 100 gallons. The concentrate used contained 1.5 pounds of 50 per cent acid-equivalent amine salt of 2,4-dichlorophenoxyacetic acid. From 8 to 10 acres can be sprayed with this quantity of solution, which contains about 880 ppm, giving an application rate of about 0.1 pounds acid-equivalent per acre. The county crews applied about 0.5 gallons of concentrate per acre.

The city crews, recruited from the Forestry Division of the Department of Parks and Recreation, consisted of one tree artisan and two forestry helpers, paid $2.03 and $1.98 per hour respectively. When breakdown of equipment, absenteeism or rain interferedwith ragweed spraying, crews were dispatched to spray poison ivy. Ammonium sulfamate and a double-strength solution of 2,4-D proved about equally effective in destroying every plant which was actually drenched; the latter was preferred by the crews.

A preliminary survey of a number of vacant tracts prompted us to assume at the outset that nearly every such tract had ragweed growing in it, unless it was well maintained; had been sprayed within the last few years; was completely covered with trees and brush vegetation; or was being actively disturbed by current construction, cultivation, or other uses. In the case of disturbed land, it will almost certainly become infested with ragweed as soon as time is allowed for germination. As ragweed is a pioneer plant (4), it is one of the first to appear in disturbed soil, fill, abandoned gardens, playgrounds, parking lots, roadside ditches, stream banks, dikes, freshly graded backfill after construction of pipe lines, street paving, etc. Each plant is capable of producing several thousand seeds (5), and each seed is capable of producing a source of pollen sometime within the next forty years or so. Continuously maintained vegetative cover is essential in preventing growth of ragweed, whether or not a spray program is successful. Maintenance of "desirable weeds" such as grasses on unimproved land is considerably enhanced by destruction of ragweed early enough in the season for grass seeds to germinate and create successful competition with the ragweed growths.

Our programs have commenced annually about the first week of June (in 1953 the starting date was May 25). Each year spraying has been continued into October, because of the benefit derived from aborting the seeds before they are fully developed. There is some indication, however, that the concentration of solution used late in the season should be increased in order to effect a quicker "knock-down" of the plants. The toxic hormone in 2,4-D is effective only after it has been absorbed through the leaves and translocated to the root system (6). Late in the season, after the peak of pollination has passed, the reduced metabolic rate slows down this translocation.

Our costs of about $6.65 per acre would have been much higher except for a feature of our policy, established at the outset, that the work would progress on a cyclic basis according to an overall plan, regardless of complaints, requests and pressure. Late in 1953, at the request of the Common Council, two additional crews were activated to respond to complaints. Operating costs of these crews were about triple those of the cyclic crews, because of increased travel distances and less efficient scheduling of spraying.

At the close of the season, the Common Council passed a new "Noxious Weed" Ordinance, repealing the one which had given the crews the right to enter on private property and destroy noxious weeds as a public service. The new ordinance will require notification of the owner, reinspection, and billing the owner for the costs of spraying. Many ramifications of this procedure remain to be worked out; meanwhile, a proposed substitute is being drafted which may succeed in eliminating much of the "red tape."

Evaluations

During the surveys of the city to determine where the crews should spray, a number of test lots were selected. An evaluation was made of the vegetation on the lot before spraying and again at intervals after spraying. These evaluations measured subjectively the effectiveness of the program.

Neighbors of the test lots, and of other tracts where heavy growths of ragweed were destroyed, volunteered to our inspectors that they had received relief from severe reactions to pollen allergy after the infestations had been destroyed. In some cases, the suspected "cause and effect" association could be ruled out, as in the case where a woman related in a club meeting that she did not have sneezing fit after walking to church that week, whereas she always had before (when ragweed was in bloom). Another member of the club, who knew that the field of ragweed which lay along her route to the church had been sprayed, described the discussion to the writer. This incident is one of several which indicate the unmeasurable benefits of spraying.

Since "testimonials" are unreliably subjective, a sounder basis of evaluation was desired. Twenty standard stations for the exposure of microscope slides were established, mostly at fire stations. Where possible these slides were exposed in holders located above a roof; at several stations they were exposed at five feet above the ground, which is the level of the average person's respiratory intake. No consistent difference has been found between counts from "roof stations" and counts from "ground stations." In general, the exposure and counting techniques conformed to the recommendations of the American Academy of Allergy (7). In addition, special studies were conducted by exposing three slides per day for eight-hours each in the same slide-holder with a 24-hour slide; exposing slides for an hour at a time on the suction side of a small centrifugal blower; exposing slides for two minutes while being whipped through the air at 100 rpm at the end of a 36-inch rod ("Durham Whip") (1).

Most startling of the effects on the pollen counts caused by spraying has been the reductions at nearby stations after a sizable tract of ragweed had been sprayed. In one case (Station C, 1950-51) the only spraying done within 10 miles was a playground tract just south of the station, which was heavily infested with common ragweed. Prior to spraying, this tract contributed enough pollen to the slide to make Station C one of the highest in the city. After this one tract had been sprayed, counts there were among the lowest.

Similar effects can be seen in data from Stations Q and R, located in the northwest part of the city and fairly close to the Rouge River where it flows through Rouge Park and Howell Park respectively. Both parks contained many acres of river banks and flood plains covered with dense growths of giant ragweed. These areas were partially sprayed at the beginning of the 1952 season and sprayed again in June 1953. Counts at Stations Q and R were decidedly reduced from 1951 to 1952. In 1953 there was some increase in their counts, but not to the extent that counts in untreated areas increased during the same period.

Reduced Counts Following Sprayings

Similar results could be shown for other stations in the sprayed areas. Maximum counts at Station E, far northeast area, where no spraying has been done, are tabulated for each year for comparison with the other stations:

TABLE I MAXIMUM 24-HOUR POLLEN COUNTS

Station and Location	1950	1951	1952	1953
E - far northeast	75	104	124	212
F - far east	117	136	* 117	137
H - near east	134	158	* 85	143
J - downtown	135	146	* 120	* 108
M - southwest	132	* 71	141	198
Q - far west	161	227	* 102	* 181
R - far northwest	79	297	* 127	* 183

* Indicates when surrounding area was sprayed. (Note recovery due to regrowth around Station M, where program was inaugurated in 1950. Repeat spraying was done in 1953, but too late to prevent pollination.)

About one-half mile south of Station M, in an abandoned garden where luxuriant growths of giant ragweed had persisted for several seasons, a special experiment was performed in August, 1951 (8). The field was deliberately omitted from the spray program until the plants were in full bloom. Tests were made with a "Durham Whip", whirling a coated slide in a 6-foot horizontal circle for 200 revolutions above the tops of the plants. (The writer had to stand on top of his car in order to clear the flower heads.) Tests were made about 9:00 a.m. and 4:00 p.m. on August 19 and August 30. The field was sprayed August 27.

TABLE II--REDUCTION ON CONCENTRATION AFTER SPRAYING GIANT RAGWEED

Description	Before Spraying	After Spraying
Date of Sampling	8/19/51	8/30/51
Count on Whip Slide #1 (am)	4400	309
Count on Whip Slide #2 (am)	629	201
Count on Whip Slide #3 (pm)	191	81
Count on Whip Slide #4 (pm)	255	177
Count at Station "T" (24-hr.)	14	54
Count at Station "M" (24-hr)	24	62

Heavy rain on August 31st ruined plans to repeat the test at intervals and plot the decline in pollen concentrations as the spray took effect. It is important to note that standard counts at Station M were increasing steadily from 24 on August 19th to 62 on August 30th, and reached a maximum of 71 on September 1. Standard counts at other stations were also increasing during this period, reaching their peaks between August 29th and September 1.

At the time of the after-spraying tests on August 30th, the blossoms were typically curled and enlarged. Some of the flowers appeared to have accelerated the production of pollen, but it was released only on violent agitation of the flower. Since 2,4-D requires about 10 days to take full effect, the reductions in atmospheric pollen concentrations in only three days were all the more significant. It is reasonable to infer that had measurements been made a week or so later as hoped, the proportion of reductions would have been even greater. In the morning hours, the reductions were most beneficial, because this was the time that the neighboring housewife formerly walked out of the house into a blast of freshly released pollen.

Jones (9) found that about 90 per cent of all giant ragweed pollen produced during a day is released between 8:00 and 11:00 a.m. To determine this, he changed slides every 30 minutes for several days.

Pollen from Local Sources is Most Significant

Our experiments with changing slides hourly, with the help of Weather Bureau observers, showed a definite pattern of high counts during the late morning and low or zero counts in the evening and night. If the usual concept of long-range uniformity of pollen concentrations were accepted, there could be no periods of zero concentrations at any time during the pollen season. Pollen released in Ohio or Indiana would have reached Detroit in time to maintain the concentrations during the evening. Since this was not the case, the conclusion is made that nearly all of the pollen found on the slides was produced in the immediate vicinity.

This conclusion is a vitally important one to anyone attempting to evaluate a ragweed control program. It contradicts the theories now widely accepted and publicized (10), that pollen is dispersed and transported in significant concentrations for hundreds of miles (11). It nevertheless explains why there are successful resorts where one may obtain relief from hay fever, within a comparatively short distance from areas where ragweed flourishes (12). It also explains why day-to-day variations in the pollen count at the doctor's laboratory do not correlate well with the variations in severity of symptoms experienced by patients living in another part of the same city. Most important to us, it explains why a public health benefit is derived from the destruction of a nearby infestation of ragweed; why we should continue to promote and support local programs for the eradication of ragweed. It demonstrates the public health significance of a ragweed control program.

There is reason to believe that a susceptible person suffers noticeable symptoms only after intake of a massive dose of pollen grains. Such concentrations could come only from local sources, since pollen from distant sources would be dispersed into a nearly uniform distribution of low density. If exposed to a <u>uniform</u> concentration of pollen grains of a density of 25 grains per cubic yard, the suggested threshold of significant counts, most of the allergic persons would probably experience no reaction. Regardless of the general level of pollen concentration in the atmosphere, that same person when walking through or close to a field of pollenating ragweed would be subjected to a large dose of pollen and would then experience noticeable symptoms. It obviously follows that destruction of this field of ragweed before it pollinated would have prevented these symptoms. In the long view, successful eradication of ragweed might have even prevented the sensitization of this or some other person.

The fact that prevalence of ragweed has an effect on the numbers of sensitized persons was demonstrated by a sample survey of Washtenaw County, Michigan (Ann Arbor and vicinity) in August, 1951. Cases were reported at the rate of one in 12 persons in urban areas, whereas there was only one in 21 persons suffering from hay fever in rural areas. Ragweed is an urban plant.

<u>Need for Better Sampling Methods</u>

The evaluation of a ragweed control program must be based on sound data. When better methods of pollen sampling have been perfected, they will be valuable (13). The present methods leave much to be desired, since the "24-hour gravity counts" cannot be correlated with the amount of pollen inhaled (14). The use of season indexes, averages or total counts is extremely fraught with error, since rain or other loss of data on a few critical days, such as Labor Day weekend, could tremendously influence such computations.

By analytical methods (15) we showed in our 1950-51 report (8) that there were statistically significant differences, even on the same day, among stations throughout the city. Use of a single station to represent a large region is therefore not proper. It is generally accepted that the "24-hour gravity count" is affected by hourly and instantaneous variations in concentrations, by wind and other weather conditions, and by geographic and environmental factors (16). Not so well understood is the influence of the lapse of time between deposit of pollen and examination of the slide. This variable was discovered during the analysis of data (17) from the stations at the Weather Bureau (D, exposed 24 hours, and X, Y, and Z, exposed for 8 hours each in the same holder.) Almost invariably the sum of the three 8-hour counts exceeded the corresponding 24-hour count. Frequently one or more of the 8-hour counts on a given day actually exceeded the 24-hour count. Apparently the pollen grains were not perfectly retained on the slide during exposure. Similar results at Stations I and II with 24-hour and 72-hour slides established the invalidity of data from slides exposed more than one day. The reliability and reproducibility of present pollen data are less than complete. Although average and total counts are not considered wholly sound, such computations are included in the appendix for references. Until sampling methods are improved, we must continue to rely on the best available technique.

Summary and Conclusions

Detroit began in 1950 and is continuing a long-term program for the control of ragweed, poison ivy and other noxious weeds. Control methods, equipment and costs are described. The effectiveness of spraying with 2,4-D has been demonstrated by field studies, personal interviews and measurements of pollen concentration. Primary influence of local ragweed growths on both measured and breathed concentrations of pollen is emphasized. Various factors which tend to reduce the reliability of present pollen sampling methods are described. In conclusion:

1. Eradication of ragweed and poison ivy is economically feasible with available equipment and herbicides.
2. Eradication of ragweed and poison ivy is a justifiable use of public funds because it benefits the citizens of the community where the work is done. Local benefits accrue from destruction of pollinating or poisonous plants in the same way that local damage is suffered from failure to destroy those plants.
3. Many factors influence the overall long-range planning of a weed control program, even when seemingly remotely related like playground development, slum clearance, flood control, subdivision development, utility construction, or traffic engineering.
4. In spite of their lack of complete reliability, the gravity-slide pollen counts provide data which justify continuation of Detroit's ragweed control program. Spraying of significant sources close to a sampling station reduces the pollen concentrations and to some extent the pollen counts.
5. Reduction of exposure of susceptibles to allergenic pollen is ample justification for including ragweed control as an objective of public health agencies.

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BREAKDOWN OF COST OF WEED CONTROL OPERATIONS

Item	1953 Total	1953 Unit	1952 Total	1952 Unit	1951 Total	1951 Unit	1950 Total	1950 Unit
Ragweed Control	(2925 acres)		(2575 acres)		(2192 acres)		(1740 acres)	
Materials	$ 5467.20	$ 1.868	$ 5564.34	$ 2.161	$ 4103.20	$1.872	$ 3193.41	$1.835
Labor	12809.38	4.382	10082.55	3.916	7357.33	3.354	8801.95	5.049
Total	$18276.58	$ 6.250	$15646.89	$ 6.077	$11460.53	$5.226	$11995.36	$6.884
Man-hours	6259	2.1	4791	1.9				
Poison Ivy Control	(201 plots, 241.7)		(200 plots, 157.1)		(141 plots, 289.7)		(240 plots, 131.5)	
Materials	$ 241.25	$ 1.000	$ 166.33	$ 1.059	$ 202.40	$0.698	$ 99.04	$0.768
Labor	1675.26	6.934	1760.08	11.211	1493.36	5.151	1194.47	9.083
Total	$ 1916.51	$ 7.934	$ 1926.41	$12.270	$ 1695.76	$5.849	$ 1293.51	$9.851
Man-hours	853	3.5	921	5.9				
General Weed Control	(350 acres)		(386 acres)		(530 acres)		(386 acres)	
Materials	$ 1026.54	$ 2.933	$ 684.85	$ 1.774	$ 918.16	$1.732	$ 471.75	$1.222
Labor	2814.83	8.036	840.36	2.177	1459.52	2.754	770.72	1.997
Total	$ 3841.37	$10.969	$ 1525.21	$ 3.951	$ 2377.68	$4.486	$ 1242.47	$3.219
Man-hours	1400	4.0	446	1.2				
Summary	(3178* acres)		(2961* acres)		(2722* acres)		(2126* acres)	
Materials: 2,4-D	1790 gal.	0.54*	1919 gal.	0.64*				
Ammate	37 Lb.	--	495 lb.	--				
Cost	$ 6255.95	$ 1.970	$ 6415.52	$ 2.162	$ 5223.76	$1.916	$ 3764.20	$1.770
Labor	17299.47	5.430	12682.99	4.284	10310.21	3.780	10767.14	5.055
Equipment	1198.15	0.377	1198.15	0.404	1198.15	0.437	1198.15	0.563
Total	$24753.57	$ 7.777	$20296.66	$ 6.850	$16732.12	$6.133	$15729.49	$7.388
Man-hours	8512	2.7	6158	2.1				

NOTE: Asterisks (*) indicate that data pertaining to poison ivy control operations have been omitted from the computations marked. Unit costs: Poison ivy area figures listed in thousands of square feet. Unit costs computed on that basis. All other items based on acres. Equipment: First cost of equipment purchased in 1950 totaled $5900.75. It is arbitrarily assumed that 20 per cent of this cost should be charged each year in computing unit costs. General Weed Control acreage in 1953 included 97 acres sprayed as a result of citizens' complaints, at an average cost of $24.80 per acre, or $8.58 per plot.

DETROIT DEPARTMENT OF HEALTH
SUMMARY OF SEASON DATA BY STATIONS---1953

Sta.	No. of Daily Counts	Daily Counts 70 & Over: No. Days	Total Count	Max. and	Count date	Daily Counts 7 & Over: No. Days	Med. Count	Avg. Count	Total Count	Season Total Count
A	49	4	386	130	8/30	31	31	37.9	1177	1209
B	47	5	468	126	8/27	33	14	32.3	1064	1087
C	*63	5	538	176	8/25	33	29	36.9	1221	1231
D	*65	10	1214	162	8/30	35	32	49.9	1749	1777
E	49	9	1076	212	8/31	34	25	47.1	1601	1625
F	48	9	829	137	8/28	27	34	47.7	1289	1322
H	47	4	403	143	8/29	32	23	34.4	1101	1128
I	*58	12	1467	183	8/28	33	49	64.1	2113	2141
J	47	10	855	108	8/28	29	37	42.2	1223	1260
K	49	8	1149	313	8/29	28	35	60.4	1690	1747
L	49	4	409	126	8/27	31	26	37.7	1177	1207
M	*63	8	943	198	8/25	29	32	52.0	1507	1555
N	**27	6	716	174	8/25	21	28	52.0	1092	1101
P	46	11	1215	212	8/30	33	35	56.2	1853	1883
Q	48	11	1354	188	8/29	32	25	55.7	1782	1807
R	46	8	991	183	8/27	32	34	52.1	1667	1693
S	48	10	933	122	8/29	32	37	47.0	1503	1548
T	45	9	1077	167	8/28	31	24	51.6	1598	1619
V	**28	6	719	166	8/25	19	61	63.8	1212	1236
W	29	10	1192	140	9/5	28	48	60.8	1701	1702
X	**49	1	90	90	8/30	22	27	26.6	585	627
Y	**49	3	269	106	8/30	28	25	34.5	953	965
Z	**49	1	88	88	8/26	13	22	32.1	417	447
Med.	49	8	799	125	8/28	34	25	43.0	1467	1496
Mean	49	7	738	123	8/28	34	28	44.9	1522	1563

NOTES: Counts of 70 and over omitted from Columns 4, 5, and 6 whenever slide was exposed 27 hours or longer. Such counts were included in other columns unless the exposure was so long as to suggest overlap with the next day.

*Pilot Stations: Station I commenced 6/23, discontinued 9/14; total count through 8/3: 11. Stations C. D. M. commenced 7/19, total count through 8/3, 0, 1, 0, respectively. Other stations ** commenced 8/4. Last slides exposed 8 AM 9/21 to 8 AM 9/22. Daily counts prior to 8/10 ranged 0 to 10. All data in pollen grains per square centimeter of slide in standard holder.

**Stations N and V were started 8/25, with first counts 174 and 166 respectively. Stations X, Y, Z exposed at airport for eight hours each in same holder as Station D, and excluded from medians, means and other computations.

DETROIT DEPARTMENT OF HEALTH
SUMMARY OF SEASON DATA BY STATIONS---1952

Sta.	No. of	Daily Counts 70 & Over				Daily Counts 7 & Over				Season
	Daily Counts	No. Days	Total Count	Max. and	Count date	No. Days	Med. Count	Avg. Count	Total Count	Total Count
A	46	5	468	105	8/25	32	30	38.7	1238	1263
B	47	4	374	121	8/30	29	30	40.1	794	1164
C	*65	9	967	159	8/31	28	34	53.5	1496	1531
D	*66	6	629	125	8/31	38	26	42.2	1602	1606
E	47	10	915	124	8/30	32	45	51.5	1645	1671
F	45	3	262	117	9/1	34	29	35.1	1193	1209
H	44	2	161	85	8/31	29	28	31.4	912	932
I	*93	14	1594	220	9/1	38	49	62.0	2356	2411
J	43	2	231	120	8/31	29	22	38.2	1108	1127
K	**32	6	677	168	8/31	27	37	48.4	1306	1311
L	43	3	276	133	9/1	28	36	41.4	1159	1180
M	*58	6	620	141	8/21	26	41	50.7	1318	1365
N	**31	1	95	95	8/21	24	37	36.9	888	892
P	41	7	673	129	9/1	31	28	42.4	1317	1331
Q	46	7	532	102	9/1	35	35	43.3	1515	1536
R	46	6	568	127	9/1	32	41	45.4	1451	1471
S	42	6	596	150	8/25	28	43	44.9	1258	1287
T	46	4	325	98	9/1	32	33	38.1	1219	1248
V	**18	1	74	74	9/5	13	25	28.2	366	380
W	39	4	403	124	8/30	33	31	38.9	1283	1307
X	43	0	00	64	8/26	21	20	24.0	505	540
Y	43	4	387	121	8/22	32	27	33.9	1082	1099
Z	45	0	00	55	8/30	23	14	18.9	434	468
Sum	**34	8	1025	194	8/25	31	49	60.9	1884	1896
II	**9	6	850	192	8/28	9	110	99.9	899	899
Med.	40	4	371	115	9/1	34	30	36.8	1250	1265
Mean	40	5	462	114	9/1	35	31	40.0	1398	1417

NOTES: *Pilot Stations: Sta. I commenced 6/24, continued through 9/26; total count prior to 8/10 was 32. Sta. C, D, & M commenced 7/15, all others about 8/4 or 8/5, continued through 9/18; total counts prior to 8/10 ranged from 0 to 9.

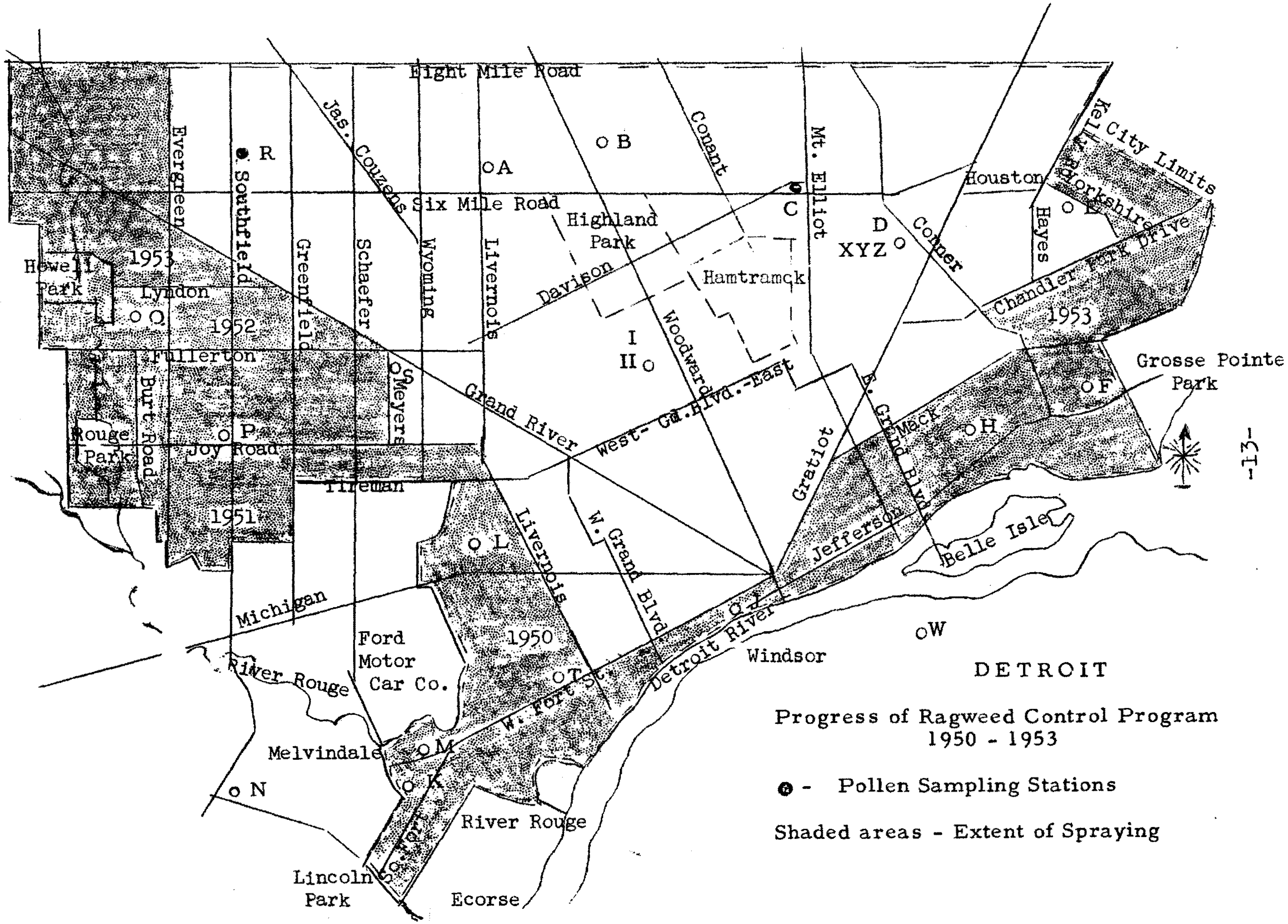
**Station K was started on 8/21, when count was 104. Station N was serviced irregularly so results are probably not representative of conditions. Station V counts (29 in all) prior to 9/3 discarded because of damage to exposed slides during transportation to laboratory. Stations X, Y, Z exposed at airport in same holder as Station D. "Sum" is computed total of X, Y, Z counts for each day. Station "II" exposed 72 hours at Station I.

DETROIT DEPARTMENT OF HEALTH
SUMMARY OF SEASON DATA BY STATIONS---1950

Sta.	No. of Daily Counts	Daily Counts 70 & Over No. Days	Total Count	Max. and	Count date	Daily Counts 7 & Over No. Days	Med. Count	Avg. Count	Total Count	Season Total Count
A	40	3	223	77	8/24	20	24	31.1	623	660
C	39	7	766	197	8/22	20	37	57.2	1143	1394
D	45	3	324	93	8/28	25	29	35.7	894	930
E	41	3	223	75	8/28	24	19	27.1	677	707
F	32	1	117	117	8/29	14	45	39.8	558	590
H	39	1	134	134	8/27	19	24	30.5	578	615
I	45	4	558	162	8/27	21	31	48.5	1020	1073
I'	36	7	748	170	8/27	24	30	47.7	1145	1176
J	25	3	458	135	8/29	13	32	48.4	628	665
L	40	4	252	103	8/28	22	21	31.0	682	790
M	35	5	522	121	8/26	24	23	40.9	981	1019
N	25	5	688	171	8/23	20	36	59.6	1191	1209
Q	39	7	680	161	8/23	24	27	46.6	1119	1149
R	42	2	233	81	9/1	24	27	34.8	835	861
S	36	2	214	128	8/27	25	28	36.9	623	658
U	31	4	557	125	8/24	19	29	48.4	920	945
V	37	6	568	164	8/22	23	23	44.5	972	1008
Mean	49	4	--	100	8/27	28	24	36.0	1008	1077

SUMMARY OF SEASON DATA BY STATIONS---1951

Sta.	No. of Daily Counts	Daily Counts 70 & Over No. Days	Total Count	Max. and	Count date	Daily Counts 7 & Over No. Days	Med. Count	Avg. Count	Total Count	Season Total Count
A	55	0	0	68	8/29	20	21	23.4	468	575
B	50	1	132	132	8/31	22	15	27.1	596	616
C	68	5	407	95	8/31	24	22	33.7	809	867
D	53	5	533	131	8/29	28	31	43.0	1205	1241
E	52	1	104	104	9/1	27	17	25.6	691	744
F	49	2	217	136	8/31	23	24	33.2	764	821
H	46	3	314	158	8/30	23	20	31.4	722	752
I	70	7	1009	289	8/21	28	33	57.8	1618	1644
J	63	1	146	146	8/31	23	15	27.7	636	715
L	57	3	188	103	9/1	25	16	25.6	640	711
M	68	1	71	71	9/1	24	25	26.7	640	797
N	33	6	497	195	8/29	21	30	39.7	834	848
P	46	4	282	133	8/31	23	18	28.3	651	691
Q	50	4	631	227	8/30	25	24	48.1	1204	1251
R	55	4	644	297	9/1	26	25	46.0	1196	1238
S	33	4	407	137	8/31	18	26	40.1	722	738
T	53	3	348	125	8/31	26	20	32.7	851	913
Mean	50	4	-	108.8	8/31	31	24	30.6	950	995



DETROIT

Progress of Ragweed Control Program
1950 - 1953

● - Pollen Sampling Stations

Shaded areas - Extent of Spraying

PROMOTIONAL ACTIVITIES IN NOXIOUS WEED CONTROL DURING 1953 IN THE STATE OF CONNECTICUT

R. K. Sprague, B. S., M. P. H.
Public Health Engineer, Greenwich, Connecticut

A personal investigation revealed that in the State of Connecticut during 1953 the promotional activities directed toward the control of noxious weeds deleterious to the public health were limited in scope and extent. No official agency actively sponsored a state wide program per se. In general, the only activities which approached a planned program basis were those routinely and seasonally sponsored by a few of the larger urban fulltime local health departments such as the City of Hartford. Here attractive posters were placed in public places, such as store windows, and on office and industrial bulletin boards; the daily pollen count was published; and well composed literature supplied by the State Department of Health was distributed. This was coupled with enforcement work which consisted of spraying if and when the owner of an infested property failed to abate the nuisance after due notification. By and large these activities were reportedly effective within their immediate areas.

However, there was one outstanding piece of promotional work carried out in Connecticut during 1953. Regrettably, it must be reported that this accomplishment can not be chalked up to the credit of a local health department, but rather to that of a local grange, the Southington Union Grange. And, from the procedure followed and its success, we as public health people may learn something. It is therefore being brought to your attention.

Southington, Connecticut, a small rural community (population about 13,000) located approximately halfway between Hartford and New Haven has a local grange, the Southington Union Grange; and the membership was confronted again with the task of selecting a project for the coming year, 1953.

Almost every member or his family has a piece of ground set aside for a vegetable or a flower garden or both. And, therefore, almost every one was conscious either directly or indirectly of the gardener's eternal "battle of the weeds". Mr. H. J. Parlin was no exception, except that he might have been a little more conscious of that battle because of his wife's being affected by the poison ivy in her flower bed, because of his own susceptibility to hay fever, as well as because of his not too successful skirmishes to liberate the rear of his lot from an established invader, namely sumach. Accordingly, it was not too strange that his suggestion was adopted when he proposed that the project be a practical study of the chemical eradication and control of weeds.

An eighteen member committee was appointed and the project got under way. First, a card party and "silent auction" were held to raise funds to buy various herbicides and knapsack sprayers to apply them for test purposes. These doings, like those of any other local association, were reported in the local papers. Next, as members wrote to various sources and obtained information about the types and use of herbicides, articles based thereon began to appear in the garden section of the local papers from late spring to summer. In the meantime members had been trying the various herbicides in various personal situations to gain first hand knowledge and conviction as to the efficacy and limitation of the formulations.

Then, with appropriate announcement by the press, a public demonstration was held at the local bathing beach and recreation field. Individual signs pointed out and identified the growths treated and the formulations used. Moreover, as was announced, members were on the spot to give practical instruction in the use of the sprays and answer questions by those who desired to borrow the equipment to try it on their garden problems.

From then on the instruction and loaning process went on throughout the summer. And concomitantly with these field activities, weekly articles on ivy poison, hay fever and health, pollen counts, and weed control (together with some antedotes as to personal experiences) were carried by the Hartford, Meridan and New Haven papers.

As a result it is estimated that about one hundred direct personal contacts were made through the loaning of the equipment and that about five thousand people were made conscious of the project through the articles in the papers. As a matter of fact, the press is said to have inquired weekly for news on the general subject and the local progress being made.

In recognition of the success of the project the Southington Union Grange received in October a plaque and defense bonds from the state grange for its accomplishments.

The foregoing "success story" was not related with a view to suggesting that local health departments duplicate this direct and personal approach; nor was it related to illustrate the several apparent elements of health education technic. Rather, it was related to point out a broader principle, namely, the oblique approach. Thereby one's preliminary efforts are directed entirely toward helping people to solve personal problems not related to public health by aiding them to develop interests and technics which later can be expanded and directed toward solving personal, as well as community, health problems. Let us keep in mind that in all probability there are more "gardeners" in the community than allergics!

WEED CONTROL DURING 1953 IN OHIO

Mrs. J. J. Bowman
Hay Fever and Weed Control Committee, Inc.
Cincinnati, Ohio

During the 1953 herbicide weed control operations in Ohio, the State Highway Department sprayed 2, 362.69 miles of highways one or more times. Twenty-four cities in Ohio, that answered a questionnaire sent out in October by the Hay Fever and Weed Control Committee of Cincinnati, have a weed control program. There are many smaller communities where the State Weed law is enforced. The Ohio Code permits officials to cut weeds and bill the violator on his next tax bill for the cost.

On September 2, 1953 Cincinnati Council unanimously amended its 1942 weed ordinance incorporating the State law provision, under which the city may destroy noxious weeds on private property and add the cost of this work to the weed violator's tax bill. Among other cities using this feature of the State law are - Alliance, Cleveland, Cuyahoga Falls, Elyria, Euclid, Hamilton, Lakewood, Lorain, Mansfield, Marion, Toledo and Van Wert.

Sandusky is one of the few cities in Ohio that has weed control only on city owned property. Springfield enforces its weed law "generally upon specific complaint". Ashtabula has no weed control "other than trying to keep weeds on vacant lots mowed and clean in general". A letter received from Dr. D. G. Caudy, Health Commissioner of Zanesville, stated, "we have no satisfactory regulation but would be interested in sample ordinances concerning this matter" (weed control). Letters from other Ohio cities indicate a desire for help in improving the manner in which they have been combating the ragweed menace. On August 5, 1953 Hamilton adopted a new weed ordinance authorizing the Health Commissioner to "cut" overgrown areas and charge the expense to the owner. Failure to pay within 30 days is subject to a 25% penalty. The cost of cutting plus the penalty charge is added to the property owner's tax bill. Offenders may be fined up to $100.

Hamilton uses its Health Department inspectors plus the radio and newspaper for educational purposes. The newspaper is the medium used by Euclid for its ragweed control publicity. Newspaper articles and radio announcements are used by Mansfield, Middletown and Youngstown. The latter city is making a study looking to more adequate enforcement of its weed ordinance on vacant lots or where the owner is out of the city. Cleveland uses radio, newspapers and releases given out by the Health Department. The Cleveland Health Museum furnishes the newspapers with the daily ragweed pollen count. In Cincinnati the pollen count is given the newspapers by the Health Department. The latter also issues releases to the three metropolitan dailies and the thirty-three suburban newspapers. Columbus and

Cincinnati utilize television besides radio and the press.

Of the 350 weed violation orders issued this year by Dayton - 250 were abated. Cleveland had approximately 1,000 hearings on weed violation summons. The Cincinnati Police Department sent 1,299 post card notices to weed ordinance violators. In 16 cases arrests were necessary. Middletown has been notifying owners of weeded areas by registered mail. Five days later, if weeds have not been cut, they are mowed by the city and the cost assessed on the owner's tax bill. Middletown hopes to simplify this proceedure by menas of new legislation.

In Toledo, a committee of five doctors, appointed in September 1953 by the Academy of Medicine, recommended to City Council the necessity for a Municipal weed spraying program. The Council ordered the City Manager to send a representative to Detroit in order to learn first hand how the Detroit Department of Health is handling its program of ragweed control. Dr. Karl D. Figley, a well known allergist and ragweed control enthusiast, is chairman of the Toledo Academy of Medicine Committee.

In Cincinnati weed eradication is accomplished about 50% by chemical control methods and 50% by cutting. Service Director Robert Sarvis estimates that the city spent $103,600 on weed eradication in 1953. This included $50,000 as the estimated cost of police work on weed law enforcement. City Manager Wilbur R.Kellogg reports that the Board of Health developed spot announcements on ragweed control for 5 radio stations and scheduled a panel discussion in which City officials participated. Mr. Kellogg writes "in those areas where spraying has been practical the use of 2,4-D weed control chemical has virtually eliminated the stands of weeds along roadways and on sizeable tracts of land a rather luxuriant growth of native grasses has taken over these areas".

The passage of Cincinnati's amended weed ordinance in September 1953 was the culmination of a good deal of work on the part of the Hay Fever and Weed Control Committee, Inc. This organization was founded in 1941 by civic minded citizens who, together with its membership, provide its only financial support. The Committee is responsible for the listing of June as National Ragweed Control Month in the U. S. Chamber of Commerce booklet "Special Days, Weeks and Months". For the past few years the Committee has brought to the attention of the Governors of the 48 States the importance of ragweed control. For June 1953, in answer to the Committee's requests, proclamations and/or news releases urging ragweed control during June, were issued by the Governors of Arkansas, Florida, Illinois, Kansas, Maryland, Mississippi, Missouri, Montana, New Jersey, New York, Ohio, Oklahoma, Pennsylvania and West Virginia. As usual the Committee secured a proclamation from Mayor Carl Rich.

Postage meter slugs "Destroy Ragweed Protect Health" were supplied by the Committee to mail order houses and department stores for use during June and July in 1953. The Committee set up educational exhibits during June in downtown Cincinnati using both varieties of ragweed, potted for this purpose by the Park Board which does this for the Committee each year. Many civic groups, including garden clubs and the Consumer Conference of Greater Cincinnati cooperate with the Committee. The Public Library, the Board of Education, the Public Health Federation and the Smoke Abatement League are valuable allies in the Committee's ragweed control educational work. The Committee secured the cooperation of all the railroads in destroying ragweed on their properties and rights of way in the city in 1953. These railroads included B & O, Penns., N. Y. C., C & O and N & W. The Greater Cincinnati Cemetery Superintendents cooperated with the Committee by destroying the ragweed on their properties.

The Board of Education needed but little urging by the Committee to include a weed study unit in the 4th grade science curriculum. The elementary school systems distributed educational circulars on ragweed control - supplied by the Committee.

The Committee sent articles and slogans on ragweed control to the newspapers. Among the many inquiries, answered in 1953, was one from Broadcast Music Inc., 580 Fifth Ave., New York regarding Ragweed Control Month. The writer stated that he would apprise all U. S. radio stations concerning Ragweed Control Month through his Newsletter.

Dr. Louis Kreindler, allergist and member of the Hay Fever and Weed Control Committee gave three talks on Ragweed Control in June 1953, one of which was given on T. V. and one on radio.

In answer to a request from National Camp Fire Girls headquarters, I, for the Committee, prepared an article which appeared in the April 1953 issue of the National Camp Fire Girls monthly publication. In it Leaders of Camp Fire Girl groups were informed how to work Ragweed Control Projects into the Camp Fire Girls' program.

Public Relations in Ragweed Control

Donald S. Benson
Director of Public Relations
New Jersey State Department of Health

The objectives of publicity in weed control, it seems to me, are two:

1. To persuade our citizens that weed control is desirable, possible, and economically practical.

2. To motivate people to take action that will achieve weed control.

We who have some familiarity with weed control think it is desirable from several points of view.

1. It is desirable from the point of view of health. Effective control of ragweed can bring about a substantial reduction in the suffering of persons who are allergic to ragweed pollen. Effective control of sumac, poison oak, and poison ivy can reduce the suffering which is now yearly visited upon both children and adults. In controlling these types of weeds, we would find that we are simultaneously helping to control the wild growth of marijuana. Its control similarly confers a health and social benefit.

2. It is desirable from the point of view of economics. Evidence now available indicates that spraying and mowing in combination constitute a cheaper and more effective method of weed control along our highways than mowing alone.

   Effective control programs over a widespread area, by reducing the incidence of hay fever and rashes from poison weeds, can lessen in some degree the family costs for medical care to secure relief from these irritants.

   There are other economic benefits which may well appear on an individual basis. A real estate salesman who has a hay fever sufferer for a client may be able to effect a sale if he can assure that client that the house in which he is interested is in an area in which there is an effective ragweed control program.

3. It is desirable from an esthetic point of view. Surely, trim and well kept highways and streets make a better impression than those on which weeds have gained the ascendency.

All these things are interrelated. The attractively kept and healthful community will enjoy at the same time higher property values than the community in which the residents are indifferent to weed control and the products which stem from that indifference.

These considerations give us a clue as to how to direct our publicity efforts. It is a basic principle in publicity that we deal not with one public but with several publics. People become members of groups on the basis of common interests.

For example, in New Jersey and in other states, the care of retarded persons and research efforts to determine causes of mental deficiency have been favorably and significantly affected in recent years by the formation of associations of parents of retarded children. These parents have a vital, mutual interest. By pooling their strength, they have accelerated a movement which is helpful to them and to their children.

To achieve weed control, we must bring together those persons who have a mutual interest.

<u>Those Who Suffer From Hay Fever</u>

In the control of obnoxious weeds, we might well consider the feasibility of associations of persons allergic to ragweed pollen. Where the community is too small to make this practical on a community basis, it could be approached on a multi-community or county basis. Associations which are articulate and which know what they want, get listened to. Certainly, they are more likely to get results than suffering individuals who seek remedial action as individuals.

Another group that we should bring into the effort includes

<u>Those Who Are Concerned With Street and Highway Maintenance</u>

There are already in existence associations of governmental officials. They are subdivided to some extent by function. It should not be difficult to bring together those persons who have responsibility for highway and street maintenance in municipality, county, and state. Generally speaking, they are interested in doing a good job and doing it as economically as possible. Here the challenge lies with our public health engineers. If they can persuade the responsible governing officials that spraying will achieve more weed control per dollar expended, they will be contributing to the over-all objective. They will simultaneously be acting in behalf of governmental economy and in the interest of the public health. In addition, they will have introduced the concept of weed control to at least some of the governmental officials who determine in the final analysis how effective and widespread the program is to be.

Garden Clubs

Gardening enthusiasts know something of the unyielding battle which must be waged with weeds if a garden is to be a thing of beauty. They do not need to be sold on weed control. They need only to be persuaded of the public health benefits which will accrue from the control of weeds not only in well kept gardens but along our highways and on vacant city lots. The garden club is an already organized group. It is interested in beautification. That interest can be the point of orientation for the development of an interest in the control of obnoxious weeds wherever they may be found.

The County Medical Society

The conscientious physician will admit that he feels frustrated by his inability to do more than provide temporary relief to the patient who suffers severely from hay fever. While there are treatments which give temporary relief, these measures treat the symptoms and not the basic cause -- the offending substance. The surest way to eliminate the expression of an evil -- in this case hay fever -- is to eliminate the source of that evil, which in this case is ragweed.

Collectively, physicians can give articulateness to the scope of the problem. It would be worth a trial to ask doctors who treat hay fever sufferers to report to a community agency a weekly summary of the number of patients they see during the summer months for hay fever, asthma, or because of skin poisoning from some plant. This informal reporting system, for a temporary period, if performed conscientiously, would give us new evidence about the incidence of the problem of hay fever in a specific community and it might well indicate those areas in the community in which the problem was the worst. These weekly reports would provide excellent opportunities for radio and newspaper stories and editorial comment as to the desirability of weed control. In no way would it be necessary for the doctor to depart from confidentiality, since all that would be desired would be numerical summaries. The approach to achieve such effort should be through the county medical society.

The opportunity to have instruction on weed control and its benefits incorporated into the program of the school system should not be overlooked. The whole control effort embodies teaching and education. Those who are trained to teach should be given an opportunity to incorporate this information in those areas of instruction in which it is most appropriate and where it will make the greatest impression.

There are other organizations whose support can be enlisted, depending upon local factors. Often a service club -- such as the Kiwanis or Rotary -- will adopt an effort of this kind as a part of its program. If the employees of a particular factory are significantly affected by hay fever, it is possible that both management and the union can be interested in efforts to overcome the cause. A good deal of missionary work must be done among the natural leaders of the community. They must be sold on the necessity for a control program if the organizations they lead are to function effectively.

"Well," you may say, "what has all this organizational work to do with publicity?"

In reply, we would say that publicity is the product of action. The publicist, with appropriate professional guidance, must often initiate and encourage the action which produces the publicity. Any action to bring about better community understanding of a problem and to prompt community action to overcome that problem is sound publicity effort in its broadest and best sense. It is information with a mission.

This may sound like heresy coming from an ex-newspaper man, but I am convinced that an interested, enthusiastic, dedicated committee will achieve more results than a front page story in the paper every week without such organizational effort. The front page story is ephemeral. It is read today and forgotten tomorrow or the next day. But the dedicated committee makes its impact felt every day in some way. It gets people to thinking and it gets them to act. It won't allow them to forget. The media of information take their place as tools to supplement, from an informational standpoint, the organizational work of such groups.

In securing the active participation of groups and media, it is helpful if you can find among them persons who are personally subject to hay fever. We can have all the time we want to promote ragweed control on a certain radio station in New Jersey because the owner suffers from hay fever. After trying to promote some control efforts on his own initiative, he was happy to welcome and support the approach of public health agencies into control efforts. While his interest stemmed in the first instance from personal misery, he now looks upon it as a challenge to the community's ability to organize to overcome a public health problem. His interest has been extended to other public health problems from which he does not suffer as an individual.

The chief executive of one of our states became more than nominally interested in ragweed control when he saw the harassing effects of hay fever upon his wife and the relief she enjoyed in areas in which ragweed had been substantially eradicated.

These examples point up the desirability of identifying prominent persons who are personally affected by hay fever because they are receptive to efforts to eradicate ragweed.

Publicity opportunities are inherent in the organizational activity outlined above. The formation of committees, the local health officer speaking before groups, control activities undertaken by the street or highway departments, views of physicians on control efforts, the amount of hay fever which prevails -- all these are news items which the newspaper and the radio will use.

I have found it productive to send news stories directed to the attention of the chief editorial writer of the paper as well as to the editor. For reasons of space or personal predilection, the copy desk may on occasion leave out the paragraphs you would particularly like the editorial writer to see. We have seen helpful editorials result from sending occasional news stories directly to the editorial writer.

If the organizational effort has been well planned, it should be followed up with requests for proclamations to mayors and to the governor. All such requests should be submitted at least a month before the period for which they are desired and they should be accompanied by a suggested proclamation. Many such requests are turned down in executive offices because they are received at the last minute and there is not time to consider them in relation to other requests for the same period of time. Governors and mayors receive as many as ten different requests to observe the same week for different purposes -- including such things as Anti-Depression Week and Expectant Fathers' Week. Other things being equal, the only fair policy the executive can follow is to consider the meritorious requests on the basis of first come, first served. Be sure your request is submitted well in advance, that its purposes are clearly stated, and, if possible, indicate that a substantial number of citizens is asking for it.

Timing is an important consideration in other ways. In 1947, a large agency of the Federal government received very unfavorable publicity when it laid off 400 disabled veterans during Employ the Physically Handicapped Week.

Usually you have no choice, but if you do have a choice in the matter of radio time, try not to have it coincide with a period when a popular program is on.

At the risk of seeming to belabor the obvious, it is advisable to get down to earth in all publicity material. Simplicity and clarity are indispensable characteristics of good publicity. It is easy to overestimate the information which people have on any subject. A few examples may help to illustrate this:

When Franklin D. Roosevelt was first elected President of the United States, the widow of Theodore Roosevelt received many congratulatory telegrams.

After Alfred E. Driscoll had been Governor of New Jersey for three years -- a period in which he successfully led a movement for a new state constitution -- eighteen per cent of the voters in a New Jersey poll said they had never heard of him.

After Dr. Kinsey and his associated published their book on "Sexual Behavior in the Human Male," the Kinsey Distilling Corporation of Philadelphia ran a large advertisement in metropolitan papers in which it asked that persons not write to the corporation for copies of the book. It had been deluged with requests.

I suppose the moral of this is that it is easy to assume that people have basic information when in fact they don't, and secondly that it is easy to cause confusion. Tell a publicity man that his presentation to the general reader must be simple and he will say, "Of course," implying that he knows it. Some do, but the material which comes across an editor's desk proves that many do not.

The studies of Rudolph Flesch confirm that understanding varies inversely with the length of words and sentence. The longer the sentence, the less understood it is.

Another suggestion is not to ignore foreign language publications in placing publicity material. A considerable segment of our population reads the foreign language press. In his book, "Essentials of Public Health," Dr. William P. Shepard tells of the Italian immigrant who went to an out-patient clinic. He was diagnosed as having diabetes and was given a list of foods to which his diet should be restricted. The list and the verbal instructions were both in English. He went home, ate some spaghetti for several days, and was returned to the hospital in a coma. He had received sound, correct information but he received it in a form which was not understandable to him. It was therefore useless to him.

Publicity is not an end in itself. It is a means to an end. In an administrative organization, the only way its effectiveness can be measured is by the contribution it makes to the attainment of over-all administrative objectives.

In the objective which we are presently considering -- weed control -- the publicity will be based on and flow from, while at the same time it contributes to, the control effort. If the control effort is sound and sustained, there will be ample opportunity to secure helpful publicity. The degree to which the opportunity is seized and utilized is a measure of the resourcefulness of the informational specialist.

PREVENTIVE WEED CONTROL ALONG NEW JERSEY HIGHWAYS AND PARKWAYS

Oliver A. Deakin[1]

Nineteen fifty-three completed our largest new highway contruction year on record. Approximately 150 million dollars more was spent in roads of all classes than in 1952. All this means an increase of about 5 per cent, or a total expenditure of about three billion dollars. The government allotted $575 million for 1953 Federal Aid, an increase of 15 per cent over last year.

Toll road developments are under way in thirty or more states which indicates the tremendous need for new expressways and parkways to handle the ever increasing traffic load. Preliminary estimate of 1953 Motor-Vehicle Registration, Bureau Of Public Roads indicates there are over forty-five million automobiles and nine million six hundred seventy four thousand trucks and buses using our highways. The total number of auto--mobiles, trucks and buses is 54,709,000 an increase of 2.7 per cent or nearly 3 per cent over 1952.

All these statistics should make not only the highway main--tenance engineer but our governing officials, and the public aware of the magnitude of the ever-increasing maintenance cost and continuing problems it presents. When one realizes that Federal aid for highways is solely for construction and right-of-way acquisition and can not be used for maintenance or admin--istrative expenses of the state. Federal Aid funds must be matched by state funds on a 50-50 basis.

Every day maintenance of our highway roadsides is a contin--uing part of the overall highway maintenance expense. Due to the ever increasing shortage of hand labor and its high cost every avenue of possible saving should be explored to the fullest degree. Intelligent use of chemicals for weed and brush control offers many possibilities. Many State Highway Departments, more than in New Jersey, have been using chemicals to an advantage in helping to control and reduce the cost of its weed and brush main--tenance problem. Our situation to date is a little different in that most of our State Highways have been completely graded and seeded. In many cases the entire right of way has been seeded to highly desirable permanent grasses, resulting in a good turf cover. Frequent mowings reduce unsightly and undesirable weeds to a minimum.

The use of new chemicals sprays as a highway maintenance tool has had a steady growth, beginning shortly after World War II in 1945, when the North Central States Weed Control Conference, on November 27, 1945 gave a list of annual weeds, winter annual weeds, and a few perennial lawn weeds classified as, "generally susceptible", intermediate, or resistant to 2, 4-D.

We can think of weed and brush control as a matter of replace--ment of undesirable species with desirable plant growth. Some

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of the noxious weeds and plants along our roadsides are giant rag-weed, dwarf ragweed, and poison ivy. These plants are a definite hazard both to the abutting property owners and the highway mainten--ance workers. Many hours of lost time, and human suffering is caused by these weeds. The presence of poison ivy and giant rag--weed in roadside picnic areas is very undesirable and should be eliminated for the protection of the public.

On many of our Township and County roads, where weed and brush control is an ever present problem, the use of 2, 4-D and 2, 4, 5T could be utilized to a good financial advantage instead of mowing and cutting much of the roadside brush growth by hand methods. Where this old method of brush removal is practiced - where one small woody plant existed, two or three new sprouts appear in its place within a very short period of time. Removal of brush by hand cutting is slow, tedious, hazardous, and an expens--ive operation.

Estimates for hand cutting are $200 to $400 per mile, once every second or third year. By using the chemical spray method, it would cost approximately $35.00 to $40.00 per mile for the first year. The second year would be about $25.00 for the re-spraying of the same mile. The third year would be about $10.00 per mile.

Roadside spraying with 2, 4-D and 2, 4, 5-T is much easier and faster than mowing and especially on roadsides that have never been completely graded and seeded to grass.

Where cut slopes and high embankments are too steep for the establishment of grass, the New Jersey State Highway Department has used Hall's Honeysuckle very effectively as a woody ground cover vine to reduce soil erosion. The use of honeysuckle in many locations has been limited because of its spreading habit, especially adjacent to farm or woodland where it may become a nuisance. However, with 2, 4-D, that objection to honeysuckle does not exist. Honeysuckle is very sensitive to 2,4-D and can be kept from spreading by this method.

The selective weed killers, such as 2, 4-D have been used rather extensively by many state highway departments for control of susceptible, perennial, noxious weeds, broad-leaved weeds, and some woody plants. The use of 2, 4, 5-T is superior to 2, 4-D for control of brambles such as blackberry and raspberry, and osage orange combinations of 2, 4-D and 2, 4, 5-T are used where species susceptible to both products occur in the same area.

The maintenance of large informal bay areas free of sprout growth along the edge of wooded areas on the Garden State Parkway, Palisades Interstate Parkway, and Rockefeller Memorial Highway could be done rapidly and economically by use of chemical spray mixture of 2, 4-D and 2, 4,5-T or "Ammate" weed killer. "Ammate" weed killer gives 95% to 100% control within 10 days or 2 weeks. The use of 2, 4, 5-T in fuel oil as a basal bark sel--ective spray produces very good results. Most effective when done during the dormant season.

In the maintenance of the roadside, highway safety is always kept in mind. Brush and weed growth on curves and approaches to inter-secting roads may be controlled by chemical sprays. Proper sight distance must always be provided for the safety of the motor--ing public.

Roadside fire hazard may be greatly reduced by the eradication of tall growing weeds and brush, especially close to the shoulders of the roadway where a discarded cigarette may easily start a fire during the dry spring and fall months of the year. Soil steril--ants may be used economically to advantage in maintaining miles of fire lanes, parking areas, bridle and footpaths along highways and parkways where no vegetation is wanted.

The use of chemicals to control weeds and brush along our highways requires an understanding of the problem and what we expect to accomplish. Promiscuous and indiscriminate spraying of herbicides along our roadsides will bring public criticism. Maintenance crews must be thoroughly trained so they understand the proper and safe use of chemical sprays for weed and brush control as they concern highway maintenance problems.

Careful use of herbicides during the proper season may be an <u>invaluable tool for reducing highway maintenance cost</u>, <u>increasing highway safety</u>, as well as making our highways more enjoyable to travel during all seasons of the year.

* * *

ROADSIDE SPRAYING FOR WEED CONTROL

ROBERT J. McMAHON
SALES MANAGER
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PRESENTED AT THE ANNUAL MEETING OF THE NORTHEASTERN WEED CONTROL CONFERENCE HELD IN NEW YORK CITY ON JANUARY 6, 1954

The late Will Rogers said, "The only thing I know is what I read in the papers". May I borrow this premise? However, the papers that I refer to are the papers that have been presented on weed and brush control. As a basis for information, I am selecting papers from the State of New Jersey because after reading them, it becomes quite obvious that they have left no stone unturned and have presented the picture as clearly, or more so, as any State in the Union.

In dealing with the highway problem, therefore, we will take as an hypothesis to it the conclusions that they have reached. The four basic reasons for controlling weeds are:

1. Economy
2. Health
3. Safety
4. Beauty

The difficulty that now exists in roadside weed control would appear to be educating the highway engineer and his boss, -- the people. We must bear in mind that when we set out to discuss weed control with highway people, that this is an incidental item in their budgets. It is very difficult to have them run a cost analysis on a "trivial" item when there are so many pressing, major matters at hand.

If a highway engineer were to look at a pavement carefully that was on the verge of crumbling, he would readily tell you whether it would be wiser to patch the road or rebuild it. He is alert in this respect. However, if we look at the roadside right-of-way which has been established by grading and seeding at considerable expense, we might ask him what thoughts were in his mind when he originally made these expenditures and what plan he had for protecting his investment.

He might say, as they do say in New Jersey, that the landscape forces employ 150 men, 25 trucks, 10 pick-ups, 23 tractors, and 70 power mowers for approximately 3,000 acres--over more than 1750 miles of State highway. He intends to use these tools to mow to protect his roadside. This mowing amounts to a considerable sum of money. Now, let us ask the highway person why he mows. Why not just let it grow? Out of several dozen (not in New Jersey) that we have asked this question, it broke down to three basic reasons. We mow for safety primarily; the second, beauty; and the third reason is compliance with various laws or customs. Having established these reasons for mowing and cutting, we then ask what do you mow for? And here again, it being such an incidental item, there are very, very few who realize just what they mow for or ever stopped to analyze it. We might sum it up by saying that the greatest single answer is just plain vegetation. Very few will hazard a guess as to what percentage of grass they are mowing for, or what is the mien on the grass, or would it be necessary to mow for safety if the heavy bodied, tall growing weeds and brush were eliminated.

Safety :

Thus, considering our highways, mowing for safety only, can barely justify the use of a single mowing machine in the State of New York. We say this on the basis that we are told by New York competent agronomists that the height of the average grass employed in roadside cover in the State of New York would be about 18 inches and there is no highway person who would consider 18 inches a serious factor, or would warrant mowing from the safety angle, as your guide rails are visible, signs are visible and sight distance is not impaired to any serious degree.

Many weeds have a height of 3 to 8 feet and are usually heavier bodied, and completely block out guide rails, signs and sight distance. (Show slides).

It has also been pointed out that spraying is much faster than mowing, which is safety in itself, and is done with a vehicle which is more conducive to protecting life than the conventional mowing machine. Now then, spraying is cheaper than mowing, and if spraying is done properly, there is no requirement to make a pick-up since there is no great volume left on the roadside. The top maintenance men in two States have told us that it cost approximately twice as much to pick up as it does to mow. Therefore, if spraying were twice as expensive in its own operation, it could be cheaper by one-third in the long run if it just eliminated the picking-up operation. If 150 men maintain 1800 miles, that would average one man plus equipment patrolling every twelve miles of highway all summer or a period of four or five months. Compare this with a total cost of $344 for three sprayings per season on the same twelve miles. It would be reasonably safe to say that the total payroll alone would run $150,000 compared with a maximum $60,000 total cost for spraying the same 1800 miles.

The only logical conclusion, if we can convince highway people of this, is that there should be no delay whatsoever in spraying all highways, as there is no question about where to get the money. If they believe what you have proven, they already have the money in their mowing budget.

Beauty

But now let us look at those who mow for beauty. At what point does vegetative growth become an eyesore? Well that's a matter of opinion, but safety demands logically that it must be mowed before it obscures guide rails, signs, and impairs sight distance. This is the maximum point that they can allow it to grow. In the roads that we have observed, if mowing were effected at this point, it would be safe to say that a minimum of three mowings per year would be necessary on the average rural road. This also would be required because of the different species of weeds, such as sweet clover that comes up in May; ragweed which comes up from June on, and Queen Anne's lace which comes up in the Fall even though the grasses grow very slowly. This is one of the reasons why roads should be sprayed three times during the summer, for it is impossible to mow for weeds which are not yet growing. It is likewise impossible to spray for them.

Beauty has been defined as "the absence of the ugly", so here too by timely spraying we have let the grasses have all the moisture that nature has provided, and there is not the tendency of brownout in them. There is nothing prettier than a nice green lawn on our roadsides, and if we mow for beauty, then we must continue to mow to keep the grass trimmed, but by spraying, we have eliminated the ugly, and have achieved something to behold.

For those who mow to comply with the laws of certain States that require the removal of noxious weeds, there is no easier way to do this than eliminate the problem which would make the law superfluous.

Now it sounds easy when we look at it and take it apart, and we might say highway departments will grab it, and there is no problem whatsoever in getting highway people to employ this system, but strange as it may seem, we seriously question if 2% of the roads in the Northeast are treated in the manner we would like them treated, namely sprayed three times each season for three years. It is not that they don't agree with you or that they don't believe you, but most highway people just are not interested in weed control and do not understand it. For the main part, their problem is brush and poison ivy. To the safety people it is sight distance; to the health people, ragweed; to the agricultural people, their problem will vary with the crops they have in their fields, but it is usually limited to one or two species of weeds. Wherein lies the solution? Quite frankly, we feel that too many are waiting for perfection in this field. The rest are unaware of it. G. K. Chesterton once said, "Anything that is worth doing, is worth doing poorly." We sincerely agree with this line of thought, but in this particular field we feel that it would not be done poorly, but almost perfectly, and there is no point in waiting further.

The health people want to spray primarily for ragweed and poison ivy, but it is very difficult to interest the highway person with this approach. Public health is defined as that group which bridge the gap between scientific research and practical application. How might they best achieve their goal of bridging this gap? The situation seems to compare favorably to that of the open garbage dump --- where one group would be complaining about flies; another rats or odors, smoke, ugliness, preservation of animals, hazardous playgrounds for children, etc. To the person that came in about rats, we would not say, "Now we are concerned about flies", and try to get them interested in fly control on the dump, but we would quickly point out that the logical answer to "their" problem would be an incinerator or sanitary land fill, and not say a word about why we personally wanted the incinerator --- just say, "Yes, we agree with you", and enlist another group to help us build an incinerator.

In roadside, each individual problem and the solution to it, is not the elimination of just the given weed, but rather the establishment of a good turf easy to maintain, which in itself eliminates or reduces the possibility of rank or noxious weed growth. It is not our purpose to see how many weeds we can kill at a given time, but rather to protect the desirable growth that is there from scavengers encroaching upon their food supply and making it difficult for them to survive.

Why are highways so important to public health people? Public health people cognizant of all the individual problems, would go to the engineer and say, "Look, Mr. Smith, hear me out. At least 5% of the people in New Jersey and New York suffer from hayfever. Hayfever is caused primarily by ragweed. A primary source of ragweed is the roadside. We, as health officials, cannot expect private citizens to heed our recommendations unless we in Government do so. Now you need more money in your budgets to build better highways and you need it badly. You need people who will vote for more money in your budget and the strange part of it is that it is pretty hard to get people to listen to your highway problem, especially when their noses are running and when their eyes are sore, and in general, they just don't feel good. Now there are a lot of these people. In New Jersey, it is in excess of 200,000; New York, well over half a million. It would be nice to have these people thinking that you people in highway are pretty wonderful. Now here is the way, if you will listen. We can show you where you can enlist a large group of citizens on your side. You say to these people who suffer from hayfever, 'We are going to spray roadsides to see if we can't alleviate your suffering, as if we spray all State roads, we can do it for $.11 per person; and while this may come to quite a sizeable bill, we think your health is more important, and we are going to do our utmost to spray roads to help municipalities further their program, and in general, to be a classroom for the public.'" Then you proceed to show him how in helping the hayfever sufferer it actually has not cost him a penny, but has rather left money in his funds to go ahead and build his highways.

You also point out that he might go to the garden clubs and say, "We are doing this for beauty, as we think beauty is a major factor; that the northeast is the beauty spot of the World by its nature; that we have the most beautiful roads, and that we like to frame them with a nice border of green grass which will not give cover to the person that they like to call the "litterbug".

You go to the utility companies and say, "We understand that one-third of your dollar has been going to taxes, and on top of this you have been expending moneys to fight poison ivy and many things which we find will no longer be necessary for you to fight. So therefore, if you will vote for more money for better roads, I'll get rid of this brush in your lines and also reduce considerably your poison ivy problem, and really give you something for your taxes."

You go to the hotel groups and say, "We understand that there are a lot of people who can't come to your area because your pollen count is high. We want to help you reduce that count and stimulate interest in ragweed control whereby you might increase immeasurably your business, but just remember when I am looking for more money in my budget to build better roads, what I am doing for you; and then point out that he might go to the various Chambers of Commerce and tell about the people who suffer from hayfever that might want to establish a plant in the area, but not in an area where he has to stay away from his business for six weeks of the year."

He says to the farmer, "I have been watching you break your back cultivating those fields for some time. The Health Department tells me about a new way to help you. While I need money to build roads, I am going to spend money to help cut down on your work, but I might not save you any money, as I might ask you to take the savings and put it back into taxes for better roads because eventually I want you out of the mud." If the highway engineer does not buy on this, then he just is not interested in building any more roads.

This sounds like double talk, but actually there is no double talk to it, because each single item in itself is enough to warrant the expenditures necessary. We could go on and on with other benefits far too numerous to cover at any one time. Public health people acclaimed 2,4-D and 2,4,5-T, and said, "We now have a tool --- there is hope!" We say to you, "We have now the mechanics and the know-how to use that tool."

Pollen Study

Richard J. Sullivan
Industrial Hygiene Engineer
Bureau of Adult and Industrial Health

When one enters the movitiate of noxious weed control it is possible to believe, by a strenuous stretch of a pliable imagination, that by the fresh, new perspective achieved, one may glean a few facts and impressions not before discussed at these conferences. It is upon such a highly tenuous assumption that I have accepted this gracious invitation to speak to weed control experts.

The usual concern of our particular program in the New Jersey State Health Department is with air pollution -- with the determination of its nature, its quantity, its sources, its effects, and its correctibility.

This year our program undertook the consideration of ragweed pollen. At first the existence of such an allergy seemed very unreasonable. Apparently a large number of people, through no conscious deficiency, is uncomfortably affected -- even disabled -- by a natural phenomenon. Contrasted with air pollution, where man justly stews in his own refuse, ragweed allergy appeared illogical. If the survival of the ragweed plant were dependent upon its pollen being breathed and everyone becoming miserable as a consequence, then Darwin's notion of survival of the fittest would explain it. Such is, of course, not the case. It was with a great deal of philosophical satisfaction that I learned that man is again responsible; where he disturbs the earth ragweed will grow, that where there is no man, soon there is no ragweed, and that pollinosis is nature's retaliation against our reckless disruption of the natural sequence of plant growth. So ragweed pollen, like all the rest, is a man-made air pollutant: it is foreign, undesirable matter, partially destructive of the value of its host medium, air.

The methods for possible solution of the public health problem created by the presence of ragweed pollen in the atmosphere can be simply classified:

(1) the allergy can be eliminated
(2) susceptible people and pollen can be separated.

The first, as indicated by Doctor Sachs, is unpleasant, uneconomical and unsatisfactory.

The second can be subdivided:

a) susceptible people can migrate;
b) they can breathe filtered air;
c) offensive pollen can be eliminated.

All of these are currently employed, but mass migration and universal air filtration are not likely solutions. It appears that elimination of the environmental causative agent is the only feasible method.

In employing the conventional means for ragweed elimination, there is a definite need for an evaluation of the before and after of our community programs. The ultimate criterion of the need for, and success of, a ragweed elimination effort is of course the prevalence of ragweed pollinosis. If by epidemiology we could determine the extensity and intensity of pollinosis, by area survey the total acreage of ragweed, and by sampling, the seasonal pollen count, of a subject community prior and subsequent to a strenuous eradication effort, we should have acquired academically beautiful comparative data. As usual the price of public health purism is prohibitive, so it becomes necessary to measure need and progress by area survey and pollen counting -- in some cases by pollen counting alone. For this purpose our Department arranged this summer to collect pollen count data from 23 sampling locations in the State. It was our intention to gather this information in order to indicate those areas which are most in need of planned elimination programs, and assist in future evaluations of the effectiveness of eradication measures.

Standard shelters as described by the American Academy of Allergy were employed and counting was done in accordance with its recommendations. Several local organizations had maintained sampling stations in previous years but in most of the locations listed on the accompanying data sheet, pollen determinations had never been made to augment the meager supply of pollen shelters, we got out our hammers and saws and built samplers of wood, and chrome-plated steel, at a cost of $.90 for material and $1.90 for labor for each device. The products will never win an award in competitive fine arts but are durable, and are productive of elegant data. The brazen simplicity of both the samplers and the method, was attested by a number of pairs of raised eyebrows encountered in the course of our field experience. In general, we had no difficulty in inducing local health departments to operate samplers; this was especially true where we had the good fortune to contact passionately interested hay-fever victims. Several resort communities were reluctant to establish stations since they presumptively advertise freedom from pollen and were fearful that objective pollen data might confute their public relations. Slides from seven stations were counted by our Department, the balance by local agencies. After the study was in progress, we received enough requests from additional local agencies to lead us to believe that 40 stations could be operated locally without further salesmanship on our part. Since sampling frequently is accompanied by some attempts at weed eradication, this response was very encouraging.

The data is summarized on the attached sheet, all counts reported in grains per sq. cm. In counting a slide I felt that I could entertain no metaphysical certitude whatever; all I know is how many grains are present on the slide and that someplace in the area of the sampler there is at least one ragweed plant growing. All else is informed speculation -- the conversion into grains per cu. yd. and the establishment of counts representing the threshold of susceptibility seem to me to be extravagant extrapolations of our simple data.

It appears to me that the comparable figure most indicative of the pollen status of a sampling location is the median count. This value has been computed for each station for a one month period, rather than for the entire study so as to eliminate the misleading zero counts before and after pollination. We might consider a median of five or less to be low, of 6 to 15 moderate, and above 15 to be high. Such a quantitative expression is not standardized but we feel that if in subsequent seasons the median count is brought from the midst of one statistical area to the midst of the lesser area, progress will be demonstrated. Actually, we cannot boast of our ragweed program until such data is collected.

I have heard and read many conflicting opinions of the value of the standard pollen sampler. Based on this season's experience, I think that the shelter is the most wonderful, inexpensive, convenient, definitive, delightful air pollution sampling device that I have ever had the pleasure of operating. I had two volumetric samplers available to me throughout the study; I never used them because I think that they cannot provide any data useful to our program which is not obtainable by simpler standard means. It may be that the seasonal median pollen count, in a given location, is directly proportional to the amount of ragweed whose pollen travels far enough to reach the sampling station. This assumption is our justification. If it be invalid then grave doubt would be cast upon the value of any type of pollen sampler, if it is valid, then no improvement in sampling is required. It seems to me that no research in air-borne ragweed pollen instrumentation is required. I only wish that such successful selective samplers were available for the determination of all the other air contaminants that beset us.

There are of course an infinite number of possibilities for experimentation in sampling method; e.g., strictly speaking, pollen counts should be related to:

wind direction and velocity;
humidity;
time of day;
temperature;
degree of inversion.

These are the problems that face us in the achievement of general air sanitation, but to attempt to solve them in the field of ragweed elimination is to make a fetish of sampling. It's also true that some attempt should be made to appraise the relative contribution, at a given location, of pollen from distant rural growth and local urban growth. But it is not true that the absence of such knowledge should obstruct any community ragweed elimination program at present. There are those who think otherwise in the whole field of air sanitation -- who offer the pure, objective, scientific approach that all of the variables must be exactly appraised before any control is undertaken. I can't help but consider that if scientific purism were applied to the hay-fever problem, the disinterested logic of mathematics would indicate that since there are so very many more ragweed plants than there are allergic persons, would it not be so simple to eradicate the relatively few people and allow the multitude of ragweed plants to grow?

But selective euthanasia would be defeatism when pollen elimination is such a desirable and feasible public health program.

Contrasted with the general air pollution problem that obstacles to an effective ragweed program are negligible; the nature, quantity, source, effect and correctibility of air pollution are frequently unknowns -- possibly indeterminate quantities in many cases. In ragweed study they are all knowable variables. Air pollution must be controlled -- we must abate the public health nuisance but retain its source; hay-fever can be eliminated by the unique and direct method of complete eradication of the source. The work that remains for us is basically a public relations activity, to sell the virtues of eradicating an eradicable quantity.

If things get a little hard to handle, as they seem to at times, as an inexpensive, direct, alternative, we might pray to God for the sudden demise of all ragweed.

Pollen Counts in gr. per sq.cm. for One Month Period

August 24 - September 23, 1953

Location	Highest Count	Median Count	% Days Over 10
New Brunswick*	126	15	65
East Brunswick	44	9.5	45
Jersey City W.	16	2	12
Summit*	63	17	74
East Orange*	45	3.5	30
Fort Dix N.	90	13	58
Fort Dix S.	48	14	55
Newark*	111	9	43
Asbury Park	32	16	56
Trenton*	131	71	87
Seabrook 1	79	5	35
Seabrook 2	31	6	32
Seabrook 3	72	15	72
Flemington	368	46	88
Teaneck	39	5.5	40
Hightstown	396	122	83
Dover*	41	7	47
Linden	126	14	69
Red Bank			
Haddonfield			

*counts made in previous years.

POISON IVY DERMATITIS CONTROL PROCEDURES

Dr. John F. Kilgus, Chief
Health Services for State Employees
Connecticut State Department of Health

Few of us think of poison ivy dermatitis as an occupational condition. In fact, few of us think seriously of poison ivy unless we have been so unfortunate as to slice our golf balls into a patch of this weed or sit in the wrong place at the company outing. However, if you even so much as mention poison ivy to a Highway Department official, he turns pale and shudders. To Highway departments, public utility companies, tree surgeons--to mention only a few--poison ivy dermatitis is a real problem in lost time and lost efficiency.

The Connecticut State Highway Department has long been plagued with the problem. Several years ago, the department's safety engineer, A. M. (Scotty) Addison, found that lost time in that department due to this type of dermatitis could be reduced 70% by an educational program and the use of a protective preparation (Ply 9 - Milburn Company).

In 1950, when the Connecticut State Health Department's Division of Health Services for State Employees was still in its infancy, the Highway Department sought its help in solving the poison ivy problem. After considerable research, it was decided to offer prophylactic injections of poison ivy extract to the Highway workers as an added precaution. There are innumerable extracts on the market--some good, bad, and indifferent. Doctor Robert L. Quimby, then head of H.S.S.E., decided upon the use of an extract marketed by the Arlington Chemical Company (now sold by Hollister-Stier Laboratories). This extract is made in accordance with the work of Sharlit and Newman(1). The stock solution is made by extracting 10 grams of freshly gathered poison ivy leaves with 100cc of absolute alcohol. The extract used is a 1:1000 dilution or 1% of the stock solution in absolute alcohol. The dosage is 0.1cc subcutaneously. The favorable experience of physicians who had used this preparation and the small dosage influenced its choice over numerous other good products in the market.

This was the beginning of the Connecticut State Highway Department's program to reduce lost time and lowered efficiency of its workers insofar as poison ivy dermatitis was concerned. None of us were so cocky or narrow-minded as to think for one instant that we had the problem licked or that any one approach was sufficient. The program, as it has developed, has many integral parts. I will discuss each of these--not in the order of its importance as I do not believe that it is possible to give a top priority to any one part of the program. It is a little like the colored gentleman who backed into the buzz saw--he was a little uncertain as to which tooth cut him.

As the program has developed, more and more attention has been directed toward eradication of the plant. This seems logical as certainly the workers can't get a poison ivy dermatitis if the plants are not present in their work area. This, however, is no small task even in a small state like Connecticut. The Highway Department's engineering staff estimates that 8,000 acres along its highways are kept under vegetative control. It is further estimated that about 10% of this, or 800 acres, is heavily infested with poison ivy. The preparation used for spraying is a mixture of 24-D and 245-T--2 parts of 24-D and 1 part of 245-T in an amine salt formula. Three quarts of this formula are used in 100 gallons of water. It is estimated that about an 80% kill is effected with the first application. Of course, this has its problems as the preparation effects all broadleaf plants and is best applied in early spring under satisfactory weather conditions with a well controlled hand spray method. An all-out attempt at destruction of the plant is planned for 1954 at an estimated cost of $25,000.00.

Education has proved a very valuable asset in the fight. Each summer, the Highway Department employs about 500 men as temporary help. For the most part, these are college boys, many of them from urban areas where poison ivy is infrequently seen. These temporary employees must be taught to recognize the plant and respect it. For far too many of them, this knowledge is gained through painful experience. They must be taught how to take care of themselves and their clothes. For a number of years, protective solutions or creams have been furnished. The preparations first used were Ply-9 and Plyothol made by the Milburn Company. During the last summer, several other preparations were used experimentally--Rhus-Lo Cream (D.R.S. Pharmacal Company, Worcester, Massachusetts) and Pro-Derna (Westwood Pharmaceuticals, Buffalo, New York). Sufficient work has not been done to evaluate these preparations, but they show promise.

Lastly, the phase of the program with which I have been most closely associated is the use of prophylactic injections of Poison Ivy Extract. If one goes through the medical literature, He is discouraged in finding many more unfavorable reports concerning the use of these extracts than favorable ones. However, almost all of these reports have to do with the use of Poison Ivy Extract as a treatment and not as preventative. In fact, some of the more recent articles (2) (3) (4) make its use as a means of treatment in acute Rhus dermatitis appear definitely dangerous. We can say with assurance that in our experience in giving more than 5,000 prophylactic inoculations of 0.1cc Poison Ivy Extract (Arlington) we have encountered no untoward reactions.

As I go over our figures for these four years in an attempt to honestly evaluate the use of the extract, I am constantly reminded of the old adage--"Figures don't lie, but liars can figure." There are so many factors that defy control--so many variables that it is practically impossible to arrive at any definite conclusions. In the first place, our program is a voluntary one. No man is told he must have the inoculations. It follows then that the men who avail themselves of the inoculations are for the most part men who know themselves to be in some degree susceptible to this type of dermatitis. Conversely, the men who do not bother to get the inoculations are for the most part permanent employees who have developed an immunity from years of contact. This is brought out quite vividly in our 1952 figures which show that among our permanent employees only 8.2% contracted poison ivy whether or not they were inoculated while under the same circumstances; 22.2% of our temporary employees developed a dermatitis in varying degrees. To be perfectly honest, the figures, as shown in the following table, were so baffling to us that we decided to see how the men in the field felt about the program and so submitted to them a questionnaire which was returned to us unsigned.

SUMMARY POISON IVY CONTROL PROGRAM
FOR CONNECTICUT HIGHWAY WORKERS
Years 1951-1952-1953

Year		No. Em-Ployees	No. Losing Time	No. Days Lost
1951	Total Employees Inoculated	469	6	25
	Total Employees Not Inoculated	1407	11	86
	Permanent Employees Inoculated	387	1	1
	Temporary Employees Inoculated	82	5	24
	Permanent Employees Not Inoculated	1312	2	23
	Temporary Employees Not Inoculated	95	9	63
1952	Total Employees Inoculated	711	24	71
	Total Employees Not Inoculated	1372	15	47
	Permanent Employees Inoculated	471	2	20
	Temporary Employees Inoculated	240	22*	51
	Permanent Employees Not Inoculated	1257	3	5
	Temporary Employees Not Inoculated	115	12	42
1953	Total Employees Inoculated	1040	27	124
	Total Employees Not Inoculated	1741	20	57
	Permanent Employees Inoculated	670	6	31
	Temporary Employees Inoculated	370	21	93
	Permanent Employees Not Inoculated	1586	6	11
	Temporary Employees Not Inoculated	115	14	46

*Only 4 cases developed dermatitis after sufficient time had been allowed for immunity to develop.

Questionnaire

We are trying to obtain the opinion of our employee's concerning the poison ivy program, particularly the part pertaining to the prophylactic inoculation and the use of Ply #9 or other protective preparations supplied by the Department. Will you, therefore, please answer the following questions with a check mark ( ) and return this form to your District Office, On or before August 15th. No signatures are required on this form.

1. District #______. Employment? ______ Permanent Employee ______ Temporary Employee
2. Are you susceptible to poison ivy? ___ Yes ___ No
3. Were you working in areas where poison ivy was ___ Heavy ___ Light ___ None?
4. Did you have a case of poison ivy this season? ___ Yes ___ No

5. Was your case of poison ivy ________ ________ ________?
First Aid Medical Lost Time
6. Were you inoculated by State Doctor or Nurse ___ ___.
Yes No
7. Were you inoculated by a private physician? ___ ___
Yes No
8. How many inoculations did you have? ___ ___ ___ ___ ___.
1 2 3 4 5
9. When did the poison ivy first appear?

Before Inoculation Within two weeks More than two weeks

10. Do you think these inoculations aid in preventing poison ivy? ___ ___
Yes No
11. Do you think these inoculations cut down the severity of the case? ___ ___
Yes No
12. Are you in favor of continuing the poison ivy inoculations? ___ ___
Yes No
13. Did you use Ply #9 or other protective preparations supplied by State? ___ ___
Yes No
14. Do you think these protective preparations help to prevent poison ivy? ___ ___
Yes No
15. Do you think these protective preparations cut down the severity of the case? ___ ___
Yes No
16. Are you in favor of continuing the use of these protective preparations? ___ ___
Yes No
17. COMMENTS: (Please feel free to express yourself with any comments you may wish to make).____

I think the prize comment, however, made by one of the men was "I am not acceptable to poison ivy."

From the 1,125 questionnaires returned, I tabulated the results of the following four questions:

1. Are you susceptible to poison Ivy?
2. Do you think that these inoculations aid in preventing poison ivy?
3. Do you think that these inoculations cut down the severity of the case?
4. Are you in favor of continuing the poison ivy inoculations?

To the first question--Are you susceptible to poison ivy? The answers were Yes - 563; No - 552. This surprised me as I had been led to believe from the low percentage (0.2%) of permanent employees who developed a dermatitis in 1952 that the percentage of relatively immune persons was considerably higher.

To the second question in regard to whether or not the inoculations aid in prevention, the answers were Yes - 718; No - 170; No opinion - 236.

To the third question relative to reduction of severity, the answers were Yes - 747; No - 94; No opinion - 284.

To the fourth question - Are you in favor of continuing the inoculations? The answers were very decisive: Yes - 853; No - 100; No opinion - 172.

The manner in which any program is received by the employees largely determines its success or failure. Even though we are unable to show striking figures to prove the success of the prophylactic use of Poison Ivy Extract, the program has a very definite psychological benefit. It appears that a great many men exposed daily to poison ivy will develop some degree of dermatitis. Our figures are based only on the lost time cases. These one would expect would be the severe cases. There is a joker in this, however. A couple of years ago our State Legislature, in a moment of extreme generosity, voted to allow any state employee disabled in the line of duty his full salary for the first week of his disability. Of our total number of lost time cases, only 6 lost more than 5 days. Of these 6, there were 3 truly severe cases, one losing 16 days, one 13 days, and 1 losing 9 days.

In conclusion, our Connecticut State Highway Poison Ivy Program consists of

1. Eradication - Destruction of the plant with 24-D and 245-T spray.
2. Education of the Employee
   a. Recognition of the plant.
   b. Ways and means of self-protection.
3. Skin Protection
   a. Use of protective preparations.
   b. Proper skin cleansing.
4. Use of Prophylactic Inoculations of Poison Ivy Extract.

We believe that all four of these phases of the program are necessary for good results.

We are far from smug and satisfied as to our results, but feel that we are traveling in the right direction and making progress.

References

(1) Sharlit, Herman - Newman, Ben A.: New York State Journal of Medicine, 37, 1937
(2) Callaway, J.D., and O'Rear, H.B.: Archives Derm. & Syph. 64:159-63, August 1951
(3) Rytand, D.A.: American Journal of Medicine - 5:548-60, October 1948
(4) Shaffer, B., Burgoon, C.F., and Gosman, J.H., J.A.M.A. 146:1570-72, August 25, 1951

NORTHEASTERN WEED CONTROL CONFERENCE

MINUTES OF THE BUSINESS MEETING

January 6, 1954

The meeting was called to order by President Beatty who then introduced guests at the head table, namely, Mr. L. I. Jones, U. S. Department of Agriculture Extension Service; Mr. E. P. Sylwester, Extension Specialist in Weed Control, Iowa State College; and Mr. C. J. Willard, Agronomy Department, Ohio State University.

The report of the Secretary-Treasurer was given in brief form and it will be found in complete form in the Supplement.

A discussion was held concerning the desirability of forming a National Weed Control Society and a motion was made that the Northeastern Weed Control Conference go on record as favoring a National Membership Society for weed control. Motion made by Fertig, seconded by Phillips and carried unanimously by the group.

The report of the Awards Committee was made at which time the following awards were presented, one hundred dollars each for outstanding papers at the meetings. The following five papers received awards:

1. Studies on Entry of 2,4-D Into Leaves - R. L. Weintraub, J. N. Yeatman, J. W. Brown, J. A. Thorne, and J. R. Conover, Camp Detrick, Frederick, Maryland.

2. The Effect of Soil Organic Matter Levels on Several Herbicides S. L. Dallyn, L. I. Vegetable Research Farm, Riverhead, New York.

3. Experimental Use of Herbicides Impregnated on Clay Granules for Control of Weeds in Certain Vegetable Crops - L. L. Danielson, Virginia Truck Exp. Station, Norfolk, Virginia.

4. Cultural vs. Chemical Weed Control in Soybeans - W. E. Chappell, Virginia Agr. Exp. Station, Blacksburg, Virginia.

5. Public Health Significance of Ragweed Control Demonstrated in Detroit - John H. Ruskin, Sanitary Engineer, Dept. of Health, Detroit, Michigan.

Following this report the nominating committee was called on for its report. The nominating committee consisted of G. H. Ahlgren, Chairman, E. R. Marshall and L. L. Danielson. The committee presented as their slate of officers; for President, A. O. Kuhn; Vice-President, J. D. Van Geluwe; Secretary-Treasurer, W. C. Jacob; Representative on Editorial Board for "Weeds", R. D. Sweet. Each office was taken up in turn by the President and nominations asked for and in no case were any nominations made from the floor, so the Secretary cast a unanimous ballot in each case for the nominations committee nominee for the office.

The meeting was then turned over to Dr. Kuhn after Dr. Beatty had thanked everyone for helping him during the past year. Dr. Kuhn indicated that he would appoint committees at a later date during the meeting.

On Thursday the following committee chairmen were announced by the President:

Program Committee Chairman - W. W. Smith

Coordinating Committee Chairman - L. L. Danielson

Publications Committee Chairman - R. J. Aldrich

Sustaining Membership Chairman - C. L. Hovey

Public Relations Chairman - R. A. Peters

Awards Committee Chairman - R. H. Beatty

Walter C. Jacob

Walter C. Jacob, Secretary

NORTHEASTERN WEED CONTROL CONFERENCE

Treasurer's Report

February 1, 1954

Receipts

Cash on hand 1/15/53	$4126.18	
Sale of Proceedings and Reprints	818.45	
Sustaining Membership	1475.00	
Sale of 1954 Proceedings	945.00	
Registration at 1954 Meeting	709.50	
Luncheon Tickets	640.00	
Total receipts		$8714.13

Expenses

General		
Postage & Communications	$378.22	
Supplies	150.98	
Travel of Executive Committee	633.05	
Stenographic help	264.38	
Awards	613.57	
Secretary's honorarium	300.00	
Miscellaneous	93.30	
Total		$2433.50
Publications		
1953 Supplement	$203.38	
1954 Proceedings	986.85	
1954 Supplement	32.25	
Mimeograph Supplies	199.23	
Newsletters	131.96	
Total		$1553.67
Meeting		
Old bill	$ 8.40	
Programs	175.00	
Badges	23.99	
Registration Clerks	60.00	
Pictures for publicity	70.00	
Travel	388.09	
Mixer	99.12	
Miscellaneous Expenses	164.26	
Luncheon	656.59	
Total		$1645.45

Total Expenditures	$5632.62
Cash on hand February 1, 1954	3081.51
Total	$8714.13

Walter C. Jacob

Walter C. Jacob, Treasurer

We have examined the foregoing financial statement of the Northeastern Weed Control Conference and find it correct as submitted.

J. D. Van Geluwe — S. N. Fertig

J. D. Van Geluwe — S. N. Fertig

NORTHEASTERN WEED CONTROL CONFERENCE

Secretary's Report of the Annual Meeting

The healthy increase in registration at the meeting was a reflection of the increased interest in weed control. A total of 494 persons were registered this year.

It is interesting to note the changes in attendance over the years and the table below gives some idea of the composition of the last four meetings.

Source of Persons	ATTENDANCE 1951	1952	1953	1954
Exp. Station & Non-Comm. Res.	85	103	110	110
Suppliers of Chemicals or Equipment	143	122	181	197
Users-Public Health, Public Utilities, Farmers, etc.	112	158	134	173
Press	-	12	7	14
TOTAL	340	395	432	494

The sustaining membership list continues to grow. This year there were 41 companies who contributed to the financial support of the Conference.

The luncheon-business meeting was well attended, a record 159 were served, and the presentation of awards was the high spot of the meeting.

The new extension section was launched with a good send-off and the future looks good. A group gathered to talk informally about aquatic weeds and a program is planned for next year on this subject.

In connection with the extension section an award was presented to Norman J. Smith, Assistant County Agent of Madison County, New York, for doing the outstanding county agent work in weed control in the Northeast. This award consisted of a suitable certificate and an all-expense paid trip to the Meeting to present a report of his program to the extension section.

The next meeting will be held at the Hotel New Yorker, New York City on January 5,6,7, 1955.

Walter C. Jacob

Walter C. Jacob, Secretary

INFORMAL AQUATIC WEED MEETING

8 P.M. Tues. Jan. 5,1954

SUMMARY

This informal meeting was attended by twenty-nine interested members. Discussion centered around the aquatic weed problem, the difficulties encountered by those faced with this problem, and the need for some sort of research program.

Basically the aquatic weed problem is this: aquatic weeds, principally submerged, frequently infest lakes, ponds, irrigation ditches, etc., to the degree that they materially interfere with the primary use of the water. The problem is to find a method of control that is inexpensive, quick, harmless to fish, other aquatic life, and mammals. Mechanical and biological control methods appear to be of limited value, hence the interest in chemical control.

However, chemical control of aquatic weeds presents several problems. Most of the chemicals used to date are toxic to fish and other forms of aquatic life. Some compounds are toxic to mammals. Also of major importance is the fact that some of the substances now under test are very expensive.

In discussing the extent of this problem, it was apparent that, to date, no one has attempted to assess, on a Nation-wide basis, the annual loss, caused by aquatics, to the farmer, resort operator, or sportsman. The United States Fish and Wildlife Service conducted a survey in Florida and Louisiana on the effects of alligator weed and water hyacinth and estimates the annual loss to fish and wildlife in these two states at 20 million dollars. A similar survey by the Fish and Wildlife Service on the effect of water chestnut on the Mohawk-Hudson River System, estimates an annual loss of $51,600.

In discussing the need for a research program three points of view were advanced:

1. The trial and error system. Under this system any material known to kill weeds is given a trial run.

2. The so-called academic approach in which the first step would be extensive study of the aquatic plant and its physiology. The idea being that if the functions of the plant are understood it may be easier to choose or develop a control substance.

3. Another suggestion is in effect a compromise between 1 and 2 i.e., it was suggested that some screening of present terrestrial herbicides be done and those showing promise be tested. In conjunction with this plan a program of basic research might be undertaken by competent botanists.

It is also felt that more information is needed on the toxicity of herbicides to fish and other forms of aquatic life.

One thing was very apparent, there is active interest in the aquatic weed problem. A section on aquatic weeds is planned for the 1955 conference. It is hoped that the interest evidenced at this meeting will multiply and produce a greater exchange of information on the subject of aquatic weed control.

John D. Gould
Aquatic Biologist
Southern Fisheries Dist.

The following attended this meeting:

John D. Gould
Douglas Moss
Tom Eastwood
Margaret Greenwald
Ralph E. Patterson
Charles J. Wall
E. H. Huber
Jonas Vengris
W. M. Bejuki
LeRoy G. Irving
Ralph H. Smith
Arthur H. Cook
David B. Cook
Thomas J. Page
Ray R. Kriner
E. S. Hagood
Helen Rigg
William A. Nieung
Philip Gorlin
William W. Doyle
Edward P. Brady
Barbara H. Davis
John H. Steenis
S. S. Sharp
Robert K. Huckins
Cole W. Wilde
Grant F. Walton
Leslie R. Reed
Laurence VanGordon

The addresses of the above may be obtained from the registration list which will appear in the supplement to the Proceedings of the Eighth Annual Meeting of the Northeastern Weed Control Conference.

REPORT OF THE RESEARCH COORDINATING COMMITTEE

OF THE

NORTHEASTERN WEED CONTROL CONFERENCE FOR 1954

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This report presents the results of a canvass of the general conference membership by the members of this committee. It is intended to give a general coverage of weed control methods in use, those which are ready for field trial, and those which are still in the strictly experimental category. In addition, the needs of future research in connection with the various weed control problems are indicated.

The materials, rates, and methods indicated are not recommendations for general local use and shall not be construed as such. These reports are presented with the understanding that all materials suggested for general use are subject to prior label approval by the U. S. Food and Drug Administration before such use.

L.L. Danielson

WEED CONTROL APPLICATION EQUIPMENT

C. W. Terry

Agr. Engr. Dept.
Cornell Univ.

CONCERNING NEW APPLICATION EQUIPMENT:

The VERMONT Agricultural Experiment Station has built a Spot Weeder, designed to facilitate destruction of individual weed plants without damaging adjacent vegetation. It is described in an experiment station publication, "Vermont Spot Weeder", by A. R. Midgley, pamphlet No. 29.

WEST VIRGINIA University Agronomy & Genetics Department has developed a spray outfit for applying spray to experimental corn plots. It consists primarily of a 3 gallon spray tank and air compressor mounted on a Planet Jr. Garden tractor with a detachable boom mounted in front. It is equipped with pressure regulators and a speedometer. This outfit can readily be loaded into a pickup truck and transported to the field and it can be operated satisfactorily by one man.

DIFFICULTIES WITH EXISTING APPLICATION EQUIPMENT WERE EXPRESSED AS FOLLOWS:

University of DELAWARE say, "Regular weed sprayer pumps usually don't have enough capacity to apply 30-50 gallons per acre and at the same time have sufficient overflow to cause agitation in the tank. (The latter is a problem with wettable powders and emulsions)."

NEW JERSEY Agricultural Experiment Station say, "1. TCA has resulted in considerable corrosion, and 2. Selector valve accompanying Century Spray unit has given us some difficulty in regulating pressure; valve sticks (2 different units)."

GENEVA (NEW YORK) Experiment Station complains of: "Wear, and consequent reduced performance of gear pumps."

PENNSYLVANIA Experiment Station workers have had trouble with pumps having rubber impellers when spraying mineral oils.

WEST VIRGINIA has "a Hansen Brodjet spraying outfit on trial but have not been able to adjust or regulate it so that it gives satisfactory application. Such a boom has many advantages and conveniences if it could be developed so that it would give even coverage in spite of wind and uneven ground."

Few special tests with NEW OR DIFFERENT APPLICATION EQUIPMENT have been reported. The GENEVA (NEW YORK) Station has done some work with "directed control spray in vineyards", and the PENNSYLVANIA Station has been "applying 2,4-D while cultivating."

Apparently several stations feel the need for NEW EQUIPMENT OR MODIFICATION OF EXISTING MODELS:

STORRS, CONNECTICUT Experiment Station want: "Equipment for applying herbicides on rocky pastures. Uneven distribution usually results if a standard boom is used because of frequent tipping as the boom travels across the field."

University of MARYLAND want: "Equipment that will apply both dusts and sprays in narrow bands between new seedlings of alfalfa. In this work they are attempting to apply weed control chemicals in a 5-inch band between rows of alfalfa that are seeded 7 inches apart. So far as they have been able to determine, no satisfactory equipment for applying dusts or granular material in this manner is available. Also, it is difficult to find a nozzle with sufficiently narrow angle to apply this spray yet be far enough off the soil to avoid damage from rocks and from roughly prepared soil."

MASSACHUSETTS Experiment Station workers think there is "Need for more work on equipment similar to the stem sprayer you devised at the MISSISSIPPI Experiment Station and at ITHACA." They believe that original thinking toward development of new devices is in order.

NEW JERSEY sees need for "additional work on attachment of sprayer to planter for several field, and vegetable crops."

GENEVA, (NEW YORK) wants "Easily replaceable parts for worn members of gear pumps."

PENN STATE workers say that "Many farmers have been spraying weeds too late." This calls for further educational programs rather than new equipment

RHODE ISLAND wants something new in dust applicators, and VIRGINIA Polytechnic Institute see the need for further development of "Equipment for applying hand sprays behind planters."

There is still need for stressing the importance of accuracy in application of weed control chemicals. No equipment can do a good job unless it has been properly designed and serviced. Close regulation of nozzle pressure and forward speed of the rig are essential. Most workers now realize the importance of having good nozzles, and the need for keeping them clean; also that periodic calibration is necessary for consistent results.

Booms have not been replaced by the nozzles that spray a wide swath for two important reasons:

(1) Wind is a very disturbing factor.
(2) Variable droplet size is required for wide coverage with a single nozzle, and a few large drops may not necessarily be as effective as many small drops of the same material.

It is going to be difficult to get any machine that will give uniform distribution over uneven ground. Perhaps the results will not justify the additional expense of obtaining such a machine.

Pumps present an economic problem. The ones that are less expensive initially are apt to result in greater overall cost when repairs, maintenance and possoble lost time or reduced capacity are considered.

PUBLIC HEALTH

A. H. Fletcher

N. J. Dept. of Health
Trenton, N. J.

Ragweed

Agreements

1. Approximately 5% of the persons living in the Northeast have pollen hayfever. It is estimated that 70-80% of these are sensitive to the ragweed pollen and a large percentage of these develop asthma after repeated attacks of hayfever.

2. The effective control of ragweed depends primarily on the prevention of pollination.

3. The low pressure aqueous foliage spray application of 500-1000 parts per million or about 1/2 to 1 pound per 100 gallons of water of acid equivalent of 2,4-D of non volatile formulations such as the sodium or amine salts of 2,4-D have been shown to be effective, practical and safe when applied as coarse foliage drenching sprays at the rate of 100 to 300 gallons per acre depending on size of plants. Ester formulations should not be used. Spraying should not be done on windy days because of drift.

4. Spraying ragweed not only prevents pollen and seed production, but has a cumulative effect. Future ragweed growth is discouraged through the stimulation of competing vegetation especially grasses.

5. The control of ragweed plants in urban areas has proven effective and economically feasible, as well as beneficial to hay-fever sufferers in the vicinity, when carried out as a centrally directed and administered spraying program using 2,4-D.

6. The time period for spraying in any community depends on equipment and manpower available in relation to extent of weed growth to be sprayed. When spraying can be completed in a few weeks it should be done as late as possible during the growing season and still be completed by the first week in August.

7. Most cities find it desirable to conduct weed control programs with several departments cooperating. Such departments generally include one or more of the following: health, public works and parks.

8. Two broad types of programs that provide the maximum of relief are:

   First, the control of the extensive and concentrated ragweed growth in urban areas where the largest number of people will benefit with the least per capita cost, and

   Second, the control of ragweed along highways and railroads where people travel, especially those highways without plant cover along banks, shoulders and right-of-ways, and those subject to erosion.

Problems Needing More Work

1. The cooperation of specialists, including aerobiologists, botanists, statisticians, public works engineers, sanitarians, agriculturists and public health administrators, is essential in solving the problems of control and in evaluating control programs.

2. Research to determine the concentration and dynamics of pollen in the atmosphere necessary to bring about allergic reactions.

3. The botanical and meteorological factors influencing the distribution of pollen in the air from the ragweed growing areas.

4. Measuring devices to quantitatively sample pollen in air. This is necessary to determine where pollen is coming from and to measure the reduction in pollen concentrations in the air following the elimination or reduction of ragweed growing areas.

5. Field surveys of States or regional areas to determine the location, the extent and the intensity of infestations of ragweed.

6. Research is needed in plant ecology. Such research should include the effect of weed killers on plants and on the use of competitive plants to compete with or suppress ragweed growth in places where competitive plants are now discouraged by an unfavorable environment.

7. Research in the development of wetting and spreading agents for use with 2,4-D.

8. The development of practical measures for the control of ragweed in connection with the growing of crops such as potatoes, corn, tomatoes, grain, etc.

9. The encouragement of private organizations, financed by public contributions, which are dedicated to the relief of hayfever sufferers.

Poison Ivy

Agreements

1. A substantial percent (as high as 20% to 25%) of the population in many suburban-type communities, where poison ivy has been allowed to grow unchecked, are poisoned each season.

2. Poison ivy is found in wood lots, along fence rows, parks, playgrounds and other recreational areas, as well as on trees, poles and in orchards.

3. Poison ivy can be effectively controlled using ammonium sulfamate, 2,4,5-T, combinations of 2,4-D and 2,4,5-T ester formulations. Higher concentrations of the chemical are necessary to kill poison ivy growing in the shade than in the sun.

4. Borax has been successfully used at rates of 4 lbs. per 100 sq. ft.

Problems Needing More Work

1. Studies of penetration, absorption and translocation of herbicides in the poison ivy plant and the influence of time of application on the effectiveness of control.

2. Research is needed to determine uniform applications of lethal amounts of herbicide to control poison ivy.

3. The cooperation of several specialists, including botanists, public works engineers, sanitarians, agriculturists and public health administrators, is essential to developing good control programs.

VEGETABLES

R. D. Sweet
Veg. Crops Dept.
Cornell Univ.

<u>Asparagus</u> - <u>Established Bed</u> (7 reports)

<u>For Extensive Use</u>

1. Cyanamid Granular - 300-400 lbs. - concentrated over row when weeds are small (4 reports). Precutting only (1report).

2. Cyanamid Defoliant grade - 75-100 lbs. during cutting season (2 reports).

3. Crag 1 - 2 lbs. Anytime during season before weeds have emerged (1 report).

4. DNOSBP - 6 lbs. pre-emergence (2 reports).

5. 2,4-D - 1 lb. before and after cutting on other than sandy soils (1 report).

6. CMU - 1/2 lb. (1 report); 1-1½ lbs. (1 report); 2-4 lbs. (2 reports).

7. NaPCP - 20 lbs. before cutting (1 report).

<u>For Trial</u>

1. Alanap 1 - 4 lbs. (1 report) before spears emerge.

2. CIPC - 8 lbs (1 report) preharvest for chickweed.

<u>Problems Needing More Work</u>

1. Control of perennial grasses and broadleaves.

2. Value of cultivation other than for weed control.

3. Chickweed control in established plantings.

<u>Asparagus</u> - <u>Seedling</u> (3 reports)

1. PCP - 6 lbs. (1 report) pre-emergence.

2. NaPCP - 10-12 lbs. (2 reports) pre-emergence.

3. DNOSBP - 3 lbs. (1 report) pre-emergence.

4. CMU - 1½ lbs. <u>trial only</u> (1 report) pre-emergence.

Lima and Snap Beans - (5 reports)

For Extensive Use

1. Dinitro (water soluble) - 6-9 lbs. at planting (2 reports).
2. Dinitro (water soluble) - 3 lbs. at emergence (3 reports)
3. NaPCP - 20 lbs. at planting (1 report).

For Trial

1. Chloro IPC - 6 lbs. at planting (1 report)

Problems Needing More Work

1. Control of perennial and annual grasses (1 report)

Beets (3 reports)

For Extensive Use

1. NaCl - 2 lbs./gal. at 4 or 5 true leaved stage (3 reports)

For Trial

1. Endothal - 6 lbs. and/or/TCA - 8-12 lbs. for grass control (3 reports).

Problems Needing More Work

1. Better herbicide for broadleaved weed control.
2. Evaluation of P.D.U. and C.M.U.

Carrots (4 reports)

For Extensive Use

1. Stoddard Solvent - 75-125 gals. per acre (4 reports)

Parsnips, Parsley, Dill

Same as for Carrots.

Celery

For Extensive Use

1. Stoddard Solvent - seed beds only.

Problems Needing More Work

1. Herbicide for celery after it has been transplanted to field.

Cole Crops (2 reports)

For Trial Use

1. Chloro IPC - 2 lbs. in warm weather, 1 lb. cool weather immediately after seeding.(1 report).

2. Natrin 3-6 lbs. on transplants.

3. TCA 25-40 lbs. 60-90 days before transplanting.

Problems Needing More Work

1. Selective herbicide for a wider range of weeds in cole crops.

2. Selective herbicide for transplanted as well as direct seeded cole crops.

Lettuce (2 reports)

For Trial Use

1. Chloro IPC - 1-3 lbs. pre-emergence (2 reports).

Onions (6 reports)

For Extensive Use

1. KOCN - 1-2 per cent spray after flag stage (5 reports).

2. Cyanamid Defoliant - 75 lbs. pre-emergence (2 reports).

For Trial

1. Chloro IPC - 4-8 lbs. muck soil pre and/or/post-emergence (1 report)

2. Chloro IPC - 4-6 lbs. mineral soil post-emergence (1 report) 4 lbs. pre-emergence (1 report)

3. CMU - 1 lb. pre-emergence muck and mineral soil (2 reports).

Problems Needing More Work

1. Place of "herbisan" and similar products in onion weed control.

2. Persistency of Chloro IPC and CMU in soils.

Peas (3 reports)

For Extensive Use

1. Dinitro (water soluble) 1-1½ lb. maximum. Rates of chemical and water volume variable depending on temperatures, crop stage, and form of DN when used post-emergence. (See state authorities for details).

2. Dinitro (water soluble) 3-4 lbs. pre-emergence (1 state).

Problems Needing More Work

1. Evaluation of MCP, NaPCP and CMU as pea herbicides.

2. Interrelationship of spray volume, Dinitro form and formulation, and environment with crop response.

Spinach (3 reports)

For Trial Use

1. Chloro IPC - 2 lbs. warm weather, 1 lb. cool weather immediately after planting (2 reports).

2. Trial only same as above (1 report)

Problems Needing More Work

1. Selective herbicide for control of henbit and lambsquarters.

2. Effect of Chloro IPC on spinach maturity.

Tomatoes (4 reports) Eggplant, Peppers, Okra (No reports)

For Extensive Use

1. No suggestions.

For Trial

1. Natrin - 4-6 lbs. after tomato is established (1 report)

Problems Needing More Work

1. Critical evaluation of 2,4-D ethyl sulfate types of materials (3 reports).

2. Continued search for a safe selective herbicide.

Vine Crops (6 reports)

For Extensive Use

1. Alanap 1 - 2-4 lbs. pre-emergence on cucumbers and muskmelons or cantaloupes and watermelons (2 reports); 6 lbs. on cucumbers (1 report).

Problems Needing More Work

1. Effect of Alanap on yields and earliness of vine crops when applied post-emergence. Effect of rates, frequency, and stage of crop, need to be included.

2. Effect of soil type and soil moisture on results with Alanap.

3. Response of squashes (both species and varieties) to Alanap.

Sweet Corn (8 reports)

Pre-emergence

For Extensive Use

1. 2,4-D Amine - 1¼ - 1½ lbs. on other than sandy soils. (3 reports)

2. 2,4-D Ester - 1/2 - 3/4 lb. (3 reports)

3. DNOSBP either oil or water soluble forms -3-6 lbs.(5 reports)

4. NaPCP - 15-25 lbs. (2 reports).

For Trial

1. CMU - 3/4 - 1 lb. at planting (2 reports)

Post-emergence

For Extensive Use

1. 2,4-D Amine - ¼ - ½ lb. (7 reports).

2. Not after 6" high (5 reports) except with drop pipes. Use drop pipes as soon as corn is tall enough to require a directed spray (2 reports)

For Trial

1. DNOSBP (water soluble) - 1½ - 3 lbs. when corn is below 3" tall (2 reports).

Problems Needing More Work

1. Evaluation of newer chemicals such as CMU, P.D.U.,TCB, etc.

2. Re-evaluation of DNOSBP, NaPCP, PCP.

3. Selectives to control grasses, both annuals and perennials.

Potatoes (6 reports)

For Extensive Use

1. DNOSBP either water or oil - 3-5 lbs. pre- or at emergence (5 reports).

Problems Needing More Work

1. Evaluation of 2,4-D ethyl sulfate, CMU, and PCP for both early and late application.

2. An effective safe herbicide for controlling grasses and especially for controlling grasses and other weeds that are troublesome late in the season.

3. Continued evaluation of cultivation for purposes other than weed control.

RASPBERRIES, BLACKBERRIES AND BLUEBERRIES

J. S. Bailey
Cranberry Experiment Station
East Wareham, Mass.

Each of the recommendations which follow came from one state only. Others were not ready to make recommendations.

Red Raspberries

Recommended

Established fields - 2,4-D at 1 lb. per acre in spring before new canes start.

Grass control - No. 2 fuel oil at the base of plants. Repeat as needed.

New Plantings - Crag Herbicide No. 1 at 3 lbs. per acre before weeds emerge.

Black Raspberries and Blackberries

Recommended

Crag Herbicide No. 1 at 3 lbs. per acre before weeds emerge.

Needed

More information about Chloro IPC and Dalapon for grass control.

Cultivated Blueberries

Recommended

Dinitro general at 1½ - 2 qts. per acre. (One state reported suppression of new shoot growth from DN application).

Sodium arsenite at 10 lbs. per acre. Material should be used with understanding that it is extremely hazardous to wildlife.

Needed

More information about CMU, (1) its tolerance limits, (2) initial symptoms of toxicity, (3) effects of soil type on toxicity, (4) breakdown and end products; long time effects of cultivation or no cultivation (chem. weed control), phenyldimethyl urea, Dalapon, new carbamates.

DNs, DN-oil combinations.

Wild Lowbush Blueberries

Recommendations

No change.

Needed

More information about CMU, polyborchlorate, control for brakes, selective chemicals.

STRAWBERRIES

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Mich. State College

Summary report from 26 research workers from Experiment Stations and commercial concerns. These reports are general and since the annual growing cycle of the strawberry will differ from Maine to Virginia, local recommendations may vary from state to state.

General Agreement

Recommendations for the new strawberry planting during spring and summer:

Crag Herbicide 1 at 2 to 4 pounds in 30 to 50 gallons of water per acre, depending on soil type. The first spray to be applied 7 to 12 days after the plants are set and before the weeds emerge. Subsequent applications of Crag Herbicide 1 as needed after cultivations during the summer.

2,4-D at $\frac{1}{2}$ pound in 10 to 20 gallons of water to kill broadleaved weeds that have emerged before Crag is applied.

Precautions - (1) Apply Crag Herbicide before weeds emerge, (2) Avoid having chemical on soil surface when runners are becoming established, (3) Avoid spraying during fruit bud initiation and flowering, (4) Soil should be well prepared and in moist condition. (5) Avoid use of Crag for a 4-6 week period after start of runner rooting.

Recommendations for established strawberry plantings:

Crag Herbicide 1 at 2 to 4 pounds in 30 to 50 gallons of water per acre applied as needed prior to weed emergence before flowering and after picking.

Precautions - (1) Apply only before flowering and after harvesting, (2) Avoid periods of runner-set and bud-differentiation, (3) Apply when soil moisture and temperatures are suitable. Crag is more effective at temperatures of 65° to 80° F. and with ample soil moisture.

Recommendations for fall and winter annual weeds in strawberry plantings:

1. Before strawberry plants become dormant:

   a. Crag Herbicide 1 used as previously mentioned.

   b. 2,4-D at ½ to 1 pound per acre to control emerged broadleaved weeds.

      Precautions - Avoid using 2,4-D during flower-bud formation.

2. Dormant strawberry plants:

   a. "Dinitro" weedkillers: Dow Premerge or Sinox PE 3 to 6 pounds in 50 to 100 gallons of water per acre.

      Precautions - (1) Spray when weeds are small, (2) Spray when temperatures are warm, preferably 65° to 80° F, (3) Do not spray on actively growing strawberry plants.

   b. "Dinitro" (Dow Selective or Sinox W) 1 to 2 pounds in 50 to 100 gallons of water per acre. (Two cooperators suggested 10 to 15 gallons of fuel oil be added to this mixture for control of "hard-to-kill" weeds). Treat when temperature is 65° - 80°.

      Precautions - (1) These materials to be used only on dormant strawberry plants, (2) Use pressure high enough (75 to 100 lbs.) to force some of the spray beneath strawberry foliage, (3) This spray will burn strawberry foliage and may even kill an occasional plant.

Problems Needing Further Research

1. Chemical Herbicides:

   a. Combination spray of 3-CIPC and Crag Herbicide 1. Suggested mixture; 2 pounds of Crag Herbicide 1 and 2 quarts (1.7 lbs.) 3-CIPC in 50 gallons of water per acre on new and established plantings during the growing season. Combination of Crag and DN's during dormant season.

b. Dalapon for annual grass control and for control of quack grass the year prior to planting strawberries.

c. Two pounds per acre of 2,4-D (amine and ester forms) after picking when the strawberry plants are quite dormant and before the weeds are too large and difficult to kill.

d. Sesin, Natrin and Crag Herbicide 1 at all seasons including flowering and fruiting periods.

e. Combinations of Sodium TCA and DN's as a post-harvest spray between the rows to reduce grasses and broad-leaved weeds.

2. **Other Technical and Cultural Problems:**

a. Chemical renewal of established plantings.

b. Spray timing and effect on yield and runners.

c. Chemical spray for blossom removal the first season.

d. Tolerance level of strawberry plants to various herbicides as post-harvest sprays.

e. Chlorosis produced by 3-CIPC -- use of other solvent may broaden use of the chemical.

f. Screening of new herbicides for strawberries.

g. Use of sawdust mulch for smothering of weeds.

h. Test all available chemicals for control of field sorrel (Rumex acetosella) in strawberry plantings.

i. Educational work on suitable and inexpensive spray equipment.

FIELD CORN AND SOYBEANS

Ernest R. Marshall
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Ithaca, N. Y.

Field Corn

General Agreement - Pre-emergence

1. Use 2,4-D, ½ - 1½ pounds acid equivalent per acre.

Remarks - In general, esters were preferred over amines for pre-emergence treatments. Low volatile esters were preferred over the more volatile esters because of safety factors primarily. 2,4-D was not strongly suggested on light sandy soils. Heavy rains following 2,4-D amine treatment often gives injury.

2. Use amine dinitros, 3-6 pounds per acre.

Remarks - One report preferred this over 2,4-D as a pre-emergence treatment. Preferred on light soils where 2,4-D injury common and where corn is grown near 2,4-D sensitive crops. Has sometimes given better annual grass control than 2,4-D and often suppresses perennial grasses.

General Agreement - Post-emergence

1. Use ¼ - ½ pound 2,4-D acid equivalent per acre post-emergence. Use drop pipes as soon as corn is tall enough to require a directed spray.

Remarks - Some reports prefer amine only others say either amines or esters. One report suggest low volatile esters at ¼ pound per acre equivalent to amine at ½ pound per acre. There were objections to spraying 15" corn post-emergence without drop pipes as this may cause servere injury and yield reduction.

For Trial Use

At Planting

1. Amine dinitro, 6-9 pounds as a band treatment simultaneous with planting.

Remarks - Heavy rains following dinitro applications reduced effectiveness. Has resulted in excellent control of annual grasses and suppression of perennial grasses.

Pre-emergence

1. CMU at ½ - 2 pounds per acre applied at planting or before emergence.

Remarks - Some stunting has been found following CMU treatment but this usually has not resulted in a decrease in yield. More research needed.

2. Calcium Cyanamid, 500 pounds per acre.

Remarks - Moisture essential for good results.

For Trial Use

Post-emergence

1. Amine dinitro, 3-4½ pounds, up until corn is 3-4 inches tall.

   Remarks - Some reports indicate serious burning of corn foliage. More work needed on effects of temperature and humidity on injury.

2. Use of a lay by spray of 1 - 1½ lbs. 2,4-D at last cultivation.

REMARKS

1. Some cultivation in addition to chemical treatment appears necessary for maximum yields. This may be only 1 cultivation.

2. One of the principal problems with 2,4-D treatments is making applications too late. Symptoms: Stunted plants, reduced leaf area, unthrifty appearance, yield reduction.

3. The most serious weed problems mentioned in order of importance were: Annual grasses, quackgrass, nutgrass, annual weeds, perennial weeds.

MATERIALS UNDER TEST THIS YEAR

1. CMU - effective before and after irrigation. Some stunting of corn. More work needed.

2. Crag) Sesin) Crag Oxalate) Control beter when applied before irrigation. Control sometimes good but often erratic.

3. 2,4-D Acids) 2,4-D Amines) 2,4-D Esters) Effective control before and after irrigation. Good control, little injury. Esters more effective than amines. One-half pound low volatile ester post-emergence in dry weather is rough on corn. Pre-emergence treatments on light soils may reduce yields.

4. Amine dinitro - Much better control after irrigation. Good control, little injury. Good in areas where crops susceptible to 2,4-D injury are grown. Six to 9 pounds per acre suppresses quack grass.

5. PCP - Good weed control, no injury.

6. PCP plus Crag - Excellent weed control. No injury. Herbicide #1

7. Calcium Cyanamid - Good control if moisture present.

8. Alanap 3 - Fair to good weed control. Slight to moderate injury.

9. Dalapon - As directed spray, killed crabgrass in corn.

10. Trichloro- No comment given.
benzoates

11. 2,4,5-T - No comment given.

Problems Needing More Work

1. Control of quackgrass and nutgrass.

2. Control of annual grasses.

3. Better control of perennial weeds and problem weeds such as smartweed.

4. Value of cultivation where weeds are chemically controlled and timing of cultivation and chemical treatments.

5. Other chemicals for pre- and post-emergence control in areas growing crops susceptible to 2,4-D and on light soils.

6. Mechanics and economics of band treating at planting in a single operation.

7. Lay by treatments which might control late germinating weeds and grasses. Investigate rate and method of application.

8. Effect of stage of growth and condition of crop upon reaction to herbicide treatments.

9. Effect of temperature and humidity on plant injury with amine DN.

10. More work on soil properties and the effects these have on chemicals used for weed control.

11. Use of Crag Herbicide 1 or other chemicals post-emergence after cultivation, rotary hoe, or weeder.

12. Pre-planting applications of Maleic Hydrazide, TCA or Amino Triazole to suppress quackgrass growth during season.

SOYBEANS

Note: The following summary is from a rather limited number of reports. Several states reported soybean weed control to be a negligible problem with them.

General Agreement- Pre-emergence

1. Amine Dinitro - $4\frac{1}{2}$ - 6 pounds per acre applied at planting or prior to come-up.

   Remarks- Results may be erratic, particularly following heavy rains. Cultivation should be started as soon as weeds begin to appear.

2. NaPCP - 20 pounds per acre, 1 - 4 days after planting.

Other Materials Suggested

1. Chloro IPC - 3-8 pounds per acre on early planted soybeans.

   Remarks: Rather selective on weeds controlled. Does well on smartweed. Such weeds as lambsquarter and pigweed more difficult to control.

2. N-1 Naphthyl phthalamic acid - 2-6 pounds. Use low dosage on light soils.

3. Other materials tested as pre-emergence treatments showing promise, were: 4-chloro phenoxyacetic acid, Crag Herbicide 1, Sesin, 2,4-D and MCP.

4. 8- 16 Lbs. emulsifiable PCP.

Problems Needing More Work

1. A chemical for selective post-emergence spraying to control weeds such as Morning Glory and Cocklebur, that come in after the last cultivation.

2. A more residual and fool-proof pre-emergence spray.

WEED CONTROL IN SMALL GRAINS

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There are nearly $3\frac{1}{2}$ million acres of small grains grown annually in the Northeastern States. Severe weed problems are frequently encountered. Much of the small grain acreage is under-seeded to grasses and legumes for forage purposes.

In view of the chemicals used and the climatic variability of the Northeast region there is surprisingly good agreement among the various experiment station workers.

Agreement

1. Spring cereals not seeded.

    a. Use of 2,4-D at $\frac{1}{4}$ to $\frac{1}{2}$ pound per acre after stooling but before jointing.

    b. Use of MCP at $\frac{1}{4}$ to $\frac{1}{2}$ pound per acre after stooling but before jointing.

2. Spring cereals under-seeded to grasses and legumes.

    a. Use of dinitros after stooling but before jointing. Weeds must be small.

    b. Use MCP or 2,4-D when canopy of 5 to 15 inches of grains exist and then only if weed problem is severe.

3. Winter ceareals not seeded.

    a. Fall treatment with amine 2,4-D or MCP at $\frac{1}{4}$ to $\frac{1}{2}$ pound per acre respectively.

    b. Spring treatment with amine 2,4-D at $\frac{1}{4}$ to $\frac{1}{2}$ pound or MCP $\frac{1}{2}$ pound per acre respectively.

4. Winter cereals under-seeded.

    a. Dinitros applied when weeds are small (6 stations)

    b. 2,4-D amine and MCP at $\frac{1}{4}$ to $\frac{1}{2}$ pound per acre if heavy canopy of weeds is present.

5. Never completely safe to spray 2,4-D or MCP on small grains that are under-seeded to legumes. Only a very severe weed problem can justify chemical control practices. The operator must be willing to risk the loss or partial loss of his legumes. Alfalfa and birdsfoot trefoil more sensitive to injury than are the clovers.

6. Spot treatment of Canada thistle may be made at rate of $\frac{1}{2}$ - 1 pound of 2,4-D per acre several times to secure effective control. Spot treatments are suggested to reduce injury to small grains.

Problems Needing More Work

1. Control of garlic by ester forms of 2,4-D or other chemicals.

2. The influence of temperature on rate and effectiveness of the dinitro chemicals.

3. The most favorable stage of growth of the cereal for application of dinitros.

4. Relative value of MCP compared to 2,4-D for weed control and legume injury.

5. Greater specificity for crop, weed and chemical.

6. A general study of the use of low volatile esters of 2,4-D.

General Observations

In the past 5 years good progress in weed control in small grains has been attained. Rates of ¼ to ½ pound per acre of 2,4-D applied as a low-gallonage, low-pressure spray have become standard for those cereals not under-seeded to legumes.

The dinitros have proved valuable for weed control in the cereals that are undersown. Their usefulness is expanding. MCP is generally being compared to 2,4-D but does not appear superior either in weed control or in lessened injury to underseeded legumes.

PASTURE (Including Hay Crops)

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General Agreement

A. Permanent pastures

Problem 1. Summer annual broadleaf weeds.

Control - One pound of 2,4-D amine or MCP per acre in early spring. Repeat if new weeds appear.

Problem 2. Brambles and woody plants.

Control - Spot treat with 2,4,5-T ester or a combination of the 2,4-D and 2,4,5-T esters in early summer or in the dormant season.

Problem 3. Wild garlic

Control - 2,4-D ester at 1 to 1.5 pounds in early spring. Repeat yearly until control is effective.

Problem 4. Horse nettle

Control - 2,4-D, 2,4,5-T ester mixture at 1.5 to 2.0 pounds applied about blossoming time. Clovers will probably need reseeding after the treatment. A single treatment may not give complete control and it should be repeated.

Problem 5. Perennial and winter annual broadleaf weeds.

Control - Frequent mowing and adequate fertilization will greatly reduce weed population. Use of 2,4-D or MCP at .5 to 1.5 pounds depending on susceptibility of weed species present.

B. Semi-permanent pastures, legume or grass legume mixtures.

Problem 1. General weeds.

Control - Rotational grazing, fertilization and mowing, are of primary importance.

C. Alfalfa and clover, seedling stage.

Problem 1. Chickweed

Control -- Water soluble dinitro 1 - 1.5 pounds.
Chloro IPC at 1-2 pounds in the absence of grass seeding.

D. Alfalfa, established stands

Problem 1. Chickweed

Control - Chloro IPC at 1-3 pounds in late fall or early winter in warmer areas in the absence of grass seeding.
DN at 1-3 pounds.

<u>Problems Needing Further Study</u>

1. Use of Dalapon for controlling grasses in legumes.
2. Preplanting treatments of cyanamide or dinitro for legumes.
3. More effective control of weeds in birdsfoot trefoil. 4 Chloro phenoxy acetic acid amine looks promising.
4. Pre-emergence treatments for legumes.
5. Control of nimeblewill (Muhlenbergii) in permenent pasture.
6. Control of conifers.
7. Pasture renovation.

HERBACEOUS PERENNIAL WEEDS

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While several chemical control measures are available, it is generally conceded that we still no not have <u>economical</u> chemical control methods for the more important perennial weeds. Cultural methods remain the most economical for large scale infestations.

No major changes from the 1953 recommendations are listed below. Dalapon and amino-triazole salt of 2,4-D are the only new chemicals mentioned among the replies received.

Quack Grass

(Agropyron repens)

Agreement

Cultural control: Fall plowing followed by frequent cultivation in the fall and the next spring and preferably throughout the summer.

Chemical control: 1. Sodium TCA at 25-75 pounds acid equivalent per acre applied on soil plowed prior to application. One report suggests disking chemical into soil. No particular time of application consistently gives the best results. Because of the high solubility of sodium TCA, its effectiveness is markedly reduced by heavy rainfall after treatment. Repeat applications are needed in such cases.

2. CMU. Ten to twenty pounds during growing season. Residual effects will be evident two or more years.

Further Work Needed

1. Use of Dalapon. Comparison of foliar vs. soil application. Best stage of growth to apply Dalapon. Duration of residual effects of Dalapon.

2. Use of combined herbicides, e.g., sodium TCA and maleic hydrazide.

3. Maleic hydrazide (MH). MH has shown promise for controlling quack grass in cropland without loss of all or a part of a growing season as is the case with sodium TCA. Five to ten pounds active material per acre in 20-100 gallons of water to be applied in spring after grass is 4-10 inches tall. Plow the soil 4-8 days after application and plant crops as usual. Suppression rather than eradication is obtained.

Nut Grass

(Cyperus esculentus)

Agreement (Most satisfactory treatment available to date)

Sodium TCA at rates of 50-75 pounds acid equivalent per acre. Apply when nut grass shoots are 2-4 inches tall followed by plowing or disking after spraying. TCA in oil suggested in one report.

Further Work Needed

1. Use of Dalapon.

2. Application of MCP, 2,4-D or CMU mixed with soil at time of tuber sprouting in spring.

3. Evaluation of combination of low dosage levels of herbicides with tillage.

4. Cultural control methods.

5. Evaluation of pre-emergence application of CMU in corn at low rates. Combine with one or two cultivations prior to lay-by.

6. Testing of TCA in conjucnction with harrowing prior to late setting of cabbage or cauliflower.

Canada Thistle

(Cirsium arvense)

Agreement

1. 2,4-D at rate of ½ - 2 pounds acid equivalent per acre in early bud stage and when regrowth reaches 4 to 6 inches. Treatment for several seasons needed for eradication. One report indicates that MCP is more effective than 2,4-D or 2,4,5-T.

Further Work Needed

1. Continued evaluation of several light applications of 2,4-D (¼ pound per acre) during growing season. One report indicated best control from this method.

2. Continued evaluation of MCP, alone and in mixture.

3. Evaluation of 4-chlorophenoxyacetic acid and of 3,4-dichlorophenoxyacetic acid compounds.

Horse Nettle

(Solanum carolinense)

Agreement

1. 2,4,5-T or 2,4-D and 2,4,5,-T mixture at 2 pounds acid equivalent per acre in near-bloom stage. Retreatment the same year and/or the next will probably be needed.

Further Work Needed

1. Most effective time of herbicide application.

2. Selective control in row crops.

Wild Garlic or Onion

(Allium spp.)

Agreement

1. Cultural control: Clean cultivation in row crops.

2. Chemical control: 2,4-D ester at 1 to 1½ pounds acid equivalent per acre in spring and fall. Retreatment for several seasons needed for eradication. This chemical method primarily applicable to pastures.

Further Work Needed

1. Use of maleic hydrazide

2. Method of control in wheat.

Milk Weed

(Asclepias syriaca)

Agreement

1. Cultural control: Clean cultivation in row crops.

2. Chemical control: None recommended.

Further Work Needed

1. Use of amino-triazole salt of 2,4,5-T.

2. Prevention of pod formation by use of 2,4-D and 2,4,5-T mixture or 2,4,5-T.

Chicory

(Cichorium Intybus)

One report suggests use of ½ pound acid equivalent of 2,4-D per acre applied in fall or spring. One-fourth pound of MCP in the fall also promising.

Bedstraw

(Galium mollogo)

Bedstraw is a problem in birdsfoot trefoil. One report suggests trials with water soluble dinitros.

Bermuda Grass

(Cynodon dactylon)

One report recommends sodium TCA at 75 pounds per acre applied in late spring or early summer. Limited work with CMU has indicated good control with 40 pounds of CMU applied in late spring or early summer. Frequent shallow cultivation throughout the growing season reported to reasonably eliminate Bermuda grass. Cultivation until late May followed by a smother crop of soybeans suggested as being more practical.

Further Work Needed

1. Use of Dalapon.

Johnson Grass

(Sorghum halepense)

Agreement

For spot treatment, apply sodium TCA at a rate of 50-75 pounds acid equivalent per acre during growing season. Application just before or at time of emergence advised.

Further Work Needed

1. Use of Dalapon.

2. Control of japanese bamboo (Polygonum japonica) and P.cuspidata. Clipping followed by treatment with sodium chlorate at 160 lbs. per acre suggested.

WEED CONTROL IN COMMERCIAL NURSERY AND ORNAMENTAL PLANTINGS

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This compilation has been prepared from completed questionnaires received from research workers associated with state and federal institutions, and the chemical industry. Commercial nurserymen and park or arboretum managers were also included. The origin of the responses used appears below.

	Research Workers in Northeast	Res. Workers in Areas Other Than Northeast	Manufacturers of Herbicides	Commercial Nurserymen in U. S.	Totals
Number Distributed	49	16	29	110	204
Number Acknowledged	12	5	7	9	33
Number Completed	8	4	6	9	27
Per cent Completed	16	25	21	8	13
States Represented	5	4	*	8	17

* Reports received from manufacturers of herbicides were given no state designation.

Areas of General Agreement

I. Woody Nursery Crops (2 or more reports)

a. pre-planting:

1. Soil fumigation of seed beds with methyl bromide (4 reports from 3 states) or chloropicrin (2 reports, 2 states).

2. Calcium cyanamid (Aero Cyanamid) at 1000 to 2000 pounds per acre before weed emergence. Species to be planted should be lime tolerant. Soil should be moist. (3 reports, 2 states)

3. Approximately 50 pounds per acre of Na T.C.A. for control of Agropyron repens (quack grass). Material should be applied at least six months prior to planting. (2 reports, 2 states)

b. Pre-emergence to crop:

Applications of contact herbicides such as Good-rite NIX, KOCN (Aero Cyanate) and mineral spirits have been used on established weeds with some success (3 reports, 1 state). Same procedure may be used before planting.

c. Emerged Seedlings:

Mineral spirits at 20 to 30 gallons per acre for weed control in all species of conifers with the exception of larch and spruce, which exhibit sensitivity. (3 reports, 3 states)

d. Liners:

1. SES (CRAG Herbicide 1) at 2 to 4 pounds per acre. Area to be treated must be free of established weeds and soil should be moist. Spray need not be directed. Species of <u>Juniperus</u>, <u>Thuja</u>, <u>Taxus</u>, <u>Syringa</u>, <u>Malus</u>, <u>Prunus</u> and <u>Rubus</u> are reported as tolerant. (4 reports, 3 states).

2. The dinitros (Premerge) at 3 to 4 pounds per acre in 50 gallons of water. Spray must be directed. Stock should be dormant. (2 reports, 2 states).

3. Good-rite NIX at 9 pounds per acre in 80 gallons of water. Spray must be directed. (2 reports, 2 states).

e. Established Stock:

1. SES (CRAG Herbicide 1) at 2 to 4 pounds per acre on most species. Area to be treated must be free of established weeds and soil should be moist. Spray need not be directed. (8 reports, 6 states).

2. CIPC at 4 to 8 pounds per acre in 50 gallons of water in most species as a directed spray. (6 reports, 3 states).

3. The dinitros (Premerge) at 3 to 4 pounds per acre in 50 gallons of water in most species as a directed spray. (5 reports, 3 states).

4. Good-rite NIX at 8 pounds per acre in 80 gallons of water in most species as a directed spray. (2 reports, 1 state).

5. Calcium cyanamid (Aero Cyanamid) at 600 to 800 pounds per acre in moist soil applied to row middles. (2 reports, 1 state).

II. <u>Gladioli and other Corm, Bulb, Etc. Crops</u>

(Reports pertain primarily to gladioli, 3 or more reports)

a. Pre-planting or seed bed treatments with methyl bromide or other fumigants.

b. Pre-emergence to crop:

1. SES (CRAG Herbicide 1) at 2 to 4 pounds per acre. Some variability as to successful weed control reported. Soil should be moist. (9 reports, 7 states)

2. The dinitros (Premerge) at 6 to 8 pounds per acre in 50 gallons of water. (5 reports, 4 states).

3. 2,4-D* at 2 pounds per acre (4 reports, 4 states)

4. CIPC at 4 to 8 pounds per acre in 40 gallons of water. (4 reports, 2 states)

* Type of 2,4-D not given in reports received.

c. Post-emergence to crop:

1. SES (CRAG Herbicide-1) 2 to 4 pounds per acre before weed emergence. Spray need not be directed. (3 reports 3 states).

2. CIPC at 4 to 8 pounds per acre in 40 gallons of water as a directed spray before weed emergence. (3 reports, 3 states).

III. <u>Other Herbaceous Ornamentals</u>

a. Scattered reports indicate that there is a need for continued research in herbaceous ornamentals. Success with contact herbicides such as the dinitros (Premerge) is reported if carefully directed. SES (CRAG Herbicide-1) at 2 to 4 pounds per acre exhibits promise in chrysanthemums and carnations. (2 reports, 1 state).

<u>Problems Needing Further Consideration</u>

1. <u>Agropyron</u> <u>repens</u> (quack grass) is the weed which is reported as most troublesome. Additional research with NaTCA is essential. Material and methods for the eradication of other perennials such as <u>Artemisia</u> <u>vulgaris</u> (chrysanthemum weed) should be developed.

2. Scattered reports not included in the compilation mentioned the successful use of herbicides such as PCP, Alanap, CMU, phenyldimethyl urea, IPC, Oktone, SESIN, NATRIN, and Endothal. These materials should be further evaluated to determine their place in nursery crops. Additional testing of materials mentioned in this report is advisable also, especially to determine the tolerance of particular nursery crops to them.

3. Selective herbicides for use in seed beds, transplant beds and herbaceous ornamentals should be evaluated, since weeding of crops in these stages is very costly.

4. Further research is necessary to determine the best materials and methods for winter weed control.

5. Species tolerance of bulb and corm crops other than gladioli to the various pre-emergence herbicides should be determined. Post-emergence herbicides of the KOCN type should be evaluated in established gladioli.

WOODY PLANTS

C. H. Foster

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The report of Dr. F. A. Ashbaugh, published in the Supplement of the Proceedings of the 1953 Conference, very thoroughly covers the most significant points of agreement (and disagreement) in the field of Woody Weed Control. There seemed to me no good reason to rework this same ground again this year. It is my recommendation that the Ashbaugh Report be made the basis for a series of reports for the 1955 Conference - by those individuals who are interested and qualified.

If it meets with the approval of all concerned this report should be dicussed at the meeting in January. We can then determine who these qualified and interested people are and induce them to prepare the reports desired.

It also seems to me that an attempt should be made to secure a directory of the names of all persons and organizations interested in the control of woody weeds, indicating where they are, what they are doing and what their specific interests are. This list should include many who have not participated in any of the weed control conferences.

ORCHARDS

O. F. Curtis

N. Y. Agr. Exp. Station
Geneva, N. Y.

Chemical methods are special-problem tools in orchards of the Northeast. Less costly mechanical means are standard. Mowing serves in apples, which tolerate some competition. Cultivation is employed in peaches which suffer severely from early or mid-season competition from sod or weeds, and is commonly employed in cherries.

Suggested Practices

1. Poison Ivy

   (a) 2,4,5-T (or 2,4,5-T - 2,4-D mixture) at 2 pounds of low volatile ester per 100 gallons. Apply at low pressure (less than 50 psi) avoiding any spray or drift on trees. Dormant basal treatment (see Woody Plants) is useful if ivy sprouts can be avoided. Do not use orchard sprayer. It should be kept in mind that apple varieties differ in susceptibility to injury by 2,4-D. Do not use on winesap variety or in pear orchards. Injury may result to stone fruit.

(b) Ammonium sulfamate at 75 to 100 pounds per 100 gallons. Apply to wet ivy foliage thoroughly. Avoid tree foliage and apply only to the ivy infested portion of cover under the trees. Usable in orchard sprayer. Do not use under trees less than 5 years old.

2. Bindweed

(a) Dinitro-fortified oil emulsions for temporary relief (see 3 below). Affords complete top kill, but resprouting restores the stand; repeat treatment necessary.

(b) 2,4-D, amine salt, at 1 pound per acre. Use all care to keep spray off the trees; high gallonage spray of 1 pound per 100 gallons desirable to this end. Chances of damage are at a minimum after harvest.

3. Other weeds

Dilute oil emulsions (10% oil) fortified with oil soluble dinitro (2 to 3 pints of "General" per 100 gallons) are safe on tree trunks and usable in orchard sprayers. They provide temporary set back of grasses and perennials, kill of annuals.

4. Virus carriers and hedgerow hosts of other orchard pests.

Needing Much Further Work

1. Practical methods for controlling weeds close to trees, to aid establishment of new plantings and maintainance of old ones. Oils with toxicity as great as diesel oil are effective, but require cautious application to avoid wetting of tree bark, particularly in the case of stone fruits.

2. Economical suppression of vegetation on orchard floors. Particularly desirable for peaches. Suppression lasting from spring until mid summer is desired.

WATER WEED ELIMINATION AND CONTROL

C. H. Curran

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The chemical control of water weeds is very much more complicated than the control of unwanted terrestial plants. On dry land it is relatively easy to control the selectivity of the killing agent. In our work at Bear Mountain we have found many examples of this, but it is only necessary to mention one or two, since this phase of weed control is covered in reports of experiments recorded by others engaged in plant control research. We have found that 2,4-D applied at the rate of one ounce of powder or salts, to two gallons of water will kill bent grasses on our soil, and if heavily applied will top-kill most other grasses. However, if applied at the rate of one ounce to four gallons of water, plantain, dandelions and chickweed are killed and while bent grass is top-killed, other grasses have not suffered any apparent injury. There is no doubt that the fact that certain plants can be very easily killed, while other are very resistant to both 2,4-D and 2,4,5-T, or combinations of the two, must play a very important role in land-weed control because there is always the danger of killing desired vegetation.

In the control of most water weeds we do not have this critical situation - at least not where water weeds themselves are concerned. However, we do have very serious problems. The first and perhaps most important of these has to do with air drift of the chemicals. In our experiments for the control of surface weeds we have found that shore foliage 200 to 300 yards away may be partly or wholly killed. In some cases this is not a very serious loss because plants that always have their roots in the water usually have a rapid regrowth. But we have found that both birches and willows can be killed back almost to extinction with a very light drift spray. In our case it does not mean too much if an occasional tree is killed, but when we deal with a private lake or large pond the results can be catastrophic and no one should undertake water weed control in such a place without thorough study of the border vegetation and wind currents.

Oddly enough we depend upon these same wind currents and gentle winds - up to ten miles an hour, to aid us in weed control in larger lakes. We find that the area covered in a sweep across a lake can be extended to 40 to 60 yards if we take advantage of the wind and use a heavier droplet. On a still day - this is the only time when ponds and small lakes should be sprayed - from 40 to 60 feet can be covered in cross-lake sweeps, even when a fine droplet is used. Everything depends upon conditions and the acumen of the sprayer, and, this is very important, the ability of the oarsman to keep a straight line.

Surface weeds

The chief surface weeds we have treated have been white water lilies, yellow or cow lilies, arrow head, pickerel weed and floating and flowering bladderwort, and the emergent miriofilum. The success against these surface plants can best be summed up under separate headings. But first let me say that there are two main attacks against emergents. 1. Use of kerosene as a carrier. In many cases this has an advantage, since it often takes only a few hours in order to cause browning and delimit sprayed areas. With some weeds it kills quickly but with others there is only a surface kill and annual regrowth is liable to occur. In other cases it does not kill at all, but merely causes a slight browning and growth of new stems and leaves is stimulated. 2. Use of an emulsion which has the advantage of penetrating into under-surface areas.

White water lilies

These are the easiest of the water lilies to kill under most conditions. In some of our Bear Mountain lakes they were taking over a width of 15 to 20 feet each year, of the water surface. In most of the treated lakes we have been able to eliminate them, but in one lake seedlings have developed so rapidly that there is a continuous fight to prevent their reinfestation. There is also the problem of dead roots filling with gases and rising to the surface in such huge masses that they form incipient "floating islands".

Yellow or Cow Lilies

One of the most difficult plants to kill because a single root system may cover more than 100 square yards and the roots themselves may be over five inches in diameter. They are edible but almost any foot or two will develop a new plant if not killed. Drainage and root spraying is effective but difficult because weather conditions must permit drying of lake bottom in order to permit spraying. Control requires several years and frequent spraying since the seeds develop into young plants within a year after the leaves are killed off.

Small water lily or Deerfood, etc. (Brasenia)

This is not too difficult to kill but all new leaves must be destroyed and it can be eliminated within two years only by perfect spray coverage and three or four applications a year.

Miriophylum (Pondweed, coontail, parrots feathers)

As an emergent these plants can be thoroughly destroyed by a single, thorough application. However, as a general rule only a small percentage of the plants are emergents. In order to bring them to the surface a heavy surface spray is necessary in order to stimulate growth. Naturally an emulsion is required. At the proper time a second spray is required.

Bladderwort

This is chiefly sub- emergent. Emergent and floating plants die slowly as a result of spraying, but fail to produce viable seeds. Where it occurs it is frequently beneath water lilies and comes into full growth after these have been destroyed. Treatment must consist of both surface and submergent spraying.

Arrowhead

Very difficult to kill since it grows rapidly from seed in shallow water. Oil sprays are far from effective but emulsions of brush killer produce excellent results. 2,4-D emulsions are not effective.

Control of sub-mergent vegetation

Our experiments are too new to make any definite statement about this method of control and two or three more years will be required before the best method has been perfected. However, several years of experimentation indicate that control is possible over a period of time.

We are still experimenting with various types of nozzles and various formulations. We do know that Coontail has been almost or completely eliminated by a combination of surface and sub-emergent spraying, and within the past two years bladderwort (our worst pest in one lake) has been very greatly reduced.

Dangers of Spraying

Water weed control is not without grave dangers. From our work we are able to show that there is no danger to insect or other aquatic life, and fishing is greatly improved. The greatest dangers lie in the development of weeds in downstream lakes and ponds. The stimulation provided by small hormonal quantities in drainage water may, and does, provide weed growth in lakes and ponds which have had no previous problem - or if there has been a slight problem it is likely to become serious. As a result a program that seems relatively small at its inception may grow enormously and instead of encompassing only two or three small lakes may spread to a dozen large ones. A situation of this kind might easily lead to legal complications.

TURF

C. K. Hallowell

County Agent - Philadelphia County
Philadelphia, Pa.

The report made last year is still the recommendations of the different states, with a few variations.

1. All agreed that proper management was primary in controlling weeds and turf grasses. The different workers pointed out the importance of improving the soil, selecting adapted grasses, and the carrying-out of a sound maintenance program. When the public is given chemical weed control, it is always important that they be informed where they can get information on a sound turf management program. It is expected that each Agricultural Experiment Station will keep literature on turf grass management up-to-date.

2. The chemical 2,4-D was recommended for control of broadleaved weeds by 5 of 6 states reporting. All five reports recommended amine formulations. Two recommended salts of 2,4-D, and two recommended esters under certain conditions. The rates of application ranged from $\frac{1}{4}$ to $1\frac{1}{2}$ pounds of actual 2,4-D per acre. Three of the five reports recommended both spring and fall treatment. The ester form of 2,4-D was recommended for control of garlic in turf grasses. It is important to make applications when garlic first appears. Clover in turf grasses is readily controlled by applications of 2,4,5-T, the recommended amount being one pound per acre in split applications, two to three weeks apart. Most recommendations call for October and November applications. One report spoke of an effective result from an April treatment.

3. Three reports recommended phenyl mercury acetate for controlling crabgrass. Rates of application varied from 1½ to 2½ ounces of 10% active material /1000 square feet for lawn type turf. A range of 1-1½ ounces per 1000 square feet was recommended for putting green turf. Two to six treatments at 7-10 day intervals were considered necessary according to conditions. One report recommended dry application of phenyl mercury acetate.

4. One report was received showing that goose or silver crabgrass was controlled by spraying with half the recommended amounts of 2,4-D and phenyl mercury, two or three applications being necessary to get effective results.

5. Potassium cyanate was recommended at a rate 8-16 pounds per acre by three reports. Two to three treatments were considered necessary. All reports suggested a minimum gallonage of water that ranged from 86-200 gallons/acre. All three reports recommended potassium cyanate for lawn or Kentucky bluegrass type of turf only.

6. Sodium arsenite is still the most efficient chemical to use when a major turf renovation program is being carried out. This chemical will control chickweed, Poa annua and knotweed. When using sodium arsenite, it is important that there be a liberal amount of soil moisture and the temperature be below 80°.

Problems Requiring Further Study

1. Methods to control goosegrass, Poa annua, and Muhlenbergii.
2. Evaluating the effect of new herbicides for crabgrass control.
3. Pre-seeding soil sterilization.

CRANBERRIES

C. E. Cross

Cranberry Experiment Station
East Wareham, Mass.

The cranberry weed control recommendations of the Cranberry Experiment Station, East Wareham, Mass. are given below as representative of the methods being used in this industry.

A. IRON SULFATE (Ferrous Sulfate):

Growers should know that this chemical is one of their most useful weed-killers. Rain must follow its application within 10 days, or the bog must be sprinkled with water to make it effective. Cranberry vines will not suffer preceptible injury from applications of 40 or even 50 lbs. per square rod if the chemical is scattered evenly, and if the bog has not been sanded within 18 months. Broadcast treatments in excess of 20 lbs. per square rod are not recommended on new bogs. If iron sulfate is mixed with common salt 9 to 1, the necessity of rain or sprinkling is eliminated. CAUTION: The addition of salt makes the iron sulfate more toxic and about half as much of the mixture is needed. If cranberry vines are wet when iron sulfate is used, there may be some injury.

1. Hair Cap Moss - 20 lbs. per sq. rod, preferably in April on dry bogs, and after the harvest on bogs with frost flow.

2. Sensitive Fern - 30 lbs. per sq. rod, or small amount to each plant - June through September.

3. Feather Fern- 35 lbs. per sq. rod, or small amount to each plant - June through September.

4. Royal Fern - Mix iron sulfate and salt 9 to 1 and apply in small handfuls to each plant - May through October.

5. Cinnamon Fern - Mix iron sulfate and salt 9 to 1 and apply in small handfuls to each plant - May thru Sept.

6. Sand Spurrey - 15 lbs. per sq. rod, late June. Safe on young bogs.

7. Tear-Thumb - 15-20 lbs. per sq. rod, late in June when the weed seedlings are just above the cranberry vines.

8. Long Leaf Asters - 35-50 lbs. per sq. Rod. June - Note cautions above on newly sanded bogs. Hand weeding after picking is helpful.

9. Cotton Grass - Small handfuls at base of each plant - June through September.

10. Needle Grass - 35-40 lbs. per sq. rod May or June- Note cautions above on newly sanded bogs.

11. Pitchforks - 20 lbs. per sq. rod, May or June; or 1 lb. in 1 gal. water at 400 gals. per acre, up to June 10.

12. Low Cudweed - (everlasting) - 1 lb. in 1 gal. water at 400 gals. per acre, July or August. Safe on young bogs.

13. White Violets - 45-55 lbs. per sq. rod on Howes; 40-50 lbs. per sq. rod on Early Blacks, anytime, but <u>never</u> on bogs sanded within <u>2 yrs</u>. Individual plants or clumps can be treated like ferns.

14. Marsh St. John's Wort - 40 lbs. per sq. rod June through August. Note cautions above on newly sanded bogs.

15. Cinquefoil - 50 lbs. sq. rod, June - July. Note cautions above on newly sanded bogs.

B. <u>P. D. B. (Paradichlorobenzene)</u>:

Consult dealer as to proper size of crystals. Scatter evenly and cover immediately with at least one inch of fine sand. Applications on thin vines require one inch of find sand while treatments on dense vine growth may need as much as two inches. Flooding or wetting down sand make treatment more effective. (This treatment also kills cranberry root grubs and white grubs.) CAUTION: This treatment should not be made in the same year after the grub flow. Keep off treated area for six weeks. Best control where drainage is good.

1. Poison Ivy - $7\frac{1}{2}$ lbs per sq. rod - mid-April to mid-November (May not ive complete control.) Areas to be treated should be staked out while weeds are in full growth.

2. Chokeberry - Same as poison ivy.

3. Wild Bean - same as poison ivy.

C. **SALT (Sodium Chloride):**

Use 3/4 to 1 lb. per gal water. Spray very lightly, never over 200 gals. per acre.

1. Wild Bean - June and July. Should not injure cranberry blossoms. (P.D.B. treatment preferred)

2. Tear-Thumb - June

D. SODIUM ARSENATE

Use $1\frac{1}{2}$ lbs. per 100 gals. water. Spray very lightly, never over 200 gals. per acre. CAUTION: Do not use later than mid-August, because of danger of poisonous residues.

1. Golden Rod - Early in August. Keeps foliage and flowers burned off, roots remain alive. Prevention of seed formation by this weed is very important.

2. Wild Bean - Early August. Harvesting is seriously hampered if this weed remains untreated. (P.D.B. treatment preferred)

E. **COPPER SULFATE:**

CAUTION: These treatments may kill fish. Never spray this solution in June or July.

1. Fireweed - 25 lbs. powder in 100 gals of water at 300 gals. per acre - August.

2. Pitchforks - Same as 1.

3. Nutgrass - 20 lbs. powder in 100 gals. water at 400-600 gals. acre. - Early August.

4. Large Nutgrass - Same as 3.

5. Green Scum (Algae) Broadcast small crystals on ice at rate of 10 lbs. per acre in February and March. Repeat in early spring if necessary using 4 lbs. large crystals or nuggets

for each acre foot of water. Put in a burlap bag and tow behind a boat, or distribute evenly in bog flowage some other way. Complete draining of bog and ditches in early April, exposing bog to air one week helps to control this trouble

F. <u>WATER WHITE KEROSENE:</u>

Any clear transparent kerosene without yellow coloring should give satisfactory results. Treatments in first half of May give the best results with the least injury to cranberry vines. Vines should not be disturbed for one week before and after treatment.

1. Hoary Alder - Apply ½ pint to 1 pint into crown of plant - anytime.
2. Sweet Gale - Same as 1.
3. Bayberry - Same as 1.
4. Dulichium - Spray or sprinkle at 400 gals. per acre.- Early May.
5. Coarse Brambles - Spray or sprinkle at 600-800 gals. per acre- Early May.
6. Carex Sps. and Related Sedges - Same as 5.
7. Wool Grass - Same as 5.
8. Spike Rush - Same as 5.
9. Poverty Grass - Spot treat heavily (1000 gals. per acre) - anytime.
10. Cut Grass (Sickle grass) - Hold winter flood until May 25th; then spray as soon as practical within 8 days at 600 to 800 gals. per acre. Try to apply when temperature is below 65°.
11. Manna Grass - Same as 10.
12. Cotton Grass - Same as 10.
13. Loosetrife - Spray or sprinkle 600 gals per acre before six inches high.
14. Horsetail - Spray or sprinkle 600 gals. per acre. May 10-20.
15. Crab Grass - Spray at 400 gals per acre, late May through June. Less vine injury when temperature is below 65° or when spraying is done in late afternoon or night.
16. Corn Grass - Same as 15.
17. Summer Grass - Same as 15.
18. Triple Awned Grass - 15.

G. 2,4-D

Triethanolamine salt 4 lbs. acid per gal. is the only type of 2,4-D recommended.

1. Three Square Grass - Apply a dilution of one part 2,4-D to two parts water without touching cranberry vines. Do not apply when windy. CAUTION: A long exposure to the skin should be avoided. Rubber gloves advised.

H. NITRATE OF SODA:

Scatter evenly when vines are dry.

1. Hair Cap Moss - 2 or 3 lbs. per sq. rod - June and July.

2. Royal Fern - Small handful will treat five plants - anytime.

3. Cinnamon Fern - Same as 2.

I. SODIUM ARSENITE:

CAUTION: Deadly poison to man and browsing animals. Wear goggles to protect eyes.

1. Shores - 15 lbs. per 100 gals. water at 400-600 gals per acre, to take place of mowing. Be careful spray does not drift onto cranberry vines. Repeated use of this spray will destroy turf of shores and dikes.

J. AMMATE: (Ammonium Sulphamate)

75 lbs. to 100 gals. water. Not poisonous, but very corrosive to equipment.

1. Ditch weeds - Drain ditches and spray or sprinkle weeds till liquid runs off. DO NOT APPLY TO CRANBERRY VINES.

2. Shores - Spray at 200- 400 gals. per acre. Two successive treatments 4-6 weeks apart will kill nearly all poison ivy and many other weeds. Will destroy turf more rapidly than the sodium arsenite treatment. This spray is very harmful to cranberry vines.

A Tabular Summary of the 1954 Report of the Research Coordinating Committee Northeastern Weed Control Conference

The following series of tables are presented only as a means of ready reference and summarization of the general research report. The materials and methods listed are not intended to be recommendations for local use and should not be construed as such. Reference is made to the general report in each item listed so that more complete information may be obtained by turning to the reference page number.

The chemicals listed in the extensive use category in this table are subject to prior label approval by the U. S. Food and Drug Administration before general use.

L. L. Danielson
Chairman

Control of Weeds in Crops

Crop	Ref. Page	Chemical	Use	Pounds per acre	Time of Applications and Comments
Alfalfa (Seedling)	29	NH_2DNOSBP	(1)	1-1½	Post-E after first frost
		CIPC	(1)	1-2	Post-E after first frost
Alfalfa (Est)	29	NH_2DNOSBP	(1)	1-3	During dormancy
		CIPC	(1)	1-3	Early winter on chickweed
Asparagus (Seedling)	14	PCP	(1)	6	Pre-E
		NaPCP	(1)	10-12	Pre-E
		NH_2DNOSBP	(1)	3	Pre-E
		CMU	(2)	1-1½	Pre-E
Asparagus (Est)	14	Gr Cyan	(1)	300-400	Pre-H conc over row
		Cyan Dust	(1)	75-100	During cutting season
		SES	(1)	2	Before weeds emerge, any stage asparagus, moist soil
		NH_2DNOSBP	(1)	6	Pre-H, Post-H
		NaPCP	(1)	20	Pre-H, Post-H
		2,4-D	(1)	1	Pre-H, Post-H. Omit on sandy soils.
		CMU	(1)	½-2	Pre-E, Post-E
		Alanap 1	(2)	4	Pre-E
		CIPC	(2)	8	Pre-H for chickweed
Beans, Snap & Lima	15	NH_2DNOSBP	(1)	6-9	At planting
		NH_2DNOSBP	(1)	3	Pre-E
		NaPCP	(1)	20	At Planting
		CIPC	(2)	6	At Planting
Beans, Soy	17	NH_2DNOSBP	(1)	4½-6	Pre-E or at planting
		NaPCP	(1)	20	Pre-E
		CIPC	(2)	3-8	Pre-E on early planted beans
		Alanap 1	(2)	2-6	Pre-E, low rate on light soil
		PCP	(3)	8-16	Pre-E

(1) For extensive use (2) For Trial only (3) For Exper. use only

Crop	Ref. Page	Chemical	Use	Pounds per acre	Time of Applications and Comments
Beets, Red	15	NaCl	(1)	2#/Gal	4-5 true-leaf stage
		Endo	(2)	6	Pre-E for grass control
		TCA	(2)	8-12	Pre-E for grass control
Blackberries	19	SES	(1)	3	Before weeds emerge
Blueberries (Cultivated)	19	DNem	(1)	$2-2\frac{1}{2}$	Directed sprays
		NaAs	(1)	10	Directed sprays
Cantaloupes	17	Alanap 1	(1)	2-4	Pre-E
Carnations	36	SES	(3)	2-4	Before weeds emerge
Carrots	15	Stod Solv	(1)	75-125G	Post-E, 3-leaf stage
Celery	15	Stod Solv	(1)	75-125G	Seed beds only
Cereals, Spr (not seeded)	27	2,4-D	(1)	$\frac{1}{4}-\frac{1}{2}$	Post-stooling, Pre-jointing
		MCP	(1)	$\frac{1}{4}-\frac{1}{2}$	Post-stooling, Pre-jointing
Cereals, Spr (Seeded)	27	NH_2DNOSBP	(1)	$1-1\frac{1}{2}$	Post-stool, Pre-joint, weeds must be small
		MCP	(1)	$\frac{1}{4}-\frac{1}{2}$	Seeding covered by grain
		2,4-D	(1)	$\frac{1}{4}-\frac{1}{2}$	Seeding covered by grain
Cereals, Wntr (not seeded)	27	2,4-DA	(1)	$\frac{1}{4}-\frac{1}{2}$	Fall or spring
		MCP	(1)	$\frac{1}{4}-\frac{1}{2}$	Fall or spring
Cereals, Wntr (Seeded)	27	NH_2DNOSBP	(1)	$1-1\frac{1}{2}$	On small weeds
		2,4-DA	(1)	$\frac{1}{4}-\frac{1}{2}$	On canopy of weeds in spring
		MCP	(1)	$\frac{1}{4}-\frac{1}{2}$	On canopy of weeds in spring
Chrysanthemum	36	SES	(3)	2-4	Before weeds emerge
Clover, Seedl.	28	NH_2DNOSBP	(1)	$1-1\frac{1}{2}$	Pre-E after weeds emerge
		CIPC	(1)	1-2	Pre-E
Cole Crops	16	CIPC	(2)	1-2	At planting, 2 in warm and 1 in cool weather
		Natrin	(2)	3-6	On transplants
		TCA	(2)	25-40	Pre-Plant 60-90 days
Corn, Field	22	2,4-D	(1)	$\frac{1}{2}-1\frac{1}{2}$	Pre-E, not on sandy soil
		NH_2DNOSBP	(1)	3-6	Pre-E
		2,4-D	(1)	$\frac{1}{4}-\frac{1}{2}$	Post-E
		NH_2DNOSBP	(2)	6-9	Banded at planting
		CMU	(2)	$\frac{1}{2}-2$	At planting or Pre-E
		Gr Cyan	(2)	500	Pre-E, moist soil needed
		NH_2DNOSBP	(2)	$3-4\frac{1}{2}$	Post-E until corn 3-4"high
		2,4-D	(3)	$1-1\frac{1}{2}$	At last cultivation, use drops

(1) For Extensive use (2) For Trial only (3) For Exper. use only

Crop	Ref. Page	Chemical	Use	Pounds per Acre	Time of Application and Comments
Corn, Sweet	18	2,4-DA	(1)	$1\frac{1}{4}$-$1\frac{1}{2}$	Pre-E, not on sandy soil
		2,4-DE	(1)	$\frac{1}{2}$-3/4	Pre-E
		NH_2DNOSBP	(1)	3-6	Pre-E
		NaPCP	(1)	15-25	Pre-E
		2,4-DA	(1)	$\frac{1}{4}$-$\frac{1}{2}$	Post-E
		CMU	(2)	3/4-1	At planting
		NH_2DNOSBP	(2)	$1\frac{1}{2}$-3	Post-E, corn less then 3" tall
Cucumbers	17	Alanap 1	(1)	2-6	Pre-E
Cranberries	42	FeS	(1)	1-4 tons	Rate and time depend on prob,
		PDB	(1)	1200	Mid Apr-Mid Nov.
		NaCl	(1)	150-200	June - July
		NaAs	(1)	$1\frac{1}{3}$-3	Early August
		$CuSO_4$	(1)	20-120	Depend on problem
		Kerosene	(1)	400-1000G.	Early May
		2,4-DA	(1)	1:2 dil	Avoid cranberry vines
		$NaNO_3$	(1)	300-500	June and July
		NaAs	(1)	60-90	For shores
		Ammate	(1)	75-300	For ditches and shores
Gladioli	35	SES	(1)	2-4	Pre-E, Post-E
		NH_2DNOSBP	(1)	6-8	Pre-E
		2,4-D	(1)	2	Pre-E
		CIPC	(1)	4-8	Pre E, Directed Post-E
Lettuce	16	CIPC	(2)	1-3	Pre-E
Nursery Stock (Seeded)	34	MBr	(1)		Pre-Pl
		CP	(1)		Pre-Pl
		Gr Cyan	(1)	1000-2000	Pre-Pl before weeds emerge
		TCA	(1)	50	Pre-Pl 6 months for quack
		NIX	(1)		Pre-E, Pre Pl
		KOCN	(1)		Pre-Pl, Pre-E
		M Spirits	(1)	20-30G	Pre-E, Post-E on conifers except larch and spruce.
Nursery Stock (Transplants)		SES	(1)	2-4	Before weeds emerge
		NH_2DNOSBP	(1)	3-4	Directed spray, dormant
		NIX	(1)	8	Directed spray
Nursery Stock (Established)	35	SES	(1)	2-4	Overall before weeds emerge
		CIPC	(1)	4-8	Directed spray
		NH_2DNOSBP	(1)	3-4	Directed spray
		NIX	(1)	8	Directed spray
		Gr Cyan	(1)	600-800	On row middles in moist soil
Onions	16	KOCN	(1)	1-2%	Post-E after flag stage
		Cyan Dust	(1)	75	Pre-E
		CIPC	(2)	4-8	Pre and Post-E on any soil high rate on muck soil.
		CMU	(2)	1	Pre-E

(1) For Extensive use (2) For Trial only (3) For Exper. use only

Crop	Ref. Page	Chemical	Use	Pounds per Acre	Time of Application and Comments
Orchards (Poison Ivy)	37	2,4,5-TLVE	(2)	1-2	Active or Dormant directed. Do not use on winesap or in pear orchards. Injury may result to stone fruits.
		2,4,5-TLVE +2,4-DLVE	(2)	2-3	Same cautions as above.
		Ammate	(2)	75-100	Directed spray. Do not use on trees less than 5-6 years old.
Orchards (Bindweed)	38	DN em	(2)	1-2	Directed and repeat
		2,4-DA	(2)	1	Post-H, directed spray
Orchards (General weeds)	38	DN em	(2)	1-2	Directed sprays, use on grasses in fence rows.
Pastures(Perm) (Ann.Brdlf.weeds)	28	2,4-DA	(1)	1	Ear. spring and repeat
		MCP	(1)	1	Ear. spring and repeat
(Woody weeds)		2,4,5-TE	(1)	2-3	Spot treat in early summer or dormant.
		2,4,5-TE +2,4-DE	(1)	2-3	Spot treat as above
(Wild garlic)	29	2,4-DE	(1)	$1-1\frac{1}{2}$	Ear. spring, repeat yearly
(Horse nettle)		2,4,5-TE +2,4-DE	(1)	$1\frac{1}{2}-2$	Blossom time.Kills clovers.
(Per & Winter ann weeds)		2,4-D	(1)	$\frac{1}{2}-1\frac{1}{2}$	Rate depends on species.
		MCP	(1)	$\frac{1}{2}-1\frac{1}{2}$	Rate depends on species.
Pastures (Semi perm)	29	Rotational grazing, fertilization, and mowing are of primary importance.			
Peas	16	$NH_2DNOSBP$	(1)	3-4	Pre-E
		$NH_2DNOSBP$	(1)	$1-1\frac{1}{2}$	Post-E
		$NH_4DNOSBP$	(1)	$1-1\frac{1}{2}$	Post-E
Potatoes,Irish	18	Dn em	(1)	3-5	Pre-E
		$NH_2DNOSBP$	(1)	3-5	Pre-E
Raspberries	19	SES	(1)	3	New fields before weeds emer
		2,4-D	(1)	1	Est fields before canes star
		No.2 Fuel	(1)	Cover	At base of plants,directed
Spinach	17	CIPC	(2)	1-2	At planting, Low tem. 1#
Strawberries	20	SES	(1)	2-4	Post Pl 7-12 days & as neede
		2,4-D	(1)	$\frac{1}{2}$	For emerged brdlf weeds
		SES	(1)	2-4	On est. beds before weeds emerge also in fall Pre-Dormant
		2,4-D	(1)	$\frac{1}{2}-1$	Fall on brdlf weeds
		$NH_2DNOSBP$	(1)	3-6	Dormant application
		$NH_4DNOSBP$	(1)	1-2	Dormant application
Tomatoes	17	Natrin	(2)	4-6	After plants established

(1) For extensive use. (2) For trial only (3) For exp. use only.

Crop	Ref. Page	Chemical	Use	Pounds per Acre	Time of application and Comments
Turf, Lawn	41	2,4-DA	(1)	¼-1½	Spring & fall for brdlf wee
		2,4-DE	(1)		For garlic
		2,4-D	(1)	¼-½	2 or 3 applns for goose gra
		2,4,5-T	(1)	½	2-3 applns at 3 wk interval
		PMA 10%	(1)	4-6	2-6 applns 7-10 day interfa
		KOCN	(1)	8-16	2-3 applns on small grass
Turf, Putting		PMA 10%	(1)	3-4½	2-6 applns 7-10 day interva
Turf renovation		NaAs			High soil moisture, temp. below 80°.
Watermelons	17	Alanap 1	(1)	2-4	Pre-E

Control of Perennial Herbaceous Weeds

Weed	Ref. Page	Chemical	Use	Pounds per Acre	Time of Application and Comments
Bedstraw (Galium Mollugo)	33	NH_2DNOSBP	(3)		Ear. spring.Repeat treat. needed.
Bermuda grass (Cynodon dactylon)	33	TCA	(2)	75#	L. Spr. or Ear. Sum
		CMU	(3)	40#	L. Spr. or Ear. Sum
Canada Thistle (Cirsium Arvense)	31	2,4-D	(1)	½-2#	Ear. bud & on 4-6 in.regrow and repeat yearly
		MCP	(1)	½-2#	Same as above for 2,4-D
Chicory (Cichorium Intybus)	32	2,4-D	(2)	½#	Fall or Spring
		MCP	(2)	¼#	Fall
Horse Nettle (Solanum carolinense)	31	2,4,5-T	(1)	2#	Pre-Bloom repeat yearly
		2,4-D + 2,4,5-T	(1)	2#	Pre-Bloom repeat yearly
Johnson Grass (Sorghum halepense)	33	TCA	(1)	50-75#	Spot treat Pre-E or Early Post-E
Milk weed (Asclepias syriaca)	32	2,4,5-T	(3)	2-3#	Use amino triazole salt
		2,4-D + 2,4,5-T	(3)	2#	To prevent pod formation
Nut Grass (Cyperus esculentus)	30	TCA	(1)	50-75#	2-4 in. ht disk & plow
		TCA+oil	(1)		On young growing grass
		MCP	(3)		Tuber sprouting in spr.
		2,4-D	(3)		
		CMU	(3)		
Quack Grass (Agropyron repens)	30	TCA	(1)	25-75#	On plowed soil & disc in.
		MH	(2)	5-10#	4-10in. ht.Plow 4-8 days la
		CMU	(1)	10-20#	During growth

(1) For extensive use. (2) For trial only (3) For exp. use only.

Weed	Ref. Page	Chemical	Use	Pounds Per Acre	Time of Application and Comments
Wild Garlic (Allium spp.)	32	2,4-D E	(1)	1-1½#	Spr & Fall Repeat yearly

Public Health Weed Control

Weed	Ref. Page	Chemical	Use	Pounds Per Acre	Time of Application and Comments
Ragweed	11	2,4-DA	(1)	½-1#	Veg. stage
		2,4-D NaS	(1)	½-1#	Veg. Stage
Poison Ivy	13	Ammate	(1)		Active growth
		2,4,5-T	(1)		Active growth or dormant
		2,4-DE + 2,4,5-TE	(1)		Active growth or dormant
		Borax	(1)	4#/100 sq.ft.	Active growth

(1) For extensive use. (2) For trial only (3) For exper. use only

Table of Abbreviations Used

Chemicals	
Alanap-1	N-1 naphthyl phthalamic acid
Ammate	Ammonium sulfamate
CIPC	Isopropyl-N-(3-chloro-phenyl) carbamate
CMU	3-(p-chlorophenyl)-1, 1-dimethylurea
CP	Chloropicrin
Cyan Dust	Calcium cyanamid dust
DN Em	Dinitro oil emulsions
Endo	Disodium 3,6-endoxohexahydrophthalate
Gr Cyan	Granular calcium cyanamid
Iron S	Ferrous sulfate
KOCN	Potassium cyanate
M Br	Methyl bromide
MCP	2,methyl 4 chlorophenoxyacetic acid
MH	Maleic hydrazide
M Spirits	Mineral spirits
NaAs	Sodium arsenite
NaPCP	Sodium pentachlorophenate
NH_2DNOSBP	Alkanolamine salts of dinitro ortho secondary butyl phenol
NH_4DNOSBP	Ammonium salt of dinitro ortho secondary butyl phenol
NIX	Sodium isopropyl Xanthate
No. 2 F. oil	No. 2 Fuel Oil
PA	Phthalamic acid
PCP	Pentachlorophenol
PMA	Phenylmercuric acetate
PDB	Paradichlorobenzene
SES	2,4 dichlorophenoxyethyl sulfate
Sesin	2,4 dichlorophenoxyethyl benzoate
Stod Solv	Stoddard solvent oil
TCA	Trichloroacetatic acid (salts)
2,4-DA	Alkanolamine salt of 2,4-D
2,4-DE	Ester form of 2,4-D

Table of Abbreviations Used con't.

2,4-DLVE	Low volatile ester form of 2,4-D
2,4-D NaS	Sodium salt of 2,4-dichlorophenoxyacetic acid
2,4,5-TE	Ester form of 2,4,5-T
2,4,5-TLVE	Low volatile ester form of 2,4,5-T

Other Abbreviations

Ea	Each
Ear	Early
Directed Spray	Directed application to base of crop
Dorm	During dormancy
G	Gallons
Post-E	Post-emergence
Post-H	Post-harvest
Pre-E	Pre-emergence
Pre-H	Pre-harvest
Spr	Spring

These designations of time refer to crops unless otherwise indicated in the table

Reaction of Woody Plants to Herbicides

H. C. Ferguson

(Reprinted From the 1953 NEWCC Proceedings)

Plant Species Common Name Scientific Name	Water Carrier-Foliage Appl'n 2,4-D - 2,4,5-T Comb'n*	 2,4,5-T alone *	 Ammate ***	Oil Carrier-Basal Appl'n 2,4-D- 2,4,5-T Comb'n**	 2,d,5-T alone **
Ailanthus (Ailanthus glandulosa)	S	S	M	S	S
Arrow Wood (Viburnum acerifolium)	S	R	S		M
Ash (Fraxinus Spp.)	R	R	M	M?	M
Basswood (Tilia americana)	R	M	M	R?	M
Beech (Fagus grandifolia)	M	M	S	S	M?
Birch (Betula Spp.)	S	S	S	S	S
Bramble (Rubus Spp.)	S	S	S	M	S
Buckeye (Aesculus Hippocastanum)	M	M	M	S	S?
Cucumber Tree (Magnolia acuminata)	S	S	S	S	S
Elm (Ulmus Spp.)	S	M	S	S	S
Green Briar (Smilax rotundifolia)	R	R	M?	R	R
Gum Black (Nyssa sylvatica)	M	S	S	M	M
Gum Red (Liquidambar styraciflua)	S	S	S		S?
Hawthorn (Crataegus Spp.)	M	M	M?	S	S?
Herculus Club (Aralia spinosa)	S	S	S		S
Haw (Viburnum prunifolium)	M	M	M	S	S?
Hickory (Carya Spp.)	M	S	M	M?	S
Honey Locust(Gleditsia triacanthos)	M	S	M	S	M
Ironwood (Ostrya virginiana)	S	R	S	S	M
Laurel (Kalmia latifolia)	R	R	M	S	M
Maple Sugar (Acer saccharum)	R	R	S	S	S
Maple Red (Acer rubrum)	R	M	M	S	S
Oak White (Quercus alba)	M	M	S	S	S
Oak Red (Quercus borealis maxima)	M	M	S	S	S
Locust (Robinia pseudo-acacia)	S	S	M	S	R
Paw Paw (Asimina triloba)	M	M	S		M
Persimmon (Diospyros virginiana)	R	R	M	M	M
Poplar (Populus Spp.)	S	S	S	S	S
Poison Ivy (Rhus Toxicodendron)	S	S	S	M?	S
Red Bud (Cercis canadensis)	M	M	S	S	M
Sassafras (Sassafras variifolium)	S	S	S	S	S
Spice Bush (Benzoin aestivale)	S	S	S		S
Sycamore (Platanus occidentalis)	S	S	S	S	M
Tulip Tree(Liriodendron tulipifera)	S	S	S	M?	S
Willow (Salix Spp.)	S	S	S	S	S
Witch Hazel (Hamamelis virginiana)	S	S	S	S	S

*Conc. 4# acid per 100 gal water
Best results June, July, Aug., early Sept.
Ten feet max. height controlled by chem.

***Conc. 75-100# per 100 gal. water
Best results May, June, July, Aug., early Sept.
Ten feet max. height controlled by chem.

**Conc. 16-20# acid per 100 gal. oil
Best results through dormant season
No limit to max. height controlled

R - Resistant
M - Moderately resistant
S - Susceptible
? - Opinion divided

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Niagara Mohawk Power Corp.
1125 Broadway
Albany, New York

Sharp, S. S.
E. I. duPont deNemours & Co.
Experiment Station
Wilmington, Delaware

Shaw, W. C.
U.S.D.A. Plant Industry Station
Beltsville, Maryland

Shelton, Richard J.
Southern Railway System
Box 233
Alexandria, Virginia

Shinn, Howard D.
Campbell Soup Co.
Parry Rd.
Riverton, New Jersey

Silvera, George E.
Larvacide Prod. Inc.
117 Liberty St.
New York 6, New York

Sisson, H. A.
Dow Chemical Co.
1400 So. Penn Sq.
Philadelphia, Pennsylvania

Skirm, Goerge W.
F. H. Woodruff & Son Inc.
69 Cherry St.
Milford, Connecticut

Skogley, C. R.
Farm Crops Dept.
N. J. Ag. Exp. Station
New Brunswick, New Jersey

Smith, David M.
Yale Forestry School
205 Prospect St.
New Haven 11, Connecticut

Smith, Norman J.
Madison Co. Ext. Service
Box 113
Wampsville, New York

Smith, Ralph H.
N. Y. S. Conservation Dept.
2-A Ridge Road
Delmar, New York

Smith, William W.
Horticulture Department
University of New Hampshire
Durham, New Hampshire

Somers, G. Fred
Del. Agr. Exp. Station
University of Delaware
Newark, Delaware

Southwick, Lawrence
The Dow Chemical Co.
1422 West Carpenter
Midland, Michigan

Sowa, Frank J.
Sowa Chemical Co.
305 E. 46th St.
New York 17, New York

Spon, F. S.
Pacific Coast Borax Co.
100 Park Ave.
New York, New York

Sprague, Milton A.
Rutgers University
Nicol Ave.
New Brunswick, New Jersey

Sprague, R. K.
Greenwich Health Dept.
Town Hall Annex
Greenwich, Connecticut

Staples, Clarence E.
Central Maine Power Co.
9 Green St.
Augusta, Maine

Steece, Henry M.
O. E. S. U. S. D. A.
Washington 25, D. C.

Steenis, John H.
Patuxent Res. Refuge, U.S.F.W.S.
Laurel, Maryland

Stern, Walter A.
Dept. of Mental Hygiene
Central Islip State Hospital
Central Islip, New York

Stevens, John E.
Shell Chemical Corp.
50 West 50th St.
New York 20, New York

Stevens, L. H.
A. T. T. Co.
1809 G. St. N. W.
Washington, D. C.

Stevens, Lewis F.
Pittsburgh Plate Glass Co.
Apt. D-13 99 E. 2nd St.
Moorestown, New Jersey

72

Stevens, Robert F.
University of Delaware
Newark, Delaware

Stevens, W. B.
Socony-Vacuum Oil Co.
26 Broadway
New York, New York

Stevinson, Melvin R.
General Aniline & Film Corp.
872 Colonial Ave.
Union, New Jersey

Strickenberg, L. R.
U. S. Forest Service
Walnut & Juniper Sts.
Philadelphia, Pennsylvania

Struckman, Harold J.
Bergen Co. Mosquito Comm.
Administrative Bldg.
Hackensack, New Jersey

Strufe, Frederick
Carolina Tree Service
Box 583
Shelby, North Carolina

Stype, Val
G. L. F.
Mattituck, New York

Suggitt, John W.
Hydro-Electric Power Comm.
620 University Ave.
Toronto, Canada

Sullivan, Dennis J.
Board of Health
City Hall
Jersey City, New Jersey

Sullivan, J. G.
N. J. Bell Tel. Co.
540 Broad ST.
Newark, New Jersey

Sullivan, Richard J.
N. J. Health Dept.
State House
Trenton, New Jersey

Swanson, Dale H.
Asplundh Tree Expert Co.
505 York Road
Jenkintown, Pennsylvania

Sweeney, R. C.
N. Y. S. Health Dept.
21 No. Broadway
White Plains, New York

Sweet, Harold A.
G. L. F.
R.F.D. Niobe, New York

Sweet, Robert D.
Vegetable Crops Department
Cornell University
Ithaca, New York

Switzer, Maurice F.
Jackson & Perkins Co.
305 Madison St.
Newark, New York

Sylwester, E. P.
Extension Service
Iowa State College
Ames, Iowa

Tafuro, Anthony
American Chemical Paint Co.
Ambler, Pennsylvania

Tate, H. Douglas
U. S. Rubber
Naugatuck Chemical Co.
Bethany 15, Connecticut

Taylor, Jack P.
American Chemical Paint Co.
Ambler, Pennsylvania

Thayer, E. A.
E. I. duPont deNemours Co.
350 Fifth Ave.
New York, New York

Thibodeau, Henry
Lucas Tree Expert Co.
179 Sheridan St.
Portland, Maine

Thompson, Don F.
American Chemical Paint Co.
Ambler, Pennsylvania

Thompson, Robert W.
Thompson Farms
Box 4
Bordentown, New Jersey

Timony, John A.
Penn. Power & Light Co.
Hazleton, Pennsylvania

Tischler, Nathaniel
Heyden Chemical Corp.
R. D. Jamesburg, New Jersey

Todd, F. Ridgely
J. H. Dulaney & Son
Fruitland, Maryland

Tomka, Louis A.
Metal & Thermit Corp.
530 Topping Hill Road
Westfield, New Jersey

Travers, Robert J.
A.T.T. Co. Long Lines
744 Broad St.
Newark, New Jersey

Trevett, Moody F.
402 Plant Science Bldg.
University of Maine
Orono, Maine

Troup, Robert E.
Rockland Lt. & Power Co.
R. F. D. Monsey, New York

Troxel, Robert B.
Lebanon Chemical Corp.
R. D. #1
Jonestown, Pennsylvania

Tubman, P. E.
Amer. Tel. & Tel Co. L. L. Dept.
32 Ave. of the Americas
New York 13, New York

Utter, L. Gordon
Diamond Alkali Co.
80 Lister Ave.
Newark 5, New Jersey

Van Camp, D. R.
The Randall Co.
Box 31
Jutland, New Jersey

Vandenberg, George B.
Rohm & Haas Co.
241 Roosevelt St.
Bristol, Pennsylvania

Van Geluwe, John
G. L. F. Soil Building Service
Ithaca, New York

Van Gordon, Laurence
Chipman Chemical Co. Inc.
Factory Lane
Bound Brook, New Jersey

Van Houten, J. R.
Dow Chemical Co.
30 Rockefeller Plaza
New York 20, New York

Van Wagoner, John W.
Vanoner Spray Service
Scotch Road
Titusville, New Jersey

Vaupel, George J.
N. J. Bell Tel. Co.
540 Broad St.
Newark, New Jersey

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Morgantown, West Virginia

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Amer. Tel. & Tel. Co.
112 State St.
Albany, New York

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University of Massachusetts
Amherst, Massachusetts

Viggars, Richard M.
F. A. Bartlett Tree Expert Co.
Greenhill & Second
Wilmington, Delaware

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Yonkers, New York

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New York, New York

Wagner, George H.
New England Tree Expert Co.
2416 N. Main Ave.
Scranton, Pennsylvania

74

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Walgren Tree Expert Co.
1708 Dixwell Ave.
Hamden, Connecticut

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Walgren Tree Experts
97 Brace Road
West Hartford, Connecticut

Walker, Harry G.
Penn Salt Mfg. Co.
1825 Bridgetown Pike
Feasterville, Pennsylvania

Wallach, Arthur
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Rm. 630 City Hall Annex
Philadelphia, Pennsylvania

Walton, Grant F.
Wildlife Dept. Rutgers University
36 Marvin Lane
New Brunswick, New Jersey

Walworth, B. L.
American Cyanamid Co.
1937 W. Main St.
Stamford, Connecticut

Wangerin, R. R.
Monsanto Chemical Co.
800 N. 12th St.
St. Louis 1, Missouri

Warren, J. R.
Chemical Week Magazine
330 W. 42nd St.
New York, New York

Washko, Walter W.
Eastern States Farmers Exchange
26 Central St.
W. Springfield, Massachusetts

Watson, A. J.
Engineering Equipment Co.
4021 N. 6th St.
Harrisburg, Pennsylvania

Waywell, C. G.
Dept. of Botany
O. A. C.
Guelph, Ontario

Weeks, Donald C.
E. I. duPont deNemous & Co.
Bldg. 87 Apt.4 Clifton Park
Wilmington, Delaware

Weintraub, R. L.
Chemical Corps
Camp Detrick
Frederick, Maryland

Weirich, C. L.
C. B. Dogle Co.
Westport, Connecticut

Wendt, Nelson E.
American Potash & Chemical Corp.
122 E. 42nd St.
New York, New York

Wert, R. W.
Attapulgus Minerals & Chemicals Corp
210 W. Washington Square
Philadelphia, Pennsylvania

Wheattley, J. R.
Carbide & Carbon Chemicals Co.
30 East 42nd St.
New York 17, New York

Wheaton, Archie J.
John Lucas Tree Expert Co.
Mechanic St.
Norridgewock, Maine

Wheeler, Wilfrid Jr.
F. A. Bartlett Tree Expert Co.
795 Memorial Drive
Cambridge, Massachusetts

White, Forest E. Jr.
Central Maine Power Co.
Box 1801
Portland, Maine

Willard, C. J.
H. & F. Bldg.
Ohio State University
Columbus 10, Ohio

Williams, A. T.
Eastern States Farmers Exchange
West Springfield, Massachusetts

Williams, E. H.
Ashland Tree Experts Inc.
1533 Carter Ave.
Ashland, Kentucky

Williams, Myron
Barker Chemical Co.
Alton, New York

Wilson, Cherles
Brookdale Place
Rye, New York

Witman, E. D.
Columbia Southern Chemical Corp.
One Gateway Center
Pittsburgh, Pennsylvania

Wolf, Dale E.
E. I. duPont deNemours & Co.
Wilmington, Delaware

Woodruff, John B.
Oscar F. Warner
24 E. Aurora St.
Waterbury, Connecticut

Woodbury, E. N.
Agricultural Chemicals Lab.
Hercules Powder Co.
Wilmington, Delaware

Woodward, Carol H.
The MacMillan Co. Publishers
60 Fifth Ave.
New York 11, New York

Worley, David
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Forestry Department
State College, Pennsylvania

Wormley, George W.
Farm Journal
Washington Square
Philadelphia 5, Pennsylvania

Wyckoff, John H. Jr.
Middlesex Co. Ext. Service
Rm. 211 P. O. Bldg.
New Brunswick, New Jersey

Young, Dale W.
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Washington Square
Philadelphia 5, Pennsylvania

Young, Virgil H. Jr.
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Res. Dept. 401 E. Main St.
Richmond, Virginia

Young, Fred H. Jr.
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266 E. Main St.
Ramsey, New Jersey

Zedler, R. J.
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Zeisig, Harry C. Jr.
Spencer Chemical Co.
Pittsburg, Kansas

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Marvin, E. D. Jr.
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Conley, Thomas
Halco Chemical Co.
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