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A PRELIMINARY STUDY OF 2,3,6-TRICHLOROBENZOIC ACID AND BIURET FOR WEED CONTROL IN FIELD CORN[1]

H. A. Collins and R. J. Aldrich[2]

Pre-emergence applications of chemicals is recognized as an important method of controlling weeds in corn and many chemicals have been tested in this role. The most widely used chemical at present is 2,4-D, although it frequently fails if extreme soil moisture conditions immediately follow treatment. Preliminary work at this Station and reports from others (1,2,3,4) indicated that 2,3,6-trichlorobenzoic acid was promising as a pre-emergence treatment in corn. A rate of biuret containing the amount of nitrogen used for side-dressing corn was found to be effective for pre-emergence weed control in other tests at this Station during 1954. This suggested that tests were warranted with this material as a lay-by treatment for weed control and fertilization.

The present study was initiated to evaluate 2,3,6-trichlorobenzoic acid and biuret for full season weed control in field corn and to measure fertilizer benefits of nitrogen in the biuret. The 2,3,6-trichlorobenzoic acid is referred to in the text as TCB acid or sodium salt.

Materials and Methods

1954

New Jersey #7 field corn was planted June 18 at a rate of 4 seeds per hill in hills 42 x 42 inches apart. Plots were 4 rows x 11 hills in size in a randomized block with three replications. Treatments shown in table 1 were made June 21. Weed counts and corn stands were taken July 20. Corn height was recorded July 27 and again August 18. Serious damage from blackbirds made it impossible to obtain yields.

1955

Four seeds of New Jersey #7 field corn per hill were planted in a sandy loam soil May 25. The plots were 2 x 11 hills in size with hills being 42 x 42 inches apart. Yield data were taken on 2 x 10 hills in each plot. The experiment was laid out in a split-plot design with four replications. The split was a surface application versus a worked in application of the treatments. Plots on which treatments were worked in were tilled with a spike tooth drag immediately before and after treating.

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[1]Acknowledgement is made to Heyden Chemical Corporation and to Allied Chemical & Dye Corporation for their support of this study.

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Fifteen treatments were used, including the sodium salt of TCB at rates of 1/2, 1, 1½ and 2 pounds per acre pre-emergence; biuret at the rates of 20, 40 and 60 pounds of nitrogen per acre pre-emergence; combination applications of 1 pound of the sodium salt of TCB pre-emergence and biuret post-emergence at 20, 40 and 60 pounds of nitrogen per acre; biuret post-emergence at rates of 20, 40 and 60 pounds of nitrogen per acre and two checks one of which was hand-weeded. Pre-emergence treatments were made May 27, two days after planting. Post-emergence treatments were made July 8 using a small turf type spreader which spread the biuret beneath the corn foliage. Prior to post-emergence treatment all plots were thoroughly cultivated and hand hoed. Plots not to be treated with biuret were side-dressed with 300 pounds of a 10-10-10 analysis fertilizer per acre at the time post-emergence treatments were made. Due to a relatively dry season the experiment was irrigated twice.

Results and Discussion

1954

Results of the 1954 trial are shown in table 1. TCB acid resulted in complete control of weeds when applied at 1 pound per acre and this rate did not reduce the height or stand of corn significantly. Observations in the field suggested that less than 1 pound of TCB could have been used for weed control. Higher rates of TCB resulted in pronounced reduction in height of corn. Corn heights on August 18 indicate the persistent effect of TCB since the relative reduction in height with 2 and 4 pounds on this date was greater than the reduction with similar rates July 27. Twenty-five pounds of biuret per acre resulted in fairly effective weed control and did not injure the corn in any way. Higher rates of this material resulted in substantial reduction in height on the early date whereas reductions on the second date of measurement were not significant.

1955

Weed control with the treatments is shown in tables 2 and 3. All pre-emergence treatments resulted in a significant decrease in broadleaf and grass weeds with the exception of 1/2 pound of TCB on grass. Counts shown in table 2 do not indicate the complete picture of weed control since it was observed that many weeds, particularly broad-leaved weeds, present in treated plots were much restricted in growth and probably did not compete seriously with corn. Biuret applied at lay-by resulted in significant weed control when 40 and 60 pounds of nitrogen were used. Grasses were more effectively controlled than were broad-leaved weeds.

Extremely dry weather followed the post-emergence application of biuret resulting in a limited number of weeds in all plots. It is probable that biuret was less effective in controlling weeds than it would have been had soil moisture been adequate.

Table 1. Effect of chemicals applied pre-emergence in corn on weed control and on corn height and stand. New Brunswick, N. J. 1954.

Pounds of Chemical per acre	Weeds per Square Foot July 20	Height per Corn Plant in Inches July 27	Height per Corn Plant in Inches Aug. 18	Number Corn Plants per Plot
Check	7.5	44.3	83.2	65.7
Check (hand-weeded)	---	44.7	83.0	64.3
TCB acid 1 lb.	0.0	41.1	75.2	66.7
" " 2 lbs.	0.0	35.3	62.9	59.3
" " 4 "	0.0	34.5	61.3	54.0
Biuret 25 lbs. N	2.1	43.6	81.9	62.7
" 50 " N	2.6	36.6	74.0	58.7
" 75 " N	0.6	36.8	75.2	65.0
2,4-D 2 lbs.	0.0	39.7	71.6	57.0
L.S.D. .05		5.8	11.2	8.3
.01			15.2	

Table 2. Effect of chemicals applied pre-emergence in corn on weed control. New Brunswick, N. J. 1955.

Pounds of Chemical per acre	Weeds per 2.11 square feet June 20 Broadleaf	Grasses
TCB Sodium salt 1/2 lb.	94.12	80.50
" " " 1 lb.	51.62	48.11
" " " 1½ lbs.	68.50	55.87
" " " 2 lbs.	18.62	29.50
Biuret 20 lbs. N	75.75	34.25
" 40 lbs. N	48.25	17.75
" 60 lbs. N	32.12	9.12
Check (hand-weeded)	148.12	142.00
Check	147.20	113.37
L.S.D. .05	32.02	36.74
.01	42.56	48.83

Table 3. Effect of biuret applied post-emergence in corn on weed control, New Brunswick, N. J. 1955.

Pounds of Chemical per acre	Weeds per 2 square feet August 2 Broadleaf	Grasses
Biuret 20 lbs. N	25.50	31.87
Biuret 40 lbs. N	19.37	15.00
Biuret 60 lbs. N	19.37	12.87
Check (hand-weeded)	23.25	54.27
Check	29.00	56.87
L.S.D. .05	3.85	28.10
.01	5.14	37.51

Observations made throughout the growing season revealed no injury to plants with the exception of the highest rate of TCB which resulted in a slight reduction in the size of plants throughout the season. Although differences among stover yields shown in table 4 were not significant, the yield of plots treated with 2 pounds of TCB was significantly less than the average yield of the other treatments. The apparent injury with 2 pounds of TCB, as reflected in stover yields, is consistent with injury in the form of reduced plant height found in 1954.

Table 4. Effect of chemicals on stover yield of New Jersey #7 field corn, New Brunswick, N. J. 1955.

Pounds of Chemical per acre	Average Stover Yield per Plot in Pounds
TCB Sodium Salt 1/2 lb.	147.52
" " " 1 lb.	138.81
" " " 1½ lbs.	147.13
" " " 2 lbs.	115.72
TCB 1 lb. + Biuret 20 lbs. N	135.31
" 1 lb. + " 40 " "	143.90
" 1 lb. + " 60 " "	131.51
Biuret 20 lbs. N	131.95
" 40 lbs. N	143.00
" 60 lbs. N	147.38
Check (hand-weeded)	140.65
Check	155.63
L.S.D.	NS

Summary and Conclusions

Pre-emergence treatments of TCB sodium salt gave significant control of broad-leaf and grass weeds with the exception of the 1/2 pound rate on grasses. Rates of 1½ pounds or less did not injure the corn in any way, whereas 2 pounds or more stunted corn and reduced stover yields.

Post-emergence applications of biuret at rates of 40 pounds of nitrogen or more per acre resulted in satisfactory control of grass and some control of broadleaf weeds.

Biuret treatments at all rates resulted in stover yields comparable to those from plots side-dressed with a 10-10-10 analysis fertilizer.

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THE CONTROL OF WEEDS IN CORN BY PRE-EMERGENCE AND EMERGENCE SPRAYS[1]

Collins Veatch[2]

Introduction

Chemical weed control is often considered supplementary to the tillage methods used in the production of row crops. However a chemical that would give full season control of weeds with one application would be desirable. Previous tests have indicated that corn is quite resistant to injury by chemicals at emergence, (E.R. Marshall and C. Veatch) or in the coleoptile or two leaf stage. An emergence application may be more effective on the weeds and more persistent than an application made at the time of planting.

The tests reported here were designed to give a comparison of various chemicals applied as pre-emergence and emergence sprays without further treatment and with a late post-emergence spray or cultivation.

Materials and Methods

The plot areas were fertilized and the corn was planted in hills by machine or by hand. The spray materials were applied with a special mechanized plot sprayer. Yield determinations were made on plots 2 rows by 10 hills. Yields were corrected for stand and reported on the basis of 15.5 per cent moisture, in bushels per acre.

The treated plots at Reedsville were 2 rows by 10 hills in size. These trials consisted of 4 replications of 15 treatments. Each treatment was applied as pre-emergence and emergence applications except that Sessin (2,4-dichlorophenoxyethyl benzoate) was used instead of 3Y9, tris-(2,4-dichlorophenoxyethyl) phosphite, in the emergence application.

The treated plots at Point Pleasant were 4 rows by 12 hills. At this location three series of applications were made. The corn was planted May 5. Pre-emergence spray was applied May 6 and emergence spray was applied May 12. One complete emergence trial was given the usual field cultivation while the other received no cultivation. One replication of the pre-emergence trial was sprayed with DNOSBP on June 10 at the rate of 4 pounds per acre using drop pipes.

The results of these trials are reported in Tables 1 and 2 which give the average yield per treatment, in bushels per acre, and the average weed index. The weed index is an estimate of comparative weed population at the time of harvest, zero indicating few if any weeds and 9 complete coverage of the area with weeds.

Discussion of Results

The trials at Reedsville were on Pope sandy loam where the weed problem was not serious as indicated by the yields of the "no control" plot reported

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in Table 1. In the pre-emergence trial the "no control" plots averaged 122.3 bushel per acre as compared to 125.8 for the whole trial. In this trial only the two lowest yielding treatments, cultivated and Herbisan treated, yielded significantly less at the 5% level than any of the other plots. Although significance of weed index differences cannot be determined the Dinitros, 2,4-D and HC-1281S showed the lowest weed index at harvest.

In the emergence treatments the "no control" plots gave the lowest yield, 99.6 bushel per acre, with a weed index of 3.50. The cultivated plots yielded 123.8 bushel, which was slightly higher than the average yield for all treatments of 120 bushel per acre. The highest yielding plots were treated with Herbisan 91, 136.7 bushel per acre, with HC-1281S, 135.9 bushel per acre. The Dinitro treated plots were higher yielding than the 2,4-D treated plots but the difference was not statistically significant.

The trials at Point Pleasant were on Wheeling sandy loam where there was a high population of weeds including ragweed (Ambrosia artemisifolia), lambs quarters (Chenopodium album), pigweed (Amaranthus spp.), smartweed (Polygonum spp.) three seeded mercury (Acalypha virginica) and various fall grasses such as foxtail (Setaria spp.) and crabgrass (Digitaria spp.).

In the pre-emergence trial the cultivated plots produced 80.4 bushel per acre, while the next highest yield was 75.7 bushels per acre on the plots treated with 4 pounds of 3Y9. The weed control, as recorded by the weed index, was poor on all of the other pre-emergence treated plots.

In the emergence trial the cultivated plots averaged 90.3 bushels per acre, whereas the treatment of 4 pounds of 3Y9 yielded 103.3 and 1 pound of 2,4-D LV ester 97.2 bushels per acre. When the weeds were not controlled the yield was only 69.2 bushels per acre.

In the trial in which emergence treatment was followed by cultivation the plots receiving cultivation alone yielded 95.5 bushels per acre whereas 7 of the chemically treated series gave somewhat higher yields. Only one of these yields would be considered statistically higher than the cultivation treatment, the 105.6 bushel yield of the plots treated with 4 pounds of 3Y9.

One replication of the pre-emergence trial was treated with DNOSBP (Premerge), at the rate of 4 pounds per acre on June 10, when the corn was about 24 inches high. The late spray did a satisfactory job of suppressing the broad leaved weeds as well as nut grass (Cyperus esculentus) and annual fall grasses. The plots receiving cultivation yielded 123.9 bushel per acre. Other high yield plots were those treated as follows: 1/2 pound HC-1281S, 127.9 bushel per acre; 1 pound 2,4-D amine, 127.5 bushel per acre; and 4 pounds 3Y9, 122.3 bushel per acre.

Comparatively good weed control was obtained on the plots cultivated and on the replication given a late post-emergence spray with Dinitro as shown by the "weed index" in Table 2.

In the pre-emergence treatments 2 pounds of 2,4-D sometimes gave better weed control than 1pound but no consistent differences in yield, however plots treated with 2 pounds of 2,4-D at emergence consistently gave lower yields than the plots treated with only 1 pound. In the case of the Dinitro treated

plots the 6 pound rate gave more effective weed control and no reduction in yield when compared to the 4 pound application.

The findings of this trial at Point Pleasant are illustrated by the average yields as follows:

Treatment	Bushels per acre
Pre-emergence spray	66.20
Emergence spray	81.03
Emergence plus cultivation	97.02
Pre-emergence plus late post-emergence	108.22

Summary and Conclusions

Where weeds are a serious problem, a pre-emergence or emergence chemical treatment will probably not control weeds the entire growing season. Cultivation or a late spraying with drop pipes will normally be required to give satisfactory control of weeds following pre-emergence or emergence treatments.

Damage to the corn was indicated by reduced yields when plots were sprayed with 2 pounds of 2,4-D per acre at emergence. No other reductions in yields were observed that could be attributed to any of the other chemicals applied at emergence.

It is possible that some of the chemicals may have a stimulating influence on the corn growth and production but it is difficult to differentiate this from reduced weed competition.

References

1. Marshall, Ernest R. Weed Control in Field Corn Following Planting and Emergence Applications of Herbicides. Proceedings of the Ninth Annual Meeting of the Northeastern Weed Control Conference, January, 1955 - page 257.

2. Veatch, Collins. Control of Weeds in Corn by Pre-emergence, Emergence and Post-emergence Treatments. Proceedings of the Ninth Annual Meeting of the Northeastern Weed Control Conference, January, 1955 - page 265.

Acknowledgment is made to the following Companies who supplied the chemicals used in these experiments: American Chemical Paint Company, Dow Chemical Company, Roberts Chemicals Inc., Naugatuck Chemical Division of U.S. Rubber Company, Heyden Chemical Corporation, Carbide and Carbon Chemical Company and Standard Agricultural Chemicals, Inc.

TABLE 1. Corn Yield and Weed Index of Weed Control Trials at Reedsville 1955

	Treatment	Rate Per Acre	Pre-emergence Yield Bu./A.	Pre-emergence Weed Index 0 - 9	Emergence Yield Bu./A.	Emergence Weed Index 0 - 9
1	3Y9	2 lbs.	127.0	2.75		
	Sessin	4 lbs.			124.1	2.25
2	HC-1281S	1/2 lb.	135.3	2.25	120.3	2.25
3	HC-1281S	1 lb.	129.4	1.75	135.9	2.25
4	Herbisan	2 gal.	113.1	4.25	119.9	4.25
5	Herbisan 91	2 gal.	119.8	4.00	136.7	4.00
6	Sinox P.E.	4.16 lbs.	123.8	2.75	124.6	2.75
7	Sinox P.E.	6.16 lbs.	121.7	3.00	117.9	2.50
8	Premerge	4 lbs.	127.5	3.50	121.7	2.75
9	Premerge	6 lbs.	130.8	2.75	125.7	2.25
10	2,4-D Amine	1 lb.	135.0	2.75	114.9	2.75
11	2,4-D Amine	2 lbs.	125.0	2.75	114.9	2.75
12	2,4-D LV-ester	1 lb.	130.6	2.50	114.9	2.50
13	2,4-D LV-ester	2 lbs.	133.6	2.25	105.3	2.25
14	No control	-	122.3	3.50	99.6	3.50
15	Cultivated	-	112.8	3.25	123.8	3.25
Average			125.8		120.0	
L.S.D. .05			17.47		13.98	

TABLE 2. Corn Yield and Weed Index of Weed Control Trials at Point Pleasant 1955

	Treatment	Rate Per Acre	Pre-emergence[1] Yield Bu./A.	Pre-emergence[1] Weed Index 0 - 9	Emergence Yield Bu./A.	Emergence Weed Index 0 - 9	Emergence & Cultivation Yield Bu./A.	Emergence & Cultivation Weed Index 0 - 9	Pre-emergence & Post-emergence INOSBP[2] Yield Bu/A.	Pre-emergence & Post-emergence INOSBP[2] Weed Index 0 - 9
1	3Y9	2 lbs.	68.8	3.6	90.0	5.5	102.5	2.0	110.9	2
2	3Y9	4 lbs.	75.7	1.6	103.3	4.5	97.1	3.0	122.3	0
3	HC-1281S	1/2 lb.	63.4	4.6	81.5	5.0	99.4	1.75	127.9	2
4	HC-1281S	1 lb.	63.3	4.3	63.5	5.75	105.6	2.25	107.9	5
5	Sinox P.E.	4 lbs.	59.8	4.3	56.1	5.0	93.5	2.75	84.1	2
6	Sinox P.E.	6 lbs.	56.8	4.3	87.9	4.5	93.0	2.25	102.6	5
7	Premerge	4 lbs.	51.0	4.6	61.8	4.75	87.0	2.50	95.4	4
8	Premerge	6 lbs.	67.8	5.0	85.9	5.25	98.8	2.75	106.2	3
9	2,4-D Amine	1 lb.	62.1	4.3	87.6	6.0	102.0	2.25	127.5	2
10	2,4-D Amine	2 lbs.	64.7	5.3	80.8	5.75	91.6	2.50	89.1	1
11	2,4-D LV-ester	1 lb.	67.9	5.0	97.2	6.0	97.9	3.00	99.0	5
12	2,4-D LV-ester	2 lbs.	69.1	4.0	83.3	6.0	93.4	2.50	115.5	1
13	Herbisan	2 gal.	55.4	5.0	78.3	6.25	99.5	2.75	107.3	3
14	Cultivated	-	80.4	2.0	90.3	3.75	95.5	3.00	123.9[4]	1
15	No Control	-	68.7	4.6	69.2	6.75	98.7[3]	3.25	103.7[4]	4
Average			66.2		81.03		97.02		108.22	
L.S.D. .05			13.55		11.55		9.75		-	

1 - Three replications
2 - One replication
3 - Cultivated
4 - Post-emergence spray

A Comparison of Eight Herbicides for Pre-emergent Weed Control in Silage Corn[1]

R. S. Bell and E. J. Bannister, Jr.[2]

The use of 2, 4-D and the dinitro-compounds for pre-emergent control of weeds is now a fairly common practice. In order, however, to achieve greater efficiency and economy in production, new herbicides need to be tested as they become available.

Materials and Methods

Field plots, each 15' x 32', located at the Agronomy experimental plots at Kingston, Rhode Island were planted with Penn. 602 corn May 16, 1955. The soil, a Bridgehampton silt loam, was fertilized with 1000 pounds per acre of 8-12-12-2. The herbicides were applied on May 18, 19 and 20. Three rates of application of each chemical were used with 4 replicates of each. The liquid herbicides were applied with a low gallonage, high pressure sprayer. The Karmex W and Karmex DW are slightly soluble. Larger volumes of water and active agitation were necessary when these materials were used. The herbicides used and rates per acre are shown in Table 1.

The corn was in the 4-leaf stage by May 31. The plots were not cultivated until July 14 at which time the corn was yellowing noticeably on the check plots and where the herbicides were not satisfactorily controlling weeds. After cultivation with a rotary hoe on July 14, the larger weeds were removed by hand-hoeing during the next 10-day period. The corn was harvested for silage on August 30.

Results and Discussion

The green weights of silage corn in Table 2 show that the 12 control plots averaged 12.5 tons per acre. This low yield was due to delayed cultivation which allowed severe competition from such weeds as yellow foxtail grass, lambs-quarters, red-rooted pigweed, spurry and others in lesser amounts. Delayed cultivation also allowed a build-up of weeds in plots treated with CDEC, CDAA, and CDEA so that average yields of only 13.1, 11.9 and 14.3 tons per acre respectively, were attained.

Percent weed cover, shown in Table 3, was estimated on July 5 while the corn was still short enough to allow easy visual comparisons. The average percent weed cover on this date for CDEC, CDAA and CDEA was 56, 59 and 40 respectively. The weed cover on plots treated with these 3 herbicides developed rapidly and by July 14 the CDAA had a weed cover comparable to the control plots. These chemicals seemed to have a shorter period of effectiveness than did the others in the test. They also are irritating to the eyes and skin which necessitates the use of goggles, respirator and rubber gloves.

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This is a practical deterrent to wide-spread use of these chemicals.

The average yields of silage corn were 16.6, 18.3 and 17.4 tons per acre, respectively, from the Karmex W, Karmex DW and the TBA (HC-1831-S) plots. The average percent weed cover on plots sprayed with these materials was 11, 10 and 7, respectively. The weed population on these plots remained low throughout the growing period.

The average yields of silage corn from the DN Premerge plots were 16.9 tons and from the 2, 4-D, low volatile ester, 17,4 tons per acre, green weight. The average percent weed cover was 29 for the Premerge and 16 for the 2, 4-D. The high rate of Premerge, 9 pounds to acre, gave better weed control than did the lower rates. Karmex W, Karmex DW and TBA (HC-1281-S) were as effective at the medium rate as at the high rate. TBA (HC-1281-S) gave the best average control at a low rate, i.e., 11 percent weed cover. The percent weed cover figures do not indicate better weed control for increasing amounts of 2, 4-D-LVE, CDAA or CDEA.

The average number of corn stalks in each treatment are presented in Table 3. Karmex W was the only treatment showing a clear-cut downward trend in plant population with increasing amounts of herbicide. Many seedlings in the Karmex W plots showed tipburn. While the extent of injury was not rated numerically it is the authors' opinion that the decreasing plant stands with increasing amounts of Karmex W was due to the toxicity of this herbicide. Corn plants within reasonable limits adjust their growth to the amount of space available, so the resulting yields may be better than expected from a certain number of plants. In the case of Karmex W the yields of 19.9, 16.0 and 14.0 tons per acre green for the low, medium and high rates, respectively, may indicate early damage to the corn plants with consequent death of some of them.

The results with Karmex W are comparable to those obtained when it was used as a pre-emergence herbicide on silage corn during 1951 and 1953. For 1951 the average yields for the 1 pound per acre rate of Karmex W (CMU) and 2, 4-D amine was 20.0 and 20.1 tons per acre, respectively. The average yield on the check plot was 19.5 tons. The average yields for 1953 for Karmex W, 2, 4-D amine and the check plots were 19.2, 20.3 and 15.2 tons per acre, respectively. The average percent weed cover in 1953 was 80 for the control, 20 for 2, 4-D amine and 28 for Karmex plots.

Summary

Eight herbicides were applied as pre-emergence sprays on silage corn. Cultivation was delayed until July 14 at which time the weed populations were so heavy in the control, CDEC, CDAA and CDEA plots that the corn was stunted and yellow, which reduced the yields considerably.

The DN Premerge and the 2, 4-D (low volatile ester) gave satisfactory weed control. More complete weed control was attained, however, where Karmex W, Karmex DW and the sodium salt of trichlorobenzoic acid were applied. Considerable tipburn on the corn seedlings was evident where Karmex W was used and some seedlings died. The data shows a decrease in plant stand and yield as

the amount of this herbicide was increased from 1/2 lb. to 1 1/2 lb. per acre. It produced a satisfactory yield of silage corn and gave fair weed control at the 1/2 lb. rate per acre. Karmex DW which is less soluble did not reduce the stand of corn and yields per acre with increasing concentrations. Karmex W (CMU) used as a pre-emergent herbicide on silage corn during 1951 and 1953 also satisfactorily controlled weeds and produced yields of corn comparable to 2, 4-D. The trichlorobenzoic acid material and Karmex DW seem to be the most promising new materials in this test.

Table 1. Herbicides Used and Rates Per Acre, Pre-emergent Weed Control in Silage Corn at the R. I. Agr. Exp. Sta. (1955)

Herbicides	Rates Low	Medium	High	Chemical Designation
DN Premerge	1 gal.	2 gal.	3 gal.	Alkanolamine salt of dinitro-o-sec-butylphenol
Karmex W	1/2 lbs.	1 lbs.	1 1/2 lbs.	3-(p-chlorophenyl)-1, 1-dimethylurea
2, 4-D LVE	1 pt.	1 1/2 pt.	2 pt.	Low volatile ester 2, 4-dichlorophenoxyacetic acid
Karmex DW	1/2 lbs.	1 lbs.	1 1/2 lbs.	3-(3, 4-dichlorophenyl)-1, 1-dimethylurea
TBA (HC-1281-S)	1/2 lbs.	3/4 lbs.	1 lbs.	Sodium salts of trichlorobenzoic acid
CDEC	3 lbs.	4 lbs.	5 lbs.	2-chloroallyl diethyldithiocarbamate
CDAA	3 lbs.	4 lbs.	5 lbs.	a-chloro-N, N-diallyacetamide
CDEA	3 lbs.	4 lbs.	5 lbs.	a-chloro-N, N-diethylacetamide

Table 2. Average Green Weight of Silage Corn from the Pre-emergent Herbicide Tests at the R. I. Agr. Exp. Sta. (1955)

Herbicides	Rates Low	Medium	High	Average
	Tons Per Acre			
DN Premerge	15.7	16.4	18.7	16.9
Karmex W	19.9	16.0	14.0	16.6
2, 4-D LVE	17.9	17.1	17.2	17.4
Karmex DW	17.1	18.4	19.3	18.3
TBA (HC-1281-S)	17.6	17.9	16.8	17.4
CDEC	14.3	11.8	13.1	13.1
CDAA	11.5	11.6	10.7	11.9
CDEA	14.2	15.6	13.0	14.3
Check	12.8	14.2	10.6	12.5
L.S.D. at .05	Treatments 3.0, TxR 2.0			

Table 3. Average Percent Weed Cover and Numbers of Corn Stalks in Two 32' Harvest Rows, July 5, 1955 with no Cultivation at the R. I. Agr. Exp. Sta. (1955)

Herbicides	Rates Low	Med.	High	Av.	Rates Low	Med.	High	Av.
	% Weed Cover				Stalks Per Plot			
DN Premerge	45	27	15	29	57	59	61	59
Karmex W	29	1	2	11	62	54	49	55
2, 4-D LVE	16	19	14	16	60	58	57	59
Karmex DW	21	4	4	10	57	57	57	57
TBA (HC-1281-S)	11	4	6	7	68	61	64	64
CDEC	66	48	54	56	66	59	61	62
CDAA	60	59	58	59	62	57	59	59
CDEA	40	41	38	40	56	61	62	60
Check	81	96	96	91	61	64	62	62
L.S.D. at .05	Treatments 14, TxR 10				Treatments 7, TxR 5			

RESULTS OF FIELD SCREENING OF SOME NEW PRE-EMERGENCE HERBICIDES ON CORN.

Marvin M. Schreiber*

INTRODUCTION

In recent years a great deal of attention has been given to the problem of annual grass control in row crops. This has been stimulated by those who have felt that constant use of 2,4-D materials, primarily for broadleaf weed control, would lead to increased danger of creating a serious grass problem. Although the areas that would fall in this category are few at this time, it has been the objective of industry and research workers to supply and investigate the grass-killing properties of some of the newer materials before the problem becomes serious.

It has been known for some time that even with 2,4-D materials some grass control has been obtained by pre-emergence application. This has not offered complete kill but in some cases has given suppression for a time sufficient to allow the crop to get the proper start. Pre-emergence weed control on corn has been a common practice for several years. Its success or failure has been a function of soil texture, weather conditions, and weed species present. Probably pre-emergence has gained prominence in recent years because of the greater injurious effects exhibited by post-emergence spraying and the specific weed problems that have existed.

The ideal pre-emergence herbicide for weed control in corn would be a material that would control both broad-leaved and annual grasses at an economical rate without seriously affecting the yield of corn. It would preferably be a material that would offer a longer residual, thus giving weed control properties over a longer period of the growing season. This would necessarily have to be a material that would be relatively unleachable and slowly broken down by soil microorganisms.

This paper is a report of a study on some new pre-emergence herbicides to determine their effect on weed control and yield of corn.

MATERIALS AND METHODS

This experiment was initiated in the spring of 1955 at the Agronomy Experimental Field, Caldwell Field, Ithaca, N. Y. The soil is classified as Dunkirk silty clay loam with a pH of 6.2 and organic matter content of 3.7. The specific field chosen had previously been in a grass-legume sod.

The plot area was seeded on May 23, 1955, with 10 pounds of mustard (*Brassica arvensis*) per acre, and 10 pounds of Japanese millet (*Echinochloa frumentacea*) per acre to insure a uniform stand of broadleaved and grass weeds. The stand of Japanese millet was insignificant and from the standpoint of weed control this experiment therefore considered only the control of mustard which is one of the worst broad leaved weeds in corn in New York State. On May 25, 1955, Cornell M-4 variety of corn was planted with a 2-row planter applying 310 pounds of 13-13-13 fertilizer per acre. The experimental design was a

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randomized complete block with three replications. Each plot consisted of 2 rows of corn 36 inches apart and 50 feet long.

On May 27, 1955, the plot areas were sprayed using an Allis Chalmers Model "G" tractor equipped specifically for small plot spraying. Table 1 is a list of the treatments by chemicals. All materials except 2,4-D amine post-emergence were applied at two rates. The Karmex compounds, CDAA, CDEA, CDEC, and Niagara 5519 and 553-T, were applied in 30 gallons of water. All the remaining materials were applied in 10 gallons of water per acre. The post-emergence treatment was applied when the corn was 8 to 10 inches tall.

Table 2 is the rainfall data for the growing season of 1955. The excess or deficiency for the months and the excess or deficiency for the year in table 2 show a marked reduction in normal rainfall through the growing season of 1955. This coupled with excessively higher temperatures throughout the growing season resulted in one of the driest and warmest seasons in New York in 54 years. The weather conditions for the growing season in 1955 had a marked effect on mustard control and these specific effects will be taken up under the results.

The experimental plots of corn were cultivated once (June 24, 1955) and side dressed with 28 pounds of nitrogen per acre two weeks later.

Observations on weed control and crop injury were made throughout the growing season along with weed stand counts. Half of each plot was harvested for silage, and half was harvested for grain.

RESULTS AND DISCUSSIONS

Yield

The silage yields expressed in tons per acre as 75% moisture are shown in Table 3. There was no significant difference in treatment in chemicals over both

Table 3. Silage Yield T/A 75% Moisture Pre-emergence Screening 1955
Means/three replications

Chemical	Rate 1	Rate 2	Chemical means
Karmex W	37.6	42.3	39.9
Karmex DW	39.4	38.4	38.9
Karmex FW	40.1	36.6	38.3
ACP L-841	42.2	48.4	45.3
ACP L-857	42.2	40.6	41.5
Hooker X-33-S	36.0	41.9	38.9
Hooker X-42-S	41.6	42.7	42.1
Heyden HC-1281-S	38.1	39.3	38.7
CDAA	50.5	42.7	46.6
CDEA	41.6	50.8	46.2
CDEC	38.4	44.0	41.2
Niagara 5519	45.0	47.9	46.4
553-T	42.7	40.6	41.6
D-4	34.6	40.4	37.5
2,4-Dow	46.6	46.6	
Check	37.7	37.7	

Table 1. Treatments - Pre-emergence Field Screening 1955

Code Name	Company	Chemical	Rates #/A	Treat No. Respectively		Formation
Karmex W	DuPont	3-(p-chlorophenyl)-1, 1-dimethylurea	½, 1	1.	2.	80% WP
Karmex DW	DuPont	3,(3,4-dichlorophenyl)-1, 1-dimethylurea	½, 1	3.	4.	80% WP
Karmex FW	DuPont	3 phenyl-1, 1-dimethylurea	½, 1	5.	6.	80% WP
ACP L-841	Am. Chem. Paint	2,4-dichlorophenoxyacetamide	2, 4	7.	8.	75% WP
ACP L-857	Am. Chem. Paint	2,3,6-trichlorobenzoic acid	1, 2	9.	10.	75% Na salt
X-33-S	Hooker	Equal tri & tetrachlorobenzoic acid	2, 4	11.	12.	100% Na salt
X-42-S	Hooker	Predominately tetrachlorobenzoic acid	2, 4	13.	14.	100% Na salt
HC-1281-S	Heyden	2,3,6-trichlorobenzoic acid	2, 4	15.	16.	Na salt 1½#/gal.
CDAA	Monsanto	Alpha chloro-N, N-diallylacetamide	3, 6	17.	18.	EC 4#/gal.
CDEA	Monsanto	Alpha chloro-N, N-diethylacetamide	3, 6	19.	20.	EC 4#/gal.
CDEC	Monsanto	2-chloroallyl diethyldithiocarbamate	3, 6	21.	22.	EC 4#/gal.
5519	Niagara	Sec.-butyl N-(3 chlorophenyl)carbamate	4, 8	23.	24.	EC 4#/gal.
553-T	Monsanto	Coded	3, 6	25.	26.	EC 4#/gal.
D-4	Pittsburg	Iso-octyl ester 2,4-dichlorophenoxyacetic acid	1½, 2	27.	28.	EC 4#/gal.
* 2,4-Dow	Dow	Amine salt 2,4-dichlorophenoxyacetic acid	½	29.		WS 4#/gal.
Check				30.		

* Post-emergence

WP Wettable powder
EC Emulsifiable concentrate
WS Water soluble

Table 2. Rainfall Data, Caldwell Field
Growing Season, 1955

Date	April	May	June	July	Aug.	Sept.
1	0.0	0.20	0.04	0.04	0.05	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.29	0.14	0.0	0.0	0.0	0.0
4.	0.05	0.0	0.0	0.0	0.12	0.0
5	T*	0.0	0.0	1.08	0.0	0.06
6	0.04	0.0	0.0	0.07	0.15	0.0
7	0.03	0.36	0.20	0.0	0.08	0.0
8	0.0	0.24	0.0	0.0	0.0	0.0
9	0.0	0.0	0.06	0.0	0.0	0.0
10	0.0	0.01	0.0	0.0	0.0	0.0
11	0.0	0.0	0.02	0.0	0.77	0.68
12	0.12	0.0	0.03	0.0	0.04	0.0
13	0.0	0.0	0.05	0.0	1.80	0.0
14	0.01	0.0	0.0	0.0	0.0	0.0
15	0.22	0.0	0.0	0.06	0.37	0.13
16	0.04	0.0	0.0	0.37	0.22	T
17	0.03	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.30	0.0
19	0.11	0.0	0.0	0.0	0.0	0.0
20	0.04	0.0	0.0	0.0	0.0	0.0
21	0.01	0.0	1.12	0.0	0.59	0.0
22	0.0	0.0	0.0	0.0	0.38	0.0
23	0.0	0.24	0.0	0.36	T	0.50
24	0.16	0.02	0.0	0.08	0.0	0.27
25	0.54	0.11	0.20	0.0	0.0	0.0
26	0.05	0.04	0.0	0.0	0.0	0.0
27	0.0	T	0.0	0.24	0.35	0.14
28	0.0	0.02	0.0	0.0	0.0	0.0
29	0.0	0.16	0.0	0.0	0.0	T
30	0.02	0.03	0.0	0.0	0.37	0.08
31		0.06		0.0	0.0	
Month Total	1.76	1.63	1.72	2.30	5.59	1.86
Normal Total	2.51	3.40	3.56	3.54	3.38	3.06
Excess or Deficit for month	- 0.76	-1.77	-1.84	-1.24	+2.21	-1.20
Excess or Deficit for year	-0.02	-1.79	-3.63	-4.87	-2.66	-3.86

* T - trace

treatments as far as the yield of corn silage. ACP L-841, the 2,4-D amide, CDAA, CDEA, and Niagara 5519 were among the higher yielding chemicals but these values were not significantly different from the check or other treatments. There was also no significant difference between the rate of chemicals from high to low in the yield of silage corn.

The ear corn, however, showed significant difference between treatment means and rate of chemical from high to low. The higher rates gave significantly increased yields over the lower rates. There was, however, no significant difference between the chemicals over both rates. The sum of chemicals over both rates for the ACP L-841 and CDAA was higher than other chemicals but the differences were not significant. Within treatments, marked differences were exhibited as shown in Figure 1. The 4-pound rates of the ACP L-841, Treatment 8, gave the highest yield of ear corn. This was followed by Treatment 17 which was the 3-pound rate of CDAA. The 8-pound rate of Niagara 5519, Treatment 24, and the 6-pound rate of CDAA, Treatment 18, were also among the higher yielding treatments. It can be easily seen from Figure 1 that the yields of these specific materials were far superior than the recommended post-emergence treatments as shown by the dashed line and by the recommended pre-emergence treatments (Treatments 27 & 28).

Figure 1 shows several chemicals that demonstrated very little effect on ear corn yield with change in concentration. Karmex W (Treatments 1 and 2), ACP L-857, (trichlorobenzoic acid, American Chemical Paint), Heyden's HC-1281-S, and Monsanto's CDEC showed very little change with concentration in relationship to yield of ear corn. This is exhibited by the shortness of the line. Probably the greatest change due to concentration was exhibited by CDEA going from the 3 pounds to the 6-pound rate. The 2,4-D amide increasing from 2 to 4-pound rate as shown in Treatment 7 and 8 showed the same effect in yield increase. Some of the significant differences shown in ear corn yield can be explained on the basis of weed control to be discussed in the next section.

Weed Control

The mustard population throughout the plot area was quite uniform except in those areas where excellent weed control was obtained prior to emergence. Figure 2 represents the mustard control by chemicals at the two dates at which stand counts were taken, June 23 and July 15. Niagara 5519 and CDAA were significantly different from all the rest of the chemicals. D-4, the low volatile ester of 2,4-D, was as effective as Niagara 5519 and Monsanto CDAA but was not significantly as good as these two materials. All the other materials as measured by chemicals in the first stand count gave little to no weed control, with 553-T giving the least of all. Since the post-emergence application (Treatment 29) 2,4-D amine, was not applied prior to June 23, 1955, the values for these plots were extremely high. A similar response was obtained at the second stand count July 15, 1955, in which again Niagara 5519 and Monsanto CDAA were highly significant from all other chemicals. D-4, the low volatile ester of 2,4-D, again, was close to the values for 5519 and CDAA but was not significantly so. The value for the post-emergence application of 2,4-D amine did markedly reduce the stand count as shown in Figure 2. The remaining materials seem to spread much more in the latter stand count showing that in some cases the materials did suppress to a certain extent the germination of mustard but were dissipated after a period of a month or two.

Getting down to the specific treatments, the various rates of each individual chemical showed highly significant differences due to treatment with

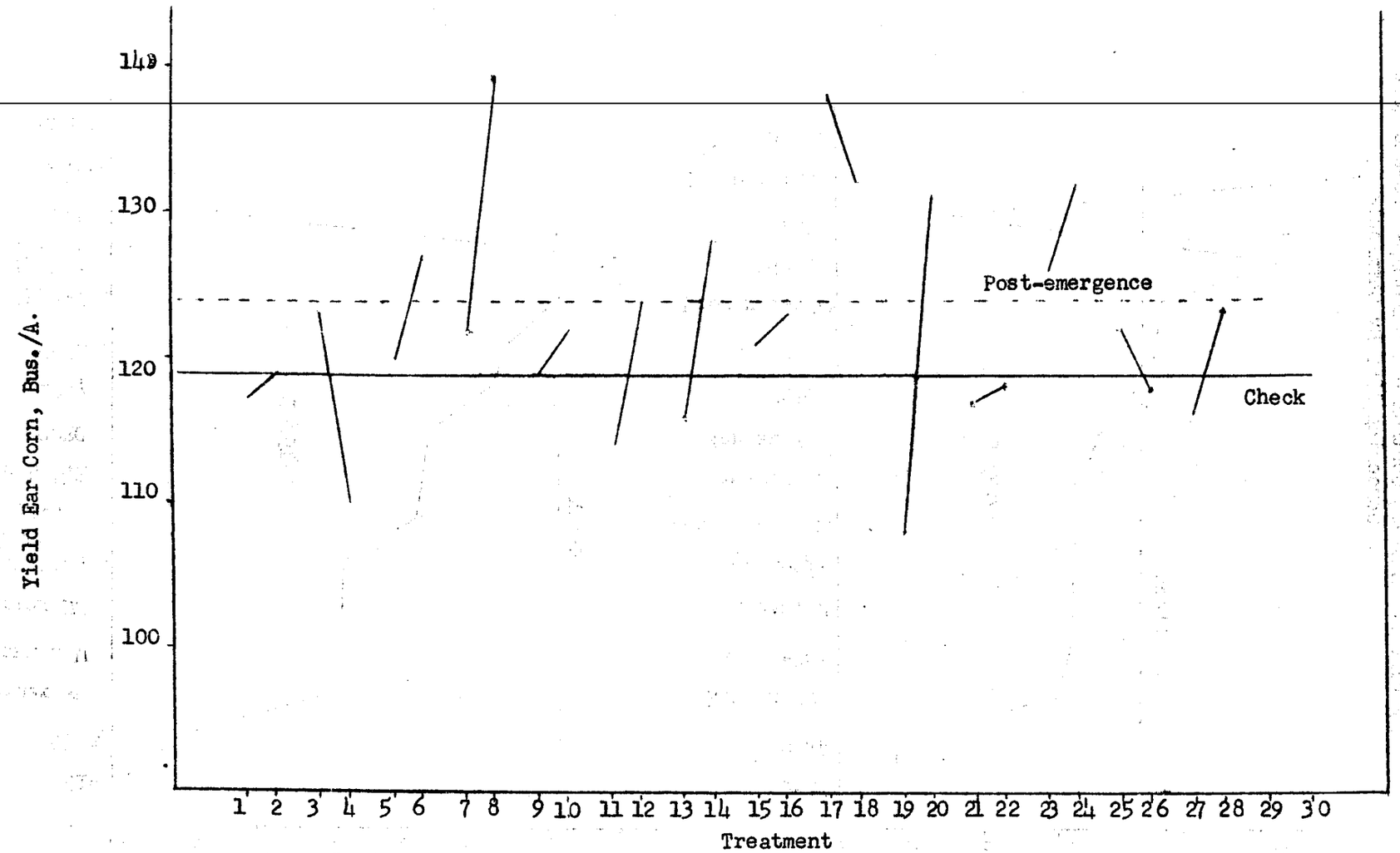
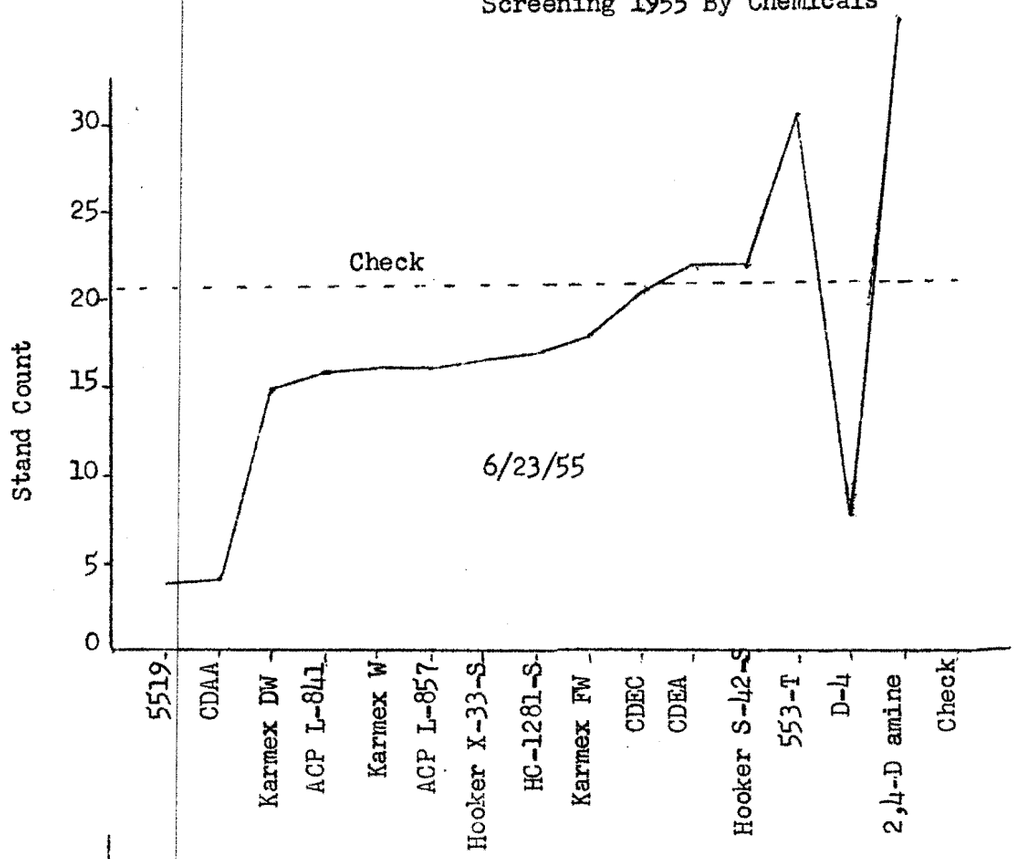
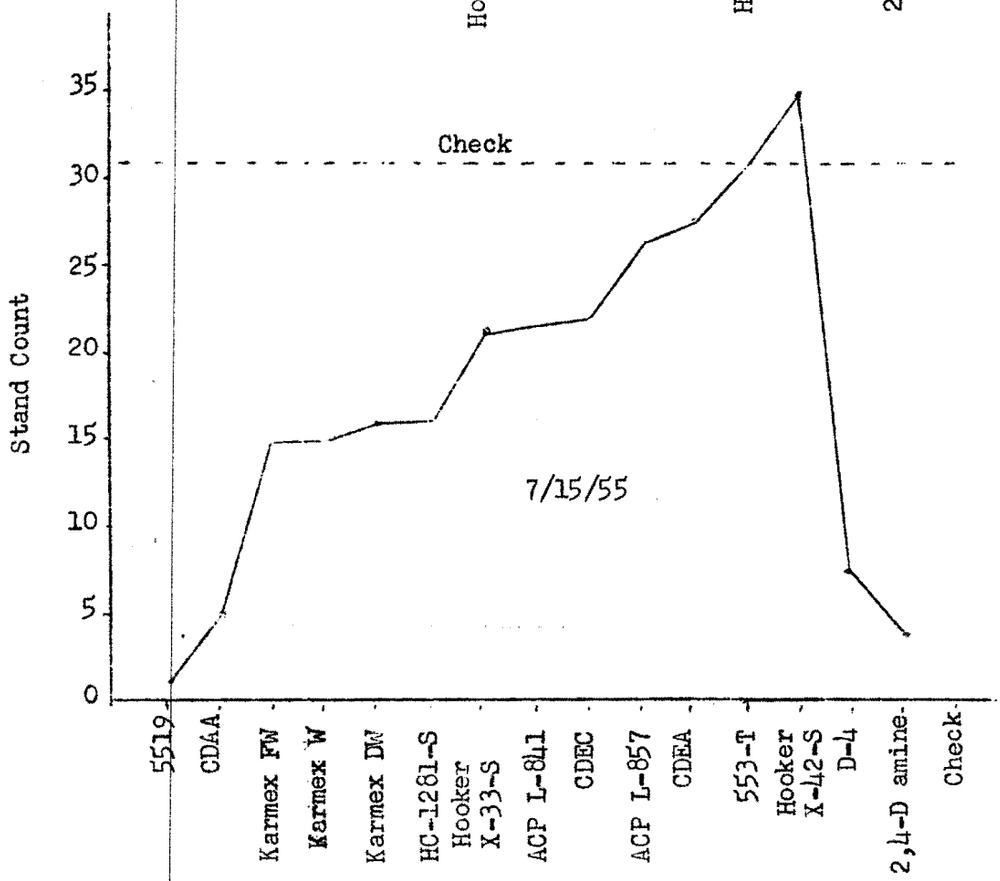


Figure 1. Yield Ear Corn - Pre-emergence Screening, 1955

Figure 2. Mustard Control - Two Dates - Pre-emergence Screening 1955 By Chemicals





6 pounds of CDAA, 8 pounds of Niagara 5519, and 2 pounds of the 2,4-D low volatile ester giving significantly more weed control than any of the other treatments (Figure 3). Most materials showed marked increase in weed control within increased concentration, particularly the 2,4-D amide (ACP L-841), and Heyden's HC-1281-S at the high rate of 4 pounds. One of the marked differences showing in Figure 3 is the difference between 1½ pounds of the volatile ester, 2,4-D, and the 2-pound rate of the same material. One and one-half pounds did not control weeds to any great extent but the one-half pound increase brought the value down to that of the two better materials -- CDAA and Niagara 5519. None of the materials used, however, were significantly better than the low volatile ester of 2,4-D at 2 pounds per acre.

Figure 4 represents the mustard control by treatment at the latter stand count date of July 15, 1955. Again significant weed control was exhibited by the high concentration of CDAA (6 pounds per acre), Niagara 5519 (8 pounds per acre) and the low volatile ester of 2,4-D (2 pounds per acre). The 2,4-D amide (ACP L-841) at 4 pounds per acre -- did give highly significant differences compared with the check and other treatments at this high rate. This is exhibited by the length of the line from the 2 pounds (Treatment 7) to the 4 pounds of the same material (Treatment 8). Since the post-emergence application had been made by July 15, 1955, the post-emergence treatment showed effective control at this latter stand count, resulting in a marked drop in the stand count for this treatment. The marked effect of some of these materials, particularly 2,4-D amide (ACP L-841) is possibly demonstrating some residual activity at the higher concentrations. Such may be the case for the CDAA under the weather conditions during the growing season.

It is also interesting to note that the chemicals that gave the highest weed control were also those materials that gave the highest yield of ear corn in bushels per acre.

The various materials that gave the best weed control such as ACP L-841, Niagara 5519, and CDAA, varied quite a bit in their formulation. ACP L-841 being a wettable powder would not be expected to move particularly at low rainfall level. CDAA and Niagara 5519, both emulsifiable concentrates, would under high rainfall tend to leach through the soil. As stated earlier, the growing season this past year (1955) has been extremely warm and dry lending themselves to greater activity of these materials at the soil surface;thus, exhibiting better weed control. Just how these materials will react under high rainfall conditions immediately and after several weeks after application will probably change appreciably the final results, particularly in weed control and possibly in crop injury with much depending on soil texture. The only material that did exhibit some injury to corn was the high rate of Heyden's HC-1281-S.

As also stated earlier, none of the newer materials gave better control or yield of ear corn than the low volatile ester 2,4-D at the standard recommendation of 2 pounds per acre. Since there was no true measure of grass control, it may be assumed that these materials could compete with the low volatile ester of 2,4-D if they offered enough grass control as well as broad leaved control to warrant their use.

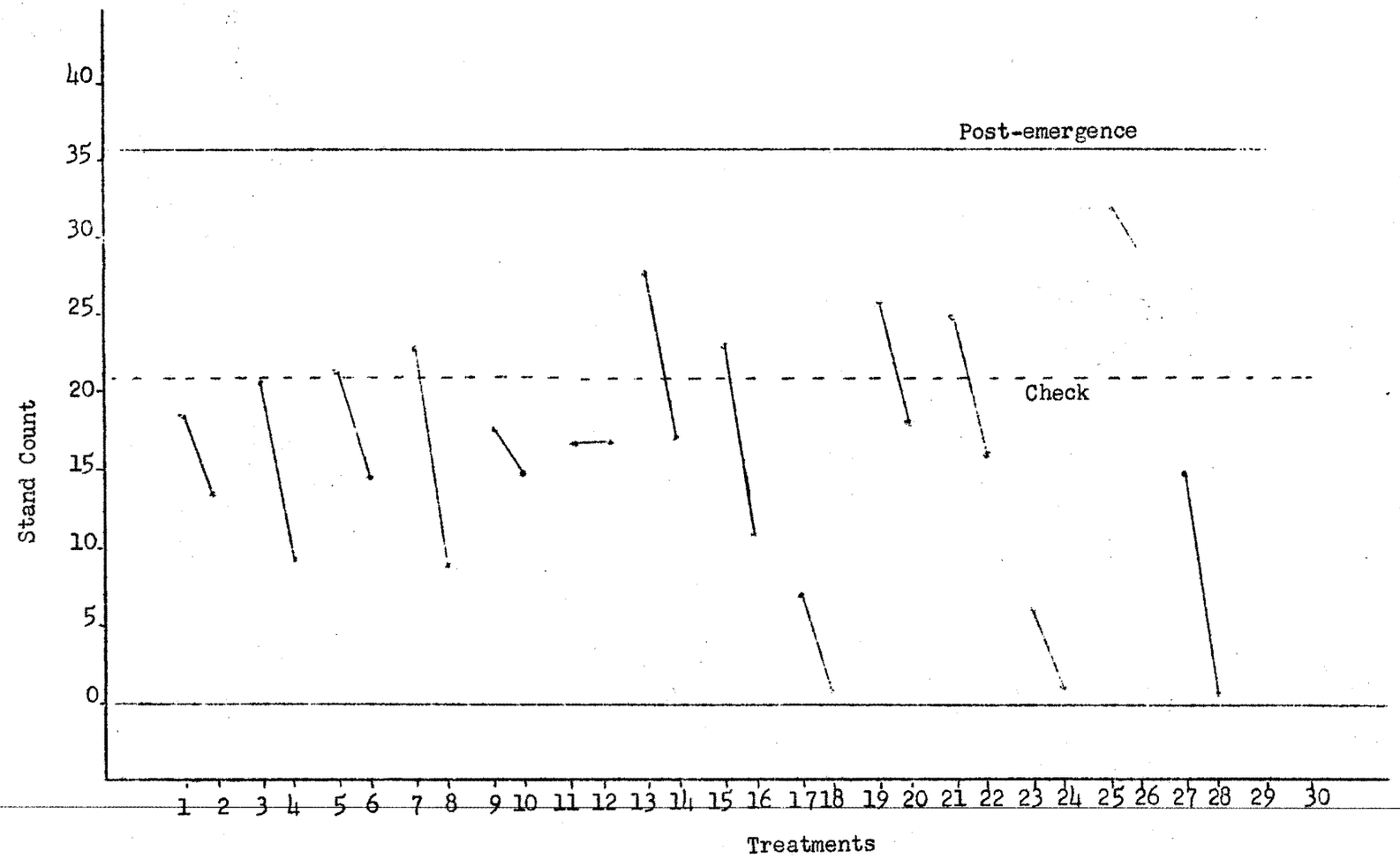


Figure 3. Mustard Control By Treatments 6/23/55
Pre-emergence Screening 1955

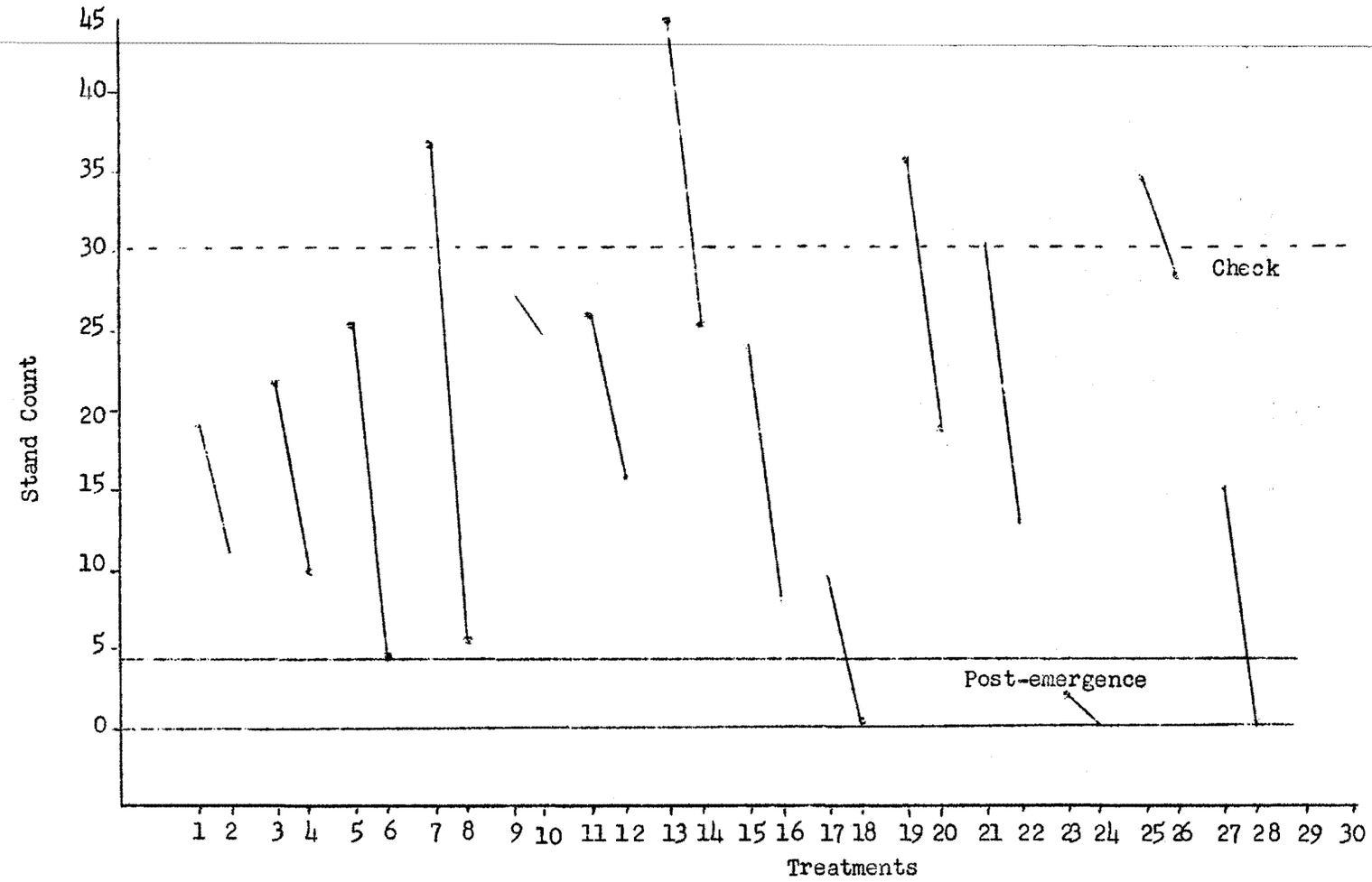


Figure 4. Mustard Control By Treatments 7/15/55
Pre-emergence Screening 1955

GENERAL CONCLUSIONS

Effective weed control without crop injury can be obtained with pre-emergence application of herbicides.

> ACP L-841 (2,4-dichlorophenoxyacetomide) at the 4 pound rate per acre, CDAA (alpha chloro-N, N-diallylacetamide) at 6 pounds per acre, and Niagara 5519 (secondary butyl N-(3 chlorophenyl) carbamate at the 8-pound rate were most effective for the control of mustard without seriously affecting the yield of corn.

Since this test was of a preliminary nature in field screening of some newer pre-emergence herbicides, few direct conclusions can be drawn at this time. These better materials certainly warrant more investigation, particularly from the standpoint of grass control and under wetter weather conditions than were exhibited in the growing season of 1955 and under varied soil textures.

Acknowledgments are made to the various chemical companies who supplied the various materials listed in this paper.

WEED CONTROL IN FIELD CORN[1]

Jonas Vengris [2]

Field corn weed control tests were conducted in 1955 to investigate new chemicals by comparing their potentialities with those of 2,4-D and dinitro herbicides. Since the annual weedy grasses have become increasingly serious in field corn, we also investigated the possibilities of controlling monocotyledonous weeds by post-emergence treatments.

EXPERIMENT I.

Procedure.

The experiment was laid out on a farm near Amherst in randomized block design with three replicates. Each plot consisted of four corn rows 25 feet long. When determining yield only, two middle rows were taken. Ohio hybrid M 15 was planted May 24. Chemicals were first applied on May 26, two days after planting. At that time the plots were free from weed seedlings. As a result of a heavy (1.45-inch) rain the previous day, the soil was moist and well compacted. The herbicides were applied a second time on June 2, nine days after planting. The corn was then in the coleoptile stage of growth. The third application was made on June 21, when the plants were 9 inches tall. The experiment was cultivated once on July 5.

Chemicals applied are listed below:

Material	Abbreviation
1. Butoxy ethanol ester 2,4-D (Weedone LV 4)	2,4-D
2. Alkanolamine salts of dinitro-o-sec-butylphenol (Dow Premerge)	DN
3. 2,3,6-Trichlorobenzoic acid (Heyden HC-1281-S)	HC-1281
4. Trichloro and tetrachlorobenzoic acid (Hooker-X-33-EC)	X-33
5. Tetrachlorobenzoic acid (Hooker-X-42-EO)	X-42

The rates presented in the tables are expressed in pounds of acid equivalent per acre.

Results and Discussion

The effect of different treatments on weeds and corn was observed during the whole growing season. The weed population consisted mostly of yellow foxtail (*Setaria lutescens*), pigweed (*Amaranthus retroflexus*), lamb's quarters (*Chenopodium* spp.), ragweed (*Ambrosia artemisiifolia*), and crabgrass (*Digitaria sanguinalis*).

Observations made July 9 and August 30 are recorded in Table I. Treated plots are all rated relative to the checks, which are given a rating of 100.

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1. Contribution NO. 1026 of the University of Massachusetts, College of Agriculture, Experiment Station, Amherst, Massachusetts
2. Assistant Professor of Agronomy, University of Massachusetts

TABLE I. Field Corn Weed Control - Corn Stands and Corn Yields
(Relative Values, Checks = 100)

No.	Treatments		Weed Stand 7/9/55 Dicot	Weed Stand 7/9/55 Monocot	Corn Stand 7/9/55	Weed Stand at Harvest Dicot	Weed Stand at Harvest Monocot	Relative Corn Yields
1	Check		100	100	100	100	100	100
2	2,4-D, 1 lb/A	2 d. after planting	42	52	100	48	70	162
3	2,4-D, 2 lb/A		57	33	86	46	60	136
4	DN, 3 lb/A		62	75	103	63	90	149
5	DN, 6 lb/A		38	43	103	52	63	164
6	HC-1281, 1 lb/A		5	15	96	7	38	180
7	HC-1281, 2 lb/A		4	8	65	1	10	174
8	X-33, 1 lb/A		8	67	103	13	80	160
9	X-33, 2 lb/A		8	30	95	7	78	167
10	X-42, 1 lb/A		10	77	103	15	97	149
11	X-42, 2 lb/A		8	58	103	5	66	150
12	DN, 3 lb/A	9 d. after planting	23	28	103	15	55	195
13	DN, 6 lb/A		10	15	95	13	20	199
14	HC-1281, 1 lb/A		5	18	103	4	25	192
15	HC-1281, 2 lb/A		3	8	67	2	14	161
16	X-33, 1 lb/A		7	55	103	5	78	179
17	X-33, 2 lb/A		5	45	100	4	77	186
18	X-42, 1 lb/A		7	63	103	10	83	142
19	X-42, 2 lb/A		5	60	103	4	85	162
20	2,4-D, 1/4 lb/A	Corn 9 inches tall	17	100	93	15	100	126
21	2,4-D, 1/2 lb/A		7	100	93	19	100	107
22	HC-1281, 1/4 lb/A		68	100	96	25	100	113
23	HC-1281, 1/2 lb/A		33	100	96	15	100	117
24	X-33, 1/2 lb/A		60	100	103	20	100	102
		L.S.D. at 5% level	14	16	12	17	24	32
		L.S.D. at 1% level	18	21	16	22	32	43

Weed surveys made July 9 and August 30 indicated that all treatments significantly controlled broadleaved weeds. Both rates of DN applied 2 days after planting were relatively less effective than treatments made 9 days after planting, probably because of rainy weather both before and after the earlier treatment. Post-emergence treatments (applied when corn was 9 inches tall) had little effect on annual weedy grasses. At that time yellow foxtail, crabgrass, and broadleaved weeds were about 5 to 6 inches tall. Where monocott weeds are a problem, pre-emergence or, better, emergence treatments are preferred over post-emergence treatments.

X-33 and X-42 effectively controlled dicot weeds but were relatively ineffective in eliminating yellow foxtail and crabgrass. The two new Hooker Company herbicides did not differ significantly.

HC-1281 at the rate of 2 lb/A 2 days after planting and 9 days after planting controlled weeds the best. The next most effective chemicals were HC-1281 at 1 lb/A and DN at 6 lb/A applied 9 days after planting. All these plots remained relatively free of weeds during the whole growing season.

Treatments that gave the best control also caused the most injury to the corn. The most apparent injury was caused by the 2-pound rate of HC-1281, followed by the 1-pound rate of the same chemical. Successively less injury was caused by the 2-pound rate of 2,4-D and the 6-pound rate of DN applied 9 days after planting. Later, corn on most plots "outgrew" evidences of injury, and on July 9 only HC-1281 at the 2-pound rate still showed injury to corn plants. Evidence of injury persisted throughout the growing season.

The weather during the second half of July was dry and hot. On weedy plots the competition between corn and weeds for moisture and for nutrients became exceptionally strong.

Corn plants on these plots were pale, yellowish, and greatly reduced in size. On plots treated with HC-1281, weed competition was largely eliminated so that even though the plants were injured by the chemical, yields from these plots were significantly better than the check plot yields. The highest yields were obtained when weeds were most effectively controlled.

The same experiment but without replicates was laid out on the Experiment Station Farm on a heavier fine sandy loam with only fair drainage. The objective was to observe the possible relationship of soil texture to chemical injury. Smartweed (Polygonum pensylvanicum) was rather prevalent, and it is of interest to note that HC-1281 gave excellent control, whereas 2,4-D at 2-pounds per acre was rather ineffective. No injury to corn by 2,4-D pre-emergence treatments was observed.

EXPERIMENT II.

The objective of this experiment was to investigate the possibilities of controlling annual weedy grasses in field corn with post-emergence applications of different herbicides. Broadleaved weeds were controlled by an application of 3-pounds per acre DN on the whole cornfield at the coleoptile stage of growth.

The field was heavily infested with crabgrass (Digitaria sanguinalis), Plots were laid out, four rows wide and 25 feet long. Herbicides were applied at two different dates: June 27, when corn was 15 inches tall, and July 8, when corn was 28 inches high. At the time of the first application, the field was rather free from crabgrass seedlings. On July 8 when the second application was made, crabgrass seedlings were from 1 to 4 inches tall. A few patches of crabgrass seedlings were over 5 to 7 inches tall. The chemical were applied directly on the soil with a knapsack sprayer. All treatments were replicated twice. The extent to which crabgrass was controlled was determined by estimation. Treated plots are rated relative to the checks, which are given a rating of 100. Corn yields obtained by harvesting the two center rows are also given as relative values in terms of the checks. The results are summarized in Table II.

TABLE II. Annual Weedy Grass Control in Field Corn
(Data relative, Checks = 100)

No.	Treatments *	Time of Application	Weedy grass Stands	Corn Yields
1	Check	Corn 15" tall	100	100
2	Dalapon, 2 lb/A		32	117
3	Dalapon, 4 lb/A		5	77
4	Heyden HC-1281, 1 lb/A		67	111
5	Hooker X-42, 1 lb/A		92	119
6	2,4-D l.v.e., 1 lb/A		86	109
7	Monsanto CDAA, 5 lb/A		35	116
8	TCA, 6 lb/A		53	85
9	CIPC, 5 lb/A		75	105
10	Crag I, 2.5 lb/A		90	101
11	Du Pont Crabgrass Killer No. 1+		80	136
12	DN, 3 lb/A		70	97
13	Dalapon, 2 lb/A	Corn 28" tall	25	93
14	Dalapon, 4 lb/A		5	95
15	Dalapon, 6 lb/A		2	81
16	Heyden HC-1281, 1½ lb/A		85	118
17	Monsanto CDAA, 10 lb/A		75	133
18	TCA, 9 lb/A		60	97
19	CIPC, 10 lb/A		76	92
20	DuPont Crabgrass Killer No. 1+		68	111
21.	DN, 6 lb/A		48	115
22	Amino-triazole, 2 lb/A		27	116
23	Amino-triazole, 4 lb/A		20	115

* Rates are lb/A of acid equivalent or active ingredient.

\+ 80% 3-(3,4-Dichlorophenyl)-1-methyl-1-N-butyl urea.

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Under conditions of the test, Dalapon, amino-triazole, and Monsanto CDAA were the most promising chemicals for controlling crabgrass in field corn. Dalapon and amino-triazole caused some injury. Corn treated with amino-triazole was somewhat chlorotic. Evidence of injury persisted throughout the season. Even though the effects of chemical injury are not reflected in yields of corn, more work must be done before any recommendations can be made.

Dalapon also caused some injury from the 2-pound-per-acre rate with both dates of application, and the corn fully recovered from each treatment. No significant decreases in the corn yields were recorded. Dalapon at lower application rates is apparently promising for the control of weedy grasses in field corn and should be investigated more thoroughly. The most satisfactory control of grass is obtained from low rates applied early, when grasses are coming up or in the small seedling stage.

Monsanto CDAA was rather effective when applied at the 15-inch stage of growth. Other studies of this material on grass-legume new seedings and elsewhere indicate that this new herbicide is promising for the control of grasses through pre-emergence applications. These results with both corn and legumes warrant further investigation.

Summary and Conclusions

1. HC-1281 applied 2 and 9 days after planting gave the best weed control in field corn. Plots treated with HC-1281, 2 lb/A rate, were relatively clean from dicot and monocot weeds throughout the growing season. Dinitro applied 9 days after planting (at coleoptile stage of growth) gave excellent weed control and was significantly more effective than when applied two days after planting. It appears that dinitro rates should be higher than 3 lbs/A. Applications of 2,4-D 2 days after planting were not particularly effective. The relatively poor results from 2,4-D or dinitro applied 2 days after planting may have been due to excessively rainy weather.

2. Post-emergence herbicide applications when corn was 9 inches tall were not effective, particularly on weedy grasses. Results from pre-emergence and especially emergence applications were much more promising.

3. DN 6 pounds-per-acre applied at emergence (9 days after planting) at first suppressed corn growth but subsequent yields were not affected. The most serious injury was observed on the HC-1281 plots at the 2 pound-per-acre rate. Evidence of injury was noticeable throughout the growing season; however, weed control was excellent, and weed competition for moisture and plant nutrients was eliminated. Therefore, the yield increase due to the HC-1281 applications was highly significant. More research is needed to investigate rates and time of application in connection with injury of corn.

4. Under the conditions of our tests, the most promising herbicides for eliminating annual weedy grasses in field corn were Dalapon, CDAA, and amino-triazole. CDAA should be applied before weed emergence. Dalapon rates should not be higher than 2 pounds per acre of acid equivalent, and the best time for applications is at the germinating or small seedling stage of growth.

Dalapon and amino-triazole injured corn plants.

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RESULTS OF FIELD TRIALS WITH NEW PRE-EMERGENCE HERBICIDES ON FIELD CORN

N. A. Ferrant, M. J. Papai, W. Baran, H. Sweet and E. R. Marshall

Introduction

Chemical weed control in field corn has become a standard practice on many farms in the northeast. A post-emergence spray with 2,4-D is the most usual type of program followed. Even though this program is most popular with farmers, it is not always the most popular with college extension and commercial field men.. There is a growing feeling among such workers that far too much corn injury is occurring as a result of post-emergence 2,4-D applications, particularly when these sprays are applied too late, after the corn is 8-10" in height. We are now noticing a trend toward earlier applications made anytime after planting up until the opening of the first leaf. A considerable number of growers have been making herbicidal applications with the sprayer attached behind the planter with a nozzle placed over each row. Other growers prefer to wait and make applications just before or as the corn is emerging.

Pre-emergence applications have been very successful. Often, however, results are not all that is to be desired. Dry conditions, excessive rainfall or a prolonged period before corn emergence may limit the effectiveness of pre-emergence herbicide applications.

It would be desirable to find a chemical which would be more consistent in weed control when used pre-emergence than the present 2,4-D on dinitro compounds. With this objective in mind a screening program was conducted during the summer of 1954. Chemicals which showed selectivity on corn and gave better weed control than the low volatile esters of 2,4-D or the dinitros in this screening test were 2,4-D acetamide (L841), 2,4,5-T acetamide (L 842) and 2,3,6 trichlorobenzoic acid (HC1281). The acetamides were applied as wettable powders because of their low solubility in conventional solvents. In order to follow up the indications of this small scale screening test, a series of large scale field trials were planned during 1955. In addition to the above chemicals certain other materials were included in these trials.

MATERIALS AND METHODS

One-half acre plots of the various chemical tests were applied at 57 locations in New York, New Jersey and Pennsylvania. The greatest number of these plots were applied in New Jersey. All treatments were applied before the corn had opened one leaf from the spikelet. In some cases treatments were applied at planting, in other cases at

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varying times up until emergence. The materials were applied with a jeep sprayer in 30 gallons of water per acre and under 40 psi pressure. Not all treatments were applied at each location but the treatments were varied from location to location. One standard pre-emergence treatment was included at each location for comparison. Soil types varying from light, sandy soil to heavy loam were encountered. The rate of each chemical applied was varied as conditions warranted. In general heavier rates were used on loam soils than on sandy soils.

Chemicals used were 2,4-D acetamide (L841), 2,4,5-T acetamide (L842), 2,4-D acid, the butoxyethanol ester of 2,4-D (LV4), an amine dinitro-Sinox PE (PE), a low volatile formulation of Sinox PE (LVPE), 2,3,6 trichlorobenzoic acid (HC1281), Sodium Salt of 2,3,6 trichlorobenzoic acid (HC1281S), mixed trichlorobenzoic and tetra chlorobenzoic acids (X33 EO and X42 EO), the sodium salts of mixed trichlorobenzoic and tetrachlorobenzoic acids (X33S and X42S), a-chloro-N, N diallylacetamide (CDAA), a-chloro-N, N-diethylacetamide (CDEA) and 2-chloroallyl diethyldithiocarbamate (CDEC).

L-841, L-842, HC-1281, and 2,4-D acid were applied as 75 percent wettable powders. The sodium salts HC-1281S, X33S and X42S were dissolved in the spray solution and the other materials were liquids. Weed counts were not taken but treatments were rated as excellent, good fair or poor insofar as weed control was concerned. Any injury resulting from treatment was noted. Data were taken at 54 of the 57 locations.

RESULTS AND DISCUSSION

At most locations exceedingly dry conditions with prolonged periods of high temperatures were encountered. Under such conditions PE and LV4 did not hold weeds as well as some of the less volatile materials. The results with each material will be discussed separately. Table 1 summarizes the results.

L841 was applied at 44 locations. It gave good weed control at 33 of these locations or in 75 percent of the cases. Rates varied from 1# to 3# per acre with the greatest number (28) of locations receiving 2# per acre. L841 was the most consistent weed control chemical used in the tests. It gave good weed control at a higher percentage of locations than did any other herbicide tested. Apparently, the activity is affected much less by hot, dry conditions or very heavy rainfall than is the activity of PE and LV4. In many cases where dry soil and high temperatures were found, LV4 gave very little weed control even when rains came to moisten the soil. In such cases L841 would give excellent control of early germinating weeds and still control weeds which germinated much later. In areas where ample moisture was available L841 gave equally good weed control. Rates of L841 used were slightly higher in most cases than rates of LV4 because earlier screening results had indicated that higher rates were necessary for equal weed control. This did not prove to be the case in this series of field tests and in cases where LV4 and L841 were used at equal rates L841 gave results as good or better than LV4.

Table 1. CHEMICALS USED, RATES APPLIED, NUMBER OF LOCATIONS AND RESULTS OF 1955 FIELD CORN TESTS

Chemical	Rate/A	Locations	Location gave good weed control
L841	1#	1	1
	1½#	4	3
	1 3/4#	1	1
	2#	28	22
	2½#	3	0
	3#	7	6
Total		44	33
L842	1#	1	1
	1½#	3	1
	1 3/4#	1	1
	2#	26	15
	2½#	3	0
	3#	7	6
Total		41	24
LV4	1#	13	8
	1½#	25	12
	2#	11	2
Total		49	22
PE	3#	2	1
	4½#	18	10
	6#	14	10
Total		34	21
HC1281	2/3#	1	0
	1#	3	1
	1½#	11	6
	2#	2	1
Total		17	8

Chemical	Rate/A	Locations	Locations gave good weed control
X33	2#	6	3
	2 1/8#	1	0
	2½#	1	0
	3#	7	2
	3½#	1	0
Total		16	5
X42	2#	7	2
	2 1/8#	1	1
	2½#	1	0
	3	9	2
Total		18	5
2,4-D acid	1#	1	1
	1½#	3	0
	2#	1	0
Total		5	1
LVPE	3#	1	1
	4#	1	1
		2	2
CDAA	4#	2	
CDEA	4#	2	
CDEC	4#	1	

In general L841 gave better control of broadleaved weeds such as mustard, ragweed, pigweed smartweed. In one case where bindweed was encountered 2# per acre of L841 applied before the corn emerged gave excellent control of this weed. In another instance velvet weed (Abutilon) was effectively controlled with L841 while LV4 gave little if any control. At several locations definite suppression of annual grasses was obtained with L841; this was not the case with LV4. At several locations L841 prevented very late germination of weeds such as ragweed, winter cress and lambsquarters in late August and early September.

There were several cases of injury from rates of L841 over 2# per acre. The corn outgrew this injury which was severe in only one case. At one location in New Jersey on early planted corn rather serious injury occurred. This injury was an extreme brittleness of the stalk at the crown which caused severe lodging following a moderate wind storm. This lodging was more serious in areas of the field which were not cultivated. Cultivation seemed to give more support to the stalks and helped prevent lodging. There was no obvious explanation for this serious injury and other corn sprayed with the same rate at the same stage of corn development under similar environmental conditions did not exhibit injury. It is possible that there was an error in the rate applied. There was also some indications that the rates of L841 in excess of 2# per acre might cause early stunting of corn.

L842 gave weed control approximating that of L841 but never quite as good. In cases of injury the injury from L842 was worse than that with L841. In general L842 does not seem to offer any particular advantage over L841 and corn is more sensitive to L842 than to L841. L842 was more consistent in weed control results than most other materials including LV4. L842 was applied at 41 locations and good weed control resulted at 24 or 58.5 percent of the locations.

LV4 gave good weed control at 22 out of 49 locations or 44.9 percent of the cases where it was used. The very hot, dry weather was responsible for most of the cases of failure. Rates used varied from 1# per acre to 2# per acre. The rate used was not an important factor in determining weed control results. When LV4 gave good results 1# per acre was just as satisfactory as 2# per acre. Weather conditions were much more of a determining factor than was rates. Some cases of 2,4-D injury were observed in the LV4 plots and this injury too was tied in more with environmental conditions than with rate applied. In general LV4 at rates up to 2# per acre did not control smartweed whereas some of the other materials did.

PE was applied at 34 locations at rates varying from 3# per acre to 6# per acre. Good weed control was obtained at 21 out of 34 locations or in 61.8 percent of the cases. PE gave variable results depending primarily upon environmental conditions. When it worked it was outstanding in weed control but as has been found many times by farmer users when conditions were unfavorable, practically no weed control could be

observed. PE was successful in areas of adequate rainfall but under hot dry conditions results were not satisfactory. PE at rates up to 6# per acre did not injure corn at any of the 34 locations where it was used.

HC-1281 was applied both as a 75 percent wettable acid and as the sodium salt. There was no apparent differences in the activity of these two forms when used at comparable rates. Rates used varied from 2/3# per acre to 2# per acre. HC1281 was applied at 18 locations and gave good weed control in 17 cases or 47 percent. It was interesting to note that this compound did not kill weeds in the early seedling stage. Formative effects could be observed in the early seedling stage but then seedlings would continue to grow until they were 4" to 6" in height before they would die. It is questionable whether farmers would wait for weed control in cases like this. Many farmers like to cultivate before weeds reach 2" in height. It would be difficult to convince them that weeds would only grow to 4" to 6" and then die. HC1281 had a very long residual activity and weeds germinating as much as 2 months after the treatments were applied showed symptoms of HC1281. In several instances this material was outstanding in the control of smartweed and milkweed. It was superior to any other material tested insofar as smartweed control was concerned. At several locations rates of HC1281 in excess of 1# per acre suppressed development of annual grasses and prevented them from becoming a problem. Injury was noted in several cases where rates in excess of 1# per acre were used. On the injured plants the uppermost leaves were rigid and failed to unroll. This material should prove valuable where 2,4-D resistant weeds such as smartweed are a problem.

X-33 and X-42 were applied as emulsions and as the water soluble sodium salts. These compounds were applied at rates of 2# per acre to 3½# per acre. X-33 gave good weed control in 8 out of 17 instances or 47 percent of the cases; X-42 gave successful weed control in 5 out of 16 instances or 31.2 percent. X-33 consistently gave better weed control than X-42 when compared on an equivalent basis. X-33 appeared to be 1/2 to 1/3 as effective on broadleaved weed species as HC1281. The emulsifiable forms X-33EO and X-42EO consistently gave better weed control results than the sodium salts X-33S and X-42S. Several cases of injury occurred when these compounds were used at rates over 2½# per acre. In one case X-33 showed marked control of crabgrass which germinated several months after the treatments were applied.

2,4-D acid gave good weed control at 1# per acre but was more injurious to corn than LV-4.

LVPE gave good weed control at the locations tested in comparison with PE. No noticeable differences could be noted between PE and LVPE insofar as weed control or length of residual activity was concerned.

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CDAA, CDEA, and CDEC gave little or no control of broadleaved species such as mustard, lambsquarters and ragweed but gave excellent control of annual grasses at 4# per acre with no injury to the corn. Of the three materials CDAA seemed to be the most effective.

No materials at the rates applied gave effective control of quackgrass or nutgrass.

Table 2 gives a summary of the numbers of locations and percent of locations showing good weed control for several of the chemicals used.

Table 2. NUMBER OF AND PERCENT OF LOCATIONS SHOWING GOOD WEED CONTROL FOLLOWING PRE-EMERGENCE APPLICATIONS OF SEVERAL CHEMICALS

Chemical	No. Locations Applied	Locations showing good weed control	
		Number	Percent
L841	44	33	75.0
L842	41	24	58.5
LV4	49	22	44.9
PE	21	34	61.8
HC1281	8	17	47.0
X33	5	16	31.2
X42	5	18	27.8

SUMMARY AND CONCLUSIONS

Field trials with several pre-emergence materials were applied at a total of 57 locations in New York, New Jersey and Pennsylvania to field corn. Treatments were made at varying rates per acre and at stages of corn development from planting to emergence.

2,4-D acetamide was the most satisfactory chemical used and gave the most consistent results. Heavy rainfall or hot-dry conditions did not noticeably decrease its effectiveness. It was the most effective material tested on bindweed. Serious injury occurred at one location.

2,4,5-T Acetamide did not show any particular advantage over 2,4-D Acetamide.

The butoxyethanol ester of 2,4-D performed satisfactorilyunless hot-dry environmental conditions were encountered and then weed control results were not satisfactory.

The amine dinitro Sinox PE gave good results when adequate soil moisture was available but fell down under hot-dry conditions. A low volatile form of this material did not give better weed control or longer residual activity than Sinox PE.

2,3,6 trichlorobenzoic acid gave good weed control although most broadleaved weeds reached 4" to 6" before being killed by this compound. The material exhibited a long residual activity. It was the most effective material tested on smartweed.

The mixed trichlorobenzoic and tetrachlorobenzoic acids did not give as good weed control as 2,3,6 trichlorobenzoic acid. In general 2,3,6 trichlorobenzoic acid was two to three times as effective as X33.

CDAA, CDEA and CDEC gave excellent control of annual grasses with no corn injury. CDAA appeared to give the best results. These compounds did not control broadleaved weeds.

Injury occurred with all chemicals except Sinox PE, CDAA, CDEA and CDEC.

No treatment effectively controlled quackgrass and nutgrass.

2,4-D acetamide proved superior to other materials testes in weed control and residual activity. If satisfactory methods can be found to apply this material as a wettable powder. it could replace the dinitros and the low volatile esters of 2,4-D as a pre-emergence herbicide.

The Effect of 2,4-D, MCP and MCP Butyric on the Yield of Spring Oats and on the Stands of Alfalfa and Birdsfoot Seeded Therein.

Marvin M. Schreiber*

INTRODUCTION

The use of chemicals for weed control in small grains is sometimes governed by the presence or absence of a legume seeding in the small grain. This is particularly true in the Northeast where the practice of making seedings in small grains is quite common. That legumes such as alfalfa and birdsfoot trefoil are most susceptible to 2,4-D and MCP has been well established. For these reasons the total acreage of small grains treated in the Northeast has been definitely limited.

For several years much attention has been devoted to this legume problem. Several new chemicals such as 4-chlorophenoxy acetic acid and 3,4-dichlorophenoxyacetic acid have been tried in the hopes of finding a material that would offer satisfactory weed control without injury to the seeded legumes or the small grains. The results with 4-chloro were not very encouraging both from the standpoint of grain injury and legume injury (1, 3, 5, 6). Results with 3,4-D were most encouraging but due to a lack of availability of the material further work on this herbicide ceased.

Quite recently a new group of herbicides has shown potentiality in weed control in seeded small grains: the butyric acid derivatives of 2,4-D and MCP (2, 7, 8). These reports from England appeared to show the specific physiological selectivity and certainly warranted further investigation.

This paper is the report of a study made with 2,4-D, MCP, and 2-methyl 4-chlorophenoxy butyric acid (hereinafter referred to as MCPB) on the injury and yield of oats and on the pure seedings of alfalfa in birdsfoot made in the oats. It was the original intention of the author to include 2,4-DB but due to a delay of shipment beyond the control of all concerned it was not included.

MATERIALS AND METHODS.

This experiment was started in the spring of 1955 employing a split block design with 6 replications with the two legumes, alfalfa and birdsfoot trefoil, as the whole block and the chemical treatments as the sub-blocks. The small grains, assuming no interaction of legumes with small grains, was equivalent to a randomized block with 12 replications. The data from the yield of oats was so analyzed.

Oats, variety Craig, were seeded April 13, 1955, at the Aurora Research Farm, Department of Agronomy, Cornell University. A grain drill was employed and the seeding was made at the rate of 2 bushels per acre using 300 pounds of 13-13-13 fertilizer. The field chosen had been in corn the previous year maintaining a rotation of corn, oats, and 2 or 3 years of hay. Ten pounds of wild mustard (Brassica Kaber) were immediately sowed on the plot area with a wheel barrow seeder. On April 20, 1955, Narragansett alfalfa at the rate of 12 pounds per acre and Viking birdsfoot trefoil at 6 pounds per acre were

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seeded using a Brillion seeder.

Treatments consisted of 2,4-D and MCP both at rates of 1/4, 3/8, and 1/2 pounds per acre and MCPB at 1/2, 1, and 1½ pounds per acre, all in 10 gallons of water. All formulations were amine salts. Applications were made using an Allis Chalmers, Model "G" tractor converted especially for plot spraying. Treatments were made on June 3, 1955, when the oats were 15 to 18 inches tall. This would normally be considered an excellent canopy with mustard ranging from 18 to 23 inches tall. Some pods had formed on the mustard plants at the time of spraying. A rather uniform stand of ragweed about 3 to 5 inches tall was present. The alfalfa was from 4 to 5 inches tall with 4 to 5 trifoliate leaves present, while the birdsfoot trefoil averaged 3 to 4 inches tall with 3 to 4 trifoliate leaves. The stage of growth for mustard control would be certainly considered late but this was unavoidable since the new experimental herbicide, MCPB was late in arriving.

Observations were made on the injury to oats and legumes as well as weed control during the growing season. Yields of oats were taken by direct combine of the plots after trimming with test weights following cleaning. Stand counts consisting of seven 1-foot quadrats per plot were made on the seeding following treatment to determine the stand of alfalfa and birdsfoot trefoil.

RESULTS AND DISCUSSIONS

Yield of Oats

Table 1 represents the yield of oats in bushels per acre following treatment with 2,4-D, MCP, and MCPB. Utilizing the Duncan test for significance, the treatments were found to be non-significant at 5 per cent level. That is, there was no difference between 2,4-D, MCP, or MCPB in the yield of oats at any concentration whether compared against a check or each other. The observations through the growing season showed no visible injury to the oats in the form of twisted stems, "onion leaf", or abnormal head development with 2,4-D, MCP, or MCPB. The data also showed no significant linear rate response from any of the materials, although 2,4-D values were somewhat higher than either MCP or MCPB. These differences, however, were not significant. Thus it would appear that the new material MCPB has no detrimental effect on oats and its over-all response is similar to that obtained with 2,4-D and MCP.

Weed Control

Although treatments were made late in relation to mustard control, satisfactory observations were made reference this weed. As stated earlier, most of the mustard plants had some pods formed prior to treatment. All concentrations of 2,4-D and MCP inhibited further pod formation being more pronounced as the concentration increased. With MCPB, only the two higher concentrations, 1 and 1½ pounds per acre, accomplished the same results on mustard. Judging from these results and results of the effect on stand count to be discussed later, it appears that the activity of MCPB may be less than that of MCP. This experiment, however, did not truly evaluate MCPB for the control of mustard since its application was late in the development of the mustard plant.

Table 1. Yield of Oats, Bushels per Acre, 1955, Seeded Oat Trial.

Treatment	Replications 1 I A	2 I B	3 II A	4 II B	5 III A	6 III B	7 IV A	8 IV B	9 V A	10 V B	11 VI A	12 VI B	Treatment Mean	Chemical means
a. 2,4-D, 1/4#/A.	80.1	91.7	77.6	85.2	84.1	76.0	93.1	80.3	69.8	76.8	75.5	79.7	80.8	
b. 2,4-D, 3/8#/A.	88.4	87.4	74.4	89.1	79.0	84.3	95.1	78.5	67.5	73.8	77.6	68.4	80.3	241.8
c. 2,4-D, 1/2#/A.	87.2	78.3	78.5	84.5	86.6	93.6	92.1	80.6	65.9	75.7	80.5	64.9	80.7	
d. MCP, 1/4#/A.	77.7	78.2	70.2	83.2	80.3	85.8	91.4	82.9	63.6	74.1	78.2	72.1	78.1	
e. MCP, 3/8#/A.	78.4	89.7	73.5	80.1	78.2	91.1	76.3	86.8	66.5	76.8	76.2	63.0	78.0	235.7
f. MCP, 1/2#/A.	79.1	89.5	87.0	90.7	83.9	76.7	88.9	85.2	65.7	72.1	72.5	64.3	79.6	
g. MCPB, 1/2#/A.	78.4	80.3	79.7	89.5	79.3	68.8	94.2	78.1	74.1	76.8	80.1	71.5	79.2	
h. MCPB, 1#/A.	71.8	74.0	68.2	89.9	73.6	79.3	79.9	82.7	61.1	74.5	78.4	74.4	75.6	233.3
i. MCPB, 1½#/A.	85.0	83.9	70.1	86.2	81.0	74.1	90.3	71.0	67.7	75.9	77.7	79.1	78.5	
j. Check	73.1	72.1	69.4	78.5	73.4	80.6	83.2	78.2	65.7	69.6	80.2	69.6	74.5	

Analysis of Variance

Source	ss	df	ms
Total	7037.43	119	
Reps	1501.12	11	
Treatments	476.74	9	52.97
Reps. x treat.	5059.57	99	51.11

A truer picture of weed control was obtained by visual estimate on ragweed control after harvest of the oats. Two independent estimates were made by two individuals without knowledge of the specific treatments in the plots. Table 2 represents the data from these estimates. The values listed are the square root of a total of the two weed estimates. These data were analyzed by the Analysis of Variance method.

The analysis showed a marked significant difference between weed control obtained with chemicals and the legume species. 2,4-D and MCPB gave effective control in the alfalfa seeded plots, while only 2,4-D was effective in birdsfoot trefoil. Weed control with MCP was significantly less in both legumes. Why the MCPB was so different in weed control within legumes is difficult to explain. A possible explanation may be the MCPB may have been effective for ragweed control early in the development, but due to lack of competition since the stand of birdsfoot trefoil was greatly reduced may have allowed more ragweed to come in and hence obtain a high figure on estimate of ragweed in those particular treatments. It is not due to the difference in weed stand of birdsfoot trefoil and alfalfa plots since the checks for both legumes were quite similar, thus removing any explanation based on differences of weed stands within the legumes. However, since ragweed is a late germinating weed, these results cannot be assumed to be a good picture of weed control from that standpoint. These results would seem to indicate, however, that ragweed is somewhat susceptible to MCPB.

Effect on Seeded Legumes

The most important phase of this study was to determine the effect of herbicidal treatment on the initial stands and subsequent yields of the seeded legumes. Table 3 represents the crop stand counts of alfalfa and birdsfoot trefoil made after the oats were removed for grain. The numbers represent the total of seven 1-foot quadrat counts made in each plot. The effects on yield will be determined for the next two hay years.

A significant difference in stand due to legumes was obtained primarily due to the marked differences in seeding rates used -- the alfalfa having been seeded at twice the rate of birdsfoot trefoil. It is interesting to note that the stand count values for alfalfa are actually about twice that of the birdsfoot trefoil.

The first important significant difference obtained was in treatment. By breaking down the treatment source it was found that the significant treatment differences were due to chemicals and specifically the linear rate of chemicals. The combined stand count from 2,4-D treated plots over all rates and for both legumes were significantly higher than MCP or MCPB, with MCP being the lowest. Taking the linear rate of chemicals over both crops led to a significant reduction in stand count as the concentration increased. This is usually the case.

The most notable significance obtained was in the interaction of legume to chemical. Figure 1 is graphical representation of this interaction. It can be readily seen that with alfalfa there was no difference between 2,4-D and MCP, but that MCPB was significantly different from 2,4-D and MCP. MCPB caused no reduction of stand at any of the concentrations used. Responses to 2,4-D and MCP on alfalfa were quite consistent with the results obtained in past years (7, 8). MCP was equally as injurious on alfalfa as 2,4-D.

Table 2. Estimates of Ragweed Stand (Sq. Root of 2 independent weed counts)

Treatments #/A.	Alfalfa 1	2	3	4	5	6	Total
2,4-D, 1/4#	1.73	2.00	2.00	2.34	2.00	2.00	12.07
2,4-D, 3/8#	2.34	1.41	1.41	1.41	1.41	1.41	9.39
2,4-D, 1/2#	2.34	1.41	1.41	2.00	1.41	1.41	9.98
MCP, 1/4#	2.65	2.83	3.16	1.73	2.00	2.45	14.82
MCP, 3/8#	2.34	2.45	2.83	2.65	2.65	2.45	15.37
MCP, 1/2#	2.83	2.83	2.83	2.65	2.24	2.00	15.38
MCPB, 1/2#	1.41	2.34	3.16	2.45	2.45	2.00	13.81
MCPB, 1#	1.73	1.41	2.00	2.00	1.73	2.00	10.87
MCPB, 1½#	1.41	1.41	2.34	2.34	1.73	2.00	11.23
Check	3.16	3.16	2.45	3.00	3.00	2.83	17.60

	Birdsfoot Trefoil 1	2	3	4	5	6	Total
2,4-D, 1/4#	2.00	1.73	2.24	2.83	1.41	2.45	12.66
2,4-D, 3/8#	1.41	1.73	2.00	2.00	1.41	2.65	11.20
2,4-D, 1/2#	2.24	1.41	1.73	1.73	1.41	1.41	9.93
MCP, 1/4#	3.16	3.16	3.16	3.16	2.65	2.83	18.12
MCP, 3/8#	2.45	2.83	2.65	2.45	2.65	2.24	15.27
MCP, 1/2#	2.45	2.45	2.65	2.24	2.00	2.24	14.03
MCPB, 1/2#	3.16	3.16	3.00	2.83	2.83	2.00	16.98
MCPB, 1#	2.65	2.83	3.00	3.00	2.45	2.83	16.76
MCPB, 1½#	2.83	3.16	3.00	2.24	2.24	2.83	16.30
Check	3.16	3.16	3.00	3.16	3.16	3.16	18.80

Analysis of Variance

Source	df	ss	ms
Legumes	1	3.1785	3.1785**
Error (a)	5	.2510	.0502
Treatment	9	20.2567	2.1395**
Chemical	2	11.5694	5.7847**
Rate	2	2.1388	1.0694**
Linear	1	1.8721	1.8721**
Legume x treatment	9	4.1744	.4638**
Legume x chemical	2	2.6835	1.3417**
Error (b)	90	10.9251	.1214

** Highly significant

Table 3. Crop Stand Counts (Nos. are totals of 7 one-foot quadrat counts per plot).

Treatments	#/A.	Replicates 1	2	3	4	5	6	Total	Mean	
2,4-D, 1/4#		49	67	88	142	149	82	577	96.2	Birdsfoot trefoil
2,4-D, 3/8#		56	57	74	80	115	60	442	73.7	
2,4-D, 1/2#		42	64	55	88	135	46	430	71.7	
MCP, 1/4#		42	65	38	58	49	92	344	57.3	
MCP, 3/8#		46	33	21	51	47	38	236	39.3	
MCP, 1/2#		43	40	18	32	14	17	164	27.3	
MCPB, 1/2#		42	76	17	59	79	39	312	52.0	
MCPB, 1#		41	42	20	32	39	30	204	34.0	
MCPB, 1½#		27	40	29	18	31	29	174	29.0	
Check		39	69	42	63	51	71	335	55.8	
Total		427	553	402	623	709	504	3218		

Treatments	#/A.	Replicates 1	2	3	4	5	6	Total	Mean	
2,4-D, 1/4#		112	86	70	143	132	130	673	112.2	Alfalfa
2,4-D, 3/8#		103	82	90	114	111	114	614	102.3	
2,4-D, 1/2#		93	50	100	109	88	77	517	86.2	
MCP, 1/4#		116	88	114	127	124	110	679	113.2	
MCP, 3/8#		90	71	67	136	130	122	616	102.7	
MCP, 1/2#		69	75	70	135	88	86	523	87.2	
MCPB, 1/2#		118	88	89	150	148	107	700	116.7	
MCPB, 1#		115	101	105	164	119	159	763	127.2	
MCPB, 1½#		101	83	80	149	128	152	693	115.5	
Check		99	87	112	157	107	126	688	114.7	
Total		1016	811	897	1384	1175	1183	6466		

Analysis of Variance

Source	df	ss	ms
Total	119	180,161	
Reps.	5	23,194	
Legumes	1	87,912	87,912**
Error (a)	5	5,867	1,173
Treatment	9	16,526	1,836**
Chemical	2	6,702	3,351**
Rates	2	8,543	4,271**
Linear	1	8,537	8,537**
Legumes x treatment	9	19,494	2,166**
Legumes x chemicals	2	17,638	8,819**
Error (b)	90	27,168	302

** Highly significant

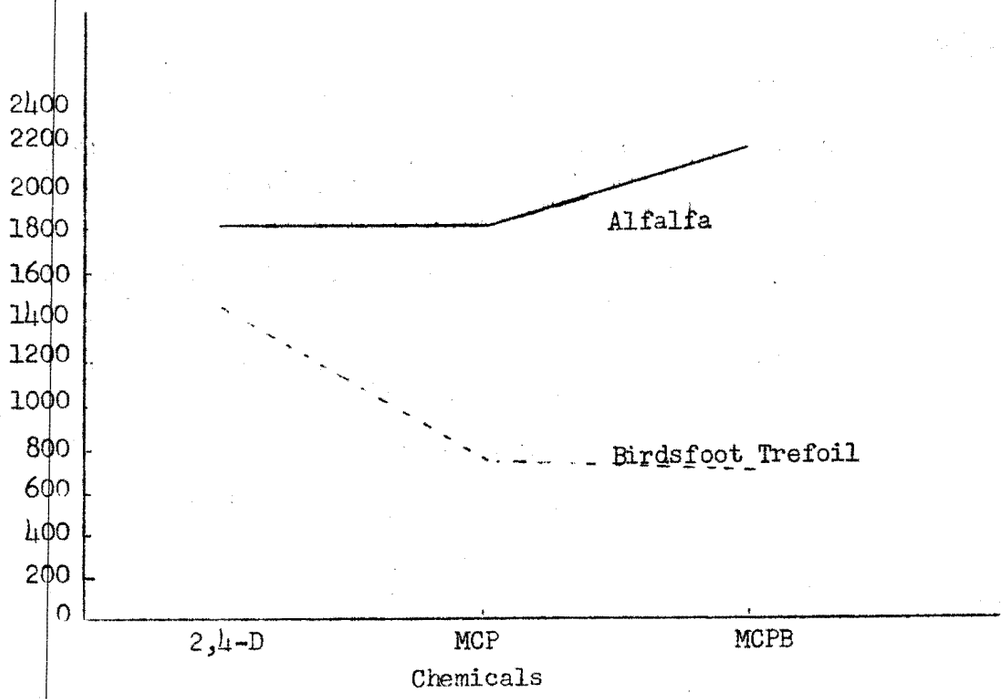

Figure 1. The interaction of legumes, alfalfa, and birdsfoot trefoil with chemicals.

The response of birdsfoot trefoil was significantly different from alfalfa with the materials tested. 2,4-D was significantly different in response when compared to MCP or MCPB. In fact, the stand count with MCP and MCPB were almost identical from the lowest concentration to the highest. This data would appear to show (Table 3) that the low concentration of MCPB ($\frac{1}{2}$ pound per acre) is about one-half the activity of MCP (1/4 pound per acre), but as the concentration of MCPB is increased (to $1\frac{1}{2}$ pounds per acre) the activity decreases. (MCPB is about one-third the activity of MCP at $\frac{1}{2}$ pound per acre).

If Wain's (8) original theory of selectivity of butyric acid by beta-oxidation is right, it would appear that birdsfoot trefoil is susceptible to MCP because of its breakdown to the MCP which in this experiment caused equal injury. The reverse situation is present in the case of alfalfa. From the data of this experiment, MCPB does not have any effect on alfalfa. It would thus appear that MCPB cannot be broken down to MCP in alfalfa.

It is interesting to project what the results would be on these two forage legumes with 2,4-D butyric (2,4-DB). Again, if the theory is correct, the 2,4-DB would possibly offer the same results obtained on alfalfa with MCPB, with the assumption, of course, that the beta-oxidizing enzymes are not present in alfalfa. However, in the case of birdsfoot trefoil with indications from the data from this experiment, the 2,4-DB would be broken down. To what extent, it is hard to estimate since the 2,4-D has been shown to be less injurious on

birdsfoot trefoil than MCP. Both of these materials are now being tested on pure seedings applied directly to alfalfa and birdsfoot trefoil.

CONCLUSIONS

The data from this experiment appear to show that:

1) MCPB was not injurious to oats and that there was no significant difference between 2,4-D and MCP in oat response.

2) MCPB was less active than either 2,4-D or MCP ranging from ½ to 1/3 the activity as the concentration increased.

3) MCPB at 1 pound or more per acre was effective for the control of mustard and ragweed.

4) MCPB was equally injurious to birdsfoot trefoil as MCP.

5) MCPB appears to be non-injurious to alfalfa.

Acknowledgment is made to the American Chemical Paint Company and the Dow Chemical Company for supplying the materials used in this experiment.

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A Comparison of Salts of MCP and 2,4-D Butyric and Acetic Acids on Mustard Control and Legume Injury in Seeded Oats.

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INTRODUCTION

Chemical weed control in oats under-sown with legumes often brings real returns to northeastern farmers by increasing the survival of legume seedlings. Heavy growth of weeds, such as mustard and ragweed, may seriously reduce seedling survival. In addition weeds interferewith the grain harvest and decrease the value of the harvested grain.

Water soluble dinitros, 2,4-D and MCP have been used successfully to eradicate mustard and other weeds from seeded oats. Under some conditions injury may occur from any of these materials. The dinitros often burn the oat nurse crop and farmers are reluctant to use dinitros for this reason. 2,4-D can be used successfully, and is used by some custom operators very successfully. However, if oats or weeds do not offer a good canopy serious reduction may occur in legume seedling survival. MCP is safer to use on clovers than 2,4-D but if alfalfa or birdsfoot trefoil are in the seeding MCP should be used cautiously and may give injury to the seedlings.

For several years new materials which might show more legume selectivity have been screened against alfalfa and other legumes without too much success. However, in 1954 Shaw at Beltsville found that certain phenoxy-butyric acid derivations showed greater selectivity on alfalfa than their phenoxy-acetic acid counterparts. In order to further test these differences the following field experiment was conducted.

MATERIALS AND METHODS

In order to compare the 2,4-D and MCP phenoxy-acetic and phenoxy-butyric compounds as weed control chemicals in oats underseeded with Narragansett alfalfa and medium red clover the following materials were used. Dimethylamine, salt of MCP (MCP), triethanolamine salt of 2,4-D (2,4-D), sodium salt of MCP butyric acid (MCPB), and sodium salt of 2,4-D butyric acid (2,4-DB). 1/4# and 1/2# rates of each chemical were applied and in addition a 1# rate of 2,4-D butyric and 1# and 2# rates of MCP butyric were applied. All treatments were applied with a jeep sprayer using 40 psi pressure and 5 gallons of water per acre. The plots were 50 feet wide and 100 feet in length, there were 4 replicates. Eight one square foot plots were marked out in each plot the day after spraying and a standing count of mustard, alfalfa and clover was taken. These same areas were recounted one month later and the per cent change was calculated using these two sets of data. We were interested in finding the effect of the various chemicals on the seedlings when they were used as a farmer would use the materials. It was felt

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that this would give a good indication of the survival of legumes after treatment. These sprayed areas were permanently marked so that yield data could be taken the following cutting year if desired.

At the time of spraying, the oats were 12" to 14" in height, alfalfa was 2" to 6" and clover was 2" to 5" high. Mustard was the principal weed. It was 12" to 14" high and in full bloom although no seed pods had set. When data were taken one month after spraying mustard stand was determined by counting those plants which had formed seed pods.

RESULTS AND DISCUSSIONS

Two days after applications were made, severe epinasty could be seen on mustard, clover and alfalfa in certain plots. Ratings were made of these injury symptoms and a summary of this data is shown in Table 1.

These data show that both MCP and 2,4-D had rapid action on mustard and 1/4# of either was better than 1# to 2# of either 2,4-DB or MCPB. No material seriously affected clover but 1/2# 2,4-D gave the most epinasty. Alfalfa was less sensitive to phenoxy-butyrics than to MCP or 2,4-D and 2# of MCPB did not produce as much injury on alfalfa as 1/4# MCP or 2,4-D.

Table 1. INJURY RATINGS ON MUSTARD, CLOVER AND ALFALFA TWO DAYS AFTER HERBICIDAL APPLICATION

Treatment	Injury Ratings*		
	Mustard	Clover	Alfalfa
MCP 1/4# /A	3.0	.2	1.5
MCP 1/2# /A	3.0	.8	2.5
2,4-D 1/4# /A	3.0	.2	1.5
2,4-D 1/2# /A	3.0	1.5	2.2
2,4-DB 1/2# /A	2.0	.2	.5
2,4-DB 1# /A	1.8	0	.2
MCPB 1/4# /A	1.5	0	.5
MCPB 1/2# /A	1.5	0	.2
MCPB 1# /A	2.8	0	1.2
MCPB 2#/A	2.8	0	.8
No treatment	0	0	0

* 0 = no epinasty or injury 3 = severe injury

Percent change in stand of mustard, clover and alfalfa from spraying to one month following treatment are shown in Table 2.

Table 2. PERCENT CHANGE IN STAND OF MUSTARD, CLOVER AND ALFALFA FOLLOWING HERBICIDE APPLICATIONS ON UNDERSEEDED OATS

Treatment		% Control of Mustard	% Change in Clover	% Change in Alfalfa
MCP 1/4# /A		90.6	+34.6	-70.4
MCP 1/2# /A		89.4	+26.8	-79.0
2,4-D 1/4#/A		73.1	-20.4	-69.6
2,4-D 1/2# /A		85.6	-51.1	-81.9
2,4-DB 1/4# /A		43.7	+10.6	-43.0
2,4-DB 1/2# /A		33.2	-23.6	-40.3
MCPB 1/4# /A		19.0	-10.4	-45.1
MCPB 1/2# /A		45.0	- 7.2	-49.2
MCPB 1# /A		52.8	- 0.3	-50.7
MCPB 2# /A		65.9	-36.8	-61.0
No Treatment		2.5	-40.0	-53.1
	.05	21.6	42.2	16.3
L.S.D.	.01	28.9	56.3	21.8

These data show that 2,4-D and MCP give better control of mustard at 1/4# per acre than 2,4-DB and MCPB at 1# to 2# per acre. Red clover stand increased over check in all plots except 2,4-D at 1/2# per acre. The greatest increase being in the MCP plots. Alfalfa stand decreased over check in the MCP and 2,4-D plots but was not affected or may have increased somewhat in the 2,4-DB and MCPB plots up to 1# per acre rate. These data are presented graphically in Figures 1,2 and 3.

Figure 1. EFFECT OF PHENOXY-ACETIC AND PHENOXY-BUTYRIC COMPOUNDS ON MUSTARD CONTROL WHEN TREATED DURING FULL BLOOM

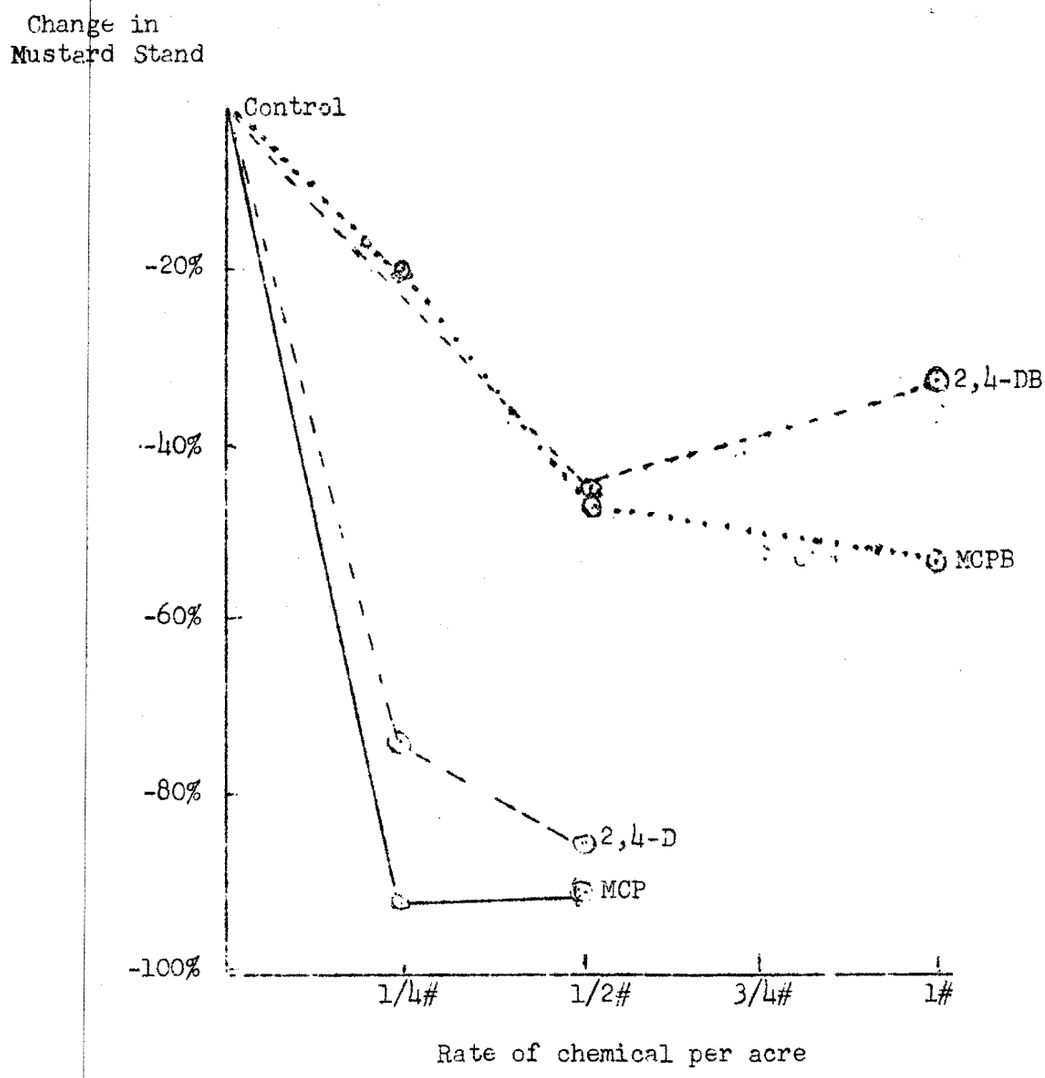
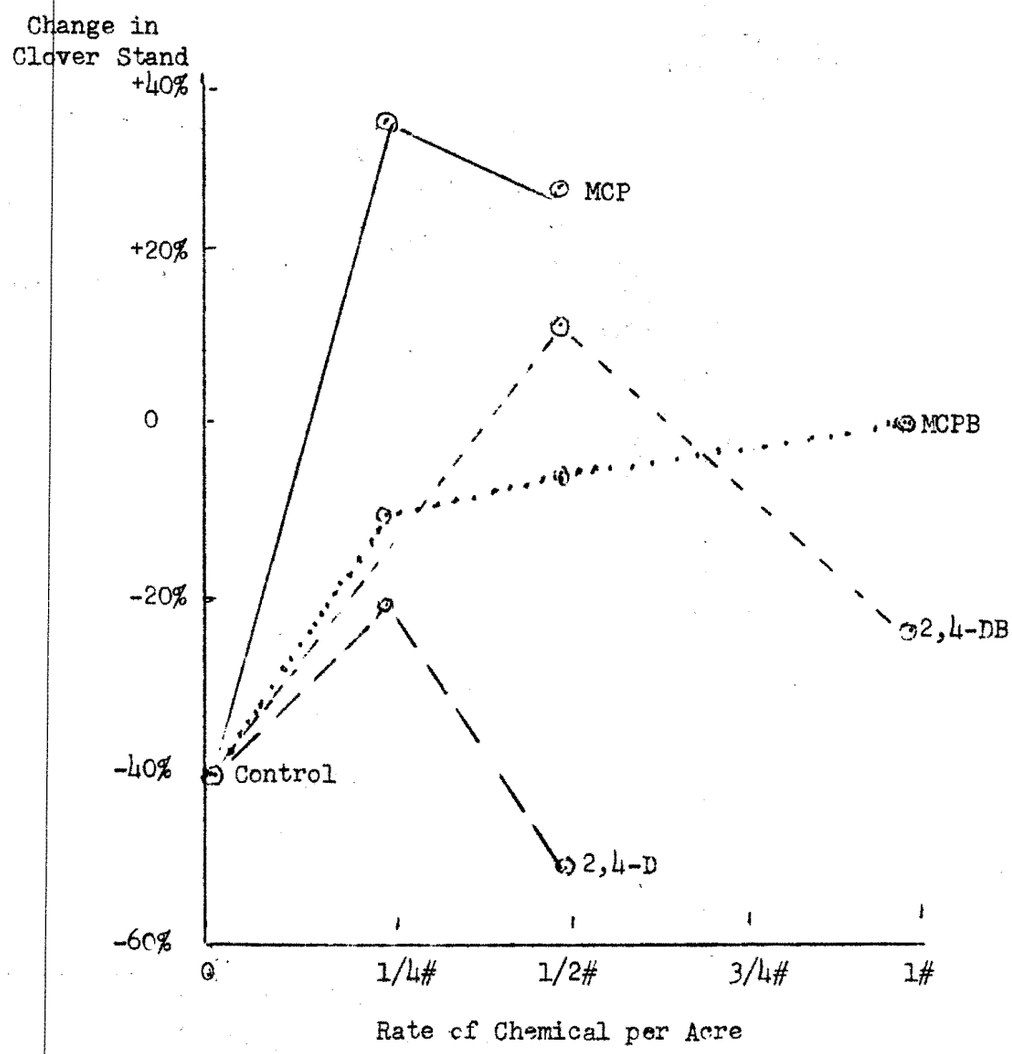


Figure 1 graphically presents the effect of the four materials on mustard. It shows that the phenoxy-butyrics are not more than 1/2 as effective as are the phenoxy-acetics. This data is in agreement with the results in England where mustard in the seedling stage was treated. The phenoxy-butyric compounds were only about one-half as effective as the phenoxy-acetic compounds. Mustard was in full bloom when these tests described here were applied. It is possible that if the applications were made at an earlier stage of mustard development more satisfactory control of mustard might be obtained.

Figure 2. EFFECT OF PHENOXY-ACETIC AND PHENOXY-BUTYRIC COMPOUNDS ON CLOVER STAND IN OATS WHEN TREATED AT 4"-5" HEIGHT



The data given in Figure 2 indicates that the phenoxy-butyric compounds are less injurious to clover than 2,4-D but more injurious than MCP. Indications are that 2,4-DB may be more injurious than MCPB.

Figure 3. EFFECT OF PHENOXY-BUTYRIC AND PHENOXY-ACETIC COMPOUNDS ON ALFALFA WHEN TREATED AT 4" to 6" HEIGHT

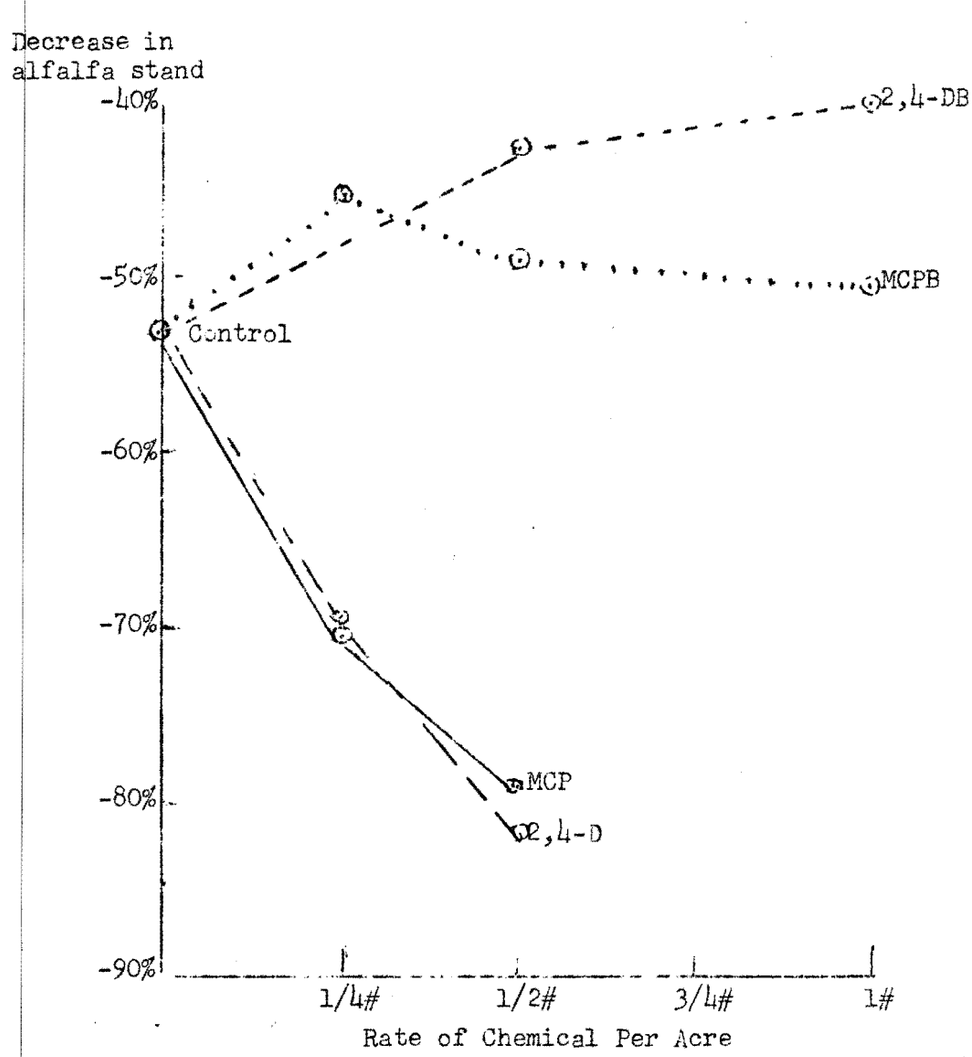


Figure 3 presents graphically the effect of the phenoxy-acetic and phenoxy-butyric compounds on alfalfa. This data show the marked difference in sensitivity of alfalfa to the two groups. Indications are that 2,4-DB may be less injurious to alfalfa than MCPB. There is no difference between 2,4-D and MCP insofar as alfalfa injury is concerned.

SUMMARY AND CONCLUSIONS

A field trial of 2,4-D and MCP phenoxy-acetic and phenoxy-butyric acid derivities was applied to a field of oats heavily infested with mustard in full bloom and undersown with medium red clover and Naragansett alfalfa.

The compounds were applied in 5 gallons of water per acre. Oats were 12" to 14" in height, alfalfa was 4" to 6" in height and clover was 4" to 5" in height.

Data taken one month later indicated that the phenoxy-butyric compounds were not as effective in killing mustard as were the phenoxy-acetic compounds. MCP-butyric was somewhat more effective on mustard than 2,4-D butyric.

The safest material to use on clover was MCP with the phenoxy-butyrics being intermediate between MCP and 2,4-D. 2,4-D was much more toxic to clover than MCP.

There was a marked difference between the phenoxy-acetics and the phenoxy-butyrics insofar as injury to alfalfa was concerned the phenoxy-butyric compounds producing approximately 1/2 the decrease in alfalfa stand as the phenoxy-acetics.

There was an indication that 2,4-DB may be safer to use on alfalfa than MCPB.

Mustard is the weed most prevalent in oat fields. A material will not find a great deal of usage on seeded oats unless it effectively controls mustard without seriously damaging the legume seeding. The phenoxy-butyric compounds did not do this at rates up to 2# per acre when mustard was in full bloom. Further testing will be necessary to determine whether or not treatment at an earlier stage of mustard development will produce satisfactory results.

HERBICIDES IN THE RENOVATION OF GRASSLANDS[1]

[2] Jonas Vengris

When renovating depleted grasslands, the first important operation is to eliminate weeds and native grasses, such as Kentucky bluegrass, bentgrass, and rough stalk meadow grass. These native species can be successfully eliminated by growing cultivated crops such as corn, a summer forage crop such as Sudan grass, or a winter cereal such as wheat or rye. Recently herbicides have been suggested in New Jersey and elsewhere as a means of destroying native vegetation prior to preparing the seedbed for a new seeding. Trials with herbicides were conducted in Massachusetts beginning in 1952 and have continued to the present.

1952 Trials. Experiments were conducted on a deteriorated pasture. Vegetation consisted of bentgrass, sweet Vernal, sheep sorrel, cinquefoil (*Potentilla canadensis*), and hair cap moss (*Polytrichum commune*). The soil was a Merrimac fine sandy loam. A split-plot randomized block design was used with two replicates. The plots were treated on September 6, 1952, and the following observations were made on October 5:

1. TCA at 20-, 40-, and 60-pound-per-acre rates. Some bentgrass, Kentucky bluegrass, and cinquefoil were still alive. Only a few live plants were left where the 60-pound rate was used.

2. Karmex W at 5-, 10-, and 15-pound-per-acre rates. All vegetation was killed.

3. Atlacide at 200-, 400-, and 600-pound-per-acre rates. Kill was complete at the 600-pound rate, but some grass was living at both lower rates.

4. Chlorax at 400-, 800-, and 1200-pound-per-acre rates. Kill was rather complete on all plots except where the 400-pound rate was applied. Some Kentucky bluegrass persisted here.

On October 6, 1952, all plots were top-dressed with lime and complete fertilizer. Each plot was then split: one half was disked and seeded to rye on October 16; the other half was left uncultivated. The rain that accumulated between the time the soil was treated with herbicides and seeded with rye amounted to 3.67 inches.

On April 10, 1953, vegetative growth was estimated on each plot. The results are listed in Table I. Treated plots were rated in terms of the check plots, which were given a rating of 100.

1) Contribution No. 1024 of the University of Massachusetts, College of Agriculture, Experiment Station, Amherst, Mass.

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The author wishes to express his appreciation to Professor William G. Colby, Head, Agronomy Department, for his interest and help in preparing the manuscript.

TABLE I. Stands of Winter Rye and Old Sod after Various Herbicide Treatments.

No.	Treatments	Stand Winter Rye	4/10/53 Old Sod
1	Check	100	100
2	TCA 20 lb./A acid eq.	56	35
3	TCA 40 lb./A acid eq.	32	30
4	TCA 60 lb./A acid eq.	12	20
5	Karmex W 5 lb./A	44	10
6	Karmex W 10 lb./A	25	2
7	Karmex W 15 lb./A	12	0
8	Atlacide 200 lb./A	75	25
9	Atlacide 400 lb./A	44	10
10	Atlacide 600 lb./A	18	0
11	Chlorax 400 lb./A	68	30
12	Chlorax 800 lb./A	50	15
13	Chlorax 1200 lb./A	37	15

Rye growth was normal on all plots except on the Karmex W plots which which were also the only plots that did not have some recovery growths of perennial grasses.

On April 10 all plots were disked, fertilized, and seeded with Ladino clover. At this time, accumulated rainfall from the time of treatment was 27.7 inches. Ladino stands on June 16 showed no injury on the TCA or Atlacide plots. On the Karmex W plots at 5 pounds per acre about 80 percent of the ground was bare. At higher applications of Karmex W, no clover growth was present. Later in the season the Karmex W plots were invaded by a vigorous growth of volunteer crabgrass.

Injury was also evident on the 1200-pound rate of Chlorax. About 40 percent of the ground was bare on June 16, but later in the season Ladino clover growth spread over the whole area.

In the Summer of 1953, plant samples were taken from each treatment. A botanical analysis was made for each sample, and each fraction dried and weighed. Results are given in Table II.

It is interesting to note that even comparatively high TCA rates did not eliminate perennial weed grasses under the conditions of the experiments. The data also indicate the importance of disking or cultivating the soil after chemical treatment.

TABLE II. Botanical Composition of Plant Samples Taken from Herbicide Treated Plots.

		Fall Disked, Seeded to Rye, Spring Disked			Spring Disked Only			
No.	Treatments	Ladino %	Grasses %	Weeds %	Ladino %	Grasses %	Weeds %	Remarks
1	Check	62	37	1	40	57	3	Grasses
2	TCA 20	72	25	3	46	54	-	were
3	TCA 40	72	24	4	69	31	-	Kentucky
4	TCA 60	93	7	-	63	25	12	bluegrass
5	Atlacide 200	99	1	-	60	33	7	and
6	Atlacide 400	96	4	-	63	37	-	bentgrass.
7	Atlacide 600	92	5	3	78	18	4	Weeds were
8	Atlacide 400	85	2	13	67	33	-	predomi-
9	Chlorax 800	98	-	2	87	9	4	nately
10	Chlorax 1200	95	-	5	87	8	5	sheep sorrel.

1953 Trials. Procedures followed in 1953 were similar to those for 1952 except that some different materials were used. The area chosen was higher in natural fertility and had a denser stand of hay and pasture grasses. Included were quackgrass, Kentucky bluegrass, bentgrass, sweet Vernal, timothy, and some orchard grass. The area was mowed, and chemicals applied July 25. Results of observations on August 26 are summarized in Table III.

TABLE III. Effect of Chemical Herbicides on Old Sod (Values are relative with checks equal to 100)

No.	Treatments	Stand of Sod Grasses	Remarks
1.	Check	100	
2	TCA 20 lb./A acid eq.	55	Orchard grass, timothy, sweet Vernal, and some quackgrass not killed. Injury proportional to rate applied.
3	TCA 40 lb./A acid eq.	30	
4	TCA 60 lb./A acid eq.	26	
5	Dalapon 20 lb./A acid eq.	9	Orchard grass and timothy not totally eliminated.
6	Dalapon 60 lb./A acid eq.	0	
7.	Karmex W 2 lb./A a. ingred.	80	Orchard grass, timothy, quackgrass and some bentgrass not killed.
8	Karmex W 4 lb./A a. ingred.	43	Bentgrass killed. Orchard grass alive.
9	Karmex W 6 lb./A a. ingred.	25	Orchard and timothy alive.
10	MH 5 lb./A acid eq.	70	Grass growth suppressed but not killed. Extent of suppression proportional to rate applied.
11	MH 10 lb./A acid eq.	55	
12	MH 20 lb./A acid eq.	40	

It is evident that timothy, orchard grass, sweet Vernal, and quackgrass are more resistant to the effects of the chemicals applied than Kentucky bluegrass and bentgrass. Of the several materials applied, Dalapon gave the most promising results.

On August 28, all plots were limed, fertilized, disked, and seeded with Ladino clover. The Summer of 1953 was dry, with an accumulated rainfall of only 1.89 inches from the time chemicals were applied on July 25 until Ladino seedlings were made August 28. Because of the dry weather that followed seeding, all plots were irrigated with 1.5 inches of water on September 3 and 4.

On October 14 a count of Ladino clover seedlings was made on all plots using one-square-foot areas selected at random. The next Spring, on June 21, the botanical composition of each plot was estimated. Results are summarized in Table IV.

TABLE IV. Ladino Seedling Counts and Botanical Composition of Plots treated with Herbicides.

No.	Treatments	Number of Seedlings per sq.ft. 10/14/53	Botanical Composition 6/21/54 Ladino %	Botanical Composition 6/21/54 Grasses %
1	Check	16	70	30
2	TCA 20	18	75	25
3	TCA 40	19	80	20
4	TCA 60	16	90	10
5	Dalapon 20	18	93	7
6	Dalapon 60	17	97	3
7	Karmex W 2	2	55	45
8	Karmex W 4	0	80	20
9	Karmex W 6	0	85	15
10	MH 5	18	60	40
11	MH 10	19	70	30
12	MH 20	19	80	20

The Karmex W plots were the only plots with injury in the Fall of 1953. By the Spring of 1954 the germination of dormant seeds and the spreading of Ladino clover from adjoining plots resulted in a good stand of clover. All plots were comparatively free of weeds; however, varying amounts of timothy, orchard grass, quackgrass, sweet Vernal, Kentucky bluegrass, and bentgrass were present. All Karmex W plots showed definite injury to clover, even though a good stand was obtained.

Summary of 1953 Trials

1. Dalapon gave the most promising results as a herbicide on old sods.

2. Maleic Hydrazide effectively suppressed growth and even killed perennial grasses; however, prolonged periods of warm dry weather may have contributed to the effectiveness of this material.

3. Karmex W at the rates applied produced prolonged residual effects that seriously injured grass and legume seedlings.

4. Adequate rainfall between the time of applying the chemicals and seeding time is essential not only to facilitate the breakdown of toxic materials but to leach them from the soil. If rainfall is seriously deficient, irrigation practices may be necessary.

1954 Trials.

A. University Farm. An experiment was laid out on a permanent pasture in a randomized block design with four replicates. The soil was rather heavy with only fair drainage and medium fertility. The vegetation consisted of Kentucky bluegrass, some bentgrass and rough stalk meadow grass, white clover, Ladino clover, dandelions, and a few sedges.

The area was mowed, and treatments applied on July 23. The materials and their rates of application are listed in Table V, which also summarizes the results of observations made one month after treatment.

TABLE V. Effect of Chemical Herbicides on an Old Sod
(Checks Equal 100 - Other Values Relative)

No.	Treatments	Blue-grass	Bent-grass	Other Grasses	Stand Height
1	Check	100	100	100	100
2	TCA 20 lb./A a.eq.	30	11	52	57
3	TCA 40 lb./A a.eq.	22	5	16	38
4	Dalapon 10 lb./A a.eq.	14	8	13	38
5	Dalapon 20 lb./A a.eq.	6	0	5	28
6	Dalapon 40 lb./A a.eq.	0	0	0	19
7	Atlacide 200 lb./A material	82	80	85	67
8	Atlacide 400 lb./A material	56	41	62	43
9	DB*)-Powder 100 lb./A material	94	89	95	76
10	DB*)-Powder 200 lb./A material	69	60	74	67
11	Atlas "A"+) 2 gal./A material	96	94	100	86
12	Atlas "A"+) 4 gal./A material	86	87	70	57
	L.S.D. at 5% level	9	14	22	19
	L.S.D. at 1% level	12	18	29	23

*) DB-Powder from Pacific Coast Co. Active ingredient is boron trioxide plus 2,4-D.
+) From Chipman Co. One gallon contains 4 pounds of arsenic trioxide.

Dalapon was one of the most effective materials, followed closely by TCA. Dalapon at 10 pounds per acre and TCA at 20 to 30 pounds per acre were apparently satisfactory rates of application. Atlacide was not so effective in these trials as it was in the 1952 trials. In general, bentgrass, possibly because of its shallower root system, is more susceptible to chemical injury than Kentucky bluegrass.

One month after treatment, all plots were divided into three subplots. One subplot was plowed and disked, the second disked only, and the third surface-scratched with a spring tooth harrow. All plots were uniformly limed, fertilized, and seeded to a Ladino clover-alfalfa seeding mixture on August 27. Accumulated rainfall from the time of treatment to seeding was 3.42 inches. Two days after seeding, however, hurricane Carol struck, bringing almost two more inches of rainfall. As a result of very favorable moisture conditions, seedling development was excellent on all plots, even on those that were only scratched on the surface. No seedling injury was observed.

In addition to the Ladino-alfalfa seedlings, a dense volunteer stand of rough stalk meadow grass (Poa trivialis) developed on all plots. Apparently the soil contained a great deal of this grass seed, which was not affected by any of the chemical treatments. With very favorable moisture conditions, many of these seeds germinated to produce a dense stand of one of the "weed" grasses. The thickest stand of rough stalk appeared on the disked plots, the thinnest on the sections that had been plowed and disked. Because of the dense volunteer growth of rough stalk meadow grass on most plots, the experiment was abandoned. The control of dormant soil-borne seeds of weedy grasses is an important new unsolved problem in the treatment of old sods with chemicals.

B. Shelburne Falls, Mass. A farm demonstration involving five chemicals was laid out on October 20. The area selected was poorly drained, and was low in soil fertility. The vegetation consisted of sedges, Kentucky bluegrass, bentgrass, and sensitive fern.

Dalapon was applied at 20 and 40 pounds per acre; TCA at 20 and 40 pounds; Karmex W at 5 and 15 pounds; Karmex FW at 5 and 15 pounds; Atlacide at 500 lbs. and 1000 pounds; and amino-triazole at 10 and 40 pounds.

Atlacide, Karmex W, and amino-triazole were the most effective materials under the conditions of this experiment. The two rates of application did not differ notably. The remaining three materials were less effective. None of the treatments were effective on sensitive fern.

1955 Trials.

Another farm demonstration was laid out near Sterling, Mass., on a low, poorly drained pasture area. The soil was high in organic matter and the fertility level was good. The vegetation consisted of bluegrasses (P. pratensis, and P. trivialis), bentgrass, timothy and on one end of the area a dense stand of tall fescue (Festuca arundinacea).

Treatments included Dalapon at 20 pounds per acre; a mixture of Dalapon 12 pounds and amino-triazole 3 pounds, and TCA at 30 pounds. The chemicals were applied July 11 with a tractor-mounted sprayer, and the following observations were made one month later:

1. Dalapon 20 pounds per acre. Bluegrasses were 95 percent killed. Bentgrass was completely killed. Timothy was considered as 85 percent eliminated, but many timothy plants were still alive with recovery possible. Alta fescue was similarly affected. Some plants although injured were alive, with recovery possible. A few orchard grass plants were scattered over the field. They were least injured of all the species present. These observations on orchard grass were similar to those made in 1953.

2. The mixture of Dalapon (12 pounds) and amino-triazole (3 pounds) was almost as effective as Dalapon alone (20 pounds). Differences were really not significant.

3. TCA at 30 pounds per acre was less effective than either of the other two treatments. About 95 percent of the bentgrass was killed, 80 percent of the bluegrasses, 55 percent of the tall fescue, and 15 percent of the timothy. Orchard grass was scarcely affected.

The area was thoroughly disked in late August preparatory to reseeding, but such abnormally wet weather followed that seeding was postponed until Spring. Observations on October 11 showed that volunteer seedlings of rough stalk meadow grass were appearing. Further treatment may be necessary to cope with this problem.

Summary and Conclusions

1. Dalapon at 10 to 15 pounds per acre and TCA at 30 pounds per acre are promising materials for the elimination of bluegrass and bentgrass sods.

The use of mixtures of Dalapon and amino-triazole should be investigated further.

Karmex W is an effective soil sterilant even on old sods but it has long residual effects that may cause injury to new seedings months after application. Further investigations are necessary.

Fall applications of chlorates (Atlacide, Chlorax powder) gave promising results.

2. The susceptibility of grass species to chemical herbicides varies. In descending susceptibility of Dalapon and TCA are bentgrass, bluegrasses, timothy, and orchard grass.

3. Bentgrass and the bluegrasses are most easily killed during midsummer.

4. The residual effects of TCA persist in the soil longer than those of Dalapon. Under normal weather conditions, a period of 30 days between treating a soil and making a new seeding is sufficient. If the weather is abnormally dry, either a longer waiting period is required or supplemental irrigation must be supplied.

5. In moist soils where rough stalk meadow grass is prevalent, serious difficulties may be encountered with volunteer stands of the grass from dormant seeds after treatment with chemical herbicides.

6. The use of chemical herbicides to destroy old sods is still in its developmental stages. The practicality of their general use has not yet been demonstrated. Further investigations are needed. Steep slopes where soil erosion is a hazard and stony land difficult to plow are the most promising areas of usefulness.

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Post-Emergence Crabgrass Control with Chemicals in Lawn Turf[1]

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The most effective chemical for the control of crabgrass in lawn turf at the Rhode Island Agricultural Experiment Station has been phenyl mercuric acetate (2, 3 and 4). Previous publications (1 and 2) report effective control with potassium cyanate-sludge mixtures. Disodium methyl arsonate has been used successfully as a post-emergence treatment (5).

The purpose of this paper is to report on the results of an experiment to control crabgrass using these and other promising materials.

Materials and Methods

The tests were conducted during the summer of 1955 on the athletic fields of the University of Rhode Island. The turf, composed of Chewing's fescue, Kentucky bluegrass, and Astoria Colonial bent, was maintained at a one-inch height of cut. Crabgrass infestation was uniform throughout the area and included both smooth crabgrass (*Digitaria ischaemum*) and hairy crabgrass (*D. sanguinalis*).

The experiment consisted of two series referred to hereafter as Series I and Series II. In Series I there were four blocks each containing twenty plots of 100 square feet. Nineteen treatments and one check were randomized within each block. Treatments were made to the four blocks as follows: two blocks received one treatment, one block two treatments and one block three treatments.

Series II consisted of three blocks: one receiving one treatment, one receiving two treatments and the third three treatments. Each block contained 20 plots of 100 square feet each. There were 17 treatments and 3 checks randomized within each block.

The materials used, the percent active ingredient in each, and the rates applied were as follows:

1. Crab-E-Rad (31.5% disodium methyl arsonate) at the rates of 10.75, 21.5, and 32.25 pounds per acre.

2. Di-Met (18.9% disodium methyl arsonate) at the rates of 10.75 and 21.5 pounds per acre.

3. Benzar (20% disodium benzyl arsonate) at the rates of 4 and 6 gallons per acre.

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4. Methar (50% disodium methyl arsonate) at the rates of 8 and 12 pounds per acre.

5. Sodium arsenite (90.67% sodium arsenite) at the rates of 25 and 50 pounds per acre.

6. PMAS (10% phenyl mercuric acetate) at the rates of 6 1/2 and 10 3/4 pints per acre.

7. Scutl (0.74% phenyl mercuric acetate impregnated in vermiculite) at settings #7 and #9 on the Scott's spreader.

8. American Cyanamid mixture #1 (4% potassium cyanate plus 96% Milorganite) at the rates of 43 and 64 1/2 pounds per acre. This material was used only in Series I.

9. American Cyanamid mixture #3 (4% potassium cyanate plus 96% Nitrorganic Tankage) at the rates of 43 and 64 1/2 pounds per acre. This material was used only on Series I.

10. Copper sulphate (99% copper sulphate) at the rates of 21.5 and 43 pounds per acre. This material was used only on Series II.

The PMAS, Crab-E-Rad, Di-Met, Benzar, Methar, Sodium arsenite, and copper sulphate were mixed with water and applied at the rate of 5 gallons per 1000 square feet. Scutl, American Cyanamid mixtures No. 1 and No. 3 were applied with a Scott's spreader.

The first application of materials was made to Series I July 15. This was followed by applications on July 29 and August 22. Materials were applied to Series II on July 29 followed by applications on August 22 and September 7.

Notes on the percent of crabgrass were taken before the first application and several weeks after the last application. Percent of crabgrass was recorded as an estimate of the area covered by crabgrass plants. The percent control for each treatment is based on the difference between the amount of crabgrass before and after treatment. Discoloration notes were taken seven days following each application of materials.

Results and Discussion

Series I

The results obtained for crabgrass control in Series I are reported in Table 1. The most effective control of crabgrass was obtained by three applications of the various materials. With two applications results varied with control ranging from 10 to 100 percent. One application of the chemicals for crabgrass control was relatively ineffective in these tests.

Crab-E-Rad at all three rates used provided 100 percent control of crabgrass with only slight to moderate discoloration following the first two treatments. With two treatments 100 percent control was obtained at the rates of 10.75 and 21.5 pounds per acre, but at the 32.25 pound rate 94 percent control resulted. With one treatment the material was not too effective.

Results with Di-Met were similar to those obtained with Crab-E-Rad. With three treatments both rates produced control of 99 percent. Two applications at 10.75 and 21.5 pounds per acre gave controls of 92 and 100 percent, respectively. One treatment was not effective at either rate. Discoloration was very slight at either rate.

Benzar at both rates produced better than 95 percent control with three treatments, and at two treatments 100 and 83 percent control was obtained. No control was obtained with one treatment. Discoloration was severe following the first treatment, but was only slight with three.

Methar at the two rates used provided 100 percent control with three applications, but discoloration was severe. With two treatments controls of 99 and 100 percent, respectively, were obtained with severe discoloration to the turf. At the low rate with one treatment 28 percent control resulted, but at the high rate 99 percent control was obtained with only moderate discoloration.

PMAS with three treatments at the 10 3/4 pint rate provided 100 percent control, but with the 6 1/2 pint rate only 42 percent control was obtained. With two treatments 96 and 100 percent control was provided at the high and low rates, respectively. Control with only one treatment was not effective. Discoloration was only slight following any of the treatments.

Scutl was most effective with two treatments, resulting in 100 and 99 percent control at settings #7 and #9, respectively. However, for some reason or other, with three treatments control of only 46 and 75 percent was obtained. Less than 45 percent control was provided by this material with one treatment. No discoloration was evident with this material.

The American Cyanamid-sludge mixtures #1 and #3 with two treatments provided control of 94 percent or better. With three treatments, mixtures #1 and #3 provided control of 72 and 11 percent, respectively, at the low rate. No control resulted from the high rate. One treatment was not effective with either of these materials.

Sodium arsenite was not effective in this experiment. Discoloration was severe following each application.

Series II

The figures presented in Table 2 represent crabgrass control on Series II. The most effective control was obtained with three applications of chemicals and ranged from 65 to 100 percent control. Two applications were less effective than three, and one application was least effective.

Crab-E-Rad with two and three applications at the rates used gave 99 percent control or better. With one application, however, control ranged from none at the low rate to 73 percent at the high rate. Discoloration was only slight with this material at the rate used.

Di-Met gave excellent control at both rates used with two and three applications, but with one application at the low rate only 38 percent control resulted. At the high rate with one application 92 percent control was obtained. This material produced only a very slight discoloration at the high rate.

PMAS at the rates used provided control better than 99 percent with three applications, but with two applications the low rate gave 72 percent control and the high rate 89 percent control. With one application only 25 and 58 percent control resulted at the low and high rates, respectively. This material produced moderate discoloration at the high rate used after the first application. This was caused by the high concentration of material being applied at a temperature above 90°F. No discoloration followed subsequent applications.

Methar at both rates of application and at all three treatments provided control of 99 to 100 percent. Discoloration was quite severe, however, following three applications. Slight to moderate discoloration followed with one and two treatments.

At the two rates used Benzar gave control of 96 to 100 percent with three applications. With two treatments the low rate produced 68 percent control and the high rate 86 percent control. One application provided controls of 20 and 25 percent at the low and high rates, respectively. With three applications discoloration was severe, but with one and two treatments only slight discoloration was observed.

Sodium arsenite at the rates of 25 and 50 pounds per acre with three treatments resulted in 100 percent control. With two treatments the high rate of 50 pounds provided 31 percent control. No control resulted with this material at the low rate with two treatments or with either rate at one application of the chemical. Severe discoloration was produced with two and three applications, but only moderate discoloration followed one treatment.

Copper sulphate with three treatments gave controls of 99 and 65 percent with 21.5 and 43 pounds per acre, respectively. With two applications 31 and 50 percent control was realized. No control was provided by either rate with one application. Moderate discoloration followed both rates of this material at two and three applications. Only slight turf discoloration could be observed after one application with the low rate, but moderate discoloration was produced by the high rate.

Scutl at both spreader settings provided crabgrass control better than 93 percent with three treatments. Two applications at setting #7 produced 77 percent control, and at setting #9 control of 92 percent resulted. With one application 43 and 25 percent control resulted at settings #7 and #9, respectively. Only a slight turf discoloration was found after three treatments, and no discoloration was produced by one or two treatments.

Summary and Conclusions

Tests for the post-emergence control of crabgrass were conducted during the summer of 1955 on athletic field turf at the University of Rhode Island. Chemicals used were Crab-E-Rad, Di-Met, Benzar, Methar, Sodium arsenite, PMAS, Copper sulphate, Scutl and American Cyanamid mixtures #1 and #3.

On Series I with three applications of chemicals Crab-E-Rad, Di-Met, Benzar, Methar and PMAS provided crabgrass control of from 96 to 100 percent. Sodium arsenite, Scutl, American Cyanamid mixtures #1 and #3 were not so effective in this test at the rates used.

Crab-E-Rad, Di-Met, Benzar, Methar, PMAS, Scutl, and American Cyanamid mixtures #1 and #3 provided control of crabgrass ranging from 83 to 100 percent with two treatments.

One application of the various chemicals was not effective except with the heavy rate of Methar which provided 91 percent control.

Discoloration was most severe with three applications, less with two and least with only one treatment. Discoloration ranked from greatest to least was as follows: Methar, Benzar, Sodium arsenite, American Cyanamid mixtures, Di-Met, Crab-E-Rad, PMAS and Scutl.

The results on Series II were similar to those on Series I. With three treatments controls ranging from 96 to 100 percent were realized with Crab-E-Rad, Di-Met, Benzar, Methar, Sodium arsenite, PMAS, Scutl and the low rate of copper sulphate; however, the high rate of copper sulphate was ineffective. Discoloration was moderate to severe with Methar, Benzar, Sodium arsenite and copper sulphate.

With two applications of the materials control ranged from 68 to 100 percent, except with copper sulphate and sodium arsenite which were not effective. Slight to moderate discoloration was obtained with some of the treatments.

Methar and the high rate of Di-Met provided control of from 92 to 99 percent with one application. The other materials were relatively ineffective. Only slight to moderate discoloration followed applications of chemicals in this test.

From the results obtained in this experiment it appears that three applications are needed for most of the chemicals tested for effective control of crabgrass.

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Table I Post-Emergence Crabgrass Control with Chemicals in Lawn Turf, Series I.
Rhode Island Agricultural Experiment Station, 1955

Material	Rate per acre	Control After 1 Trt.	Control After 2 Trts.	Control After 3 Trts.	Discoloration* After 1 Trt.	Discoloration* After 2 Trts.	Discoloration* After 3 Trts.
		- - - - - - Percent - - - - - -					
Crab-E-Rad	10 3/4 lbs.	54	100	100	.3	1.5	0
Crab-E-Rad	21 1/2 lbs.	59	100	100	.8	.5	0
Crab-E-Rad	32 1/4 lbs.	45	94	100	1.1	2.3	0
Di-Met	10 3/4 lbs.	0	92	99	3	.1	0
Di-Met	21 1/2 lbs.	0	100	99	.5	.5	0
Benzar	4 gals.	0	83	96	3.3	2.3	1
Benzar	6 gals.	0	99	96	3.8	2.3	2
Methar	8 lbs.	28	100	100	3.3	3.5	2
Methar	12 lbs.	99	99	100	3.8	4	3
Sodium arsenite	25 lbs.	0	10	0	1.8	2.5	2
Sodium arsenite	50 lbs.	0	38	0	3.5	5	3
PMAS	6 1/2 pints	17	96	42	.3	0	0
PMAS	10 3/4 pints	23	100	100	.8	1	0
Scutl	Setting #7**	44	99	46	0	0	0
Scutl	Setting #9	50	100	75	.4	0	0
Am. Cyan. #1	43 lbs.	23	99	72	1.1	.1	0
Am. Cyan. #1	64 1/2 lbs.	28	94	0	1.4	1	0
Am. Cyan. #3	43 lbs.	0	94	11	1.1	0	0
Am. Cyan. #3	64 1/2 lbs.	3	95	0	1.4	0	0
Check	———	—	—	—	—	-	-

*Discoloration index: 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = turf injury.

**Refers to setting number on Scott's spreader.

Treatments were applied on July 15, July 29 and August 22.

Table 2. Post-Emergence Crabgrass Control with Chemicals in Lawn Turf, Series II
Rhode Island Agricultural Experiment Station, 1955

Material	Rate per acre	Control After 1 Trt.	Control After 2 Trts.	Control After 3 Trts.	Discoloration* After 1 Trt.	Discoloration* After 2 Trts.	Discoloration* After 3 Trts.
		- - - - - -Percent- - - - - -					
Crab-E-Rad	10 3/4 lbs.	0	100	99	0	0	.1
Crab-E-Rad	21 1/2 lbs.	33	100	100	0	0	.1
Crab-E-Rad	32 1/4 lbs.	73	100	99	0	0	.7
Di-Met	10 3/4 lbs.	38	100	99	0	0	.1
Di-Met	21 1/2 lbs.	92	100	100	0	0	.4
PMAS	6 1/2 pints	25	72	99	0	0	.1
PMAS	10 3/4 pints	58	89	100	0	0	2.3
Methar	8 lbs.	99	100	100	2	2	4.6
Methar	12 lbs.	99	100	100	2	3	3.3
Benzar	4 gals.	20	68	96	0	.5	2.3
Benzar	6 gals.	25	86	100	1	1.5	3.3
Sodium arsenite	25 lbs.	0	0	100	2	2	3.5
Sodium arsenite	50 lbs.	0	31	100	2	3	4.3
Copper sulphate	21 1/2 lbs.	0	50	99	1	1	2
Copper sulphate	43 lbs.	11	72	65	2	2	2.5
Scutl	Setting #7**	43	77	93	0	0	.4
Scutl	Setting #9	25	92	97	0	0	.7
Check	----------	—	---	---	-	---	---

*Discoloration index: 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = turf injury.
**Refers to setting number on Scott's spreader.
Treatments were applied on July 29, August 22 and September 7.

CLOVER CONTROL IN LAWN TURF WITH SPRINGTIME APPLICATION OF CHEMICALS[1]

A. J. Wisniewski and J. A. DeFrance[2]

White Dutch clover (Trifolium repens) is a serious and troublesome pest in lawns and in playing areas of all types. Its presence can be a hazard since it is soft and slippery to walk on. Clover does not hold up the golf ball and it stains clothing and athletic equipment.

Clover grows in patches, breaks up the continuity of an even-textured turf and provides an uneven, slow playing surface. Its persistence is somewhat unpredictable; it may disappear almost overnight or "winter-kill", leaving large unsightly bare areas.

This paper presents the comparative effectiveness of several chemicals that are presently being used as clovercides and some that are currently in the experimental stage.

Methods and Materials

The experimental area was located on the University of Rhode Island campus on 12-year-old lawn turf composed of Rhode Island Colonial bentgrass, Kentucky bluegrass, and Chewing's fescue. The lawn was mowed at approximately 1 inch and received no artificial watering.

Individual plots were 5 x 10 feet. Treatments were in quadruplicate randomized in each of 2 blocks. The plots had an initial clover infestation which ranged from a minimum of 18 per cent to a maximum of 55 per cent.

Thirty-eight chemical treatments were applied on May 3, 1955. The day was sunny and bright, temperature was 75 degrees, and the soil was moderately moist. Twenty-three treatments, which constituted the second application, were applied May 27, 1955. The day was cloudy, temperature was 68 degrees, and the soil was moist. In order to determine the feasibility of using Scott's ECC-1 at a rate higher than that recommended by the manufacturer, additional plots were added to the experiment at this time.

Scott's ECC-1, a dry formulation, was applied with a Scott's spreader. All other formulations were applied using a 15-gallon power sprayer. Water was used as a carrier at the rate of 200 gallons per acre.

Notes on clover infestation in each plot were taken before the first treatment and 2, 4, and 6 months after the first treatment. Turf discoloration notes were taken approximately 1 week after treatment.

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[2]Graduate Assistant and Agronomist, respectively

The following chemical formulations were used in this experiment:

Abbreviation	Chemical Formulation
2,4,5-T	2,4,5-trichlorophenoxyacetic acid, butoxy ethanol ester 58.5%, 4 pounds acid equivalent per gallon
ECC-1	2,4,5-trichlorophenoxyacetic acid impregnated in vermiculite
ACP L-857	Polychlorobenzoic acid, 80% wettable powder
2,4-D	Triethanolamine salt of 2,4-dichlorophenoxyacetic acid 63%, 4 pounds of acid equivalent per gallon
Endothal	Disodium 3,6-endoahexahydrophthalate 19.2%
Crab-E-Rad	Disodium methyl arsonate 12.6%
Sodium Arsenite	$4\ Na\ As_5\ O_2 \cdot As_2\ O_3$, 90.67%
Benzar	Disodium benzyl arsonate 20%
Ammonium sulfate	Sulfate of ammonia 20.5% N
EH 6249	Sodium 2,2,3-trichloropropionate 80%

Results and Discussion

Observation of the plots after treatment indicated that the turf was not significantly discolored by the chemicals that gave effective clover control. The months of July and August were hot and dry, resulting in some drought injury to the lawn on which the experimental area was located.

Data in Table 1 summarize the results obtained in this experiment with the various chemical formulations used and also presents the amount of turf discoloration after the various treatments.

By far the most effective chemical used in this test was 2,4,5-T. When two applicationswere made three weeks apart, the 1-quart rate yielded 98.8 per cent control, whereas the 2-quart rate resulted in 99.9 per cent control. One application at the 1-quart rate gave 63.4 per cent control, while the 2-quart rate produced 85.1 per cent control.

Scott's ECC-1 gave 87.4 per cent clover control with two applications on a Scott's spreader setting of 4.5. One application at the same rate resulted in no control six months after treatment. On May 27 two additional rates of application of this material were added to the experiment. Applications were made using a Scott's spreader setting of 5.5 and 6.5. One application at the 5.5 rate resulted in almost complete clover control; however, the bentgrass and fescue populations were considerably reduced as the season progressed. The 6.5 setting almost completely eliminated the bentgrass and the fescue but did no visible damage to the Kentucky bluegrass. One treatment at the 6.5

setting produced 99.9 per cent control of clover. All applications of ECC-1 were made when there was visible moisture on the clover leaves and grass blades.

Results obtained from ACP L-857 treatments were encouraging. Clover control achieved with two treatments was 58.4 and 74.1 per cent for the 1-and 2-pound rates, respectively. This chemical did not cause any objectionable discoloration or injury when used at the above rates. However, further study is needed with this new chemical to determine more satisfactory rates of application.

The results with 2,4-D at the rates used in this experiment indicate that this material does not give satisfactory control of clover for a prolonged period of time. With two treatments at the 1-and 2-quart rates control was only 23.8 and 37.4 per cent, respectively. One treatment at the 1-and 2-quart rate resulted in no clover control six months after application.

Endothal provided 90.1 per cent control with 2 applications at the 6-pint rate six months after treatment. At the 3-pint rate 77.9 per cent control resulted. One application of endothal did not result in any lasting control at either rate.

With 2 treatments at the 27-quart per acre rate, Crab-E-Rad gave 48 per cent control. This chemical shows a tendency to inhibit clover flower formation. Further study is needed with this material to determine whether it is feasible to use it as a clovercide.

Almost complete defoliation of the clover resulted from the sodium arsenite and ammonium sulfate treatments; however, the clover made a rapid recovery and data in Table 1 show that there was no clover control from these two materials six months after treatment.

Benzar did not effectively control clover. However, one application eliminated all the mouse-ear chickweed from the plots.

Experimental herbicide 6249 did not give satisfactory clover control at any of the rates used.

Summary and Conclusions

Under conditions of this experiment, 2,4,5-T applied in late springtime proved to be the most effective clover control material. With this chemical, as well as with the other chemicals, more effective control was obtained when 2 applications were made.

Scott's ECC-1 provided good clover control when 2 applications were made at the manufacturer's recommended setting of 4.5. This material when applied at settings of 5.5 and over resulted in serious injury to the bentgrasses and fescues.

Results obtained with the new chemical ACP L-857 (polychlorbenzoic acid) were encouraging, and further study should be conducted to determine optimum rates for satisfactory clover control without injury to the basic turfgrasses.

Endothal with two applications at the 3-and 6-pint rates produced effective control. With one treatment no control resulted.

Benzar, Crab-E-Rad, sodium arsenite, ammonium sulfate, experimental herbicide 6249, and 2,4-D at the rates used in this experiment did not give satisfactory clover control.

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Table 1. Clover Control in Lawn Turf with Springtime Applications of Chemicals

at the Rhode Island Agricultural Experiment Station, 1955

Material	Rate	% Clover Control After 2 Months		% Clover Control After 4 Months		% Clover Control After 6 Months		Discoloration** Approximately 1 Week After treatment	
		1 trt.	2 trt.	1 trt.	2 trt.	1 trt.	2 trt.	1 trt.	2 trt.
2,4,5-T	1 qt./A	91.5	99.6	75.0	99.2	63.4	98.8	0.25	0.34
2,4,5-T	2 qts./A	98.0	100	95.7	99.8	85.1	99.9	0.50	0.59
ECC-1	4.5*	24.2	99.9	0	96.1	0	87.4	0	0
ECC-1	5.5	99.9	—	99.9	—	99.8	—	0	—
ECC-1	6.5	100	—	99.9	—	99.9	—	0	—
ACP L-857	1 lb./A	35.0	82.5	6.6	80.3	0	58.4	0	0.1
ACP L-857	2 lb./A	53.3	80.5	30.7	80.5	7.3	74.1	0	0.18
2,4-D	1 qt./A	0	85.7	0	50.8	0	23.8	0	0
2,4-D	2 qt./A	29.8	94.1	13.5	81.7	0	37.4	0	0
Endothal	3 pt./A	16.8	95.9	12.4	89.4	0	77.9	0.88	1.13
Endothal	6 pt./A	36.6	98.8	0	95.0	0	90.1	1	1.63
Crab-E-Rad	13.5 qt./A	8.1	22.8	0	8.8	0	0	0	0.25
Crab-E-Rad	27 qt./A	22.5	73.3	35.0	61.7	10.0	48.0	0.15	0.67
Sodium Arsenite	54 lb./A	0	24	0	8.1	0	0	0.88	3.25
Sodium Arsenite	67 lb./A	5.7	33.9	0	16.9	0	0	1.3	3.5
Benzar	21.5 qt./A	0	4.7	0	0	0	0	0.38	0.34
Benzar	43 qt./A	0	29.1	0	0	0	0	1.0	0.59
Ammonium Sulfate	200 lb./A	0	8.8	0	0	0	0	0.38	2.75
Exp. Herb. 6249	2 lb./A	0	0	0	0	0	0	0	0
Exp. Herb. 6249	4 lb./A	0	0	0	0	0	0	0	0
Exp. Herb. 6249	8 lb./A	0	45.7	0	0	0	0	0	0

Treatments were applied on May 3 and May 27, 1955

*Refers to setting on Scott's spreader. All other materials were applied in 200 gallons of water per acre

**Discoloration Index - 0 = None, 1 = Slight, 2 = Moderate, 3 = Severe, 4 = Very Severe, 5 = Turf Injury

Disodium Methyl Arsonate Field Tests - summer, 1955

Gallagher and Beatty

These abstracts represent a series of tests with Weedone Crabgrass Killer (disodium methyl arsonate) conducted at the American Chemical Paint Company research farm, Ambler, Penna., during the spring and summer of 1955. Because of the unusually extreme weather conditions of the summer of 1955, the results reported here, may in part, be due to the environmental conditions at the time of the experiment. These tests were designed to determine the following information:

1. The response of common turf grasses to single and repeat application of disodium methyl arsonate at various rates.
2. The maximum rate and minimum number of treatments needed for effective kill of seedling and half matured crabgrass plants.
3. The maximum rate of application for effective crabgrass kill with minimum turfgrass discoloration during the spring and summer season.
4. The activity of disodium methyl arsonate as a crabgrass killer when applied with different volumes of water.

In all tests, rate per acre refers to the amount of active material and unless specified, the volume of water used was 200 gallons per acre. Individual plots were 5' X 10'. The test area for turfgrass response consisted of 10' X 200' strips of the following: Seaside creeping bentgrass, Astoria, and Highland colonial bentgrass, Merion, and Kentucky bluegrass, chewings and Illahee fine leaf fescue, Meadow fescue and Kentucky-31 tall fescue, Timothy, perennial ryegrass, red top, Meyers zoysia, U-3 and common seed Bermuda grass and mixed crabgrass (Digitaria ischaemum and d-sanguinalis). The area for seedling crabgrass response consisted of an open field with a volunteer mixture of crabgrass, foxtail, and nutgrass, (Cyperus esculentus).

Test #1

Purpose - to determine turfgrass discoloration.
Experimental period - 5/25 - 6/6 (average air temperature for experimental period - 80°F).
Materials - disodium methyl arsonate and potassium cyanate.
Rates - 4, 8, and 16 pounds per acre, single application.
Procedure - using a small plot sprayer, both materials were applied at all rates to the following grasses: bent grasses, bluegrasses, and fine leaf fescue grasses.
Results - disodium methyl arsonate at 4, 8, and 16 pounds per acre produced discoloration to fine leaf fescue grasses in proportion to the rate per acre, and slight tip burn to Merion and Kentucky bluegrass at 16 pounds per acre. Potassium cyanate at 8 pounds per acre produced discoloration to fine leaf fescue grasses and bluegrasses, and at 16 pounds per acre, produced discoloration to bentgrasses, bluegrasses and fine leaf fescue grasses.
Comments - the initial discoloration on the fine leaf fescue grasses of the potassium cyanate was ultimately equalled by that of disodium methyl arsonate. The reaction of disodium methyl arsonate was a delayed one. The fine leaf fescue plots were below optimum moisture at the time of application.

American Chemical Paint Company
Ambler, Pennsylvania

Test #2

Purpose - a repetition of test #1 to determine whether low moisture was a factor in the discoloration of fine leaf fescue grasses when treated with disodium methyl arsonate.
Experimental period - 6/9 - 6/20 - (average air temperature for experimental period - 81°F).
Material and rates - Same as in test #1.
Procedure - fine leaf fescue grasses received irrigation the equivalent of 1/2-3/4 inch of rainfall, 48 hours before application of chemicals.
Results - the results of test #1 were duplicated.
Comments - the factor of soil moisture apparently was not the determining one causing discoloration to fine leaf fescue grasses. The fine leaf fescue grasses were subject to discoloration when treated with disodium methyl arsonate regardless of soil moisture conditions.

Test #3

Purpose - to compare two sets of recommended rates of disodium methyl arsonate with 1, 2, and 3 treatments at weekly intervals for the control of seedling crabgrass.
Experimental period - 5/26 - 6/15 (average air temperature for experimental period - 81°F).
Material - disodium methyl arsonate.
Rates - 3.4, 6.8, and 4 and 8 pounds per acre.
Procedure - using a small plot applicator sprayed 5' X 10' plots of mixed crabgrass, foxtail, and nutgrass (Cyperus esculentus) seedlings.
Results - in all cases 4 and 8 pounds per acre gave complete kill of existing crabgrass seedlings. The single treatment of 3.4 pounds per acre gave 70% kill, the 2 and 3 applications of the 3.4 pound per acre rate and all applications of the 6.8 pound per acre gave complete kill of existing crabgrass.
Comments - one week following the third treatment, new crabgrass seedlings had germinated in all plots. Foxtail and the above ground parts of nutgrass were killed but needed two treatments.
Conclusion - under the conditions of this test, disodium methyl arsonate gave control of seedling crabgrass, foxtail, and the above ground part of nutgrass (Cyperus esculentus).

Test #4

Purpose - to determine the maximum rate of disodium methyl arsonate to be used without turfgrass discoloration.
Experimental period - 6/18 - 7/18 (average air temperature for experimental period - 95°F).
Material - disodium methyl arsonate.
Rates - 1, 2, 3, 4, 5, and 6 pounds per acre.
Procedure - using a small plot sprayer applied disodium methyl arsonate across the turfgrass strips, three treatments at weekly intervals.
Results - three days following the second application, colonial bentgrasses, Kentucky bluegrass, and the fine leaf fescue grasses showed discoloration at

the 6 pound per acre rate, (fine leaf fescue grasses showed discoloration at 3, 4, 5, and 6 pounds per acre). Two days after the third treatment, showed that rates of 3 pounds per acre and below did not discolor turf grasses other than fine leaf fescue grasses and that rates of 4 pounds per acre and above produced severe injury to fine leaf fescue grasses and observable discoloration to bent grasses and bluegrasses. Perennial ryegrass, red top, meadow fescue, and Kentucky-31 tall fescue were not affected by disodium methyl arsonate at these rates.
Comments - under the conditions of this test, 3 pounds per acre, 3 applications was the maximum rate to be used without discoloration to turfgrasses other than fine leaf fescue grasses.

Test #4-A

Purpose - to determine the minimum rate at which crabgrass can be controlled.
Experimental period - material - rates per acre - the same as in test #4.
Procedure - applied material to 5' X 10' plots of volunteer mixture of crabgrass and foxtail in the 2,4 leaf stage.
Results - data collected one week following the third application showed that a single application of 4, 5, and 6 pounds per acre produced 50, 70, and 100% kill; the double application of 2, 3, 4, 5, and 6 pounds per acre produced 70-100% kill; and the triple application of 2, 3, 4, 5, and 6 pounds per acre produced 90-100% kill.
Conclusion - under the conditions of this test, effective control of crabgrass in the unbranched stage-with a minimum of discoloration - was obtained when 2 or more applications of disodium methyl arsonate was applied at 3 - 4 pounds per acre rate.

Test #5

Purpose - the control of crabgrass in Meyer zoysia.

Experimental period - 6/10 - 7/11 (average air temperature for experimental period - 91°F).
Material - disodium methyl arsonate.
Rate - 4 and 8 pounds per acre; 1, 2, and 3 treatments at 10 day intervals.
Procedure - using small plot sprayer applied disodium methyl arsonate to crabgrass infesting a 1 year stand of Meyer zoysia plugs.
Results - nine days following the second application and 19 days following the first, those plots receiving the single application of 4 and 8 pounds per acre, showed no effects on crabgrass or zoysia; those plots receiving two 4 pound acre treatments showed 75% kill of crabgrass;and those plots receiving two 8 pound per acre treatments showed 95% kill of crabgrass. One week following the third treatment of the series, showed 90% kill of crabgrass with three 4 pound treatments; 100% kill with three 8 pound treatments, 70% kill with two 4 pound treatments; and 90% kill with two 8 pound treatments.

Survival of crabgrass after the third treatment

1 - 4 pound treatment	150%
2 - 4 " "	25%
3 - 4 " "	4%
1 - 8 " "	300%
2 - 8 " "	2%
3 - 8 " "	0%
Control	300%

Injury recorded on zoysia only at the three 8 pound per acre treatments. (A very slight yellowing).

Test #6

Purpose - to determine whether the activity of disodium methyl arsonate as a crabgrass killer was affected when applied with different volumes of water.
Experimental period - 7/7 - 7/18 (average temperature for experimental period - 96°F).
Material - disodium methyl arsonate.
Rates - 2, 4, and 6 pounds per acre.
Procedure - sprayed 5' X 10' plots at 3 rates in four volumes of water - 25, 50, 100, and 200 gallons of water. Applied 2 treatments at 7 day intervals.
Results - data collected after the second treatment showed complete kill at the 4 and 6 pound per acre rate regardless of volume of water. At the 2 pound per acre rate control was poor and in the case of the 25 gallon rate the results were spotty due to the apparatus used.
Comment - volume of water, apparently was not a factor in control, providing sufficient material was used to kill crabgrass.

Test #7

Purpose - to test the effect of disodium methyl arsonate on weed grasses.
Experimental period - 8/25 - 9/22 (average air temperature for experimental period - 84°F).
Material - disodium methyl arsonate.
Rate - 7 pounds per acre-two treatments at 7 day intervals.
Procedure - applied material with a tractor spray rig making two passes over the treated area with each application.
Results - data collected 9/22 - 3 weeks after second application.

Weed Grasses	Injury
1. Perennial rye grass - Lolium perenne	0
**2. Dallis grass - Paspalum dilatatum	5
3. Orchard grass - Dactylis glomerata	0
4. Barnyard grass - Echinochlua crusgalli	7
5. Foxtail - Setaria virdis	10
6. Bermuda - common - Cynodon dactylon	0
*7. Johnson grass - Sorghum halepense	9
8. Quack grass - Agropyron repens	0
9. Timothy - Phleum pratense	0

Rating 0 = no injury
10 = kill

*Johnson grass tops killed (plants were 4' tall at time of application).
**This represents injury to top of plant. Kill will be determined by regrowth next spring.

Post-emergence Control of Crabgrass in Putting-Green Turf /1

J. A. DeFrance and S. W. Hart /2

The control of crabgrass once it has become established in putting greens has always been a difficult problem. At the time when post-emergence treatments are applied, the bentgrasses are lacking in vigor and are subject to discoloration and injury from chemical treatment. The material that has been most effective for several years at the Rhode Island Agricultural Experiment Station has been phenyl mercuric acetate (1) (2). The use of disodium methyl arsonate as a crabgrass killer has recently received increased attention (3). Mechanical methods of crabgrass elimination offer many possibilities from the standpoint of discouraging crabgrass runners and reseeding (4).

During the summer of 1955 a post-emergence experiment was conducted on Piper velvet bent, and on Astoria Colonial bent at the Rhode Island Agricultural Experiment Station. The object of this investigation was to evaluate Crab-E-Rad, PMAS, PMAS Plus, and Scutl for crabgrass control on putting-green turf. The Verticut machine which is a vertical mower was also employed in this test.

Methods and Materials

The experimental areas were located on a planting of Piper velvet bentgrass and on Astoria Colonial bentgrass made in 1946, and maintained under putting-green conditions. Crabgrass infestation on both plots was severe and fairly uniform.

The plots were 100 square feet in area, measured 3 by 33 1/3 feet and were in duplicate for both tests. There were randomized within each replication, nine treatments and one check.

The materials and equipment used, the percent active ingredient in each material and the rates applied were as follows;

1. PMAS (10% phenyl mercuric acetate) at 3/4, 1 and 1 1/4 ounces per 1000 square feet. These were used in both tests.

2. PMAS Plus (a 50% solution of ammonium nitrate plus 1 ounce of PMAS per pint) at the rates of 3/4 and 1 pint per 1000 square feet. This material was used only on the Astoria Colonial bentgrass.

3. Scutl (0.74% phenyl mercuric acetate impregnated in vermiculite) applied with Scott's spreader at settings number 4 and 5 on the Piper velvet bent, and at number 3 and 4 on the Astoria Colonial bent.

/1. Contribution No. 878 of the R. I. Agricultural Experiment Station.

/2. Agronomist and Research Assistant in Agronomy, respectively.

4. Crab-E-Rad (12.6% disodium methyl arsonate) at 2 1/2, 5 and 7 1/2 ounces per 1000 square feet. This material was used in both tests.

5. Verticut (vertical mower) at setting 3.5 was used at 2, and 4 times over the plot. This machine was used on only the Piper velvet bent area.

PMAS, PMAS Plus, and Crab-E-Rad were mixed with water and applied at the rate of 5 gallons per 1000 square feet with a 15 gallon power sprayer. Scutl was applied with a Scott's spreader. The adjustor on the Verticut machine was set at three and one-half turns.

The first treatment to Piper velvet was made July 19, 1955 when crabgrass was in the two-leaved stage, followed by two more treatments at intervals of 3 weeks. Discoloration notes were taken 7 days following each treatment. Crabgrass notes were taken before the first application and several weeks after the last application. Crabgrass percentages were taken as visual estimates of the amount of area covered by crabgrass. Percent control was determined by comparing the amount of crabgrass before treatment and the amount remaining after the experiment was terminated.

Materials were applied on the Colonial bentgrass plots August 4, 1955 followed by two applications at intervals of two weeks. Discoloration notes and crabgrass figures were taken in the same manner as in the preceeding experiment.

Results and Discussion

The figures in table 1 give the percent control of crabgrass and turf discoloration on the Piper velvet bent. These results show that Scutl was the most effective material used in this test. At Scott's spreader setting #4, 95 percent control resulted, and at setting #5, 99 percent control was obtained. Turf discoloration after this first treatment is a result of misapplication of materials at the ends of the plot due to slowness in shutting off spreader flow.

PMAS gave 80 and 84 percent control with 1 and 1 1/4 ounces, respectively, but at 3/4 ounces provided only 6 percent control. Only slight discoloration was observed after the first application with the heavy rate of 1 1/4 ounces of this material.

Crab-E-Rad at the low rates of 2 1/2 and 5 ounces did not control crabgrass in this test.

The Verticut, set at three and one-half turns, twice over the plot, did not control the crabgrass and provided a slight increase. At four times over the plot, 25 percent control resulted. Eight percent injury to the turf was observed at 4 times over the plots. This injury was permanent because actual bare areas existed in the plots. No injury was noted with the twice-over the plot treatment.

The results obtained on Astoria Colonial bentgrass are presented in table 2. The mercurials again were effective in reducing crabgrass population. PMAS at the 3/4 ounce per 1000 rate provided 69 percent control. At the 1 and 1 1/4 ounce rate 71 and 93 percent control, respectively, resulted. No discoloration followed any of the three treatments. PMAS in previous tests on putting-green turf (1) provided 100 percent control of crabgrass with five applications at intervals of ten days. PMAS Plus at 3/4 pint per 1000 square feet gave 70 percent control, and with the higher rate of one pint 82 percent control resulted. No discoloration was evident at either rate used.

Scutl at settings #3 and #4 produced 70 and 80 percent control, respectively, with no discoloration.

Crab-E-Rad at 5 ounces per 1000 square feet resulted in 69 percent control and, at the higher rate of 7 1/2 ounces gave 81 percent control. These control figures with slightly higher rates seem to indicate that better reduction could be obtained with higher dosages although turf discoloration might be a factor to be considered in raising the rates as slight discoloration resulted at the 5 and 7 1/2 ounce rate following the first treatment.

Summary and Conclusions

Post-emergence tests for the control of crabgrass in putting-green turf were conducted on Piper velvet bent, and on Astoria Colonial bent at the Rhode Island Agricultural Experiment Station during the summer of 1955. Chemicals used included PMAS, Scutl, PMAS Plus and Crab-E-Rad. The Verticut vertical mower was also used. Three applications were applied on both test areas.

On Piper velvet bent the mercurials, PMAS and Scutl, were the most effective materials used in this study. Rates of PMAS at 1 and 1 1/4 ounces were superior to the 3/4 ounce rate. Scutl was the most effective treatment used giving over 95 percent control at settings of #4 and 5 on the Scott's spreader.

Crab-E-Rad (disodium methyl arsonate) at the rates suggested by the manufacturer did not prove successful in this test.

The Verticut machine twice over was ineffective, but four times over the plot pvovided 25 percent control.

Discoloration was not serious with any of the chemical treatments. The Verticut at four times over removed grass plants thus producing permanent turf injury.

On Astoria Colonial bent the mercurials produced the best control of crabgrass, providing control ranging from 69 to 93 percent. PMAS at 1 1/4 ounces was the most effective treatment giving 93 percent control. The 3/4 and 1 ounce rates produced 70 percent control. Scutl at settings #3 and #4 provided control of 70 and 80 percent, respectively. PMAS Plus at the rates used produced over 70 percent control. Crab-E-Rad at the high rate of 7.5 ounces per 1000 sq. ft. produced 81 percent control while at the low rate of 5 ounces 69 percent control was obtained.

From the results obtained in this study with only three applications the phenyl mercurials applied in either the liquid or dry form appear to be the most satisfactory for post-emergence crabgrass control in putting-green turf.

The new formulation of PMAS plus ammonium nitrate appears promising, but further study to determine more satisfactory rates and time intervals of application is indicated. This also applies to disodium methyl arsonate. Some modifications of the Verticut machine blades and time intervals of treatment might be of benefit with the mechanical control of crabgrass.

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Table 1. Post-Emergence Control of Crabgrass in Piper Velvet Bent Putting-Green Turf. Rhode Island Agricultural Experiment Station, 1955.

Treatment	Rate per 1000 sq. ft.	% Crab before trt.	% Crab after trt.	Percent control	Discoloration* July 26	Aug. 1	Aug. 26
PMAS	3/4 oz.	11.5	10.8	6	0	0	0
PMAS	1 oz.	12.5	2.5	80	0	0	0
PMAS	1¼ oz.	9.5	1.5	84	1	0	0
Scutl	Setting #4**	10.0	0.5	95	1	0	0
Scutl	Setting #5**	8.5	12.5	99	2	0	2
Crab-E-Rad	2½ oz.	5.5	13.5	--	0	0	0
Crab-E-Rad	5 oz.	8.5	17.0	--	1	0	0
Verticut	2X	12.0	12.3	--	0	0	0
Verticut	4X	13.0	9.8	25	2	0	5
Check	----------	13.5	19.8	--	-	-	-

*Discoloration index: 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = permanent injury.

**Refers to setting number on Scott's spreader.

Treatments were applied: July 19, August 1, August 17.

Table 2. Post-Emergence Control of Crabgrass in Astoria Colonial Bent Putting-Green Turf. Rhode Island Agricultural Experiment Station, 1955.

Treatment	Rate per 1000 sq. ft.	% Crab before trt.	% Crab after trt.	Percent control	Discoloration* Aug. 11	Aug. 26	Sept. 2
PMAS	3/4 oz.	45.0	14.0	69	0	0	0
PMAS	1 oz.	41.0	12.0	71	0	0	0
PMAS	1¼ oz.	43.0	3.0	93	0	0	0
PMAS Plus	3/4 pint	43.0	12.8	70	0	0	0
PMAS Plus	1 pint	42.0	7.8	82	0	0	0
Scutl	Setting #3**	40.0	12.0	70	0	0	0
Scutl	Setting #4	43.0	8.8	80	0	0	0
Crab-E-Rad	5 oz.	45.0	4.0	69	1	0	0
Crab-E-Rad	7½ oz.	46.5	8.8	81	1	0	0
Check	----------	40.0	43.5	--	0	0	0

*Discoloration index: 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = permanent injury.

**Refers to setting number of Scott's spreader.

Treatments were applied: August 4, 18 and 26.

Pre-Emergence Control of Crabgrass with Chemicals in Lawn Turf[1]

S. W. Hart and J. A. DeFrance[2]

Prevention of crabgrass infestation before it becomes evident has only recently been the subject of scientific research. This method offers many possibilities for saving time, labor and materials. Previous publications by Gallagher and Emerson (1), Gallagher and Musser (2), and Hart and DeFrance (3), indicate varying success with this method.

The purpose of this paper is to report the results of a series of pre-emergence crabgrass control experiments conducted during the spring and early summer of 1955.

Methods and Materials

The tests were made at three different locations in the vicinity of Kingston, Rhode Island; on a home lawn, on the campus, and on the athletic field. The turf on all three areas was composed of a mixture of Chewing's fescue, Kentucky bluegrass and Astoria Colonial bentgrass. All three areas were uniformly infested with smooth crabgrass (Digitaria ischaemum) and a small amount of hairy crabgrass (D. sanguinalis) the preceding season of 1954. The turf was mowed regularly at a height of approximately one inch.

The plots were 100 square feet in size and were randomized in each block. There were 18 treatments and two check plots in each block. Treatments were applied at three-week intervals.

The materials used, the percent of active material in each and the rates applied were as follows:

1. Scutl (0.74% phenyl mercuric acetate impregnated in vermiculite) at settings number 5 and 7 on the Scott's spreader.

2. Alanap-1F (Dry formulation of 90% N-1 naphthyl phthalamic acid plus urea) at 720 lbs. per acre.

3. PMAS (10% phenyl mercuric acetate) at 5 and 7 pints per acre.

4. Crag herbicide-1 (90% sodium 2,4 dichlorophenoxyethyl sulfate) at 3 and 6 pounds per acre.

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[1] Contribution No. 875 of the R.I. Agricultural Experiment Station.

[2] Research Assistant in Agronomy and Agronomist, respectively.

5. Methin (80% sodium-2-methyl-4-chlorophenoxyethyl sulfate) at 3 and 6 pounds per acre.

6. DuPont Compound No. 127 (80% 3-(3,4-dichlorophenyl-1 methyl-1-n-butylurea) at 3 and 4 pounds per acre. Hereinafter designated as DuP 127.

7. ACP L-841 (80% 2,4-dichlorophenoxyacetamide) at 3 pounds per acre.

8. ACP L-842 (80% 2,4,5-trichlorophenoxyacetamide) at 3 pounds per acre.

9. Crab-E-Rad (12.6% disodium methyl arsonate) at 25 and 50 pints per acre.

10. Benzar (20% disodium benzyl arsonate) at 21.5 and 43 quarts per acre.

PMAS, Crag-1, Methin, DuP 127, ACP L-841, ACP L-842, Crab-E-Rad and Benzar were applied as liquids in 10 gallons of water per 1000 square feet with a power sprayer. Scutl and Alanap-1F were applied dry with a Scott's spreader to a turf that was moistened before application. Two applications at intervals of three weeks were made of all chemicals. In addition, Alanap-1F was applied so that one plot received only one application.

The first treatment was applied on Series I, May 20, followed by the second application June 10. Series II was treated June 1 and June 22. Series III was treated June 3 and June 27. No crabgrass germination had occurred on any of the three areas before the materials were applied.

Discoloration notes were taken seven days following each treatment. Crabgrass notes were taken as estimates of the amount of plot area covered by the crabgrass plants. The percent control data is based on the difference between the amount of crabgrass on the treated plots and that on the check plots.

Results and Discussion

Series I. Home Lawn Area

The figures presented in Table 1 show the comparative effects of the various chemical treatments in preventing crabgrass germination and the amount of turf discoloration caused by them. With the exception of temporary discoloration from Scutl, PMAS, Crab-E-Rad and Benzar following the first application very little discoloration of the basic grasses was noted.

DuP 127 at 3 and 4 pounds per acre gave 60 and 73 percent control.

Alanap-1F with one treatment provided 67 percent control and with two treatments gave 71 percent control.

ACP L-841 and ACP L-842 at 3 pounds per acre provided 65 and 67 percent control, respectively.

Crab-E-Rad at 25 and 50 pints per acre resulted in 61 and 70 percent control.

Scutl, PMAS, Crag herbicide-1, Methin and Benzar at the rates used and under the conditions of this experiment provided less than 60 percent control.

Series II. Athletic Field Area

The results obtained in Series II are reported in Table 2. A much better control of germinating crabgrass was obtained in this series than in Series I. Discoloration was evident only from the first treatment, and no permanent injury resulted.

Alanap-1F with one treatment gave 92 percent control, and, for some reason or other, with two treatments only 84 percent control was obtained. Plots treated with this material possessed a very dark green color and produced more rapid growth than adjacent plots.

In this series DuP 127 at 3 and 4 pounds per acre provided 90 and 87 percent control, respectively. As was the case with the Alanap-1F treated plots, the ones treated with butylurea also had a very dark green color and luxuriant growth.

Crab-E-Rad at the rate of 25 pints per acre provided only 60 percent control, and at 50 pints per acre 80 percent control was obtained.

Benzar at the rates of 21.5 and 43 quarts per acre resulted in 66 and 83 percent control, respectively.

At the rates of 5 and 7 pints per acre PMAS treated plots resulted in controls of 70 and 63% respectively. Scutl at settings #5 and #7 gave 60 and 57 percent control.

Crag-1, Methin, ACP L-841, and ACP L-842 gave less than 20 percent control.

Series III. Campus Area

In the third series of plots which received the same materials and rates as in the previous two series, results were not quite as good with some treatments as in Series II, but were superior to Series I. Crabgrass control and discoloration are presented in Table 3.

DuP 127 gave the best control of germinating crabgrass providing 90 and 88 percent control.

Alanap-1F with one treatment provided 88 percent control, and with two treatments 69 percent control.

PMAS at the rate of 5 pints per acre provided 56 percent control and at the rate of 7 pints per acre gave 79 percent control.

Methin at 3 pounds per acre gave 81 percent control while at the rate of 6 pounds no control was obtained.

Crab-E-Rad at the rates of 25 and 50 pints per acre provided controls of only 50 percent in each case.

Benzar at 21.5 and 43 quarts per acre resulted in control of 48 and 52 percent, respectively.

Scutl, Crag-1, ACP L-841, ACP L-842 were not effective giving controls of less than 40 percent.

Summary and Conclusions

A series of experiments for the pre-emergence control of crabgrass were conducted on lawn turf at the Rhode Island Agricultural Experiment Station during the spring and early summer of 1955. Materials used were Alanap-1F, PMAS, Scutl, Crag herbicide-1, Methin, DuP 127, ACP L-841, ACP L-842, Crab-E-Rad and Benzar.

On three series of experiments at different locations, treatments were applied on different days. Treatments were applied at intervals of 21 days on all three series.

Turf discoloration was not very evident from the treatments used in this experiment. Some slight temporary discoloration was observed, but recovery was rapid with no permanent injury. Injury at the time these treatments were applied was minimized because the grass was making healthy growth and could readily absorb shock from chemical treatment.

On Series I, DuP 127, Alanap-1F, ACP L-841, ACP L-842, and Crab-E-Rad provided pre-emergence crabgrass control ranging from 65 to 73 percent. Scutl, PMAS, Crag-1, Methin and Benzar were not so effective in this series.

Series II results were somewhat better. Treatment with Alanap-1F, Butylurea, Crab-E-Rad, Benzar and PMAS gave crabgrass control from 92 to 57 percent. Crag-1, Methin, ACP L-841 and ACP L-842 were not effective.

Series III treatments were less effective. Here Alanap-1F, DuP 127, PMAS, Methin, Crab-E-Rad and Benzar gave control ranging from 90 to 48 percent. Scutl, Crag-1, ACP L-841, and ACP L-842 were not effective.

From the results obtained in these experiments, it appears that the effectiveness of crabgrass control by pre-emergence chemical treatment depends on a number of factors. Further research and study is needed to learn just what factors are responsible for the variable results. Further evaluation of materials

considering time of application, frequency of application, soil temperatures and soil moisture is needed before specific recommendations can be made.

Acknowledgements

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Table 1. Pre-Emergence Control of Crabgrass in Lawn Turf with Various Chemicals - Series I, Home Lawn Area. Rhode Island Agricultural Experiment Station, 1955

Material	Rate of Application	% Crabgrass Sept. 1	% Control	Discoloration** May 28	June 3	June 10	June 17
Scutl	Setting #5*	32.5	32	0	0	0	0
Scutl	Setting #7*	30.0	37	0.5	0	0	0
Alanap-1F[a]	720 lbs./A	15.5	67	0	0	0	0
Alanap-1F	720 lbs./A	14.0	71	0	0	0	0
PMAS	5 pints/A	30.5	36	0.5	0	0	0.5
PMAS	7 pints/A	30.0	37	1.0	0	0	0.3
Crag-1	6 pounds/A	29.0	39	0	0	0	0
Crag-1	9 pounds/A	25.0	47	0	0	0	0
DuP 127	3 pounds/A	20.5	57	0	0	0	0
DuP 127	4 pounds/A	17.0	73	0	0	0	0
Methin	3 pounds/A	30.0	37	0	0	0	0
Methin	6 pounds/A	26.0	65	0	0	0	0
ACP L-841	3 pounds/A	26.0	65	0	0	0	0
ACP L-842	3 pounds/A	15.5	67	0	0	0	0
Crab-E-Rad	25 pints/A	18.5	61	0	0	0	0
Crab-E-Rad	50 pints/A	14.5	70	0.8	0	0	0
Benzar	21.5 quarts/A	20.0	58	2.0	0	0.5	0
Benzar	43 quarts/A	21.0	56	3.0	0	1.0	0
Check	----------	47.5	0	---	-	---	-

*Refers to setting on Scott's spreader

**Discoloration index = 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = permanent injury.

Treatments applied May 20 and June 10.

[a]One treatment only. All others received two.

Table 2. Pre-Emergence Control of Crabgrass in Lawn Turf with Various Chemicals - Series II. Athletic Field Area. Rhode Island Agricultural Experiment Station - 1955.

Material	Rate of Application	% Crabgrass Oct. 3	% Control	Discoloration** June 8	June 15	June 22
Scutl	Setting #5*	8.8	60	0	0	0
Scutl	Setting #7	9.5	57	0	0	0
Alanap 1F[a]	720 lbs./A	1.8	92	0	0	0
Alanap 1F	720 lbs./A	3.5	84	0	0	0
PMAS	5 pints/A	6.5	70	0.5	0	0
PMAS	7 pints/A	8.0	63	1.0	0	0
Crag-1	6 lbs./A	18.0	18	0	0	0
Crag-1	9 lbs./A	19.5	11	0	0	0
DuP 127	3 lbs./A	3.3	90	0	0	0
DuP 127	4 lbs./A	2.8	87	0	0	0
Methin	3 lbs./A	26.0	0	0	0	0
Methin	6 lbs./A	24.0	0	0	0	0
ACP L-841	3 lbs./A	17.5	20	0	0	0
ACP L-842	3 lbs./A	17.5	20	0	0	0
Crab-E-Rad	25 pints/A	8.8	60	0	0	0
Crab-E-Rad	50 pints/A	4.3	80	0	0	0
Benzar	21.5 quarts/A	7.5	66	0.25	0	0
Benzar	43 quarts/A	3.8	83	0.25	0	0
Check	----------	21.8	0	0	0	0

*Refers to setting on Scott's Spreader

**Discoloration index: 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = permanent injury.

Treatments applied June 1 and 22.

[a]One treatment only. All others received two.

Table 3. Pre-Emergence Control of Crabgrass in Lawn Turf with Various Chemicals - Series III, Campus Area. Rhode Island Agricultural Experiment Station - 1955.

Material	Rate of Application	% Crabgrass Sept. 2	% Control	Discoloration** June 10	June 17	July 1
Scutl	Setting #5*	5.6	0	0	0	0
Scutl	Setting #7*	3.0	38	0	0	0
Planap-1F[a]	720 lbs./A	0.6	88	0	0	0
Planap-1F	720 lbs./A	1.5	69	0	0	0
PMAS	5 pints/A	2.1	56	0	0	0
PMAS	7 pints/A	1.0	79	0	0	0
Crag-1	6 lbs./A	4.5	6	0	0	0
Crag-1	9 lbs./A	3.5	27	0	0	0
DuP 127	3 lbs./A	0.6	88	0	0	0
DuP 127	4 lbs./A	0.5	90	0	0	0
Methin	3 lbs./A	0.9	81	0	0	0
Methin	6 lbs./A	5.0	0	0	0	0
ACP L-841	3 lbs./A	2.9	40	0	0	0
ACP L-842	3 lbs./A	4.3	11	0	0	0
Crab-E-Red	25 pints/A	2.4	50	0	0	0
Crab-E-Red	50 pints/A	1.4	50	0	0	0
Benzar	21.5 quarts/A	2.5	48	0.5	0	0
Benzar	43 quarts/A	2.3	52	0.5	0	0
Check	----------	4.8	0	---	-	-

*Refers to setting on Scott's Spreader.
**Discoloration index: 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, 5 = permanent injury.
Treatments applied June 3 and 27.
[a]One treatment only. All others received two.

CRABGRASS CONTROL WITH ORGANIC ARSENICALS - 1955

R. E. Engel and C. R. Skogley[1]

Some experimental arsenicals and standard crabgrass herbicides were compared for crabgrass control at the New Jersey Agricultural Experiment Station of Rutgers University during 1955. Phenyl mercury acetate, potassium cyanate and sodium arsenite were used as standard post-emergence treatments. The experimental materials used were monoethanolamine arsonate, methylarsonic acid, disodium benzylarsonate, cacodylic acid (dimethylarsinic acid), and disodium methyl arsonate.[2] The chemical treatments were made to a turf that was predominantly Kentucky bluegrass. The turf area was seeded with crabgrass in early June to help assure a uniform stand. All treatments were made on plots 5 x 20 feet and a total of three applications were made for all treatments, except as indicated in the table. The dates of application were August 15, 22, and 26. Soil moisture was high to very high during this period. All applications were made with water spray at a rate of 100 gallons per acre.

Turf injury ratings were taken 11 and 38 days after the third treatment. Injury was estimated on the basis of 0 = none, 1 = trace, 2 = moderate, 3 = severe, and 4 = very severe. Estimates given in the accompanying table are based on the average readings for 2 and 3 observations for the respective dates. The first injury readings are a measure of temporary discoloration and the second readings are a measure of more enduring injury based on plant kill.

Crabgrass control readings were taken on September 29, and they were based on three independent observations. The percentage control reported is a composite of the three individual readings.

Results and Conclusions

The results show good control with the standard materials, potassium cyanate and phenyl mercury acetate. Among the experimental arsenicals used, the best results were obtained with methyl arsonic acid, cacodylic acid, and disodium methyl arsonate. The latter gave less turf injury; however, further testing of methyl arsonic acid and cacodylic acid might show other rates which give good control with less injury. These materials are worthy of further testing. The disodium methyl arsonate preparation (1) with the lower arsenic trioxide equivalent (0.12 lb. As_2O_3/acre/4 pound application) gave satisfactory control with less injury as compared with the preparation (2) with a higher arsenic trioxide equivalent

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[1]Associate Research Specialist and Research Associate in Farm Crops, Rutgers University, respectively. R. J. Aldrich, Agronomist, U. S. Department of Agriculture, ARS, Field Crops Research Branch, cooperated in the conduct of this work, and is recognized as a joint leader of the study.

[2]The disodium methyl arsonate (1) and the benzylarsonate preparations were supplied by the W. A. Cleary Corporation and all other arsenicals were supplied by the American Smelting and Refining Company.

(0.50 lb. As_2O_3/acre/4 pound application.) These results suggest the arsenical impurities may be important in formulating disodium methyl arsonate for crabgrass control.

Disodium methyl arsonate may be considered an effective chemical for controlling crabgrass. Its degree of effectiveness did not differ greatly from that of potassium cyanate or phenyl mercury acetate. The results and observations suggest phenyl mercury acetate preparations are more selective and give better control than disodium methyl arsonate when they are used skillfully under favorable conditions. While bentgrass was scarce in the test area, there were indications that disodium methyl arsonate can be used more successfully in the presence of this species than is possible for potassium cyanate. The disodium methyl arsonate preparations, like all new materials that appear on the market, should be studied carefully with regard to plant tolerances, season of application, temperature, and moisture relationships.

Crabgrass control with post-emergence treatments on established turf. New Brunswick, N. J. 1955.

Treatment	Rate lbs./A	No. Treat.	Injury 11 days after final treat.	Injury 39 days after final treat.	Crab-grass control
Check	0	-	0	0	28.3
Potassium cyanate	8	3	2.0	1.44	94.6
Phenyl mercury acetate	7 (pts.)*	3*	1.3	0.56	96.8
Na As + 2,4-D	1 - ¼	3-2	2.5	2.22	85.0
Disodium benzyl arsonate	6	3	1.3	0.89	53.6
" " "	12	3	1.8	1.11	72.4
Monoethanolamine arsenate	2	2	2.0	1.78	47.2
Methylarsonic acid	3	3	2.3	1.51	98.6
" "	6	2	3.0	2.44	99.1
Cacodylic acid	3/4	3	4.0	3.67	98.9
" "	1½	1	2.0	1.44	96.8
Disodium methyl arsonate (1)	4	3	1.0	0.56	92.1
" " "	8	3	2.7	2.11	98.6
" " " (2)	4	3	1.8	1.56	75.8
" " "	8	3	3.2	2.56	95.1

*A 10 percent solution of phenyl mercury acetate was applied at a rate of 7, 7, and 5 pints per acre respectively.

(1) A 50 percent solution prepared by the W. A. Cleary Corp.

(2) A 2 lb. per gallon solution prepared by the American Smelting and Refining Company.

(1954) THE EFFECT OF HERBICIDES UPON POTATOES USED FOR CHIPPING

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

This work was a continuation of research reported previously (1,2,3,4,5,6,7,8,9). The pre-emergence herbicidal treatments used are listed in Table 4. All the materials were applied in water at the rate of about 50 gallons per acre.

Both the Katahdin and the Russet Rural varieties of potatoes were grown. Katahdin was planted on 22 May, and Russet Rural on 24 May, 1954, at State College, Penna. Herbicides were applied on the Katahdin potatoes on 4 June, and on the Russet Rural potatoes on 7 June, 1954. The crop was dug on 7 October, and it was graded on 8 October, 1954. The first chipping tests were started on 8 October, 1954.

Yield data and weed counts were reported previously (4).

Chipping samples were mixed composites from the four field replicates and were 90 pounds in weight. One-third of the samples (A series) were put directly into curing storage. The rest of the samples were put into cool/cold storage for a period of 9 weeks (B series) at an average temperature of 50°F.

All these potatoes received a curing storage treatment of eight weeks duration at 70°F following their respective periods of cool/cold storage. These curing storage samples were 30 pounds in weight. Chipping tests were conducted on a biweekly basis, making a total of 5 observations per sample. The tests included chip taste, chip color (fry test), and specific gravity, and the data are given in Tables 1,2, and 3 respectively. Chip taste tests were performed only on those samples which had a chip color of 1 to 4 on the Research Laboratory Grade Scale. Per cent losses in curing storage, Table 5, and in cool/cold storage, Table 6, were calculated.

SUMMARY

The color of the potato chips was not effected by the use of the pre-emergence herbicidal materials. This held for 1951, 1952, 1953, and 1954.

For unknown reasons, the chip color was darker with the tubers from the hoed or weeded check plot than from the unhoed or unweeded check plot.

The freshly dug (A series) Katahdin potatoes had a better chip color than did the freshly dug Russet Rural potatoes. This was experienced for all four years.

The Russet Rural potatoes from the "B" series (those which had received 9 weeks of cool/cold storage before the curing storage treatment) were lighter in chip color than were the Katahdin potatoes. This was experienced for all four years.

Erratic data from year to year made it difficult to state whether or not the herbicide materials had any direct effect upon the chip taste. Limited data collected in 1954 and 1953 indicated no response. The 1952 data indicated an erratic, but adverse, response. Only the 1951 data indicated a definite adverse response.

The chip flavor of the two varieties, Katahdin and Russet Rural, were similar.

The herbicides had an erratic effect upon the specific gravity of the tubers. These responses were variable in both magnitude and direction for 1954, 1953, and 1952. The 1951 data indicated a straight line reduction in specific gravity of the potatoes.

These erratic specific gravity responses were in part caused by two interactions. The interaction between previous cool/cold storage before the curing storage period and herbicidal material was not consistent. It was not present significantly in 1954, but it was in 1953 and 1952. The design of the 1951 experiment did not permit such a study.

The major interaction, which caused the erratic responses in specific gravity, was the one between potato variety and herbicide material. Further, this interaction was complicated by the previous cool/cold storage treatment. In the 1954 work, the herbicides caused only a small increase in specific gravity of the Katahdin tubers in the "A" series and a general reduction in the "B" series. The Russet Rural tubers showed a more pronounced increase in specific gravity in the "A" series, and a large increase in the "B" series. This variety response agreed in general with the data for 1953 and 1952 (this comparison could not be made in 1951 because of the experimental design). The variety Katahdin appeared to be more responsive to changes in specific gravity and the trend was toward a reduction.

The potatoes of the variety Russet Rural had the usual higher specific gravity than those of the variety Katahdin for all four years.

Reducing sugar measurements were not made in 1954. However, the results for 1953, 1952, and 1951 indicated that the use of the herbicides did not alter the level of reducing sugar in the potato tubers.

The amount of reducing sugar present in the potato tubers varied as to the variety and the conditions of the previous storage before the period of curing storage. In the "A" series, the level was low and similar for both varieties. In the "B" and the "C" series, the amount was increased in the tubers, with the greater amount in the Katahdin than in the Russet Rural tubers.

The herbicidal materials had no effect upon the keeping quality of the potatoes in curing storage.

The potatoes of the variety Katahdin kept much better than the potatoes of the Russet Rural for all four years in all curing storage conditions.

The application of the pre-emergence herbicides did not alter the keeping quality of the tubers in cool/cold storage.

Although the losses in cool/cold storage were similar, the Katahdin potatoes kept a little better than did the Russet Rural potatoes.

Table 1.

1954 Penn State Herbicide Expt: Mean Percent Losses in Cool/Cold Storage for Potatoes for 18 Weeks

Herbicides		Varieties		
Mat.	Amt/A	Kat.	R.R.	Herb.$\bar{x}$
Check	hoed	3.0	4.3	3.7
Check	weedy	2.8	2.3	2.6
Dow G	25 lbs.	2.9	4.4	3.7
Dow G	15 lbs	3.1	5.0	4.1
Premerge	8 qts	2.9	4.4	3.7
Sinox Gen.	4 qts	3.2	4.0	3.6
Sinox Gen.	2 qts	3.1	4.8	4.0
CMU	2 lbs	2.9	4.0	3.5
CMU	1 lb	3.2	3.8	3.5
Variety Means		3.0	4.1	3.6

Stat. Anal	Herb.	Var.
F. Value	1.33	20.15
F. Sign	NS	HS
LSD-5%	1.2	0.6
LSD-1%	1.7	0.8

Table 2.

1954 Penn State Herbicide Experiment: Mean Chip Color Values for Potatoes with 0 and 9 Weeks of Previous Cool/Cold Storage

Herbicides		Previous Storage Periods - Weeks								
		0 Weeks (A)			9 Weeks (B)			0 to 9 Weeks (AB)		
Material	Amt/A	Kat.	R.R.	Herb. $\bar{x}$	Kat.	R.R.	Herb. $\bar{x}$	Kat.	R.R.	Herb. $\bar{x}$
Check	Hoed	4.2	5.0	4.6	7.2	7.0	7.1	5.7	6.0	5.9
Check	Weedy	3.2	4.4	3.8	6.6	5.6	6.1	4.9	5.0	5.0
Dow G.	25 lbs	3.4	3.8	3.6	7.2	7.0	7.1	5.3	5.4	5.4
Dow G.	15 lbs	3.2	4.0	3.6	7.2	6.6	6.9	5.2	5.3	5.3
Premerge	8 qts	4.0	4.4	4.2	6.8	6.2	6.5	5.4	5.3	5.4
Sinox Gen.	4 qts	2.8	3.6	3.2	6.8	6.6	6.7	4.8	5.1	5.0
Sinox Gen.	2 qts	3.4	4.6	4.0	6.6	6.4	6.5	5.0	5.5	5.3
CMU	2 lbs	3.6	4.4	4.0	7.2	5.6	6.4	5.4	5.0	5.2
CMU	1 lb	3.6	3.8	3.7	7.4	5.8	6.6	5.5	4.8	5.2
Var. $\bar{x}$		3.5	4.2	3.9	7.0	6.3	6.7	5.2	5.3	5.3

Stat. Anal.	F Value	F Sign	LSD 5%	LSD 1%	F Value	F Sign	LSD 5%	LSD 1%	F Value	F Sign	LSD 5%	LSD 1%
Cure Time	64.00	HS	0.5	0.6	44.05	HS	0.5	0.7	12.87	HS	0.6	0.8
Herb.	3.25	HS	0.6	0.8	1.74	NS	0.7	1.0	0.83	NS	0.8	1.1
Variety	24.00	HS	0.3	0.4	15.46	HS	0.3	0.5	0.0	NS	0.4	0.5

Table 3.

1954 Penn State Herbicide Experiment: Mean Specific Gravity Values for Potatoes with 0 and 9 Weeks of Previous Cool/Cold Storage

Herbicides		Previous Storage Periods - Weeks								
		0 Weeks(A)			9 Weeks(B)			0-9 Weeks (AB)		
Material	Amt/A	Kat.	R.R.	Herb. $\bar{x}$	Kat.	R.R.	Herb. $\bar{x}$	Kat.	R.R.	Herb. $\bar{x}$
Check	Hoed	717	773	745	771	741	756	744	757	751
Check	Weedy	751	763	757	747	798	773	749	781	765
Dow G.	25 lbs	709	830	770	735	814	775	722	822	772
Dow G.	15 lbs	737	792	765	719	772	746	728	782	755
Premerge	8 qts	719	816	767	751	821	786	735	819	777
Sinox Gen.	4 qts	749	779	764	746	784	765	748	781	755
Sinox Gen.	2 qts	698	770	734	722	771	746	710	770	740
CMU	2 lbs	733	791	762	753	784	768	743	788	755
CMU	1 lb	747	807	777	726	792	759	736	800	768
Variety Means		729	791	760	741	786	764	735	789	762

Stat. Anal.	F. Value	F. Sign	LSD-5%	LSD-1%	F. Value	F. Sign	LSD-5%	LSD-1%	F. Value	F. Sign	LSD-5%	LSD-%
Cure Time	1.20	NS	--	--	34.78	HS	0.0020	0.0026	19.14	HS	0.0015	0.0020
Herb.	2.60	S	0.0023	0.0031	2.00	NS	0.0027	0.0035	2.39	S	0.0021	0.0027
Variety	131.55	HS	0.0011	0.0014	51.55	HS	0.0013	0.0017	120.69	HS	0.0010	0.0013
Herb. x Var.	4.01	HS	0.0033	0.0043	2.89	HS	0.0038	0.0050	3.37	HS	0.0029	0.0038

Code (Sp. G.) = Code number x 0.0001 + 1.0000

Table 4.

Herbicidal Treatments Used for Chipping Tests

Amount/A	Trade Name	Chemical Name
8 qts. (60 lbs.)	DN Premerge	Alkanolamine Salt (Ethanol and Isopropanal Series) of dinitro-o-sec-butyl phenol. 53% (Equiv. 3 lbs. DNOSBP /gal)
2 & 4 qts. (2.5 & 5.1 lbs.)	SN Sinox General	Dinitro-o-sec-butyl phenol, 50% and dinitro-o-sec-Amylphenol, 10% (Equiv. 5.1 lbs. DNOSBP per gal.). Use 10 gal. No. 2 oil per gal. with DN material (Cobb says not necessary)
15 & 25 lbs.	Dow G.	Sodium Pentachlorophenate, 85%
1 & 2 lbs.	CMU	Karmex W.-3-p-chlorophenyl-1-1-dimethyl urea, 80%

Table 5.

1954 Penn State Herbicide Expt: Mean Percent Losses in Curing Storage for Potatoes with 0 and 9 Weeks of Previous Cool/Cold Storage

Herbicides		Previous Storage Periods - Weeks								
		0 Weeks (A)			9 Weeks (B)			0-9 Weeks (AB)		
Mat.	Amt/A	Kat.	R.R.	Herb.$\bar{x}$	Kat.	R.R.	Herb.$\bar{x}$	Kat.	R.R.	Herb.$\bar{x}$
Check	hoed	6.6	18.3	12.5	8.3	12.7	10.5	7.5	15.5	11.5
Check	weedy	7.0	14.0	10.5	7.0	25.1	16.1	7.0	19.6	13.3
Dow. G.	25 lbs.	8.0	21.6	14.8	8.0	13.3	10.7	8.0	17.5	12.7
Dow. G.	15 lbs.	8.6	19.3	14.0	7.0	9.7	8.4	7.8	14.5	11.2
Premerge	8 qts.	11.6	15.3	13.5	7.3	14.7	11.0	9.5	15.0	12.2
Sinox Gen.	4 qts.	10.0	12.6	11.3	7.0	12.0	9.5	8.5	12.3	10.4
Sinox Gen.	2 qts.	6.6	23.0	14.8	7.3	11.7	9.5	7.0	17.4	12.2
CMU	2 lbs.	10.3	13.0	11.7	9.3	12.0	10.7	9.8	12.5	11.2
CMU	1 lb.	9.3	17.0	13.2	8.3	11.7	10.0	8.8	14.4	11.6
Var. Means		8.7	17.1	12.9	7.7	13.7	10.7	8.2	15.4	11.8

Stat. Anal.	Herb.	Var.	Herb.	Var.	Herb.	Var.
F. Value	0.38	26.00	0.82	13.81	0.23	34.35
F. Sign	NS	HS	NS	HS	NS	HS
LSD-5%	--	3.8	--	3.7	--	2.8
LSD-1%	--	5.6	--	5.4	--	4.1

Table 6.

1954 Penn State Herbicide Expt: Mean Percent Losses in Cool/Cold Storage for Potatoes for 18 Weeks

Herbicides		Varieties		
Mat.	Amt/A	Kat.	R.R.	Herb. $\bar{x}$
Check	hoed	3.0	4.3	3.7
Check	weedy	2.8	2.3	2.6
Dow G.	25 lbs.	2.9	4.4	3.7
Dow G.	15 lbs.	3.1	5.0	4.1
Premerge	8 qts.	2.9	4.4	3.7
Sinox Gen.	4 qts.	3.2	4.0	3.6
Sinox Gen.	2 qts.	3.1	4.8	4.0
CMU	2 lbs.	2.9	4.0	3.5
CMU	1 lb.	3.2	3.8	3.5
Variety Means		3.0	4.1	3.6

Stat. Anal.	Herb.	Var.
F. Value	1.33	20.15
F. Sign	NS	HS
LSD-5%	1.2	0.6
LSD-1%	1.7	0.8

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Pre-emergent and Post-hilling Herbicide Tests on Potatoes[1]

R. S. Bell and E. J. Bannister, Jr.[2]

More economical methods of controlling weeds in potatoes, both before and after hilling, are needed to allow potato growers a better return on their investment. While the dinitros are generally satisfactory for pre-emergent weed control in Rhode Island, no material is known at the present time which is entirely satisfactory for post-hilling weed control.

Sawyer and Dallyn (2) found that dinitros gave the most satisfactory pre-emergent weed control with potatoes on Long Island. Aldrich and Campbell (1) also reported that dinitro formulations were satisfactory in tests in New Jersey. They found that one-half pound of CMU per acre, before emergence, inhibited weeds effectively for a long period of time. Crag I (Ses) and CMU were materials suggested to be tested for post-hilling weed control by the research coordinating committee of the Northeastern Weed Control Conference for 1955.

Materials and Methods

The field plots were located on a Bridgehampton silt loam on the Agronomy plots at Kingston, Rhode Island. They contained 5 rows of Katahdin potatoes, 32 feet long and spaced 3 feet apart. Rows 2 and 3 were harvested for yield estimates. The potatoes were planted on April 20 with 2000 pounds of 8-12-12-2 fertilizer per acre in bands. Previous to plowing the cover crop was top-dressed with 200 pounds per acre of cyanamid.

In this experiment CDEA, Alanap #2, Karmex DW, Dinitro (DN) Premerge were used as pre-emergent herbicides and Dalapon, Crag I, Crab-E-Rad and Karmex DW were used after hilling on another section of the test area. Three rates per acre of each chemical were used and there were 4 replicates of each treatment. The chemicals used, rates per acre, and chemical designations are shown in Table 1.

The pre-emergent plots were not cultivated until June 14 in order to see which annual weeds developed. The quackgrass in the area was not inhibited by the herbicides. The post-hilling section was cultivated often to keep the quackgrass in check. All potatoes were hilled on June 28 and the post-hilling herbicides were applied on that date using knapsack sprayers. The chemicals were directed at the soil so only small amounts hit the potato foliage. Standard fungicide and insecticide applicates were used as required during the season. The plots were harvested September 14 and 15.

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Results and Discussion

No foliar damage was noted from any of the herbicide applications. The average yields of U.S. #1 potatoes in bushels per acre are shown in Table 2. The total average yields of all plots in the pre-emergent tests was 480 and from the post-hilling, 507 bushels per acre. These higher yields may be partially due to early cultivation, which reduced the competition from quackgrass.

Pre-emergent Tests

In the pre-emergent trials, the average yields of potatoes treated with Alanap #2 were significantly lower than from the other treatments. The total average acre yield ranged from 430 bushels with Alanap #2 to 511 for DN Premerge. The check yields were 480 bushels. The lower yields on the Alanap #2 plots may have been due, in part, to a heavy infestation by annual weeds. Analysis of the data showed that the yields of potatoes were also significantly decreased by the high rates of CDEA and Karmex DW.

The percent annual weed cover on June 13 in the pre-emergent tests are presented in Table 3. The two most prevalent were common chickweed and spurry. A few plants of smartweed, lambs'-quarters and ragweed were scattered throughout the field.

The Karmex DW plots were practically free of weeds with a few showing on the DN Premerge plots. The weed stand was heavy on the check and Alanap #2 plots. The control was fair on plots which received CDEA. On the basis of the 1955 trials, Karmex DW and DN Premerge were the more satisfactory herbicides. The plots were rated for crab and barnyard grasses on August 30. These weeds were not uniformly distributed in the area. It appeared that pre-emergent herbicides had little or no effect on the development of annual grasses following hilling.

Post-hilling Tests

In the post-hilling tests the total average bushels of U.S. #1 potatoes per acre ranged from 459 for Dalapon to 531 for Crag I. The average yield on the check plots was 512 bushels. No significant differences were found among the treatments with the exception of the consistently lower yields from Dalapon. There were no significant differences due to increased rates. The annual weeds in post-hilling tests were principally crabgrass with a scattering of barnyard grass. No plots were free of crabgrass. Data presented in Table 3 suggest that Dalapon and Crag I at the high rates reduced the incidence of crabgrass. There was insufficient barnyard grass to allow sound conclusions to be reached concerning the possibility of its control.

The specific gravities were determined for composite samples of potatoes from each treatment. Table 4 shows there was little difference among them. The specific gravity range in the various control plots was from 1.0584 to 1.0641 with a comparable range with the other treatment. The two lowest noted were from the high rates of Crab-E-Rad and Karmex DW in the post-hilling test.

These were 1.0500 and 1.0489, respectively.

Many of the potato tubers from plots treated with Crab-E-Rad were severely roughened and cracked No estimate was made of the percentage of damaged potatoes but they were great enough so that the Crab-E-Rad treated plots could be recognized readily as the potatoes came over the digger apron. It is not known whether the herbicide was translocated from foliage or absorbed by the roots. Analysis of the tubers were made by the Department of Agricultural Chemistry and are shown in Table 5. The analyses indicated a fairly direct relationship between the amount of arsenate applied to the potato crop and the parts per million found in the damaged tubers. The greatest amount found, 1.8 ppm, As_2O_3, was lower than the tolerance set by the Miller Bill, 3.5 ppm. Three tests were made to compare the peel to the remainder of the potato. In none of these tests did the arsenic content of the peel differ from that of the potato. This damage to tubers by the disodium methyl arsenate eliminates it for consideration as a herbicide for potatoes.

Conclusions

It is concluded from these tests that while the dinitro pre-emergent herbicides are satisfactory, a need still exists for safer, more efficient weed-killers. This is particularly true for the post-hilling control of weeds. Karmex DW looks promising as a pre-emergent herbicide and Crag I seems to lessen the population of annual grasses after hilling without reducing the yield of potatoes. Further trials are required before specific recommendations can be formulated.

Summary

The following materials were applied to Katahdin potatoes as pre-emergent herbicides: CDEA, Alanap #2, Karmex DW and a Dinitro (DN) Premerge. Alanap #2 failed to control annual weeds with consequent reduction in potato yields. High rates of CDEA and Karmex DW depressed the yields. Satisfactory weed control was obtained with Karmex DW and the DN Premerge. In the post-hilling tests, Dalapon depressed yields of potatoes while Crag I and Dalapon, at the high rates, gave some control of crabgrass. None of the materials tested was entirely satisfactory in over-all weed control in the post-hilling tests. Crab-E-Rad damaged some of the potato tubers and increased their arsenic contents. The specific gravity of the tubers from the various treatments were similar, the lowest occurring in the post-hilling tests at the high rates of Crab-E-Rad and Karmex DW.

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Table 1. Herbicides Used in Pre-emergent and Post-hilling Weed Control in Katahdin Potatoes at the R. I. Agr. Exp. Sta. (1955)

Herbicide	Pounds Per Acre Low	Medium	High	Description of Chemical Designation
			Pre-emergence	
CDEA	3	4 1/2	6	a-chloro-N, N-diethytacetamide
Alanap #2	4	6	8	(N-1 napthylphthalimide)
Karmex DW	1/2	1	1 1/2	3-(3, 4-dichlorophenyl)-1, 1-dimethylurea
DN Premerge	1 1/2	2 1/4	3	Alkanolamine salts of dinitro-o-sec-butylphenol
			Post-hilling	
Dalapon	1	2	3	2, 2-dichloropropionic acid
Crag I	6	8	10	Sodium 2, 4-dichlorophenoxyethyl sulphate
Crab-E-Rad (31.5%)	15	20	25	Disodium methyl arsonate
Karmex DW	1/2	1	1 1/2	3-(3, 4-dichlorophenyl)-1, 1-dimethylurea

Table 2. Average Yields in Bushels of U.S. #1 Katahdin Potatoes from the Herbicide Tests at the R. I. Agr. Exp. Sta. (1955)

Herbicides	Rates Low	Medium	High	Average
		Pre-emergence		
CDEA	505	496	464	488
Alanap #2	460	461	369	430
Karmex DW	521	489	462	491
DN Premerge	491	532	511	511
Check	475	493	471	480
Average	490	496	455	480
L.S.D. at .05	Treatments 43, Rate 38, TxR 33			
		Post-hilling		
Dalapon	464	473	441	459
Crag I	509	531	552	531
Crab-E-Rad	476	553	518	515
Karmex DW	500	535	523	519
Check	545	509	481	512
Average	499	520	503	507
L.S.D. at .05	Treatments 55, TxR 43			

Table 3. Average Percent Weed Cover on Pre- and Post-emergent Herbicide Tests on Katahdin Potatoes at the R. I. Agr. Exp. Sta. (1955)

Herbicide	Rates Low	Medium	High	Average
	Percent Annual Weed Cover, June 13			
		Pre-emergent		
CDEA	27	22	31	27
Alanap #2	75	95	67	79
Karmex DW	1	0	0	0
DN Premerge	9	4	0	4
Check	95	94	100	96
Average	41	43	40	
	Percent Crabgrass Cover, August 30			
		Post-hilling		
Dalapon	30	35	15	27
Crag I	50	45	33	43
Crab-E-Rad (31.5%)	60	65	55	60
Karmex DW	60	38	53	50
Check	78	93	75	82
Average	56	55	46	

Table 4. Specific Gravity of Potatoes Grown in Herbicide Tests at the R. I. Agr. Exp. Sta. (1955)

Herbicide	Rates Low	Medium	High
	Pre-emergence		
CDEA	1.0613	1.0622	1.0652
Alanap #2	1.0620	1.0609	1.0582
Karmex DW	1.0593	1.0630	1.0592
DN Premerge	1.0590	1.0573	1.0581
Check	1.0605	1.0611	1.0641
	Post-hilling		
Dalapon	1.0638	1.0625	1.0616
Crag I	1.0590	1.0693	1.0599
Crab-E-Rad	1.0571	1.0598	1.0500
Karmex DW	1.0615	1.0585	1.0489
Check	1.0641	1.0584	1.0605

Table 5. PPM As_2O_3[1] from Tubers Grown in Plots Treated with Disodium methyl arsonate

	Rate Low	Medium	High	Check
Smooth	0.2	0.4	0.5	0.0
Netted	1.3	1.2	1.8	
	Miller Bill Tolerance 3.5			

[1]Analyses by Charles Olney, Dept. of Agr. Chem. at R. I. Agr. Exp. Sta. (1955)

EVALUATION OF LAY-BY SPRAYS IN POTATOES ON WEED CONTROL, YIELD, SPECIFIC GRAVITY, AND STORAGE LIFE[1]

R.L. Sawyer, S. L. Dallyn and D. J. Cotter[2]

Annual weeds, particularly of the grass family, are a late season problem in many potato fields on Long Island. The increased use of potato combines has magnified this problem since the weeds tend to hold the soil together and the combine separation of potatoes from the vines and dirt is very difficult. The change in variety from Green Mountain, with its upright dense foliage, to Katahdin, with its sparse spreading foliage, has also magnified the late grass problem.

This experiment was set up to evaluate the effect of lay-by sprays on potato vine tolerance, weed control, yield, internal quality, chipping quality, and storage quality. Included were chemicals which have previously looked promising and new materials which appeared to have possibilities. In general the chemicals used in 1954 (3) had a slight depressing effect on yield. Aldrich and Campbell (1) found that Sesin, Natrin and Dalapon showed promise for the control of late germinating weeds. Cunningham and Trevitt (2) have tried several materials as lay-by sprays for controlling broad leaved weeds in potatoes.

MATERIALS AND METHOD

Katahdin potatoes planted April 22 were given the normal cultural treatments for Long Island until July 8, 1955, when the lay-by sprays were applied. At this time the vines had practically covered the ground. The date of last cultivation was June 21. The rainfall and irrigation water received for the month after treatment are as follows measured in inches: July 12, irrigation 1:00; July 20, rain .04; July 22, irrigation 1:00; July 25, rain .04; July 26, rain .03; July 28, rain .06; July 29, rain .09; August 1, irrigation 1.00.

The field plot design was randomized block with 4 replications. Plots were single rows 30 feet long. An overall application was made to the treatment row and the area between rows on either side of the treated row using a hand sprayer delivering 50 gallons per acre. Treatment rows were separated by buffer rows. Sprayer wheel rows were not included in the experiment.

Potato vine tolerance ratings were made on July 14 and again on July 28. Weed control ratings were made August 24. Yield and specific gravity data were taken at harvest on September 13. Samples from each plot were placed in storage for shrinkage and sprouting data and for processing into potato chips. The storage data will be presented in next year's report since it is impossible to obtain the results of this year for the current year's report. Included in this year's report are the storage results from the 1954 experiment. Tubers were stored at 40°F. and 50° F. at harvest on September 28, 1954. Shrinkage and sprouting data were taken on January 6, 1955 for tubers stored at 50° F. and August 8, 1955 for tubers held at 40° F.

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RESULTS AND DISCUSSION

Potato vine tolerance, weed control, yield, and quality results are given in Table 1 with the materials and dosages used.

Table 1. Potato Vine Tolerance, Weed Control, Yield and Specific Gravity of Tubers from Plots Treated with Lay-by Sprays.

Materials	Lbs./ Acre	Potato Vine* Tolerance	Weed** Control	Yield U.S. No. 1 Bushels/ Acre	Specific Gravity
Craig I	4	5.2	7.0	566	1.0630
Dalapon	4	3.0	7.0	529	1.0590
Sesin	4	9.0	4.6	557	1.0632
Natrin	4	7.2	5.6	561	1.0615
Alanap 2	4	8.7	6.0	630	1.0637
3Y9	3	8.5	5.6	595	1.0660
CDAA	3	6.7	3.6	587	1.0612
"	6	5.7	5.6	524	1.0602
CDEA	3	8.7	5.3	635	1.0637
"	6	7.0	6.3	607	1.0622
CDEC	3	8.5	5.3	566	1.0627
"	6	8.5	5.6	574	1.0627
Karmex DW	1/2	4.0	5.6	555	1.0602
"	3/4	3.5	8.6	520	1.0585
Check		8.5	1.6	597	1.0615
L.S.D.	5%	1.1	3.4	68	.0028
	1%	1.4	4.6	92	.0037

* Potato Vine Tolerance Rating, 9= no damage and 1= vines dead
** Weed Control Rating, 9= no weeds, 1= no control of weeds, 5= commercially acceptable weed control.

Sesin, Natrin, Alanap 2, 3Y9, CDEA and CDEA gave relatively little if any foliage damage. Commercial acceptance by farmers would be very difficult to attain with any material which causes burning or malformation even though this may have no detrimental reflection on yield of U. S. No. 1 tubers.

All of the materials except Sesin and CDAA at 3 lbs./A. gave satisfactory commercial control of grasses. At the time weed readings were made the check plots had considerable grass while Karmex plots at 3/4 lbs./acre were practically weed free. Craig, Dalapon, CDEA at 6 lbs./A. and Alanap 2 also looked good when compared to the check plots.

Plots treated with Dalapon, CDAA at 6 lbs./A. and Karmex DW at 3/4 lb./A. yielded significantly less U. S. No. 1 tubers than check plots. Plots with other treatments were not significantly different from check plots. There was no general depressing effect on yields due to chemicals when an average for all chemicals was compared with the check treatment.

Tubers from Karmex DW plots at 3/4 lb./A. had a lower specific gravity than tubers from check plots. Similar decreases in quality were observed

from pre-emergence sprays with substituted ureas in 1954 (5). Tubers from 3Y9 plots had significantly better internal quality than tubers from all other treatments except CDEA at 3 lbs./A. and Alanap 2 plots. Alanap 2 looked promising in terms of quality in 1954 (3) also.

The storage results for 1954 (3) are shown in Table 2. These materials were also included in 1955 at the same dosage. Tubers from Dalapon and Sesin plots had significantly less sprouting than tubers from any of the other plots. This data indicates the importance of following harvested tubers through storage life in experiments where chemical sprays are applied during the growing season. A material which gave very good weed control would be worthless if it were going to increase sprouting in storage.

Table 2. Sprouting and Shrinkage of Tubers Stored at 40° F. and 50° F. from Lay-By Spray Plots.

Material	Lbs./Acre	50° F. Gram of sprouts per kilogram of tuber	50° F. % Total Shrinkage	40° F. % Total Shrinkage
Dalapon	4	8.3	6.1	12.1
Craig I	4	7.3	5.7	10.9
Sesin	4	8.1	5.6	10.7
Natrin	4	5.3	5.4	11.0
Alanap 2	4	7.7	5.6	10.9
Check		6.7	5.7	11.2
L.S.D.	5%	1.2	NS	NS
	1%	1.7	NS	NS

In an overall evaluation of the materials, Natrin, Alanpa 2, 3Y9, CDEA and CDEC look promising although there are no storage results with the latter three. In future trials 3Y9, CDEA and CDEC should be tried at higher dosages to determine if better weed control can be obtained without detrimentally affecting the other factors being studied. Even though Natrin tends to give some injury and weed control with Natrin and Alanap 2 is not exceptional, they merit careful consideration from an overall standpoint. The only material which gave exceptional weed control was Karmex DW. However, in an overall evaluation Karmex DW was poor.

SUMMARY

1. The materials listed in Table 1 were applied as lay-by sprays to potatoes and evaluated from the standpoint of potato vine tolerance, weed control yield of U. S. No. 1 tubers and specific gravity.

2. Sesin, Natrin, Alanap 2, 3Y9, CDEA and CDEC gave little if any foliage damage.

3. Karmex DW at 3/4 lb./A. gave excellent weed control. All materials except CDAA at 3 lbs./A. and Sesin at 4 lbs./A. gave commercially acceptable control.

4. Plots treated with Karmex DW at 3/4 lb./A., CDAA at 6 lbs./A. and Dalapon at 4 lbs./A. yielded significantly less U.S. No. 1 tubers than check plots.

5. Tubers from Karmex DW plots at 3/4 lb./A. had a lower specific gravity than tubers from check plots. Tubers from 3Y9 plots at 3 lbs./A. had a better specific gravity than tubers from all other treatments except CDEA at 3 lbs./A. and Alanap 2 at 4 lbs./acre.

6. Tubers from Natrin plots had significantly less sprouting than tubers from any of the other treatments included in the storage experiment. Tubers from Sesin and Dalapon plots had more sprouting than tubers from check plots.

7. In an overall evaluation, Natrin, Alanap 2, 3Y9, CDEA and CDEC merit consideration in future lay-by work.

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SUBSTITUTED UREAS FOR PRE-EMERGENCE WEED CONTROL IN POTATOES[1]

R. L. Sawyer, S. L. Dallyn and D. J. Cotter[2]

The purpose of this experiment was to determine if low dosages of pre-emergence substituted urea sprays would give good weed control without the detrimental effects on quality and yield encountered in 1954 (1) when a dosage of 1-½ pounds per acre was used.

MATERIALS AND METHODS

Katahdin potatoes were planted on April 6 in rows 34 inches wide and fertilized with a ton of 7-7-7 per acre. Herbicidal sprays were applied at 50 gallons per acre on May 10 when the first plants were starting to break through the ground. Moisture, in inches, for the remainder of May was as follows: May 17, rainfall .14; May 23, irrigation 1.00; May 24, rainfall .03; May 26, rainfall .34; May 30, rainfall .16; May 31, rainfall .14. Weed counts were made on June 7. Normal cultivation was started June 13. Potato vine tolerance readings were made several times during the growing season. Yield and specific gravity of tubers were taken at harvest on September 20.

The field design was randomized block with four replications. Plots were four rows wide and 25 feet long.

RESULTS AND DISCUSSION

Comparable weed control was attained with all materials. For the two week period following application there was no appreciable rainfall. Thus, an irrigation application was made to help activate the materials. In this two week period a few weeds in all plots had grown beyond the stage where they would be affected by the materials after activation. As the weed counts indicate, small weeds were starting in large numbers on the check plots by June 7. At this time these later weeds were still being controlled by all of the sprays.

No foliage damage due to pre-emergence chemicals was observed at any time during the growing season. There were no detrimental effects on quality or yield from the use of the chemical sprays.

[1] Paper No. 397, Department of Vegetable Crops, Cornell University

[2] Long Island Vegetable Research Farm, Riverhead, N. Y.

Table 1. The Effect of Several Pre-emergence Sprays on Weed Control, Yield and Specific Gravity of Tubers.

Materials	Dosage	Weed Count 9 sq. ft.	Yield B./A. U. S. No. 1	Specific Gravity
DNOSBP (amine salt)	3	7	589	1.0635
KARMEX DW	1/2	13	568	1.0640
Karmex W	1/2	9	557	1.0635
Karmex DW	3/4	12	563	1.0635
Karmex W	3/4	5	520	1.0635
Karmex DW	1	6	526	1.0625
Karmex W	1	6	553	1.0640
Check		69	576	1.0632

SUMMARY

1. Karmex DW and W were compared with a DNOSBP (from amine salt).

2. All gave comparable weed control with no effect on potato vine tolerance, yield of U. S. No. 1 tubers and specific gravity of tubers.

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(1) Sawyer, R. L. and S. L. Dallyn. Pre-emergence herbicides and cultivation for weed control in potatoes. NEWCC Proc. pps. 227-229. 1955.

THE EFFECT OF 2,4,5-TRICHLOROPHENOXYETHYL SULFATE AND ITS DIETHANOLAMINE DERIVATIVE ON THE QUALITY OF TOMATO FRUIT[1]

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

Abstract[3]

During the past two years several investigations have reported satisfactory weed control with 2,4,5-trichlorophenoxyethyl sulfate without reduction in tomato yields. Information is needed regarding 2,4,5-trichlorophenoxyethyl sulfate effects on tomato fruit quality. At this Station, periodical studies revealed that 2,4,5-trichlorophenoxyethyl sulfate sometimes increased the amount of cracking in the fruit.

The purpose of the present investigation was to study the effect of 2,4,5-trichlorophenoxyethyl sulfate on fruit quality as measured by taste of juice, chemical composition of fruit and the incidence of fruit cracking and blossom end rot.

2,4,5-trichlorophenoxyethyl sulfate and its diethanolamine derivative were sprayed at rates of 2½ and 5 pounds per acre on tomato plants 3 weeks after transplanting and during early blossom in the summer of 1954 (1). Since 2,4,5-trichlorophenoxyethyl sulfate treatments applied shortly after transplanting have generally been very toxic to tomato plants, this discussion concerns only fruit from late applications. Fruit samples were taken for chemical analyses September 15 and 30. Each sample was ground in a commercial food chopper, then lyophilized. The dried samples were then analyzed in the laboratory for total nitrogen, phosphorus, potassium, sodium, total acids, total carbohydrates and percentage dry matter. Applications of 5 pounds of either chemical significantly increased total nitrogen but decreased total acid content of the fruit. Total nitrogen and total acids were not affected by applications of 2½ pounds of either chemical. All chemical applications of either rate of 2,4,5-trichlorophenoxyethyl sulfate or the 2½ pound rate of the diethanolamine derivative decreased phosphorus, whereas 5 pound applications of the diethanolamine derivative had no effect. Chemical applications had no significant effect on the total carbohydrates, potassium or percentage dry matter of the tomato fruit.

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[1]Acknowledgement is made to the Carbide and Carbon Chemical Company for their support of this study.

[2]Research Fellow in Farm Crops, Rutgers University, the State University of New Jersey, and Agronomist, Field Crops Research Branch, ARS, U.S. Dept. of Agriculture, in cooperation with the New Jersey Agricultural Experiment Station, New Brunswick, N. J.

[3]Abstract of a manuscript to be published in a forthcoming issue of WEEDS.

Three and 6 pounds per acre of 2,4,5-trichlorophenoxyethyl sulfate were applied during July 1955 to tomato plants in blossom. As the fruit was harvested, a "map tracer" was used to record the extent of fruit cracking and blossom end rot. A penetrometer was employed to record the relative skin strengths of fruit since it was thought that this might be correlated with the incidence of cracking. 2,4,5-trichlorophenoxyethyl sulfate applied at 6 pounds per acre significantly increased fruit cracking and 3 pounds increased cracking slightly but not significantly. 2,4,5-trichlorophenoxyethyl sulfate applied at 6 pounds per acre caused the only significant increase in blossom end rot. Skin strength readings could not be satisfactorily correlated with the incidence of fruit cracking. Additional fruit samples were processed into tomato juice. Taste tests of juice are to be made following storage for 3 and 9 months. These tests have not been completed.

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Effect of Granular Herbicides On Yields Of Tomatoes and Sweet Potatoes 1,2/

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The data presented here constitute a progress report on the continuation of research on granular herbicides begun in 1952. Earlier phases of this work have been described previously (1, 2, 3, 4). The purpose of this report is to make the accumulating data on this subject available on a current basis.

Granular herbicide trials in previous years have given encouragement for the idea that an increased selectivity may be obtained with an herbicide when used in granular form as compared to its use in spray form on a crop. This physical selectivity added to the inherent chemical selectivity of an herbicide offers the possibility of broadening its use to include crops which will not tolerate spray applications. It also gives a greater margin of safety on tolerant crops. The results of the 1955 trials presented here offer confirmation of the results of previous years with respect to granular herbicides.

Materials, Methods, and Results

Experimental materials, conditions, procedures, and results are presented in a concise, standard form for each trial. This is followed by a brief summary and table of conclusions.

Treatments were applied overall on the crops in both the spray and granular forms. Granular materials were removed from the foliage by dragging a burlap bag over the row.

All treatments were applied at lay-by time. The primary purpose of the trials was to determine the effect of the treatments on the crops in terms of injury symptoms and yield.

1/ Contribution from the Plant Physiology Department, Virginia Truck Experiment Station, Norfolk. Paper No. 124, Journal Series. Approved for publication November 7, 1955.

2/ Grateful acknowledgment of assistance in a portion of this work is made to the Columbia-Southern Chemical Company for a grant-in-aid and to the manufacturers of the other materials for generous assistance in the preparation of experimental lots.

TRIAL I. Comparison of Lay-by Applications of Granular and Spray Forms of CIPC, Dalapon, CIPC-Crag Combination, Natrin, and CMU on Tomatoes.

Trial Location: Norfolk Station field.
Soil Type: Sandy clay loam. Crop Variety: Rutgers. Exp. Design: Rand. block. No. Reps.: 4. Plot Size: 40 ft. of 7 ft. row. Plant Spacing: 3 ft. Transplanting Date: 5/4/55. Treatment Date: 6/23/55. Developmental Stage at Treatment Time: Early fruiting stage. Some tomato fruits 2.0 inches in diameter. Harvest Period: 7/15 - 8/15. Cultivation Practice: Usual cultivation as needed. Hand Weeding: As needed to keep all plots free of weeds. Treatments and Rates: See table of yield results.
Rainfall Record: For three week period following treatment. Soil moisture at treatment time - high. Rainfall - 1st wk. 0.49 in., 2nd wk. 0.80 in., 3rd wk. 0.94 in. Total for three week period 2.23 in.
Temperature Record: For three week period following treatment in degree-hours above 0° F. 1st wk. 13153, 2nd wk. 14687, 3rd wk. 13394. Total for three week period 41234.

Observations: Extremely dry weather followed by a heavy rain in the early fruiting stage caused a heavy loss of early fruit in all plots due to blossom end rot and stem end rot. Later harvests were not appreciably affected by these rots.

Very striking differences in the effect of spray and granular applications of Dalapon were apparent in 2 to 3 days after treatment. Sprayed terminal foliage became chlorotic and fruits less than 2 inches in diameter and all blossoms dropped in a period of 2 to 3 weeks. Slight chlorosis and malformation of the new growth was noticed in the granular Dalapon treated plots. Least injury of the crop due to granular Dalapon was noted in the granular tobacco plots. Yields reflected the extremes between spray and granular effects.

Sprays of CMU caused severe foliage injury symptoms in 2 to 3 days. Granular applications of CMU at the same rate on No. 2 vermiculite did not cause noticeable foliage injury where the material was thoroughly brushed off the foliage immediately after treatment. Some injury was apparent on limited areas in the granular CMU plots and was considered to be due to the presence of a small percentage of particles above 100 mesh sieve size present in this granular material which were not removed from the foliage by the brushing technique. It appeared that an air blast on the foliage might be a practical solution to this problem.

CIPC and Natrin treatments did not produce noticeable foliage or stem injury symptoms.

Mixtures containing Crag Herbicide No. 1 produced foliage injury symptoms similar to those produced by 2,4-D but the effect was not extensive or severe.

Yield Results:

Chemical	Acre Rate Lbs.	Method of Application	Average Yield Lbs./10 Plants
CIPC	2	Granular No. 2 Verm. 40.5 lbs.	55.4
CIPC	2	Granular No. 2 Verm. 28.0 lbs.	63.7
CIPC	2	Granular 30-60 Attaclay 48.0 lbs.	61.8
CIPC	2	Spray 50 gals. water	59.4
CIPC	4	Spray 50 gals. water	55.8
CIPC + Crag	2 + 2	Granular No. 2 Verm. 32.0 lbs.	49.4
CIPC + Crag	2 + 2	Spray 50 gals. water	53.8
Dalapon	6	Granular tobacco 44.0 lbs.	50.7
Dalapon	6	Granular 30-60 Attaclay 44.0 lbs.	53.3
Dalapon	6	Spray 50 gals. water	22.1
Natrin	4	Granular 30-60 Attaclay 46.0 lbs.	50.2
Natrin	4	Spray 50 gals. water	63.2
CMU	1	Granular No. 2 Verm. 40.5 lbs.	41.2
CMU	1	Spray 50 gals. water	37.2
Control	0	- - - - -	54.6
L.S.D. 5%			14.6
1%			16.9

Conclusions:

1. These results combined with those of previous years indicate very strongly that Rutgers tomatoes have a practical tolerance of 2 lbs. of CIPC per acre in either spray or granular form at lay-by.

2. Natrin at 4 lbs. per acre was tolerated in either spray or granular form by Rutgers tomato plants at lay-by without injurious effects on soil of high fertility level. These results confirm those of previous years but commercial field plots in 1955 indicated that injury might be expected on soils of low fertility.

3. The greater selectivity of the granular applications of 6 lbs. per acre of Dalapon compared to spray applications of Dalapon at the same rate at lay-by on Rutgers tomatoes confirmed the 1954 results on this granular and spray comparison.

4. CIPC and Crag in combination at a rate of 2 lbs. of each chemical applied at lay-by on Rutgers tomatoes was not severely injurious in either spray or granular form. Further study is needed to determine the effect of this combination on the crop. Its excellent weed controlling properties may justify further consideration even though some foliage effects were observed.

5. CMU at 1 lb. per acre applied in spray form at lay-by severely damaged the foliage of Rutgers tomatoes. The same amount at the same time applied in granular form on No. 2 Vermiculite produced much less foliage injury. Yield results, however, indicate that both forms of application

6. Observations on weed control indicated that granular applications of herbicides may give somewhat better weed control than sprays under the foliage spread of the tomato plant.

TRIAL II. Comparison of Lay-by Applications of Granular CIPC and Granular Natrin on Tomatoes in Commercial Fields in Observational Trials.

Purpose: To conduct small observational trials in a number of commercial fields to find obvious defects in the methods preliminary to small yield trial plots in commercial fields in 1956. Materials used were restricted to granular forms of Natrin and CIPC due to the limitations of time.

Trial Locations: (1) Edwin Brock Farm, Norfolk, Va. (2) R. E. Williams Farm, Norfolk, Va. (3) Preston Scott Farm, Cape Charles, Va. (4) George Tinkham Farm, Cape Charles, Va. (5) V. G. Doty Farm, Eastville, Va. (6) Brooks Johnson Farm, Accomac, Va. (7) Carlton Byrd Farm No. 1, Parksley, Va. (8) Carlton Byrd Farm No. 2, Parksley, Va. (9) L. K. Chandler Farm, Onley, Va. (10) Eastern Shore Substation, Virginia Truck Experiment Station, Onley, Va.
Soil Types: Sandy clay loam and sandy silt loam. Crop Varieties: Rutgers on all farms except Tinkham and Doty farms where Waltham Trellis No. 22 was grown and the Substation where Rutgers and Valiant were treated.
Exp. Design: Single plots were treated with each material on each farm.
No. Reps.: Not replicated. Plot Size: 50 ft. of row. Approx. 15 plants per plot. Treatment Dates: Farms (3) and (5) 6/9/55. Farms (4) and (10) 6/17/55. Farms (1) and (2) 6/27/55. Farms (6), (7), (8) and (9) 6/28/55.
Developmental Stage of Plants at Time of Treatment: Early fruiting stage. Largest fruits 2 to 3 inches in diameter at lay-by. Hand Weeding: None following treatment. Treatments and Rates: CIPC used at 2 lbs. per acre in 48 lbs. of 30-60 mesh Attaclay. Natrin used at 4 lbs. per acre in 46 lbs. of 30-60 Attaclay. Method of Application: Materials applied with small hand shaker overall. Foliage was brushed with a burlap bag following the application of treatment to dislodge granules of herbicide.
Data Collected: Observational only. Weed growth and plant symptom examinations of the plots were made on each location 3 times during the growing season.

Observations: Commercially acceptable weed control was obtained with each of the materials, Natrin and CIPC, in all but two locations. Control of crabgrass and bullgrass was most apparent. These weeds represent the principal weed problem following lay-by in tomatoes.

Symptoms of injury similar to 2,4-D injury appeared in two locations on the Natrin plots, namely, the Onley Substation on both Valiant and Rutgers varieties and on the Chandler farm at Onley on Rutgers. These symptoms were extremely severe on the Substation and were intermediate on the Chandler farm.

Conclusions:

1. These results on the farms indicate that CIPC in granular form may be of practical use in controlling weeds in tomatoes after lay-by. Further commercial field trials are indicated.

2. The severe injury caused by Natrin in two locations indicates that this material must be studied very critically to determine the cause of these effects. Examination of the results indicates that injury is associated with low soil fertility conditions and nutrition experiments may offer some explanations.

TRIAL III. Comparison of Lay-by Applications of Granular and Spray Forms of CIPC, and Spray Form of Alanap-2 on Sweet Potatoes.

Trial Location: Norfolk Station field.
Soil Type: Sandy clay loam. Crop Variety: Porto Rico. Exp. Design: Rand. block. No. Reps.: 6. Plot Size: 35 ft. of row. Plant Spacing: 15 inches. Transplanting Date: 5/10/55. Treat. Date: 7/14/55. Plant Growth Stage at Time of Treat.: Vines 2 ft. long. Cultivation Practice: Usual cultivation as needed. Hand Weeding: As needed to keep all plots free of weeds. Harvest Date: 10/6/55. Treatments and Rates: See table of yield results.
Rainfall Record: For three week period following treatment. Soil moisture at treatment time - low. Rainfall - 1st wk. 0.34 in., 2nd wk. 0.29 in., 3rd wk. 0.45 in. Total for three week period 1.08 in.
Temperature Record: For three week period following treatment in degree-hours above 0° F. 1st wk. 12745, 2nd wk. 13003, 3rd wk. 12866. Total for three week period 38614.

Observations: No symptoms of injury were apparent on the foliage or other parts of the sweet potato plants in any of the treatments.

Yield Results:

Chemical	Acre Rate Lbs.	Method of Application	Primes Average Yield Lbs./Plot
CIPC	2	Spray 50 gals. water	54.1
CIPC	2	Granular 30-60 Attaclay 48 lbs.	52.7
Alanap-2	4	Spray 50 gals.	49.8
Control	0	- - - - -	49.6

L.S.D. Diff. not significant.

Conclusions:

1. Results presented here on CIPC combined with those of two previous years indicate that this chemical at 2 lbs. per acre at lay-by may have practical possibilities for weed control in commercial plantings of Porto Rico sweet potatoes. Spray and granular applications appeared equally effective.

2. Results presented here on Alanap-2 combined with those of two previous years indicate that this chemical at 4 lbs. per acre in spray form at lay-by may also prove practical for control of weeds in Porto Rico sweet potatoes. Granular forms of Alanap-2 have not been tried.

3. Observations indicated that better weed control was obtained with granular CIPC than with either CIPC or Alanap-2 as a spray. This may be explained as being due to the fact that practically all of the granular material sifts down to the soil readily whereas sprays are intercepted by the foliage resulting in poor soil coverage and reduction in the actual amount of chemical which reaches the soil.

Summary

Trial I. Rutgers tomatoes were treated at lay-by with spray and granular forms of CIPC, Natrin, Dalapon, CIPC and Crag Herbicide No. 1 in combination, and CMU in experiment station trials.

Trial II. Small observation plots were prepared comparing granular Natrin and granular CIPC treatments on Rutgers, Waltham Trellis 22, and Valiant varieties of tomatoes at lay-by on 9 commercial fields distributed over a wide area of the coastal section of Virginia.

Trial III. Porto Rico sweet potato plots were treated at lay-by with spray and granular forms of CIPC and with Alanap-2 sprays for yield and weed control comparisons.

General Conclusions From All Trials

1. Application of certain herbicides in granular form increases their selectivity as compared to spray applications of the same chemicals.

2. Granular applications appear to be superior to sprays in controlling weeds in crops such as sweet potatoes and tomatoes where dense foliage covers the soil at lay-by time.

3. Commercial use of granular herbicides on tomatoes and sweet potatoes at lay-by may be practical in the near future.

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Suggestions for Using Experimental Herbicide NATRIN 80S in Tomatoes

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Introduction:

Experimental Herbicide NATRIN 80S (sodium 2,4,5-trichlorophenoxyethyl sulfate) is a water soluble powder which will kill germinating weed seeds. NATRIN is safe on plant foliage because it is not activated until after it comes in contact with the soil. Although a certain amount of activated NATRIN may be around the crop root zone some crops, such as tomatoes, appear to tolerate it. Therefore, if the material is applied to established tomatoes after a clean cultivation, annual weed infestation can be prevented for 4 to 6 weeks.

Results on Tomatoes in 1953:

This was the first year NATRIN was evaluated in the field. Limited tests in New Jersey, Pennsylvania and New York indicated it had promise as a tomato herbicide.

1954:

NATRIN was evaluated in 20 locations in 1954 in the United States and Canada. The material was applied at different times after transplanting and at dosages ranging from 1 to 8 pounds per acre. These data indicated that NATRIN at 2 to 4 lbs. per acre would safely prevent weed growth in tomatoes and that the widest margin of safety existed if the herbicide was applied when the tomatoes were well established.

1955:

Since tomatoes were most tolerant to NATRIN when they were well established and also because a weed problem existed in tomatoes at lay-by, an extensive grower trial program was initiated using the herbicide at that time. Sixty-eight grower trials have now been reported. In 52 of these tests NATRIN was used at lay-by. The majority of the trials were conducted in the Northeast. In addition, research workers in ten states have tested the herbicide in tomatoes at various times of application and at several dosages. When considering all these tests, NATRIN was safely used when applied to tomatoes two weeks after transplanting in heavy soil types providing the new plants were vigorous. However, in some locations applications a few days after transplanting were successful. In those areas where light soils exist NATRIN was safe when applied 5 weeks after setting the tomatoes. The herbicide was used safely in 48 tests at

lay-by. Some tomato injury was reported in 4 tests when NATRIN was used at this time. Several reasons have been suggested for this injury. 1. Excessively high temperatures prevailed at the time of application. This reason has been advanced for injury to younger plants in Missouri. 2. The plants were in low vigor and a relatively high dosage was used for the particular soil type.

Control of annual weeds with early applications of NATRIN was good in most tests. A successful demonstration of weed control was difficult when the herbicide was applied at lay-by time because of the extremely dry weather this past season. In many tests a weed problem did not exist because of this weather. In some tests enough moisture was present to encourage weed seed germination but not enough to activate the herbicide. Poor weed control was evident in these tests.

Suggestions for Use in 1956:

1. Time of Application: We suggest that NATRIN be used earlier than at lay-by in 1956. This is for two reasons. (1) The weeds which are the most trouble to the grower at harvest are those which germinate prior to the lay-by cultivation. They are missed when he cultivates. (2) If the herbicide is used closer to transplanting time adequate moisture for activation of the herbicide is more apt to be present. NATRIN should be used on vigorously growing tomato plants which have been in the ground for several weeks. Just how long this will be depends upon the soil type. In some of the lighter soils, such as found in Delaware, a five-week period is necessary. In New York and the Midwest, where the soils are heavier, two weeks is adequate, providing the plants are vigorous.

2. Dosage: A dosage of two to four pounds per acre is suggested. The higher rates should be used in the heavier soil types. On heavier soils well established tomatoes will tolerate up to 6 lbs. per acre, although there is no apparent increased benefit in regard to weed control over a 4 lb. per acre rate. The rate of application should not exceed 3 lbs. per acre on very light soils.

3. Effect of Moisture: Rain or irrigation immediately after treating does not seem to narrow the margin of crop safety. However, prolonged dry conditions after treatment are not conducive to successful weed control. Where there is not enough moisture for any weed growth, NATRIN will become activated when the rains come and will still stop ensuing weed germination.

4. Method of Application: NATRIN may be applied with a tomato fungicide sprayer, providing a brush boom is used. This type of boom is necessary to obtain adequate coverage of the ground with the herbicide. NATRIN is compatible with carbamate type fungicides.

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In conclusion, it is suggested that grower use of NATRIN be encouraged next season. However, such usage should be on a limited scale until the grower becomes familiar with the use of this material under his own conditions.

Herbicide Evaluations On Vegetable Leaf Crops[1,2]

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The trials described here represent a continuation of a program of herbicide evaluation on vegetable leaf crops which has been under way for a number of years. The data are presented as a concise experimental record of the current year's research.

Weed problems in vegetable leaf crops in the coastal area of Virginia cover a broad range of weed types due to the planting of these crops during hot summer weather and cool fall and spring weather. Principal summer weeds are crabgrass (Digitaria sanguinalis), bullgrass (Eleusine indica), pigweed (Amaranthus retroflexus), lamb's quarters (Chenopodium album), carpet weed (Mollugo verticillata), and purslane (Portulaca oleracea). Principal winter weeds are chickweed (Stellaria media), henbit (Lamium amplexicaule), German moss (Spergula arvensis) and annual blue grass (Poa annua).

Previous research on the use of CIPC (isopropyl N 3-chloro phenyl carbamate) in this area of Virginia has shown that this chemical would give practical control of annual grasses, purslane, and chickweed at rates which could be used as pre-emergence applications on such vegetable leaf crops as kale, collards, spinach, turnip greens, Hanover salad, beet greens, and upland cress. Results on the control of henbit with CIPC have not been satisfactory and this weed has become one of the prime targets of this program of evaluation of new chemicals for vegetable leaf crops. Results presented this year indicate that chemical control of henbit in these crops may be a practical possibility.

Materials, Methods, and Results

Experimental materials, procedures, conditions, and results are presented in a concise, standard form. Climatic conditions are recorded in detail. Temperature records are presented in terms of degree-hours which represents an accurate cumulative record of experience. A general summary of the entire series of trials is presented in the conclusion of the report.

1/ Contribution from the Plant Physiology Department, Virginia Truck Experiment Station, Norfolk. Paper No. 123, Journal Series. Approved for publication November 7, 1955.

2/ Grateful acknowledgment of assistance in a portion of this work is made to the Columbia-Southern Chemical Company for a grant-in-aid and to the manufacturers of the various chemicals for generous supplies of their products.

TRIAL I. Evaluation of CMU, Endothal, CIPC, and Endothal-CIPC Combinations as Pre-emergence Sprays for Control of Weeds in Spinach and Kale in Preliminary Pot Experiments.

Trial Location: Norfolk Station Drainage Tile Plots. Drainage tile 30 in. long and 15 in. dia. set on end in the soil.
Soil Type: Sandy clay loam. Crop Varieties: Vates Blue Scotch Kale, Old Dominion Blight Resistant Spinach. Exp. Design: Rand. block. No. Reps.: 10. No. Seed Per Tile: 50 kale, 50 spinach. Planting Depth: ½ inch. Planting Date: 9/13/54. Treat. Date: 9/13/54 immediately following planting.
Harvest Dates: 10/25,26,27/54. Treatments and Rates: See table of results.
Soil Organic Matter: 2.21%.
Rainfall Record: For three week period following treatment. 1st wk. 0, 2nd wk. 0.82 in., 3rd wk. 0. Total for three weeks 0.82 in.
Temperature Record: For three week period following treatment in degree-hours above 0° F. 1st wk. 12152, 2nd wk. 11793, 3rd wk. 12525. Total for three weeks 36470 degree-hours.

Evaluation Data: (Collected when plants were 6 weeks old).

		Kale			Spinach		
Chemical	Acre Rate Lbs.	Av. Emergent Stand	Av. Final Stand	Av. Fr. Wt./10 Plants Grams	Av. Emergent Stand	Av. Final Stand	Av. Fr. Wt./10 Plants Grams
Control	0	33.4	21.3	19.1	12.7	15.2	16.3
CMU	0.5	33.6	14.9	8.1	19.6	20.1	20.9
CMU	1.0	31.2	4.5	4.6	14.4	15.3	19.6
CMU	2.0	23.5	0.8	0.9	6.0	6.5	10.4
CMU	3.0	20.1	0	0	1.3	1.4	9.7
CMU	4.0	21.2	0	0	0.4	0.3	0.5
CMU	5.0	18.5	0	0	0	0	0
Endothal	2.0	27.4	16.9	13.1	17.5	19.7	20.8
CIPC	2.0	32.9	18.5	9.4	17.2	17.9	33.1
Endo. + CIPC	4 + 2	15.9	11.4	16.0	16.2	16.3	23.6
L.S.D. 5%		5.9	4.2	5.1	3.7	4.7	7.7
1%		7.8	5.5	6.8	4.9	6.2	10.2

Conclusions:

1. Kale did not show a practical tolerance of CMU at a weed killing rate of application.

2. Spinach showed a practical tolerance of CMU at 1.0 lb. per acre as a pre-emergence spray.

3. Kale and spinach showed a practical tolerance of Endothal and CIPC applied individually at a rate of 2 lbs. per acre as pre-emergence sprays.

4. Kale stands were reduced significantly by pre-emergence sprays of 2 lbs. of CIPC and 4 lbs. of Endothal per acre in combination.

5. Spinach showed a practical tolerance of 4 lbs. of Endothal and 2 lbs. of CIPC applied in combination as pre-emergence sprays.

TRIAL II. Evaluation of CIPC and CIPC-Endothal Combinations As Pre-emergence Sprays for Control of Chickweed and Henbit in Spinach in Preliminary Small Scale Field Plots.

Trial Location: Norfolk Station Field.
Soil Type: Sandy clay loam. Crop Variety: Old Dominion Blight Resistant Spinach. Exp. Design: Rand. block. No. Reps.: 3. Plot Size: 250 ft. of 3½ ft. bed. 3 rows spinach per bed. Planting Depth: Approx. ¼ inch. Planting Date: 10/22/54. Treat. Date: 10/22/54. Harvest Date: 3/3/55. Cultivation: None. Hand Weeding: As needed on ½ of each plot for harvest purposes.
Rainfall Record: For three week period following treatment. Soil moisture at treatment time - medium. Rainfall - 1st wk. 0.63 in., 2nd wk. 0.81 in., 3rd wk. 0. Total for three week period 1.44 in.
Temperature Record: For three week period following treatment in degree-hours above 0° F. 1st wk. 9400, 2nd wk. 7698, 3rd wk. 7578. Total for three week period 24676 degree-hours.

Observations: Examination of the plots revealed that only the chickweed was killed in the plots treated with CIPC. In the plots treated with both CIPC and Endothal, chickweed and henbit were killed. This effect could be seen at a glance. Weed counts were made to confirm it.

Stand Count Results:

Chemical	Rate Lbs./A.	Spinach Av. No. Plants Per Foot	Chickweed Av. No. Plants Per Sq. Ft.	Henbit Av. No. Plants Per Sq. Ft.
Control	0	27	147	241
CIPC	1.0	31	0	142
CIPC + Endothal	1 + 2	28	0	0
L.S.D.		N.S.		

Yield Results:

Chemical	Rate Lbs./A.	Av. Wt. - Lbs. Per 1000 Plants
Control	0	95
CIPC	2.0	90
CIPC + Endothal	1 + 2	105
L.S.D.	Diff. not sig.	

Conclusions:

1. Cool weather plantings of spinach were not injured by a combination of 1 lb. of CIPC and 2 lbs. of Endothal applied as a pre-emergence spray in 50 gallons of water per acre on a sandy clay loam soil.

2. Practical control of both chickweed and henbit were obtained with the combination of CIPC and Endothal.

3. Endothal is no longer available commercially but these data may suggest other compounds of a similar structure which would accomplish the same result.

TRIAL III. Comparison of Pre-emergence Applications of Various Carbamates Supplied by Columbia-Southern Chemical Company for Control of Weeds in Seven Vegetable Leaf Crops and Two Root Crops.

Trial Location: Norfolk Station Field.
Soil Type: Sandy clay loam. Crop Varieties: Spinach (Old Dominion Blight Resistant), Kale (Dwarf Curled Scotch Kale), Cabbage (Ferry's Round Dutch), Lettuce (Imperial 44), Turnips (Large White Globe), Mustard (Giant Curled), Collards (Vates), Seeded Onions (Silver Skin), and Carrots (Long Chanteney). Exp. Design: Rand. block. No. Reps.: 3. Plot Size: One row each of the nine crops plus a row of Italian ryegrass on an area 10.5 ft. by 10 ft. Planting Date: 5/2/55. Treat. Date: 5/3/55. Cultivation: None. Hand Weeding: None.

Chemicals:
- BP-1 Propynyl N-phenyl carbamate
- BP-2 Propynyl N-(3-chlorophenyl) carbamate
- BP-3 Alpha carbo 2,4-dichlorophenoxy ethoxy N-phenyl carbamate
- BP-4 A & B. Alpha carbo 2,4-dichlorophenoxy ethoxy N-(3-chlorophenyl) carbamate. These were two formulations of the same compound.
- BP-5 Isopropyl-N-(3-chlorophenyl) carbamate.

Rates of Application: See table of treatment evaluations. Data Collected: Observational ratings on crops and seven weed species 6/1/55.
Rainfall Record: For three week period following treatment. Soil moisture at treatment time - low. Rainfall - 1st wk. 0.12 in., 2nd wk. 0.39 in., 3rd wk. 0.73 in. Total for three week period 1.24 in. Irrigation: 1 inch per week beginning day following treatment.
Temperature Record: For three week period following treatment in degree-hours above 0° F. 1st wk. 10363, 2nd wk. 10030, 3rd wk. 10462. Total for three week period 30855 degree-hours.

Observations: Very striking differences in the selectivities of the various chemicals were apparent in the field.

Evaluation Data:

Average Crop Ratings

Rating Scale 1-5
0 = crop killed.
5 = normal growth.

Chemical	Acre Rate	Crop Ratings: Spinach	Onions	Kale	Cabbage	Carrots	Lettuce	Turnips	Mustard	Collards
BP-1	0	3.0	4.0	3.7	3.3	3.0	1.3	4.3	4.3	3.3
	1	3.3	4.3	3.7	4.0	4.0	2.7	5.0	4.7	3.7
	2	2.7	4.3	3.7	3.0	3.3	1.7	5.0	4.7	4.3
	4	2.3	4.3	3.0	3.0	2.7	1.0	3.7	3.3	4.0
BP-2	0	4.3	5.0	5.0	3.7	4.0	1.7	4.7	4.7	4.7
	1	4.3	4.3	4.7	5.0	4.7	1.7	4.7	4.7	4.3
	2	4.0	4.7	4.3	4.7	4.0	1.3	4.7	4.0	4.0
	4	4.7	4.7	4.7	4.0	3.3	1.7	3.0	2.0	4.0
BP-3	0	4.3	5.0	5.0	3.7	3.7	2.0	4.7	5.0	5.0
	1	1.7	0	0.3	2.0	2.0	0	3.0	1.7	3.3
	2	1.7	0	0.3	0	0	0	1.3	0	1.7
	4	1.0	0	0.3	0	0	0	0.7	0	1.0
BP-4A	0	4.0	4.7	4.7	4.7	4.3	2.0	5.0	5.0	4.7
	1	3.0	2.7	1.0	1.7	2.7	0	2.0	1.7	2.3
	2	1.3	0	0.3	0	0	0	0	0	0
	4	1.3	0	0	0	0	0	0	0	0
BP-4B	0	2.7	3.3	3.3	3.3	3.0	1.3	4.7	4.0	4.0
	1	2.3	1.3	0.7	1.7	0.7	0	3.7	1.7	2.0
	2	1.0	0	0	0.3	0	0	2.0	0.3	1.0
	4	0	0	0.3	0	0	0	0.7	0	0.7
BP-5	0	4.0	4.0	4.0	3.7	4.0	2.0	4.7	4.3	4.3
	1	3.7	4.0	4.0	4.3	3.3	2.7	5.0	3.3	3.7
	2	3.3	3.0	3.7	2.3	3.0	1.7	2.3	0	3.3
	4	3.3	2.3	2.3	1.3	3.0	0.7	0.7	0	2.3

Average Weed Ratings Rating Scale 1-5
0 = all weeds killed.
5 = no weeds killed.

Chemical	Acre Rate	Rye Grass	Crab-grass	Pig-weed	Lamb's Q.	Chick-weed	Hen-bit	Carpet-weed
BP-1	0	3.0	4.7	1.0	1.3	2.7	3.0	4.7
	1	3.3	4.7	2.0	1.7	4.0	4.7	4.0
	2	2.3	3.7	0.3	2.3	2.0	3.3	4.3
	4	1.0	2.0	0	1.7	0	1.3	3.0
BP-2	0	5.0	5.0	3.0	2.0	4.0	4.7	5.0
	1	1.7	3.3	3.0	0.7	2.7	3.7	4.7
	2	0.3	1.0	3.3	1.0	0	1.3	4.0
	4	0	0	1.3	0	0	0	0.3
BP-3	0	4.7	4.7	2.0	1.7	3.3	4.0	4.0
	1	4.7	1.0	0	0.3	1.0	1.3	1.7
	2	3.7	0	0	0	0	0	0
	4	3.7	0	0	0	0	0	0
BP-4A	0	5.0	5.0	3.0	1.7	4.0	4.3	4.3
	1	4.7	1.0	0	0	2.3	2.0	2.0
	2	3.7	0	0	0	0	0	0
	4	3.3	0	0	0	0	0	0
BP-4B	0	5.0	3.3	1.0	1.0	3.0	4.0	4.0
	1	4.0	0	0	1.3	1.7	2.0	1.0
	2	3.0	0	0	0	0	0	0
	4	2.3	0	0	0	0	0	0
BP-5	0	4.7	4.0	2.3	3.0	2.7	3.7	3.7
	1	0.3	1.0	1.3	0.3	0	3.3	1.0
	2	0	0	0.3	0	0	1.0	0
	4	0	0	0	0	0	0.3	0

Conclusions:

1. All crops were tolerant of 1, 2, and 4 lbs. of BP-1 per acre applied as a pre-emergence spray. Only pigweed and chickweed were satisfactorily controlled at any rate.

2. All of the crops except mustard were tolerant of BP-2 at rates of up to 4 lbs. per acre as a pre-emergence spray. Mustard tolerated a maximum of 2 lbs. All weeds except pigweed were satisfactorily controlled at 4 lbs. per acre.

These results indicate that BP-2 may have practical possibilities for use on these crops. Continued research on BP-2 is indicated.

TRIAL IV. Comparison of Pre-emergence Applications of a Carbamate and Two Acetamides supplied by Monsanto Chemical Company for Control of Weeds in Six Vegetable Leaf Crops.

Trial Location: Norfolk Station Field.
Soil Type: Sandy loam soil. Crop Varieties: Spinach (Old Dominion Blight Resistant), Kale (Vates Dwarf Curled Scotch Kale), Collards (Vates), Mustard (Giant Curled), Turnip Greens (White Globe Turnip), and Hanover salad greens.
Exp. Design: Rand. block. No. Reps.: 3. Plot Size: One row each of the six crops plus a row of Italian rye grass on an area 7 ft. by 20 ft.
Planting Date: 5/2/55. Treatment Date: 5/3/55. Cultivation: None.
Hand Weeding: None.

Chemicals: CDAA Alpha-chloro-N,N-diallylacetamide
CDEA Alpha-chloro-N,N-diethylacetamide
CDEC 2-chloroallyl diethyldithio carbamate

Rates of Application: See table of treatment evaluations. Data Collected: Observational ratings on crops and seven weed species 6/1/55.
Rainfall Record: For three week period following treatment. Soil moisture at treatment time - low. Rainfall - 1st wk. 0.12 in., 2nd wk. 0.39 in., 3rd wk. 0.73 in. Total for three week period 1.24 in. Irrigation: 1 inch per week beginning day following treatment.
Temperature Record: For three week period following treatment in degree-hours above 0° F. 1st wk. 10363, 2nd wk. 10030, 3rd wk. 10462. Total for three week period 30855 degree-hours.

Observations: All crops appeared vigorous in all treatments. Weed control results and crop tolerance appeared best in CDEC plots.

Evaluation Data:

Average Crop Ratings — Rating Scale 1-5
0 = crop killed
5 = normal growth

Chemical	Acre Rate	Crop Ratings					
		Spinach	Kale	Collards	Mustard	Turnip	H.Salad
CDAA	0	3.3	4.3	4.3	4.7	4.3	4.3
	2	3.0	3.1	3.7	4.0	4.7	4.7
	3	3.0	3.3	3.3	4.3	4.7	4.7
	4	3.3	3.7	3.3	4.3	4.3	4.3
CDEA	0	3.3	4.0	3.7	4.0	4.0	4.3
	2	3.0	4.0	3.0	4.0	4.7	4.0
	3	3.7	5.0	4.3	4.7	5.0	4.3
	4	2.7	3.7	3.7	3.7	4.0	4.3
CDEC	0	3.3	4.7	4.0	4.7	4.7	4.0
	2	3.0	4.0	3.3	4.0	4.3	4.0
	3	3.0	3.7	2.7	3.7	4.3	4.0
	4	2.3	2.7	3.0	4.7	4.7	4.3

Average Weed Ratings Rating Scale 1-5
0 = all weeds killed
5 = no weeds killed

Chemical	Acre Rate	Weed Ratings: Rye Grass	Crab-grass	Pig-weed	Lamb's Quarters	Chick-weed	Hen-bit	Carpet-weed
CDAA	0	4.7	4.0	1.3	1.3	4.7	4.3	5.0
	2	2.3	1.3	0.3	0.3	0.3	2.7	3.3
	3	2.7	1.3	0	0.3	1.7	1.7	3.0
	4	2.7	0.7	0	0	1.0	2.0	3.3
CDEA	0	4.3	4.7	0.7	0.7	4.3	4.0	5.0
	2	3.7	0.7	0.7	0	3.3	4.0	4.0
	3	3.3	1.0	1.0	0	4.3	4.7	4.3
	4	2.7	1.0	2.0	0.3	1.7	2.7	3.7
CDEC	0	5.0	5.0	1.7	0.7	4.7	4.3	5.0
	2	0.7	2.7	0	0	4.0	2.3	3.7
	3	0.3	0.7	0.3	1.0	0	0	2.7
	4	0	1.0	0	0	0.3	0	0.3

Conclusions:

1. All crops showed practical tolerance of all of the chemicals at rates up to 4 lbs. per acre applied as pre-emergence sprays.

2. Most effective weed control was obtained with CDEC at 3 to 4 lbs. per acre. A point of special interest was the fact that chickweed and henbit were both controlled by CDEC at this rate. Excellent annual grass control was obtained at these rates.

These results indicate that CDEC may hold practical possibilities for use in control of weeds in these crops. Continued research on CDEC is indicated.

General Conclusions From All Trials

1. Spinach showed a practical tolerance of a pre-emergence spray application of a combination of CIPC and Endothal which killed both chickweed and henbit as well as annual grasses.

2. Spinach, kale, collards, cabbage, lettuce, turnip greens, seeded onions, and carrots showed practical tolerances of (BP-2) propynyl N-(3-chlorophenyl) carbamate and (CDEC) 2-chloroallyl dithethyldithio carbamate as pre-emergence sprays. These chemicals killed annual grasses, chickweed, and henbit.

3. Research should be continued to develop further field data on these very promising materials.

PRE-EMERGENCE WEEDING OF SNAP BEANS WITH AMINO TRIAZINE, CDEA (DIETHYLACETAMIDE), CDEC (DIETHYLDITHIOCARBAMATE) AND DINITRO

M. F. Trevett[1]

This paper is a report of a 1955 test of herbicides applied pre-emergence to snap beans.

Procedure and Materials

Tenderlong snap beans were planted June 9, 1955, 1 1/2 inches deep in a sandy loam soil containing 4 percent organic matter. Herbicides were applied June 14, 1955 with a small plot sprayer at 40 pounds pressure and 50 gallons per acre volume. Treatments were replicated 6 times in a randomized block. Each treated plot was paired with a check plot.

Only the interrow area was cultivated throughout the season. The soil 6 inches on either side of the crop row was not disturbed. The principal broadleaf weed was lamb's-quarters (*Chenopodium album* L.). Wild mustard (*Brassica arvensis* Ktze.) and black mustard (*Brassica nigra* Koch.) were present. The principal annual grass was barnyard grass (*Echinochloa Crus-galli* Beauv.).

Rainfall data for the 4-day period prior to treatment and for 16 days after treatment are found in Table 1. The herbicides used in the test are listed in Table 2.

Table 3 lists the treatments applied, percent of annual grass and broadleaf weed control, and the yield of snap beans. The somewhat erratic weed control data (see 2, 4, 6, and 8 pounds CDEA, Table 3) are a consequence not only of the usual variability of weed distribution, but more particularly to mild sheet erosion that occurred over portions of this block on June 13, 1955. Yield data were taken from only those plots that were rated satisfactory for annual grass and broadleaf weed control, and for crop vigor.

1/ Associate Agronomist, Maine Agricultural Experiment Station, University of Maine, Orono, Maine. Statistical analyses were made by Mildred Covell, Technical Assistant, Maine Agricultural Experiment Station.

Experimental Results

Effect of Treatment on Weed Control

CDEA in this test was inferior to CDEC for the control of both broadleaf weeds and barnyard grass. The average reduction in stand for all CDEA treatments, without DN added, was 11.3 percent for broadleaf weeds and 19.5 percent for barnyard grass; for CDEC, without DN added, the reduction in stand was 42.7 percent and 70.5 percent, respectively. The effectiveness of CDEC in controlling broadleaf weeds was due, perhaps, to the fact that the predominating broadleaf weed was lamb's-quarters, towards which CDEC exhibits marked phytotoxicity. The situation might have been otherwise, if the predominating weed had been a species such as wild mustard which apparently has considerable tolerance to both CDEA and CDEC.

Combination treatments of DN with CDEC, and DN with CDEA, improved broadleaf weed control over that obtained with CDEA or CDEC alone, but did not significantly improve annual grass control. For example, 4 pounds of CDEC per acre gave 32.7 percent control of broadleaf weeds and 65.1 percent control of barnyard grass. A treatment composed of 4 pounds of CDEC and 3 pounds of DN per acre gave 83.3 percent control of broadleaf weeds and 68.6 percent control of barnyard grass.

The combination treatments were made because of the possibility that the individual effects of the herbicides might be additive (without synergism being necessarily involved). Data from the present test, however, do not indicate that the individual effects of the herbicides used are additive when, as in the current test, the mixtures are applied prior to weed seedling emergence. It is possible, however, that with herbicides of the type used, the effects might be additive if treatment could be deferred until weed seedlings had emerged or were emerging. In such a situation full advantage could be taken of the contact action of DN.

Amino triazine, at 6 and 9-pound acre rates (Table 3), resembled DN in its effect on weeds, giving excellent broadleaf weed control and fair annual grass control.

Effect of Treatment on Snap Beans

The 6 and 9-pound applications of amino triazine per acre were the only treatments that gave pronounced injury to snap beans beyond the usual amount associated with DN treatments. For a period of 2 weeks following emergence, bean seedlings were severely stunted and distorted in the 6 and 9-pound triazine plots. Four weeks after emergence, however, the bean plants had recovered from the triazine injury.

Summary

Snap bean yields from plots treated with 3 pounds of DN plus 4 pounds of CDEC per acre were significantly higher than check plot yields and yields from plots treated with 6 or 9 pounds of amino triazine, or 4.5 pounds of DN. Yields from plots treated with 8 pounds CDEC, or 4 pounds CDEC plus 1.5 pounds DN per acre did not differ significantly from yields of plots treated with 3 pounds of DN plus 4 pounds of CDEC per acre.

Weed control data indicate that mixtures of DN and CDEA or DN and CDEC, when applied pre-emergence to weeds, are complementary in their effect rather than additive.

TABLE 1. RAINFALL - JUNE 10 TO JUNE 30, 1955, MONMOUTH, MAINE

Date	Inches
June 10 (10:30 PM - 7:30 AM June 11)	.19
11	.50
12	.26
13	.44
14	.09
15	.01
16	--
17	--
18	--
19	--
20	.25
21	.04
22	.02
23	.13
24	--
25	.19
26	.01
27	--
28	--
29	--
30	--

TABLE 2. HERBICIDES APPLIED PRE-EMERGENCE IN 1955 SNAP BEAN TESTS

Abbreviation or Designation	Active Ingredient	Manufacturer
CDEA	Alpha chloro-N,N diethylacetamide	Monsanto
CDEC	2-chloroallyl diethyldithiocarbamate	Monsanto
DN	Dinitro-o-sec-butyl phenol ("Premerge")	Dow
Triazine	2-chloro-4,6-bis(diethylamino)-S-triazine (444E)	Geigy

TABLE 3. SUMMARY OF 1955 PRE-EMERGENCE TESTS IN SNAP BEANS

Pounds Active Ingredient Per Acre	Weed Control (as percent of check)1/		Adjusted Yields of Snap Beans4/
	Broadleaf2/	Annual Grass3/	Pounds Per Acre
4.5# DN	82.3	42.8	6760
2# CDEA	8.9	24.4	--
4# CDEA	10.2	3.4	--
6# CDEA	24.9	15.3	--
8# CDEA	1.3	35.2	--
3# DN + 2# CDEA	70.7	22.9	--
3# DN + 4# CDEA	89.4	34.4	--
1.5# DN + 2# CDEA	62.1	17.4	--
1.5# DN + 4# CDEA	70.5	20.4	--
2# CDEC	22.6	48.2	--
4# CDEC	32.7	65.1	--
6# CDEC	56.2	78.2	--
8# CDEC	58.6	90.4	8529
3# DN + 2# CDEC	85.2	25.2	--
3# DN + 4# CDEC	83.3	68.6	8982
1.5# DN + 2# CDEC	67.5	41.5	--
1.5# DN + 4# CDEC	57.7	70.5	7595
3# triazine	58.3	38.7	--
6# triazine	96.0	27.8	6938
9# triazine	84.6	55.0	6644
Check (no treatment)	--	--	3020
LSD 5%	--	--	1820
1%	--	--	2457

1/ Check plots averaged 20.1 broadleaf weeds and 17.7 annual grass plants per square foot. Weed counts were made four weeks after treatment.

2/ Lamb's-quarters (Chenopodium album L.) was the principal broadleaf weed. Wild mustard (Brassica arvensis Ktze.) and black mustard (Brassica nigra Koch.) were present.

3/ Barnyard grass (Echinochloa Crus-galli Beauv.).

4/ In the design of the experiment each treated plot was paired with an untreated plot. In the statistical analysis of the data, covariance was employed to adjust treatment yields to a common check yield.

A COMPARISON OF SEVERAL HERBICIDES FOR LIMA BEAN WEED CONTROL, UNDER HIGH AND LOW SOIL MOISTURE LEVELS

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Herbicides are used on approximately 3000 acres of lima beans in Delaware. The herbicide used most extensively is dinitro-o-sec-butylphenol (sold as Premerge or Simox PE). Sodium pentachlorophenate (sold as pelleted Santobrite) is used on about 1,000 acres. Growers have found the latter material objectionable because of its disagreeable odor, but also have found it to be effective more consistently than dinitro-o-sec-butylphenol over a wider range of climatic conditions. The experiments reported here were conducted to determine climatic conditions responsible for some of the failures in lima bean weed control -- particularly the effect of heavy rainfall following herbicide application.

Procedure

These experiments were conducted on Norfolk loamy sand at the Georgetown Substation in 1954 and 1955. Herbicides used and their rates of application are listed in Table 1. All were applied in 50 gallons of water per acre except the Dow General and Santophen 20, which were applied in 50 gallons of oil-water emulsion per acre. Herbicides were applied immediately after seeding lima beans of the Thorogreen variety. Treatments were replicated 4 times in randomized blocks. A plot consisted of 3 rows, each 3 feet apart, and 20 feet long. The tests covered both irrigated and non-irrigated areas adjacent to each other. The non-irrigated area represented severe drought conditions, because in 1954 following seeding on June 17, there was no rain for 17 days. Daily maximum temperatures during this period were mostly above 90° F with a maximum of 101°F. Following seeding on June 27, in 1955, there was no rain for 8 days, and daily maximum temperatures during this period were mostly above 90°F. with a maximum of 96°F. In 1954, the irrigated area received 1-inch of water the day after seeding and herbicide-application; in 1955, the irrigated area received 2 inches of water 3 days after seeding and herbicide application. Three weeks after seeding number and weights of weeds were taken on 1 by 3-foot areas, 6 feet from the plot border. After weed data were taken, plots were cultivated when necessary, but were never hoed. Weed population consisted mostly of crabgrass, pigweed,

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TABLE 1 - HERBICIDES AND THEIR RATES OF APPLICATION USED

Treat. No.	Herbicide	Rate per Acre	Active Ingredient	Active Ingredients p Acre, lbs.
2.	Santobrite (NaPCP)	25 lbs.	Sodium pentachlorophenate	22
3.	Santophen 20 (PCP)	23.1 lbs.	Pentachlorophenol	22
4.	Premerge (DN-amine)	2 gals.	Dinitro-o-sec-butylphenol, amine salt	6
5.	Dow general (DN-acid)	1.17 gal.	Dinitro-o-sec-butylphenol	6
6.	Alanap-1	2 lbs.	N-1-naphthylphthalamic acid	1.8
7.	Chloro DEC	6 lbs.	2-Chloroallyldiethyldithiocarbamate	6

lamb's quarters, and ragweed. At harvest, when beans graded 90 percent or more green beans, plants from the center row of each plot were pulled and run through a small portable pea and lima bean viner.

Results and Discussion

Yield of shelled beans, weight of weeds per square foot 3 weeks after seeding, and stand of lima bean plants per foot of row, for the 1954 and 1955 experiments are presented in Tables 2 and 3.

The most noteworthy feature of these results was the fact that in the irrigated area in 1955, DN-amine and DN-acid did not control weeds nearly as well as did NaPCP or ChloroDEC (Table 3). This may at least partially explain why the DN's have not controlled weeds on sandy soils as consistently as NaPCP. Under the conditions of this experiment (1955) there were 3 days following seeding and herbicide-application when considerable volatilization of the DN's could have taken place during the hot and dry weather (daily maxima of 84, 89, and 91°F.). Three days after the herbicide-application, 2 inches of irrigation, simulating a heavy rainfall, were applied. Possibly this treatment could have leached the DN's more than NaPCP or ChloroDEC. There was no evidence of crop injury from any of these chemicals. Plant stand was not affected. The smaller bean yields from the DN-treated plots were probably due to the increased weed competition.

This type of response did not occur in the 1954 experiments where all chemicals gave equally good weed control under irrigation. However, in the 1954 experiment, as explained above, 1 inch, instead of 2 inches, of irrigation were applied, 1 day rather than 3 days, after seeding and herbicide-application. This allowed less time for volatilization and 1 inch of irrigation would undoubtedly cause less leaching than 2 inches.

Surprisingly, in 1954 yields from the non-irrigated plots were nearly double those from the irrigated plots (Table 2). This was due to the fact that plants on irrigated plots emerged and came into bloom several days before those not irrigated; and, because hot, dry weather prevailed during bloom of the irrigated plants, they set poorly.

Alanap-1 in 1954 caused considerable crop injury which was reflected in lower yields. Low yields from non-irrigated plots treated with this chemical were partly due to poor weed control.

With the exception of Alanap-1, all herbicides gave commercial weed control under non-irrigated conditions. However, in 1955 under dry weather conditions, NaPCP and DN-acid were somewhat superior in weed control to DN-amine and ChloroDEC.

Summary and Conclusions

At rates generally recommended for weed control in lima beans, NaPCP and ChloroDEC gave much better weed control in 1955 than DN-amine or DN-acid when a long period of hot, dry weather followed seeding and herbicide-application, and when 2 inches of irrigation were applied 3 days following seeding and herbicide-application. It was assumed that under these conditions lack of weed control was due to excessive volatization and/or leaching of the DN's.

When lima beans were not irrigated the herbicides tested all gave satisfactory commercial weed control in 1954 and 1955 with the exception of Alanap-1.

TABLE 2 - YIELD OF SHELLED BEANS, WEIGHT OF WEEDS PER SQUARE FOOT, AND PLANT STAND, UNDER IRRIGATED AND NON-IRRIGATED CONDITIONS IN 1954 EXPERIMENTS

Treat. No.	Treatment	Yield, Shelled Beans per A, lbs.		Weeds, Wt. per Sq.Ft. gms.[1]		Stand, Plants per foot	
		Not Irrig.	Irrig.	Not Irrig.	Irrig.	Not Irrig.	Irrig.
1.	Check	1475[2]	851	4.2[2]	2.7[2]	6.2	5.5
2.	NaPCP	2303	1157	.08	.03	7.1	5.4
3.	PCP	2246	1271	.06	.04	6.4	6.4
4.	DN-amine	2364	1327	.5	.07	5.7	7.0
5.	DN-acid	2643	1373	0	.07	6.5	5.7
6.	Alanap-1	1951[2]	1078	4.8[2]	.07	6.2	5.4
	L. S. D. 5%	402	N. S.	0.84	0.15	N. S.	N. S.

1. Taken 3 weeks after seeding.

2. Significantly different from DN-amine, the herbicide most used by growers.

TABLE 3 - YIELD OF SHELLED BEANS, WEIGHT OF WEEDS PER SQUARE FOOT, AND PLANT STAND, UNDER IRRIGATED AND NON-IRRIGATED CONDITIONS IN 1955 EXPERIMENTS

Treat. No.	Treatment	Yield, Shelled Beans per A/lbs.		Weeds, Wt. per Sq. Ft. gms.[1]		Stand, Plants per foot	
		Not. Irrig.	Irrig.	Not Irrig.	Irrig.	Not Irrig.	Irrig.
1.	Check	-	-	4.7[2]	22.2[2]	-	-
2.	NaPCP	2647	2496	0.1[2]	0.3[2]	5.5	5.4
4.	DN-amine	2704	1948	1.0	8.3	5.4	4.8
5.	DN-acid	3026	2156	0.2	8.4	5.5	5.5
7.	Chloro DEC	2591	2874[2]	1.4	0.5[2]	5.2	5.2
	L. S. D. 5%	N.S.	695	0.9	6.3	N.S.	N.S.

1. Taken 3 weeks after seeding.
2. Significantly different from DN-amine, the herbicide most used by growers.

TESTS WITH NEW MATERIALS FOR PRE-EMERGENCE WEED CONTROL IN RED KIDNEY BEANS

Ernest R. Marshall, George Bayer and Don Robinson *

INTRODUCTION

There has been a continuing growth in the use of dinitros for weed control in beans. Lima beans, snap beans, dry beans and soybeans have all been weeded very successfully with the water soluble dinitros. The dinitros are relatively safe materials to use and do not give injury on beans when used at several times the recommended rate.

There are several drawbacks to future widespread growth in the use of dinitros on beans. The first is that weed control results are often erratic. Probably the most common cause of failure in the dinitros is applying them in low gallonages (10 gpa or less) under hot (80-90°F) dry conditions. Often when dinitros are applied under these conditions, no appreciable weed control can be observed, particularly if grasses are a problem. Dinitro applications followed by 5-6 inches of rain soon after application also often fail. The most common cause of failure, however, is hot, dry weather.

The second reason for slow acceptance of the dinitros, particularly on dry beans is the cost per acre. With per acre costs running $5.-$10. many growers feel that this is excessive. Another objection is that bean growers would like to apply the weed killer as the beans are being planted and thus eliminate a separate spraying operation. The dinitros work fine applied at planting but often the residual weed control is not long enough and a weedy field is the result. Most bean growers are convinced that chemical weed control is a real help and could the above objections to dinitros be overcome, would move more rapidly into chemical weed control. Defoliation of dry beans is becoming a standard practice and weeds interfere with successful results in defoliation so this factor too will help promote the increased usage of chemical weed control measures.

Because of the objections to the use of dinitros, a screening program on beans has been conducted for several years. The results of the 1955 screening program on red kidney beans is given in this paper.

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MATERIALS AND METHODS

Red kidney beans were planted on June 5,1955 in a medium loam soil near Stanley, New York. Plots two rows wide and 40 feet long were laid out immediately after planting and herbicides were applied to these plots. The soil was very dry at time of planting and no rain fell for 4 weeks after the treatments were applied. Treatments were applied with a small plot CO_2 sprayers in 50 gallons of water per acre.Weed control and injury ratings were taken on July 5th. Materials used in this screening test were as follows: A water soluble dinotro (Sinox PE) a low volatile form of water soluble dinitro (EH333); 2 methyl 4 chlorophenoxyethyl sulphate (methin); 2-chloro-4, 6-bis (diethylamino)-s-triazine (444); a-chloro-N, N-diallylacetamide (CDAA); a-chloro-N, N-diethylacetamide (CDEA); 2-chloroallyl diethyldithiocarbamate (CDEC); two experimental materials from the American Chemi l Paint Company, L883 and L878; a group of experimental materials from Carbide & Carbon Chemical Co. 8389, 7355, 8717 and 6831; and 2 methyl 4 chlorophenoxy butyric acid sodium salt (MCPB).

Data are given in Table 1.

Environmental conditions following these applications of herbicides at planting were not favorable for good weed control with dinitros. Sinox PE and EH333 at 4½# and 6# per acre did not give satisfactory control of weeds. The four weeks of very dry hot weather decreased the effectiveness of the dinitros. A rating of 8.0 or better could be considered satisfactory weed control and the ratings on the dinitro plots were below this. EH333 did not give longer residual control than Sinox PE. There was no injury from the dinitros.

Methin at 3# per acre did not give satisfactory weed control but seriously injured the emerging beans.

444 gave excellent weed control at 6# per acre and it appeared that lower rates would have been satisfactory. 444 at 6# per acre injured the beans. Perhaps by decreasing the rate per acre satisfactory weed control could be obtained without damaging the bean plants. Further testing should show whether or not this might be the case. It was noted that when only two rows of beans were treated pre-emergence with 444, one more row on each side of the two treated rows showed typical 444 injury which first appears as water soaked areas on the edges of the leaves and then progresses inward until the whole leaf appears water soaked. This later turns brown. It was apparent that either the beans were picking the 444 up by root absorption or that it was volatile enough to affect the beans as they emerged. The latter is the most probable cause.

Tab
Table 1. RESULTS OF PRE-EMERGENCE HERBICIDES APPLIED AT PLANTING ON RED KIDNEY BEANS

Material	Rate /Acre	Weed Control Rating*	Injury Rating*
Sinox PE	4½#	5.0	0
Sinox PE	6#	7.0	0
EH333	4½#	5.3	0
EH333	6#	5.7	0
Methin	3#	5.0	8.0
444	6#	10.0	5.7
444	12#	10.0	8.0
CDAA	3#	9.0	0
CDAA	6#	9.0	0
CDEA	3#	8.0	0
CDEA	6#	8.0	0
CDEC	3#	10.0	0
CDEC	6#	8.7	0
L883	1/2#	3.7	0
L883	1#	3.7	0
L878	2#	3.3	0
L878	4#	5.0	2.7
8389	3#	2.7	0
8389	6#	2.7	0
7355	3#	3.0	0
7355	6#	8.0	0
8717	3#	2.0	0
8717	6#	5.0	0
6831	3#	1.3	0
6831	6#	3.0	0
MCPB	2#	3.3	2.7
MCPB	4#	4.0	3.3
Check		0	0

*0= No control 10 = no weeds or grass

**0= No injury 10 = complete kill

CDAA, CDEA and CDEC gave the best weed and grass control of the materials tested. It was particularly noted that these materials have been used primarily as annual grass killers but in this instance they gave excellent control of lambsquarters, redroot and ragweed. Of the three materials CDAA seemed to be the most consistent and promising material. Very good results were obtained at rates as low as 3# per acre. Their residual weed control held up even when followed by 4 weeks of hot, dry weather. Certainly more work needs to be done with these materials as pre-emergence weed control possibilities in beans either alone or in combination with other broadleaved weed killers. There was no injury from these three compounds which were the most promising in the screening test.

L883, L878, 8389, 7355, 8717, and 6831 at the rates used did not give satisfactory weed control. L878 at 4# per acre slightly injured the beans. MCPB was included in the test because of the selectivity of this material for certain legumes. Weed control was not satisfactory at 4# per acre and rather serious injury occurred to the beans.

SUMMARY AND CONCLUSIONS

A screening test of several new herbicides as pre-emergence weed control chemicals was conducted on red kidney beans. Materials were applied at planting. Data were taken one month after the materials were applied.

Because of the hot, dry weather following application, the water soluble dinitros did not provide adequate weed control.

Of the materials tested, the most promising were CDAA, CDEA and CDEC. CDAA appeared to be the most promising material of these three. These materials controlled broadleaved weeds as well as annual grasses.

444 gave excellent weed control but injured the bean plants.

Further testing should include 444 at lower rates and more extensive testing of CDAA alone and in combination with other broadleaved weed killers.

Weed Control in Onions[1,2]

J. J. Jasmin and W. Ferguson

In 1955 Ferguson and Jasmin (1) reported on the action of certain herbicides on onions. To further evaluate the action of several of these herbicides on the development of the onion a yield trial on large size plots was started at the Organic Soil Substation, Ste. Clothilde de Chateauguay, P.Q. The onions were sown on deep muck on which the natural weed population is relatively high and is composed mainly of oakleaf goosefoot (Chenopodium glaucum L.), pigweed (Amaranthus ritroflexus L.), ragweed (Ambrosia artemisiifolia L.), lamb's quarters (Chenopodium sp.), purslane (Portulaca oleracea L.), with some plantain (Plantago major L.), dandelion (Taraxacum officinale Weber) and mustard (Brassica arvensis L.).

Procedure

Onions of the variety Brigham Yellow Globe were planted on April 30. A four row seeder with drills spaced 17 inches apart was used in planting this trial, consequently the plots were 11 1/3 feet wide, or twice the width of the seeder, and 60 feet long. Pre-emergence treatments were applied on May 3, partial-emergence treatments on May 9 and post-emergence treatments on June 7. All applications were made at the rate of 60 gallons of liquid per acre and applied with a boom sprayer mounted on an Allis-Chalmers "G" tractor. A nylon roller pump supplied a relatively uniform pressure of 60 pounds. A randomized block design with four replications was used. The following treatments were applied:

1. Chloro IPC (isopropyl N-3-chlorophenyl carbamate) applied at pre-emergence at the rate of 6 pounds per acre, plus Weednix (sodium isopropyl xanthate) applied at the rate of 12 pounds per acre on June 7 when the second crop of weeds were unfolding their first true leaves.

2. Chloro IPC applied at pre-emergence at the rate of 6 pounds per acre plus KOCN (potassium cyanate) applied at a 2 per cent concentration when on June 7 the second crop of weeds were unfolding their first true leaves.

3. Chloro IPC applied at partial emergence at the rate of 6 pounds per acre plus the same Weednix treatment as in #1.

4. Chloro IPC applied at partial emergence at the rate of 6 pounds per acre plus the same KOCN treatment as in #2.

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[1]A preliminary report of this work was presented at the Ninth Meeting of the Eastern Section, National Weed Committee in October, 1955.

[2]Contribution No. 864 from the Horticulture Division, Experimental Farms Service, Ottawa, Canada.

5. Selective herbicidal oil applied at partial emergence at the rate of 60 gallons per acre plus the same Weednix treatment as in #1.

6. Selective herbicidal oil applied at partial emergence at the rate of 60 gallons per acre plus the same KOCN treatment as in #2.

7. CMU (3-(para-chlorophenyl)-1, 1-dimethyl urea) applied at the rate of one pound per acre at pre-emergence.

8. Check, clean cultivation by the use of a rotary hoe between the rows and hand weeding in the row.

Weed counts taken on June 15 were composed of the total of four square feet taken separately and at random in each plot. Stand was taken on June 8 and was the total number of onion plants growing on 4 sections of row, each section 6 feet long and taken at random in each plot. On June 18, although the weed population was small, some weeds had become relatively tall and all plots were cultivated with a rotary hoe, as well as hand weeded. One other hand weeding was necessary before the end of the season.

Results and Discussion

Weed counts were relatively low and all treatments except 5 and 6 seemed to control weeds satisfactorily in the first part of the summer. No significant difference could be found for stand of onions between treatments. This seems to indicate that none of the herbicides used had any influence on germination or development of the young onion plant. No significant difference could be detected from analyses between yield of marketable bulbs harvested from each treatment or even from yield of unmarketable bulbs harvested from each treatment.

Table 1.--Influence of herbicides on weed count, stand and yield of onions at Ste. Clothilde, 1955.

Treatment	Weed counts per 4 sq.ft.	Stand of onions per 4, 6ft.length	Av. yield onions/plot Unmarketable (lb.)	Av. yield onions/plot Marketable (lb.)
1	6	131	16	234
2	17	139	16	223
3	15	136	22	222
4	26	131	12	236
5	47	129	23	226
6	30	140	20	229
7	24	144	18	243
8	-	117	19	213
L.S.D. P = 0.05	17	N.S.	N.S.	N.S.

This experiment showed clearly that under our conditions none of the herbicides used had any damaging effect on the onions. Of all the treatments used, only 5 and 6 are not recommended. The weed control obtained with the use of selective herbicidal oil is not as good as that obtained with Chloro IPC. CMU may have some possibilities when used as selective herbicide for onions at the rate of one pound per acre on muck soil.

What we have found this year is that no damaging effect was brought about by the use of Chloro IPC but we also realize that chemical weed control alone is not sufficient and that additional hand weeding and mechanical weeding may be essential. Further work is needed to evaluate the monetary gain obtained by commercial applications of chemical herbicides such as the ones used here. More than one application of Weednix or KOCN might be used to advantage. Further work along these lines is needed.

Conclusions

1. Chemical weed control in onions is far from perfect but is definitely a help in onion production.

2. No ill effect could be detected from the use of Chloro IPC in combination with later sprays of Weednix or KOCN.

3. No ill effect could be detected from the use of CMU at the rate of one pound per acre.

4. Selective herbicidal oil at partial emergence was not found as effective in controlling the weeds as was pre- or partial-emergence sprays of Chloro IPC.

References

1. Ferguson, W., and J.J. Jasmin. Chemical Weed Control in Onion, Squash and Tomatoes. Proc. Ninth An. N.E. Weed Control Conf. pp. 169-175, 1955.

Selective Herbicidal Oil on Celery[1,2]

J. J. Jasmin and F. S. Browne

Further to the studies of Emond and Moffat (1), Ries and Sweet (2) and others, it was decided to experiment with the use of selective herbicidal oil on different varieties of celery. A few growers in the Montreal area have been using selective herbicidal oil on their transplanted celery without indication of any visual damage. Care has been taken to apply the spray as soon as possible after transplanting, usually 10 to 15 days.

Procedure

On June 7 celery was planted in muck soil at the Organic Soil Substation, Ste. Clothilde de Chateauguay, P.Q. A lattice square design was used.

Two early varieties, Summer Pascal and Cornell 619, were planted along with two late varieties, Utah 15 and Utah 5270. Each plot was composed of a single 60-foot row of each of these four varieties. Over-all sprays at the rate of 60 gallons per acre of commercial selective herbicidal oil were applied 11 and 18 days, respectively, after planting. A boom sprayer, mounted on an Allis Chalmers "G" tractor, was used. A nylon roller pump supplied a relatively uniform pressure of 60 pounds. Hand and mechanical weeding were done when necessary. Treatments consisted of the following:

A - Check, no herbicide applied.

B - Selective herbicidal oil applied on June 18 at the rate of 60 gallons per acre.

C - Selective herbicidal oil applied on June 25 at the rate of 60 gallons per acre.

D - Selective herbicidal oil applied on June 11 and also on June 25 at the rate of 60 gallons per acre.

Each variety of celery was harvested at its best stage of development; Cornell 619 on August 26, Summer Pascal on August 31, Utah 15 and Utah 5270 on September 17. Weight of celery harvested and number of marketable stalks were recorded.

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[1]A preliminary report of this work was presented at the Ninth Meeting of the Eastern Section, National Weed Committee in October, 1955.

[2]Contribution No. 863 from the Horticulture Division, Experimental Farms Service, Ottawa, Canada.

Results and Discussions

The analysis seems to indicate significant differences in yield between varieties and between treatment but not in the interaction varieties x treatments.

Table 1.--Analysis of variance for yield from post-emergence sprays of selective herbicidal oil on celery.

	DF	SS	MS	F	L.S.D. P=0.05
Treatment	3	10184	3395	11.77**	74
Rows	3	3880			
Columns	3	3306			
Error (a)	6	1822	304		
	15	19192			
Varieties	3	77012	25671	76.36**	158
Varieties x treatment	9	3238	360	1.07	N.S.
Error (b)	36	12102	336		
Total	63	111544			

It was known from previous variety trials that the late varieties, namely, Utah 15 and Utah 5270, were significantly better yielders than the early varieties, namely, Cornell 619 and Summer Pascal. This is also shown in this experiment.

Varieties	Yield of trimmed celery in pounds per plot
Utah 5270	703
Utah 15	568
Cornell 619	408
Summer Pascal	349
L.S.D. P = 0.05	158

It was interesting to note that the application of selective herbicidal oil reduced the yield of celery quite appreciably. See Table II.

No significant difference in yield of marketable celery could be detected between the early and the late application of oil. The short interval of time between the two treatments was most probably the cause for such a result. When both the early and the late applications were made, the yield of marketable celery was not significantly lower than when only one spray was applied.

It is interesting to mention here that from visual observation no difference could be found between treated and non-treated celery before harvest. The sprayed celery looked just as tall and just as good as the check.

Upon trimming, it was found that the sprayed celery had developed many suckers and that in some cases the suckers were just as large as the mother plant. In those cases, both the mother plant and the suckers were too small to be packed. Very few plants with black or brown hearts were found. In other words the yield per plot appears to be directly correlated with the number of marketable plants per given area and not with size of plant. This is indicated by Table II.

Table II.--Yield, population of marketable plants per plot and average weight per plant on celery treated with selective herbicidal oil.

Treatment	Average yield of marketable celery per plot (lb.)	No. of marketable celery plants per plot	Average weight per plant (lb.)
A	591	320	1.85
B	501	295	1.70
C	476	265	1.80
D	460	270	1.70
L.S.D. P = 0.05	74		

On October 25 celery was taken out of cold storage and examined for any abnormality to the heart. A total of 2336 plants were examined and none was found to have any trouble which could be associated with the action of selective herbicidal oil. Only 12 plants were discarded; the others were good marketable celery plants.

Conclusion

This information corroborates the previous findings of Emond and Moffat (1), and those of Ries and Sweet (2). Early application of selective herbicidal oil reduces the yield of celery but has very little influence on the formation of "damaged hearts". The four varieties used in this experiment seem to react similarly to the action of selective herbicidal oil.

References

1. Emond, R.E. and F.G. Moffat. The effect of Stoddard Solvent as a selective herbicide in celery. Supplement of the Proc. of the Sixth Annual Meeting, N.E.W.C.C. 1952.

2. Ries, S.K. and R.D. Sweet. Effect of time and method of application of Stoddard Solvent on celery. Proceedings of the Seventh Annual Meeting N.E.W.C.C. 1953.

Chemical Weeding of Garden Beets[1]

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

A concentrated salt solution is commonly used as a weed killer in fields of garden beets. The salt solution is applied in a post-emergence application when the beets have 4 to 5 true leaves. If the weeds are large at this stage of beet growth, the kill is poor. Lambs-quarters and purslane are not killed by this treatment, even if small at time of treatment. A better herbicide is needed for this crop.

A number of pre-emergence treatments have been tried at Penn State during the last few years for weed control in garden beets. Endothal has given the most encouraging results but has not been consistent from season to season. An experiment was conducted in 1955 which included three application rates of Endothal applied at three day intervals following planting. A second screening experiment was carried out in 1955 using 14 chemicals alone or in combination at 2 or 3 rates per acre.

PROCEDURE

In the first experiment Endothal was applied in pre-emergence applications at the rates of 4, 8 and 12 pounds per acre, one, four, and seven days after planting. One plot was untreated. (Table 1.)

The land was prepared and seeded to the variety Tall Top Early Wonder on May 2nd. A light rain fell the night of May 7th. Some beets had emerged by May 8th, at the time of last treatment. It was relatively dry throughout the growing season. Beets were harvested July 6th.

Individual plots were 27 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 one foot at the rate of 34 gallons per acre under a pressure of 35 pounds per sq. foot. Weeds between the rows were controlled through cultivation.

An estimate of weed control was made prior to harvest on a basis of 1 to 10, 1 being most desirable and 10 least desirable. At harvest a record was made of plant stand and weight of marketable beets.

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[1] Authorized for publication on Nov. 23, 1955, as paper No. 2026 in the journal series of the Pennsylvania Agricultural Experiment Station.

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

In the second experiment fourteen different chemicals were tried together with untreated check plots, (Table 2.) One in a pre-planting application and all others in a pre-emergence application. The land was prepared May 31st and planted June 1st. The soil was dry at planting time and remained dry until June 8th. The application of DCU was made prior to planting. The post-emergence applications of the other treatments were made nine days after planting. Beats emerged 12 days after planting.

RESULTS AND DISCUSSION

The results of the first experiment are presented in Table 1. The treatments had no significant effect on yield or stand of beets. There was no significant difference between rates of Endothal applied the same day. All Endothal treatments applied 7 days after planting were significantly better than the untreated plot at the 1% level. Although there was no significant difference between the early and late treatments at any one rate, the indications are that the late treatment gave the best weed kill.

The results of the second experiment are presented in Table 2. All pre-emergence chemicals gave significant increases in weed control at the 1% level as compared to the untreated check plot. Where weeds were not greatly reduced by use of herbicides weed competition reduced the stand of beets. Six treated plots had significantly better stand of beets as compared to the untreated plot. These were, at the 1% level; Endothal 8 lbs., combination of Endothal 4 lbs. and TCA 10 lbs., CDAA 8 lbs., and Herbisan at 2 gal. per acre; and at the 5% level: Herbisan 91 2 gal. per acre.

Significant increases in marketable beets per acre at the 1% level as compared to the untreated checkd plot were obtained with the combination treatment of Endothal 4 lbs and TCA 10 lbs. and TCA 20 lbs., Karmex DW at 1 lb., Karmex W at 1 lb., and CDAA at 8 lbs., per acre, and at the 5% level Endothal at 8 lbs. and Herbisan 91 at 4 gal. per acre.

CONCLUSION

In the first experiment Endothal reduced the weeds in beets in a pre-emergence application without reducing the stand or yield of beets. The best results were obtained when applied following a light rain at time of emergence.

In the second experiment, taking into consideration weed control and stand and weight of marketable beets, the best two treatments were the combination treatment of 4 lbs., of Endothal and 10 lbs. of TCA, and CDAA at eight pounds per acre.

Table 1. The effect of three rates of Endothal applied at three different rates in a pre-emergence application, on stand and yield of beets and on weed control.

Chemical	Rate per Acre	Application Days after planting	Beet Yield Per Plot Stand	Marketable roots	Weed Control
				lbs.	
Nothing	---	---	66	4.2	7.3
Endothal	4 lbs.	1	68	4.5	4.6
"	"	4	58	3.8	5.4
"	"	7	72	4.5	3.3
Endothal	8 lbs.	1	67	4.5	5.0
"	"	4	71	4.7	4.6
"	"	7	61	4.8	3.3
Endothal	12 lbs.	1	68	4.1	4.5
"	"	4	75	4.5	4.8
"	"	7	66	5.3	2.5
Least significant difference 5% level			NSD	NSD	2.4
" " " 1% "			NSD	NSD	3.4

*Weed control 1-10 1 perfect weed control, 10 no weed control.

ABBREVIATIONS

The following abbreviations have been used in this paper for new and relatively unfamiliar chemicals. Other abbreviations or common names are used for older or readily recognized chemicals.

(1) CDAA a-chloro-N, N-diallylacetamide
(2) Niagra 5518 isopropyl N-(3-methylphenyl) carbamate
(3) Niagra 5020 2-chloroethyl N(3-chlorophenyl) carbamate
(4) Hayden 1291 - AN Trichloro Benzoic Acid
(5) Hooker X-42-S sodium polychlorobenyrate
(6) Hooker X-42-ED polychlorobenzoic acid
(7) Herbisan bis(ethyl xanthic) disulfide 58%
(8) Herbisan bis(ethyl xanthic) disulfide 90%

The effect of pre-planting and pre-emergence herbicides on stand and yield of beets and on weed control.

Herbicides	Rate Per Acre	Beet Yield Stand	Beet Yield Wt. Marketable Beets	*Weed Control
Nothing	-------	34.0	.02	10.0
DCU (only pre-	6 lbs.	38.8	.06	8.6
" planting	12 lbs.	24.0	.04	8.7
" application)	18 lbs.	16.8	.00	8.7
Endothal	4 lbs.	43.7	.31	6.9
"	8 lbs.	65.1	.39	4.2
[illegible] and TCA	4 & 10 lbs.	70.8	.57	3.0
" " "	4 & 20 lbs.	47.2	.59	2.8
TCA	10 lbs.	45.9	.19	6.3
"	20 lbs.	48.6	.18	4.2
Karm[illegible] W	1 lb.	12.3	.76	1.2
" "	2 lbs	7.0	.29	1.1
Karme[illegible] W	1 lb.	21.5	.77	1.1
" "	2 lbs.	5.3	.21	1.0
**(1)CDAA	4 lbs.	48.3	.26	5.8
"	8 lbs.	57.8	1.15	3.8
(2)Niagra 5518	4 lbs.	30.5	.06	8.1
" "	8 lbs.	38.0	.15	6.5
(3)Niagra 5020	4 lbs.	55.4	.21	3.5
" "	8 lbs.	24.6	.16	1.9
Amino Triazole	10 lbs.	8.6	.06	1.1
" "	20 lbs.	0.2	.00	1.0
(4)Hayden 1281-AN	3 lbs.	1.1	.01	1.0
" "	6 lbs.	0.0	.00	1.0
(5)Hooker X - 42-S	4 lbs.	0.0	.00	1.3
" " "	8 lbs.	0.1	.00	1.1
(6)Hooker X - 42-ED	3.4 lbs.	1.7	.02	1.4
" " "	6.8 lbs.	0.0	.00	1.2
(7)Herbisan	2 gals.	55.3	.31	4.8
"	4 gals.	40.8	.17	3.5
(8)Herbisan 91	2 gals.	50.4	.34	4.9
" "	4 gals	36.4	.44	3.8
Least significant difference at .05 level		14.7	.34	1.5
Least significant difference at .01 level		19.3	.45	1.9

*Weed control 1-10: 1 perfect weed control
10 full weed growth

**Numbered herbicides correspond with numbered abbreviations.

PRE-EMERGENCE WEEDING OF PROCESSING PEAS

M. F. Trevett and H. J. Murphy[1]

Because currently recommended post-emergence treatments do not adequately control annual grasses in processing peas, the pre-emergence technique is becoming an increasingly important practice. This paper is a report of 1954 and 1955 tests of herbicides applied pre-emergence to peas for processing.

Procedure and Materials

In 1954 and 1955 Surpass peas were planted at the same location the last week in May in a sandy loam soil containing 4 percent organic matter. Treatments were applied 48 hours before emergence in 1954, and 24 hours before emergence in 1955. Herbicides were applied with a small plot sprayer at 40 pounds pressure and 50 gallons per acre volume. Treatments were replicated five times.

Japanese millet, which served as a test annual grass, was sowed at the rate of 14 pounds per acre immediately after the peas were planted. It has been observed that Japanese millet is "controlled" to a greater degree than barnyard grass (*Echinochloa Crus-galli* Beauv.) or the annual foxtails (*Setaria* species). This disparity in effect is probably a consequence of a more uniform germination period on the part of millet than of the wild annual grasses. The principal broadleaf weed was wild mustard (*Brassica arvensis* Ktze.).

The herbicides and the acre rates applied pre-emergence in 1954 and 1955 are found in Table 1.

Experimental Results

Table 2 contains the 1954 treatments and acre yields of shelled peas. Pea yields were adjusted to a common tenderometer reading by covariance analysis. Acceptable annual "grass" control was obtained in all treated plots.

1/ Associate Agronomist and Assistant Agronomist, respectively, Maine Agricultural Experiment Station, University of Maine, Orono, Maine.

TABLE 1. HERBICIDES USED IN PRE-EMERGENCE TESTS IN PEAS FOR PROCESSING, 1954 AND 1955

Abbreviation or Designation	Active Ingredient	Manufacturer
CDEA	Alpha chloro-N,N diethylacetamide	Monsanto
CDEC	2-chloroallyl diethyldithiocarbamate	Monsanto
DN	Dinitro-o-sec-butyl phenol ("Premerge")	Dow
Dalapon	Na 2,2-dichloropropionate	Dow
EH 6249	Na 2,2,3-trichloropropionate	Am. Cyanamid
Triazine	2-chloro-4,6-bis(diethylamino)-S-triazine (444E)	Geigy
Triazole	3 amino-1,2,4-triazole	Am. Chemical Paint
CIPC	Isopropyl N (3 chlorophenyl) carbamate	Am. Chemical Paint

TABLE 2. THE EFFECT OF DINITRO, CHLORO IPC, AND DALAPON APPLIED PRE-EMERGENCE ON PEA YIELDS, 1954

Treatment (Lbs. active ingredient per acre)	Lbs. Shelled Peas Per Acre (Adjusted means)	Tenderometer
A. 3 lbs. DN	4907	--
6 lbs. DN	4762	--
4 lbs. CIPC	4722	--
3 lbs. DN + 2 lbs. CIPC	4020	--
Check	3429	--
3 lbs. DN + 4 lbs. CIPC	3278	--
8 lbs. CIPC	2991	--
LSD 5%	964	--
1%	1294	--
B. Check	4410	144
3.4 lbs. Dalapon	4846	123
	NS	NS

The individual degrees of freedom test for statistical significance between the yields in Table 2A indicated the following:

(1) Three and six pounds of dinitro, four pounds of chloro IPC, and three pounds of dinitro plus two pounds of chloro IPC gave significantly higher yields than check (no treatment).

(2) Yields from plots treated with eight pounds per acre of chloro IPC were significantly lower than yields from plots treated with chloro IPC at the rate of four pounds per acre.

(3) Yields from plots treated at acre rates of three pounds of dinitro plus two pounds of chloro IPC were not significantly different from yields of plots treated with three pounds of dinitro plus four pounds of chloro IPC per acre.

(4) A significant difference did not exist between yields from plots treated with three pounds or six pounds of dinitro per acre.

All rates of chloro IPC applied in 1954 stunted the peas during the seedling stage. However, except for the eight-pound per acre rate, all plots recovered from this early stunting.

Dalapon in 1954 applied at the rate of 3.4 pounds of active ingredient per acre gave acceptable "grass" control without injury, or at least lasting injury, to peas (Table 2B). In 1955, however, both 1.7 and 3.4 pounds of Dalapon applied pre-emergence resulted in significant injury to peas (Table 3). The probable reason for this difference in effect lies in the rainfall patterns for 1954 and 1955. In 1954 no rain fell for a 20-day period following treatment. In 1955 1.97 inches of rain fell during the first five days after treatment, with a total of 3.21 inches for the 20-day period immediately after treatment. Thus, the absence in 1954 of leaching rains shortly after treatment endowed Dalapon with a fictitious selectivity. The same situation, of course, exists with respect to 1954 chloro IPC treatments.

The 1955 treatments, Tables 3 and 1, included several new herbicides which reputedly are particularly effective for grass control. It is obvious, from the weed control ratings in Table 3, that even for some of the more potent "grass killers" that in a mixed weed population if both adequate broadleaf and annual grass control is to be obtained that a mixture of herbicides must be applied.

TABLE 3. THE EFFECT OF HERBICIDES APPLIED PRE-EMERGENCE ON WEED CONTROL AND GROWTH OF PEAS, 1955

Pounds of Active Ingredient Per Acre	Ratings 1/		
	Pea Injury	Weed Control	
		Broadleaf 2/	Annual Grass 3/
1.6 lbs. EH 6249	2.25	2.17	3.17
3.2 lbs. EH 6249	2.42	2.00	6.50
Check	2.45	1.91	2.00
2 lbs. CDEC	3.30	1.83	7.20
4.5 lbs. DN	3.40	9.00	9.00
4 lbs. CDEC	3.77	2.20	9.00
4 lbs. CDEA	4.03	1.42	6.08
6 lbs. CDEA	4.43	3.67	7.50
2.5 lbs. Triazole	5.10	8.83	7.33
6 lbs. Triazine	5.20	9.00	9.00
1.7 lbs. Dalapon	5.88	2.66	9.00
3.4 lbs. Dalapon	6.48	3.16	8.91
LSD 5%	1.30	1.80	1.60
1%	1.70	2.50	2.10

1/ Ratings for weeds: 1 = no control.
10 = complete control.

Ratings for peas: 1 = crop injury absent. "Injury" may be due to chemical, weed competition, or both.
10 = sufficient crop injury to reduce plant size and vigor 50 percent.

2/ Broadleaf weeds were not a serious problem. Principal broadleaf weed: wild mustard (*Brassica arvensis* Ktze.).

3/ Japanese millet.

Summary

Considering severity of injury to the crop and adequacy of both broadleaf weed and seeded annual grass (Japanese millet) control in 1954 and 1955 pre-emergence tests, the standard dinitro treatment was not surpassed in performance by four and eight pounds of chloro IPC, 1.6 and 3.2 pounds of EH 6249, two and four pounds of CDEC, four and six pounds of CDEA, 1.7 and 3.4 pounds of Dalapon, 2.5 pounds of triazole, or six pounds of triazine.

WEED CONTROL IN BUTTERNUT SQUASH - 1955

By William H. Lachman*

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Butternut squash has become an important commodity in the markets of the Northeast. As in the culture of most crops, a search is being conducted for a relatively inexpensive chemical that will kill weeds without harming the crop. Alanap-1, although valuable for weeding several of the vine crops, was harmful to the Butternut squash (1, 2, 3). Last year some preliminary work indicated that three pounds of a water soluble dinitro weed killer in pre-emergence applications gave good weed control without apparent crop damage (2). The purpose of this paper is to present further evidence concerning the effect of the dinitro weed killer on Butternut.

Materials and Methods

In the development of pre-emergence weed control methods for various crops the margin of safety obtained with chemicals is often directly related to the depth to which the seed can be planted. The means of escape, then, often depends on depth protection of the soil. Planting the seed to extreme depths, however, naturally interferes with proper seedling development, and then a poor stand of plants and reduced yields are to be expected.

The object of this work, then, resolved itself to finding the optimum combination of planting depth for the seed with the rate of dinitro application to give best weed control and yield of squash.

The soil, a Scarborough very fine sandy loam of medium fertility was prepared in the usual manner and an 8-16-16 fertilizer was broadcast at the rate of 1200 pounds per acre. The squash seed was planted on June 8, 1955, at ½-, 1-, 1½-, and 2-inch depths, respectively. Specially built blocks or molds were thrust into the soil surface to provide for accuracy in obtaining proper planting depths. Ten seeds were planted in each hill, and the stand was later thinned to three plants to a hill.

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*Credit is due to Louis F. Michelson for analysis of the data.

Contribution No. 1022 of the University of Massachusetts, College of Agriculture Experiment Station.

Sixteen treatments, involving the four planting depths previously described and three rates of dinitro application, as well as controls, were involved in these tests. This provided a two-factorial experiment at four levels. The treatments were arranged at random and replicated three times. Each plot consisted of a four-hill row, with the hills spaced six feet apart and the rows twelve feet apart. Guard rows were provided at the borders of the planting. The weed killer was applied to a strip six feet wide over the squash rows; weed control in the six-foot section between the treated strips was dependent upon cultivation.

Premerge was used to supply the dinitro (DNOSBP), and applications of 3, 4½ and 6 pounds per acre were the rates used. Appropriate controls where no dinitro was applied were also maintained for each planting depth. The dinitro was applied on July 9, the day after planting. Soil moisture conditions remained ideal for good weed control for approximately one month after application of the weed killer.

The weed killer was diluted with water and applied at the rate of fifty gallons per acre. The spray was applied with a Brown Open-Hed No. 4 hand-pressure sprayer fitted with a No. 8004 Spraying Systems flat-spray Tee Jet nozzle. The abundant weed population consisted of purslane, smartweed, lamb's quarters, chickweed, pigweed, galinsoga and crab grass.

Germination counts were made on June 20 and then the squash plants were thinned to a uniform stand of three plants per hill. Since one plot had less than the required number of plants, its yield records were adjusted to a perfect stand. Weed count and size were recorded on July 5 after which the plots were all hand-hoed and then tractor-cultivated three times before lay-by.

Results

The results of these investigations are presented in Table I. It is evident that all three rates of dinitro were very effective in reducing the weed stand compared to the controls. Weed development tends to be suppressed to a greater extent by the higher rates of dinitro, but the differences are far from significant. So far as weed number is concerned, there are no real differences among the dinitro treatments. Within the limits of error, then, these tests indicate that 3.0 pounds of dinitro were just as effective as the 4.5 or 6.0 pound application in preventing weed growth.

Almost the same statements can be made concerning the effect of dinitro on the size of weeds as were made for its

Summary

Dinitro weed killer (Premerge) applied at the rate of 3.0 to 6.0 pounds per acre controlled weeds effectively for four weeks in plots of Butternut squash without affecting the quality or yield of the crop. From the results of these tests as well as from previous tests with this crop it is suggested that the seed be planted about one inch deep and that three to four-and-a-half pounds of dinitro (DNOSBP) per acre be applied soon after planting.

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Table I Effect of Seed Planting Depth and Rate of Dinitro Spray on Butternut Squash

Planted June 8, 1955 - Recorded July 5, 1955

Plot	Treatment Seed Depth Inches	Treatment DNOSBP Lbs./Acre	Weeds per Sq. Ft.	Weed Height Inches	Plant Stand	Total Yield Lbs.
1	0.5	3.0	5.3	6.7	25.6	227.6
2	0.5	4.5	4.3	5.7	26.6	211.7
3	0.5	6.0	2.6	4.7	29.0	202.4
4	0.5	-	41.6	10.3	28.0	196.3
5	1.0	3.0	8.0	6.3	25.4	236.7
6	1.0	4.5	4.0	5.7	26.0	202.5
7	1.0	6.0	3.0	4.7	26.0	223.1
8	1.0	-	34.0	10.3	25.0	214.6
9	1.5	3.0	8.0	6.3	25.4	237.6
10	1.5	4.5	6.0	6.3	29.3	215.1
11	1.5	6.0	2.3	4.0	23.0	220.0
12	1.5	-	37.0	10.7	26.4	183.6
13	2.0	3.0	7.7	5.7	18.7	182.7
14	2.0	4.5	2.6	5.3	21.3	218.3
15	2.0	6.0	5.0	4.7	21.3	201.3
16	2.0	-	43.6	10.7	17.7	219.4
L.S.D.@	.05		13.4	1.9	N.S.	N.S.
L.S.D.@	.01		18.1	2.6	N.S.	N.S.

effect on the number of weeds, except for one comparison, where the seed planted 0.5 inch deep with 3.0 pounds of dinitro was poorer than the seed at 1.5 inches deep and 6.0 pounds of dinitro. Generally, there is a slight trend for the higher rates of dinitro to suppress weed growth, but the differences with the one exception are too small to be significant.

The stand of squash plants appeared to be relatively poor at the two-inch planting depth, but the differences were not significant. Under less favorable planting conditions, however, planting Butternut squash seed at a two-inch depth would not be prudent.

The effects of planting depths, rate of dinitro, or the interaction between the two had no significant effects on the yield of squash. The various treatments did not appear to have a perceptible influence on the quality of the squash. All features of growth in plant and crop were apparently comparable among the treatments at harvesttime.

THE EFFECT OF PRE- AND POST-EMERGENCE APPLICATIONS OF CERTAIN HERBICIDES ON ASPARAGUS SEEDLINGS

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The contact pre-emergence method of chemical weed control in asparagus seed-beds (3) is extensively used. The herbicide most used in Delaware for this technique is pentachlorophenol (sold as Geigy PCP No. 10), which usually controls weeds for approximately the first 5 weeks. To further reduce expensive hand weeding, growers desire chemical weed control beyond this period.

Since CMU (3-p-chlorophenyl-1, 1-dimethylurea) has given such long-lasting weed control in asparagus cutting beds (3), an experiment was conducted in 1954 to test pre- and post-emergence applications of this material for full-season weed control in asparagus seed beds. In addition, Stoddard Solvent, NaPCP (sodium pentachlorophenate), and Alanap-1 (N-1 naphthylphthalamic acid) were also evaluated. Stoddard Solvent has been reported to be of value for weed control in asparagus seedlings in post-emergence applications until they are 3 inches tall (1). NaPCP has been reported to be of value when applied pre-emergence (2). Alanap-1 has looked promising for weed control in asparagus cutting beds (3).

Procedure

This experiment was located in a commercial field near Dover, Delaware on a Sassafras sandy loam. Seed of the Mary Washington variety was planted on April 6, 1954, at an 8-pound-per-acre rate, in rows 2 feet apart. Treatments used are described in Table 1. They were replicated 3 times in randomized blocks. A plot consisted of 3 rows 25 feet long. Pre-emergence treatments were applied 2 weeks after seeding, when many weeds had emerged. This was just before asparagus had emerged. All post-emergence treatments, except Stoddard Solvent were applied after clean cultivation. As explained in Table 1, post-emergence treatments were applied at 2 different times: on June 16, 10 weeks after seeding, when the asparagus was 5 inches tall; and on July 21, 15 weeks after seeding, when the asparagus was 10 inches tall.

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The weed population was high, and consisted chiefly of crabgrass, lamb's quarters, pigweed, smart weed, and rag weed. Weed counts were taken only once, 7 weeks after seeding, on those plots receiving the pre-emergence treatments. Weed counts were not taken on plots receiving post-emergence treatments, because, due to misunderstanding, they were hand-weeded before weed-counts could be taken. This was not too serious, because, as cited above, the weed control value of the herbicides used had been established. Weed data consisted of number and weight of weeds on May 27 in a 1 by 3 foot area over the row, 6 feet from the plot border. After May 27, plots were cultivated and hand-weeded as needed.

Crowns from the center row of each plot were dug on November 9, 1954. They were graded into No. 1 grade and culls, and counted and weighed. Culls were crowns that were very small and spindling. No. 1 crowns were those that remained. They were considered good for producing vigorous plants in the cutting bed.

Results and Discussion

Number and weight of No. 1 crowns for all treatments, and number and weight of weeds per square foot 5 weeks after herbicide-application for the pre-emergence treatments are presented in Table 2.

Neither Karmex W (CMU), nor Alanap-1, in either pre- or post-emergence overall applications, at the rates used, injured asparagus visibly in the field, or as revealed by number and weight of No. 1 crowns dug on November 9. As the weed data indicate, Karmex W was slightly superior to Alanap-1 in weed control. These data suggest that Karmex W could be used alone, in a combination of pre- and post-emergence applications, for full season weed control in asparagus seedlings; or only in post-emergence application, with Geigy PCP No. 10 in a contact pre-emergence application.

Santobrite, 10 lbs. per acre, applied pre-emergence 2 weeks after seeding significantly reduced number and weight of crowns. Post-emergence application of Stoddard Solvent, 75 gals. per acre, when asparagus seedlings were 5 inches high, also significantly reduced weight of crowns. This latter material visibly injured the seedlings to a considerable degree.

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TABLE 1 - TREATMENTS USED IN ASPARAGUS SEEDLING WEED CONTROL EXPERIMENT

AT DOVER, DELAWARE, IN 1954

Treat. No.	Herbicide	Rate per acre[1]	Time of Application	Active Ingredients
1.	Geigy PCP No. 10 (PCP)	6 gals.	2 wks. after seeding	Pentachlorophenol
2.	Santobrite (NaPCP)	10 lbs.	2 wks. after seeding	Sodium pentachlorophen
All plots prior to receiving the following treatments received Geigy PCP No. 10 two weeks after seeding, as i Treatment 1 above, to kill weeds that had already emerged.				
3.	Karmex W (CMU)	1 lb.	2 wks. after seeding	3-p-chlorophenyl-1, 1 dimethylurea
4.	Karmex W (CMU)	1 lb.	2 wks. after seeding	" " "
	" "	1 lb.	When asparagus was 5" tall.	" " "
	" "	2 lbs.	When asparagus was 10" tall.	" " "
5.	Alanap-1	2 lbs.	2 wks. after seeding.	N-1-Naphthyl phthalamic
6.	"	2 lbs.	2 wks. after seeding	" " "
	"	2 lbs.	When asparagus was 5" tall.	" " "
	"	4 lbs.	When asparagus was 10" tall.	" " "
7.	Stoddard Solvent[2]		When asparagus was 5" tall.	Aromatics

1. Applied in 60 gals. of finished spray per acre.
2. Applied at rate of 75 gals. per acre.

TABLE 2 - YIELD OF CROWNS AND WEED DATA TAKEN FROM ASPARAGUS SEEDLING WEED CONTROL EXPERIMENT AT DOVER, DELAWARE In 1954

Treat. No.	Treatment[1]	No. 1 Crowns from 3 plots (75 ft. of row) No.	Wt., lbs.	Average wt. of crowns, oz.	No. of culls from 3 plots	Weeds per sq. ft. 7 weeks after seed: No.	Wt. gm
1.	Geigy PCP No. 10 - pre-emerg.	334	36.5	1.7	66	0.2	0.03
2.	Santobrite - pre-emerg.	207[3]	20.5[3]	1.6	71	0	0
3.	Karmex W - pre-emerg.[2]	356	32.0	1.4	72	0	0
4.	Karmex W - pre-emerg., Karmex W - post-emerg., two applications[2]	316	30.3	1.5	59	-	-
5.	Alanap-1 - pre-emerg.[2]	330	34.1	1.6	56	2.0[3]	0.30[3]
6.	Alanap-1 - pre-emerg., Alanap-1 - post-emerg., two applications[2]	343	38.4	1.8	38	-	-
7.	Stoddard Solvent - post-emerg.[2]	307	27.2[3]	1.4	68	-	-
(Adjoining area not sprayed with any herbicide).		-	-	-	-	(12.0)	(12.50)
L. S. D. 5%		67	6.6	N.S.	N.S.	0.6	0.09

1. See Table 1 for further explanation of treatments.
2. These treatments received Geigy PCP No. 10, two weeks after seeding, as in Treatment 1, to kill weeds that had already emerged.
3. Significantly different from Treatment 1, which is universally used by growers.

WEED CONTROL IN SWEET CORN - 1955

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Studies to find economical weed killers for sweet corn have been in effect at this station for about ten years. The extensive plantings of sweet corn in the Northeast make this project significant, especially since the crop is often planted on the most weedy soils. Extreme values were assigned to 2,4-D for weeding corn soon after its discovery, but now some of its properties, particularly volatility and total systemic translocation, make its use uncertain where corn is grown in small fields that are adjacent to 2,4-D sensitive crops. It is also difficult to remove its harmful traces from spray tanks that are to be used for spraying other crops.

As a result, a search has been made to find other chemicals that would control weeds in sweet corn fields in an effective and economical manner. The purpose of this paper is to present the results of some tests made during 1955 to help solve this problem.

Materials and Methods

Eighteen treatments, involving eight chemicals, were applied to plots of Golden Beauty sweet corn; these treatments were replicated three times. The plots consisted of four 24-foot rows each, and the seed was planted by hand with the rows spaced 3 feet apart and the hills 3 feet apart in the row. Records were taken from the two middle-plot rows only. The soil, a Scarborough very fine sandy loam, was prepared in the usual manner, and an 8-16-16 fertilizer was broadcast at the rate of 1200 pounds per acre. The corn was planted on June 29, 1955.

The following chemicals with their respective per-acre rates were applied to the corn on June 30, the day after planting: 4.5 pounds of dinitro (Premerge); 1.5 pounds of amine 2,4-D; 0.60, 0.80, and 1.00 pound active Karmex W; 0.6, 0.8 and 1.00 pound active Karmex DW; 0.6, 0.8, and 1.00 pound active Karmex DL; 1.0 pound active TCB acid (HC-1281); 3.0 and 6.0 pounds active CDAA; and 3.0 and 6.0 pounds active CDEC.

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*Thanks are due to the Dow Chemical Co., du Pont Co., Heyden Chemical Co., and Monsanto Chemical Co. who kindly supplied the various weed killers.
Credit is due to Louis F. Michelson for analysis of the data.

Contribution No. 1023 of the University of Massachusetts, College of Agriculture Experiment Station.

Treatment 2 involved the application of 2.25 pounds of dinitro on the corn plants July 5 when they were one inch high. Appropriate controls were also maintained. All the chemicals were diluted with water and applied at the rate of 50 gallons per acre. The sprays were applied with a Brown Open-Hed No. 4 hand-pressure sprayer fitted with a No. 8004 Spraying Systems Tee Jet, fan-type nozzle. The soil was in excellent condition for seed germination, and growth and moisture conditions were ideal for good weed control.

The weed population consisted of purslane, smartweed, lamb's quarters, chickweed, galinsoga, pigweed, and crab grass.

Readings on weed count and height and crop height were made on July 22 and then the plots were all cultivated twice prior to lay-by. The weather during July was hot and dry with hot and very wet conditions in August. The corn was side-dressed with 400 pounds of nitrate of soda in late July helping to maintain good growth until August 29 when the ears were harvested and weighed.

Results

The results of these tests with corn are presented in Table I.

The degree to which all the chemicals controlled weeds is particularly noteworthy. The plots that had received 2.25 pounds of dinitro when the plants were at the "spike" stage were especially outstanding. There, only 0.3 weeds, 0.7 inch tall, was present per square foot as compared to the control plots where 48.3 weeds, 14.2 inches tall, were present. It was surprising that 1.5 pounds of 2,4-D provided the poorest control of any of the treatments. The three Karmex formulations gave good weed control at all rates, and, interesting to note, the differences among the various plots were not significant. As was the case with our tests in 1954 (1), TCB was very effective in controlling weeds in this crop. CDAA and CDEC, two new compounds, showed excellent promise for weeding corn, with perhaps CDEC apparently the more desirable of the two.

Although yields did not differ greatly among the plots, some possible comparisons were significant. CDAA at 3.0 pounds per acre provided the highest yield, but only the 2,4-D treatment and the control were poorer in weed control. CDEC, however, rated among the best of the materials tried. Karmex W caused depressed yields, and the 0.8-pound rate resulted in the poorest yield of all treatments. Dinitro, as in previous years (1), provided excellent weed control without depressed yields.

Table I Effect of Weed Killers on Weed Control, Growth, and Yield of Golden Beauty Sweet Corn

Planted June 29, 1955 - Recorded July 22, 1955

Plot	Treatment	Rate per Acre lb. active	Weeds per Sq. Ft.	Weed Height Inches	Crop Height Inches	Yield Marketable Ears/Lbs.
1	DN(Premerge)	4.50	1.7	1.9	16.6	19.4
2	DN(Premerge)	2.25	0.3	0.7	16.7	18.7
3	Dow Form 40	1.50	15.3	3.3	16.2	15.2
4	Karmex W	.60	1.7	1.3	16.6	15.8
5	Karmex W	.80	3.0	2.7	14.9	14.9
6	Karmex W	1.00	1.7	1.7	15.7	15.3
7	Karmex DW	.60	5.7	3.5	16.5	17.0
8	Karmex DW	.80	3.0	2.5	16.1	16.8
9	Karmex DW	1.00	2.7	2.2	16.3	18.3
10	Karmex DL	.60	4.0	3.0	16.2	18.5
11	Karmex DL	.80	2.3	2.7	16.2	17.5
12	Karmex DL	1.00	2.3	1.8	17.7	17.6
13	Control	-	48.3	14.2	18.3	17.1
14	TCB(HC-1281)	1.00	2.0	1.4	19.7	18.7
15	CDAA	3.00	6.3	3.3	19.0	21.3
16	CDAA	6.00	2.7	2.0	19.2	20.3
17	CDEC	3.00	2.3	1.5	18.0	20.2
18	CDEC	6.00	1.0	1.7	18.0	19.2
L.S.D. @ .05			5.6	2.2	N.S.	2.0
L.S.D. @ .01			7.5	2.9	N.S.	2.7

Summary

Eight chemicals used in pre-emergence applications were effective for killing weeds in sweet corn. The 2,4-D application resulted in the poorest weed control and gave yields that were among the lowest of all the treatments. Karmex formulations gave effective weed control with DW and DL forms providing better yields than the W form. CDEC and TCB are apparently excellent herbicides for sweet corn. The results of the dinitro treatments substantiate the excellent performance that they have made on our plots in previous years.

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PRE-EMERGENCE WEEDING OF SWEET CORN

M. F. Trevett[1]

This paper is a report of a 1955 test of herbicides applied pre-emergence to sweet corn.

Procedure and Materials

Carmelcross sweet corn was planted June 9, 1955, 1 1/2 inches deep in a sandy loam soil containing 4 percent organic matter. Herbicides were applied with a small plot sprayer at 40 pounds pressure per square inch and at a spray volume of 50 gallons per acre. Single row plots were used. Treatments were replicated 8 times. Each treated plot was paired with a check (untreated) plot. The check plots were hand hoed 4 weeks after the treatments had been applied. Treated plots were not hand hoed. All plots were cultivated, but during cultivation the soil 6 inches on either side of the crop row was not disturbed. In the statistical analysis of the data, covariance was used to adjust treatment yields to a common check yield.

Herbicides were applied at 2 dates. One series of plots was treated June 10, the day following planting; a second series of plots was treated June 15. Corn emerged June 19.

The sources of the herbicides applied are listed in Table 1. Table 2 contains the rainfall data for a 20-day period following planting. Table 3 contains the rates at which the herbicides were applied, the percent reduction in stand of broadleaf weeds and annual grasses, and the yield of sweet corn in pounds of snapped ears per acre. Yield records were not taken for certain treatments because of obviously unsatisfactory overall weed control. Table 4 contains ratings of injury to sweet corn following pre-emergence treatment.

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Experimental Results

Effect of Treatment on Weed Control

The outstanding treatments, considering both broadleaf weed control and annual grass control (Table 3), were 0.4 and 0.8 pounds of CMU FW, and 1.0, 2.0 and 3.0 pounds of TCB. Treatments that gave excellent broadleaf weed control, but poorer annual grass control than the former group, included 4.5 pounds DN, 0.2 pound CMU FW, 0.5 pound TCB, and 9.0 pounds of triazine per acre. Six pounds of triazine gave unsatisfactory annual grass control, but excellent broadleaf weed control; 3.0 pounds of triazole gave unsatisfactory control of both annual grasses and broadleaf weeds.

Dalapon applied at the rate of 3.4 pounds per acre gave distinctly better annual grass control than 3.2 pounds of EH 6249, 6.0 pounds of CDEA, or 6.0 pounds of CDEC.

The poor annual grass control (13.3 percent) following the June 15 application of 6.0 pounds of CDEC per acre is difficult to reconcile with the excellent control (78.2 percent reduction) obtained from a like rate of CDEC applied June 14 to snap beans in another part of the same field.[2] The only contingency that might have affected weed control was a difference in the amount of sheet erosion that occurred in the two areas on June 13. The bean area, which has a smaller percent slope than the corn area, received only mild sheet erosion in one corner of the block. In the corn block, on the other hand, severe sheet erosion occurred over the entire area. Whether or not sheet erosion occurring immediately before a delayed pre-emergence treatment will affect the percent of weed control obtained, or whether a difference in this regard exists between herbicides, is conjectural. The percent reduction in broadleaf weeds and annual grass following the application of TCB, CDEA, and DN before (June 10) and after (June 15) the occurrence of sheet erosion follows:

Treatment	Percent Reduction in Stand of Weeds			
	June 10 Application		June 15 Application	
	Broadleaf	Grass	Broadleaf	Grass
1# TCB	93.7	70.9	88.0	44.8
6# CDEA	25.5	39.7	14.2	16.0
4.5# DN	88.8	19.7	86.3	20.5
Average	69.3	43.4	62.8	27.1

2/ Trevett, M. F. Pre-Emergence Weeding of Snap Beans with Amino Triazine, CDEA (Diethylacetamide), CDEC (Diethyldithiocarbamate) and Dinitro. Proceedings of the Tenth Annual Meeting of the Northeastern Weed Control Conference. January 1956.

Effect of Treatment on Sweet Corn

The profound importance of the rainfall pattern following a pre-emergence treatment in determining the safety of that treatment is evident in the ratings of crop injury for 1.0 pound of TCB for the June 10 and the June 15 treatment dates, Tables 2 and 4. The leaching conditions following the June 10 application were associated with marked stunting of the seedling corn, whereas crop injury following the June 15 application was negligible, even for a 2-pound rate of TCB.

At harvest (August 26) crop injury had been outgrown, except in those plots treated June 10 with 3.4 pounds of dalapon or 3.0 pounds of TCB. At the 1 percent level the yield of snapped ears from plots receiving 3.0 pounds of TCB per acre on June 10 was significantly lower than from all other treatments harvested, including hand hoed check plots. All treated plots, except those receiving 3.0 pounds of TCB, produced higher yields than the unhoed check plots. The individual degree of freedom test indicated that significant yield differences did not exist between plots receiving 0.2, 0.4, and 0.8 pounds of CMU FW per acre, nor between plots receiving 0.5, 1.0, and 2.0 pounds of TCB per acre.

Summary

Pre-emergence applications of 0.2 pound of CMU FW, 0.5 pound of TCB acids (Heyden), 4.5 pounds DN, or 9.0 pounds of amino triazine per acre gave approximately the same order of broadleaf weed and annual grass control without marked injury to Carmelcross sweet corn, and without significant differences in yield of snapped ears per acre compared to hand hoed check plots. Higher rates of CMU FW and TCB gave better over-all weed control, but this enhanced weed control was not reflected in significantly higher yields.

Dalapon applied at the rate of 3.4 pounds per acre was significantly more effective in reducing the stand of barnyard grass than EH 6249 applied at the rate of 3.2 pounds per acre. Neither herbicide gave adequate broadleaf weed control, and at the rates used gave excessive injury to sweet corn.

Amino triazole applied pre-emergence at the rate of 3.0 pounds per acre gave unsatisfactory control of broadleaf weeds. Six pounds of CDEC or 6.0 pounds of CDEA per acre applied pre-emergence was not injurious to sweet corn, but gave poor control of both broadleaf weeds and barnyard grass.

TABLE 1. HERBICIDES USED IN 1955 SWEET CORN TESTS

Abbreviation or Designation	Active Ingredient	Manufacturer
CDEA	Alpha chloro-N,N diethylacetamide	Monsanto
CDEC	2-chloroallyl diethyldithiocarbamate	Monsanto
DN	Dinitro-o-sec-butyl phenol ("Premerge")	Dow
Dalapon	Na 2,2-dichloropropionate	Dow
EH 6249	Na 2,2,3-trichloropropionate	Am. Cyanamid
CMU FW	3-(p-chlorophenyl)-1,1 dimethylurea	DuPont
TCB	2,3,6-trichlorobenzoic acid (HC-1281-S)	Heyden
Triazine	2-chloro-4,6-bis(diethylamino)-S-triazine (444E)	Geigy
Triazole	3 amino-1,2,4-triazole	Am. Chemical Paint

TABLE 2. RAINFALL - JUNE 10 TO JUNE 30, 1955, MONMOUTH, MAINE

Date	Inches
June 10 (10:30 PM - 7:30 AM June 11)	.19
11	.50
12	.26
13	.44
14	.09
15	.01
16	--
17	--
18	--
19	--
20	.25
21	.04
22	.02
23	.13
24	--
25	.19
26	.01
27	--
28	--
29	--
30	--

TABLE 3. SUMMARY OF WEED CONTROL TESTS IN SWEET CORN, 1955

Treatment (Lbs. active ingredient per acre)	Percent Reduction of Weeds[1] Four Weeks After Treatment		Adjusted Yields of Snapped Ears[4] Pounds Per Acre
	Broadleaf[2]	Annual Grass[3]	
Treatments applied June 10			
3# triazole	66.6	17.0	--
3.4# dalapon	+22.1[5]	97.3	--
0.2# CMU FW	84.2	22.1	5372
0.4# CMU FW	96.8	61.0	6296
0.8# CMU FW	97.0	85.5	5277
3.2# EH 6249	+11.3[5]	33.9	--
1# TCB	93.7	70.9	5768
3# TCB	99.0	90.0	3324
6# CDEA	25.5	39.7	--
4.5# DN	88.8	19.7	6186
Treatments applied June 15			
0.5# TCB	80.7	21.9	4894
1.0# TCB	88.0	44.8	5719
2.0# TCB	92.0	56.2	5796
6.0# CDEC	6.9	13.3	--
6.0# CDEA	14.2	16.0	--
4.5# DN	86.3	20.5	5386
6# triazine	96.1	1.5	--
9# triazine	96.3	30.3	5280
Check, hand hoed[6]	--	--	5120
LSD 5%	--	--	1074
1%	--	--	1428

1/ Check plots averaged 23.8 broadleaf weeds and 22.2 annual grass plants per square foot.

2/ The principal broadleaf weeds were: black mustard (*Brassica nigra* Koch.), wild mustard (*Brassica arvensis* Ktze.), lamb's-quarters (*Chenopodium album* L.), red-root pigweed (*Amaranthus retroflexus* L.).

3/ Barnyard grass (*Echinochloa Crus-galli* Beauv.).

4/ Checks were cultivated throughout the summer, and were hand hoed once July 12 -- immediately after weed counts had been made. Each treated plot was paired with a check plot.

5/ An increase.

6/ Untreated plots that were cultivated but not hand hoed averaged 3300 pounds of snapped ears per acre.

TABLE 4. RATINGS OF INJURY TO SWEET CORN FOLLOWING PRE-EMERGENCE TREATMENT

Treatment (Lbs. active ingredient per acre)	Injury Ratings 1/ July 4	July 15
Treatments applied June 10		
3.0# triazol	2.25	1.00
3.4# dalapon	8.75	5.87
0.2# CMU FW	2.25	1.00
0.4# CMU FW	2.37	1.12
0.8# CMU FW	2.37	1.12
3.2# EH 6249	4.87	2.25
1.0# TCB	4.87	5.12
3.0# TCB	7.87	8.00
6.0# CDEA	2.00	1.62
4.5# DN	2.37	1.00
Treatments applied June 15		
0.5# TCB	2.00	1.12
1.0# TCB	2.62	1.12
2.0# TCB	2.50	1.12
6.0# CDEC	2.12	1.62
6.0# CDEA	2.12	1.00
4.5# DN	2.50	1.12
6.0# triazine	2.44	1.11
9.0# triazine	2.12	1.12

1/ 1 = crop injury absent. "Injury" may be due to herbicide, weed competition, or both.

10 = sufficient crop injury to reduce plant size and vigor by 50 percent.

A COMPARISON OF POST-EMERGENCE APPLICATIONS OF NEW HERBICIDES ON SWEET CORN.[1]

by S. K. Ries[2] and B. H. Grigsby[3]

The suggested weed control practices for sweet corn in Michigan are the application of four pounds of DNBP or one pound of 2,4-D at time of corn emergence or in the spike stage. Although these chemicals are effective on weeds that have emerged at time of application, they give little residual control of weeds, and are not effective under dry conditions.

Reports concerning two relatively new chemicals, CMU (3 p-chlorophenyl 1, 1 dimethyl urea) and 3-amino-1,2,4-triazole have been too variable to warrant their recommendation or further trial (1), (2), (6), (5).

Derivitives of trichlorobenzoic acid have proved effective when applied to sweet corn at emergence (4), (7), and on field corn (3).

The following work, which was undertaken in 1955, was designed to evaluate: 1) Several new chemicals and formulations as compared to a standard application of DNBP; 2) The response of an early variety of sweet corn usually susceptible to standard 2,4-D treatments and a midseason variety normally resistant to 2,4-D treatments.

MATERIALS AND METHODS

A split plot factorial design with two replications was used. The largest division was for variety. The two varieties used were North Star, a standard early variety, and Golden Cross Bantam, a standard midseason variety. Both varieties were seeded June 2 on a Hillsdale sandy loam. The rows were 34 inches apart with plants 12 inches apart in the row.

The chemicals used were DNBP (Dinitro-o-sec-butylphenol), Hooker X-33 (a blend of 2,3,6-trichlorobenzoic acid and tetrachlorobenzoic acids), Hooker X-42 (predominately a mixture of tetrachlorobenzoic acids), Heyden TCB (6 isomers of trichlorobenzoic acid), ACP L-841 (2,4-D Amide), CDAA (a-chloro-N-N-diallylacetamide), CDEA (a-chloro-N-N-diethylacetamide), DCU (Dichloral urea), 3Y9 (tris-2,4-dichlorophenoxyethyl phosphite) and Geiggy 444 (2-chloro-4,6-bis /diethylamino/ s-triazine).

The chemicals were applied on June 9. Both varieties were past the spike stage and were $1\frac{1}{2}$ - $2\frac{1}{2}$ inches high at time of treatment. A small plot sprayer was used that applied the equivalent of 27 gallons of water per acre. Each plot was 30 feet long and 2 rows wide. Two rows 25 feet long were harvested.

Weed control ratings were made June 30. Yield records taken included the total number of marketable ears and weights per plot. The variety North Star was harvested August 10 and the Golden Cross Bantam on August 22.

1/ Journal Article 1851 from the Michigan Agricultural Experiment Station.
2/ Assistant Professor, Department of Horticulture, Michigan State University.
3/ Professor, Department of Botany and Plant Pathology, Michigan State University.

TABLE 1. YIELD AND WEED CONTROL OF TWO VARIETIES OF SWEET CORN FROM APPLICATION OF CHEMICALS AT THE TWO INCH STAGE.

Chemicals	Rate lbs/acre	Weed Control Ratings[1]	Marketable Yield	
			tons/acre	No. of ears per plot
None		1.0	4.35	51.8
DNBP	4	6.0	4.33	54.8
Heyden TCB	1	7.0	4.06	44.2
Heyden TCB	3	8.8	4.24	48.3
"Hooker X-33"	1	1.5	4.19	48.5
"Hooker X-33"	3	6.0	4.22	49.5
"Hooker X-42"	1	2.8	4.10	43.0
"Hooker X-42"	3	8.0	4.85	52.2
ACP L-841	1	5.5	4.47	53.8
ACP L-841	2	8.5	4.25	47.8
CDAA	4	2.8	4.65	49.8
CDEA	4	1.0	5.03	50.2
DCU	10	1.8	4.77	59.8
Naugatuck 3Y9	2	8.0	3.60	48.8
Geiggy 444	6	4.2	4.02	41.2
LSD at 5%		1.1	N.S.	N.S.
LSD at 1%		1.5	N.S.	N.S.
Coefficient of Variability		16.5%	18.1%	18.8%

Rating Scale 1 = No control, 6 = commercial control, 9 = eradication.

RESULTS

The weed control ratings are presented in Table 1. The weeds present were Crabgrass (Digitaria sp.), foxtail (Setaria sp.), purslane (Portulaca oleracea), pigweed (Amaranthus retroflexus) and lamb's quarters (Chenopodium album). Several chemicals gave better weed control than DNBP. These were: three pounds per acre of Heyden TCB, three pounds per acre of Hooker X-42, two pounds per care of ACP L-841, and two pounds per acre of Naugatuck 3Y9. The reason for the better weed control was not due to the amount of initial kill but the residual control. No hoeing was necessary for the entire season on treatments with a rating higher than 6.0. The one pound per acre rate of Heyden TCP and ACP L-841 compared favorably with DNBP.

Neither the weight nor number of ears per plot differed significantly for any treatment as shown in Table 1. There was considerable variability in the yield data, which was probably due to corn breakage from a severe wind storm. The yield from Naugatuck 3Y9 was not lower than the other treatments when tested with a single degree of freedom.

The varieties North Star and Golden Cross Bantam responded similarly to all treatments.

SUMMARY

1) None of the 15 treatments significantly reduced the yield when compared to the check.

2) Both the varieties North Star and Golden Cross Bantam responded similarly to all chemicals.

3) The following treatments applied at the two-inch stage seem worthy of further trial: 1) 1 and 3 pounds of Heyden TCB, 2) 1 and 2 pounds ACP-841, 3) 3 pounds of Hooked X-42 and 4) 2 pounds Naugatuck 3Y9.

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TRICHLOROBENZOIC ACID AND OTHER HERBICIDES FOR SWEET CORN

by
Robert D. Sweet, C. R. Benedict, and Garvin Crabtree
Cornell University 1/ 2/

Although 2,4-D has given broadleaf weed control at nominal per acre costs, it has not met the need for a selective herbicide for the grasses which are a problem in some areas, and is always a potential danger to susceptible crops. Other herbicides used in sweet corn are often expensive or fail to give the desired control of all weeds.

The experiments reported here were designed to test a number of compounds for their relative value as selective herbicides in sweet corn, and to study the influence of several factors on the response of sweet corn to trichlorobenzoic acid.

SCREENING

Methods

Plots for screening tests were planted on June 27 and July 9 and sprayed on July 9 and July 16, respectively. At the time of treatment the sweet corn and weeds were emerging. Since there was very little difference in response of chemicals in the two tests, and since the weed development was poor in the area where the second test was conducted, only the results of the first test are reported here. Golden Cross variety was grown on a sandy loam soil in three foot spaced rows, and two replications of single row plots 20 feet long were treated. Supplemental irrigation was supplied as needed. This amounted to 1 1/2 inches of water during the week following treatment. Mechanical cultivation was used between the rows and weed ratings of grasses and broadleaves were made on the uncultivated strip directly in the row, 18 and 68 days after the chemicals were applied. The weed population consisted mainly of redroot pigweed (*Amaranthus retroflexus*), purslane (*Portulaca oleracea*), candy grass (*Eragrostis sp.*), and crabgrass (*Digitaria sanguinalis*). A list of the chemicals used is presented in Table 1.

Results

Good broadleaf weed control was obtained with the low volatile 2,4-D ester and dinitro compound that were used as standards. No treatment included in this test gave better control than one pound per acre of LV-4 or 1 1/2 pounds of Premerge. 3/ Some improvement in broadleaf control over the

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1/ Paper No. 402 of the Department of Vegetable Crops.
2/ Part of this research was made possible by a grant-in-aid from Heyden Chemical Corp.
3/ All statistical comparisons made by "new multiple range test". Duncan, D. B., 1955. Multiple Range and F. Tests. Biometrics 2: 1-42.

Table 1. Chemicals used in sweet corn screening test.

Designation	Active Agent
6831	Crag-1 type
7977	Crag-1 type
DCU	Dichlorourea
8703	Crag-1 type
6711	Na-2-methyl-4-chloroethyl sulfate
CDAA	a-chloro-N,N-diallylacetamide
CDEA	a-chloro-N,N-diethylacetamide
CDEC	2-chloroallyldiethyldithiocarbamate
444	2-chloro-4,6-bis-(diethylamino)-s-triazine
3-Y-9	tris-(2,4-dichlorophenoxyethyl) phosphite
SD 1369	P,P-dibutyl-N,N-diisopropylphosphinic amide
M-1-W	3-(3,4-dichlorophenyl)-1-methylurea
Karmex W	3-(p-chlorophenyl)-1,1-dimethylurea
Crabgrass Killer	3-(3,4-dichlorophenyl)-1-methyl-1-N-butyl urea
2,4-D Amine	triethanolamine salt of 2,4-D
LV-4	butoxyethanol ester of 2,4-D
L-841	2,4-dichlorophenoxyacetamide
L-857	Sodium trichlorobenzoate
1281-S	Na-2,3,6-trichlorobenzoate
DN	amine salts of DNSOBP
LV-DN	low volatile formulation of DNSOBP
L-878	P-chlorophenoxyethanol
N-5519	sec.-butyl-N-(3-chlorophenyl) carbamate
CIPC	isopropyl-N-(3-chlorophenyl) carbamate

1/2 pound per acre rate of LV-4 was obtained by 1 1/2 and 3 pounds of L-841 and 444. Other materials such as SD-1369 and HC 1281-S gave superior weed control but damaged the sweet corn crop. Other materials resulting in crop injury were DCU, Karmex W, and CIPC.

The majority of the compounds gave better grass control than the 1/2 pound per acre rate of LV-4, but only a few materials, that were considered safe for sweet corn, gave significantly better results than one pound of LV-4 or 1 1/2 pounds of Premerge. These were CDAA, L-841, and mixtures of L-841 with 2,4-D ester or amine. The means of the ratings made 68 days after treatment are presented in Table 2.

Table 2. Effect of chemicals on weed control.

Chemical	Rate Pounds/acre (active)	Rating Means 4/ Broadleaves	Grasses
6831	2	9.0	1.5
	4	7.5	2.0
7977	2	7.0	4.5
	4	8.0	7.0
DCU	2	3.5	7.5
	4	4.5	8.0
8703	3	5.0	3.0
	6	7.5	4.5
6711	2	6.5	6.0
	4	6.0	5.0
CDAA	3	8.5	8.5
	6	7.0	6.5
CDEA	3	6.0	5.5
	6	8.5	7.0
CDEC	3	7.5	7.0
	6	7.0	5.0
444	6	9.0	5.0
	12	9.0	8.5
3-Y-9	2	5.0	7.0
	4	8.0	7.5
SD-1369	3	9.0	8.0
	6	9.0	8.5
M-1-W	1/2	8.0	4.0
	1	8.5	7.0
Karmex W	1/2	8.0	5.5
	1	8.5	2.0
Crabgrass Killer	1/2	8.5	6.0
	1	8.5	6.5
2,4-D Amine	1/2	8.0	5.0
	1	8.5	5.0
LV-4	1/2	8.0	3.0
	1	8.5	7.5
L-841	2	8.5	8.5
	4	8.5	7.5
L-857	2	9.0	3.5
	4	9.0	7.0
1281-S	2	8.5	7.0
	4	9.0	8.5
DN	1 1/2	8.5	7.5
	3	8.5	5.5
LV-DN	1 1/2	8.0	3.5

4/ Ratings made 68 days after treatment. (1-no weed control, 9-complete weed control). At 1% significance level, treatments significantly better than checks must have a rating mean of 7.0 or above for broadleaves and 9.0 or above for grasses.

Table 2. Effect of chemicals on weed control. (cont'd)

Chemical	Rate Pounds/acre (active)	Rating Means 4/ Broadleaves	grasses
2,4-D Amine + L-841	1/4 + 1 1/2	8.5	8.5
	1/2 + 3	9.0	5.0
LV-4 + L841	1/4 + 1 1/2	8.5	8.0
	1/2 + 3	9.0	8.5
DN + L841	3/4 + 1 1/2	9.0	7.0
	3/4 + 3	8.5	8.0
L-878	2	8.0	5.5
	4	8.0	7.0
N-5519	3	7.0	6.5
	6	8.5	4.0
CIPC	3	7.5	2.5
	6	7.5	6.0
Check	-	6.0	3.5
	-	6.0	4.0

TRICHLOROBENZOIC ACID STUDIES

Methods

In order to study the influence of water on sweet corn response to TCB a split plot-randomized block-split plot test was planned in which the main split was irrigation levels, the randomized treatments were combinations of rates and formulations (See Table 3), and the final split was application of the herbicide prior to or following the first irrigation treatment. The irrigation levels of 1 inch and 3 inches during the month after spraying were chosen to be sufficient to move the chemicals into the soil enough to be effective for weed control, or leach the chemicals into the root zone of the sweet corn, respectively.

The variety Golden Gross was planted on June 27 and 3 replications of 20 foot single row plots were treated on July 8. A duplicate test was planted July 11 and treated July 19. Leaf rolling and stem curvature were chosen as criteria of injury to the sweet corn and visual ratings of these responses were made three weeks after the chemicals were applied.

Results

There was good agreement in plant response to treatment effect between the two tests although the treatments of higher rates resulted in more injury in the first test. Analysis of the ratings showed no differences between

the criteria used. Differences between treatments and the treatment x rate of irrigation interaction were significant at the 1% probability level. When considering the three formulations of HC 1281 the differences between treatments could be attributed significantly only to rate of application of the chemicals. The treatment x rate of irrigation interaction could be attributed to a greater response of the sweet corn plants to the chemicals applied when the larger amount of irrigation was used. The factor of applying the chemical before or after irrigation, and the interaction of this and the other factors did not significantly influence the response of the sweet corn. Since the amount of irrigation or its timing in relation to treatment did not influence the responses rated in this test, these effects are combined for the treatment means presented in Table 3.

Table 3. Treatment list and effect ratings from test of influence of water on sweet corn response to TCB.

Material	Rate Pounds/acre (active)	Rating Means 5/ Leaf rolling	stem curvature
HC 1281-WD	1/2	8.2	6.6
	1	7.2	6.4
	2	5.9	5.9
HC 1281 - AD	1/2	8.2	6.6
	1	7.8	6.8
	2	6.2	4.8
HC 1281 - S	1/2	7.8	7.2
	1	8.1	5.6
	2	6.8	6.2
2,4-D Amine	1/2	8.5	7.5
	1	8.8	7.2
Untreated check		7.7	8.8

5/ Means of ratings from 12 plots (1 - plant dead, 9 - no injury).

Weed control was good and was rated "commercially acceptable" in nearly all of the treated plots one month after treatment. There was a tendency for slightly better weed control at the higher rates of chemicals used and for better control when the chemicals were applied before, rather than after, irrigation.

TCB Timing

A field test was applied to sweet corn (varieties Golden Cross and Golden Beauty) with four times of application of HC-1281 wd at a one pound per acre rate (active material). There were four replications with the

varieties confounded in the replications. The test was planted June 27 and sprays were applied on July 2, July 11, July 18, and July 26. These spray dates resulted from application at stages of development of the sweet corn as follows: when it was germinated but not yet emerged, in the "spike stage", 10 inches high, and 18 inches high.

The two varieties responded similarly with severe injury at the first time of application, a slight reduction in plant response ratings at the second time of application, and no effect from the last two application dates. Weed control was excellent for the remainder of the season on plots treated the first time and commercially acceptible on plots treated on the second date. Very poor weed control was obtained on plots treated on the last two dates.

DISCUSSION AND SUMMARY

Screening test results indicate that it is unlikely, that any of the materials tested will give weed control superior to 2,4-D ester or dinitro at a competitive cost per acre. It, appears, however, that there may be some value in the use of the amide form of 2,4-D or in mixtures of the amide form of 2,4-D or in mixtures of the amide with 2,4-D amines or esters for grass control. In addition, 444 gave excellent broadleaf and grass control with no serious injury to the corn, but rates were relatively high.

Considering the rather severe injury to sweet corn obtained in some of the trichlorobenzoic acid plots, the margin of safety with this material on sweet corn appears to be quite low. Although the high rates, which caused the most severe damage, were not necessary to obtain satisfactory weed control, there were some detrimental effects on the plants at the lower rates. The timing for optimum weed control appears to be closely correlated with the extent of damage.

In the second test on the influence of watering, the marked decrease in severity of effect was possibly due to lower temperatures during the growth of the crop. More severe injury in plots receiving larger amounts of irrigation water would be expected from the effect of leaching the material into the root zone of the sweet corn. In view of the rather limited conditions necessary for escape from injury, it seems questionable that trichlorobenzoic acid should be used on sweet corn.

A PRELIMINARY EVALUATION OF WEED CONTROL IN CRANBERRIES[1]

Richard J. Aldrich[2]

Weeds are particularly troublesome in cranberry bogs since mechanical equipment cannot be used for their control. Consequently, there has been considerable interest for many years in chemicals for weed control. Among the chemicals presently being used are iron sulfate, paradichlorobenzene, sodium chloride, sodium arsonate, copper sulfate, sodium arsenite and kerosene or other herbicidal oils.[3] The acre cost of treatment with these chemicals is relatively high. Treatment also involves problems of application common to these chemicals which must be applied in relatively large quantities per acre. There has been considerable interest, therefore, in the newer herbicides.

Experimental

Tests were started in 1953 in New Jersey to evaluate certain of the newer herbicides thought to have promise for selectively controlling redroot (*Lachnanthes tinctoria*) which is a particularly troublesome weed in many New Jersey bogs.

1953 Tests

Chemicals other than oil were applied in 40 gallons of water per acre May 29 to plots 5 by 15 feet in size using 3 and 4 pounds per acre of CIPC; 2, 4, and 8 pounds per acre of phenyldimethylurea and CMU; 2 and 4 pounds per acre of maleic hydrazide; and 80 and 120 gallons of a herbicidal oil per acre. Redroot was 6 to 8 inches tall when treated. Observations October 13 indicated no effect on redroot or cranberries with CIPC or maleic hydrazide. Four and 8 pounds of phenyldimethylurea and CMU resulted in practically complete kill of redroot whereas 2 pounds were ineffective. There were two few cranberry vines to be certain of their tolerance for the ureas but it appeared that 8 pounds was very injurious. Eighty gallons of herbicidal oil resulted in kill of redroot but was quite injurious to the cranberries present.

1954 Tests

A pre-emergence and post-emergence evaluation of chemicals on redroot was made in 1954. The test area was uniformly infested with redroot but had a good growth of cranberry vines.

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[1]Acknowledgement is made to Dr. Martin T. Hutchison, Entomology Department, Rutgers University, for assistance in 1953 and 1954.

[2]Agronomist, Field Crops Research Branch, ARS, U.S. Dept. of Agriculture in cooperation with the New Jersey Agricultural Experiment Station, New Brunswick.

[3]"Weeds of the Masschusetts Cranberry Bogs: Part I - The Grasses", Chester E. Cross. Mass. Agr. Expt. Station Bul. 463, April 1952.

The pre-emergence treatments were made April 1 using phenyldimethylurea, CMU and 3-(3,4-dichlorophenyl)-1, 1-dimethyl urea at 3, 4 and 5 pounds per acre. The chemicals were applied in 40 gallons of water per acre to plots 6 by 10 feet in size in a randomized block design with 4 replications. Cranberry vines had not initiated new growth at the time of treatment and redroot did not appear in the plots until about May 1. The lowest rate of all three chemicals resulted in pronounced damage to the cranberry vines and a complete loss of the crop.

Treatments were made post-emergence May 12 using 5, 10 and 15 pounds per acre of Dalapon; 1, 2 and 4 pounds per acre of amino triazole; 3, 4 and 5 pounds per acre of CMU; and 40, 60 and 80 gallons per acre of a herbicidal oil. Chemicals other than the oil were applied in 40 gallons of water per acre to plots 6 by 10 feet in size in a randomized block design having 4 replications. Redroot was 3-5 inches tall at the time of treatment. Amino triazole was the only chemical which showed promise for selectively removing the weed. The lowest rates of Dalapon, CMU and oil used resulted in practically a complete loss of the crop. It should be pointed out that the oil used was an experimental material. Redroot counts and cranberry yields for amino triazole treatments are shown in table 1. The redroot counts do not show as effective control as was actually obtained since those plants present in treated plots were much retarded when compared with those in check plots. It is probable that many of the redroot plants present in treated plots actually emerged after the treatments were made which accounts for the relatively small differences among rates. It is quite apparent from the yields that although cranberries have some tolerance for amino triazole the tolerance range is rather narrow. Yields were reduced considerably by 4 pounds of amino triazole but berry vines were relatively unaffected. Observation of these plots in 1955 indicated very effective redroot control with all three rates of amino triazole used during 1954.

1955 Tests

Results of tests during 1953 and 1954 suggested that amino triazole was the only chemical of those used showing possible selectivity. The tests with amino triazole suggested that 2 pounds was about the maximum rate usable on cranberries and suggested also that repeat treatments were worthy of consideration.

One and 2 pounds of amino triazole per acre were applied June 6 to plots 5 by 10 feet in size in a randomized block design having 4 replications. Appropriate plots were also included which received additional treatments on September 1. Redroot was 4 to 8 inches tall at the time of the first treatment. Cranberry yields shown in table 2 indicate no reduction with any treatment. Redroot control was relatively poorer during 1955 than in 1954. It was thought that this was due to the relatively larger size of redroot at the time of treatment in 1955 than in 1954.

Summary

Phenyldimethylurea, CMU, 3-(3,4-dichlorophenyl)-1, 1-dimethyl urea, Dalapon, a herbicidal oil, and amino triazole were evaluated as selective herbicides for the control of redroot in cranberries.

Amino triazole was the only chemical which appeared to have sufficient selectivity at rates necessary for control of the weed. It appeared that 2 pounds was approximately the maximum quantity of amino triazole per acre which could be used without damaging cranberries. Results also suggested that repeat treatments warrant further study.

Table 1. Effect of amino triazole applied May 12, 1954 on redroot (*Lachnanthes tinctoria*) and on cranberry yields. Whitesbog, New Jersey.

Pounds of amino triazole per acre in 1954	Number of redroot plants per square foot September 2, 1954	Grams of berries per plot 1954	Grams of berries per plot 1955
Check	33	1766	2145
1	18	1975	2293
2	19	1122	
4	10	274	352
L.S.D. .05		950	

Table 2. Effect of amino triazole on yield of cranberries, Whitesbog, New Jersey, 1955.

Pounds of amino triazole per acre June 6 1955	September 1 1955	Grams of berries per plot
1	0	4631
2	0	3886
1	1	4540
1	2	4222
2	1	4626
2	2	5035
0	0	4658
L.S.D.		NS

The Effect of CIPC on Field Sorrel (Rumex acetosella) in Strawberry Plantings

By R. F. Carlson[1]

Field sorrel has become a real problem to strawberry growers in Michigan. It was first most severe in strawberry plantings in the Upper Peninsula but is now generally a problem in the entire State (1). While testing various materials for the control of common Chickweed, it was observed that Field sorrel growing in the same fields was affected by CIPC (isopropyl N-3-chlorophenyl carbamate). Subsequent field tests with CIPC were set up in the fall of 1953 and 1954 in the Traverse City area where the sorrel was becoming a serious problem.

1953 Field Trials

Two-year old strawberry fields of Catskill and Premier varieties were treated with two and three pounds per acre of CIPC in October. Each area treated comprised about one quarter of an acre. The chemical was applied with a standard power weed sprayer in a volume of 50 gallons of water per acre.

The Field sorrel was at various stages of development — some being in the seedling stage, some well established, and some well matured with seed-stalks.

Results

Six weeks following treatment the sorrel showed some effects from the CIPC treatment. The younger plants, although still green, apparently had not grown since the treatment. The leaves were flaccid lying close to the ground, indicating that the plants were unable to take up water. The roots had begun to take on a brown color in contrast to the white roots of untreated plants. The symptoms of the established and mature sorrel plants were not as striking as those of the seedling plants six weeks after treatments.

The following May most of the seedlings were dead, and the older and more mature plants were noticeably retarded in both top and root development. It was apparent that CIPC had toxic effects on the sorrel late in the fall and perhaps in the spring. Some of the established sorrel plants, however, apparently had enough vigor left in the spring to regenerate from creeping roots. Weed counts taken in May showed a 60 to 70 per cent reduction in sorrel plants. There was no significant difference in control between the two and three pound rate. Annual fall applications with CIPC would tend to reduce the population of Field sorrel and facilitate harvesting of berries.

1954 Field Trials

A first year Catskill strawberry planting infested with Field sorrel in the seedling stage was treated in late October to determine if commercial control could be obtained with CIPC. The chemical was applied with a power sprayer at the rate of two pounds in 50 gallons of water per acre.

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[1] Department of Horticulture, Michigan State University, East Lansing, Michigan

Results

The Field sorrel showed similar effects to those described in the 1953 field tests. Control was not very obvious following treatment in the fall; however, by spring 70 to 75 per cent of the weed had succumbed to the treatment. The untreated portion of the field was green with Field sorrel in contrast to the comparatively weed-free treated field.

Effects on Strawberry Plants

Prior to the field tests here reported, CIPC was used experimentally in strawberries for control of common Chickweed without any serious effects on the strawberries. At present CIPC is recommended for Chickweed control at two pounds per acre.

In the 1953 and 1954 field tests new strawberry leaves showed temporary stunting and marginal yellowing in the spring at the three-pound rate of CIPC. Commercial yield of berries was not reduced as observed during the harvest season. The effect on strawberry plants treated with two pounds per acre of CIPC was very slight.

Summary

1. During the 1953 and 1954 seasons, CIPC was tested in commercial strawberry plantings at two and three pounds per acre for control of Field sorrel. The chemical was applied in October each year on Catskill and Premier varieties.

2. The seedling Field sorrel exhibited a wilted appearance but remained green for two months following the treatment. Well established sorrel plants were not as noticeably affected. In May following the treatment 60 to 70 per cent of the seedling plants were dead and the older plants appeared stunted in growth.

3. Growth and yield of strawberry plants were not hampered by the CIPC fall treatment.

4. For practical control of Field sorrel in commercial strawberry plantings CIPC at two pounds per acre should be applied in the fall when this weed is in the seedling stage.

Literature Cited

1. Carlson, R. F. Fall Applications with CIPC on Three Strawberry Varieties for Control of Common Chickweed. Proc. 9th Annual Northeastern Weed Control Conference. 221-222. 1955.

CONTROL OF LAMBKILL (KALMIA ANGUSTIFOLIA) IN LOWBUSH BLUEBERRY FIELDS

M. F. Trevett[1]

Lambkill (Kalmia angustifolia L.) is an abundantly occurring weed in many lowbush blueberry[2] fields of eastern Maine. Because the lowbush blueberry is as sensitive as lambkill to herbicidal concentrations of 2,4-D and 2,4,5-T, summer foliage sprays have resulted in excessive injury to blueberry plants. However, considering both the growth habits of lambkill as compared to those of the lowbush blueberry, and cultural practices employed, it may be possible to time applications so as to obtain an acceptable degree of lambkill control with only minor injury to blueberry plants. Thus, since lambkill leaves are persistent, and blueberry leaves are deciduous, a spray applied after the blueberry leaves have abscised should result in a sufficiently great absorption differential to make the treatment essentially selective. Further, if the treatment is applied the autumn previous to a spring burn[3] even though some of the herbicide might be absorbed through blueberry stems, early spring burning would destroy the stems before a significant amount of the herbicide could be translocated to the rhizomes, or to the shoot initiating area.

Experimental Results

A. Effect of Date of Application on Lambkill and Lowbush Blueberries

The data graphed in Figure 1, for three pounds of 2,4,5-T acid per acre from an ester formulation[4] applied as a water spray at various dates in 1952, indicate that as blueberry

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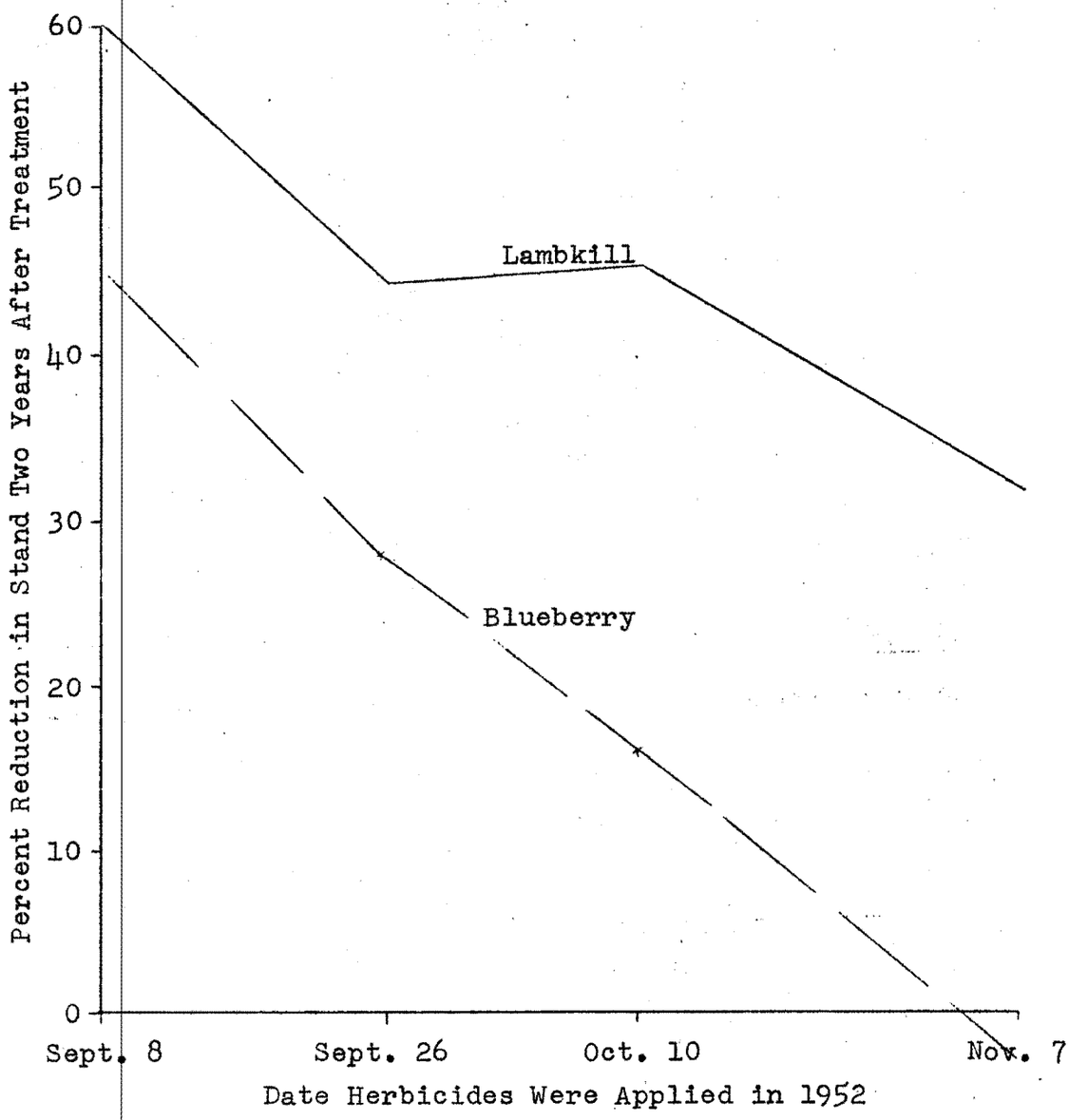
2/ Vaccinium angustifolium Ait., V. nigrum (Wood) Britton, V. myrtilloides Michx., and their hybrids.

3/ Lowbush blueberry fields are burned in the spring periodically - a pruning process.

4/ "Esteron 245" - Dow Chemical Co., Midland, Michigan. Active ingredient: 2,4,5-trichlorophenoxyacetic acid, propylene glycol butyl ether esters.

FIGURE 1. REDUCTION IN STAND OF LAMBKILL AND LOWBUSH BLUEBERRY PLANTS TWO YEARS AFTER AN APPLICATION OF THREE POUNDS OF 2,4,5-T ACID (ESTER) PER ACRE AT VARIOUS DATES



leaves pass from the completely green stage (Sept. 8) through a red leaf stage (Oct. 10) to complete leaf fall (Nov. 7) progressively less injury occurs to blueberry plants. Thus, a 44.8 percent reduction in blueberry stand occurred when the treatment was applied at the green leaf stage compared to a 16.2 percent reduction following treatment at the semi-red stage and compared to no reduction in stand when treatment was postponed until complete leaf fall.

The effect of the herbicide on lambkill similarly decreases with increasing lateness of treatment: a 59.5 percent reduction in lambkill stand followed the Sept. 8 treatment compared to a 31.9 percent reduction for the Nov. 7 treatment. The decreased sensitivity of lambkill may be accounted for by a lessened absorption resulting from an increased thickness of cuticle, or to a damping of the absorption process due to a lower mean temperature, or to the increasing difficulty of wetting lambkill leaves coincident with a change of the angle at which the leaves are displayed. In early autumn the topmost lambkill leaves are horizontal, thus being ideally oriented to intercept a maximum amount of spray. As the season progresses the leaves droop to approximately a 45 degree angle. In this condition, the uppermost leaves are difficult to wet.

B. The Effect of Spraying Angle, Wetting Agents and Spray Volume on Lambkill Control

Changing the spraying angle from directly overhead (90 degrees) to oblique (45 degrees), or the addition of extra wetting agent has not consistently resulted in better lambkill control.

Increasing spray volume from 40 up to 100 gallons per acre (40 psi) has improved lambkill control. At the densities of stand encountered (average: 29.4 stems per square foot) increasing the spray volume to 150 gallons per acre has not brought further improvement in control.

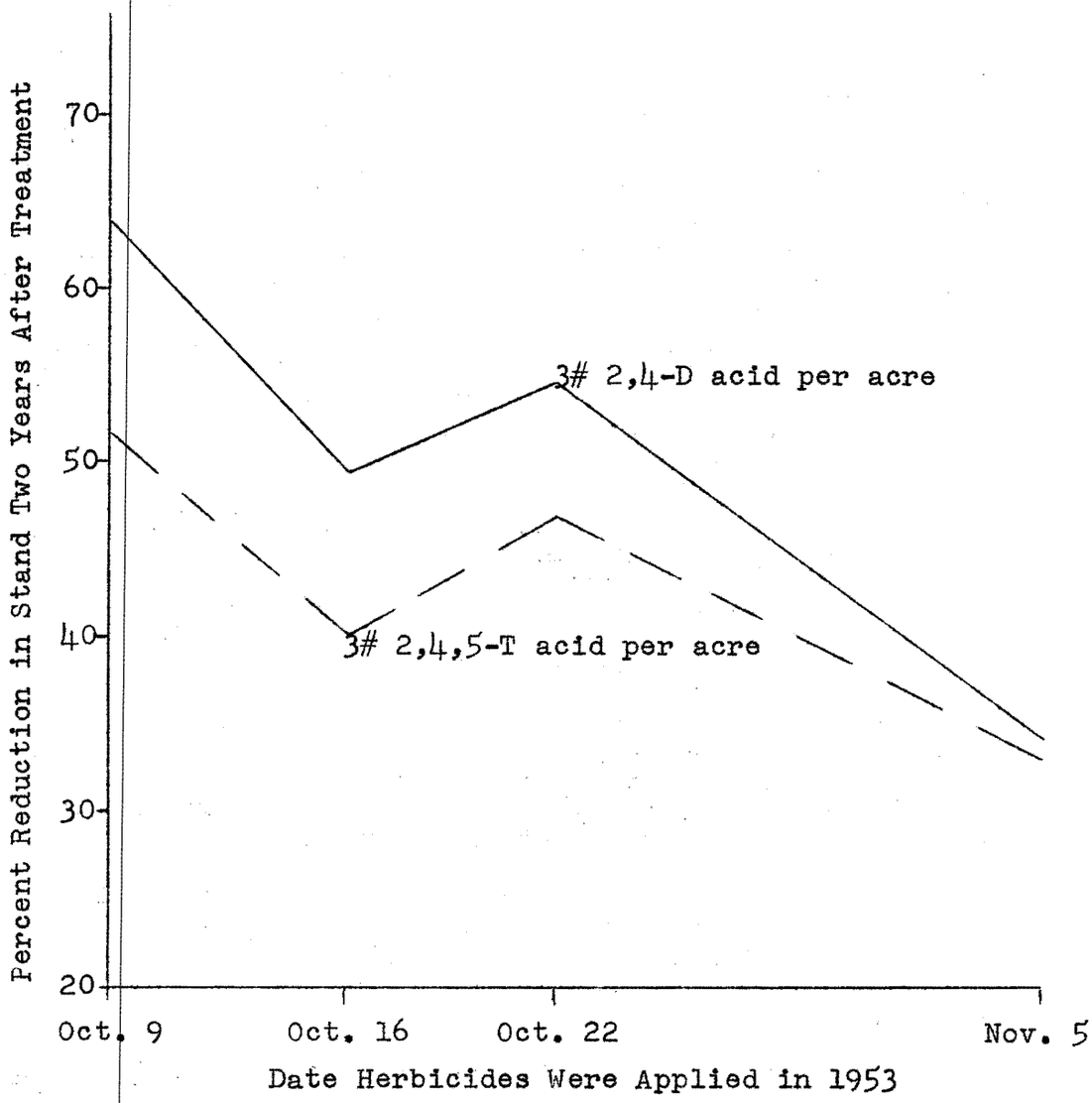
These volume relationships apparently hold for fields that are burned at least every three years. In fields that are burned less frequently, lambkill plants are ordinarily so large that adequate control may require a volume of from 100 to 150 gallons per acre.

C. Comparison of 2,4-D with 2,4,5-T for Control of Lambkill

At equal pounds of acid applied per acre, 2,4-D esters[5/] have generally given better lambkill control than 2,4,5-T esters, Figure 2. For either herbicide, when the rate of application

5/ Dow Chemical Co., Midland, Michigan. Active ingredient: 2,4-dichlorophenoxyacetic acid, propylene glycol butyl ether esters.

FIGURE 2. REDUCTION IN STAND OF LAMBKILL TWO YEARS AFTER TREATMENT WITH 2,4-D AND 2,4,5-T ESTERS APPLIED AT VARIOUS DATES



was increased from three to six pounds of acid per acre, lambkill control was increased only five to ten percentage points.

Other herbicides have been tested, but have been discarded because of poor or inadequate control obtained, or for other reasons. These herbicides include: the amines of 2,4-D and 2,4,5-T; sodium arsenite; herbicidal oils, both fortified and unfortified; dinitros; and substituted ureas.

D. Comparison of 2,4-D with 2,4,5-T for Effect on the Lowbush Blueberry

Data graphed in Figure 3 indicate that at equal rates of acid applied per acre 2,4-D esters are more injurious to lowbush blueberries than 2,4,5-T. A six-pound acre rate of acid for either herbicide did not differ significantly in effect from a three-pound rate; hence data for the six-pound rate are not included in the graph, Figure 3.

Both 2,4-D and 2,4,5-T defer emergence of new blueberry shoots following burn. The time interval elapsing between emergence in check plots and emergence in treated plots has been as great as seven days. However, in those instances where stands have not been reduced by treatment, deferred emergence has not resulted in reduced yields.

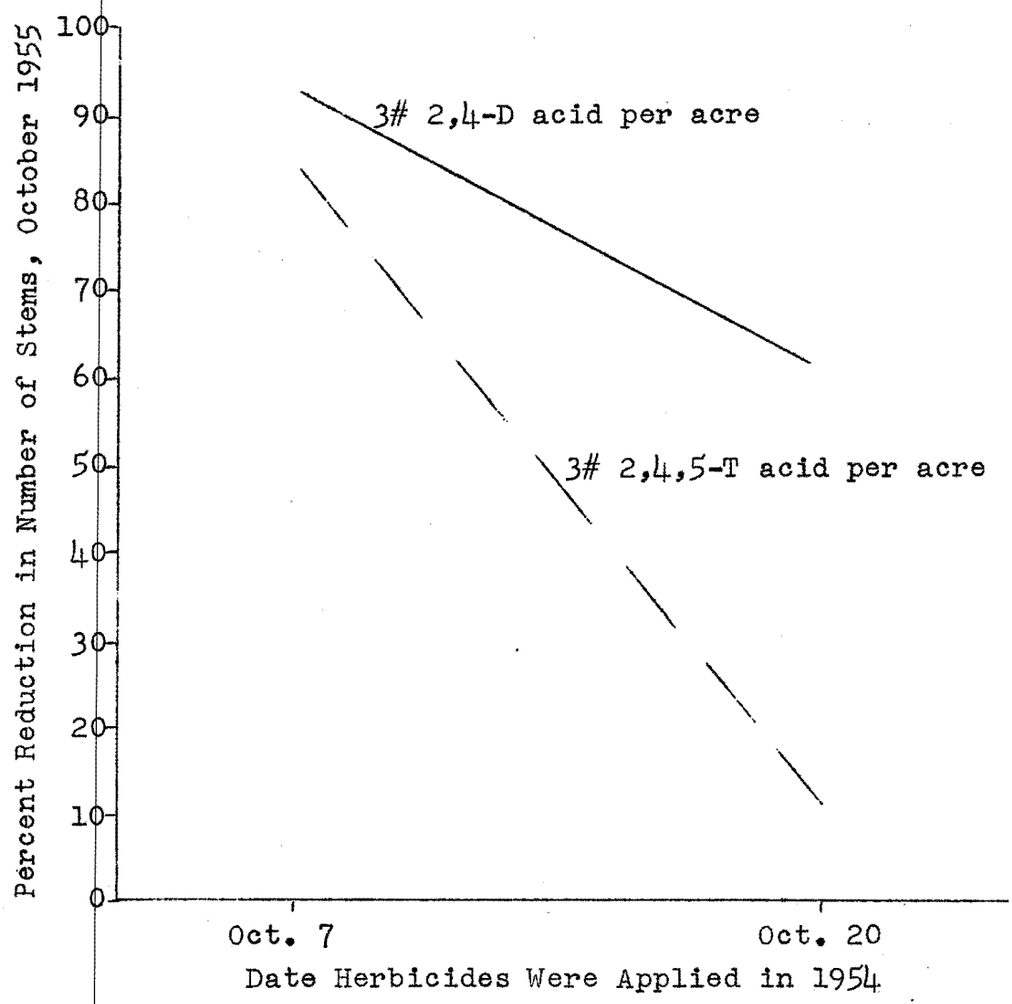
If burning is deferred until late spring, increased injury to blueberry plants may occur. Thus, in general, the earlier the burn the less the injury from a given rate of herbicide.

Summary

When 2,4-D or 2,4,5-T is applied in a water spray to lowbush blueberry fields, the autumn before an early spring burn, for the control of lambkill, minimum blueberry injury will occur if the treatment is deferred until the blueberry leaves have completely abscised. Maximum lambkill control, on the other hand, is obtained if the application is made in early autumn, when blueberry leaves are green. A reasonable compromise might be to apply these herbicides when blueberry leaves are completely red and are in the process of abscising.

Three pounds of acid per acre, from ester formulations, appears to be a satisfactory rate. At equal rates of acid applied per acre 2,4-D esters are more injurious to lowbush blueberries, and are more effective in controlling lambkill than 2,4,5-T esters.

FIGURE 3. EFFECT OF DATE OF APPLICATION OF 2,4-D AND 2,4,5-T ESTERS ON TOTAL NUMBER OF STEMS PER UNIT AREA OF BLUEBERRY SOD



Some Effects of Herbicides Used in Apple Orchards on Fruit Quality

W. E. Chappell 1/

In 1951, studies were begun on the control of poison ivy in apple orchards. A low volatile ester of 2,4-D -2,4,5-T mixture at concentrations of 1000 and 2000 ppm (acid equivalent) was applied to three varieties of apples. Four trees each of Red Delicious, Stayman and Winesap apple trees were sprayed July 13, 1951. Representative samples of fruit (a total of 20 per tree) were taken from treated and untreated trees on October 1 for comparison in the laboratory.

The harvested fruit were checked for firmness, color and sugar content. Firmness, a measure of ripening, was measured by a standard fruit pressure testing instrument. A standard color chart (California Department of Agriculture) was used in determining fruit color as another measure of ripening. The sugar content was measured by a refractometer using a composite sample of juice from twenty fruit per tree. The results of the 1951 experiment are given in Table 1. The results show no difference in either 1000 or 2000 ppm on fruit ripeness as compared to the check.

Table 1 - The effect of concentration of brush killer at harvest on color, firmness and sugar content on three apple varieties in 1952

	Red Delicious			Styaman			Winesap		
Treatment	Firmness	Color 1/	Sugar	Firmness	Color	Sugar	Firmness	Color	Sugar
	Lbs.		%	Lbs.		%	Lbs.		%
1000 ppm	15.95	2.25	10.70	17.85	1.80	12.85	20.93	2.75	12.65
2000 ppm	16.45	2.87	12.65	17.85	1.85	13.90	22.79	2.70	11.85
Check	15.80	2.85	13.40	18.95	1.80	11.70	24.30	2.67	12.90

No significant difference

1/ Higher figure indicates more advanced ripening

1/ Plant Physiologist, Virginia Agricultural Experiment Station, Blacksburg, Virginia

The 1951 studies showed that 2000 ppm of a 2,4-D - 2,4,5-T ester was very effective in controlling poison ivy and this was used as a basis for further studies which were started in 1954. Treatments in 1954 were applied to six trees each of Red Delicious, Golden Delicious, Stayman, and Grimes Golden varieties of apples. Three formulations of brush killer, 2,4,5-T amine, 2,4,5-T Lv ester and 2,4-D - 2,4,5-T LV ester were applied on July 1, 1954 at 2000 ppm. Twenty fruit were harvested in early October and compared for ripeness as outlined above. Results from the 1954 experiment are presented in Table 2. As in 1951 there was no apparent effect on the harvested fruit from the various treatments.

Table 2 - The effects of three formulations of brush killer on apple fruit at harvest in 1954.

	Golden Delicious			Red Delicious			Stayman			Grimes Golden		
Formulation	Firm.	Color	Sug.%	Firm.	Col.	Sug.%	Firm	Col.	Sug.%	Firm.	Col.	Sug.%
Amine 2,4,5T	17.88	1.31	13.83	18.29	1.91	13.52	17.19	2.07	13.05	20.48	-	12.4
Ester 2,4,5T	17.63	1.45	14.04	17.89	1.85	13.21	22.70	1.95	13.70	21.52	-	12.8
Ester 2,4-D-2,4,5T	17.68	1.35	13.55	18.66	2.15	12.40	21.52	1.82	13.14	22.06	-	13.4
Check	17.95	1.15	13.62	18.03	2.11	13.70	19.69	1.99	13.13	21.23	-	12.7

No significant difference

Many orchardists in the State have a problem of mice feeding on the roots of apple trees in the winter and some feel that if all weeds and grass could be controlled near the base of the trees the problem would be lessened, the idea being that the mice would not nest where the ground was bare. In 1955 preliminary studies were carried out on grass control under Staymen apple trees. Five trees each were sprayed with chemicals in the summer of 1955. The chemicals used and their effect on grass and fruit are listed in Table 3.

Early treatment with Dalapon seemed to be more effective than later when the grass was older. A mixture of cyanamid 6249 and amino triazole was more effective than the 6249 alone. Fruit ripening and sugar content was not affected by any treatments.

Table 3 - Grass control materials used in 1955

Treatment 1/	Grass control 2/ Rank 9/25	Effect on fruit Firmness	Color	Sugar %
1. Dalapon 1#/5 gal. applied 4/19	8	---	---	---
2. " 1#/5 gal. applied 6/10	6	---	---	---
3. " 3/4#/5 gal. applied 6/10	5	---	---	---
4. " 1/2#/5 gal. applied 6/10	5	---	---	---
5. " 1#/5 gal. applied 6/10	7	16.48	1.45	12.5
6. " 3/4#/5 gal. plus 2,4-D - 2,4,5-T2000 ppm - 6/10	6	15.81	1.44	11.5
7. Cyanamid 6249 1#/5 gal - 6/10	6	---	---	---
8. Cyanamid 6249 1#/5 gal. plus amino triazole .06#/5 gal. - 7/6	8	16.30	1.53	12.5
9. Cyanamid 6249 1#/5 gal. - 7/6	6	---	---	---
10. Dalapon 1#/5 gal. - 7/6	7	---	---	---
11. Check	1	15.99	1.59	11.95
		NS	NS	NS

1/ 3/4 gallon of spray applied per tree

2/ 1 = no control 9 = 100% control

Summary

1. Chemicals used in these studies had no apparent effect on ripening and sugar content of apples.

2. Poison ivy was effectively controlled by a directed spray using esters or amine formulations of 2,4,5-T and 2,4-D - 2,4,5-T mixtures at 2000 ppm.

3. Preliminary grass control studies showed that Dalapon and 6249 were effective in keeping down grass.

Progress Report on Amizol (3-amino-1,2,4-triazole) on Woody Plants

W. A. Meyers, R. H. Beatty, and W. W. Allen

Extensive field tests over the past three years have indicated that Amizol has a great deal of promise as a selective herbicide on woody plants. This new chemical has exhibited a remarkable degree of plant selectivity when applied to stands of mixed brush, completely controlling some species while being harmless to others.

Amizol is readily absorbed by the aerial parts of plants and translocates rapidly to the growing points. After being absorbed, Amizol affects susceptible plants by upsetting chlorophyll synthesis. Woody plants react in two ways to foliage treatment. In the case of poison ivy, a rapid and complete dessication of sprayed stems and leaves results within a short time. White ash, on the other hand, has responded differently to foliage sprays. The reaction is much slower and up to two years are required before the plants succumb. The spring following treatment of ash, the plants have leafed out in a completely chlorotic condition with subsequent death of the plant during the ensuing fall and winter.

Final data has been taken on foliage applications to mixed brush during the summer of 1953. Perhaps it will be of value to note the reaction of the susceptible plants found on these plots.

A series of test plots were laid out on the right-of-way of the Philadelphia Electric Company near Dreshertown, Pa., during July, 1953. Amizol was applied to the plots at rates of 3, 9, and 12 pounds per 100 gallons of water. All plants were sprayed to the point of run off. The species reactions to these treatments varied greatly.

By the fall of 1954 white ash (Fraxinus americana) was completely killed in all cases by the 9 and 12 pound applications. No resprouting has occurred to date in these plots. Plants treated at the 3 pound rate produced white, chlorotic leaves during the summer of 1954. By the fall of that year, some green leaves appeared. The majority of these plants showed recovery during the summer of 1955. It appears, therefore, that recommended rates should not be lower than 6 pounds active ingredients per 100 gallons of water.

Black oak (Quercus velutina) was killed in all instances by the 9 and 12 pound rates of application. Most plants were dead by the end of the 1954 growing season. At the 3 pound rate however, only 50% of the plants were killed. Plants which recovered seem to be making normal growth. Mockernut hickory (Carya tomentosa) reacted similarly to black oak. All plants in the plots receiving the higher concentrations were killed while recovery at the 3 pound rate was approximately 50% by the fall of 1955.

Scrub oak (Quercus ilicifolia) was readily controlled with foliage applications of 6 pounds Amizol per 100 gallons of water. In tests applied during July, 1953 at the U. S. Government Experimental Forest near Effort, Pa., data has shown that effective control was accomplished by 1954 and 80% control

American Chemical Paint Company,
Ambler, Pennsylvania

was recorded on these plots during September, 1955. By the summer of 1955 approximately 40% of the scrub oak treated at the 3 pound rate had recovered. Some of these plants were still producing leaves which were mottled with white, but it is assumed that they will eventually become normal. Tests applied to scrub oak at various sites during 1954 indicate that the reaction of the plants will be the same as in the 1953 tests.

During July, 1954, a series of test plots was put down on an area of mixed oak near Newaygo, Michigan. Northern pin oak (Quercus illipsoidalis) predominated with a fair mixture of red oak (Quercus rubra), white oak (Quercus alba) and wild black cherry (Prunus serotina). Amizol was applied as a drenching spray to the point of run off to the foliage and stems to the ground line, with no attempt being made to spray the ground. Rates of 4 and 6 pounds active ingredients per 100 gallons of water were used. The plants on the area averaged 4 to 6 feet in height.

Data taken in September of 1955 showed excellent control of all species. The kill on northern pin oak and red oak was 97% for the 6 pound rate. White oak showed a 99% kill and wild black cherry a 96% kill. By kill we mean that the plants showed no leaves on the old treated stems and no new regrowth from the root collar of the treated plants. Some of the wild black cherries which were still alive showed very small pinkish colored leaves and it is expected that some of these plants will fail to survive.

A series of test plots on mixed brush was applied in cooperation with the Davey Tree Expert Company on the Ohio Edison Company right-of-way at Newton Falls, Ohio. These plots were put down in August of 1954 and checked in June of 1955. Amizol was applied as a drenching spray at rates of 3, 6, and 9 pounds per 100 gallons of water. All plants were sprayed to groundline with no attempt being made to cover the ground with the spray.

Effective control of susceptible species such as white ash, hickory and various oaks was obtained with the 6 and 9 pound rate. The 3 pound rate gave only erratic control and was not satisfactory.

Cucumber magnolia (Magnolia acuminata) was greatly affected by the 6 pound rate of application. The treated plants leafed out in a completely chlorotic condition, and the leaves were definitely stunted. Results with this plant can not be tabulated accurately until next year, but indications are that it is susceptible to Amizol at rates of 6 pounds and over. American elm and American beech also seemed to be affected by the 6 and 9 pound rates. These plants will be checked carefully next year when final data is taken.

Of the other species in the test area, the following seemed to be resistant to the treatments given: hawthorn (Crataegus spp.), elderberry (Sambucus canadensis), red maple (Acer rubrum), spicebush (Lindera benzoin) and hop hornbeam (Carpinus virginiana).

Poison ivy (Rhus radicans) has been eradicated completely with a

drenching spray of 2 pounds or less of Amizol per 100 gallons of water. Control of poison ivy was achieved regardless of whether the treated plants were growing in the shade or in a position fully exposed to the sun. Rapid dessication of the leaves and stems of the treated plants takes place with the effects spreading rapidly to the underground parts. No chlorotic symptoms appear as is characteristic in other susceptible species. Although this species has proved very susceptible to Amizol it is nevertheless very important that the material be applied when the leaves are fully expanded. Tests put down when the plants were just leafing out gave relatively no control even at very high rates.

Poison oak (Rhus toxicodendron) has been successfully controlled in California by foliage sprays of Amizol. Dr. Oliver Leonard of the University of California has reported good control using a drenching foliage spray of 4 to 8 pounds of Amizol per acre. Best results were obtained when the plants were sprayed after the fruit had developed, but before the leaves began to turn yellow. Retreatment will probably be needed in most cases to get complete kill of this plant.

Amizol has been effective on many species of woody plants resistant to sprays of 2,4-D and/or 2,4,5-T. It was thought that by combining Amizol with the phenoxy compounds, control of a wider range of plant species might be achieved. With this thought in mind, a great many mixtures of Amizol with 2,4-D and 2,4,5-T acetics, and propionics were tried. To date, these mixtures have been disappointing. There does not appear to be the synergistic action that we had hoped would result from these mixtures. Although these tests are being continued, mixtures of the materials can not be recommended.

Because it would be impossible to include results of all the many tests in regard to susceptibility of individual species to various rates of Amizol, it may be of interest to list the susceptible and resistant species from the data we now have.

A. Species susceptible to Amizol at varying rates.

1. Ash, white (Fraxinus americana)
2. Cherry, wild black (Prunus serotina)
3. Hickory, mockernut (Carya tomentosa)
4. Oak, black (Quercus velutina)
5. Oak, northern pin (Quercus illipsoidalis)
6. Oak, red (Quercus rubra)
7. Oak, scrub (Quercus ilicifolia)
8. Oak, white (Quercus alba)
9. Poison ivy (Rhus radicans)
10. Poison oak (Rhus toxicodendron)

B. Species which show promise of being controlled by Amizol

1. Basswood (Tilia americana)
2. Beech (Fagus americana)
3. Cucumber magnolia (Magnolia acuminata)
4. Elm, American (Ulmus americana)
5. Blackberry (Rubus spp.)
6. Staghorn Sumac (Rhus typhina)
7. Prickly ash (Xanthoxylum americana)
8. Buckbrush (Symphoricarpos spp.)

C. Species resistant to Amizol

1. Blueberry (Vaccinium spp.)
2. Sassafras (Sassafras variifolium)
3. Smooth sumac (Rhus glabra)
4. Red maple (Acer rubrum)
5. Sweet fern (Comptonia peregrina)
6. Viburnum (Viburnum spp.)
7. Spicebush (Lindera benzoin)
8. Hawthorn (Crataegus spp.)
9. Elderberry (Sambucus canadensis)
10. Hop hornbeam (Carpinus virginiana)
11. Horsechestnut (Aesculus spp.)
12. Quaking aspen (Populus tremuloides)

Summary - Several series of foliage sprays using Amizol at varying rates were applied to mixed brush during the summers of 1953 and 1954. Species which were controlled by rates of 6 pounds Amizol per 100 gallons of water were: white ash, black cherry, hickory, poison ivy, poison oak, and various species of oaks. The most sensitive species treated was poison ivy, completely eradicated by rates of 2 pounds Amizol per 100 gallons of water.

Several other species such as cucumber magnolia, basswood, beech, elm, blackberry, prickly ash, staghorn sumac, and buckbrush show promise of being successfully controlled with Amizol.

Mixtures of 2,4-D and 2,4,5-T acetics and propionics with Amizol have not been promising to date. However, more work is needed along this line before a final conclusion can be drawn.

HELICOPTER APPLICATION OF 2,4,5-T IN 1954 TO RELEASE WHITE PINE REPRODUCTION

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A foliage spray was applied by helicopter to release white pine reproduction from hardwood competition. This was done in July 1954 on the U. S. Forest Service's Massabesic Experimental Forest in southwestern Maine. Observations in the fall of 1955 show that the release was successful.

A low volatile ester of 2,4,5-T was used. Two areas were treated; one of 15 acres and the other of 30 acres. On the smaller area, the rate of application per acre was one pound of 2,4,5-T acid equivalent; on the larger area it was 3 pounds. In both instances the chemical was diluted with No. 2 fuel oil to make 2½ gallons of solution per acre.

A helicopter equipped for general spray work was used. Swaths were kept about 50 feet wide to assure complete coverage; wider strips could have been flown. We found that the winds--5 to 10 miles an hour--were too high for good control of the spray. The drift killed vegetation for 200 yards; and in one place birch trees 1/4 mile away were killed. This shows one of the hazards of aerial application of silvicides, particularly near property lines or in the vicinity of sensitive crops. In 1955, when the air was calm, damage from drift was less than 100 yards.

The two areas treated were less than 1/4 mile apart, on land burned over in 1947. The stand on the smaller area was mixed white pine and hardwoods before the fire. Most of the pine and some of the hardwoods were fire-killed. This left a fairly uniform overstory of oaks, about 60 feet tall, with about 100 trees per acre. There were a few pole-sized white pine that also survived the fire.

By 1954 the understory was made up of white oak, red oak, and red maple sprout clumps, white and gray birch, some poplar and fire cherry--all about 10 feet tall. White pine reproduction and an occasional balsam fir, generally less than 2 feet tall, were fairly well distributed over the area. Sweet fern was the principal shrub species. A sample tally of gray and white birch showed stocking of about 47,000 stems per acre.

The larger area had been a nearly pure stand of white pine with some codominant oaks. Most of the oaks and a few of the white pines were still alive in 1954. The understory had the same species composition as the smaller area. The hardwoods were somewhat shorter and there were fewer stems per acre. A sample tally of birch showed stocking of about 31,000 stems per acre.

Extent of kill in the understory was probably restricted as much by differences in the overstory and density of new growth as by amount of silvicide used per acre. The shading effect by the large hardwoods was particularly noticeable during early stages of leaf kill in 1954.

Both applications resulted in a complete foliage and twig kill of the older hardwoods. Neither application damaged the older pines. In 1955, new sprout growth started only along the main stem and larger branches of the oak trees.

The less vigorous sprout clumps (shorter and fewer stems per clump) were the most susceptible. This was evident when the sampled red maple sprout clumps on the larger area were divided into three vigor classes. In the least vigorous class, 26 percent of the clumps were more than three-fourths killed in 1955. In the most vigorous class, only 15 percent of the clumps showed comparable damage. The more susceptible oaks showed this same trend.

In 1955 there was a difference in extent of understory kill. On the area treated with 1 pound of 2,4,5-T per acre, 2/3 of the birch and half the white oak were killed; there was no sprout growth from the root collars of these stems. Only 1/10 of the red oak and none of the red maple were killed to this extent. Damage exceeded three-fourths top kill for all the birch, most of the white oak sprout clumps, better than half the red oak clumps, and nearly 1/10 of the red maple sprout clumps (table 1).

On the area treated with 3 pounds per acre, damage exceeded three-fourths top kill for all the birch, nearly all white oak sprout clumps, 9/10 of the red oak, and 1/6 of the red maple. Few of the birch or white oak show new sprout growth in 1955. There are not as many red oaks with new sprouts on this area (table 2). On both areas, poplar seems to be damaged to about the same degree as red oak, and cherry about the same as birch.

Sweet fern was killed, but new root suckers outnumber the originals. The 1-pound rate killed about 1/3 of the sweet fern and partially killed the rest. With 3 pounds, all stems were killed. On both areas, new sprouts have added about one-third to the number of stems present before treatment. None of this new growth is actively competing with the white pine seedlings. Bracken fern was killed back but grew up again in 1955.

Young white pines were tagged only on the area treated with 3 pounds per acre. This was done primarily to determine extent of damage from the treatment. Examination in the fall of 1955 showed that of the 82 seedlings tagged, none was killed, 7 were obviously damaged (1954 terminals killed back), and 8 showed some slight injury (distortion of growth). The silvicide caused most damage where there was less protective covering (table 3). No records were kept for balsam fir, but the species seems comparable with white pine.

Release of trees can be measured by response as well as reduction in number of competing stems. The tagged trees showed a definite response to release. They grew 3/16 inch in diameter in 1955, measured 1 inch above the ground. "Check" pines on an adjoining undisturbed area grew only 1/16 inch in diameter. The growth after release by silvicides was the same as for other pines that had been released in 1952 by cutting back competing stems and keeping them cut back.

SUMMARY

A helicopter application of 2,4,5-T made in July 1954, on areas burned over in 1947, released white pine reproduction from hardwood competitors. The application slightly damaged a few of the pines. All of them have responded to release. Two dosages of 2,4,5-T were used--1 pound and 3 pounds--both diluted in No. 2 fuel oil to make a total application of 2½ gallons per acre. Overstory oaks were very severely damaged with either application, while associated white pines were not hurt. More understory hardwoods were killed with the stronger application.

Young birch and white oak trees were the most susceptible. At the 1-pound rate, nearly all were killed and less than half of them resprouted. At the 3-pound rate, less than one-fourth resprouted. Red oak was more resistant and red maple was the most resistant species observed. Sweet fern was top-killed but root-suckered prolifically; one year later the total number of stems was greater than before. However, these were not big enough to interfere much with the pines.

Table 1.--Results from 1-pound application of 2,4,5-T per acre

Extent of understory kill	Species							
	Birch		White oak		Red oak		Red maple	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Killed, no new sprouts	274	64	16	57	8	13	--	--
Top-killed, new sprouts in 1955	122	29	5	18	6	9	6	7
Total completely top-killed	396	93	21	75	14	22	6	7
Crowns more than 3/4 dead	31	7	6	21	16	26	--	--
Crowns from 1/2 to 3/4 dead	--	--	--	--	6	9	--	--
Crowns less than 1/2 dead	--	--	1	4	27	43	84	93
Total number sampled	427	--	28	--	63	--	90	--

NOTE--"Number" refers to number of parent oak and maple stumps examined. Each stump had at least one clump of sprouts (from 2 to 5 or more stems per clump) dating from 1948. The "extent of kill" at each stump was tallied as that of the greenest stem in the fall of 1955.

Table 2.--Results from 3-pound application of 2,4,5-T per acre

Extent of understory kill	Species							
	Birch		White oak		Red oak		Red maple	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Killed, no new sprouts	265	70	18	90	37	37	2	2
Top-killed, new sprouts in 1955	113	30	1	5	34	34	6	5
Total completely top-killed	378	100	19	95	71	71	8	7
Crowns more than 3/4 dead	--	--	--	--	16	16	11	9
Crowns from 1/2 to 3/4 dead	--	--	--	--	2	2	4	3
Crowns less than 1/2 dead	--	--	1	5	11	11	97	81
Total number sampled	378	--	20	--	100	--	120	--

NOTE--"Number" refers to number of parent oak and maple stumps examined. Each stump had at least one clump of sprouts (from 2 to 5 or more stems per clump) dating from 1948. The "extent of kill" at each stump was tallied as that of the greenest stem in the fall of 1955.

Table 3.--Damage to white pine by degree of exposure to silvicides

Amount of damage to white pine	Extent of cover at time of treatment							
	Less than 1/3		Between 1/3 and 2/3		More than 2/3		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Severely damaged	6	22	1	8	--	--	7	8
Very light damage	5	19	1	8	2	5	8	10
No damage	16	59	10	84	41	95	67	82
Total number of tagged trees	27	33	12	15	43	52	82	100

Chemical Control of Woody Species: A Summary

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Introduction

The purpose of this paper is to present a preliminary summary of current trends and techniques in chemical weed control of woody species. A species list previously accompanying such a report is omitted for several reasons. Such a list should include the effects of various spray techniques in regard to leaf burn, stem-kill, and root-kill. In the literature, however, it is extremely difficult to interpret the results of many studies in terms of these three basic points. Furthermore, observations covering less than two growing seasons are of limited value in interpreting root-kill since resprouting frequently occurs after a year of dormancy (Meyers et al 1954). Therefore, two to three years or longer are needed before root-kill can be definitely stated. Such a table, when sufficient data can be collected for each species, will be extremely enlightening in regard to the effectiveness of various techniques now being used commercially. Until such a table is compiled a list comprising over 400 species, woody as well as herbaceous, with literature references by Nickell (1952) is recommended. In order to make this report as brief as possible literature citations are given to enable one to readily find further information on specific topics.

Foliage sprays

Currently foliage sprays are probably more widely employed in small-scale operations, as well as commer-

cially in roadside and right-of-way maintenance, than any other technique. In forest management they are also being utilized, especially in aerial spraying. Although foliage applications have a definite role in woody weed control programs, the following limitations should be noted: selective treatment is extremely difficult and therefore, if desirable species are present within the area they are usually destroyed; such blanket spraying unavoidably results in browning of the vegetation which is extremely undesirable in many areas; and finally, root-kill is not easily ascertained for many tree species with currently available formulations.

The most commonly used formulations are the 2,4-D-2,4,5-T esters (hereafter referred to as D & T) and 2,4,5-T esters (hereafter referred to as T) 1% by volume in an aqueous or water-oil mixture. Ammate is so corrosive that the esters are preferable in most cases. Large scale applications are applied during the growing season by a power spray unit mounted on a power wagon. Foliage, as well as portions of the stem, are usually covered.

The primary effect of foliage treatment is leaf-burn and various degrees of stem-kill which results in suppressing or reducing the leafy cover. The effectiveness of stem-kill is indicated by Bramble & Byrnes' (1955a) study where only 45% stem-kill resulted from foliage sprays in contrast to over 90% for more selective basal techniques. Root-kill, as previously mentioned, is usually poor. Roe (1953) reports that "...complete kill of root systems is seldom obtained from one spraying...." Egler (1952) states that "Foliage spraying of brush, though still a commercial practice on a large scale, was abandoned in July 1949, since at that time the root-kill obtained from any one year of basal-bark treatment was markedly superior to that from four years of foliage spraying on the same individuals of certain woody species." Similar trends are evident on the Connecticut Arboretum right-of-way demonstration area. From observations of the writer on rights-of-way in Connecticut up to 80% of the oaks, maples, and other tree species are still living even after two foliage applications. As would be expected a higher percentage of resprouting occurs following foliage spraying than when other techniques are employed. For example, Bramble & Byrnes (1955b) found that after two growing seasons 21% resprouting occurred following D & T foliage applications, 27% with Ammate foliage, and only 5% with basal sprays. Presumably some species are more susceptible to this technique than others. Meyers et al (1955) report 90-100% kill (no resprouting after two years) of black birch but only 10-20% kill for red maple and oak. In contrast, better

kill of oak and maple resulted when new formulations were used. Probably increased effectiveness of aqueous foliage treatments in attaining root-kill will occur when these new formulations are made available on the market. Apparently the T esters in a mixture of oil and water are proving more effective in attaining stem-kill and root suppression (Beatty 1953). This is revealed from aerial spraying (Ralston & Coulter 1955) (Arend & Coulter 1955) and from brush control work (Kauffman, personal correspondence).

Why are aqueous foliage sprays relatively poor in obtaining root-kill? Although Crafts (1953) reports that in bean seedlings and other herbaceous species 2,4-D moves through the cuticle and into the leaves, later to be transported down the stem into the roots, such does not apparently occur to any great extent, if at all, in woody species. The relatively low percentage of root-kill is indicative of this. Ih most cases the chemical is probably trapped in the leaves and therefore downward movement is negligible. The stem-kill which results is apparently due in part to the chemical which gets on the stems. The increased effectiveness of an oil-water carrier may be correlated with the oil holding the chemical on the plant longer and therefore inhibiting new growth. Further investigation is needed on the physiological action of the herbicides following foliage applications.

Basal-bark sprays

The basal-bark technique is also being used commercially in the maintenance of roadsides and rights-of-way as well as in forest management. Since these sprays are selectively applied any desirable species present can be saved, no mass browning of the vegetation results, and root-kill is more easily ascertained.

In basal-bark spraying effective concentrations reported range from 2-5% by volume of D & T and T esters in diesel or fuel oil. In applying, the stems must be thoroughly weeted 8-10 inches up from the ground line. Application until run-off occurs is important so that the root collar region is well saturated. When woody stems over 3-4 inches d.b.h. are treated frill girdling is recommended. The spraying is usually done with knap-sack sprayers. However, recently observed basal-bark applications using power equipment appear most promising as an adjunct to the knap-sack technique. Although basal sprays can be applied throughout the year, certain seasons are proving more effective for some species. For example, root suckering species appear to be best controled by summer basal applications (Arend 1953) whereas winter basal is more

effective on bear or scrub oak (Worley et al 1955). Further studies are needed on seasonal aspects.

As in the case of foliage sprays, the physiological effects are not well understood. In some cases the quick top-kill may be indicative of upward movement of the chemical. However, more often the dying is prolonged over a year or two. From the meager data available, movement of the chemical down into the roots is negligible. Therefore, the movement may be no farther than the oil penetrates downward along the outside of the roots (Coulter 1952). Presumably the phloem (Eames 1950) in the bark region is destroyed which may disrupt the movement of food materials. This may be thought of as chemical girdling, If this occurs.the above ground parts, which often remain alive for some time after spraying, would tend to exhaust the roots of their stored food which cannot be replaced by downward movement (Egler 1952). In addition the chemical's hormonal effect on the root collar may also prevent adventitious bud formation and subsequent resprouting for several years or until the reserve foods in the roots are exhausted. If resprouting is inhibited long enough eventual exhaustion of food materials and death of the root systems results. If this inhibition of adventitious bud formation occurs, then resprouting after several years of dormancy can be accounted for in that the effect of the hormone has worn off before the reserve foods were exhausted from the roots. If the processes described are operative, this may account in part for the poorer root-kill following foliage spraying. Further research is necessary in this area in order to better interpret our field results.

Frill-girdle technique

In attempting to kill trees 3-4 inches d.b.h. or over the frill-girdle technique is recommended. It consists of a single line of overlapping downward ax cuts encircling the base of the tree into which the chemical is placed. Although the esters previously mentioned for the basal-bark treatment are effective aqueous mixtures of T esters are also being used (Chaiken 1951). Following proper treatment no resprouting occurs. Red dyes are frequently used to indicate treated trees.

Notches

The use of Ammate crystals in notches spaced at six inch intervals around the tree is also recommended (Chaiken 1951). A level teaspoon of Ammate is placed into each notch. The cost is rather high but the results are good. Although any season has been suggested for this technique in the Southeast, best results are obtained during the summer (August) in the North-

east (McQuilkin 1955). This points out that the same mode of treatment is not always applicable in different climatic regions.

Stump treatment

In general the stumps of most species can be sprayed to prevent resprouting. However, root suckering species have been most difficult. Soaking the tops and sides of the stumps until run-off occurs with T esters 5% by volume in oil is effective in most cases. This technique also appears promising for white ash, one of the more difficult species to control at present. In the case of ash, stump sprouts are cut and the stubs then thoroughly soaked (D & T 1:40 in oil). With smaller stumps, 4 inches or less, a teaspoon of dry Ammate crystals in the V-shaped cuts will also prevent resprouting of many species (Chaiken 1951).

Cornell tool

This instrument is used to make a series of jabs around the base of the tree and at the same time inject the weed killer. Satisfactory control of oak has been reported with the Cornell tool using a concentrated solution of Ammate. Goddard (1954) also reports success in releasing pines by using T esters in diesel oil.

Sodium arsenite

Although sodium arsenite is extremely effective in killing woody species, its mode of application and toxicity to man and wildlife has curtailed its wide spread use up to this time. However, recently a safer technique of application has been devised by Swain (1954). It consists of placing a blotting paper tab ½ x 2 inches treated with sodium arsenite in a pocket between the bark and the wood. Pine and hardwoods up to 4-5 inches d.b.h. have been killed with one tab. For larger trees several tabs are needed. Softwoods can be treated throughout the year while hardwoods are most easily treated during the peeling season - late May to early August. Since arrangements for manufacture and distribution of tabs were under way in 1954 they may already be available. Another improved technique involves the application of a 50% sodium arsenite solution through holes bored in the trees (Curry & Rushmore 1955). This has been particularly effective on large sugar maple, yellow birch, and beech.

Root suckering species

The species concerned include sassafras, trembling aspen,

tree-of-heaven, black locust, blackberry, and the sumacs. Since they root sucker vigorously following foliage spraying and most dormant basal treatments they are one of the biggest problems. However, summer basal techniques are proving increasingly effective. In Michigan scrub aspen have shown no evidence of suckering for three years following summer applications of D & T esters 2-4% by volume in diesel oil (Arend 1953). In Pennsylvania similar trends are evident (Worley et al 1954). Here, although suckering of the aspen (2 inches d.b.h.) occurred, it was least when sprayed during the growing season with T esters in oil. To obtain comparable results with winter basal it was necessary to repeat the treatments for three consecutive years. In the Connecticut Arboretum the effectiveness of summer basal has also been observed on winged sumac and tree-of-heaven. In addition to the season of application the concentration of the herbicide also appears to be important (Worley et al 1954). Extremely high concentrations were not as effective on aspen as lower concentrations. The effectiveness of the lower concentration might indicate that with the slower kill there may be more time to exhaust the food supply from the extensive lateral root systems. Much more study is needed on these species.

Maintenance of roadsides and rights-of-way

Currently the maintenance of roadsides and rights-of-way is of major importance in woody weed control. Therefore a short impartial discussion evaluating present techniques follows.

Maintenance of roadsides: many roadsides are now being sprayed rather than hand cut in order to maintain suitable rights-of-way and adequate vision. The most popular technique is that of foliage spraying. Its wide spread application was sharply pointed out to the writer this past summer. In driving West practically every state, with the exception of Connecticut, displayed brown sprayed swaths along the highways. This indiscriminate spraying has aroused considerable public attention and some states are already taking action. In Connecticut an extremely progressive policy has been enacted. Greene (1955) states that "Foliage spraying of brush is not permitted to avoid the unsightly brown-outs that are evident in many areas where the use of chemicals is promiscuous. That is the reason we have adopted the method of cutting the brush and applying the 2,4,5-T as a basal spray. The control is just as effective and the resultant appearance is better." Since there are ornamentally desirable shrubs and low trees along most roadsides it is much more satisfactory just from the aesthetic point of view not to use a blanket spray technique. With a more selective treatment these native species can be left to further enhance the highway. Since such a plan is now in operation in Connecti-

cut a similar one in other states appears feasible.

Maintenance of rights-of-way: this is probably the biggest commercial spraying operation now in progress throughout the country. On rights-of-way the basic objectives are to manipulate the vegetation in such a way that trees do not grow into the lines and that the lines are readily accessible for repair. Taking these points into account what type of plant cover would be most desirable ecologically? Obviously the tall trees must be eliminated directly under the lines. However, low shrubs such as huckleberry, low-bush blueberry, sweet fern, and others where present should not be destroyed since they form a tight ground cover which tends to prevent the invasion of tree seedlings. Beyond the wires along the rights-of-way only the potentially taller trees need be eliminated since low trees and taller shrubs such as witch hazel, sumac, and others will never endanger the lines and again the dense cover formed by these species will tend to prevent invasion of tree seedlings. This technique aims to manipulate the vegetation in such a way that it will aid in maintaining maximum stability in the future. In addition, shrubs and low trees that are left provide excellent food and cover for wildlife. This technique is not new. It has already proved its ecological soundness on many rights-of-way throughout the country (Egler 1954a, 1954b). Recently the Pennsylvania Department of Forests and Waters adopted this plan of vegetation management for all rights-of-way crossing state forests (Goddard 1955).

How can this plan best be accomplished? Numerous techniques are available. Since selectivity is important, the basal technique is most applicable. However, where there are dense impenetrable thickets, such as green brier, local foliage sprays may be needed to supplement the basal sprays. Several techniques may often be required, in contrast to the currently popular indiscriminate blanket spraying- a one-technique approach- which tends to reduce the density of the vegetation but often fails to excercise any sound ecological principles. Unfortunately much right-of-way spraying has followed a hit-of-miss procedure with little guidance from the ecologist or botanist with whose material they are dealing. Would one build a bridge or road without consulting an engineer? The problem is really this fundamental. Only with proper guidance in the future can we expect to gain the utmost from our weed killers in the maintenance of rights-of-way.

Forest management

The use of silvicides in forest management has expanded greatly in recent years in releasing suppressed conifer stands as well as in improvement of hardwood stands. Summary follows.

Trees and stump sprouts up to 3-4 inches d.b.h.

D & T esters or T esters 2-5% by volume in fuel oil, basal application

Further references: Burbage 1954; Cook 1954; Foster 1954; Stephens et al 1954.

Trees 3-4 inches d.b.h. or over

See sections on frilling, notches, Cornell tool, sodium arsenite.

Stump treatment

See section on same.

Aerial application

In the Lake States considerable success in releasing pines is reported with T esters in oil-water mixture, foliage spray. Applications after August 15 are recommended in order to prevent browning of conifers.

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SOIL STERILANT STUDIES TO CONTROL VEGETATION ON REFINERY FIRE WALLS[1]

Many potential applications exist in the petroleum industry for herbicidal treatments to prevent the growth of vegetation. Examples of these are around Western Canada's 6000-7000 oil-well sites, along the pipeline rights-of-way to the refineries and, in particular, on the walls of soil surrounding the storage tanks within a refinery.

Since the cost of manpower required for hand mowing or applying herbicides is relatively large, it is important that the degree of effectiveness of any herbicide be maintained at a high level for as long a period as possible. So far, such a safe, durable treatment for permanently controlling vegetation in refinery areas economically has not been found. This is primarily due to the fact that the most effective herbicides or their decomposition products are somewhat readily removed from the soil, presumably as a result of their water solubility or fixation by soil colloids.

Crafts and Raynor [1, 2] found that high concentrations of borax ($Na_2B_4O_7$ $10H_2O$) and colemanite ($Ca_2B_6O_{45}H_2O$) were toxic to many plants, but should be combined with other pesticides for maximum sterilizing effect. Sodium arsenite will kill all vegetation (3) but is rapidly leached from the soil. In this connection, Young and Loomis (4) have observed that the toxic effects from sodium arsenite (320 pounds per acre) were inversely proportional to the degree of leaching by water. Consequently, it should be applied during dry periods to provide the most prolonged results for a given quantity of chemical. Ammonium sulphomate and sulphamic acid are reported (5) to function as contact toxicants and soil sterilants. However, their corrosive nature limits their use in the vicinity of metal pipes and tanks. Trichloracetic acid (T.C.A.) has provided 50% weed control after five months (80 pounds per acre) and, if half of this amount of T.C.A. were blended with 80 pounds of sodium chlorate and applied early in the spring, somewhat greater effectiveness was obtained (4).

Some studies have also been made on the use of petroleum oils as herbicides. Cracked gas oils boiling between 500 and 700°F. and containing 50-60% aromatics, provided weed control for one season if used as two or more incremental applications of 60 gallons per acre (4). However, oils having lower aromatic contents and distillation ranges gave poor results. Tests in this laboratory (6) with two distillates of similar aromatic content confirmed that large quantities of oil were required to arrest the growth of vegetation, but suggested that they might be particularly valuable when applied after the growth of perennials had been controlled by chemical treatment.

The present paper describes investigations on the effect of time of application of some soil sterilizing herbicides and the interaction of certain petroleum oils with these materials.

(1) R. E. Emond, Research Department, Imperial Oil Limited, Sarnia, Ontario.

Materials and Treatments

The herbicides were applied to mowed vegetation (about 3 inches in height) growing on a fertile heavy clay loam which, in its undisturbed state, supported a lush growth of weeds and grass such as plantain, teasel, wild carrot, ragweed, yarrow, fleebane, old witchgrass and twitch. In one representative check plot the number of such plants totalled 630 per square foot.

Selected, commercially available sterilants were applied at varying rates alone or in conjunction with petroleum oils on 3 replicated plots of 100 square feet each. Aqueous dispersions of borax, T.C.A. and C.M.U. (80% wettable powder), a petroleum cutback asphalt and aromatic oils were used at a rate of 3.6 gallons per plot. Periodically, two workers evaluated the effectiveness of the herbicides by visually estimating the proportion of the plot area which showed no growing vegetation. These averaged values have been used to denote the degree of soil sterilization.

DATA

EFFECTS OF SEVERAL CHEMICALS AS SOIL STERILANTS

A preliminary experiment was conducted with a group of materials that could be used for sterilizing soil on refinery firewalls. These compounds were applied at similar rates during both the months of May and June. Table 1 shows that complete sterilization of the plot areas for 16 months was obtained by a May application of 80 pounds per acre of C.M.U. and marked control of vegetation with 40 pounds per acre. In these tests borax, T.C.A., Paris Green and the two petroleum oils gave insufficient residual action to meet the requirements of a sterilant.

STUDIES ON C.M.U.

Decline in Sterilizing Effect of C.M.U. with Concentration and Time

Previous work on C.M.U. had indicated that the concentration of the initial application had a marked effect on the extent of residual herbicidal activity after 16 months. Hence it was desirable to investigate further the rate at which the sterilizing effect of aqueous suspensions of C.M.U. declined. The results (Table 2) show that the effectiveness of C.M.U. treatments up to 40 pounds per acre gradually decreased with time. At a concentration of 20 pounds of C.M.U. the sterilizing effect was reduced to 42 and 23 percent after 12 and 27 months, respectively. The control obtained with an application of 40 pounds per acre was essentially complete for one year, and had declined to 68 % after 27 months. Since the degree of control from the 40 pounds per acre treatment at the end of 24 months (75%) was about twice that which was obtained at the end of the twelve-month period with the 20 pound application (42%), the higher rate is favoured from the standpoint of saving in costs of application.

TABLE 1

EFFECT OF SEVERAL CHEMICALS AS SOIL STERILANTS

Treatment	Rate	Date Applied 1952	% of Area Sterilized* 16 Months
Borax (sodium borate)	1700 lb/ac	May	12
" " "	" "	June	0
T.C.A. (Sodium salt of trichloracetic acid)	435 lb/ac	May	0
	" "	June	25
Heavy Catalytically Cracked Gas Oil 600 - 800°F. distillation range	20 gal/ac	May	0
	" "	June	0
Light Catalytic Cracked Gas Oil 400 - 650°F. distillation range	20 gal/ac	May	0
	" "	June	0
Paris Green	870 lb/ac	May	0
	" "	June	0
CMU (80% Wettable Powder)	20 lb/ac	May	55
	" "	June	38
	40 lb/ac	May	70
	" "	June	65
	80 lb/ac	May	100
	" "	June	65

* Each figure is an average of 3 replicated plots (10' x 10')

TABLE 2

DECLINE IN STERILIZING EFFECT OF C.M.U. WITH CONCENTRATION AND TIME

Treat-ment	Date Applied 1953	Rate (lb/acre)	Form of Blend	Percent of Area Sterilized*						
				3 Mos.	11 Mos.	12 Mos.	16 Mos.	22 Mos.	24 Mos	27 Mos.
C.M.U.	July	1	A Aqueous	0	0	0	0	0	0	0
"	"	5	Suspension	17	8	3	3	0	0	0
"	"	10	"	75	36	25	20	16	16	11
"	"	20	"	90	58	42	33	30	30	23
"	"	40	"	100	100	93	86	75	75	68**

* Average of 3 replicated plots 10' x 10'

** Sterilizing e ffect extended approximately one foot outside boundary of a level plot.

TABLE 3

EFFECT OF MONTH OF APPLICATION ON THE STERILIZING ACTION OF C.M.U.

Treatment	Date Applied Month	Rate (lb/ac)	Percent of area sterilized*		
			12 Mos.	16 Mos	24 Mos.
C.M.U.	May	20	-	55	-
	June	20	-	38	-
	July	20	42	33	30
	September	20	25	25	5
C.M.U.	May	40	-	75	-
	June	40	-	60	-
C.M.U.	May	80	-	100	-
	June	80	-	95	-

* Each figure is an average of 3 replicated plots (10' x 10')

Effect of Month of Application on Sterilizing Action of C.M.U.

The response of some herbicides is known to vary when applied at different seasons. Experiments conducted previously suggested this was also true for C.M.U. In a further study, C.M.U. - water dispersions of the same concentration were applied during the period from May to September. The results show that the earlier the C.M.U. was applied, the more persistent was its effectiveness (Table 3). This decrease in effectiveness was observed for all three levels of C.M.U. and has possibly some connection with the seasonal variations occurring in adsorption by clay colloids.

Comparison of the Sterilizing Effect of Aqueous Suspensions of C.M.U. Alone and in Conjunction with a Cutback Asphalt

The usefulness of C.M.U. for refinery firewalls is limited not only by the fact that there is a gradual decline in control, but that complete freedom from vegetation in some cases permits soil erosion. Chepil (7) showed that mixing 200 gallons per acre of cutback asphalt with the soil decreased erodibility for about two years. However, the effect of such petroleum hydrocarbons when applied in conjunction with soil sterilants does not appear to have been investigated.

A preliminary study was made of the effectiveness of combined cutback asphalt - C.M.U. treatments. Data are given in Table 4 comparing the herbicidal activity of C.M.U. (20 pounds per acre) when used alone, and before or after the application of a cutback asphalt at the rate recommended for soil stabilization (1 gallon per 4 square yards or 1700 gallons per acre). A marked difference was observed in the extent to which the vegetation was controlled. The control from the aqueous application alone was reduced to an unsatisfactory degree (23%) after 12 months. However, if the sterilant was applied preceding the asphalt, sufficient amount of the area (70%) was free from vegetation at the end of 26 months that this 20 pound rate was considered equivalent to the sterilizing efficiency produced by 40 pounds per acre. An application of the sterilant to the soil after treating with cutback asphalt provided an intermediate effect (53% control after 26 months).

STUDIES ON BORAX

Effectiveness of Subsequent Oil Application on the Sterilizing Action of Borax

Crude borax has found widespread use as a weed killer in the petroleum industry because of its fire retardant and soil sterilizing properties (8). However, the high application rate required to obtain satisfactory weed control is a limitation. Scammon's results (9) indicated that 5000 pounds of borax per acre (12 pounds per 100 square feet) was necessary, in areas of less than 25 inches of Annual rainfall, to provide 95 percent control for 2 years. Since the duration of effectiveness of C.M.U. had been increased when used in conjunction with a cutback asphalt it was also of interest to determine the effect of a petroleum oil on the sterilizing action of borax.

The results (Table 5) show that the herbicidal potency of aqueous borax at a 1700 pounds per acre rate (4 pounds per 100 square feet) had decreased to a 12 percent control after 16 months. However, when an application of borax at the same rate was followed by catalytically cracked gas oil (20 gallons per acre), the sterilizing power after 16 months was still at a very high level, (95% for May application; 60% for June). This unique effect of subsequent oil application in maintaining the soil sterilizing activity of borax parallels the previous results (Table 3) obtained with cutback asphalt and C.M.U.

It has been shown that the sterilizing power of aqueous suspensions of C.M.U. may be prolonged by subsequently applying a petroleum cutback asphalt. Also, the herbicidal potency of aqueous borax treatments is markedly enhanced when used in conjunction with a petroleum gas oil. It is believed that the longevity of soil sterilizing power exhibited by these materials is due to a weather proofing action contributed to the chemicals by the petroleum products.

TABLE 4

COMPARISON OF STERILIZING EFFECT OF AQUEOUS SUSPENSIONS OF C.M.U. IN CONJUNCTION WITH A CUTBACK ASPHALT

Treatment	Date Applied	C.M.U. (lbs/ac)	Cutback Asphalt (gal/ac)	Percent of Area Sterilized*				
				8 Mos.	10 Mos.	12 Mos.	20 Mos.	26 Mos.
C.M.U. Aqueous	September 1953	20	-	66	42	23	23	20
C.M.U. following Cutback Asphalt	September 1953	20	1600	66	78	75	53	53
C.M.U. preceding Cutback Asphalt	September 1953	20	1600	88	90	85	85	70

* Each figure is an average of 3 replicated plots (10' x 10').

TABLE 5

EFFECTIVENESS OF SUBSEQUENT OIL APPLICATION ON THE STERILIZING ACTION OF BORAX

Treatment	Date Applied	Rate: Borax lbs/acre	Rate: Gas Oil gal/acre	Percent of Area Sterilized* 16 Mos.
Borax	May 1952	1700		12
	June 1952	1700		0
Borax followed by Cracked Gas Oil	May 1952	1700	20	95
	June 1952	1700	20	60

* Each figure is an average of 2 replicated plots (10' x 10').

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A STUDY OF HORSE NETTLE AND ITS CONTROL

Harry E. Bradbury and Richard J. Aldrich[1]

Abstract[2]

Horse nettle, Solanum carolinese, is recognized as a serious weed problem in many areas of New Jersey and neighboring states and it seems to be spreading. This pest is prevalent throughout the farming areas of the state and is particularly troublesome in crops such as alfalfa, corn, tomatoes, potatoes and orchards. Effective cultural and chemical methods of controlling it have not been developed.

The present study, begun in the spring of 1954, included an examination of the growth habits and propagation of the weed and an evaluation of herbicides for its control.

The primary manner of propagation and spread of nettle within an area in New Jersey appears to be by means of rootstocks and rhizomes. Despite seed germination as high as 54 percent in the laboratory, seedlings have been found in only one 3 by 4 foot area under very unique environmental conditions. This is the only instance of germination in the field noted in two seasons of careful searching. However, since the weed produces a great abundance of viable seed and since widely scattered patches of horse nettle are found throughout the state, it would seem that plants do grow from seed under the proper conditions.

During the 1954 season, the following chemicals were evaluated: the amine, ester and sodium salt of MCP, the amine and ester of 2,4-D, 2,4,5-T amine, 2,4,5-trichlorophenoxy propionic acid, 2,4-D plus 2,4,5-T (2:1 mixture of esters), 3,4-D amine, amine salt of 4-chlorophenoxy acetic acid (4CPA), ethyl trichlorobenozate, sodium 2,3,6-trichlorobenozate, and 3-amino-1,2,4-triazole.

The chemicals were included in one or more of the following tests: applications June 12 to horse nettle just emerging to 6 inches high; applications July 12 to horse nettle 6 inches high to bud stage; applications of 1/16 and 1/8 pound per acre repeated 4 times at intervals of 5 days starting July 18, and; heavy applications to the soil October 10.

Although many of the summer treatments resulted in top kill of horse nettle, none provided significant reduction in stand the following year. It is worthy of note that plants in the trichlorobenzoate and 4CPA plots exhibited moderate to severe hormone injury symptoms throughout the 1955 season and none formed mature seed balls despite the failure of legume tests to detect phytotoxic residues in the soil. Fall applications were quite effective in

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[1]Agent (Agr. Aid) and Agronomist, respectively, Field Crop Research Branch, ARS, U.S. Dept. of Agriculture in cooperation with the New Jersey Agricultural Experiment Station.

[2]Abstract of a manuscript to be published in a forthcoming issue of WEEDS.

reducing stands, however, with 32 pounds per acre of all phenoxy compounds resulting in practically complete control.

1955 treatments included amino triazole, combinations of amino triazole and 2,4-D, trichlorobenozic acid compounds, 2,4-D and 2,4,5-T. Again, many treatments provided control of the current season's growth.

Information derived from the study to date indicates that a control program for horse nettle can logically be designed to eradicate rather than control the weed since reproduction from seed is apparently negligible. The best treatments for eradication, of those tried, appear to be heavy rates of phenoxy compounds applied to the soil.

EXPERIMENTS ON QUACK-GRASS (AGROPYRON REPENS) WITH SODIUM TRICHLOROACETATE

by

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Review of Literature

In 1947 the earliest reports were published (16,17) on ammonium trichloroacetate as an herbicide. The next year sodium trichloroacetate appeared and its promise as a grass killer resulted in numerous papers in subsequent years.

A seasonal response of grass to TCA treatment was shown by Elder and Stephens (6) in Oklahoma in 1948. Johnson Grass was controlled best during July and August, less effectively in May and June and unsatisfactorily in September and October while Bermuda Grass was controlled satisfactorily by all except April and May treatments.

A response to specific weather conditions was shown by research elsewhere. In New Hampshire quackgrass sod applications which were made from mid-June to late July 1948 were most effective in hot, dry weather as reported by Hodgdon (7), while Barrons and Watson (3), in Michigan during the next year achieved best control on a moderately dry soil when the treatment was followed by scant to moderate rainfall. Later investigation by Watson (14) further showed that moderate rainfall after treatment improved the control.

Willard (15) stated as follows in 1950, "Treatment (of quackgrass) is most effective when the soil is moist and offers good growing conditions. If TCA is applied on dry soil there will be no effect until rain carries it into the soil - - - The best time of year to treat quackgrass with TCA is not yet known. The soil should be moist and conditions favorable for active growth for best results."

In line with this the Dow Chemical Company (1) in 1951 recommended spraying of quackgrass when the soil is moist and moderate rainfall is anticipated. According to them "Suitable moisture conditions seem more important than season or stage of grass growth."

More recently Raleigh (13), 1951 reported on treatments of quackgrass with TCA made on September 21 and 22 and on November 8. Sod applications of 100 lbs. of TCA per acre, in September, resulted in very little (10%) reduction of grass, while November applications were reported as quite ineffective.

Loustalot and Ferrer (8) in Porto Rico studied the persistence of TCA in soils at different temperatures and various moisture levels. From their work it can be assumed that climatic factors probably play an important role in deter-

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mining the effectiveness of TCA under yield conditions.

Lowe and Buchholtz (9) working only with cultural methods of controlling quackgrass found that July and August cultivation following cutting was the most effective control. They mentioned the research of Pinckney (11) who showed that in North Dakota, the reserves of foods in quackgrass do not fluctuate much during the year.

The persistence and effectiveness of TCA seem also to be related to soil characteristics. This was well brought out in Loustalot and Ferrer's (8) studies in which TCA was shown to persist much longer in clay than in lighter soils, also in Blouch and Fults (5) work where soils with considerable organic material and high fertility seemed to absorb the TCA and thus permit selective weed control. Rai and Hammer's (12) investigations showed that wheat was affected by TCA after twice as long a period in muck as in soils low in organic material. However, a further complication is introduced by Barrons and Hammer (2) who stated that the rate of inactivation of TCA was greater in a composted soil high in organic matter.

Experimental Work in New Hampshire with TCA

In 1949, at the University of New Hampshire, a program of work with TCA and quackgrass was begun. It was felt that the complex of environmental factors in the field is so involved that generalizations are not well founded from one season of work or from a few trials here and there. None of the experiments discussed below involved any tillage operations. In 1949, it became evident elsewhere that these greatly increased the effectiveness of TCA applications, but so far as our experiments were concerned sod-application was considered to be suitable. Initially there were three main objectives, i.e., to find out the most effective concentrations of TCA for control of quackgrass in sod, the most suitable climatic and seasonal conditions for treatment and to determine the advantage, if any, of cutting the grass before treatment. All plots in 1949 which were mowed before treatment consistently showed results equal to, or better than uncut plots. After 1949, all subsequent treatments were made only on plots that had been mowed and cleared of cut grass immediately before spraying with the herbicide. All areas selected for treatments were as uniform as could be found regarding soils, site and growth of the grass. Applications were made consistently with 4-gallon tank-type sprayers. In all cases with the exception of a few plots specially treated in 1949 which showed no unusual effects the amount of material applied was one gallon of solution per 100 sq. ft. of area. The TCA used throughout was the sodium trichloroacetate, in 1949, in the 70% formulation and subsequently at 90%. The relatively small amounts of material actually used have been given in the schedules of treatments on an acre basis in terms of active TCA to agree with rather standard reporting procedure for field treatments of herbicides. Plots were mostly of 100 sq. ft. areas but in a few instances larger rectangular areas were treated. Controls were set up for each treatment.

The results are given in the following categories: *Complete when no quackgrass shoots were evident at the time observations were made and rhizomes appeared to be lifeless. Very good when very scattered shoots were present mostly in one part of plot only. Good with scattered shoots (not over 10% survival) at time of observation. Fair with about 10-20% survival, and Poor more than 20% survival. These are admittedly approximations, but in as much as the plots differed somewhat in density of cover of quackgrass before treatments, it is obviously difficult after treatment to calculate kill in exact percentages.

*See Table 1

Table 1

1949 Treatments

Date	Pounds per acre	Soil-type	Effectiveness at end of season
April 13	37	sand	very poor
" 13	75	"	" "
May 4	37	clay	" "
" 4	75	"	poor
" 4	150	"	good
June 11	75	sand	"
" 11	150	"	complete
June 15	75	clay	fair
" 15	150	"	good
" 15	225	"	complete
June 30	75	sand	"
" 30	150	"	"
July 15	112	clay	"
" 15	150	"	"
" 15	225	"	"
July 29	75	sand	"
" 29	150	"	"
Sept. 8	37	clay	good
" 8	75	"	very good
" 8	150	"	complete
Oct. 6	37	"	fair
" 6	75	"	"
Nov. 5	37	"	very poor
" 5	75	"	" "
	1950 Treatments		
June 15	50	clay	fair-good
" 15	100	"	very good
" 15	200	"	complete
June 26	50	sand	very good
" 26	100	"	complete
" 26	200	"	"
July 14	50	clay	good
" 14	100	"	complete
" 14	200	"	"
July 26	50	sand	"
" 26	200	"	"
Sept. 7	50	"	poor
" 7	100	"	fair
" 7	200	"	complete

1949 and 1950 Treatments

Both the 1949 and 1950 treatments were carried out in Dover and Bedford. The Dover area was a uniform dense growth of grass, occupying a nearly level and rectangular site which was formerly a garden. The soil was a heavy, clay-loam and tended to bake in hot, dry weather. The Bedford infestation was also uniform and flat, the area a nursery. The soil in Bedford was a sandy-loam and tended to become dry at the surface very quickly after a rain.

Discussion of 1949-50 Treatments

Concentrations of 37, 50 and 75 lbs. per acre of TCA showed no consistent seasonal differences. The control of grass improved until summer and then showed a progressive decline until late fall. The effect obtained within both the sand series and the clay series though in the lighter soils kills were sometimes more effective than in clays at the same concentration. A pronounced relation of time of year to TCA treatments would seem to be indicated but modified by other factors, in this case perhaps soil texture or water relationships. The April, May and November applications had been expected to yield better results, perhaps because of the implication in certain recommendations that good growing conditions for witchgrass would enhance treatments with TCA. All except the 150 lb. per acre treatment on May 4, however, were unsatisfactory.

1951 and 1952 Treatments in Durham, New Hampshire

In 1951 it was decided to increase considerably the number of replications in order to eliminate the factor of accident or unusual effect from the operation as much as possible. With a relatively small area of available uniform quackgrass, it became necessary then to make but two treatments. It was decided to try to ascertain the most favorable part of the summer for TCA application.

Table 2

1951 Treatments

Date	Pounds per acre	Soil-type	Effectiveness at end of season
June 28	50	clay-loam	fair to poor
" 28	100	"	fair to good
" 28	200	"	very good
July 27	50	"	fair
" 27	100	"	good
" 27	200	"	very good to complete
	1952 Treatments		
May 30	50	clay-loam	poor to very poor
" 30	100	"	good
" 30	200	"	very good
July 25	50	"	good
" 25	100	"	very good to good
" 25	200	"	nearly complete
Nov. 7	50	"	very poor
" 7	100	"	poor
" 7	200	"	"

A band of quackgrass 175 feet in length and 20 feet in width roughly followed the contour of a slope where a garden had been planted a year or two previously. The soil was a heavy, clay-loam. The growth of quackgrass was fairly uniform and heavy over most of the area. A linear series of 35 rectangular plots each 5 feet, by 20 feet, was divided into 5 equal blocks of 7 plots each. In each block 3 plots were selected at random and treated on June 28, 3 others similarly selected and treated on July 27, the remaining plot being used as a control. At

each date one plot was treated at 50 lbs. per acre, another at 100 lbs. and the third at 200 lbs. per acre.

After final observations were made on all of the treatments in early November, all of the controls and other extensive persisting areas of quackgrass in any of the other plots were treated with 100 lbs. per acre of TCA which, as indicated above, was reasonably satisfactory for the summer.

On May 19, 1952, there was no other evident effect of this mid-autumn application than a slight suppression of quackgrass growth. The percentage of kill was negligible. While not intended as an integral part of the experiment, the spectacular contrast of this mid-autumn treatment to both of the summer applications would again demonstrate the seasonal nature of quackgrass response to TCA.

Further work in 1952 seemed to be justified by the continued recommendations of investigators outside of New England which ran counter to our findings and also because only June and July treatments were made by us in 1951.

A conveniently located rectangular tract of quackgrass was made available. It was the site of a former garden on heavy, clay-loam soil. Most of its area was rather uniformly covered with quackgrass, but with a slight admixture of other grasses in places. The eastern corner of the area was somewhat lower and wetter than the other plots while the part toward the western corner was sparsely grassed over. Reference to Table 2 will show the average effect of treatments.

Discussion of Results

In 1949, applications of 75 lbs. per acre of TCA were very effective from June 30 to September 8. Before and after these dates the same amount was not effective. In 1950, applications of 50 lbs. per acre were very effective only in sand and with the July 26 treatment. Particularly on September 7, the 50 lb. treatment was considerably less effective.

It is to be noted from studies of weather data (5,10) that the year 1949 was very dry. A deficit of some 6.33 inches of precipitation had accumulated up to the beginning of September most of which resulted in June, July and August. The actual dryness was somewhat greater that year because of the high temperatures, June being 5.2°F and July 4.8°F above the average. For August there are no available figures and September was near to normal. On September 8, the grass had not yet begun its usual vigorous late summer and fall growth and the conditions were reported dry at time of treatment.

In 1950 rainfall was less than half the normal average for May, June and July. But in August and early September before September 7, nearly 6 inches of rain fell and the weather had been -3°F cooler than the average. The soils were noted as moist at the time of treatment and the condition of grass vigorous.

It is also possible that the very different September results of 1949 and 1950 can be interpreted partly in terms of soil-texture differences, the sandy soils allowing rapid removal of TCA by leaching during the August and September rains while the heavy, clay-loam soils retained lethal quantities of TCA in the vicinity of grass roots despite the considerable amount of water present.

The control of grass is seen to have been most effective during the hotter, drier parts of the summer and to have become progressively less effective with

earlier and later applications, while good growing conditions for quackgrass in early September appear to have considerably diminished the effectiveness of TCA.

There was increasing evidence in 1951 and 1952 that summer applications of TCA were most effective. However, the result of 50 lbs. per acre applications in 1951 was a fair control while that of 1952 was good, both however, being superior to the corresponding late May or June Treatments. Again whether data (5,10) were studied to provide a possible solution of this discrepency.

The year 1951 was close to normal both in precipitation and in temperature. From May to September about 1 inch of rainfall deficit occurred and the monthly average temperature over this 5 month period was a little more than 1 degree Fahrenheit above the average. The June 28 treatment was made under partly cloudy conditions with light rains each of the following 3 days totalling about .8 inch. Conditions for grass growth during the week following application were very good. The results were certainly not as might be expected if light rains following application are supposed to improve the effectiveness of treatments. Similarly by coincidence, the July 27 treatment fell during a moist period in which approximately 1/3 inch of rain fell the night before treatment and 1/3 inch on each of the next 2 days, the conditions again being favorable for growth of grass.

In 1952 the period from May to September maintained a monthly average of approximately 3°F above the normal average, while the rainfall accumulated an excess of 1.5 inches for the entire period. However, for July only 1.7 inches of rain fell (a deficit of 1.64 inches for the month) and the average temperature for the month was + 5.2°F. On July 25, at the time of treatment the temperature was 85°F, the day was sunny and dry and the observation was made that the weather had been dry for some time. The results were satisfactory, although according to the results of the previous year only fair results might have been expected at 50 lbs. per acre. The principal differences between the July 25, 1952 series and those of July 26, 1951, relate either to weather or the condition of grass. Essentially the hot, drier weather of 1952 permitted a satisfactory control of quackgrass while the moist cooler weather of 1951 did not.

Summary and Conclusions

Four years results of Sodium TCA applications on quackgrass are reported here.

Quackgrass under certain conditions is eradicated completely or brought under excellent control by summer applications of as low as 37-50 lbs. of TCA per acre without cultivation.

In both heavy and light soils consistently better results were obtained at the low application rates (37-75 lbs. per acre) in late spring or summer than in April, early May, October or November. Mid-summer seemed to be the most effective time of application.

In no case did excessive dryness appear to limit the effectiveness of the TCA. However, heavy rainfall preceding and following early September treatments on light soil seemed to be responsible, in part at least, for poor results.

There is some indication that TCA on heavier soils gave more uniform results with varying amounts of water than on sandy soils.

At the times when quackgrass seemed least vigorous, which however, were invariably coincident with periods of hot and dry weather, it was most readily killed by TCA.

From this study it appears that a complex relationship obtains among the following factors, i.e., kind of weather, type of soil, condition of the plant and/or time of year, all of which may affect field treatments of quackgrass with TCA.

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CHEMICAL CONTROL OF QUACKGRASS[1)]

Jonas Vengris[2)]

Quackgrass (Agropyron repens) is a common troublesome weed in Massachusetts. Until recently, the application of TCA (trichloro acetate) has been suggested as a control measure, but newer chemicals are reportedly more effective. Trials with some of these chemicals for quackgrass control were begun at Amherst in 1952 and have been continued to the present.

1952/53 Trials. The principal objective of these trials was to determine the effect of different rates of application, time of application, and also the value of split applications of TCA on quackgrass-infested land. It was thought that split applications would reduce the influence of leaching and permit lower rates of application.

The soil was a fine sandy loam moderately well drained. A randomized block split plot design was used involving three replicates. One half of each plot was cultivated before applying treatments; the other half was not. Fall applications were made on November 5, and spring treatments on May 11.

Results and Discussion

Observations on the effectiveness of different treatments were made June 16. Later, on August 5, tiller counts were made on square-foot areas taken at random on each plot. The results are summarized in Table I. Values given treated plots are in terms of checks that equal 100.

TABLE I. Effect of Rates and Time of Application of TCA on the Control of Quackgrass

No.	Treatments	Quackgrass Stand 6/16/53 Check=100		Tiller Number per square foot 8/5/53	
		Disked	Not Disked	Disked	Not Disked
1.	Check	100	100	13	50
2	TCA 15 lb/A Fall 1952	90	90	8	46
3	TCA 15 lb/A Spring 1953	20	43	7	37
4	TCA 7.5 lb/A Fall 1952 plus 7.5 lb/A Spring 1953	50	87	7	51
5	TCA 30 lb/A Fall 1952	87	81	8	38
6	TCA 30 lb/A Spring 1953	10	37	2	22
7	TCA 15 lb/A Fall 1952 plus 15 lb/A Spring 1953	13	47	3	32
8	TCA 60 lb/A Fall 1952	30	37	3	22
9	TCA 60 lb/A Spring 1953	3	20	1	10
10	TCA 30 lb/A Fall 1952 plus 30 lb/A Spring 1953	10	3	1	24
	L.S.D. at 5% level	16	11		
	L.S.D. at 1% level	22	16		

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1) Contribution No. 1025 of the University of Massachusetts, College of Agriculture, Experiment Station, Amherst, Mass.

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TCA applied in the fall was not nearly so effective as TCA applied in the spring. Fall applications, however, were made long after most plant growth had ceased. Earlier applications, when plants were growing actively, might have been more effective. Spring applications were made when growth was lush. An abnormally wet fall and early spring (10.4 inches over normal) may have been another important factor in the ineffectiveness of fall applications. Heavy rains may necessitate repeated application.

Tiller counts showed that disking or cultivation helps to eliminate quackgrass. Control was almost as good in the plot that was only disked as in the best undisked TCA plot. Disking greatly increased the effectiveness of TCA on all treated plots. On cultivated land 30 pounds of TCA is suggested to control quackgrass; on uncultivated land, twice the amount.

1954 Trials. The principal objective of these experiments was to compare the effectiveness of TCA with Dalapon and maleic hydrazide (MH) in the control of quackgrass. The soil was a fine sandy loam fairly well drained. A block design was used with a block for each herbicide. Each treatment was replicated four times, as follows:

TCA	Dalapon	MH and 2,4-D
1. Check	1. Check	1. Check
2. TCA 25 lb/A a.eq.	2. 12.5 lb/A a.eq.	2. MH 5 lb/A a.eq.
3. TCA 50 lb/A a.eq.	3. 25 lb/A a.eq.	3. MH 10 lb/A a.eq.
4. TCA 75 lb/A a.eq.	4. 50 lb/A a.eq.	4. 2,4-D 30 lb/A a.eq. (amine form)

Treatments were made May 26 with a spray application. Water was used at the rate of 60 gal. per acre. The TCA plots were plowed and disked before treatment while the other materials were applied diredtly to the foliage. The quackgrass at the time was about 6 inches high. One week after treatment the Dalapon, MH, and 2,4-D plots were plowed and disked. On July 8 all plots were sprayed with 2,4-D at the rate of 1 lb. per acre to control the growth of broad-leaved weeds.

Results and Discussion

Observations made September 18 are summarized in Tables II, III, and IV. Check plots were rated as 100. Treated plots were rated relatively.

TABLE II. Quackgrass Control by TCA
(Values Relative with Checks = 100)

No.	Treatments	Vegetative Growth
1	Check	100
2	TCA 25 lb/A a.eq.	63
3	TCA 50 lb/A a.eq.	29
4	TCA 75 lb/A a.eq.	17
	L.S.D. at 5% level	26
	L.S.D. at 1% level	37

TABLE III. Quackgrass Control by Dalapon
(Values Relative with Checks = 100)

No.	Treatments	Not Cultivated Vegetative Growth	Cultivated Vegetative Growth
1	Check*	100	100
2	Dalapon 12.5 lb/A	26	76
3	Dalapon 25 lb/A	26	64
4	Dalapon 50 lb/A	19	40
	L.S.D. at 5% level	15	33
	L.S.D. at 1% level	22	50

* Seed heads formed on check plots.

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TABLE IV. Quackgrass Control by MH and 2,4-D
(Values Relative with Checks = 100)

No.	Treatments	Not Cultivated Quackgrass Stand	Cultivated Quackgrass Stand
1	Check*	100	100
2	MH 5 lb/A	36	22
3	MH 10 lb/A	15	16
4	2,4-D 30 lb/A	95	34
	L.S.D. at 5% level	11	15
	L.S.D. at 1% level	17	23

* Seed heads formed on check plots

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Results and Discussion

TCA, Dalapon and maleic hydrazide were all effective in the control of quackgrass. Under the conditions of the experiment, the optimum rate of application was 50 lbs. per acre for TCA and Dalapon and 10 pounds for MH.

The influence of cultivation after spraying with Dalapon and MH was variable. Cultivation of the Dalapon treated plots six days after spraying reduced effectiveness of Dalapon. On the other hand, cultivation increased the effectiveness of maleic hydrazide, particularly at the 5 pound-per-acre rate. Cultivation also increased the effectiveness of 2,4-D. In fact, without cultivation, 2,4-D at the high rate of 30 lbs. per acre had almost no effect on the growth of

quackgrass. Not enough data are available to explain why cultivation has variable effects on these different herbicides.

1955 Trials. The 1955 trials were similar to those for 1954, except that 2,4-D was replaced by Amizol. The area selected, a few miles north of Amherst, was an old sod heavily infested with quackgrass. The soil was a well drained fine sandy loam. A randomized block split plot design was used with three replicates.

All chemicals were applied June 3. The quackgrass at this time was 6 to 10 inches in height. TCA was applied immediately after disking; all other chemicals were applied to the foliage.

On June 13 each block was split in half, and one half was disked. Diskings were repeated July 5 and 22. At the time of the first disking, quackgrass leaves on the Amizol plots had already become chlorotic.

To control broad-leaved weeds, a uniform application of 4 pounds of DN per acre was made June 15.

Observations made September 6 are summarized in Table V. Quackgrass growth on the uncultivated check plots is rated at 100. All other values are relative to these checks.

TABLE V. Quackgrass Control by Chemical Herbicides
(Values relative. Undisked checks = 100)

No.	Treatments		Quackgrass Stand
1	Check, not disked	later not disked	100
2	TCA 25 lb/A after disking	later not disked	40
3	TCA 50 lb/A after disking	later not disked	27
4	TCA 75 lb/A after disking	later not disked	23
5	Dalapon 25 lb/A on foliage	later not disked	37
6	Dalapon 50 lb/A on foliage	later not disked	25
7	Dalapon 25 plus Amizol 5 lb/A on foliage	later not disked	31
8	Amizol 5 lb/A on foliage	later not disked	92
9	Amizol 10 lb/A on foliage	later not disked	93
10	Check, disked 3 times	Later disked 3 times	53
11	TCA 25 lb/A after disking	Later disked 3 times	22
12	TCA 50 lb/A after disking	Later disked 3 times	17
13	TCA 75 lb/A after disking	Later disked 3 times	15
14	Dalapon 25 lb/A on foliage	Later disked 3 times	32
15	Dalapon 50 lb/A on foliage	Later disked 3 times	21
16	Dalapon 25 plus Amizol 5 lb/A on foliage	Later disked 3 times	20
17	Amizol 5 lb/A on foliage	Later disked 3 times	41
18	Amizol 10 lb/A on foliage	Later disked 3 times	40
	L.S.D. at 5% level		15
	L.S.D. at 1% level		20

Results and Discussion

As in 1954, TCA and Dalapon controlled quackgrass effectively. Amizol alone was not effective either alone or added to Dalapon. Unlike 1954, repeated diskings (3 times) did not markedly increase the effectiveness of TCA, but repeated diskings, as in 1954, reduced the effectiveness of Dalapon.

Summary and Conclusions

The effectiveness of TCA, Dalapon, maleic hydrazide, Amizol (aminotriazole), and 2,4-D on the control of quackgrass was investigated.

1. Dalapon and TCA were the most effective materials studied. Dalapon can be applied directly to the foliage, but TCA is more effective if the soil is first cultivated. Late fall applications of TCA were not satisfactory. The effectiveness of TCA may also be reduced by excessive rainfall. Repeated treatments may be required. TCA at the rate of 30 pounds to 50 pounds per acre and Dalapon, 12.5 to 25 pounds, are suggested.

2. In both 1954 and 1955 the effectiveness of Dalapon was reduced by cultivation after application.

3. Amizol alone or with Dalapon was ineffective in quackgrass control.

4. Plowing and disking six days after application of 2,4-D greatly increased the effectiveness of this material. The rate of application was 30 pounds per acre acid equivalent.

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LIGHT EFFECTS ON PHYTOTOXICITY WITH RESPECT TO HERBICIDES[1]

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There have been published recently several reviews (3,4,6,7,8,9) of papers on weed research. These and collections of papers on weed control give no evidence of any work done on the influence of colored light alone, or in combination with other environmental factors, upon the effectiveness of herbicides. Considerable emphasis has been placed on the need for basic research on such problems (8,9). Colored fluorescent lamps have been found to be well adapted for studying effects of light quality on tomato seedlings (5). Similar equipment was employed in these investigations.

Experimental Methods

Mustard plants (Brassica juncea) were germinated and grown through the seedling stage in a greenhouse. For preliminary experiments cans of soil were used. Later, they were superseded by plastic containers of vermiculite supplied with nutrient solution at intervals. The seedlings were then placed under fluorescent light of various wave-lengths in an air-conditioned chamber for a period of conditioning to light. Three different light qualities could be compared simultaneously. Both at the start of this light period and at the end of it, control plants were harvested to give the levels of fresh and dry weights and other data at each of those stages. A representative portion of the remaining plants under each condition then received a spray application of the sodium salt of 2,4-dichlorophenoxyacetic acid (hereafter referred to as 2,4-D). After this the plants were returned to their position under the lights and along with appropriate controls were allowed to remain there for an additional 5 days. All of these were then harvested for fresh and dry weights. Thus, a measure of the effects on dry weight production, as well as water content, etc., of 2,4-D as modified by light quality could be obtained. Probably dry weight yield is the most precise measurement of this effect and any decrease in this value below that of the controls may be considered as an adverse effect due to 2,4-D.

The colors of fluorescent lamps used were blue, pink, gold, cool white, and warm white. While not at all strictly monochromatic, the colored lamps give emission spectra fairly well restricted to blue and yellow for the blue and gold lamps respectively. Light from pink lamps is primarily in the orange region, overlapping parts of red and yellow about equally. Of the two white lamps, warm white emits somewhat more of red and less blue than cool white. Further work is in progress with red and green lamps.

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Results and Discussion

A fairly large proportion of these experiments were of a preliminary nature, to determine methods of procedure. Results from some of them will be very briefly mentioned in passing.

Effect of photoperiod. Incidental to the testing of other variables, three different lengths of daily light exposure were used. This was in no way exhaustive, but merely to achieve a satisfactory working basis for investigation of light quality effects. The three daily light periods were (a) continuous light (b) 14 hours light, (c) 16 hours light. The continuous light was merely a "stop-gap" measure pending installation of proper automatic switches. Of the other two, the 16 hours light was best, i.e., the plants remained entirely vegetative during the test period, thereby providing more uniform material for 2,4-D action. Some effects of 14 hours light may be seen from results of 2 different experiments presented in Table 1.

Table 1

Effect of photoperiod of 14 hours light on flowering of mustard - 480 plants for each treatment

Time	Kind of light	No. of plants flowered	% of plants flowering
20 days light	Blue	177	36.8
	Warm white	75	15.6
	Cool white	61	12.7
14 days light	Blue	130	27.1
	Pink	94	19.6
	Gold	15	3.1

This shows that blue light more strongly promotes flowering than either of the whites and that blue and pink are more effective than gold in this respect.

Effect of age of plant. Aside from the experiments on the effects of light quality on 2,4-D action, two sets of mustard cultures were grown in soil (1 gal. cans) entirely in the greenhouse to determine the effect of age of plants on 2,4-D action. Different groups of plants were started at weekly intervals so that they could all be treated with 2,4-D and harvested at the same time. The ages of the different groups of plants were: 10, 17, 24, 31, and 38 days. The first set of plants was grown during the period Jan. 12 to Feb. 19 and the particular photoperiod prevailing during the earlier growth of the two oldest sets of plants induced flowering and fruiting, while the younger plants were vegetative. Due to this uneven state of growth phases the subsequent response of the plants to 2,4-D in terms of dry weight yield was not uniform according to age. There was considerable decrease in both fresh and dry weights of older plants compared to peak performance of those in a more vegetative state. A later repetition of this experiment on plants grown Mar. 9 to Apr. 16 produced plants uniformly vegetative. The results showed that age of plants makes no particular difference in the degree of effect of 2,4-D on dry weight compared to untreated controls.

Effect of length of light conditioning period. The number of days of exposure to the particular quality of light before the application of the herbicide

has a bearing on the extent of response to the herbicide. From the limited number of our experiments there is an indication that longer light conditioning causes greater response to 2,4-D in lowering dry weight production. This is shown in the data for two experiments in Table 2.

Table 2

Effect of length of light conditioning period on response of mustard to 2,4-D

Treatment All lamps adjusted to 1060 F.C. for 20 day period and 950 F.C. for 7 day period	Length of light conditioning period 20 days Average of 10 plants in grams Fresh Weight	20 days Dry Weight	7 days Fresh Weight	7 days Dry Weight
Start of light conditioning period	2.37	0.15	0.78	0.03
At end of light conditioning period (2,4-D applied at this time)				
Cool white	5.83	0.82	2.39	0.23
Warm white	5.76	0.83	2.48	0.26
Blue	5.56	0.84	2.59	0.27
After 5 days additional light				
Controls - untreated				
Cool white	8.99	0.89	2.45	0.29
Warm white	6.11	1.09	2.53	0.34
Blue	5.98	1.93	2.61	0.35
Sprayed with 2,4-D 1000 ppm				
Cool white	6.83	0.87	2.80	0.28
Warm white	6.93	0.95	2.82	0.29
Blue	7.20	1.02	2.82	0.30
Sprayed with 2,4-D 5000 ppm				
Cool white	5.20	0.66	2.41	0.24
Warm white	6.46	0.89	2.74	0.25
Blue	6.92	0.97	2.78	0.28

The decrease in dry weight of 2,4-D treated plants below that of the corresponding controls is greater for the 20 day plants than for those with a conditioning period of 7 days, particularly in those under blue light.

Effect of concentration of 2,4-D. It may be seen from Table 2 that of the two concentrations of 2,4-D used there, the stronger produced the greater reduction in dry weight. The effect produced by the stronger solution was not proportional to the increased concentration. In order to have more information concerning the most suitable concentrations to use in tests of this kind, a comparison of four of these was made, as shown in Table 3.

Table 3

Effect of concentration of 2,4-D on dry weight of mustard

Treatment Light uniform throughout - ½ Warm white, ½ cool white at 1100 F.C.	Mean Wt. of 12 groups 20 plants each Fresh weight in grams	Dry weight in grams
Control - Start of light conditioning period	3.90	0.36
Control - After 7 days of light (2,4-D applied at this time)	4.60	0.47
After 5 days additional light		
Control - untreated	5.22	0.75
2,4-D 1 ppm	5.84	0.82
2,4-D 10 ppm	6.13	0.77
2,4-D 100 ppm	5.65	0.64
2,4-D 1000 ppm	5.40	0.55

All plants were under uniform light quality, consisting of equal mixtures of the two whites, and uniform intensity. The dry weight yields indicate a slight stimulating effect of 2,4-D at the two lower concentrations, with higher yields than the controls. However, there is a steady decrease in dry weight with increase in 2,4-D concentration. Further, it appears that concentrations of 1000 ppm, or greater, are necessary to show pronounced effects on these plants.

Effect of light intensity. An experiment was performed with pink, gold, and cool white lamps at different intensities. The luminaires containing these lamps could be slanted above the plants so as to achieve six different intensities. The plants were placed on a rotating table at each position so as to receive uniform intensity at that position. The intensities for pink and gold lamps varied from about 300 to 1100 foot candles at level of tops of plants, and those for cool white from 650 to close to 1500 F.C. The plants were grown without 2,4-D treatment. In general, yields increased with increasing intensity, but did not give an indication of saturation for the colored lamps under these conditions. For the white light it probably is between 1100 and 1500 f.c. Just what light intensity is best for demonstrating effects of 2,4-D on these plants remains to be determined. Experiments by Blackman and Robertson - Cuninghame (1,2) on *Lemna* and on sunflower show that each is more sensitive to certain 2,4-D effects at relatively low light intensities than at higher ones.

Effect of light quality. The effects of lamps of three different light qualities on 2,4-D action have been presented in Table 2. There it is evident that for the 20-day light conditioning period the effect of blue light is considerably greater than either white light in causing dry weight reduction by 2,4-D. For the shorter period the warm white effect is slightly in the lead. Experiments on comparison between each of these with other lamps in various groups of three were performed, but in some instances with other lengths of light conditioning periods and other intensities. Since Table 2 represents fairly typical data,

the yields for the other experiments will not be presented. Having regard to the diversity, in some instances, of length of light conditioning periods and of light intensities, it is probably not safe to draw very strict conclusions. However, in an effort to make a general comparison of the light quality effects, the average of the ratios of reduction in dry weight by 2,4-D to the increase of dry weights in the control plants during the total light period were calculated for each kind of lamp. These are presented in Table 4 and the size of the ratio is proportional to the extent of 2,4-D injury as indicated by dry weight reduction.

Table 4

Ratio of reduction of dry weight by 2,4-D to increase in dry weight by controls

Light Quality	Blue	Pink	Gold	Warm white	Cool white
Ratio	.96	.47	.31	.24	.18

These ratios were first corrected to a common light intensity of 1000 f.c. and to a total light period of 20 days. Each average is based on at least three different experiments and sometimes on four. This indicates that the portions of the spectrum emitted by the colored lamps are more effective in causing 2,4-D action than those of the white lamps, or more complete spectra. Of these colored lamps, blue gives greatest effect. Two preliminary experiments included a comparison of plants grown under natural daylight in the fall with plants under two kinds of fluorescent light. The response of plants in daylight to 2,4-D action was not so great as for the others. The intensity of the daylight at that time of year was, in general, quite low, as low as 300 f.c. on cloudy days. This factor, plus that of varying photoperiod already discussed, led to the conclusion that some artificial white light with standard conditions is probably a more desirable basis of comparison for these experiments.

Summary

The modifying effects of various colored and white fluorescent lights on 2,4-D action were measured by decrease in dry weight of mustard plants (Brassica juncea) compared to untreated controls. The plants were first subjected to a conditioning period of light before 2,4-D application.

Several preliminary experiments to establish procedure gave results as follows: (a) a photoperiod of 16 hours light was better than a shorter light period daily. In the former all of the plants remained vegetative and offered more uniform material for the 2,4-D effect, (b) up to 38 days, age of plants made no particular difference in degree of 2,4-D action, (c) longer light conditioning periods were more effective than shorter ones in causing modifying action of 2,4-D on dry weight, (d) effect of 2,4-D on dry weight was greater with increasing concentrations. Under these conditions about 1000 ppm is probably the best strength to use for showing light quality effects,(e) increasing light intensity increases dry weight yields of mustard, but what intensity is best to show 2,4-D effects has not been fully determined, (f) from the limited results so far, the three colored lamps, blue, pink, and gold, produced greater decrease from 2,4-D action than the warm white or cool white lamps. Blue showed greatest effect of all. Preliminary experiments with natural daylight in comparison to fluorescent light indicated that some other standard of comparison is desirable. This was because of the extreme variations in intensity and photoperiod of daylight.

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A COMPARISON OF THE HERBICIDAL PROPERTIES OF SEVERAL CARBAMATES[1]

S. L. Dallyn, R. L. Sawyer, and R. D. Seif[2]

The carbamates have become increasingly important in the field of chemical weed control. Among the crops in this area on which CIPC has looked good are onions, beets, spinach, lima beans, and to a lesser extent, lettuce. The object of the present investigation was to compare a number of carbamates plus several formulations of CIPC in a search for a material with maximum residual activity and minimum crop injury. Basic studies on a number of these materials have been reported on by Linder et al (2) and some field comparisons by Aldrich (1), and Marshall et al (3,4,5).

GENERAL METHODS

The following nine materials (Nos. 1-7 from Niagara Chemical) were used in a randomized block design with 4 replications.

(1) Isopropyl N-(3-methylphenyl) carbamate
(2) sec.-Butyl N-(3 chlorophenyl) "
(3) 2- Chloroethyl N (3-chlorophenyl) "
(4) (1-Chloropropyl-2) N- (3-chlorophenyl) carbamate
(5) (1- " -2) N- (3-methylphenyl) "
(6) 2- Chloroethyl N- (3-methylphenyl) "
(7) CIPC (isopropyl N-3-chlorophenyl carbamate)
(8) A material supplied by G.L.F. containing 57% active technical CIPC impregnated on a solid diluent containing a wetting and dispersing agent.
(9) A low volatile CIPC formulation supplied by Guenter Loeffler, Cornell University.

Three treatments with each material were used (1) 3 lbs./A. June 10, plus July 10, (2) 6 lbs./A. June 10, (3) 6 lbs./A. June 10 plus 6 July 10. All were applied as directed sprays at the rate of 100 gals./A.

Sweet Spanish onions were used as the test crop and the Texas produced transplants set here in the field April 14. Rows were 34 inches apart and the plants spaced at 4 inches in the row. During the growing season the middles received normal cultivation and weeds in the row were removed by hand before each chemical treatment. Weed counts and control ratings were made July 5 and an additional rating made August 5. Treatments which failed to hold the weeds were hand weeded before appreciable competition with the crop occurred. The crop was harvested August 16.

1 Paper No. 395 , Department of Vegetable Crops, Cornell University
2 Long Island Vegetable Research Farm, Riverhead, N. Y.

RESULTS AND DISCUSSION

A summary of the data is presented in Table 1. There was no effect of treatment on the yield of onions. The mean yield of all the treated plots however was significantly higher than that of the check, indicating that some weed competition had occurred before the plots were weeded. Evidently none of the chemicals at the rates used had any detrimental effect on the growth of onions. Another, more sensitive test crop, such as spinach, or perhaps even cauliflower, would have to be substituted in order to determine their relative safeness in such crop production.

All treatments gave a very marked degree of weed control though several of the materials did not measure up to Niagara #7, the formulation of CIPC used as a standard in this test. Weed counts made July 5, on plots receiving 3 lbs./A. applications, indicated that the Niagara chemicals 2, 5, and 6 were not as effective as the standard. On the 6 pound basis, comparing the averages of treatments 2 and 3 for each material, this same relationship held true for Niagara 5 and 6. Visual ratings of the 3 pound rates did not place any of the materials lower than the standard though Loeffler's CIPC was somewhat better. Similar ratings on the 6 pound plots, however, placed Niagara 4, 5, and 6 as less effective than the standard. A considerable portion of the discrepancy between actual weed counts and visual ratings can be accounted for by differences in weed size - which to some extent, is a measure of the residual activity of the herbicide.

Ratings made August 5 indicated that, considering the average of the three treatments, Niagara #5 was the only one to fall significantly below the CIPC standard. The best index of residual action can be obtained by comparing the #2 treatments of each chemical since this final rating was made 2 months after application. Niagara numbers 1, 3, 4, and 5 were rated less effective than the standard in this respect.

The overall effect of increasing rates was to increase the effectiveness of weed control. The lower rate, i.e. two applications of 3 lbs./A. each, gave good weed control and would be more satisfactory commercially than the single application of 6 lbs./A. early.

SUMMARY

1. Three formulations of CIPC and six related carbamates were compared for crop toxicity and weed control effectiveness - including residual activity.

2. None of the materials, at the rates used, had any measurable effect on the growth of sweet Spanish onions. A more sensitive test crop would be required to determine the relative "safeness" of these materials.

3. A standard formulation of CIPC (Niagara #7) was as effective as any in overall weed control. All of the Niagara materials were rated lower than the standard in at least one respect. Niagara #5 appeared to be lowest in herbicidal activity, followed by numbers 6 and 4 in that order.

TABLE 1. RESULTS FROM SEVERAL CARBAMATES USED FOR WEED CONTROL IN SWEET SPANISH ONIONS

Treatment							Weed Count[1] July 5	Rating[2] July 5	Rating Aug. 5	Yield Bus./A.
1.	Niagara 1	3	lbs.	+	3	lbs.	19	5.8	4.6	741
2.	"	6	"	"	0	"	10	4.5	4.3	741
3.	"	6	"	"	6	lbs.	13	4.8	3.9	726
4.	Niagara 2	3	"	+	3	"	26	4.5	4.8	741
5.	" "	6	"	"	0	"	12	3.8	4.1	720
6.	" "	6	"	"	6	"	13	5.0	3.8	756
7.	Niagara 3	3	"	"	3	"	17	5.5	4.0	750
8.	" "	6	"	"	0	"	11	4.5	4.8	702
9.	" "	6	"	"	6	"	18	4.0	3.9	696
10.	Niagara 4	3	"	+	3	"	10	6.8	3.6	750
11.	" "	6	"	"	0	"	8	4.8	4.8	753
12.	" "	6	"	"	6	"	16	6.0	3.6	726
13.	Niagara 5	3	"	+	3	"	33	6.0	5.9	729
14.	" "	6	"	"	0	"	11	5.8	5.8	732
15.	" "	6	"	"	6	"	23	6.3	6.3	687
16.	Niagara 6	3	"	+	3	"	26	6.3	4.4	759
17.	" "	6	"	"	0	"	14	5.5	4.0	732
18.	" "	6	"	"	6	"	27	6.0	4.1	750
19.	Niagara 7	3	"	+	3	"	10	5.0	4.1	729
20.	" "	6	"	"	0	"	3	2.5	2.8	687
21.	" "	6	"	"	6	"	7	4.5	3.3	741
22.	G. L. F.	3	"	+	3	"	16	6.3	4.4	750
23.	" " "	6	"	"	0	"	5	3.3	3.1	741
24.	" " "	6	"	"	6	"	14	4.3	2.5	768
25.	Loeffler	3	"	+	3	"	12	3.0	3.1	747
26.	"	6	"	"	0	"	3	2.5	2.8	750
27.	"	6	"	"	6	"	6	2.3	2.8	723
28.	Check						109	8.3	7.4	681
	L.S.D. 5%						14	2.0	1.5	N.S.

[1] Average per 4' of row

[2] 1= excellent
9= poor

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SOME RELATIONS OF GROWTH TO PLANT RESPONSE TO ISOPROPYL-N-(3 CHLOROPHENYL) CARBAMATE

by
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The response of various weed and crop plants to CIPC under field conditions is well known. The investigation reported here was designed to obtain information on the relationship of these responses to the suggested mode of action of this material at the cellular level.

Ennis (1948) reported that treatment with O-Isopropyl-N-phenyl-carbamate (IPC) resulted in the failure of the miotic cycle to go to completion. This appeared to be the result of abnormal spindle action prior to anaphase. This action would likely be associated with changes in the nitrogen metabolism of the cell which may explain the effect reported by Swanson, et al (1953) of a decreased respiration rate but an increased R. Q. in plant tissue treated with CIPC. If the respiration associated with cell division is affected, it is possible that the respiration processes in elongating or mature cells would not be similarly altered since the metabolic mechanisms in these cellular states are thought to be different (Steward, 1954).

The study of these problems was approached by measuring the rate of decrease of growth rate of treated plants and the time lapse between treatment and effect.

METHODS

An apparatus (Seiler, 1951) was devised in which corn seedlings could be grown at a constant temperature in contact with various herbicide solutions and with near optimum moisture and aeration conditions. Growth was determined by measuring the elongation of the primary root at one hour intervals.

Plants were prepared by germinating sweet corn (variety, Ioana) for 36 hours before the test and selecting uniform appearing seedlings with a radicle one centimeter long. After the seedlings were placed under test conditions, the herbicide solutions could be changed and root lengths measured with a kathetometer without disturbing the plants.

A test was designed with two temperatures (28°C and 34°C) and four treatment times. These included: (1) no CIPC, (2) CIPC at the beginning of the 36 hour treatment period, (3) CIPC after 12 hours, and (4) CIPC after 18 hours. The test included two replications and three seedlings per treatment.

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2/ Part of this work was made possible by a grant-in-aid from the Esso Research and Engineering Company.

RESULTS

In order to test the deviations of the growth rate of treated plants from the untreated plants, the normal growth rate must be linear. Analysis of variance of the untreated plants (Table 1) show significant differences at the one percent level for time of measurement. Even though much of this can be attributed to differences in growth rate of check plants at the lower temperature, the best method to employ under the circumstances is a visual comparison of the growth rate curves (Figure 1). Growth rate curves for the lower temperature are similar to those in Figure 1 except a lower rate of growth in the untreated plants resulted in less differences between the curves.

DISCUSSION

The results show a rather gradual decrease in growth after treatment, with the effect less pronounced after a greater time lapse before treatment.

Table 1. Analysis of variance of growth rates of untreated sweet corn roots.

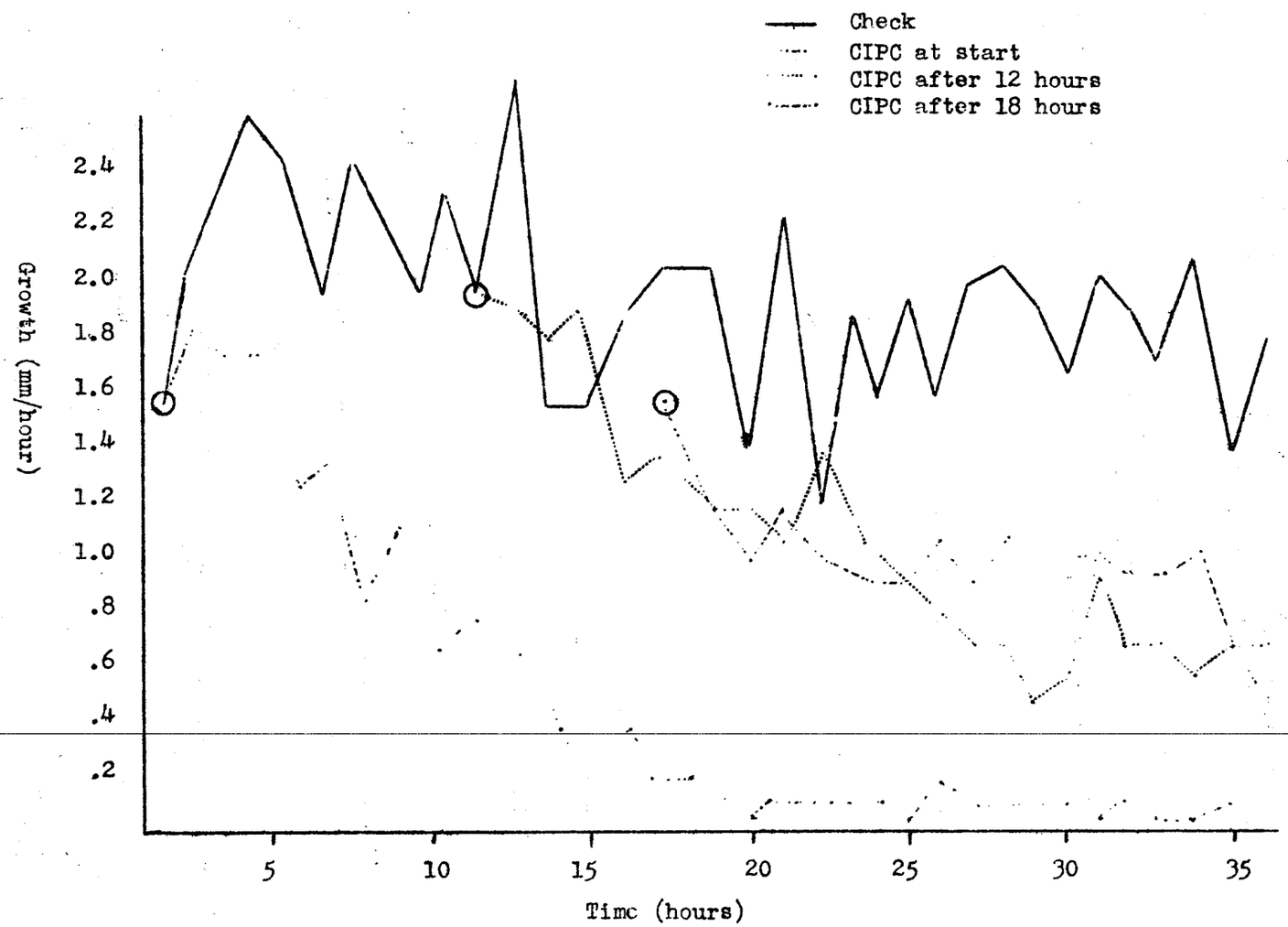
Source	d.f.	M.S.
Seedlings	11	804
Replications	1	1942
Temperature	1	3461 *
Error A	9	382
Times of measuring	35	314 **
Error B	385	56

* Significant F test at the 5% level.
** Significant F test at the 1% level.

The immediate response could be largely a result of stopping or greatly reducing the amount of cell division in the root. The continued growth after this initial response could be attributed to normal elongation and abnormal elongation and abnormal enlargement (Ennis, 1948) of cells formed before treatment.

A larger number of unelongated cells in older plants would delay the ultimate stopping of growth, as measured by elongation, and explain the lesser slope in depression of growth rate curves with older plants. As Ennis (1948) found with large plants growing in nutrient solutions, if the cells of a root come in contact with a sufficient concentration of CIPC,

Figure 1. The influence of time of application of CIPC on the growth rate of roots of sweet corn seedlings at 34°C.



growth will stop regardless of the size of the plant; and escape from injury by large plants is probably due, therefore, to penetrating of roots to depths in the soil beyond the penetration of the CIPC.

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Field Evaluation of the Influence of Soil Organic Matter on Herbicides.

Dallyn, S. L., Sawyer, R. L., Seif, R. D. & Robinson, R. W.[1]

ABSTRACT[2]

An area is available on the L. I. Vegetable Research Farm where various levels of organic matter have been established, within the same general soil type, through the long-term application of manure. A large number of experiments have been carried out over the past three years in an attempt to assess the importance of the soil organic matter - herbicide relationship in crop production.

This past season the following chemicals were tested: Karmex W, FW, and DW at rates of ¼, ½, 3/4, and 1.0 lbs. per acre, and CIPC at 1.5, 3.0, 4.5, and 6.0 lbs. per acre. Test crops used were onions and beets representing small seeded vegetables and corn and lima beans representing the large seeded group. Onions and beets were seeded April 12, treated two days later and harvested June 27. The plots then were disked deeply and the corn and beans planted July 12, treated the 13th and harvested August 24. Complete data were taken on the effects of all treatments on weed and crop plants.

In essentially all cases the results followed a pattern of direct relationship with the primary factors - soil organic matter and the applied herbicides Direct correlations existed between weed control and rate of all four herbicides. Linear effects of the herbicides, particularly the ureas, and crop plants, the small seeded ones especially, were also observed. Weed counts were correlated with organic matter. No significant interactions between soil organic matter and herbicidal treatment occurred this year. In only one year out of three have such interactions occurred, indicating that organic matter variation (within the range of normal cultural practices) in the same soil type may not be of primary importance in the use of many herbicides in crop production.

[1] L. I. Vegetable Research Farm, Cornell University

[2] Summary of 3 years results to be published in WEEDS.

WEED CONTROL IN TRANSPLANTED SWEET SPANISH ONIONS[1]

S. L. Dallyn, R. L. Sawyer and R. D. Seif[2]

Work on weed control in Sweet Spanish onions has received considerable attention at this station over the past four years (1). Numerous herbicides have been tested and a relatively few, CIPC and Karmex W in particular, have been selected as having good possibilities. Rates of these materials for use under our conditions have been fairly well established. Directed application of the sprays has always been found superior to overall application--both in effectiveness of weed control and minimization of crop injury.

GENERAL METHODS

The objective of the present work was to determine the maximum use of the herbicides considering the effects on both weed and crop plants. Time and frequency of the sprays were varied; concentration and method of application (directed) were held constant.

CIPC at 4 lbs. per acre (per application) Karmex W, and Karmex DW at ½ lb. per acre (per application) were the materials and concentrations selected. The latter chemical was added to determine whether we could get weed control with it equal to Karmex W and with less crop injury. A split plot design, five replications, was used with chemicals forming the three major plots. Each of these in turn was divided into the following ten treatments:

(1) single application June 10
(2) " " July 10
(3) June 10 + July 10 (standard)
(4) soil sprayed just before setting the plants
(5) " " " " " " " + standard
(6) spray applied immediately after setting
(7) " " " " " + standard
(8) sprayed 3, 6, 9, and 12 weeks after setting
(9) " 6, 9, and 12 weeks after setting
(10) Check

The preplanting treatments were applied April 14 and the transplants set the same day with a self propelled Holland celery planter. Treatment 6 and the first part of 7 were put on the next day. Plots receiving subsequent treatments were counted or rated and weeded immediately prior to treatment. As a measure of effectivenss of the treatments the earlier collected data were combined into two catagories. The first of these was the total number of weeds which grew on the plots up to and including the last weeding, which was made on July 6. The second was the number of hand weedings required to keep

1 Paper No. 394, Department of Vegetable Crops, Cornell University
2 Long Island Vegetable Research Farm, Riverhead, N. Y,

the weeds under good commercial control during this same period. A final visual rating was made one month later on August 3 and the crop harvested August 15.

RESULTS

The results from the experiment are summarized in Table 1. By May 20, plots which had not received a herbicide (treatment 1, 2, 3, 9, 10) were fairly heavily infested with weeds and were cleaned out by hand. The average weed count in these plots at that time was 43 per 4' of row (8" band), and largely accounts for the size of some of the figures in column 2 of the table. All of the earlier herbicide treatments were still giving good control through May 20. Comparing treatments 8 and 9 of each chemical it is apparent that when the herbicides were applied 3 weeks after setting excellent weed control was achieved, but when application was delayed until 6 weeks after setting heavy weed growth had already occurred necessitating hand weeding before the sprays could be put on. No overall statistical analyses were possible on the data collected through July 6; pertinent individual comparisons supported the general conclusions mentioned later.

Split plot analyses of the August 3rd rating and the crop yield indicated high significance for both chemicals and treatments but no chemical-treatment interactions. Karmex W, in general, reduced onion yields and gave poorer weed control than either Karmex DW or CIPC. The two latter chemicals did not differ from each other in either of these respects.

Treatments 3, 4, and 5 with Karmex W all reduced yields in comparison to the check. No difference in yield occurred between treatments with Karmex DW. Yields from CIPC 4 and 5 were not below the check but were exceeded by #2, the highest yielding treatment. The data indicated that preplanting application of herbicides was more likely than later applications to result in crop injury.

Karmex W in this and previous work has always tended to give some crop injury, under our conditions, when used over too wide a range. If Karmex DW continues to perform as it did this season, it will be a much more safe and useful herbicide than "W" for onions and will perhaps equal the potentialities of CIPC.

The ideal treatment should perform well in three catagories:

(1) reduce hand weeding to a minimum
(2) hold weeds from lay-by until harvest (hand weeding in this period is difficult and can cause substantial crop injury).
(3) have no detrimental effect on yield or quality.

Treatments rated above 4.0 on August 3, in general, did not hold satisfactorily through to harvest. Considering overall performance, treatments 8 and 9 were the most satisfactory, particularily with Karmex DW and CIPC. Treatment 9 might be favored by a commercial operator if he found difficulty doing a good job of directional spraying on plants which had been set for only 3 weeks.

TABLE 1. SUMMARY OF HERBICIDE EFFECTS ON WEEDS AND SWEET SPANISH ONIONS

Treatment	Total No.[1] Weeds	No. of Hand[2] Weedings Required	Visual Rating[3] Aug. 3	Yield Bus./A.
1. Karmex W, June 10	63	2-3	4.0	647
2. " July 10	85	3	3.4	629
3. " June 10 + July 10	65	2-3	3.6	545
4. " Before planting	22	2	5.4	566
5. " " " + June 10 + July 10	14	1	2.6	494
6. " Immed. after planting	24	2	4.4	672
7. " " " " + June 10 + July 10	13	1	2.2	614
8. " 3, 6, 9 and 12 wks. after planting	4	0	2.4	600
9. " 6, 9 and 12 " " "	60	1	2.2	639
10. Check	79	4	5.4	665
11. Karmex DW, June 10	55	2-3	3.0	698
12. " July 10	78	3	3.0	710
13. " June 10 + July 10	58	2-3	2.2	705
14. " Before planting	19	2	3.8	635
15. " " " + June 10 + July 10	11	1	2.0	642
16. " Immed. after planting	17	2	4.6	701
17. " " " " + June 10 + July 10	13	1	2.4	654
18. " 3, 6, 9 and 12 wks. after planting	3	0	2.0	680
19. " 6, 9 " " " " "	50	1	2.0	683
20. Check	61	4	4.0	632
21. CIPC, June 10	60	2-3	2.2	692
22. " July 10	98	3	3.0	708
23. " June 10 + July 10	63	2-3	2.0	675
24. " Before planting	11	2	4.0	624
25. " " " + June 10 + July 10	10	1	1.8	594
26. " Immed. after planting	22	2	5.0	657
27. " " " " + June 10 + July 10	15	1	1.8	695
28. " 3, 6, 9 and 12 wks. after planting	10	0	1.6	689
29. " 6, 9 " " " " "	55	1	1.6	701
30. Check	92	4	5.2	659
L.S.D. 5%	---	-	0.6	80

1- Total number weeds, per 4', produced on plots through July 5 - date of last weeding.
2- To lay-by July 5.
3- 1= excellent control, 4= commercial control, 9= poor control

SUMMARY

(1) Karmex W, Karmex DW and CIPC were compared to determine their maxiumum usefullness as herbicides in production of Sweet Spanish onions from transplants.

(2) Karmex DW and CIPC were rated approximately equal as herbicides (considering both weed control and crop injury), and substantially better than Karmex W.

(3) Spraying the soil before planting gave good weed control but tended to be more injurious to the crop. Directed sprays immediately after setting were satisfactory but might be difficult for growers to apply properly on a commercial basis.

(4) Highest overall rating were given to two treatments:

(a) Directed herbicide applications at 3, 6, 9, and 12 weeks after setting.
(b) Same as above with a hand weeding substituted for the first spray and made a few days prior to the 6-week application.

(5) Under the conditions of this experiment, it was possible to achieve good commercial weed control with a maximum of one hand weeding and the correct use of herbicides. Five hand weedings were necessary to provide similar control in the checks.

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OBSERVATIONS AND SUMMARY OF RESULTS OF 1955 PRE-EMERGENCE HERBICIDE SCREENING PLOTS ON EIGHT CROPS

Ernest R. Marshall, George Bayer and Don Robinson*

INTRODUCTION

During the 1954 growing season a pre-emergence herbicide screening test was conducted near Cedarville, New Jersey. The purpose of this screening test was to furnish leads on new herbicides which might be used in future larger scale trials on various crops later in the same growing season. For this reason in the past, these screening tests have been conducted in Florida and along the Eastern shore where the early growing season precedes the New York growing season far enough to enable data from the screening test to be available for use in tests in upstate New York the same growing season. These screening tests are preliminary in nature and data taken are not considered conclusive but rather merely guides in future test planning. This paper will describe the screening test and the information gained from it.

MATERIALS AND METHODS

Eight crops were planted in single rows two feet apart on May 11,1955. Immediately after planting on May 12th, the pre-emergence treatments were applied. The crops planted were cucumbers, beets, spinach, soybeans, green beans, lima beans, peas and corn. Mustard green and domestic rye grass were sowed over the entire area to insure a uniform stand of broadleaved and grass species simulating weeds. This made rating of weed and grass control much easier. The crops were planted lengthwise of the field and thetest plots run perpendicular or across the rows. The test plots were 6 feet wide and 18 feet long. There were three replicates but certain treatments in the third replicate were irrigated with 4 inches of water during a three week period after planting. There were a total of 231 plots. Data were taken on June 6th. Rates used were either those suggested by cooperating chemical companies or those which were judged to be sufficient to control weeds or grass. Treatment used and the source of these materials are as given in Table 1 along with the weed and grass control ratings.

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RESULTS OF 1955 HERBICIDE SCREENING PLOTS, CEDARVILLE, NEW JERSEY

Treatment	Rate/A	Source of Chemical	Rating* Weeds	Rating* Grass
1. BP1	4#	Columbia Southern Chem. Co.	2	8
2. BP1	8#	" " " "	6	10
3. BP2	4#	" " " "	0	8
4. BP2	8#	" " " "	1	9
5. BP3	4#	" " " "	0	4
6. BP3	8#	" " " "	4	4
7. BP4	4#	" " " "	2	4
8. BP4	8#	" " " "	8	7
9. CDAA	4#	Monsanto Chemical Co.	2	10
10. CDAA	8#	" " "	6	10
11. CDEA	4#	" " "	2	9
12. CDEA	8#	" " "	4	10
13. CDEC	4#	" " "	4	10
14. CDEC	8#	" " "	6	10
15. 5521	4#	Niagara Spray Chemical	3	7
16. 5521	8#	" " "	8	7
17. CIPC	4#	G.L.F. Soil Bldg. Service	9	10
18. CIPC	8#	" " " "	10	10
19. CIPC WP	4#	" " " "	5	9
20. CIPC WP	8#	" " " "	8	10
21. LV CIPC	4#	" " " "	10	10
22. LV CIPC	8#	" " " "	10	10
23. HC1281 AN	1#	Heyden Chemical Co.	8	2
24. HC1281 AN	2#	" " "	9	4
25. HC1281 S	1#	" " "	7	4
26. HC1281 S	2#	" " "	9	6
27. HC1281 WP	1#	Heyden Chemical Co.**	6	0
28. HC1281 WP	2#	" " "	9	2
29. HC1281 WP	3#	" " "	10	6
30. X33EO	1#	Hooker Electrochemical Co.	2	2
31. X33EO	2#	" " "	4	2
32. X33EO	3#	" " "	7	3
33. X33S	1#	" " "	4	4
34. X33S	2#	" " "	4	4
35. X33S	3#	" " "	6	5
36. X33 WP	1#	Hooker Elec. Co.**	0	0
37. X33 WP	2#	" " "	9	0
38. X33 WP	3#	" " "	9	0
39. L857	1#	American Chem. Paint Co.	0	0
40. L857	2#	" " " "	10	0
41. L857	3#	" " " "	10	0
42. X42EO	1#	Hooker Electrochemical Co.	4	6
43. X42EO	2#	" " "	5	6
44. X42EO	3#	" " "	5	7
45. X42S	1#	" " "	4	6
46. X42S	2#	" " "	5	7
47. X42S	3#	" " "	8	9

Treatment	Rate/A	Source of Chemical	Rating* Weeds	Rating* Grass
48. X42WP	1#	Hooker Electro.Co.**	0	0
49. X42WP	2#	" " "	4	0
50. X42WP	3#	" " "	6	0
51. LV4	1#	American Chem.Paint Co.	9	5
52. LV4	2#	" " " "	10	6
53. 638	1#	" " " "	9	1
54. 638	2#	" " " "	10	4
55. 2,4-D acid WP	1#	G.L.F.Soil Bldg.Service	5	2
56. 2,4-D acid WP	2#	" " " "	9	3
57. L841	2#	American Chem.Paint Co.	10	5
58. L841	4#	" " " "	10	8
59. L842	2#	" " " "	10	2
60. L842	4#	" " " "	10	6
61. Methin	3#	Carbide &Carbon Chem.Co.	8	6
62. SES	3#	" " " " "	9	4
63. 6831	3#	" " " " "	0	0
64. 6831	6#	" " " " "	0	0
65. 8717	3#	" " " " "	0	0
66. 8717	6#	" " " " "	0	0
67. L878	2#	American Chem.Paint Co.	0	0
68. L878	4#	" " " "	0	0
69. L883	1/4#	" " " "	0	0
70. L883	1/2#	" " " "	0	0
71. L883	1#	" " " "	0	0
72. L383	2#	" " " "	0	0
73. 444	8#	Geigy Chemical Co.	10	10
74. 444	16#	" " "	10	10
75. Baron	4#	Dow Chemical Co.	0	5
76. Baron	8#	Dow Chemical Co.	4	6
77. CMU	1#	DuPont Chemical Co.	10	10
78. CMU	2#	" " "	10	10
79. EH333		Std. Agr. " "	3	0
80. EH333		" " " "	10	8
81. EH333		" " " "	10	8
82. Sinox PE		" " " "	9	4
83. Sinox PE		" " " "	10	9
84. Sinox PE		" " " "	10	9
85. No treatment				

* 0 = no control 10 = complete kill

** Basic chemicals supplied by manufacturer but formulated by GLF

RESULTS AND DISCUSSION

In discussing the test results the treatments will be grouped according to type.

The first group to be discussed will be the grass killers. Treatment 1-22 in Table 1. Each of these materials was applied at two rates 4 and 8 pounds per acre. The materials BP1, BP2, BP3 and BP4 did not seem to be as active as CIPC and lacked some of the selectivity on crop plants. BP1 and BP2 gave better grass control than BP3 and BP4. They were not too effective on mustard. BP2 showed a little more selectivity than the other three compounds. At dilutions of 1-50 there was some trouble spraying BP1 and BP2 because of a precipitate forming in the spray solution.

CDAA, CDEA and CDEC were very effective grass killers with a high degree of selectivity. CDEC seemed to give less injury to crop plants than either CDAA or CDEA. Crops which were particularly tolerant were spinach, soybeans, green beans, peas and corn.

5521 was not as effective in killing ryegrass as CIPC and was somewhat less selective on crop plants.

Three forms of CIPC were applied. A 50% wettable powder, a regular formulation and a low volatile formulation. Mustard was killed by 4 and 8 pounds per acre of regular CIPC and the low volatile form. The wettable powder formulation did not appear to have much of an advantage over the regular CIPC although it may be slightly more selective on corn. The low volatile formulation was as effective or more effective in mustard and rye grass control than the other forms. Both the regular CIPC and the LV CIPC killed all corn in the plots whereas 8# of the CIPC WP did not injure corn. Corn growing in the CIPC and LVCIPC plots did not form brace-roots and could be lifted easily from the soil. Irrigation did not seem to influence the effectiveness of these materials greatly. Crops particularly tolerant of CIPC were beets, spinach, soybeans, green beans, and peas.

The next group of materials are the tri and tetrachlorobenzoic acid derivatives. This group showed selectivity on corn only. HC1281 was more effective than X42 or X33. The wettable powder forms did not have any particular advantage over the other forms. The sodium salts were just as effective in broadleaved weed control as the emulsifiable acids. Irrigation greatly increased the effectiveness of the tri and tetrachlorobenzoic compounds.

L841, the 2,4-D acetamide, was the most effective form of 2,4-D applied but was not significantly different than L842, the 2,4,5-T acetamide, insofar as broadleaf control was concerned. L841 was safer to use on corn than L842.

444 at 8# per acre eliminated everything except peas. This chemical is very effective and lower rates could have been used and satisfactory control obtained.

Baron was not too effective under these conditions.

CMU gave excellent weed and grass control at 1 pound per acre and showed selectivity on beets and spinach.

The low volatile form of dinitro EH333 was not superior to Sinox PE and under these hot, dry conditions both materials volatilized and injured emerging crops in adjacent plots.

SUMMARY AND CONCULSIONS

CDAA, CDEA and CDEC look promising as selective grass control materials at rates of 4 or less pounds per acre.

A low volatile formulation of CIPC gave better weed and grass control than a wettable powder formulation.

The trichlorobenzoic acid derivatives were more effective than the mixed trichloro and the tetrachlorobenzoic acid derivatives on broadleaves. These materials showed no selectivity other than on corn.

2,4-D acetamide was more effective on broadleaves than the emulsifiable or wettable acid or the butoxyethanol ester.

444 was a very effective herbicide at 8 pounds per acre and showed selectivity on peas only. It should be tested at lower rates.

EH333 was not superior to Sinox PE and both showed volatility injury on adjacent plots.

Irrigation increased the effectiveness of most materials, particularly the benzoics.

Wettable powder formulations were generally as good as emulsifiable formulations but no better.

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THE INFLUENCE OF "CHEMICAL ADDITIVES" AND SOIL TYPE ON THE RESIDUAL ACTIVITY OF ISOPROPYL-N-(3 chlorophenyl) CARBAMATE

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It has been reported that the effect of CIPC might be reduced through rapid evaporation when applied to the soil (1). It was also stated by Linder (2) that carbamates which have a lower vapor pressure are less injurious to certain crop plants. The response of various weed and crop plants to CIPC under field condition is well know, but it was thought that better weed control could be obtained if the material were more persistent in the soil.

The investigation reported here was designed to: (1) Determine the influence of low vapor pressure solvents on the vapor toxicity of CIPC, (2) Test the relationship of soil type and the persistance of CIPC in the soil, and (3) Obtain information on the relationship between the vapor activity of CIPC from various soils and the persistance of the compound.

Materials and Methods

In order to reduce the volatility of CIPC several high molecular weight materials were added in concentrations of 15, 30 and 45 per cent by volume to technical CIPC. Each formulation was made equal to a 4 pound per gallon formulation by adding five per cent emulsifier and xylene. Additives used were chlorowax 40 (Diamond Alkali) polyethylene glycol 400, polyethylene glycol 600, Ucon Lubricant HB 5100 (Carbide and Carbon) and Aroclor 5460 (Monsanto Chemical Company). A standard CIPC formulation was also prepared adding only emulsifier and xylene.

To measure the vapor activity of these different formulations, a bioassay was used with cucumber Burpee hybrid seedlings as test plants. Pregerminated seeds were placed on wet filter paper in a 6 ounce paper cup, which was sealed in a polyethylene bag. A filter paper disc impregnated with 1 c.c. of a 125 p.p.m. concentration of the formulation to be tested was fastened within the bag just above the paper cup. After 72 hours the roots of the cucumber seedlings were measured.

Assuming an inverse relation between root growth and vapor activity, the formulation with the lowest vapor activity was selected and its persistance compared in various soils. For this experiment small clay pots were filled with three different soils, (Dunkirk silty clay loam, muck soil, and equal parts mixture of quartz sand and Dunkirk fine sandy loam) and treated at rates of 12 and 24 pounds per acre of active material with two formulations of CIPC. One was the same as the commercial formulation, while the other was formulated with 30 per cent of Ucon Lubricant HB 5100. For simplicity this formulation is called "Ucon." The soil was kept at or near field capacity with subirrigation. After 19, 63 and 122 days, one complete set of pots was removed and seeded with Mohawk oats and grown at 70°F. to 80°F. in a greenhouse. After the oats in the check pots were 12 to 14 cm. tall the lengths of leaf blades of five seedlings per pot were measured.

Since the results of this experiment showed that the CIPC with a lower vapor activity had more herbicidal effect after a period of time, a third series of experiments was set up to determine the interaction between soil type and the reduced vapor activity. Two experiments were conducted for this purpose, in which CIPC and "Ucon" were applied at a concentration of 1000 p.p.m. to the three soils previously listed.

The first experiment included all three soils. Fifty grams of air dried soil in a petri dish was treated with 10 c.c. of the CIPC emulsion. The petri dishes were sealed in a bell jar with a dish of 10 cucumber Burpee hybrid seedlings. These were grown for three 24 hour intervals in continuous light and constant temperature of 90°F. At the end of each 24 hour period, the seedling root lengths were measured and a dish with new seedlings was enclosed under the bell jar.

In the second experiment only the sand mixture and the organic soil were compared. Both soils were wet to field capacity before treatment. Seedlings were measured after six 24 hour intervals.

Results

Experiments to evaluate additives in the CIPC formulation, showed that the vapor activity of CIPC, as measured by cucumber root extension was significantly decreased from the standard formulation by adding Ucon Lubricant HB 5100 or polyethylene glycol 600. It also appeared that in general there was a reduction in vapor activity with increases in molecular weight of the additive and the amount used.

Table 1. Vapor activity of various CIPC formulations as measured by cucumber root elongation.

No.	Formulation	Mean Length cm.
1	CIPC + Chlorowax 40 - 15%	5.95
2	" " " - 30%	5.12
3	CIPC + Polyethylene glycol 600 - 15%	5.46
4	" " " " - 30%	5.01
5	" " " " - 45%	6.59
6	CIPC + Polyethylene glycol 400 - 15%	5.87
7	" " " " - 30%	4.11
8	" " " " - 45%	6.27
9	CIPC + Ucon Lubricant HB 5100 - 15%	5.42
10	" " " " " - 30%	6.80
11	" " " " " - 45%	5.63
12	CIPC + Aroclor 1 lb. per gallon	3.99
13	CIPC regular formulation	4.42
14	Control	6.92

The experiments in which CIPC and the "Ucon" formulation were applied to the three soils, showed the following results: When oats were planted 19 days after soil application both rates used were rather toxic and no differences between soils or rates were obtained. When oats were seeded 63 days after soil application, the analysis of variance showed a significant difference for soil, highly significant differences for treatments and for soils x treatment interactions (Table 2). The data suggest that herbicidal activity was greater in the mineral soils than in the organic soil. The addition of Ucon increased the residual effect of the herbicide. This can best be seen from Figure 1.

Table 2. Residual activity of CIPC and "Ucon" as measured by top growth of oats planted 63 days after soil treatment.

No.	Treatment	lbs./A.	Sand	Loam	Muck	Means for treatment
1	Control		10.10	11.65	11.53	11.09
2	CIPC	12	5.24	5.15	6.45	5.61
3	"	24	3.74	1.61	3.41	2.92
4	Control		10.75	11.39	11.86	11.33
5	Ucon	12	1.39	.49	5.20	2.36
6	"	24	.85	.41	1.83	1.03
	Means for soil		5.35	5.12	6.71	

Figure 1 shows the effect of the addition of Ucon Lubricant to the formulation on mineral and organic soils. It is rather clear that the low volatile material keeps a higher herbicidal activity than the standard formulation in mineral soils, and to a lesser degree in organic soils.

When oats were planted 122 days after treatment the herbicidal activity had become so low that no significant differences were obtained.

The experiment measuring the CIPC evaporation from air dry soils shows more of the herbicide evaporated on the first day than on the second and third, and that CIPC evaporated at a higher rate than "Ucon." On all three days the material evaporated more from the loam than from the sand or muck (Table 3).

Table 3. Influence of soil and time on the vapor activity of CIPC and Ucon as measured by the root elongation of cucumber seedlings (seedlings exchanged daily).

Day	Treatment	Sand	Silty Clay Loam	Muck	Means for treatment
1	CIPC	1.27	1.34	1.38	1.33
	Ucon	1.50	1.32	1.47	1.43
	Control	1.84	1.70	2.11	1.88
	Means for soils	1.53	1.45	1.65	

Table 3 (con't.)

Day	Treatment	Sand	Silty Clay Loam	Muck	Means for treatments
2	CIPC	1.51	1.55	1.86	1.64
	Ucon	1.60	1.54	1.98	1.70
	Control	2.03	1.73	1.97	1.91
	Means for soils	1.71	1.60	1.93	
3	CIPC	1.46	1.31	1.62	1.46
	Ucon	1.53	1.45	1.96	1.64
	Control	2.21	1.80	2.12	2.04
	Means for soils	1.73	1.52	1.90	

Disregarding the formulation of CIPC the data show that less material evaporates from muck than from sand or loam.

When CIPC and "Ucon" were applied to sand and muck at field capacity, the results were somewhat different than in the previous experiment (Table 4).

Table 4. Influence of soil and time on the vapor activity of CIPC and Ucon as measured by the root elongation of cucumber seedlings (data presented as per cent of check).

Time	Treatment	Sand Length - per cent of check	Muck Length - per cent of check	Means for days
1st day	CIPC	59.3	60.7	
	Ucon	62.1	79.1	
	Means for soils	60.7	69.9	65.3
2nd day	CIPC	61.1	77.2	
	Ucon	70.5	78.0	
	Means for soils	65.8	77.6	71.7
3rd day	CIPC	64.6	90.2	
	Ucon	64.8	72.8	
	Means for soils	64.7	81.5	73.1
4th day	CIPC	66.2	82.3	
	Ucon	67.1	90.3	
	Means for soils	66.7	86.3	76.5
5th day	CIPC	58.7	79.2	
	Ucon	68.0	79.7	
	Means for soils	63.4	79.5	71.5

Table 4 (con't.)

Time	Treatment	Sand Length - per cent of check	Muck Length - per cent of check	Means for days
6th day	CIPC	64.1	79.5	
	Ucon	58.5	80.0	
	Means for soils	61.3	79.7	70.5

The results show that: (1) The vapor activity decreased until the fourth day and then increased, indicating that the herbicide does not vaporize at a continuous rate (Figure 2). Although the CIPC and "Ucon" did not differentially influence the total response, the formulations did interact with the linearity of time effect. (2) The soil type influences the rate of evaporation with a greater and more variable vapor activity from sand than from muck treated with CIPC or "Ucon" (Figure 3).

Discussion and Conclusions

The data showed that it is possible to decrease the vapor activity of CIPC by decreasing the partial pressure of the solvent in the CIPC formulation. This phenomena of decreased volatility with such additives can be explained by the fact that after evaporation of the water these high boiling materials remain as a residual solvent or carrier for the toxicant. In explaining these effects, the following formula describing an ideal solution can be used.

$$\text{Partial pressure CIPC (in solution)} = \frac{\text{Moles CIPC}}{\text{Moles CIPC + Moles (xylene + additive)}} \times \text{partial pressure CIPC (pure)}$$

This would indicate that as the number of moles of the solvent (xylene + additive) approaches zero, the fraction $\frac{\text{Moles CIPC}}{\text{Moles CIPC + Moles Solvent}}$ would approach 1, and the partial pressure of CIPC in solution would approach the partial pressure of the pure CIPC. However, since the vapor pressure of the solvent additive is very low, the fraction $\frac{\text{Moles CIPC}}{\text{Moles CIPC + Moles Solvent}}$ will tend to remain smaller than 1. Since the total pressure consists of partial pressure CIPC + partial pressure xylene + partial pressure additive, the total pressure would become relatively lower as the partial pressure of xylene approaches zero. From this it appears that if a formulation with longer residual activity is desired, a formulation such as "Ucon" may be of value. Since it would not be expected that a solution of CIPC would exist as an ideal system in the soil, the influence of soil factors should be considered. Anderson (1) has extrapolated evaporation from other surfaces to soil conditions, and stated that CIPC may evaporate from soils in sufficient amounts to reduce its effectiveness. Ogle and Warren (3) included other

Figure 1. Influence of soil type on residual activity of CIPC and Ucon as measured by top growth of oats planted 63 days after chemical application.

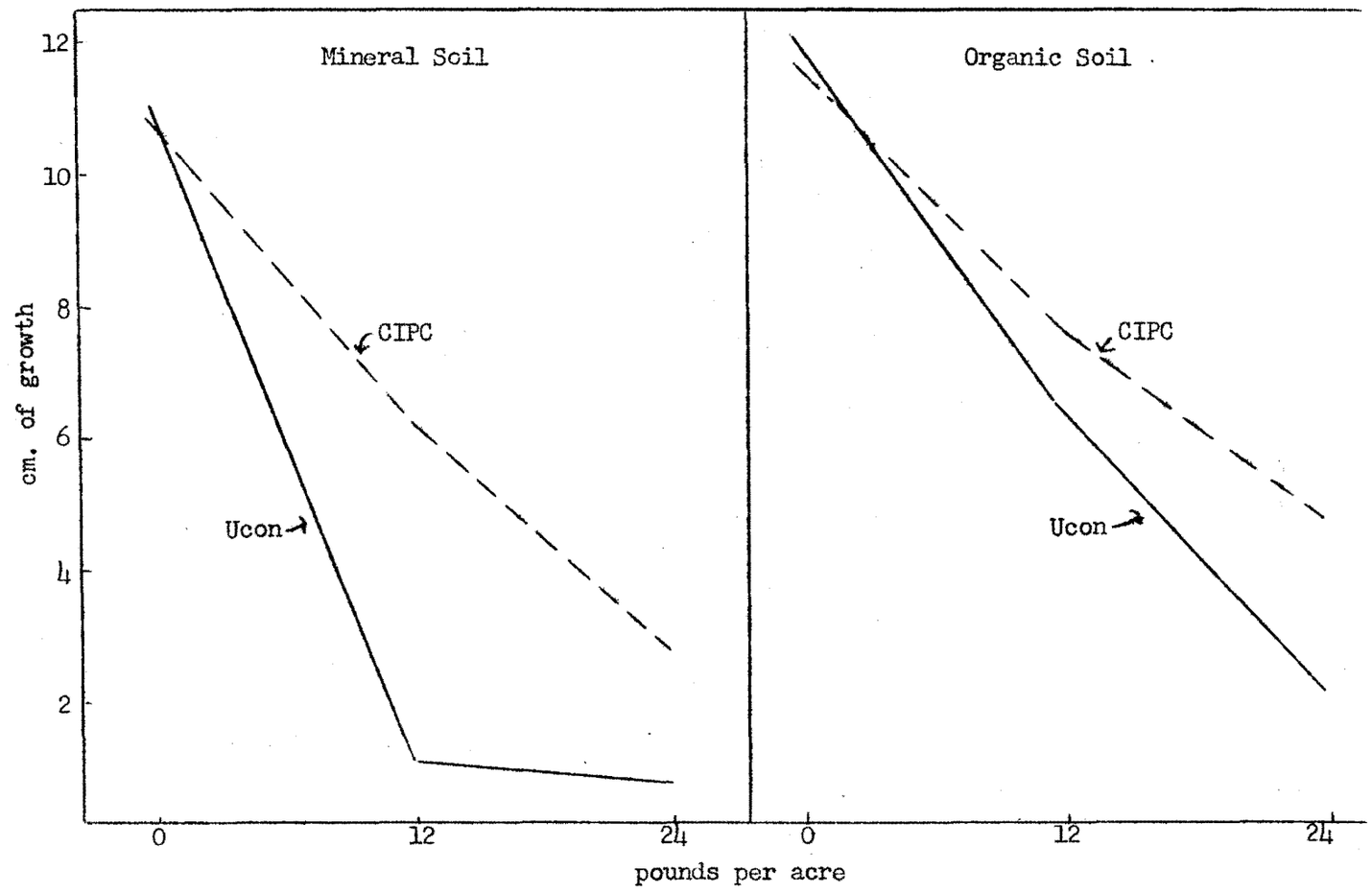


Figure 2. Influence of time on vapor activity of CIPC and Ucon from moist soils as measured by root elongation of cucumber seedlings.

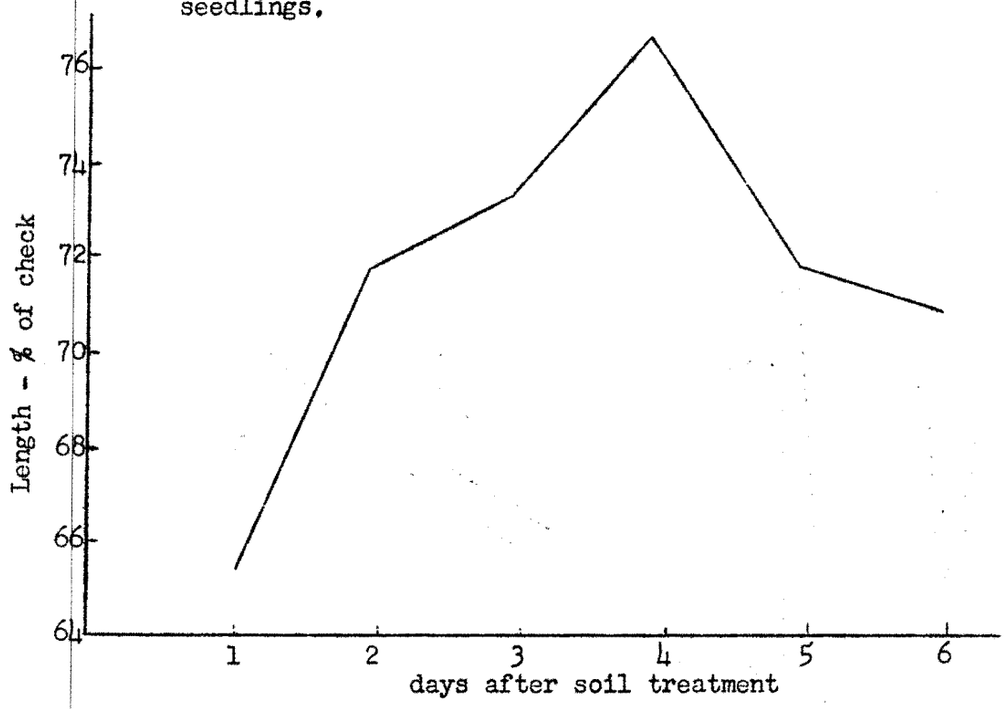
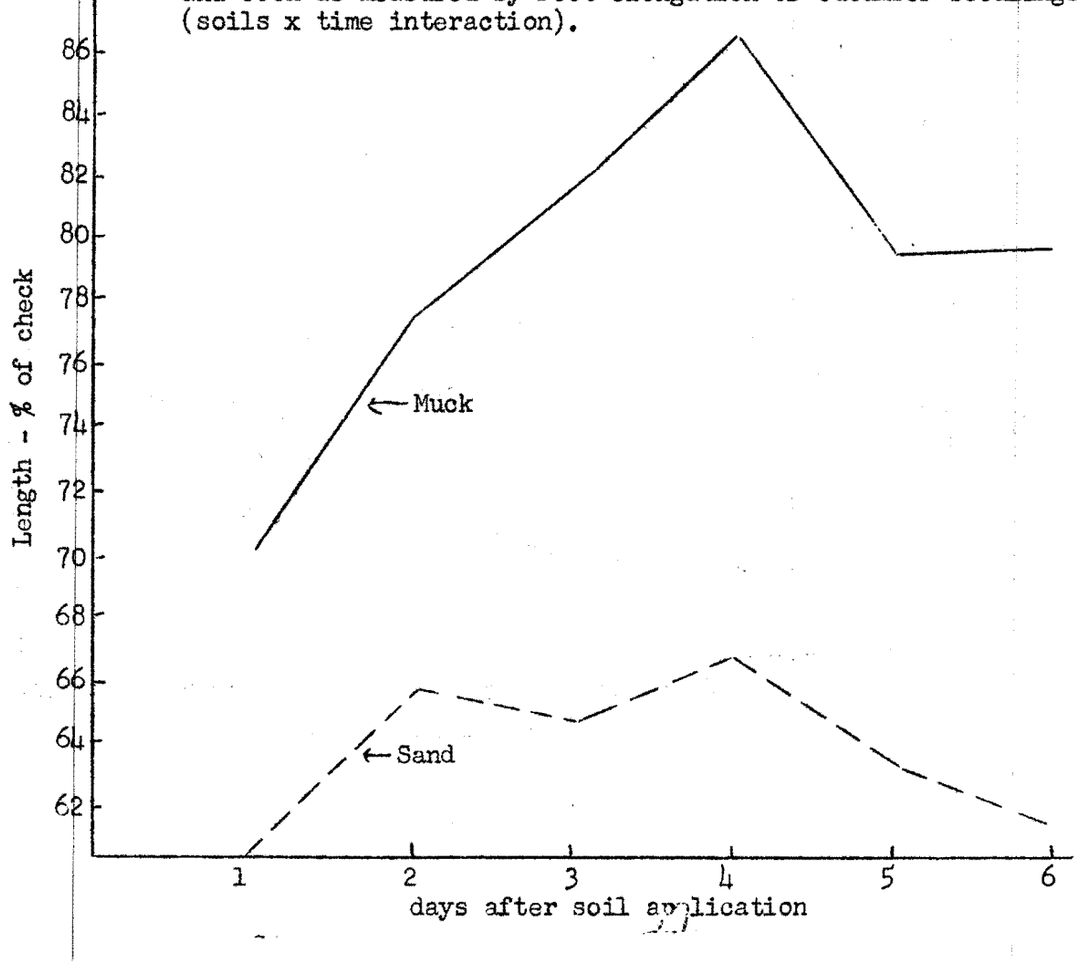


Figure 3. Influence of moist soils and time on vapor activity of CIPC and Ucon as measured by root elongation of cucumber seedlings (soils x time interaction).



factors such as leaching, microorganism metabolism, and attachment to soil particles as contributing to loss of herbicidal activity.

Herbicides are adsorbed to a varying extent on different soils and only the strongly adsorbed material is not free to evaporate. The amount of vapor activity depends on the amount of free or mobile CIPC in the soil. Perkins (4) found that more CIPC is adsorbed by organic soils than by other soils. This is due to the large amount of negatively charged soil colloids which retain the positively charged CIPC.

The studies described in this paper show that when soils were kept at field capacity for 63 days both CIPC and "Ucon" had a longer residual effect in sand and loam than in organic soil. This seems contrary to the statement by Perkins, but in his experiments there was no time for microbial breakdown.

From the fact that the low volatile CIPC formulation showed more residual activity than the regular CIPC formulation, it seems probable that the decreased vapor activity resulted in longer persistance in the soil.

In the experiments designed to establish the relationship between the persistance in soils and vapor activity on the basis of the influence of soil type and formulation, one factor that seemed to be important was soil moisture. Much evaporation occurred in the first day from air dry soil. During the next day the evaporation was low; probably the material was tied up by soil colloids. On the third day the data show that evaporation increased again. In soils kept at field capacity evaporation decreased for four days and then increased. It is suggested that this may be an indication that the moisture content had an influence on the evaporation of the herbicide since the soils actually became drier during that period. This would also fit in with the theory on ideal solutions explained above, if the soil water is considered part of the solvent system.

Since the experiments measuring vapor activity showed more CIPC evaporation from sand than from muck, other factors then evaporation must influence the longer persistance of the material in sand. One factor is probably higher microorganism activity in organic soils.

In the field some of these factors might be entirely different. No results of experiments on the persistance of CIPC in various soil types under field condition are reported, but Raleigh (unpublished data (5)) showed that CIPC persisted in muck fields for 12 months.

Since the strong adsorption of the CIPC on the organic colloids of muck tends to prevent its downward movements by leaching or loss by evaporation, it tends to remain in the surface layer, which much of the time is too dry for microbial activity that would result in the loss of herbicidal activity. This would explain the greater persistance of CIPC in the field than persistance found in the moist muck soil used in the experiment described here.

From the experiments reported here in regard to volatilization and persistance of CIPC, it might be concluded that if a residual affect is desired, "Ucon" would be more persistant than CIPC, especially in mineral soils.

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RECOVERY OF DNOSBP AS AFFECTED BY SOIL PROPERTIES[1]

Clyde C. Dowler and N. M. Baughman[2]

Introduction

Empirical work in chemical weed control has shown that the effectiveness of different herbicides varies with soil environmental conditions. Sometimes this variability results only in poor weed control, but often it results in serious crop injury.

Some soil conditions affecting the activity of chemicals used in weed control have been studied. Meadows and Smith (5) and Dallyn (1) have concluded that soil organic matter is one of the most important factors in reducing the persistence and effectivenss of herbicides. Any given amount of 2,4-D or CMU gave better weed control at the lower organic matter levels on the same soil type. Davis, Selman, and Davis (3) and Davis and Selman (2) have reported that the leaching of dinitro compounds is directly proportional to the amount of water applied and that the amount of leaching varies with the soil type.

The identification and measurement of all soil conditions affecting herbicidal activity would be a valuable contribution to the fundamental knowledge concerning herbicides and their application. This report is concerned with the effect of soil reaction, soil type and rainfall on the herbicidal activity of DNOSBP. It is a part of a study being conducted as a Northeastern Regional Project to determine factors affecting the herbicidal activity of various herbicides when applied to the soil surface.

Materials and Methods

The chemical used in this study was Premerge, a product of the Dow Chemical Company containing as an active ingredient the alkanolamine salts (of the ethanol and isopropanol series) of dinitro-ortho-secondary butyl phenol. Soils used in the experiment was obtained from three sources: Wharton silty clay loam from the West Virginia University Agronomy Farm at Morgantown, West Virginia; Pope sandy loam from the Experimental Farm at Reedsville, West Virginia; and Monongahela sandy loam from the Reymann Memorial Farms at Wardensville, West Virginia.

Table 1 shows the results of chemical and physical analyses made to characterize these soils.

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2 Graduate Assistant and Assistant Professor respectively, West Virginia Agriculture Experiment Station, Morgantown, West Virginia.

TABLE 1. CHEMICAL AND PHYSICAL ANALYSES OF SOILS USED IN THIS STUDY

Analysis			Soil		
			Wharton	Pope	Monongahela
Sand	.05 mm	%	17.00	70.06	68.24
Silt	.05-.002 mm.	%	48.30	17.09	17.65
Clay	.002 mm.	%	34.70	12.85	14.11
Moisture Equivalent		%	23.50	13.00	8.14
Organic Matter		%	2.07	2.47	0.92
Truog P. lbs/acre			196.00	208.80	136.80
C.E.C.	me/100 gms		12.63	9.60	7.80
pH			*6.40	*5.40	*6.00

*Original pH level of soil

The soils were brought to the greenhouse, air dried, screened through 1/4 mesh screen, and thoroughly mixed. The reaction of individual lots of each soil was adjusted to pH 5, pH 6, and pH 7, by the addition of sulfuric acid or lime according to buffer curves for each soil. The soil was then mixed, moistened and allowed to stand for two weeks to reach equilibrium. The pH determinations made at the conclusion of the experiment showed that the reaction of individual flats did not vary more than 0.4 of a pH unit from that desired.

A thin layer of glass wool was placed in the bottom of galvanized metal flats having perforated bottoms and the flats were filled to a depth of 2.5 inches with soil. Twelve kilograms of the Pope and Monongahela soils and 11 kilograms of the Wharton soil were used respectively. Each treatment was replicated 3 times.

DNOSBP was applied to the soil surface at the rate of 6 pounds per acre. An experimental greenhouse sprayer developed at Oregon State College (6) was used to apply the herbicide. Twenty-four hours after the application of the herbicide, distilled water as simulated rainfall was applied at rates of 0, 1/4, 1/2, and 1 acre inch. A Hudson hand sprayer having a capacity of 2.5 gallons was used with the experimental greenhouse sprayer for application of the rainfall. Three days after the application of rainfall, samples of soil were removed from each replication at four depths: 0-1/4", 1/4-3/4", 3/4-1-1/4" and 1-1/4 to 2-1/2". The surface area sampled was 77 square inches.

The soil samples were well mixed and 300 grams of each sample was placed in seeding bands and planted with 10 soybean seeds. The soybeans were removed after 6 days and the lengths of the radicles measured to give a biological determination of active DNOSBP. At the time that the soybeans were seeded, a 65 gram sample of soil from one replication of each treatment was taken to the laboratory for chemical analysis of DNOSBP. The chemical analysis was similar to that used by Davis and Selman (2).

Results and Discussion

The amounts of DNOSBP recovered were never 100% for any soil at any pH level. DNOSBP added to water and immediately distilled was entirely recovered. When DNOSBP was added to soil, in amounts proportional to that used in the ex-

perimental procedure and distilled immediately 80% recovery was attained. This would indicate some retention or inactivation of the herbicide by the soil.

The correlation between the average length of radicles on germinating soybeans in the seeding bands and the amount of DNOSBP recovered chemically per 100 grams of soil for each soil at each pH level is shown in Table 2. These correlations show that the length of radicles decreased with increasing concentration of DNOSBP. The correlation coefficients are all significant at the 0.01 probability level. This shows that the amount of DNOSBP recovered by the chemical procedure is closely related to the herbicidal activity of DNOSBP in the soil.

TABLE 2. CORRELATION COEFFICIENTS FOR THE RELATION BETWEEN LENGTH OF SOYBEAN RADICLES AND AMOUNT OF DNOSBP RECOVERED FROM SOIL

	Soil Type		
pH	Wharton	Pope	Monongahela
5.0	-0.89	-0.90	-0.98
6.0	-0.96	-0.96	-0.80
7.0	-0.93	-0.92	-0.76

Required for significance at 0.01 probability level -0.606

The total amount of DNOSBP applied to the area sampled was 33.94 milligrams. In moist soil, DNOSBP moves slightly. This was apparent when the results of chemical recovery for the no-rainfall flats were examined. These data are given in Table 3.

TABLE 3. DIFFUSION AND RECOVERY OF DNOSBP FROM SOILS WITHOUT RAINFALL

	Soil Type								
	Wharton pH			Pope pH			Monongahela pH		
	5	6	7	5	6	7	5	6	7
Recovery (mg) from top 1/4" of soil	17.85	16.97	21.37	21.90	20.13	22.66	19.08	16.28	21.72
Translocation below top 1/4" of soil	1.85	2.05	1.03	1.42	3.53	3.75	1.90	7.31	2.48
Per cent moisture at time of sampling	15.5	15.3	10.6	7.2	9.4	9.3	6.0	4.8	6.6

The data presented in Table 3 show that movement of DNOSBP from the surface 1/4" of soil is affected by the moisture content of the soil. The only exception is at pH 6 for the Monongahela soil. The greater translocation occurring in this case may have been caused by uneven porosity of the soil in that particular flat.

The amount of DNOSBP recovered from soil is affected by pH as well as moisture. The data in Table 3 show that total amount of DNOSBP recovered is

higher at pH 7 that at either pH 5 or pH 6 regardless of the moisture content of these soils. Volatility of DNOSBP has been shown to be reduced as the reaction of the soil is increased (3,4). Presumably the greater recovery at the high pH levels is due to lowered volatility, while translocation occurs by diffusion in the soil water. Movement at low pH may also occur in the vapor state.

Rainfall increases translocation of DNOSBP downward in the soil resulting in lowered total recovery. The data for recovery of DNOSBP from all soils at all pH levels as affected by rainfall are given in Figures 1, 2, and 3. These data show that the greatest total decrease in recovery occurs from the application of the first 1/4" of rain. This trend is more evident for pH 5 and 6 than it is for pH 7. The reduction in recovery may be partly due to leaching through the soil.

The effect of soil type on recovery of DNOSBP is recorded in Table 4.

TABLE 4. AVERAGE TOTAL RECOVERY OF DNOSBP AT pH LEVELS 5, 6 AND 7

pH	Soil Type		
	Wharton	Pope	Monongahela
5	13.18	14.79	15.31
6	16.47	19.34	17.64
7	14.71	19.32	17.86
Average	14.79	17.82	16.94

The average recovery of DNOSBP is lowest on the soil with the highest colloidal content (Wharton) and highest on the soil with the highest organic matter content (Pope). The translocation of water soluble material should be less where large surface for absorption is present. In the case of the Wharton soil, inactivation by the tie-up with the colloids probably prevents chemical recovery. In the Pope soil recovery is highest indicating that organic matter retains DNOSBP from leaching, yet permits the recovery of the chemical by distillation.

These data indicate that at all pH levels, less chemical is recovered from the Wharton soil than from the Pope soil. The sandy nature of the Pope soil should have permitted a greater movement of rainfall through the soil. Percolation studies (not presented) have shown this to be true. The fact remains that organic matter prevents translocation of DNOSBP.

Summary and Conclusions

The amount of DNOSBP recovered chemically in this study was closely related to the herbicidal activity of the chemical in the soil. Correlations between soybean radicle growth and chemical recovery of DNOSBP were highly significant in all cases.

Increasing soil pH to the neutral point results in an increase in the amount of DNOSBP recovered.

Increase in rainfall results in a decrease in the amount of DNOSBP recovered chemically and an increase in the translocation downward in the soil. This translocation varies with soil type and pH.

High amounts of organic matter resits leaching of DNOSBP and reduce its effectiveness as a herbicide. Soil of high colloid content apparently ties up the chemical and prevents chemical recovery.

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Acknowledgment is made to Dow Chemical Company who supplied the Dinitro used in these experiments.

FIGURE 1. TOTAL RECOVERY OF DNOSBP AT pH 5 AS AFFECTED BY RAINFALL

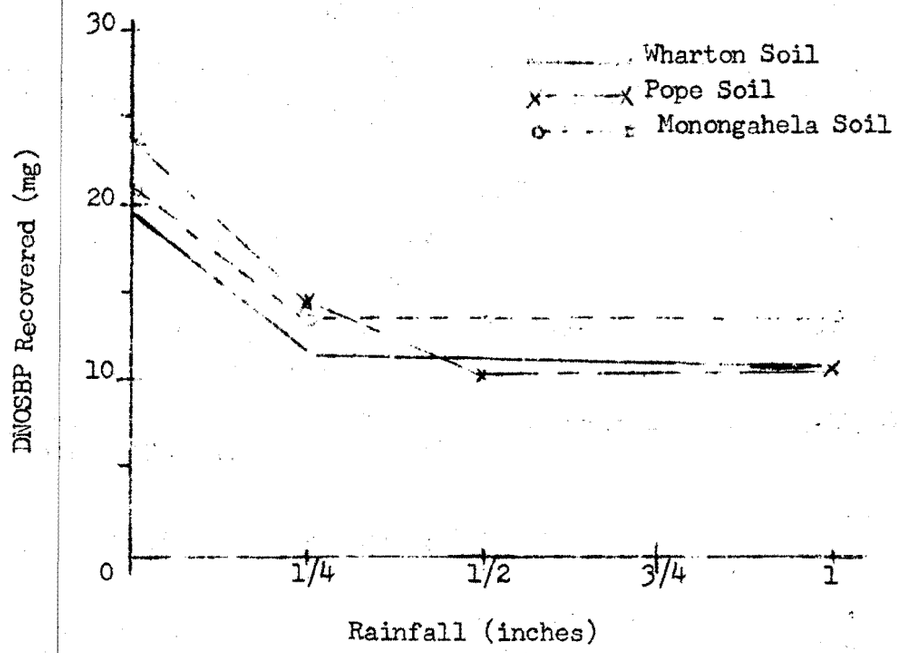


FIGURE 2. TOTAL RECOVERY OF DNOSBP AT pH 6 AS AFFECTED BY RAINFALL.

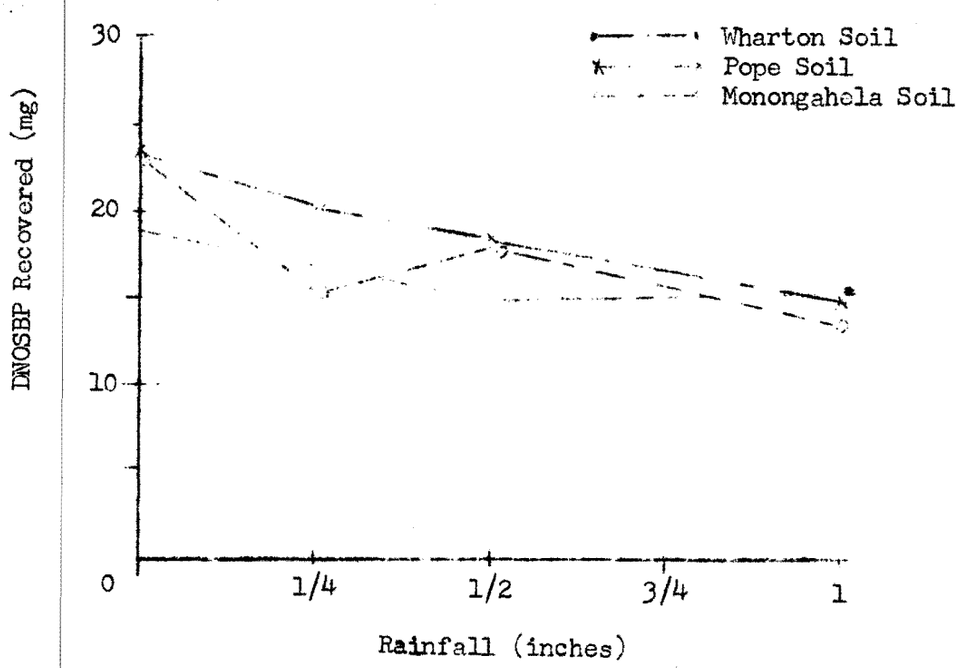
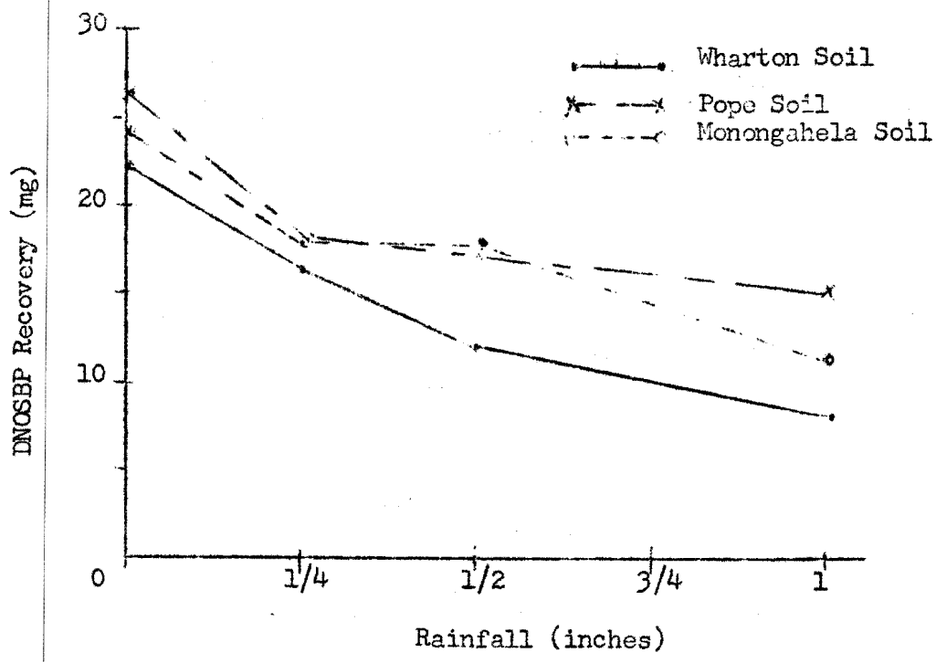


FIGURE 3. TOTAL RECOVERY OF DNOSBP AT pH 7 AS AFFECTED BY RAINFALL



"FIELD EXPERIENCES IN 1955 WITH DEFOLIATING CHEMICALS AS AN AID TO HARVESTING DRY EDIBLE BEANS"

Leslie R. Reed
Chipman Chemical Company, Inc.

On September 13, 1954, Dr. Alvin R. Hamson of the Vegetable Crops Department at Cornell, wrote as follows in a special letter to all growers of dry edible beans in New York State:-

"The prospects for wide-scale use of defoliants on dry beans have developed so rapidly the last two weeks that I feel that it is advisable that I should send you what information we have to anticipate questions which will shortly arise." This was the culmination of several years work by Dr. Hamson's department and which has started what amounts to a chain reaction of interest across the country.

Bean defoliation with chemicals (and throughout this paper the word "beans" is used to describe those grown for dry edible purposes) is a new practice that had its inception in the demand from New York bean growers for some means of speeding up the bean harvest. The demand has not, however, been confined to New York State, but has arisen from time to time in all the main bean growing areas in the country, including Michigan, California and the Pacific Northwest.

In New York: Dr. Hamsons earlier work on Red Kidney and White Bean varieties, showed that there are a number of outstanding advantages in defoliating beans. These he summarized as follows:

1. Hastens maturity and drying and the possibility of earlier harvesting for timely planting of wheat and other Fall crops.

2. Reduces delays in harvesting, because of unfavorable weather conditions especially following late planting and the excessive use of nitrogenous fertilizers.

3. Permits threshing of beans directly after pulling with elimination of drying in the windrow.

4. Hastens drying of late maturing areas and thus promotes even ripening of the entire crop.

5. Assures quicker drying to 18% moisture or less thus reducing dockage and storage problems.

6. Reduces percentage of immature discolored and moldy beans.

7. Reduces bean losses due to shattering during harvesting operations.

8. Reduces likelihood of stones getting into the combine due to elimination of the necessity of turning the beans in the windrow.

The big incentive to growers among all these advantages is the possibility of allowing the beans to dry out attached to the soil thus eliminating the weather hazards involved when beans are laid in the windrow to dry.

All or most of these advantages have been experienced during the 1955 season in commercial and semi-commercial applications in New York State, in Michigan, and in the Pacific Northwest.

1955 was not a good year in which to introduce the new practice of bean defoliation. The crop was generally well below average in New York and in Michigan due to the poor set of flowers in the very hot weather. The production of a second crop of flowers later did little to help, as the chance of the late crop maturing before frost was poor.

In spite of the season with the promise of low yields, there was a marked interest among farmers, although in New York State only some 6,000 - 7,000 acres was actually defoliated on a commercial scale.

In Michigan: The practice of bean defoliation was completely new to growers, although some test work with Endothal in 1954 indicated that this chemical was not suitable for this purpose.

Dr. Hamson's work in New York in 1954 had, however, shown that Shed-A-Leaf - the Chipman sodium chlorate/borate defoliant, originally developed for cotton, could be used with safety as a spray on both Red Kidney and White Navy Beans. It was necessary, however, to test its effect on the variety Michelite the predominating variety grown in Michigan before permitting it to be used commercially in that State.

Following a preliminary survey of the main bean counties in Michigan, made in the Fall of 1954, plans were made in early 1955 for a series of large scale field demonstrations with Shed-A-Leaf in six of the main bean counties. These plans were discussed with

Dr. Grigsby of the Botany Department of MSU and with the Extension people who promised their full support in making the necessary arrangements with the County Agents. The Michigan Bean Co. was also keenly interested in the outcome of the demonstration, and offered full support. It was planned to lay down some 40 plots of 2-5 acres in extent (actually nearly 50 were completed) on which to make observations. The demonstration fields were selected in July and early August with the help of the County Agents. Arrangements were also made to start spraying the earlier maturing fields at the end of August and to invite farmers through the press and radio to come to see the applications made, and to view the results later. Observations were also to be made with moisture records on the rate of defoliation and drying out of the crop. These results will be discussed later.

As an indication of the interest shown, many of these demonstrations were visited by parties of as many as 30 or more farmers at a time; from the point of view of attracting attention, they were successful beyond all expectations. They also confirmed the value of using a defoliant to hasten the harvest.

Before discussing the results in further detail, some words about the application problems involved are in order.

Application Problems: In New York the predominating variety is Red Kidney which has an upright habit of growth and is usually planted in 34 inch rows, thus there was no problem in using a tractor mounted sprayer, at least not in 1954. Airplanes were used as well in that year to test the feasibility of this method of application and it proved most successful. In 1955 bean growth in New York was heavy and farmers were reluctant to try the new practice with ground sprayers, as they did not want to damage their crops with the tractor wheels. Most of the 6,000 acres sprayed in New York State in 1955 was, consequently, sprayed by airplane.

In Michigan a similar but more acute problem existed. Here the predominating variety, Michelite, of spreading habit is grown in 28 inch rows, which results in complete coverage of the ground at harvest. This appeared to rule out all possibility of using ground sprayers, although most of the beans are grown in small fields which it would not be feasible to spray by airplane. Another problem was the dearth of air applicators in this part of Michigan, who could spray on a sufficient volume to give adequate coverage (a minimum of 6 gals/A was required.) In due course both of these problems were solved, the first by encouraging the development of efficient vine lifters which could be fitted on to any tractor, and the second by importing out-of-state airplane applicators who could put on the required volume of spray.

With the exception of two, all 43 demonstrations in Michigan were applied by airplane, the usual swath width being 35 ft.. The spray boom was fitted with D8 nozzles placed 2 ft. apart. Usual height flown above crop was 2 to 5 ft.

At two centers, application was made by a small ground sprayer (loaned by the Botany Department MSU) using the special vine lifting equipment already referred to, mounted in front of each of the four tractor wheels. This equipment was made and fitted by the Hopkins Manufacturing Company of Saginaw. Many farmers became interested in these vine lifters as the season progressed, and quite a few sets were purchased. These lifters proved very successful even in heavy vines, and are not too costly.

The sprayer used for ground application was fitted with cone nozzles, (¼T No. 12) spaced 20" apart on the spray boom, and at a height of about a foot and a half above the crop. The pressure used was 30 to 40 lbs. per square inch, the sprayer covering eight, twenty-eight inch rows at a time. No drop legs were used in these tests, although drop legs are considered necessary in New York where the less viney variety Red Kidney seems to require it to obtain good coverage.

The wider availability of these vine lifters will undoubtedly help to popularize the use of defoliants on beans. Many farmers are reluctant to spend money on air application, apart from the fact that their fields may be too small or unsuitably placed for aerial work.

Materials and Rates Used:

In addition to a series of small scale field plots laid down by the Botany Department of MSU comparing different defoliants, a comparison of Magron[1], Shed-A-Leaf[2] and Shed-A-Leaf L[3] was made in three field scale demonstration plots, two of which were applied by ground equipment.

Application rates were based on the results obtained in New York State last year , Shed-A-Leaf being applied at 7½ lbs. per acre in the form of a soluble powder, and 1½ gallons per acre in the liquid Shed-A-Leaf L formulation.

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1. Magron - a liquid containing 40% Magnesium Chlorate - A Dow Chemical Company product.

2. Shed-A-Leaf - a soluble powder containing 40% sodium chlorate with sodium metaborate - A product of Chipman Chemical Company, Inc.

3. Shed-A-Leaf L - a liquid formulation containing 18% sodium chlorate with sodium metaborate - A product of Chipman Chemical Company, Inc.

In some instances 10 lbs. and 2 gallons were tried where bean foliage was green or excessively heavy. Magron was applied at 3 qts. per acre. All materials were applied in 6 gallons of water per acre by air, and in 15 to 20 gallons of water per acre by ground sprayer. It had also been planned to try out some dust defoliants but lack of equipment necessitated dropping the project for 1955. The following is a general summary of the results obtained:

Results of Tests and Demonstrations in Michigan

1. Only six test plots failed to show satisfactory response to defoliation, (two of these showed none at all).

2. Four of these six plots (all in Huron County) had inadequate dosage applied, due to the inability of the airplane at that time to apply more than 3½ gallons per acre.

3. Shed-A-Leaf at 7½ lbs. of soluble powder or 1½ gallons of the Shed-A-Leaf L formulation appeared to be adequate this season both for ground and air application. Magron at 3 qts. per acre also gave good desiccation and defoliation.

4. In all the other demonstrations the farmers on whose beans they were made, expressed themselves as well satisfied with the results. In many cases these cooperating farmers had a further acreage sprayed commercially, and others who visited the demonstrations requested commercial application on their own beans.

   Dr. Grigsby visited a number of test plots in Saginaw and Huron Counties including both air and ground applications, and also saw the results of some commercial applications of Shed-A-Leaf in the Saginaw area.

General Effects of Defoliation in Michigan Demonstrations are summarized as follows:

1. Rapid fall of leaves (3 - 7 days after application).

2. Rapid drying of the bean plants, including pods.

3. Rapid fall in moisture content of beans.

A few farmers took advantage of this, and pulled defoliated beans as soon as they saw that they were ready and combined them either the same or the next day. The majority of farmers, however, left their beans unharvested until the untreated areas caught up with the treated, days or even weeks later. This meant that the treated areas were often over-ripe by the time they were harvested.

Defoliation and drying out of these early and mid-season beans was rapid and the date of harvest was advanced by two weeks or more as compared with untreated portions of the same field. On later beans, defoliation was slower, especially where nights were cool.

Defoliation and Effect on Moisture Content of Beans

Moisture tests and observations were made at 13 centers. It was obvious from these, that defoliation had a marked affect under the conditions existing in Michigan this season in bringing about a very much quicker drying of the standing beans that that which occurred when beans were pulled and windrowed in the usual way, and left to dry out on the ground. Eighteen percent is the acceptable moisture content of dried beans in New York and Michigan, above which there is a penalty which includes a deduction of 2 lbs. of weight per hundred weight for each 1% over 18% and a charge for drying.

It was noticed in those plots in which moisture determinations were made, that defoliated beans reached the desired 18% moisture level or below very quickly while standing. The data from eight of the thirteen moisture tests made have been averaged to illustrate this. Average moisture content of treated beans fell to 14.73% in an average time of 11.8 days while untreated beans in the same period fell to only 20.37%.

It was also found that beans that had been defoliated previously could be pulled and combined either the same day or within 24 hours of pulling if weather permitted, a marked saving of time, and with a minimum risk of damage to beans if the weather should turn wet during the harvesting operation.

The possibilities for a combine harvester for beans to handle the crop directly from the standing row has always been obvious. The wider use of defoliants makes the possibility even more attractive and the problem has been referred to farm machinery manufacturers for their consideration.

Weather during the test period of the earlier demonstrations was generally fair and hot, with temperatures often in the 90's. These conditions helped beans to dry naturally and also favored rapid defoliation. Elevator managers complained as the season progressed of too many split beans, due to beans being too dry. In these circumstances, it would have been easy to blame the use of defoliants, but fortunately, all cases recorded except one, occurred in beans that had not been treated. Farmers who use defoliants in the future, will have to be careful that beans do not become too dry before pulling and combining.

Effect of Defoliation on Tendency to Shattering

At no center did beans treated with Shed-A-Leaf or Magron develop a greater or lesser tendency to shatter in the field or during harvesting operations then did untreated, in spite of their usually lower moisture content.

Effect of Defoliation on Yields

In New York State trials in 1954, defoliation actually increased yields per acre of marketable beans by lowering the percentage "pick". Although no similar studies were undertaken in Michigan this year, it is conceivable that the practice could reduce yield if application wars made too early.

Early applications should, therefore, be avoided. The best defoliation in any case is likely to be obtained when foliage is beginning to show signs of yellowing - an indication that the abscission layer between leaf and stem is beginning to form naturally. When application is made at this stage no reduction of yield should occur. On the Red Kidney variety defoliation can be carried out when beans inside the pods begin to show pink.

Marking of Pods and Beans

In last years tests carried out at Cornell, considerable marking of both pods and beans was noticed with certain chemicals used as defoliants. Shed-A-Leaf, however, was one of the few, if not the only one, to show no marking of White Beans, even at higher rates than those normally recommended.

In Michigan, very special care was taken to observe if there was any sign of marking, and not one instance was recorded, although some blotching and spotting on the outside of the pods was often noticed.

Effect of Drift on Other Crops

The effect of spray drift on sugar beet, corn and alfalfa was recorded when this occurred, and the following summarizes the findings. Sugar Beet: leaves became mottled and brown and later some of the outer leaves actually died, although heart leaves were generally unaffected. It is doubtful whether this would affect sugar beet adversely at this late season, but nevertheless it is recommended that Shed-A-Leaf spray should not be allowed to drift onto this crop. Corn: leaves became spotted and streaked. Later the leaves dried up much more rapidly than the leaves on unsprayed corn. This had no apparent deliterious effect on the grain which had reached the dent stage, an application of Shed-A-Leaf may even help to ripen off the crop and hasten havest. Alfalfa: although drift spotted the leaves it did not seem to have any permanent injurious effect.

Effect on Weeds Present in the Crop

At the rates of Magron and Shed-A-Leaf used for defoliating beans, very few weeds showed much affect. In Michigan Milk Weed (Asclopias syriaca) and Smartweed (Polygonum persicaria) showed the most marked effect and were often completly desiccated by the time the beans were ready for pulling. Other weeds such as mustard, Canada Thistle and Sow Thistle and in New York State heavy infestations of Pigweed were spotted, but were not seriously affected. Where weeds are a major problem, heavier rates than those normally required for defoliation could be used to help dry up the weeds as well as the beans before pulling.

Effect on Beans with Mosaic

There were several cases where test fields had a noticeable number of bean plants affected with what appeared to be one of the mosaic diseases. These virus affected plants were most conspicuous in sprayed fields because they would not defoliate normally. Dr. Axel Anderson of the Plant Pathology Department MSU, inspected one of these fields with the writer, and confirmed the presence of mosaic, and expressed the view that such plants might not readily translocate chemicals.

The Effect of Very Green Foliage on Defoliation

It was noticed throughout the demonstration series that bean plants in this stage of growth would not defoliate readily with 7½ lbs. of Shed-A-Leaf per acre. When a higher rate (10 lbs.) was used the leaves became brown as though slightly frosted but no better defoliation resulted.

One test deliberately applied to beans in this stage, showed no signs of defoliation five days later when frost intervened.

It is concluded from these limited observations and from commercial applications that where defoliation is desired such beans should not be sprayed until they reach a more advanced stage of maturity. If the lateness of the season prohibits waiting than a higher rate of application (10 to 12 pounds per acre) can be made which will cause the leaves to dry up as though frosted and thus hasten the dessication of the pods and beans. This worked very well in New York State on Red Kidney this season.

In only two instances did rain follow close enough to application of Shed-A-Leaf to be considered as a possible cause for failure. The tests in New York State in 1954, indicated that even heavy rain, provided that it does not fall within six hours of application, is not likely to interfere seriously with the results.

Effect of Defoliation on Pick

The term "Pick" (used generally throughout the bean industry) refers to the foreign matter and moldy and damaged beans which are removed in the cleaning process in order to bring up to grade. A picking charge is made (on the pounds of defective material actually removed) of about 7¢ per pound on Red Kidney in New York, and 8¢ a pound on White Beans elsewhere.

This season the weather was so hot and dry during the demonstration tests in Michigan that little or no difference in regard to moldy beans could be expected. For this reason no actual comparisons of pick were made. Later maturing beans caught in the wet period that followed could not be harvested, owing to the physical impossibility of getting a combine into the fields. This applied to both defoliated and non defoliated beans in New York and Michigan.

Results on Late Maturing Beans and Effect of Temperature

It is with late maturing beans that the greatest harvesting troubles are usually experienced. In these demonstrations the use of Shed-A-Leaf and Magron has helped to bring about earlier drying of late maturing beans just as well as earlier maturing beans. However, it has been found that the time taken for the leaves to drop is usually longer (from 7-10 days) depending largely on the temperature. The lower the temperature the longer defoliation takes. As previously mentioned this should be taken into account when defoliants are to be used on late maturing beans towards the end of the season, when consideration should be given to using higher rates to achieve dessication rather than defoliation.

Defoliation of Varieties Other Then Michelite

Shed-A-Leaf was tried only on a limited scale at one center in Michigan on the varieties Dark and Light Red Kidney, Cranberry, and Yellow Eye. This was in the variety test plots of the MSU in Montcalm County. Shed-A-Leaf was flown on at 7½ lbs. per acre in 6 gals. of water. It was also used commercially at the same rates on twelve acres of the variety Pinto, in the neighboring county of Gratiot. The results showed that while the kidney varieties, Cranberry and Pinto responded well, the variety Yellow Eye did not. This may have been due to this variety being too green at time of application. This will have to be checked another season.

Germination of Treated Beans used for Seed

No tests have so far been made in Michigan to check if the use of Shed-A-Leaf or other defoliants is likely to affect adversely the subsequent germination of the beans if used for seed. Some tests were carried out last year at Cornell, and no adverse affects was then noted. Germination tests are being arranged with beans sprayed this season in California.

Residue Data

Following up on the negative residue determinations made on sprayed beans from the Cornell (N. Y. State) tests last year, samples of both pods and beans from a number of the sprayed and unsprayed plots in Michigan were taken in 1955 for chemical determinations of residual chlorate and boron. Even when using more sensitive analytical methods than those used in 1954, no added boron could be found in the beans themselves, and only a very small residue on the pods. In one instance the untreated pods showed the presence of 37.5 parts per million where the treated showed 50. So far it has been impossible to demonstrate the presence of any sodium chlorate as a residue, presumably owing to the rapid breakdown of this chemical in the presence of moisture and organic matter. It would seem that there is no residue problem with this material when used at recommended rates. This work is being repeated, however, on pods and beans from the 1955 New York experimental plots.

Costs and Economics of Defoliation

The cost of chemical will vary from about $1.75 to $2.40 per acre depending on the amount used. Aerial operators this year in Michigan, and New York charged $3.00 per acre for small acreage for application, which was not unreasonable considering that 6 gals. per acre had to be applied. To a farmer using his own ground sprayer the cost per acre would be considerably less. Assuming a total cost of $4.75 for application and chemical, and a market price for beans of $7.00 per 100 pounds, a saving of a little over one bushel of beans per acre would pay for the whole defoliation cost. Such a saving could readily be achieved in most seasons, and in others the saving would be considerably more. Farmers and County Agents with whom the matter was discussed considered the practice to be economically sound, and in addition it assures a dryer and cleaner crop in a shorter time with less risk of weather damage.

Summary

The use of certain defoliants previously found suitable for defoliating dry edible beans in N. Y. State, have proved equally satisfactory in 1955 for Michigan conditions, for assisting in earlier havesting and for reducing risks due to bad weather. Defoliants can be used as such or as dessicants to speed up moisture reduction in the plant parts. Air and ground spray applications are equally effective but the latter presented certain problems which have been overcome by the development of an efficient vine lifter attachment, to be fitted to the tractor to prevent wheel damage to the crop. Analytical studies made with Shed-A-Leaf defoliant indicate that residue problems are unlikely with this material. The economics of using defoliants or beans are briefly discussed.

GROWTH OF YOUNG APPLE TREES WEEDED WITH CMU, CRAG, SESIN, MH, OR DALAPON.

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During the early years in an apple orchard weed control is needed to allow maximum tree development. Continuing throughout the life of the orchard is a need to clear all weeds that might provide cover for mice near the tree trunks. Application of dinitro-fortified oil emulsions is a safe and effective means of suppressing weed competition; and the grasses, notably quack grass, that recover quickly can be controlled by an undiluted oil such as fuel oil (Proc. NEWCC 1951 Suppl., p. 115-125). However, frequent applications of the fortified emulsions may be needed as successive weed crops appear; and the undiluted oil has a serious drawback in that it must be applied carefully to avoid wetting of the tree trunks.

The object of this paper is to report results on some residual materials (CMU, Crag No. 1, and Sesin) which might prolong the period of weed control following use of the fortified emulsion, and on some material that show promise for quack grass control (Dalapon and Maleic Hydrazide).

CMU, Crag No. 1, Sesin

Methods. The trees employed had been grown one year from seed in greenhouse beds, then transplanted to the field row as one-year whips of about 1/4 inch caliper. The planting site had been cultivated repeatedly in the previous year and was cultivated again just before planting.

Four rows containing 1600 trees spaced 18 inches apart in the row provided 64 treatment plots of 25 trees each. The four main treatments, nominally (1) CMU at one-pound/A applications, (2) CMU at 3-pound applications, (3) Crag No. 1, or Sesin, (4) Dinitro Fortified oil emulsion (hereafter abbreviated as DN) were repeated in 16 replicates. In alternate replicates the CMU plots received an extra application each year.

Sprays were applied by knapsack sprayer with 80-degree fan type Teejet nozzles at a pressure of about 30 psi. A band two to three feet wide was treated on each side of the tree row, with the spray pattern overlapping and wetting the lower few inches of the tree trunks. Low branches and suckers also received the spray.

Weed Control. Following the June cultivation in 1953 there was practically no weed emergence for two months; consequently there was no need for treatment of the DN plots. Winter annuals (chiefly pepper grass) emerged in September and formed a dense cover on all plots except those that had received the late application of Crag at 5 lbs. or CMU at 3 lbs. These weeds were destroyed by the October cultivation. At the time of the May treatments in 1954 a crop of summer annuals were emerging; a high degree of control showed in plots that had received the late application of CMU at 3 lbs., in spite of the soil disturbance done by fall cultivation.

Table 1. Weed control treatments in apple plots.

Date of treatment	Plot designation and treatment.[a]							
	CMU-1	CMU-3	Sesin	DN	CMU-1x	CMU-3x	Crag	DN
1953								
Apr 28 Plant	x	x	x	x	x	x	x	x
Jun 22 Cultivate:	x	x	x	x	x	x	x	x
Jun 25 - - - - -	CMU	CMU	S	-	CMU	CMU	C	-
Jul 24 - - - - -	-	-	-	-	CMU	CMU	C	-
Oct Cultivate:	x	x	x	x	x	x	x	x
1954								
May 11 - - - - -	CMU	CMU	S-DN	-	CMU	CMU	C-DN	-
Jun 5 - - - - -	-	-	-	DN	-	-	-	DN
Jun 8 Treat quack:	oil	oil	oil	oil	oil	oil	oil	oil
Jun 28 - - - - -	-	-	S-DN	DN	CMU	CMU	C-DN	DN
Jul 20 Treat Quack:	oil	oil	oil	oil	oil	oil	oil	oil
Aug 22 - - - - -	CMU	-	S	-	CMU	CMU	C	-
1955								
May 14 - - - - -	CMU	CMU	S-DN	DN	CMU	CMU	C-DN	DN
Jul 6 Treat quack:	-	-	oil	oil	-	-	oil	oil
Aug 9 - - - - -	-	-	S	-	CMU	CMU	C	-
Total applied, lbs. active/A	3	7	14	-	6	17	24	-

(a) Herbicides sprayed on 4 to 6 foot strip centered on the tree row; basal few inches of the tree trunks wet by all sprays except oil. Per acre rates refer to the treated area.

CMU-1. 3-(p-chlorophenyl)-1, 1-dimethyl urea (now Karmex W); 0.8 lbs. active in 50 gal/A.

CMU-3. 1.8 to 3.0 lbs. active in 40 to 60 gal/A.

Sesin. (S). 2,4-dichlorophenoxyethyl benzoate; 1.5 to 3.0 lbs. active in 40 to 100 gal/A.

DN. Dinitro-fortified oil emulsion; 3 pints Dow General or Sinox General plus 10 gal. fuel oil per 100 gal., applied at about 100 gal/A.

Crag (C). 2,4-dichlorophenoxyethyl sulfate; 2.5 to 5.0 lbs. active in 40 to 100 gal/A.

Oil Fuel oil No. 2 fortified with one pint Dow General per 100 gal., applied as spot treatment to wet quack grass.

In the May, 1954 treatment of Crag and Sesin plots, DN was used to kill the emerged weeds. Instead of applying a separate treatment of the DN, the Crag or Sesin was included in the water phase of the DN mixture. Similar mixed sprays were used subsequently when emerged weeds were present. DN was planned for use on the CMU plots after observation of weed kill effects, but kill of the small seedlings (ragweed and smartweed) was so somplete that no DN was deemed necessary. The light weed population recorded for CMU-1 plots in June (Table 2) reflects the small percentage of smartweed that survived the one-pound application of CMU.

Table 2 gives some data on weed populations found in the growing season of 1954 and in 1955. These data show peak levels of weed growth as recorded just before a complete series of herbicide treatments, or at the end of the growing season. All of the spray schedules kept the plots at a low level of weed competition.

Table 2. Weed populations in apple rows treated as in Table 1.[a]

Treatment	Quack, no. shoots per plot.[b] Jun 27 1954	Apr 28 1955	Nov 24 1955	Other weeds, % cover. Jun 27 1954[c]	Apr 28 1955[d]	Nov 23 1955[e]
CMU-1	20	33	22	2	1	10
CMU-3	5	5	5	0	0	1
Sesin	40	148	88	0	9	9
DN	25	83	75	8	14	34
CMU-1x	35	40	10	1	2	2
CMU-3x	1	0	0	0	0	0
Crag	16	114	67	1	3	15
DN	36	150	66	7	27	31
Averages						
CMU-1 and -1x	27	37	16	1	1	6
CMU-3 and -3x	3	2	2	0	0	1
Sesin and Crag	28	131	77	0	7	12
DN	30	114	70	7	21	32

(a) Record for plots not cultivated since Oct., 1953.
(b) *Agropyron repens*. Count on plot area of about 100 sq. ft. Estimates of % ground cover would all be less than 10%.
(c) Principle weeds are ragweed (*Ambrosia artemisiifolia*) and smartweed (*Polygonum Persicaria*), both as seedlings less than 2 inches high.
(d) Principle weeds are pepper grass (*Lepidium campestre*), Mayweed (*Anthemis Cotula*), mouse ear chickweed, and brome grass (*Bromus commutatus*), all of which have developed during fall and winter, plus recently germinated seedlings of ragweed, smartweed, and lambs quarters (*Chenopodium album*).
(e) Principle weeds are pepper grass, shepherds purse (*Capsella*) and unidentified species in winter rosette stage.

Quack grass began to appear in the plots in 1954. Spot spraying with fuel oil, directed to avoid the tree trunks, was done on the grass of all plots in 1954. So little grass appeared in the CMU plots that oil was not used on them in 1955. Quack grass re-establishment was almost prevented by two 3-pound applications of CMU each year, and was suppressed by lesser amounts of CMU (Table 2). It is unlikely that such amounts of CMU would have been as effective if not supplemented by the cultivation before and during the first year, and by the oil treatment in the second year of planting.

All other weeds encountered in the planting and recorded in Table 2 were of seedling origin. Emergence of the successive crops of seedling weeds was prevented by the 3-pound applications of CMU. The trace of weeds recorded in the latest record consisted of plantains (Plantago major and P. lanceolata) and wild carrot (Daucus Carota). Lesser amounts of CMU also gave practical control, in part due to fortunate circumstances in the weed populations. Weeds emerged in early fall or late spring and were vulnerable to the spring sprays if not prevented by residual effects of previous sprays. With weeds of different species and seasonal patterns, as observed in tests on other plantings, a single application of one to three pounds of CMU did not control seedling weeds for the full growing season.

The use of Crag No. 1 or Sesin did not reduce the number of DN sprays needed to control emerged weeds in this experiment. However, marked residual effects were observed. In addition to the applications on the experimental plots extra plots in nearby rows were treated on some dates to compare the Crag and Sesin applied alone or in DN mixtures. When weeds did emerge in check plots within a month, residual effects were observed, whether or not the application was in DN mixture, and there were indications of more prolonged control with Sesin than with Crag.

Tree Growth. Results for the three years of the experiment are given in Table 3. Trunk diameters were measured annually at a marked level about three inches above the soil surface, and overall height was measured at the end of the three-year period. The growth data as given is adjusted for initial trunk diameter by analyses of covariance. This adjustment reduced error by 25% to 50%.

Differences in growth among the several treatments are very slight, amounting to only about 10%. The only effect showing is for less growth in the DN plots than in the others. A part of the response in DN plots is attributable to a subdivision in the experiment that is not separated in the tables. In 1954 two rows, involving half of the replicates, were cultivated thoroughly on June 1 and in October. The dinitro plots in these rows did not receive the two DN treatments and oil treatments indicated for that season. A moderate weed growth developed in these plots, and tree growth was reduced for the year, as shown in the following record of diameter growth:

Plot designation	Rows not cultivated Spray on all plots		Rows cultivated No spray on DN plots	
	1954	3-yr. total	1954	3-yr. total
CMU, Crag, Sesin	6.5	16.1	6.7	17.4
DN - - - - - - - -	6.2	15.6	5.4	15.1
LSD at 5%	0.6	1.2	0.5	1.0

Table 3. Growth of apple trees under herbicide treatments for first three years after planting.

Treatment[a]	No. trees	Increase in trunk diameter, mm[b] 1953	1954	1955	3 yr. total	Height at 3 yrs. cm
CMU-1	200	3.0	6.2	7.1	16.3	165
CMU-3	"	3.0	6.6	7.6	17.3	166
Sesin	"	3.0	6.5	6.8	16.3	163
DN	"	2.9	5.6	6.7	15.2	161
CMU-1x	"	3.0	6.7	7.3	16.9	167
CMU-3x	"	3.0	7.0	7.4	17.3	174
Crag	"	3.2	6.7	6.9	16.9	166
DN	"	3.0	5.9	6.6	15.5	160
Sign. of diff.		ns	*	ns	*	ns
LSD at 5%		0.3	0.6	0.8	1.4	16
Averages						
CMU-1 and -1x	400	3.0	6.4	7.2	16.6	166
CMU-3 and -3x	"	3.0	6.8	7.5	17.3	170
Sesin and Crag	"	3.1	6.6	6.9	16.6	164
DN	"	2.9	5.8	6.7	15.3	161
Sign. of diff.		ns	**	**	**	ns
LSD at 5%		0.2	0.4	0.6	0.9	10

(a) Treatment is as outlined under these headings in Table 1.
(b) At mark about 3 inches above soil surface. Initial diam. 5 mm.

The average lesser growth in the DN treatment traces mostly to the effect of omitting the DN spray from half of the plots in one season.

There is no indication of damage from CMU as the amount or frequency increases within the range of applications used. Neither was there an effect when rows cultivated in 1954, involving mixing of CMU with the soil, were evaluated separately from the other rows. Symptoms of CMU were not conspicuous on low branches that were wet with the spray, though a trace of diffuse chlorosis was occasionally observed. In this respect apples are much less sensitive than peaches, cherries or plums.

Dalapon, Maleic Hydrazide

Methods. The apple population had been grown for a year in the field after transplanting from the greenhouse as one-year old whips. The rows had been cultivated repeatedly during the year before planting and twice in the year since, but a moderate and relatively uniform stand of quack grass was appearing in the row selected for the experiment. Spacing between trees in the row was about two feet.

Thirty ten-tree plots in a row were divided into nine replicates of three treatments; the extra three plots received no treatment other than the routine cultivation done twice each year. With the objective of measuring tree tolerance to Dalapon and maleic hydrazide, the three treatments compared were

1) Dalapon at about 10 lbs/A each spring when grass growth was less than eight inches high. A second application was made on four replicates in the summer, though emerged grass was absent.
2) Maleic hydrazide at 4 to 7 lbs/A in the spring, followed by dinitro-fortified oil emulsion (DN) one week later to kill the grass foliage. A second application was made in summer, though the grass stand was negligible.
3) Oil check. Considerable grass growth occurred in the summer after cultivation, and a spray of fuel oil was used to eliminate grass competition as a factor in the tree growth comparisons.

Table 4 gives an outline of the weed control measures used for the two years of the experiment. Sprays of DN were applied if needed to control other weeds in the treatment plots. The sprays were applied to a two to three foot band on each side of the tree row, with a knapsack sprayer and Teejet 80-degree fan type nozzles. All sprays except the oil wet the lower few inches of the tree trunks and occasional low branches and suckers.

Quack Control. Records of grass stand for three different dates over the two years are given in Table 5. Thorough cultivation in spring and fall did not prevent quack from becoming a problem. The single oil treatment in conjunction with cultivation provided practical seasonal control; more effective control was had with the MH, and Dalapon kept the plots almost free of grass.

Tree Growth. Data on growth in trunk diameter and on increase in tree height are given in Table 6. Trunk growth is somewhat greater under MH treatment than the others; the reason for this apparently significant response is unknown. The trend of growth results hints that the two Dalapon treatments each year may have caused slight growth suppression of these young trees. However, the amount of Dalapon exceeded that needed for seasonal control of quack, and the counterbalancing benefits of grass control are not measured in the comparisons. No visible symptoms of injury were noticed, except for varying degrees of necrosis on leaves that were actually wet with Dalapon spray.

Table 4. Schedule of treatments for quack grass control.

Date of treatment	Plot designation and treatment.[a] Dal-1	Dal-2	MH	Oil	No Herb.
1954					
May 14 - - - - - -	Dal 9#	Dal 9#	MH 4#	-	-
May 22 - - - - - -	-	-	DN	DN	-
Jun 1 Cultivate:	x	x	x	x	x
Jun 25 - - - - - -	-	Dal 8#	MH 7#	-	-
Jul 20 - - - - - -	-	-	-	Oil	-
Aug 2 - - - - - -	DN	DN	DN	DN	-
Oct Cultivate:	x	x	x	x	x
1955					
May 5 - - - - - -	Dal 12#	Dal 12#	MH 7#	-	-
May 30 - - - - - -	DN	DN	DN	DN	-
Jun 10 cultivate:	x	x	x	x	x
Jul 6 - - - - - -	-	-	-	Oil	-
Aug 16 - - - - - -	-	Dal 8#	MH 10#	-	-

(a) Dal. 2,2 dichloropropionic acid as sodium salt. Figures are pounds acid equivalent/per acre, applied in about 50 gal/A.
MH. Maleic hydrazide as sodium salt (MH-40). Figures are pounds active per acre, applied in about 50 gal/A.
Oil. No. 2 fuel oil fortified with one pint Sinox General/100 gal. Applied to wet grass thoroughly, avoiding tree trunks.
DN. Dinitro-fortified oil emulsion. Three pints Sinox General plus 10 gal fuel oil per 100 gal, applied at 100 gal/A.

Table 5. Populations of quack grass (*Agropyron repens*).

Herbicide	Jun 25 1954[a] % cover	May 5 1955 % cover	May 5 1955 No shoots per 40 sq.ft.	Nov 11 1955 No shoots per 40 sq.ft.
Reps with Dal once per year				
Dal-1 - - - - -	0	2	12	4
MH - - - - -	9	14	67	12
Oil - - - - -	42	32	214	142
Reps with Dal twice per year				
Dal-2 - - - - -	0	0	3	1
MH - - - - -	14	10	78-	10
Oil - - - - -	24	33	180	185
All reps combined				
Dal-1 or -2 - -	0	1	8	3
MH - - - - -	12	12	72	11
Oil - - - - -	32	32	199	161
No herbicides -	50	63	383	370

(a) Before application of first oil or second Dalapon spray.

Table 6. Growth of young apple trees with trunk sprays of Dalapon or Maleic Hydrazide.

Treatment	No. trees	Trunk diameter, mm Initial 1954	Trunk diameter, mm Growth in 2 years	Increase in height, cm 1954	Increase in height, cm 1955	Increase in height, cm Total 2 years
Reps with Dal once per year						
Dal-1	50	6.6	14.8	52	53	105
MH	50	6.1	15.8	52	54	106
Oil	50	7.0	14.7	45	50	95
Reps with Dal twice per year						
Dal-2	40	7.8	14.2	43	44	87
MH	40	8.3	16.0	47	50	97
Oil	40	7.5	14.9	47	47	94
All reps combined						
Dal-1,2	90	7.1	14.5	48	49	97
MH	90	7.1	15.9	50	52	102
Oil	90	7.2	14.8	46	49	95
Diff. among 3 main treatments			*	n.s.	n.s.	n.s.
LSD, (5%) " " "			1.2	7	7	11

Conditions for obtaining injury through the soil were perhaps at a minimum in this experiment. Rainfall was abnormally light. Ignoring the August 1955 treatment, which could hardly have affected measured growth, rainfall in the first two weeks after application was less than 0.5 inch at all treatment dates. Three inches of rain fell within the month after the May 1954 treatment, but only one inch in the month after the other two treatment dates.

Summary

- CMU treatment schedules involving one or three pounds per acre applied once or twice each year were used around young apple trees for three years after planting. Growth measurements revealed no evidence of harmful effects on the trees. Re-establishment of quack grass was markedly slowed or prevented by the heavier application schedules. Other weeds, which were solely of seedling origin, were controlled by less than the maximum applications, and were kept within practical control by the minimum application.

Dalapon at about 10 pounds each spring, or maleic hydrazide at two applications of about 6 pounds to control quack grass, did not materially alter the growth of young apples during two years of use. There was some hint that a second application of Dalapon each year may have reduced growth of the young trees slightly.

QUACKGRASS CONTROL 1955

S. M. Raleigh
Penn State University

Three rather extensive tests conducted in 1955 show that quackgrass may be killed successfully by means of chemical applications. Some varation is to be expected in results, depending on soil and weather conditions when the chemical is applied.

In Areas 1 and 2 where conditions were favorable for plowing and cultivating, 16 treatments gave 90% more control, while in Area 3 where the soil was dry, making plowing and cultivating difficult, control of quackgrass was poor. All treatments stunted the quackgrass so the plants were weak.

Over 400 plots of quackgrass were sprayed. There were three replications for all treatments. The plots where corn was planted after treatments, were 12 feet wide by 20 feet long. The treatments were applied with a 12-foot hand boom with pressure regulator. For all treatments 45 gallons of water per acre were used in spraying the plots.

Area 1

The treatments as given in table 1 were applied April 30, 1955, on an old quackgrass sod. About 15 feet of each plot was plowed on May 9. The remainder was plowed and planted May 30.

Area 2

The treatments as given in table 1 were applied May 9, 10 and 11, 1955. The plots were adjacent to area 1. The plots were plowed and planted on May 30, 1955. The soil is a Hagerstown silt loam. There was enough moisture in the soil so the field plowed easily.

Area 3

This area was less than a mile away from area 1 and 2. The field was in corn in 1954. The treatments as given in Table 1 were applied May 2, 3, and 4. The soil is a Hagerstown clay loam, which was very dry and hard to plow on May 24. The area was planted May 25. In this same field 14 wilting agent and formulations of amino triazole using 1 and 2 pounds per acre were sprayed on May 6 and 7.

A quackgrass sod containing birdsfoot trefoil was sprayed May 16, 17 and 18 with 10, 20 and 30 pounds per acre of Karmex W, DW, FW, Dalapon and 6249, 20, 40 and 60 pounds of TCA, 1, 2, 4 and 8 pounds of amino triazole and combinations of amino triazole with dalapon and 6249. These plots were 6 x 20 feet.

There was no apparent injury to corn plants from any amino triazole treatment. There was no apparent injury from dalapon or 6249 in area 1 where the soil was plowed and allowed to stand three weeks before planting corn. There was some injury at the 20-pound rate when dalapon was applied April 30 and the soil was not plowed until May 30. There was severe injury at the

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10 and 20-pound rates and slight injury at the 4 and 6-pound rates of dalapon and 6249 in area 3.

It will be necessary to wait till spring to evaluate the quackgrass kill on sod which was not plowed. Annual weeds were quite thick on many plots. Dalapon apparently did not injury birdsfoot trefoil at any of the rates used in this test.

Since none of the treatments gave 100% control, and because some quackgrass seed in the soil will germinate, it will be found desirable to apply chemical treatment on two successive seasons. The quackgrass plants were very weak when the corn was cut for silage, indicating that in some cases disking or plowing after corn is removed for silage might give 100% control of plants coming from the underground stems.

When amino triazole is used for quackgrass control, the plants should be growing vigorously. After being sprayed, they should be allowed to turn white which takes two to three weeks. The areas should be plowed and planted to corn the same day if possible.

With dalapon or 6249 the quackgrass should be plowed about a week after treatment. The corn should be planted a week or two after plowing. Apparently soil organisms decompose the chemicals rather quickly. The length of time may vary with soil and moisture conditions.

Table 1

The Number of Culms (shoots) of quackgrass per square yard and percent control. Counts made December 1955

Treatment and rate in pounds per acre		Area 1 No. of Culms	Per cent control	Area 2 No. of Culms	Per cent control	Area 3 No. of Culms	Per cent control
No treatment		136.0		108.7		141.3	
amino triazole	*1			16.7	85	51.0	64
" "	2	6.7	95	11.7	89	38.3	73
" "	4	4.3	97	5.3	95	23.3	83
" "	8	3.0	98	5.7	95	21.3	85
Dalapon	2			24.7	77	51.3	64
"	4			28.7	74	42.7	70
"	6			28.7	74	33.0	77
"	10	11.3	92	18.7	83	50.0	65
"	20	8.3	94	18.7	83	21.3	85
Am. cyanamid	2			32.0	71	75.0	47
6249	4			48.7	55	55.3	61
	6			16.7	85	45.0	68
	10	14.0	90	20.7	81	49.3	65
	20	14.7	89	21.7	80	26.3	81
A. T. 1 Dalapon	2			10.7	90	41.3	71
" " 1 "	4			11.3	90	34.3	76
" " 1 "	6			20.7	81	28.3	80
" " 1 6249	2			35.3	67	38.0	73
" " 1 "	4			41.3	62	33.0	77
" " 1 "	6			16.3	85	52.0	63
" " 2 Dalapon	2			5.0	95	20.0	86
" " 2 "	4			11.7	89	35.7	75
" " 2 "	6			16.0	85	22.3	84
" " 2 6249	2			19.0	83	22.0	84
2 "	4			11.0	90	31.3	78
2 "	6			12.7	88	37.0	74
Maleic hydrazide	10	8.3	94			42.7	70
" "	20	4.3	97			31.7	78
Amino triazole	#1			17.7	84		
" "	2			13.7	87		
" "	4			8.7	92		
" "	8			6.3	94		

* From Weedazol which is 50% 3-amino 1, 2, 4 triazole therefore Weedazol used at 2, 4, 8 and 16 pounds per acre.

\# From Meno which is 90% amino triazole.

NORTHEASTERN WEED CONTROL CONFERENCE

MINUTES OF THE BUSINESS MEETING

January 6, 1956

The meeting was called to order by the President, J. G. Van Geluwe.

The Coordinating Committee Report was presented by Robert A. Peters, chairman of the committee. The part dealing with brush was returned to that group for review. The remainder of the report was approved. It was suggested that future committees be appointed early to provide ample time for preparing the report. The President indicated that this would be considered at the spring meeting of the executive committee.

The Secretary reported a registration of 667 at the combined meeting of the Weed Society and the Northeastern Weed Control Conference. The Secretary also commented briefly on the type of stencils to be used for papers appearing in the Proceedings. A. B. Dick 960 stencils are specified in the call for papers since they work most satisfactorily with the conferences' equipment. Many other types do not make clear, uniform print with the water-base ink used. Others are not suitable for as many copies as are made.

The report of the Treasurer was given in brief and it was indicated that the complete report would appear in the Supplement.

Mr. W. Kennard Lacy, county agriculture agent in Otsego county, New York was introduced as winner of the extension award by Donald A. Schallock.

A Constitution was presented to the Conference and approved with a few minor changes.

An auditing committee consisting of M. A. Sprague and W. A. Cleary was appointed by President Van Geluwe.

The Conference moved to commend Claude E. Phillips for an important contribution in the guide to weed identification which he prepared entitled, "Weeds of The Northeast". Copies may be obtained from Professor Phillips at a cost of 75¢ each.

The nominating committee presented as their slate of officers; for President, L. L. Danielson; for Vice-President, C. L. Hovey; for Secretary, R. J. Aldrich; for Treasurer, D. A. Schallock. No further nominations were made from the floor and the secretary was instructed to cast an unanimous ballot for each nominee of the slate.

President Van Geluwe expressed his appreciation for the help of those who contributed to the success of the Conference during the year before turning the meeting over to the new president, L.L. Danielson.

S. M. Raleigh invited the conference to meet in State College, Pennsylvania in the summer of 1957 so as not to conflict with the

meeting of the Weed Society in January, 1958. The invitation was referred to the executive committee for consideration.

The following committee appointments were announced by president Danielson:

Program Committee Chairman - R. A. Peters

Coordinating Committee Chairman - J. Havis

Coordinating Committee Vice-Chairman - P. W. Santelmann

Sustaining Membership Committee Chairman - L. G. Utter

Public Relations Committee Chairman - E. M. Rahn

Richard J. Aldrich

Richard J. Aldrich, Secretary

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NORTHEASTERN WEED CONTROL CONFERENCE
Treasurer's Report
February 7, 1956

Receipts

Cash on Hand 2/15/55	$ 1,380.26	
Sustaining Membership	1,635.00	
Sale of 1955 Proceedings and Reprints	686.00	
Sale of 1956 Proceedings	1,060.00	
Registration at 1956 Conference	981.00	
Luncheon tickets	880.00	
Weed Society Registrations	958.50	
Weed Society Abstracts	478.00	
Sale of Proceedings (1955) at 1956 Conference	50.00	
Total Receipts		$ 8,108.76

Expenses

General			
Travel of Executive Committee	$ 177.77		
General Secretarial Expenses	333.88		
Stationary & envelopes	124.25		
Telephone	11.49		
Miscellaneous	23.47		
Total		$ 670.86	
Publications			
1955 Supplement	$ 447.51		
Newsletters	282.00		
Coord. Committee Reports	190.80		
1956 Proceedings	1,383.65		
1956 Supplement (partial)	141.38		
Total		$2,445.34	
Meeting			
Clerks	$ 86.14		
Badges	14.63		
Printing	35.40		
Awards	200.00		
Travel	30.00		
Luncheon	923.48		
Mixer	294.25		
Miscellaneous	42.25		
Weed Society regis. remitted	958.50		
Weed Society abstract fees	428.00		
Total		$3,067.04	
Total Expenditures			$ 6,183.24
Cash on Hand February 7, 1956			1,925.52
Total			$ 8,108.76

Donald A. Schallock

Donald A. Schallock, Treasurer

We have examined the foregoing financial statement of the Northeastern Weed Control Conference and find it correct as submitted.

M. A. Sprague

M. A. Sprague

W. A. Cleary

William Cleary

REPORT OF THE RESEARCH COORDINATING COMMITTEE OF THE NORTHEASTERN WEED CONTROL CONFERENCE FOR 1956

This following report is based upon a survey made of both experiment station and industrial personnel actively engaged in weed work in the Northeastern area.

This report does not constitute a list of recommendations sanctioned by the Northeastern Weed Control Conference. It is to be used solely as a guide by those who must make specific recommendations for local use. No part of this report may be reprinted under the name of the Northeastern Weed Control Conference without the permission of the Executive Committee.

Responsibilities Imposed by Public Law 518

Public Law 518, commonly referred to as the Miller Amendment, places a new responsibility on any agency or person making specific recommendations for use of herbicides on crops to be shipped in interstate commerce. The Law provides that the Food & Drug Administration shall have the authority to establish residue tolerances for specified herbicide residues which may be found in or on raw agricultural commodities. If a level exceeding the stated tolerance is found, the commodity is subject to confiscation.

There are some chemicals which will present no residue problems as used in normal agricultural practices because they leave no residues. Those chemicals determined by the Pesticide Regulations Section of the United States Department of Agriculture will not require a numerical tolerance. It is expected that many herbicide uses will fall in this category.

Other chemicals may present no residue problems because of their low toxicity. These chemicals may be declared to be safe when applied to growing crops in accordance with good agricultural practices and may be exempted from the requirements of a tolerance by the Food & Drug Administration.

No recommendation for grower use on a specific crop should be made if there is any chance of its use resulting in a residue remaining in or on the edible portion of a commodity unless a tolerance or exemption has been announced. At the present time it is held that not only the seller of the chemical but the person or agency making a recommendation which results in an illegal residue may be legally liable.

The status of a given herbicide on a given crop can be determined through correspondence with the Manufacturer.

Recommendations in the following report are on the basis of biological activity only. No attempt has been made to designate usage which will insure residues below the limits set under Public Law 518.

Robert A. Peters, Chairman
University of Connecticut
Storrs, Connecticut

VEGETABLES GROUP I
Carrot Family, Cole Crops, Salad Crops, and Green Crops

A. J. Tafuro
Agricultural Chemicals Division
American Chemical Paint Co.
Ambler, Pa.

Carrots (7 reports)

For extensive use

1 - Stoddard Solvent
All agree to no change for 1956 recommendations.

Problems needing more work

All agree to no change for 1956.

Parsnips, Parsley, Dill (7 reports)

Same as for carrots. All agree no change for 1956.

Celery (7 reports)

For extensive use

1 - Agree no change for 1956 (6 reports).
2 - One report asks to include 75 gallons Stoddard Solvent per acre before celery breaks ground.

Problems needing more work

Agree no change for 1956 (7 reports).

Cole Crops

For trial use

1 - Agree no change for 1956 (3 reports).
2 - 1 report asks to omit Natrin.

Problems needing more work

1 - 3 reports agree no change for 1956.
2 - 1 report asks to include CDEC.

Spinach

For extensive use

1 - Agree no change for 1956 (7 reports).

For trial use

1 - 6 reports agree no change for 1956.

Problems needing more work

1 - 6 reports agree no change for 1956.
2 - 1 report asks for addition of CDEC for further testing.

Lettuce

For extensive use

1 - agree no change for 1956 (5 reports).
2 - one report asks ½ to 1 pound Chloro IPC pre-emergence immediately after seeding on mineral soil.
3 - 1 report asks 1 to 1½ pounds Chloro IPC one week after transplanting.

For trial use

1 - No change for 1956.

Problem needing more work

1 - Add use of CDEC (1 report)

VEGETABLES GROUP II

Tomatoes, Peppers, Asparagus, and Sweet Corn

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Asparagus Cutting Beds

For Extensive Use

1 - CMU (Karmex W) - Before spears appear and after cutting- 1½ lbs. (4 reports); 1-2 lbs. (2 reports); 1½-2 lbs. (2 reports); 2 lbs. (2 reports); 2-3 lbs. (1 report). After cutting season only - 1-1½ lbs. (1 report).

2 - SES (Crag Herbicide 1) - Before spears appear - 2½-3 lbs. (2 reports); 3 lbs. (1 report); 3-4½ lbs. (1 report); 3-6 lbs. (1 report). After cutting season - 3-3½ lbs. (1 report).

3 - Cyanamid Granular - Before or after cutting season, concentrated over row. 200-400 lbs. (4 reports); 300-400 lbs. (2 reports). Broadcast 400-800 lbs. (1 report). Before cutting season only - 300 lbs. (1 report); 500 lbs. (1 report).

4 - DNOSBP - Pre-emergence before cutting season - 6 lbs. (2 reports); 5 lbs. (2 reports); 2-3 lbs. (1 report). Before and after cutting - 3 lbs. (1 report).

For control of winter weeds while asparagus is dormant

5 - CIPC 1½ lbs. (1 report)

6 - CIPC 1 lb. plus SES 2 lbs. (2 reports)

For Trial

1 - Alanap - 1 - pre-emergence 4 lbs. (3 reports)
4-6 lbs. (1 report).

2 - For quackgrass and annual weeds after cutting season
2 lbs. CMU + 10-20 lbs. Dalapon (2 reports);
2 lbs. CMU + 5-10 lbs. Dalapon (1 report);
1½-2 lbs. CMU + 10 lbs. Dalapon (1 report).

3 - 2,4-D acetamide 1½ lbs. (1 report).

Asparagus Seed Beds

For Extensive use

1 - PCP (10% emulsifiable) 6 gals. in 60 gals. just before seedlings emerge (3 reports).

2 - CMU (Karmex W) pre-emergence 1½ lbs. (2 reports);
½-1 lb. (1 report).

3 - Stoddard Solvent 80-100 gals. pre-emergence (2 reports).

For Trial

1 - CMU (Karmex W) 1 lb. at planting (2 reports); 1½ lbs. after clean cultivation and plants are 5" high (1 report).

2 - DNOSBP 3 lbs. (1 report).

Problems needing more work

1 - CMU - effect on quality (including taste), persistence in soil, effect on crops planted after asparagus, how to clean spraying equipment following use.

2 - Control of volunteer asparagus seedlings, plantain, foxtail, milkweed, bindweed, quackgrass, witch grass, chickweed.

3. Value of cultivation other than for weed control.

4. Herbicides for new seedlings.

Sweet Corn

Pre-emergence

For Extensive Use

1 - DNOSBP - At planting - 4½-6 lbs. (4 reports);

For Extensive Use con't.

6 lbs. (2 reports); 2-3 lbs. (2 reports); 4 lbs. (1 report); 3-6 lbs. (1 report). Just before emergence - 3-4½ lbs. (6 reports); 3-6 lbs. (2 reports); 1-2 lbs. (2 reports).

2 - 2,4-D amine - 1¼-1½ lbs. on other than sandy soils (6 reports); ½ lb. (1 report).

For Trial

1 - CMU (Karmex W) 3/4 lb. at planting (2 reports); 1 lb. (2 reports); 1/3-½ lb. at planting (1 report).

2 - Trichlorobenzoic acid ½- 1 lb. (3 reports); 1 lb. at planting (1 report).

3 - Dalapon - 10-30 lbs. applied in fall for control of perennial grasses where sweet corn is to be planted in spring (2 reports).

Post-emergence

For Extensive Use

1 - 2,4-D amine - ½ lb. (6 reports); ¼-½ lb. (3 reports); 1 lb. at spike stage (1 report). Use drop nozzles (6 reports) when corn is 6" high (2 reports); when 10"- 12" high (2 reports).

2 - DNOSBP - At emergence 1½-3 lbs. (3 reports). At spike stage 1-2 lbs. (1 report); 2½ lbs. (1 report); 4 lbs. (1 report).

For Trial

None

Problems needing more work

1 - A material as selective and economical as 2,4-D, but without the residue and volatility problems.

2 - Proper cultural practices following pre-emergence treatments.

3 - Control of grasses, milkweed, smartweed, horsenettle.

4 - Varietal responses of sweet corn to 2,4-D.

5 - Phytotoxicity of various amine 2,4-D formulations.

Tomatoes

For Extensive Use

No suggestions.

For Trial

1 - Natrin - 2-4 lbs. (6 reports) after tomatoes have become well established and after clean cultivation (3 reports); at lay-by and only on plants that have been well fertilized (1 report).

2 - DNOSBP - 6 lbs. pre-setting (1 report).

Problems needing more work

1 - New chemicals that are effective weed killers but safe for tomatoes.

2 - Information on relation between phytotoxic effect of Natrin and fertility level of soil.

3 - Control of late season grass on light soil.

Peppers

For Extensive Use

No suggestions.

For Trial

1 - Natrin - 2 lbs. at lay-by (1 report); 3 lbs. 5 weeks after setting and following clean cultivation (1 report).

2 - DNOSBP - 6 lbs. pre-setting (1 report).

Problems needing more work

1 - New herbicides that are more selective.

2 - Control of late season grass on light soil.

VEGETABLES GROUP III
Vegetable Legume and Bulb Crops

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Peas

Pre-emergence

Recommended

1. Dinitro (DNOSBP) 3-6 lbs/A in 30-40 gal. water 9 agree
2. Dinitro (DNOSBP) 1½-3 lb/A at emergence 3 agree

For Trial

1. Granular calcium cyanamid 300 lbs/A 1-3 days after planting. 2 reports
2. NaPCP 15-20 lbs/A in 30 gal. water 1 report

Problems needing more work

1. Evaluation of new chemicals, especially for pre-emergence control of weeds. 2 reports

Post Emergence

Recommended

1. Dinitro (DNOSBP) 3/4-1½ lbs/A in 30-60 gal. water when peas 3-8 inches tall. Use lower rates when temperatures are high. Do not treat if temperatures are 80-85°F or above. 10 agree

For Trial

1. Dinitro (DNOSBP) 4½ lbs/A for grass control. Apply when grass is in seedling stage regardless of state of peas. 1 report
2. Dalapon 1 lb/A for grass control. Apply when grass is in seedling stage. 1 report

Problems needing more work

1. Grass control in peas for processing 5 reports
2. Minimum gallonage needed, possibly airplane application 7 reports
3. Effect of heavy rain following pre-emergence application 6 reports
4. Possible use of MCP where seedlings involved 2 reports

Beans, Lima and Snap

Pre-emergence

Recommended

1. Dinitro (DNOSBP) 3-6 lbs/A in 30-40 gal. water. The light rates to be used on sandy soil or until near emergence. 10 agree

For Trial

1. CIPC 2-4 lbs/A immediately after planting for grass control 4 reports
2. Dalapon 15-20 lbs/A in fall preceding spring planting of beans for perennial grass control 2 reports
3. NaPCP 15-20 lb/A. 4 reports

Problems needing more work

1. Control of grass and later weeds that come in after last cultivation — 9 reports
2. Control of quack grass and barnyard grass — 8 reports
3. Cultural requirements following pre-emergence treatments — 6 reports

Onions

Pre-emergence

Recommended

1. CIPC 2-8 lbs/A on seed onions (2-4 lbs/A on mineral soils and 6-8 lbs/A on muck soils) — 5 agree
2. CIPC 2-6 lb/A on set onions — 7 agree
   2 reports 2 lbs/A, 1 report 2-4 lbs/A, 4 reports 4-6 lbs/A

For Trial

1. CIPC 2-4 lbs/A on seed or set onions on mineral soils — 3 reports
2. CMU ½-1 lb/A — 5 reports

Problems needing more work

1. More effective control of lambs quarters and grasses — 1 report

Post-emergence

Recommended

1. KOCN 1-2% on seed onions 100 gal./A at emergence or after flag. stage. 2% on large onions 6" high or larger — 5 agree
2. KOCN 2% on set onions 6" high or larger — 4 agree
3. CIPC 2-8 lbs/A on mineral soils 4-8 lbs on muck soils when onions 6" in height or larger — 2 agree
   1 report - muck grown onions injured at these rates
4. CIPC 8-12 lbs/A after 3-4 true leaves. Spray directed to base of plant. — 1 report

For Trial

1. Combination pre and post-emergence spray for muck grown onions.
   CIPC 6 lbs/A pre-emergence — 1 report
   KOCN 2% Weednix 12 lbs/A post-emergence
2. Dalapon prior to planting crop in two application 10 days apart at the rate of 5-10 lbs/A to control perennial grasses. — 1 report

Problems needing more work

1.	Rates of CIPC for seed, set and transplant onions grown on mineral soils	7 reports
2.	Combination of pre- and post-emergence treatments	9 reports
3.	Improved methods of weeding seeded onions on light mineral soils	7 reports
4.	Control of CIPC tolerant weeds such as lambs quarters, redroot etc.	8 reports
5.	More effective grass killer	8 reports
6.	Pre-harvest sprays	1 report

VEGETABLE GROUP IV
Cucumber, Muskmelon, Watermelon, Squash Pumpkin and Sweet Potato

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Cucumber, Muskmelon and Watermelon - 12 reports

Extensive Use

1. Alanap-1, 2-6 pounds per acre pre-emergence (7 reports). Alanap-1, 2-4 pounds per acre post-emergence to extend period of weed control, applied 4 to 6 weeks after pre-emergence treatment (2 reports). Alanap-1 applied to a dry soil followed by dry weather will be in-effective. Alanap-1 must be applied before weeds emerge. Use lower recommended rates on light or sandy soils. Note--Alanap-1 is no longer commercially available having been replaced by Alanap-3. While research data indicates little difference between the activity of the two, Alanap-3 cannot yet be recommended for extensive use because of insufficient trial.

2. For quackgrass control, apply 12 to 15 pounds acid equivalent Dalapon per acre in the fall. Apply to vigorously growing quackgrass 6 to 8" tall (1 report).

3. About one week before seeding, prefit seed bed. When seeding, disturb soil as little as possible. Just before crop emerges, apply DNOSBP or PCP (1 report).

Trial Use

1. DNOSBP, 2-4 pounds per acre pre-emergence (5 reports). Apply immediately after planting. Plant seed deeper than usual.
2. Alanap-1 2-6 pounds per acre pre-emergence.

Experimental Use

1. CDAA, CDEA, CDEC, 4-6 pounds per acre pre-emergence (1 report).
2. Dalapon, fall and spring applications for quackgrass control. (2 reports).

Problems needing further work

1. Find a more dependable selective herbicide for both pre- and post-emergence applications.

2. Effect of Alanap-1 on yield and earliness.

3. Effect of environment, particularly soil temperature and moisture content on the effect of Alanap-1.

Squash and Pumpkin (7 reports)

Extensive Use

1. DNOSBP, 2-3 pounds per acre pre-emergence (3 reports).

2. Alanap-1, 2-4 pounds per acre pre-emergence (2 reports). Apply immediately after planting. Use only on varieties proved to be resistant, such as Zuchinni and Delicious.

3. For quackgrass control, apply 12 to 15 pounds per acre acid equivalent Dalapon in the fall. Apply to vigorously growing quackgrass 6 to 8" tall (1 report).

Trial Use

1. DNOSBP, 1½ pounds per acre pre-emergence (1 report).

2. Dalapon, 4 to 7 pounds per acre. Fall control of quackgrass with 2 or 3 repeat applications at 7 to 10 days intervals.

Experimental Use

1. CDAA, CDEA, CDEC, 4-6 pounds per acre for grasses and certain broadleaved weeds.

Problems needing further work

1. Find a better selective herbicide.

2. Establish conditions under which to apply DNOSBP.

Sweet Potato

Extensive Use

1. Alanap-2, 4 pounds per acre at lay-by (1 report).

Trial Use

1. CIPC, 2 pounds per acre at lay-by (1 report).

2. Natrin, 3 pounds per acre 5 weeks after transplanting (1 report).

Experimental Use

None

Problems needing further work

1. A better selective herbicide.

2. Possible use of granular form at lay-by.

VEGETABLE GROUP V
Potatoes and Root Crops

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White Potatoes

For Extensive Use

1. Premerge or Sinox P.E. (2-6 lbs) 1-2 gal. in 50-100 gals. water per A. (9 reports)

2. Dow General or Sinox General (3-5 lbs) 2-4 quarts plus 6-10 gal. fuel oil and agitation during spraying operation, 50-100 gal. water per A. (7 reports)

Trial, pre-emergence

1. CMU ½-1 lb. per acre (2 reports)
2. Sesin, 4 lbs per A (1 reports)
3. Karmex D W 3/4 lbs. per A (3 reports)
4. Karmex W 3/4 lb. per A (3 reports)
5. Amino triazole 4 lbs. per A (4 reports)
6. Dalapon 20 lbs. per A (3 reports)

Trial, for late weeds or last cultivation treatments

1. Sesin - 2-4 lbs. per A in 50 gal. water.
2. Crag I - 2-4 lbs. per A
3. Natrin - 2-4 lbs. per A
4. Alanap 2 - 2-4 lbs. per A
5. CDEA - 3-6 lbs. per A
6. CDEC - 3-6 lbs. per A
7. 3Y9 - 3-6 lbs. per A

Problems needing more work

1. Use of strong killer such as Karmex D W or W in pelleted form for lay-by application.

2. Control of perennial weeds as well as annual.

3. Control of late weeds, grasses especially, by treatments after last cultivation.

Red Beets

For Extensive Use

1. NaCl - 2 lbs. per gal. of water 100-200 gal. per acre

   a. 4-5 leaf stage of beet plant growth
   b. Not effective against Chenopodium album (6 reports)

2. TCA - 8-12 lbs. in 30 gal. water per acre, pre-emergence.

Trial

1. CMU - ¼-½ lb. per acre
2. Karmex D W ¼-½ lb. per A
3. CIPC - 2-3 lbs. per A
4. Endothal - 4 lbs. plus TCA - 10 lbs.

SMALL FRUITS

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Strawberries

For Extensive Use

1. SES - 2-4 pounds as needed except during rooting of runners (14 reports).
2. 2,4-D (amine) - 0.5 pounds for emerged small weeds in new planting (8 reports).
3. 2,4-D (amine) - 1-2 pounds immediately after harvest (11 reports).
4. CIPC - 2 pounds for common chickweed during Oct., Nov., and Dec. (7 reports).
5. NH_2DNOSBP - 3 pounds when strawberry plants are strictly dormant (4 reports).
6. Dalapon - 15 pounds for quackgrass in the summer or fall prior to spring planting (2 reports).
7. CIPC and SES - 2 pounds each 7-10 days after planting, before runner set, pre-dormant and late winter (1 report)

For Trial Use

1. Dalapon - 2-4 pounds repeat fall preplant treatment for quackgrass control at 7 to 10 days intervals 2 and 3 times (2 reports).
2. CIPC and SES - 2 pounds each in granular form 7-10 days after planting, before runner set, predormant and late winter (1 report).
3. Methyl bromide (odorized) - 1 pound per 100 cu. ft. as a fumigant of straw before mulching. The straw needs to be moist and covered with polyethylene plastic. The exposure period should be 24 to 48 hours at a temperature above 65° and for a minimum of 48 hours at a temperature below 65° F.

For Experimental Use

1. CIPC - 1.5 pounds and 2,4-D 0.5 pound combination spray during October and November for control of yellow rocket, sheep sorrel, wild carrot, common chickweed, mouse-ear chickweed, dog fennel, and biennial bluegrass (1 report).
2. CDEC - 2-6 pounds before weeds emerge during growing season (2 reports).

Grapes

For Extensive Use

1. DNOSBP - 2 pounds + 15 gallons fuel oil as row applications as needed in established vineyards (5 reports).

For Trial Use

1. CMU - 2-6 pounds during spring for control of broad-leaved weeds and young grasses in established vineyards (4 reports).
2. CIPC - 8-16 pounds as row applications before weeds and grasses emerge in the spring (8 reports).
3. Dalapon - 2-4 pounds as repeat row applications in fall and late spring for control of quackgrass and other grasses (2 reports).

For Experimental Use

1. Amizol - 4-8 pounds as row applications for control of persistent weeds and grasses (1 report).
2. Dalapon - 2-4 pounds repeated at 10-14 days intervals in fall and/or spring (1 report).
3. CDEC, CDEA, and CDAA - for weeds and grasses before they emerge (1 report).
4. SES - 2-4 pounds before weeds emerge (1 report).

Brambles (Red and Black Raspberries and Blackberries)

For Extensive Use

1. DNOSBP - 3 pounds for control of grasses and weeds except during suckering or tip-layering (9 reports).
2. SES - 3-4 pounds before weeds emerge (12 reports).
3. 2,4-D - for broad-leaved weeds (7 reports).
4. CIPC - 6-8 pounds for control of grasses and chickweeds in the fall or early spring (4 reports).
5. Dalapon - 10-15 pounds - fall application prior to spring planting for control of grass (1 report).

For Trial Use

1. Dalapon - 6-8 pounds applied in the fall or spring for control of grasses (2 reports).

For Experimental Use

1. Dalapon - 2-4 pounds at 7 to 10 day intervals in the fall and/or spring (2 reports).
2. Amizol - 2-6 pounds in fall and /or spring for grass control (1 report).

Blueberries (cultivated)

For Extensive Use

1. DNOSBP - 3-4 pounds during summer and early fall (5 reports).
2. SES - 3 pounds before weed emergence (4 reports).
3. Dalapon - 10-15 pounds fall preplanting treatment for quackgrass control (1 report).

For Trial Use

1. Dalapon - 2-3 pounds repeated 2 and 3 times at 10 day intervals in the fall or spring (2 reports).
2. CIPC - 6-12 pounds as row applications before weed's emergence (2 reports).
3. CMU - 2-3 pounds as row application before weed emergence (2 reports).

For Experimental Use

1. Amizol - 4-6 pounds for grass control during spring, summer and fall.

PASTURE AND HAY CROPS

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General Agreement

Permanent Pastures

Problem 1. Summer annual broadleaf weeds.

Control - one pound of 2,4-D amine or MCP per acre spring. Repeat if new weeds appear.

8 states agree. 2 states suggest adding esters. 1 state suggests delete since no problem.

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.
11 states agree. 1 state suggests addition of oil spray in summer or winter.

Problem 3. Wild garlic

Control - 2,4-D ester at 1 to 1.5 pounds in early spring. Repeat yearly until control is effective.

10 states agree. 1 state suggests MCP. 1 state reports no problem.

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 probably need reseeding after the treatment. A single treatment may not give complete control and it should be repeated.

8 states agree. 1 suggests 2,4,5-T alone 1 suggests spot treatment. 2 states suggest addition of amino triazole.

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 ½ to 1½ pounds depending on susceptibility of weed species present.

11 states agree. 1 state suggests addition of Amino triazole for milkweed, Canada thistle and goldenrod control.

Semi-Permanent Pastures, Legume or Grass-Legume Mixtures

Problem 1. General weeds.

Control - Rotational grazing, fertilization and mowing are of primary importance.

11 states in full agreement

Alfalfa and Clover, seedling stage

Problem 1. Chickweed

Control - Water soluble dinitro - 1½ pounds. Chloro IPC at 1 to 2 pounds in the absence of grass seeding.

10 states agree. 2 states suggest time of application should be included. 1 state suggests delete CIPC because not effective on a mat of chickweed.

1 state suggests Problem 2 - other annuals

Control - DN amine - 3/4 to 1½ pounds per acre when legumes in 2 to 3 five leaf stage.

Alfalfa, established stands

Problem 1. Chickweed

Control - Chloro IPC at 1 to 3 pounds in late fall or early winter in warmer areas in the absence of grass seeding. DN at 1 to 3 pounds if grasses present.

11 states agree. 1 state suggests addition of DN may be needed both fall and spring.

Several suggestions for listing two other problems under this heading and the addition of another category.

Problem 2. Downy Brome (chess)

Control - Trial Use 2 to 3 pounds of Dalapon per acre or CIPC 5 to 8 pounds early in the spring or late before frost.

Problem 3. Yellow Rocket

Control - Trial Use Early silage cut or ¼ to ½ pound of 2,4-D or MCP during dormant period (fall or spring)

Birdsfoot Trefoil - established stands

Problem 1. Bedstraw

Control - Trial Use 10 pounds of Dalapon in the fall or early spring.

Problems Needing Further Study

1. Use of Dalapon and CIPC for control of weedy grasses in legume hay fields.
2. Use of 3 amino 1,2,4-triazole for control of horse nettle, thistle, and curled dock.
3. Preplanting treatments of cyanamide and dinitro for legumes.
4. Weed control in birdsfoot trefoil. Dalapon looks promising for bedstraw and quackgrass.
5. Pre-emergence treatments for legumes.
6. Control of conifers.
7. Complete sod kill prior to reseeding. CMU, Dalapon plus 2,4-D; 3 amino triazole at reduced rates look promising.
8. Indicator crops for use in determining dissipation of chemicals from soil prior to reseeding.
9. Intensive investigations of the potential of the Butyric acid derivatives of 2,4-D, MCP and others in hay and pasture crops.

New additions suggested

1. Economical control of Hardhack or Steeple bush (Spirea tomentosa) in old pastures.

2. Include CDAA in No. 5 above.

3. Control of wild carrot.

4. Use of 2,4-D and MCP on ladino clover stands.

5. An intensive study on the ecology of weeds in pastures and hay field and the life history of weeds common to pasture and hay fields.

ORCHARDS

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Thirty-four questionnaires were sent out and 12 informational replies received. Suggested practices are as follows:

Poison Ivy

Extensive use

1. Ammate, 100 lbs. per 100 gals. water (Ammate-X 75 lbs. per 100 gals. water) applied to wet ivy foliage thoroughly during the growing season. (5 reports)

2. 2,4-D plus 2,4,5-T, 1 3/4 to 3 lbs. acid equivalent per 100 gals. water, applied as directed spray during growing season (3 reports) or 3 lbs. acid equivalent in 40 gals. fuel or Diesel oil as dormant application (1 report).

3. 2,4,5-T, 2 lbs. acid equivalent per 100 gals. water, applied early spring, August, or fall; low-volatile ester preferred (2 reports).

4. 3-amino-1,2,4 triazole (amino triazole) 2 lbs. active per 100 gals. water, applied as low-pressure spray when ivy is in full leaf (1 report).

Trial use

1. 2,4,5-T, 1½ to 4 lbs. acid equivalent per 100 gals. water applied at various times of year, low-volatile ester preferred (3 reports) or dormant application in oil, late fall or very early spring (1 report).

2. 3-amino-1,2,4 triazole, 4 to 6 lbs. active per 100 gals. of water applied as drenching spray when ivy leaves are fully developed (2 reports).

Trial use con't.

3. 2,4-D plus 2,4,5-T 2 1/3 to 3¼ lbs. acid equivalent per 100 gals. water applied when ivy leaves are fully developed (1 report).

4. Ammate, 80 lbs. per 100 gals. water applied to wet ivy foliage (1 report).

Experimental use

1. 3-amino-1,2,4 triazole, 2 to 4 lbs. active per 100 gals. water foliage and dormant applications (2 reports).

CAUTIONS: All applications should be directed sprays at low pressure, avoiding contact of the spray with the trees and drifting of the spray onto tree foliage. The Winesap varieties of apples are particularly susceptible to 2,4-D and 2,4,5-T injury. Use Ammate around trees under 5 years old with caution. Pears may be injured by hormone herbicides, do spot-spraying only. Peaches and other stone fruits are particularly susceptible to injury. Do not use orchard sprayer for weed spraying.

Ground Cover Suppression

Extensive use - Apples

1. Dilute oil emulsions (10% oil) fortified with 2 to 3 pints of oil-soluble DN per 100 gals. emulsion - safe on tree trunks and useable in orchard sprayers (1 report).

2. DNOSBP, 1 to 1½ lbs. per acre (1 report).

3. Sodium arsenite, 5 lbs. per acre (1 report).

4. Dalapon, 4 lbs. per acre in April, June, and August, around young trees; and 8 lbs. per acre in April plus 5 lbs. per acre in September around established trees, primarily for grass control (1 report)

4. 2,4-D amine, 1 lb. per acre for broad-leaved weeds (1 report).

Extensive use - Peaches and Cherries

1. MH-30, 4 lbs. per acre when grass is 1 foot high, cover with soil 2 weeks later, for grass suppression around young trees (1 report)

Trial use - Apples

1. Dalapon, 3 to 20 lbs. per acre at various intervals for grass control. Suggested for pears also (3 reports).

2. 3-amino-1,2,4 triazole, 2 to 5 lbs. active per acre (2 reports).

Trial use - Apples con't

3. DNOSBP , 2 to 6 lbs. per acre at various intervals during growing season (1 report).

4. CMU, 2 lbs. per acre applied pre-emergence or when weeds are small, spring and/or late summer (1 report).

5. American Cyanamid 6249, 20 lbs. per acre (1 report).

6. DN oil soluble, 1 to 2 lbs. in 5 to 20 gals. oil as 100 to 200 gals. of emulsion per acre (1 report).

Trial use - Peaches and Cherries

1. MH-30, 4 lbs. plus CIPC, 4 lbs. per acre when grass is growing vigorously; for around young trees. (1 report).

2. DN oil soluble, 1 to 2 lbs. in 5 to 20 gals. oil as 100 to 200 gals. of emulsion per acre (1 report).

Experimental use - Apples

The following were suggested for further experimental use in suppressing sod and weeds: Dalapon, 3-amino-1,2,4 triazole, CMU plus Dalapon, MH-30, MH-40, D-T.

Experimental use - Peaches and Cherries

The following were suggested for further experimental use to suppress sod and weeds under young trees: Dalapon, CMU plus Dalapon, MH-30, MH-40, CIPC.

CAUTIONS: In general, avoid direct contact of spray with trees and drift of spray onto tree foliage, but wetting of trunks safe with DN, Dalapon, and CMU. Limit Dalapon and CMU to 2-foot radius around trunks.

Water sprout control on apple trees

Trial use - MH-40, 2,000 to 3,000 ppm in water, applied to sprouts when 4 to 6 inches long. Spray just the area with sprouts to be controlled. Second application may be necessary to control stimulated lateral growth. Has been done effectively on Delicious, Stayman, Rome Beauty, and Northern Spy.

FIELD CORN AND SOYBEANS

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Field Corn (11 reports, 10 states)

For Extensive Use - Pre-emergence

1. 2,4-D, 1-1½ pounds acid equivalent per acre (9 reports).
   Remarks - Low volatile esters were preferred (7 reports). The higher rates were preferred on heavier soils, and caution was suggested in recommending 2,4-D on sandy soils. Two reports suggested the use of 2,4-D at emergence.

2. Amine dinitros, 3-6 pounds per acre (6 reports).
   Remarks - Preferred on light soils where 2,4-D injury is common and where corn is grown near 2,4-D sensitive crops. There was recommended also the use of 3-6 pounds per acre at corn planting. In general it is best to treat as near to the time of emergence as possible. Four reports even suggest to spray at emergence before first corn leaf is unrolled.

For Extensive Use - Post-emergence

1. 2,4-D, ¼-½ pound acid equivalent per acre. Use drop pipe nozzles after corn is over 1 foot high.
   Remarks - Amine form of 2,4-D is preferred mostly (6 reports) - especially when corn is over 12 inches tall. Some suggest to increase 2,4-D up to 1 pound per acre for corn over 1 foot tall (2 reports). Do not spray during high temperature and high humidity (1 report).
   Pre-emergence application where possible should be preferred (2 reports).

For Trial Use - Pre-emergence

1. TCB, ½-1½ pounds acid equivalent per acre.
   It has a longer residual effect than 2,4-D. Injury to corn with higher rates is a problem.

2. 2,4-D amide, 1½ pounds active ingredient per acre.
   Three reports indicate very good results.

For Trial Use - Emergence

1. Amine dinitros, 3-6 pounds per acre applied at or just before corn breaks through the ground. This is a rather promising practice and some suggest extensive use (4 reports).

For Trial Use - Post-emergence

1. Amine dinitros, 1½-6 pounds per acre. This is usually applied at the coleoptile stage or 1 to 2 leaf stage of growth. More work is needed.

For Experimental Use - Pre-planting

1. Dalapon, 4-10 pounds per acre on quackgrass foliage 5-10 inches tall. Plow one week after application and plant corn three weeks after application.
   Remarks - Some report amino-triazole, a mixture of Dalapon and Amino-triazole, and MH as promising chemicals in quackgrass control.

For Experimental Use - Pre-emergence

1. Karmex W (CMU), ½-2 pounds per acre. More research needed. Some reports indicate good results (3 reports).

2. CDAA, CDEA, CDEC 2-6 pounds per acre. These are promising materials as pre-emergence herbicides, particularly in control of weedy annual grasses (3 reports).

General Remarks

1. Some cultivation of field corn in addition to chemical treatment appears necessary for maximum yields, especially on heavier soils. One cultivation may be sufficient.

2. Standard 2,4-D post-emergence applications indirectly encourage the spread and growth of weedy annual grasses. It seems that where annual weedy grasses are a problem, pre-emergence and emergence applications would be preferred.

3. The most serious weed problems mentioned in order of importance were: annual weedy grasses, quackgrass, annual broadleaved weeds, nutgrass, horse nettle, morning glory and Johnson grass.

Promising Materials Tested Recently

1. Dalapon applied at 2 pounds per acre by direct application when corn is over 20 inches tall for control of annual weedy grass seedlings shows promise. Slight corn injury occurs but two years data reveals no significant effect on yields.

2. Amino-triazole, 2-4 pounds before plowing, for quackgrass control in corn.

3. ATA, 8-12 pounds pre-emergence and 4 pounds as post-emergence.

4. Naugatuck 3-Y-9tri(2,4-dichlorophenoxyethyl) phosphate. No comments given.

Promising Materials Tested Recently con't.

5. Niagara 5519, for pre-emergence use.

6. LVDN Sinox EH 333, use as pre-emergence.

7. CDAA, CDEA, CDEC 2-6 pounds, use as pre-emergence.

Problems Needing More Work

1. Quackgrass control through the use of pre-planting applications of herbicides such as dalapon, amino-triazole, MH, TCA(4 reports).

2. Control of annual weedy grasses in corn (8 reports). It is one of the most important problems in field corn weed control.

3. CDAA, CDEA, CDEC for control of late germinating annual weedy grasses.

4. Control of quackgrass, Johnson grass, nutgrass in corn.

5. Control of weeds after corn is "laid by".

6. Pre-emergence weed control in sandy soils.

7. Differences in injury to corn between pre-emergence and post-emergence herbicide applications.

Soybeans (6 reports, 6 states)

For Extensive Use - Pre-emergence

1. Amine dinitros, 3-6 pounds per acre (5 reports). Two reports suggested the use of banded applications.

For Trial Use - Pre-emergence

1. PCP, 20-25 pounds per acre. One report suggested extensive use.

For Experimental Use - Pre-emergence

1. CIPC, 6-8 pounds per acre.

2. Alanap 3, 2-6 pounds per acre.

3. CDAA, CDEA, CDEC, 3-6 pounds per acre. Listed as promising herbicides in four reports.

General Remarks

1. The most serious weed problems mentioned in order or importance were: annual broadleaved weeds, annual weedy grasses, morning glory, Bermuda grass, horse nettle.

2. In general need is indicated for effective cheaper treatments for soybean weed control.

Promising Materials Tested Recently

1. Geigy 444, 2-6 pounds per acre.

2. CDAA, CDEA, CDEC, 3-6 pounds as pre-emergence.

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 full-proof pre-emergence spray.

3. To develop practical post-emergence herbicides.

SMALL GRAINS

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Spring Grains-not seeded

For Extensive Use (14 reports)

1. 2,4-D amine at ¼ to ½ lb. per acre after stooling but before jointing.

2. MCP at ¼ to ½ lb. per acre after stooling but before jointing.

Spring Grains - seeded to grasses and legumes

For Extensive Use

1. DNOSBP at 3/4 to 1.5 lbs. per acre - to be used when weeds are small and grain not over 6 inches high.

   a. In 30-75 gallons of water. (10 reports concurring with 1955 NEWCC report)
   b. In 20-40 gallons of water. (2 reports)
   c. Add "but after legumes have reached second true leaf stage". (1 report).

2. 2,4-D amine or MCP at ¼ to ½ lb. per acre where weeds and grain form a canopy over legumes. Use MCP on red clover only. (11 reports)

   a. Restrict MCP for use with red clover only. (2 reports)

   b. Retain MCP with rate not to exceed 3/8 lb. per acre. (1 report).

Winter Grains - not seeded

For Extensive Use

1. 2,4-D amine or MCP at ¼ to ½ lb. per acre in spring after stooling but before jointing. (12 reports)
2. 2,4-D amine or ester at ¼ to ½ lb. per acre in spring after stooling but before jointing. (1 report)
3. 2,4-D or MCP amine at ¼ to ½ lb. per acre in fall to control winter annuals. (1 report)
4. DNOSBP at 3/4 to 1.5 lb. per acre for chickweed control. (1 report)

Winter Grains - seeded to grasses and legumes

For Extensive Use

1. 2,4-D amine at ¼ to ½ lb. per acre in early spring when weeds are small. (10 reports)

    a. Above to be deleted. (1 report)
    b. DNOSBP at 3/4 to 1½ lbs. in 20-40 gallons of water per acre; 2,4-D amine or MCP at ¼ to ½ acre with canopy; MCP restricted to red clover(1 report).

2. DNOSBP at 1 lb. per acre to control chickweed. (11 reports)

    a. Add "two applications (early fall and late winter) necessary for heavy infestations. (2 reports)
    b. DNOSBP at 3/4 to 1½ lbs. per acre. (1 report)

3. 2,4-D or MCP at ¼ to ½ lb. per acre in fall for winter annuals. (1 report)

Wild garlic or onion control in winter grain

For Extensive Use

1. 2,4-DLVE at ½ to 1½ lbs. per acre on wheat not seeded. (5 reports)

    a. When garlic is 3-5 inches tall. (1 report)
    b. On first day temperature exceeds 60°F. (1 report)
    c. Repeated clipping helpful. (1 report)

2. MCP at ½ lb. after stooling but before jointing.(2 reports)

For Experimental Use

1. Preseeding treatment with AT.

Problems Needing More Work

1. Complete evaluation of MCP and 2,4-D Butyrics on underseeded small grains. (4 reports)
2. Wild garlic control re:

    a. Time of spray application. (1 report)
    b. Better chemicals. (2 reports)

Problems Needing More Work con't.

3. Herbicides more selective and less harmful to underseeded legumes especially alfalfa and birdsfoot trefoil.(3 reports)
4. Effects of AT and 6294 on underseeded legumes. (1 report)
5. Problems listed in 1955 NEWCC Report still applicable. (2 reports)
6. Control of German knot-grass - Scleranthus annuus.(1 report)

HERBACEOUS PERENNIAL AND BIENNIEL WEEDS

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Most states thought that quack grass, nut grass, horse nettle, wild garlic, and yellow rocket were the worst weeds of the region, although the southernNEWCC states included Johnson grass and Bermuda grass. There seems to be no major changes from the 1955 report except Dalapon and Amino-triazole moving from the experimental class to the trial use category in many instances.

Bedstraw (Gallium Mollugo)

Extensive Use

Dalapon at 10 pounds per acre applied as a fall treatment. (3 reports)

Experimental Use

Use of Dalapon in spring.
Split applications of Dalapon, 5 #/A each time.

Bermuda Grass(Cynodon dactylon)

Extensive Use

TCA at 75-100 pounds per acre without accompanying cultural practices. 20 to 30 pounds per acre when used with tillage practices (3 reports).

Trial Use

Dalapon at 25 to 40 pounds per acre (2 reports). 5 to 10 pounds of Dalapon repeated in 7-10 days (2 reports).

Further work needed

Use of Amino-triazole and Maleic hydrazide alone and in combinations with Dalapon.
Tolerance of crop plants to Dalapon.

Canada Thistle (Cirsium arvense)

Extensive Use

1. 2,4-D or MCP (esters preferred) at ½ to 1½ pounds per acre applied at the pre-bud or early bud stage (5 reports)
2. Chemical and cultural, mowing plus 2,4-D.

Trial Use

Amino-triazole at 2 to 4 pounds (acid equivalent) per acre (3 reports).

Further work needed

1. Most effective stage of treatment.
2. Use of Amino-triazole.

Chicory (Cichorium Intybus)

Extensive Use

2,4-D at ½-1 pound per acre when plants are in vegetative state (1 report).

Chrysanthemum Weed (Artemisis Vulgaris)

Two reports indicate that the weed is a problem. One suggests the use of a 4000 ppm solution of 2,4,5-T ester.

Horse Nettle (Solanum carolinense)

Extensive Use

2,4,5-T or 2,4-D--2,4,5-T mixtures at 2 to 4 pounds per acre, just before or at the early bloom stage (5 reports). At least 2 applications are usually needed.

Further work needed

1. More information about the plant and its life cycle.
2. Use of Amino-triazole, probably at 2 to 8 pounds per acre.

Johnson Grass (Sorghum halepense)

Extensive Use

1. Use of 50-100 pounds per acre of TCA just prior to or at emergence.
2. Use of 150-200 pounds per acre of TCA during the growing season (1 report).
3. Use of 30-50 pounds of Dalapon, preferable followed by tillage (2 reports).

Experimental Use

Dalapon, 10 pounds per acre, either on the young shoots or as repeated applications 7-10 days apart.

Further work needed

1. Tolerance of crop plants.
2. Combinations of Amino-triazole and Dalapon, or use of Amino triazole plus tillage.
3. Control of combinations of regrowth and new seedlings.

Milkweed (Asclepias syriaca)

Three reports recommended cultural practices such as mowing or hand pulling. Two mentioned the use of 2 to 4 pounds per acre of Amino triazole in 100 gallons of water. One of these had it for experimental use only.

Further work needed

1. Use of CMU
2. Use of Silvex
3. Use of Amino-triazole post-emergence (2-4 pounds, 2 reports).

Nut Grass Cyperus esculentus)

Extensive Use

1. TCA at 50 to 100 pounds per acre (acid equivalent). Apply when nut grass shoots are 2-6 inches tall, preferably followed by discing or harrowing (5 reports).

Experimental Use

1. Use of Amino-triazole plus plowing.
2. Repeat applications of 5 to 10 pounds per acre of Dalapon on young shoots.

Further work needed

Use of combinations of Dalapon with Amino-triazole, PMA, Silvex, or 2,4,5-T. Use of 4-6 pounds of DNBP per acre, post-emergence.

Quack Grass (Agropyron repens)

Extensive Use

TCA, 50-100 pounds per acre applied to plowed soil. Generally best to follow with discing or harrowing (8 reports). Late summer or early fall generally thought best.

Trial Use

Application of Dalapon at 10 to 20 pounds per acre in early spring followed by working soil 7 days later. Plant crops 3 weeks later (4 reports).

Experimental Use

1. Use of MH in the spring at 10 pounds per acre, followed by plowing and planting about 10 days later.
2. Use of Amino-triazole in the spring at 4 to 8 pounds per acre, plow and plant 10 to 14 days later.

Further work needed

1. Crop tolerance to Dalapon.
2. Reasons for inconsistencies in control with Amino triazole and Dalapon.
3. Repeat applications of low rates of Dalapon.
4. Use of combinations of Dalapon and other chemicals
5. Timing of applications of Dalapon and Amino triazole in relation to stage of growth and cultural practices.

Wild Garlic (Allium spp.)

Extensive Use

1. In grains (without legumes) - 3/4 to 1½ pounds of 2,4-D ester applied in the very early spring (March),(2 reports).
2. In pastures - 1 to 2 pounds of the ester of 2,4-D or MCP in the spring and repeated in the fall. Retreatment for at least 2 years needed (5 reports).

Further work needed

1. Method of control in underseeded grains.
2. Stage of growth at time of application.

ORNAMENTALS

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This report is based on information obtained from research workers affiliated with State Experiment Stations, commercial and State nurseries, and chemical companies throughout the United States.

One hundred fifty-one questionnaires were sent out. Twenty-eight were completed and included in this report. No comments are made as to the reactions of various species of nursery stock to the herbicides mentioned because of the tremendous number of different ornamentals grown commercially.

Woody Nursery Stock

Pre-planting treatment in beds for seedlings or liners

Extensive Use

1. Methyl bromide, 1 lb./100 sq. ft. (6 reports)
2. AERO Cyanamid, Granular, 2000 lbs./A (3 reports)
3. Steam (2 reports)
4. 2,4-D, 1 lb./A (1 report)
5. CIPC (1 report)
6. Dalapon, 8 lbs./A, quack grass, fall (1 report)
7. Premerge (1 report)
8. SES, 3-4 lbs./A (1 report)

Trial Use

1. Amizol, 8 lbs./A, quack grass, fall (1 report)
2. CIPC, 2 lbs./A (1 report)
3. 2,4-D, 2 lbs./A + CIPC, 2 lbs./A (1 report)

Experimental Use

1. Amizol, 4-12 lbs./A (4 reports)
2. Dalapon, 2-4 lbs./A (1 report)
3. Methyl bromide, 1 lb./100 sq. ft. (1 report)
4. Premerge, 6-9 lbs./A (1 report)
5. Sodium chlorate, 3-6 months prior to planting (1 report)

Pre-emergence in beds

Extensive Use

1. Mineral spirits, 20-75 gals./A (3 reports)
2. SES, 3-4 lbs./A (3 reports)
3. AERO Cyanate, 10-20 lbs. in 60-100 gals of water/A (1 report)
4. CIPC, 4-8 qts/A (1 report)
5. Flame (1 report)
6. 2,4-D, ½ lb./A (1 report)

Trial Use

1. CIPC, 2 lbs./A (1 report)
2. Premerge (1 report)
3. 2,4-D, 2 lbs./A + CIPC, 2 lbs./A (1 report)

Experimental Use

1. Amizol, 2-4 lbs./A (1 report)
2. Dalapon, 2-4 lbs./A (1 report)
3. Natrin, 2-4 lbs./A (1 report)

Post-emergence for seedlings

Extensive Use

1. Mineral spirits, 8-75 gals/A, conifers, (6 reports)
2. SES, 2-4 lbs./A (3 reports)

Trial Use

1. SES, 3 lbs./A (2 reports)
2. CIPC, 2 lbs./A (1 report)
3. CIPC, 2 lbs./A + SES, 2 lbs./A (1 report)
4. Mineral spirits, 10 gals./A, conifers (1 report)

Experimental Use

1. Amizol, 2-4 lbs./A (1 report)
2. CIPC (1 report)
3. Dalapon, 2-4 lbs./A (1 report)
4. Karmex DW, ½-1 lb./A, directed (1 report)
5. Natrin, 2-4 lbs./A (1 report)
6. SES, 3½-4 lbs./A (1 report)
7. SES, 4 lbs./A + Karmex W ½ lb., conifers (1 report)
8. SES, 2½ lbs./A + Alanap 2½ lbs./A, conifers (1 report)
9. 3-(3,4-dichlorophenyl)1-methyl-1-n-butyl urea, 1-4 lbs/A, directed (1 report)

Liners

Extensive Use

1. SES, 2-4 lbs./A (5 reports)
2. CIPC, winter weeds (2 reports)
3. Xanthate, 4 lbs. in 100 gals. water per acre, directed (1 report)
4. Sawdust mulch + mineral spirits, directed (1 report)

Trial Use

1. SES, 3-6 lbs./A (2 reports)
2. Alanap-3, 6 lbs./A (1 report)
3. SES, 2 lbs./A + CIPC, 2 lbs./A (1 report)

Experimental Use

1. CIPC, 6 lbs./A, directed (2 reports)
2. Karmex W, 1 lb/A, directed (2 reports)
3. 3-(3,4-dichlorophenyl)1-methyl-1-n-butyl urea, 1-4 lbs/A, directed (1 report)
4. Amizol, 2-4 lbs./A (1 report)
5. Dalapon, 2-4 lbs./A (1 report)
6. Natrin, 2-4 lbs./A (1 report)
7. SES, 4 lbs./A + Karmex W, ½ lb./A, conifers (1 report)
8. SES, 2½ lbs./A + Alanap, 2½ lbs./A, conifers (1 report)
9. SES, 2-3 lbs./A + CIPC, 2-3 lbs./A (1 report)

Established Evergreens

Extensive Use

1. SES, 2-4 lbs./A (7 reports)
2. Premerge, 3-12 lbs/A, directed (4 reports)
3. CIPC, 4-8 lbs./A, winter weeds, directed (2 reports)
4. AERO Cyanate, 10-20 lbs. in 60 gal. of water/A, directed (1 report)

Extensive Use con't.

5. Aromatic oil + DNBP or PCP (1 report)
6. IPC, 1/8 lb/1400 sq. ft., directed (1 report)
7. Mineral spirits, 10-40 gals/A (1 report)
8. Xanthate 4 lbs. in 100 gals. of water/A, directed (1 report)

Trial Use

1. SES, 4-6 lbs/A (2 reports)
2. Alanap-3, 6 lbs/A (1 report)
3. Dalapon, 5-7 lbs/A, directed (1 report)
4. Karmex W, directed (1 report)
5. SES, 2 lbs/A + CIPC, 2 lbs/A (1 report)

Experimental Use

1. CIPC, 6-10 lbs/A, directed (3 reports)
2. Karmex W, ½-2 lb/A, directed (3 reports)
3. Amizol, 2-12 lbs/A, directed (2 reports)
4. Karmex DW, ½-2 lbs/A, directed (2 reports)
5. 3-(3,4-dichlorophenyl)1-methyl-1-n-butyl urea, 3-4 lbs/A, directed (1 report)
6. CIPC, 10 lbs/A + CMU, 1-2 lbs/A (1 report)
7. Natrin, 2-4 lbs/A (1 report)
8. SES (1 report)

Established deciduous plants

Extensive use

1. Premerge 3-12 lbs., directed (4 reports)
2. SES, 3-6 lbs/A (3 reports)
3. AERO Cyanate, 10-20 lbs. in 60 gals. of water, directed (1 report)
4. Aromatic oil + DNBP or PCP (1 report)
5. CIPC, winter weeds, directed (1 report)
6. SES, 2 lbs/A + CIPC, 2 lbs/A (1 report)

Trial Use

1. Ses, 4-6 lbs/A (3 reports)
2. CIPC, 4-6 lbs/A (1 report)
3. Dalapon, 5-7 lbs/A (1 report)
4. Karmex W, directed (1 report)

Experimental Use

1. Amizol, 2-12 lbs/A, directed (2 reports)
2. CIPC, 10 lbs/A, directed (2 reports)
3. Karmex DW, ½-2 lbs/A, directed (2 reports)
4. 3-(3,4-dichlorophenyl)1-methyl-1-n-butyl urea, 3-4 lbs/A, directed (1 report)
5. CIPC, 10 lbs/A + Karmex W 1-2 lbs/A, directed(1 report)
6. Dalapon 2-4 lbs/A (1 report)
7. Natrin 2-4 lbs/A (1 report)

Herbaceous Ornamental Crops

Gladiolus, pre-emergence

Extensive Use

1. SES, 3-6 lbs/A (6 reports)
2. Premerge 3-12 lbs/A (5 reports)
3. 2,4-D, 1-2 lbs/A (3 reports)
4. CIPC, 10 lbs/A (2 reports)
5. Karmex W, 1-2 lbs/A (2 reports)
6. AERO Cyanamid, Granular, 600-800 lbs/A (1 report)
7. NaTCA, 10 lbs/A + 2,4-D, 1 lb/A (1 report)
8. NaTCA, 10 lbs/A (1 report)
9. Oktone in mineral spirits, 8 lbs. in 20-50 gals./A (1 report)
10. Sodium arsenite, 1 gal./A (1 report)

Trial Use

1. Karmex DW, 1-2 lbs/A (2 reports)
2. Dalapon 12-15 lbs/A, quack grass, fall pre-planting treatment (1 report)
3. SES, 2 lbs/A + CIPC, 2 lbs/A (1 report)

Experimental Use

1. 3-(3,4-dichlorophenyl)1-methyl-1-n-butyl urea 3-4 lbs/A (1 report)
2. Amizol, 2-4 lbs., (1 report)
3. Dalapon, 2-4 lbs. (1 report)
4. Dalapon, 5-9 lbs./A, quack grass, spring pre-planting treatment (1 report)
5. Karmex DW, ½-2 lbs/A (1 report)
6. Natrin 2-4 lbs/A (1 report)
7. SES, 4 lbs/A + CIPC, 4 lbs/A (1 report)

Gladiolus, Post-emergence

Extensive Use

1. SES, 3-4 lbs./A (3 reports)
2. 2,4-D, 1 lb/A (1 report)
3. AERO Cyanate, 10-20 lbs. in 60 gals of water/A, directed (1 report)
4. Karmex W, ½ lb/A (1 report)

Trial Use

1. Karmex DW, 1-2 lbs/A (1 report)
2. SES, 4 lbs/A (1 report)
3. SES, 2 lbs/A + CIPC, 2 lbs/A (1 report)

Experimental Use

1. 3-(3,4-dichlorophenyl)-1-methyl-1-n-butyl urea, 3-4 lbs/A (1 report)

Experimental Use con't.

2. Amizol, 2-4 lbs/A (1 report)
3. CIPC, 4% dust (1 report)
4. Dalapon, 2-4 lbs/A (1 report)
5. Karmex DW, ½-2 lbs/A (1 report)
6. Natrin, 2-4 lbs/A (1 report)
7. SES, 4 lbs/A + CIPC 4 lbs/A (1 report)

Perennials

Extensive Use

1. SES, 3-4 lbs., chrysanthemums (2 reports)
2. AERO Cyanamid, Granular, 2000 lbs/A pre-planting treatment (1 report)
3. Methyl bromide, 1 lb/100 sq. ft., pre-planting treatment (1 report)
4. Premerge, 3-4½ lbs. in 25 to 40 gals. of water, directed - dormant plants (1 report)

Trial Use

1. SES, 2-6 lbs/A (2 reports)
2. CIPC, 4-6 lbs/A (1 report)
3. Dalapon 12-15 lbs/A quack grass, fall pre-planting treatment (1 report)
4. Sodium arsenite, 1 gal/A, pre-emergence (1 report)

Experimental Use

1. 3-(3,4-dichlorophenyl)-1-methyl-1-n-butyl urea 1-4 lbs/A (1 report)
2. Amizol, 4 lbs/A, pre-planting treatment (1 report)
3. CIPC, 2 lbs/A + SES, 2 lbs/A (1 report)
4. Dalapon, 5-9 lbs/A, quack grass, spring pre-planting treatment (1 report)
5. Granular Premerge (1 report)
6. Karmex DW, ½-2 lbs/A (1 report)
7. Natrin, 2-4 lbs/A (1 report)
8. SES (1 report)

Annuals

Extensive Use

1. AERO Cyanamid, Granular, 2000 lbs/A pre-planting (1 report)
2. Methyl bromide, 1 lb/100 sq. ft., pre-planting treatment (1 report)
3. SES, 2-4 lbs/A, post-emergence (1 report)

Trial Use

1. Dalapon, 12-15 lbs/A, quack grass, fall pre-planting treatment (1 report)
2. SES, 2-4 lbs/A (1 report)

Experimental Use

1. 3-(3,4-dichlorophenyl)-1-methyl-1-n-butyl urea, 1-4 lbs/A (1 report)
2. CIPC, 4-6 lbs/A (1 report)
3. CIPC, 2 lbs/A + SES, 2 lbs/A (1 report)
4. Dalapon, 5-9 lbs/A, quack grass, spring pre-planting treatment (1 report)
5. Natrin, 2-4 lbs/A, post-emergence (1 report)
6. SES, 3-6 lbs/A (1 report)

AQUATIC WEEDS

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Emergents

Cattail, Typha latifolia

For trial use

1. Dalapon Sodium Salt, 15-20 pounds per 100 gallons. Spray until wet. Treat after all sprouts have emerged for maximum disintegration of foliage.

2. Dalapon plus 2,4,5-T ester, 16 pounds Dalapon plus 1 pound (acid equiv.) 2,4,5-T ester in 100 Imperial gallons of water - spray until wet.

3. MH-40-plus cutting. 5 pounds/100 gallons water. Spray at beginning of flowering stage. Underwater cutting one week later.

4. Sodium Chlorate. 1 pound per 100 square feet. Spray until wet at early fruiting stage.

Bulrush, Scirpus subterminalis

For research use

1. Sodium Arsenite as soil sterilant. (Rates not given).

Bulrush, Scirpus spp.

For trial use

1. 6.68 pounds acid equivalent 2,4-D plus ½ percent Tergitol. Late flowering stage - 100% control - plants in 6 to 12 inches water having salinity 10 to 12%.

Bur Reed, Sparganium americanum

For reearch use - Sodium arsenite as soil sterilant.

Maiden Cane, Panicum hemitomon

For trial use

1. Dalapon - 75-100 lbs/acre (acid equiv.) in Georgia (May). Complete eradication.

2. TCA - 240 pounds per acre (acid equiv.) in Georgia, (May). Complete eradication.

Giant Cutgrass, Zizaniopsis miliacea

For trial use

1. 380 pounds TCA/acre gave 100% surface kill and apparently dead rootstocks in drained habitat, (Savannah) in July.

Reed Grass, Phragmites communis

For trial use

1. CMU at 40 pounds per acre. Treated twice by hand dusting. Second application during late flowering stage. 100% kill.

Problems needing more work

1. Use of soil sterilants on drained habitats
2. Effects of above agents on a wider variety of plant species.

Rooted submersed plants

For extensive use

1. Sodium arsenite - effective at rates of 2.5-10 ppm. on wide range of species.

Water Milfoil, Myriophyllum heterophyllum

For trial use

1. Phygon-XL at rates of 10-20 pounds per acre. Gave 85-90% control.

Pond Weed, Potamogeton crispus

For trial use

1. Copper sulphate at 400 pounds per acre- broadcast sowing of crystals. Limited area treatments.

2. 53-55% Tri-basic copper applied by drag-bag method. 200 pounds per acre. Limited area application.

Pond Weed, Potamogeton pectinatus

For trial use

1. Chlorea, (rates not given). Exposed bottom treatment.

Bladder wort, Utricularia inflata

For trial use

1. Limestone. One ton per acre foot in acid waters - for exposed or partially drained habitat.

Problems needing further work

1. Use of soil sterilants on drained habitats
2. Testing of Phygon-XL on variety of species
3. Information on effects of dilution of herbicides in plots of different sizes.

Algae Control

For Extensive Use

1. Copper sulphate widely used at rates neighboring 0.5 ppm.

For trial use

1. Phygon-XL - 0.1 - 0.3 ppm.
2. Delrad, in accordance with manufacturers directions

Problems needing further work

1. Development of selective algacides.
2. Development of algacides generally non-toxic to fish life.

General Needs - all types of aquatics

1. Life history information
2. Physiological information
3. Habitat limitations

HIGHWAYS

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The use of herbicides on state highway roadsides in the northeast of the United States has increased considerably in the past year. Reports were received recently from 10 of the 13 state highway agencies in this conference area. All of those reporting had a herbicide control program in 1955. The kind and extent of work is

indicated in the following tabulation:

Herbicides Used for	Yes	Volume of Work: Large	Small or Trial	Tests
Broad leaf weed control	9	7	2	
Brush control	9	7	2	
Chemical mowing				
To retard vegetation	5	3		2
To eliminate vegetation	5	1	2	3

Because there has been comparatively little reported experimental work on weed control by these highway agencies, and as highway weed control problems are very similar to those studied by others and reported by the Coordinating Committee for "Woody Plants", "Turf", "Pastures & Hay Crops", "Soil Sterilization" and other sections, reference to these reports should be made for information on specific procedures and materials for broad leaf weed control, brush control and control of vegetation around structures.

PUBLIC HEALTH

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RAGWEED

Rayweed
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 rayweed pollen and a large percentage of these develop asthma after repeated attacks of hayfever.

2. A few people develop a dermatitis when they come in physical contact with the ragweed plant.

3. The effective control of ragweed depends primarily on the prevention of seed production and fertilization.

4. The low pressure aqueous foliage spray application of 500-1000 parts per million or about ½ 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 100-300 gallons per acre, depending on size of plants. High volatile ester formulations should not be used. Spraying should not be done on windy days because of drift.

5. 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.

6. The control of ragweed plants in urban areas, using 2,4-D has proven effective and economically feasible, as well as beneficial to hayfever sufferers within such areas. Control along highways and railroads is highly desirable to complement and supplement urban control programs.

7. 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.

8. Most municipalities 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.

9. Two types of programs that provide the maximum of control 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 between home and work.

Problems Needing More Work

1. The cooperation, participation and support of specialists, including allergists, agriculturists, botanists, engineers, epedemiologists, sanitarians, public health administrators, and health educators 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, extent and intensity of infestations of ragweed.

6. The extension of control programs on a regional basis.

7. Continued 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.

8. Reseach is needed on the life history of ragweed in order to better understand the problems of control.

9. The development of practical measures for the control of ragweed in connection with the growing of crops such as potatoes, corn, tomatoes, grain, etc. Progress has been made in developing chemical methods of weed control in the growing of potatoes.

10. The encouragement of private organizations, financed by public contributions, that are dedicated to the relief of hayfever sufferers.

11. The organization of professional groups to encourage the interchange of information and experience and to encourage cooperation and integration of effort.

12. Development, thru publicity and health education, of community efforts to acquaint the general public and especially the property owner in identification of noxious plants, recognition of health and economic hazards therein; and creation of awareness of individual responsibility for noxious plant control and eradication.

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 from contact with this plant each season.

2. Poison plants killed by chemicals retain some of their poisonous quality for a considerable period of time after they turn brown and appear dead.

3. Research is needed on the life history of poison ivy in order to better understand the problems of control.

4. Poison ivy is found in wood lots, along fence rows, in parks and school playgrounds and in other recreational areas, as well as growing on trees, poles and in orchards.

5. Poison ivy can be effectively controlled using, ammonium sulfamate, 2,4,5-T, and 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.

6. 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 and in the development of wetting and spreading agents.

3. The cooperation, participation and support of several specialists, including botanists, public works engineers, sanitarians agriculturists and public health administrators, is essential to developing good control programs.

TURF

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I Lawn Turf

1. Broad-leaved weeds

A. Dandelion, plantain, buckhorn, etc.

For extensive use

2,4-D (8 reports) (2 specified amine) rates from ¼ to 1½ pound actual 2,4-D per acre; 2,4,5-T at the rate of ¼ to 1½ pound per acre (1 report).

For trial use

DuPonts N-butyl urea (3 reports).

B. Clover

For extensive use

2,4,5-T at ½ to 1½ pounds per acre (3 reports), spring and fall applications considered best.

For trial use

Polychlobenzoic acid at 1 and 2 pounds per acre (1 report). Disodium methyl arsonate (1 report).

C. Chickweed

For extensive use

Sodium arsenite, potassium cyanate in late fall (1 report). 2,4-D and 2,4,5-T (1 report); also suggested for spring application.

For trial use

DNOSBP at 1 pound per acre (2 reports). Disodium benzyl arsonate at 21 quarts per acre (1 report); disodium methyl arsonate; H-butyl urea 3 to 5 lbs. per acre (1 report).

D. Wild garlic

For extensive use

2,4-D ester 1 to 1½ pounds per acre (3 reports).

2. Crabgrass

A. Post-emergence

For extensive use

PMA (10%), KOCN, (8 reports)

For trial use

Disodium methyl arsonate (3 reports).
Disodium benzyl arsonate (1 report).

For experimental use

Methyl arsonic acid; di methyl arsinic acid; chlordane preparations; 2,4,5-T acetamide; copper formulations (1 report on each).

B. Pre-emergence

For extensive use

PMA formulations wet or dry (1 report)
Crag 1 (1 report)

For trial use

N-phthalamic acid (2 reports)
DuPont's N-butyl urea (3 reports)
Crag 1 (1 report)
Chlordane; 2,4-D; 2,4,5-T (1 report)

II Putting-green turf

A. Crabgrass

Post-emergence

PMA 10% (3 reports)
Disodium methyl arsonate (1 report)

III Problems needing more work (reported by 1 or more)

1. Annual bluegrass, goosegrass, chickweed, knotweed, nimbelwill, pearlwort, clover, spotted spurge (milk purslane).

2. Continuation of the evaluation of the arsenical preparations, and other chemicals, with respect to effect on the basic turfgrasses, rates of application, time intervals, etc.

3. Fundamentals and basic work.

4. Better equipment for application.

5. Pre-emergence.

SOIL STERILIZATION

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For the purpose of this report "soil sterilization" was considered to encompass only the application of those treatments designed to kill all existing vegetation and prevent any regrowth for an extended period. Accordingly, transitory materials such as those employed to kill weed seeds in plant beds or on new turf areas prior to seeding were not included here.

Extensive Use (unlimited commercial application)

Boron compounds (4 reports)

"Borascu" (sodium biborate (Borax) 93%)

Apply 10 lbs./100 sq. ft.

"Borascu" 44 (boron trioxide 44%)

Apply 7-3/4 lbs./100 sq. ft.

Conc. "Borascu" (anhydrous sodium biborate (borax) 89%)

Apply 5 - 9 lbs./100 sq. ft.

"Tronabor" (borax pentahydrate - sodium borate minimum 44% B_2O_3

Apply 7-1/2 - 12 lbs./ 100 sq. ft. Spot retreatment of some areas at about one-half normal dosage may be advisable later.

"Gerstley Borate" (a sodium calcium borate ore, a mixture of Ulexite ($NaCaB_5O_9.8H_2O$) and Colemanite ($Ca_2B_6O_{11}.H_2O$))

Apply 10 - 12 lbs./100 sq. ft.

All of the above compounds should be applied dry by hand

broadcast or mechanical spreader as pre-emergence or early post-emergence treatments (i.e. in the fall, winter or early spring). On deep-rooted perennials, treatments should be made in the fall or winter.

Where practical, cut and remove all growth exceeding 4-6" in height to insure an even spread of chemical.

On bare ground, raking will prevent material from washing away during heavy rains.

Sodium chlorate (6 reports)

"Atlacide" (58% sodium chlorate)

Apply 1½ - 3 lbs./100 sq. ft. either dry or in 200 - 300 gals. water/acre. On perennials in dry areas, treat in fall or winter. For annuals and in heavy rainfall areas, treat in spring. Best results obtained when soil is moist.

Borate - Chlorate Combinations (8 reports)

Polybor - Chlorate (sodium pentaborate 58%, sodium biborate pentahydrate 15%, sodium chlorate 25%)

Apply 1 - 4 lbs./100 sq. ft. dry or 2 lbs./gal. of water per 150 sq. ft. as spray. Apply to annuals early in spring when plants are growing vigorously.

Polybor - Chlorate - 88 (sodium pentaborate 44%, sodium tetraborate 11%, sodium chlorate 22%

Apply as a spray at 2 lbs./125-175 sq. ft. on annuals and 2½ - 5 lbs./100 sq. ft. on perennials. Both polyborchlorates should be applied to perennial weeds near maturity or in dormant stages, or in fall months.

Chlorax 40 (40% sodium chlorate, 58% sodium metaborate)

Apply dry or in water solution at 4 lbs./100 sq. ft. On perennials in dry areas, treat in fall or winter. For annuals and in heavy rainfall areas, treat in spring. Best results when soil is moist.

Other Combinations Including Borates or Chlorates

Methoxone/Chlorax liquid (175 lbs. sodium chlorate and 2 lbs. 2-methyl-4-chlorophenoxyacetic acid/100 gals.) (1 report)

Apply as spray at 85 gals/acre adding an equal volume of water (total volume - 170 gals./acre). Treat when weeds are in active growth stage. Recommended for track areas on railways and railway sidings, especially where chlorate resistant weeds such as Kochia are present.

Chlorea (40% sodium chlorate, 57% sodium metaborate, 1% 3-(p-chlorophenyl)-1,1-dimethylurea) (1 report)

Apply dry or as a water spray at 1 - 3 lbs./100 sq. ft. On perennials in dry areas, treat in fall or winter. For annuals and in heavy rainfall areas, treat in spring. Best results when soil is moist. Kills shallow rooted and deep-rooted weeds with long lasting surface action. Use especially where grass weeds predominate.

Ureabor (sodium borate/substituted urea complex) (1 report)

Apply 1 - 4 lbs./100 sq. ft.

Sodium Arsenite (6 reports)

Atlas "A" (sodium arsenite solution (4 lb. As_2O_3/gal.))

Apply 1 gal. in 3-10 gals. water per 300-1200 sq. ft. when weeds are in foliage. Especially recommended for control of aquatic and semi-aquatic weeds.

Chipman Sodium Arsenite (90.67% sodium arsenite or 75% As_2O_3

Apply 5 lbs./300 - 1200 sq. ft. directly when weeds are in foliage. Will give good control of annuals for a year. Control of deep-rooted perennials depends on rainfall to carry chemical down to roots.

"Triox" (52.5% sodium arsenite, 40% As_2O_3, 6 lb. As_2O_3/gal.)

Dilute 1 to 9, use 10 gals./250 sq. ft. as a spray or sprinkle using low pressure when growth is small. If ground is dry, moisten before treating.

Substituted Urea Herbicides

"Telvar" W (3-(p-chlorophenyl)-1,1-dimethylurea - 80%) (11 reports)

Apply 20-60 lbs./acre as a spray. For optimum results apply shortly before growth begins. Up to 80 lbs./acre and repeat spot treatment may be required for deep-rooted perennials.

"Telvar" DW (3-(3,4-dichlorophenyl)-1,1-dimethylurea - 80%) (2 reports)

Especially suited for application in areas of high rainfall, to light sandy soils and/or where treatment is desired early in a dormant period to provide control during the next growing season. Apply at 20-60 lbs./acre. For optimum results apply shortly before growth begins. Up to 80 lbs./acre may be required for deep-rooted perennials.

TCA (sodium trichloroacetate - 90%) (2 reports)

Apply ½ - 1 lb./100 sq. ft. as a spray for spot treatment of perennial grasses.

Baron (Erbon) (2-(2,4,5-trichlorophenoxy)-ethyl-2, 2-dichloro-propionate (4 lbs./gal.)) (3 reports)

Apply 25-40 gals/acre in sufficient water to thoroughly wet all vegetation and soil. Apply in spring during early growing season. Recommended for control of existing vegetation with residual control during year of application.

Trial use (limited commercial or large scale experimental use)

2,3,6-trichlorobenzoic acid (1 report)

HC-1281-S (Sodium salt of 2,3,6-trichlorobenzoic acid)

Apply 5-25 lbs./acre (active) in water as a spray by hand or power sprayer.

HC-1281-AN (solvent solution of 2,3,6-trichlorobenzoic acid)

Apply 5-25 lbs./acre (active) in oil by hand or power sprayer, or by airplane.

Apply both products pre-emergence or early post-emergence. On perennials, foliage and basal applications are recommended. Where possible, soil injection should be evaluated. Further work is needed on the effect of combinations with other herbicides.

Experimental Use (research only)

Experimental Herbicide DB Granular (Complex of sodium borate and 2,4-D acid. Active ingredient: B_2O_3 - 40.9%, 2,4-D acid equivalent - 7.0%) (1 report)

Apply 1-3 lbs./100 sq. ft. Apply dry by hand or fertilizer spreader directly to soil. For deep-rooted perennials use fall application. For annuals apply when seedlings appear in spring. Designed primarily for control of deep-rooted perennials on non-cultivated land and/or small patches in cultivated land where residual action is not objectionable.

Experimental Herbicide DB Spray Powder (Complex of sodium borate and 2,4-D acid. Active ingredient: Boron Trioxide 59.5%, 2,4-D equivalent - 7%) (1 report)

Apply 1-3 lbs./100 sq. ft. (1-2 lbs./gal. water) as a spray. Deep-rooted perennials: fall application. Annuals: apply when seedlings appear in spring. For woody brush, make applications to soil and out to perimeter of foliage.

Tabular Summary of the 1956 Report
Research Coordinating Committee
Northeastern Weed Control Conference

The purpose of the following table is to provide a ready reference to the most effective weed control measures reported in the general research report. For most crops recommendations are given for extensive use only. Where no extensive recommendations are available, a trial recommendation is given.

Recommendations in the following summary are on the basis of biological activity only. No attempt has been made to designate usage which will insure residues below the limits set under Public Law 518.

Robert A. Peters
Chairman

Weed Control in Specific Crops

Crop	Ref. Page	Chemical	Use*	Lb/Acre unless Specified	Comments
Alfalfa, Seedling		NH_2DN	(1)	1-1½	Post-E.
(Chickweed)	18	CIPC	(1)	1-2	Post-E. May injure grass.

* (1) Extensive Use (2) Trial Use or large scale experimental

Crop	Ref. Page	Chemical	Use*	Lb/Acre unless Specified	Comments
Alfalfa, Est. (Chickweed)	19	CIPC	(1)	1-3	Late fall, early winter. May injure grass.
		DN	(1)	1-3	Dorm. season.
(Downy Brome)	19	Dalapon	(2)	2-3	Fall before frost or in spring.
		CIPC	(2)	5-8	Fall before frost or in spring.
(Yellow rocket)	19	2,4-D	(2)	¼-½	Dorm. period.
		MCP	(2)	¼-½	Dorm. period.
Asparagus, cutting beds	6	CMU	(1)	1-3	Before spears appear and after cutting.
		SES	(1)	2-6	Before spears appear.
		Gr Cyan	(1)	200-400	Concentrated over row, before or after cutting season.
		DN	(1)	2-6	Pre-E. Before cutting.
(Winter Weeds)	7	CIPC	(1)	1½	
(Winter Weeds)	7	CIPC + SES	(1)	1 and 2	
Asparagus, seed beds	7	PCP (10% emulsion	(1)	6 G in 60 G H_2O	Late pre-E.
		CMU	(1)	½-1½	Pre-E.
		Stod Solv	(1)	80-100G	Pre-E.
Beans, lima and snap	10	DN	(1)	3-6 to 30-40 G H_2O	Pre-E. Light rates on sandy soil or near emergence.
Birdsfoot Trefoil (Bedstraw)	19	Dalapon	(2)	10	Fall or early spring.
Blackberries		DN	(1)	3	Before suckering or layering.
		SES	(1)	3-4	Before weed emergence.
		CIPC	(1)	6-8	Fall-before weed emerg.
		2,4-D	(1)	1	Emerged broad-leaved weeds.
Blueberries, cultivated	16	DN	(1)	3-4	Early summer and fall.
		SES	(1)	3	Pre-E.
Cantaloupes	12	Alanap-1	(1)	2-6	Pre-E. Lower rates on light soils, moist soil necessary.
		Alanap-1	(1)	2-4	Post-E. Apply 4-6 wks. after Pre-E.
(Quackgrass)	12	Dalapon	(1)	12-15	In fall when quack 6-8 in tall.

* (1) Extensive Use (2) Trial Use or large scale experimental

Crop	Ref. Page	Chemical	Use*	Lb/Acre unless Specified	Comments
Carrots	5	Stod Solv	(1)	75-125G	After 2nd true leaf. Apply on cool, cloudy days.
Celery	5	Stod Solv	(1)	75-125G	Seed beds.
		Stod Solv	(1)	75 G	Before celery breaks.
Cole Crops	5	CIPC	(2)	1-2	High rate above 60°F, low rate in cool weather.
		Natrin	(2)	3	On transplants.
Chrysanthemums	36	SES	(1)	3-4	Post-E.
Clover, seedling	18	NH_2DN	(1)	1-1½	Post-E.
Corn, field	23	2,4-D	(1)	1-1½	Pre-E. Esters preferred. Use caution on sandy soils.
		NH_2DN	(1)	3-6	Pre-E. Preferred for sandy soils.
		2,4-D	(1)	¼-½	Post-E. Amine preferred. Use drop nozzles when over 1 ft. tall.
Corn, sweet	7	DN	(1)	3-6	Pre-E.
		DN	(1)	1-3	At emerg.
		2,4-DA	(1)	1¼-1½	Pre-E. Not on sandy soils.
		2,4-DA	(1)	¼-½	Post-E. Drop nozzles when corn is 6-12 in.
Cranberries	Pr Yr	$FeSO_4$	(1)	1-4T	Rate and time depend on problem.
	Pr Yr	POB	(1)	1200	Mid Apr - Mid Nov.
	Pr Yr	NaCl	(1)	150-200	June - July
	Pr Yr	NaAs	(1)	1½-3	Early August
	Pr Yr	$CuSO_4$	(1)	20-120	Rate depends on problem.
	Pr Yr	Kerosene	(1)	400-1000 G	Early May
Cucumbers	12	Alanap-1	(1)	2-6	Pre-E. Lower rates on light soils, moist soil necessary.
		Alanap-1	(1)	2-4	Post-E. Apply 4-6 wks. after Pre-E.
(Quackgrass)	12	Dalapon	(1)	12-15	In fall when quack 6-8 in. tall.
Dill	5	Stod Solv	(1)	75-125G	After 2nd true leaf. Apply on cool, cloudy days.

* (1) Extensive Use (2) Trial Use or large scale experimental

Crop	Ref. Page	Chemical	Use*	Lb/Acre unless Specified	Comments
Gladiolus	35	SES	(1)	3-6	Pre-E
		NH_2DN	(1)	3-12	Pre-E
		2,4-D	(1)	1-2	Pre-E
		CIPC	(1)	10	Pre-E
		CMU	(1)	1-2	Pre-E
		SES	(1)	3-4	Post-E
Grapes	16	DN+Fuel Oil	(1)	2+15 G	Row application in estab. vineyards.
Lettuce	6	CIPC	(1)	1½	1 wk after transplanting field. Delays maturity one week.
		CIPC	(1)	½	At time of seeding.
Nursery stock, woody					
(Pre-planting in beds)	32	Mt Br	(1)	1 lb/100 sq ft	
		Gr Cyan	(1)	2000	
(Pre-E. in beds)	32	Steam Mineral spirits	(1)	20-75 G	
		SES	(1)	3-4	
(Pre-E. for seedlings)	32	Mineral Spirits	(1)	8-75 G	For conifers
		SES	(1)	2-4	
(Liners)	33	SES	(1)	2-4	
		CIPC	(1)		Winter weeds.
(Est. evergreens)	33	SES	(1)	2-4	
		NH_2DN	(1)	3-12	Directed.
		CIPC	(1)	4-8	Winter weeds., directed.
(Est. Deciduous)	34	NH_2DN	(1)	3-12	Directed.
		SES	(1)	3-6	
Onions (Seeds)	11	CIPC	(1)	2-4	Pre-E. on mineral soil.
				6-8	Pre-E. on muck soil.
(Sets)	11	CIPC	(1)	2-6	Pre-E.
		CIPC	(1)	2-8	When onions 6 in. in height or taller.
		CIPC	(1)	8-12	After 3-4 true leaves. Directed spray.
Orchards (Poison Ivy)	20	Ammate	(1)	1 lb/gal H_2O	Growing season.
		2,4-D + 2,4,5-T	(1)	2-3 lb/100G H_2O	Growing season.
		2,4-D+ 2,4,5-T	(1)	3 lb/2 40 G oil	Dorm.
		2,4,5-Tlve	(1)	2 lb/100G H_2O	Early spring, Aug or Fall.
		Am Tr	(1)	2 lb/100G H_2O	Growing season. Pears and winesap apples most sensitive to D and T.

Crop	Ref. Page	Chemical	Use*	Lb/Acre unless Specified	Comments
con't Orchards (Ground cover suppression)					
Apples	21	DN	(1)	1-1½	
		Fortified oil	(1)	2-3 pts DN/ 100 G 10% oil emulsion	
		Na As	(1)	5	
		Dalapon	(1)	4 For young trees. 8 and 5 On est. trees	Apr., June and Aug. First rate in Apr., Second in Sept. For grass control.
		2,4-DA	(2)	1	Broadleaf weeds.
Peaches & Cherries	21 22	MH-30	(1)	4	Grass control when 1 foot tall. Cover with soil 2 wks later.
(Water sprout control on apples)	22	MH-40	(3)*	2000-3000 ppm in H_2O	When sprouts 4-6 in. long.
Ornamentals, Herbaceous (Perennials)	36	Gr Cyan	(1)	2000	Pre-planting.
		Methyl bromide	(1)	1 lb/100 sq. ft.	Pre-planting.
		NH_2DN	(1)	3-4½	Dorm., directed.
(Annuals)	36	SES	(1)	2-4	Post-E.
		Methyl bromide	(1)	1 lb/100 sq. ft.	Pre-plant.
		Gr Cyan	(1)	2000	Pre-plant.
Parsnips	5	Stod Solv	(1)	75-125 G	After 2nd true leaf. Apply on cool, cloudy days.
Pastures, permanent (Sum ann brdlf weeds)	17	MCP	(1)	1	E spr and repeat if needed.
		2,4-DA	(1)	1	E spr and repeat if needed.
(Brambles and woody plants)	17	2,4,5-TE	(1)		Spot treat early sum or dorm.
		2,4-DE + 2,4,5-TE	(1)		Spot treat early sum or dorm.
(Wild garlic)	18	2,4-DE	(1)	1-1½	Ear spr and repeat as needed.
(Horse nettle)	18	2,4-DE + 2,4,5-TE	(1)	1½-2	Blossom time and repeat if necessary.
(Per and winter ann weeds)	18	2,4-D	(1)	½-1½	Mowing and fertilization important.
		MCP	(1)	½-1½	

* Experimental Use only

Crop	Ref. Page	Chemical	Use*	Lb/Acre unless Specified	Comments
Pastures, Semi Perm.	18	General weeds -		Rotational grazing, fertilization and mowing are of primary importance.	
Peas	9	DN	(1)	3-6 in 30-40 G H_2O	Pre-E.
		DN	(1)	1½-3	Emerg.
		DN	(1)	DN 3/4-1½in 30-40 G H_2O	Post E. When peas 3-8 in. tall. Do not treat over 80-85°F.
Peppers	9	Natrin	(2)	3	Five wks after setting following clean cultivation.
			(2)	2	Lay-by.
		DN	(2)	6	Pre-setting.
Pumpkin	13	DN	(1)	2-3	Pre-E.
		Alanap I	(1)	2-4	Pre-E. Apply at planting time. Not all varieties resistant.
(Quackgrass)	13	Dalapon	(1)	12-15	In fall when quack 6-8 in. tall.
Raspberries	16	DN	(1)	3	Before suckering or layering.
		SES	(1)	3-4	Before weed emergence.
		CIPC	(1)	6-8	Fall-before weed emerg.
		2,4-D	(1)	1	Emerged broad-leaved weeds.
Small Grain, Spring (Not seeded)	26	2,4-DA	(1)	¼-½	Post stooling, pre-joint.
		MCP	(1)	¼-½	Post stooling, pre-joint.
(Seeded with forage)	26	DN	(1)	3/4-1½	When weeds, small, grain not over 6 in. tall.
		2,4-DA	(1)	¼-½	Use when weeds and grain form a canopy.
(Red clover only)	26	MCP	(1)	¼-½	Best for red clover. Use when weeds and grain-form a canopy.
Small Grain, Winter (Not seeded)	27	2,4-DA	(1)	¼-½	Spring, post-stooling, pre-joint.
		MCP	(1)	¼-½	Spring, post-stooling, pre-joint.
		DN	(1)	3/4-1½	Chickweed control

Crop	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Small Grain, con't.					
(Seeded to Forages)	27	2,4-DA	(1)	¼-½	Early spring.
		DN	(1)	1	Chickweed control.
(Wild garlic and onion control)	24	2,4-DLVE	(1)	½-1½	On unseeded grain.
		MCP	(1)	½	Post-stooling, Pre-joint.
Soybeans	25	NH_2DN	(1)	3-6	Band application may be used.
Spinach	5	CIPC	(1)	1-2	2 lb. above 60°F., 1 lb cooler weather.
Squash	13	DN	(1)	2-3	Pre-E.
		Alanap I	(1)	2-4	Pre-E. Apply at planting time. Not all varieties resistant.
(Quackgrass)	13	Dalapon	(1)	12-15	In fall when quack 6-8 in. tall.
Strawberries	15	SES	(1)	2-4	Post-P. 7-14 days and as needed following cultivation.
		2,4-D	(1)	½	For young broadleaf weeds.
		2,4-D	(1)	1-2	Immediately Post-H.
		CIPC	(1)	2	Oct.,Nov. and Dec. for common chickweed.
		NH_2DN	(1)	3	Dormant strawberry plants.
		Dalapon	(1)	15	Fall preplanting for quackgrass. Apply to green foliage.
Sweet Potato	13	Alanap 2	(1)	4	At lay-by.
Tomatoes	8	Natrin	(2)	2-4	After plants have established following cultivation.
		DN	(2)	6	Pre-setting.
Turf, lawn	43	2,4-D	(1)	¼-1½	
Broad-leaved weeds	43				
Clover control	43	2,4,5-T	(1)	½-1½	Spring and fall application best.
Chickweed	43	NaAs			Late fall.
		KOCN			Late fall.
		2,4-D + 2,4,5-T			Late fall.

Crop	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Turf, lawn con't.					
Wild Garlic	44	2,4-DE	(1)	1-1½	
Crabgrass	44	KOCN PMA			Post-E. Post-E. or Pre-E.
Watermelons	12	Alanap Alanap	(1) (1)	2-6 2-4	Pre-E. Post-E. Apply 4-6 wks after Pre-E. treat.
(Quackgrass)	12	Dalapon	(1)	12-15	In fall when quack 6-8 in. tall.

Aquatic Weeds

Weeds	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Emergents (Typha litifolia Cattail	37	Dalapon	(2)	15-20/100G	After sprouts have emerged.
		Dalapon + 2,4,5-TE	(2)	16+1 in 100 Imperial G	
		MH-40	(2)	5/100 G	At flowering stage. Cut under water one week later.
		$NaClO_3$	(2)	1/100 sq. ft.	Drenching spray. Early fruiting stage.
Bulrush (Scirpus subterminalis)	37	2,4-D + ½% Tergitol	(2)	6.68	Late flowering stage.
Maiden Cane (Panicum hemitomon)	38	Dalapon	(2)	75-100	May
		TCA	(2)	240	May
Giant cutgrass (Zizaniopsis miliacea)	38	TCA	(2)	380	July
Reed Grass (Phragmites communis)	38	CMU	(2)	40	Hand dusting. Two applications.
Rooted submersed plants	38				
General		NaAs	(1)	2.5-10 ppm	
Water Milfoil (Myriophyllum heterophyllum)		Phygon-XL	(2)	10-20	

Weeds	Ref. Page	Chemical	Use	Lb/Acre Unless Specified	Comments
Rooted submersed plants con't.					
Pond Weed (Potamogeton crispus)	38	$CuSO_4$	(2)	400	Broadcast sowing of crystals.
		Tri-basic Cu(53-55%)	(2)	200	Dry-bag method.
(Potamogeton Pectinatus	39	Chlorea	(2)		Exposed bottom method.
Bladder wort (Utricularia inflata)	39	$CaCO_3$	(2)	1 ton per acre foot	For exposed or partially drained area.
Algae Control General	39	$CuSO_4$	(1)	.5 ppm	

Herbaceous Perennial and Biennial Weeds

Weed	Ref. Page	Chemical	Use	Lb/Acre unless specified	Comments
Bedstraw (Galium Mollugo)	28	Dalapon	(1)	10	Fall treat.
Bermuda Grass (Cynodon dactylon)	28	TCA	(1)	75-100	Without tillage.
		TCA	(1)	20-30	With tillage.
Canada Thistle (Cirsium arvense)	29	2,4-DE	(1)	½-1½	Pre-bud or early bud stage.
		MCP	(1)	½-1½	Pre-bud or early bud stage.
Chicory (Cichorium Intybus)	29	2,4-D	(1)	½-1	Vegetative stage.
Horse Nettle (Solanum carolinense)	29	2,4,5-T	(1)	2-4	Early bloom stage. Repeat treatment needed.
		2,4-D + 2,4,5-T	(1)	2-4	Early bloom stage. Repeat treatments needed.
Johnson Grass (Sorghum halepense)	29	TCA	(1)	50-100	At emerg.
		TCA	(1)	150-200	Growing season.
		Dalapon	(1)	30-50	Follow with tillage.
Nutgrass (Cyperus esculentus)	30	TCA	(1)	50-100	When shoots 2-6 in. followed by tillage.
Quack Grass (Agropyron repens)	30	TCA	(1)	50-100	Late summer or early fall best. Apply on plowed soil. Follow if possible with tillage.

Weed	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Wild Garlic (Allium spp.)	31				
Grains with no forage seeding Pastures		2,4-DE	(1)	3/4-1½	Very early spring.
		2,4-DE	(1)	1-2	Spring and fall. Repeat treatments needed.
		MCP	(1)	1-2	Spring and fall.

Public Health Weed Control

Weed	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Ragweed	Pr Yr	2,4-DA	(1)	1½-3	
		2,4-DS	(1)	1½-3	
		2,4-DA			
Poison Ivy	Pr Yr	Ammate	(1)		
	Pr Yr	2,4,5-T	(1)		
	Pr Yr	2,4-D + 2,4,5-TE	(1)		
	Pr Yr	Borax	(1)	4/100 sq. ft.	

Soil Sterilization

(All recommendations are for extensive use)

Chemical**	Ref. Page	Rate per 100 sq ft	Comments
Boron compounds	45		Apply dry. Pre-E. or early Post-E. Remove growth before treatment.
Borascu	45	10	
Borascu 44	45	7 3/4	
Conc. Borascu	45	5-9	
Tonabor	45	7½-12	Spot retreatment if necessary.
Gerstley Borate	45	10-12	
Sodium Chlorate			
Atlacide	46	1½-3	Dry or in 200-300 G H_2O. Dorm. or early growth.

** Refer to Coordinating Report for chemical composition of compounds listed.

Chemical**	Ref. Page	Rate per 100 sq ft	Comments
Borate-Chlorate Combinations			
Polybor-chlorage	46	1-4 2	Dry 2-16 G of H_2O per 150 sq. ft. in Spring on annuals. On perennials at maturity.
Polybor-chlorate 88	46	1-3 2½-5	Annuals As spray on perennials at maturity.
Chlorax 40	46	4	Dormant or early growth.
Other Combinations			
Methoxone-Chlorax liquid	46	2 G of chemical with 2 G H_2O	Active growth.
Chlorea	47	1-3	Dorm or early growth.
Ureabor	39	1-4	
Sodium Arsenite			
Atlas A	47	1/6 G	Foliar Spray. Aquatics and semi-aquatics.
Chipman Sodium Arsenite	47	1	Foliar
Triox	47	4 G of 1-9 dilution.	Small growth.
Substituted Ureas			
Telvar W	47	.05-.15	As growth starts.
Telvar DW	47	.05-.15	As growth starts. For high rainfall or sandy soil areas.
TCA	47	½-1	Perennial grasses.
Baron	48	.06-.1 G	Drenching spray. Early growth.

** Refer to Coordinating Report for chemical composition of compounds listed.

Table of Abbreviations Used in Summary

Chemicals

Alanap-1	N-1 naphthyl phthalamic acid
Ammate	Ammonium sulfamate
Am Tr	Amino Triazole
BHC	Benzene hexachloride
$CaCO_3$	Calcium carbonate
Chlorea	40% sodium chlorate, 58% sodium metaborate
CIPC	Isopropyl-N-(3-chloro-phenyl) carbamate

Chemicals con't.

CMU	3-(p-chlorophenyl)-1, 1-dimethylurea
$CuSO_4$	Copper sulfate
Dalapon	2, 2-dichloropropionic acid
DN	Dinitro-ortho secondary butyl phenol, water soluble formulation
Gr Cyan	Granular calcium cyanamid
KOCN	Potassium cyanate
MCP	2,methyl 4 chlorophenoxyacetic acid
MH	Maleic hydrazide
Me Br	Methyl bromide
Na As	Sodium arsenite
Na ClO_3	Sodium chlorate
Natrin	2,4,5-trichlorophenoxy-ethyl sulfate
NH_2DN	Alkanolamine salts of dinitro ortho secondary butyl phenol
NH_4DN	Ammonium salt of dinitro ortho secondary butyl phenol
PCP	Pentachlorophenol
PDB	Paradichlorobenzene
SES	2,4-dichlorophenoxyethyl sulfate
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
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

E	Early
Directed	Directed application to base of crop
Dorm	During dormancy
G	Gallons
Post-E	Post-emergence
Post-H	Post-harvest
Ppm	Parts per million
Pre-E	Pre-emergence
Pre-H	Preharvest
Spr	Spring
Sum	Summer
Treat	Treatment
Wk	Week