THE ROLE OF HERBICIDES IN THE EXPANDED HIGHWAY PROGRAM

By

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We have entered an era of tremendous highway construction, the largest peace time public works program in history. The design and development of the automobile, with its high power and speed, has been far ahead of the roads on which it has been required to travel. During the next decade, roads of the highest type will be constructed so that travel to every major location in the country can be accomplished safely, efficiently, economically, and with less driver fatigue through healthy and attractive countrysides.

Few people realize the tremendous impact this program will have on the people of this country. We, perhaps, are all undoubtedly aware of what it will do to the economy of the country, because of the published figures of dollar expenditures--and all of us become conscious of what happens when it hits our pocketbook.

However, the effect this program will have on our land is entirely another phase. In the 41,000 miles of the interstate network program alone, it is estimated there will be approximately a million acres under vegetation. This vast acreage will be almost entirely in addition to the acres in our existing systems, our great toll roads, and the large amounts of land in our secondary, county, and local roads.

All of these acres, I assume, will be properly and adequately landscaped with as much of the existing area as possible left undisturbed and the natural trees and flora conserved. The areas that are disturbed by construction will undoubtedly have functional plantings designed and installed to direct the flow of traffic, block headlight glare, abate highway noise from abutting properties, to create driver interest and thus reduce fatigue, and to increase the attractiveness of the roadsides. The slopes and roadside areas will be adequately proofed against erosion with large expanses of turfed areas and ground cover plantings.

But what about the maintenance of these huge properties? The streamlined cross sections and the development of more efficient equipment will be of great assistance--but to find the manpower to operate the equipment as much as will be necessary is another story. The machines are necessary and will be used extensively. However, that is only a small part of the answer.

The solution to this maintenance problem is the use of selective herbicides. These valuable chemical tools that have been developed and will be produced by the scientists and manufacturers are a tremendous boon and will be even more so in undertaking this chore of vegetative maintenance.

It is indeed fortunate that by the selective application of these herbicides we can almost pinpoint the use of a specific material that will cope with the situation. At present we, of course, have 2,4D, 2,4,5T, pre-emergence weed sprays, systemic grass killers, soil sterilents, growth inhibitors, etc. It is not my business to tell you, the scientists, manufacturers and technicians, how we should use these tools--you are much more capable than I am along those lines.

I do wish to say, however, that we in the highway departments are grateful for your discoveries. We need to be further educated and directed. And we will need improvements and continued research from you in the techniques of application.

There are several very competent and progressive contractors throughout the country with personnel that are well trained in the selective application of these chemicals. These contractors will be required to expand their operations and additional ones will be needed to accomplish this job.

More and more education is essential among the administrators of the highway departments in the advantages of using these tools. Some of the chemicals, also, showing great promise need further development to improve their efficiency.

Conservation practices must be in the minds of all of us. Nature, if properly assisted and encouraged, will do much in the way of development of natural plant materials ecologically adaptable to the locations. With proper and judicious use of these chemical tools by trained personnel, a great deal of proper vegetative cover can be encouraged to grow on these rights-of-way. In this way, many of these vast acres will become more attractive and more interesting.

The highway departments throughout the nation are gradually increasing their use of herbicides. At the present time, approximately 30 states are now using, to some degree, this type of pesticide. Our experiences in Connecticut, with such favorable results, indicate that our use of these chemicals will undoubtedly increase as we become more and more aware of their valuable performances.

All in all, we anticipate that our highways in the future will be safer, healthier, more attractive, and our maintenance standards will be necessarily higher. And we believe it will be more economical to maintain these areas with less manpower required to perform the work. The majority of the vegetative maintenance will be adequately cared for by the chemical herbicides that you, the scientist, have put in our hands to serve the traveling, taxpaying public.

With the judicious use of these chemicals we will secure safe, beautiful and healthful highway areas, while reducing maintenance costs and promoting roadside conservation practices.

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Slides illustrating use of chemicals to be presented.

EPTC[1]

An Experimental Herbicide For Pre and Post-emergence Application For Grass and Broadleaf Weed Control in Vegetables, Ornamentals, Forage, and Agronomic Crops.

By

Joe Antognini, H. M. Day, and Harry Tilles[2]

Ethyl N,N-di-n-propylthiolcarbamate (EPTC) has been greenhouse and field tested for the past two years on a wide variety of crops and weeds. The purpose of this paper is to summarize the data obtained to date.

COMPOSITION

Ethyl N,N-di-n-propylthiolcarbamate:

$$C_2H_5\text{-S-}\overset{\displaystyle O}{\overset{\|}{C}}\text{-N}\begin{matrix}\diagup CH_2CH_2CH_3 \\ \diagdown CH_2CH_2CH_3\end{matrix}$$

CHEMICAL AND PHYSICAL PROPERTIES

Pure EPTC is a clear liquid with an aromatic odor. It is slightly soluble in water and infinitely soluble in most organic solvents including benzene, toluene, xylene, acetone, isopropanol, and methanol. The vapor pressure is low and the boiling point at 20 m.m. is 127°C. The refractive index is N_D^{30} 1.4755. The density at 30°C. is 0.9543 g./ml. EPTC is quite stable and apparently non-corrosive.

TOXICOLOGY

No adverse effects have been observed in the handling of EPTC during production or in laboratory and field testing during the past two years.

Toxicological data obtained by the Hazleton Laboratories at Falls Church, Virginia follow:

Acute oral LD-50 for male albino rats - 1631 mg./kg. of body weight.

Acute dermal LD-50 for male albino rabbits - 2641 mg./kg. of body weight.

1/ Letter designation for Ethyl N,N-di-n-propylthiolcarbamate approved by the Terminology Committee of the Weed Society of America.

2/ Research and Development Laboratories, Stauffer Chemical Co.

HERBICIDAL ACTION

EPTC has been effective in controlling all of the grasses and many of the major broadleaf weeds against which it has been tested. To be effective it must be applied before the weeds emerge. In controlled experiments EPTC has been effective against grassy weeds when applied at any stage of germination or growth prior to emergence. Resistant crops have been treated safely at any stage of germination or growth (including established plants). Susceptible crops and weeds have shown no injury when treated any time after the early seedling stage.

EPTC has resulted in excellent weed control for the entire growing period of crops such as corn. Results to date have shown that this extended period of weed control is due to EPTC downward movement in soil with resulting kill of weed seeds to a considerable depth rather than to an active concentration remaining on the soil surface.

CROP AND WEED SUSCEPTIBILITY

Tables I and II below covering crop and weed susceptibility were tabulated from field test results obtained during the 1955 and 1956 seasons in ten states throughout the country.

Table I - Pre-emergence Crop Resistance

Resistant 1/	Fairly Resistant 2/	Susceptible 3/
Alfalfa	Cotton	Barley
Asparagus	Cantaloupe	Bean, Lima
Bean, Red kidney	Cucumber	Buckwheat
Bean, Snap	Lettuce	Fescue, Chewings
Bird's-foot Trefoil	Peas	Fescue, Meadow
Beet, Sugar	Spinach	Peppers
Beet, Table	Squash	Peppermint
Cabbage	Stock	Rye Grass
Carrot		Seaside Bent
Clover, Crimson		Sorghum
Clover, Red		Sudan Grass
Clover, White		
Corn, Field		
Corn, Sweet		
Eggplant		
Lespedeza, Korean		
Onion		
Radish		
Soybean		
Tomato		
Zinnia		

1/ Resistant to rates of 10 lbs./acre or higher.
2/ Resistant to 5 lbs./acre, but show slight injury at 10 lbs./acre.
3/ Susceptible to rates as low as 1 lb./acre.

Table II - Weed Susceptibility

Susceptible 1/	
Barnyard Grass	*Echinochloa crusgalli*
Bluegrass	*Poa annua*
Crab Grass	*Digitaria sanguinalis*
Crowfoot Grass	*Dactyloctenium aegyptium*
Dallis Grass	*Paspalum dilatatum*
Foxtail, Barley	*Hordeum jubatum*
Foxtail, Bristly	*Setaria verticillata*
Foxtail, Green	*Setaria viridis*
Foxtail, Giant	*Setaria Faberii*
Foxtail, Yellow	*Setaria lutescens*
Johnson Grass	*Sorghum halepense*
Oats, Wild	*Avena fatua*
Sandspur	*Cenchrus panuciflorus*
Dead Nettle (Henbit)	*Lamium amplexicaule*
Jimson Weed	*Datura Stramonium*
Lamb's Quarters	*Chenopodium album*
Nodding Spurge	*Euphorbia nutans*
Pigweed, Red-root	*Amaranthus retroflexus*
Moderately Susceptible 2/	
Chickweed	*Stellaria media*
Mustard, Wild	*Brassica arvensis*
Plantain, Buckhorn	*Plantago lanceolata*
Pigweed, Prostrate	*Amaranthus blitoides*
Purslane	*Portulaca oleracea*
Shepherd's Purse	*Capsella Bursa-pastoris*
Velvet Leaf	*Abutilon Theophrasti*
Resistant 3/	
Radish, Wild	*Raphanus Raphanistrum*
Morning Glory	*Convolvulus arvensis*
Pigweed, Spiny	*Amaranthus spinosus*

1/ Susceptible to rates in the range of 1-5 lbs./acre.
2/ Susceptible to rates in the range of 5-10 lbs./acre.
3/ Resistant to a rate of 10 lbs./acre.

FACTORS AFFECTING PERFORMANCE

Soil Surface Conditions: EPTC is similar to most herbicides that are effective in controlling weeds before they emerge in that the seed bed should be smooth, preferably rolled with a roller immediately behind the planter and before the spray nozzle, for best results.

Volume of Aqueous Solution/Acre: EPTC has been equally effective when applied in volumes of solution ranging from 20 to 80 gallons/acre. It has been relatively ineffective when applied in volumes of 10 gallons or less/acre.

Soil Moisture and Rainfall: EPTC has been effective over a wide range of soil moisture and rainfall conditions. In one field test, EPTC was applied at rates of 2½, 5, and 10 lbs./acre to dry sandy soil as a pre-emergence treatment to corn (variety Dixie 18 hybrid). The soil remained dry until it rained four weeks after application. Weed control ratings eleven weeks after application are given in Table III. There was no injury to corn at the rates used.

Table III - Weed Control Eleven Weeks After Application

Treatment	Rate/Acre	% Control*
Check	0	0
EPTC	2½ lbs.	37
EPTC	5 lbs.	75
EPTC	10 lbs.	90

*Principle weeds were crowfoot grass and spiny amaranthus.

In another field test, application was made to Sorrento loam soil immediately after seeding cabbage to moisture. No rain fell until after the crop had emerged (two weeks after treatment) and excellent weed control with no crop injury was obtained.

Normal rainfall (or sprinkler irrigation) following application has had no adverse effect on the action of EPTC. Where 2 in. of water was applied immediately after seeding and application, good weed control was obtained with no crop injury.

A series of tests have been conducted to determine to what depth an herbicidally active concentration of EPTC could penetrate air dried soil. Sorrento loam soil containing wild oat and corn seeds was placed in glass columns, 1-3/4 in. x 33 in., consisting of three inch sections. The EPTC was applied at the rate of 10 lbs./acre to the soil surface and then leached with 16 in. of water using several application cycles. Twenty-four hours after leaching the columns were dismantled and each three inch section of soil was placed in an individual pot and germination and growth data were obtained. Leaching cycles used and data on wild oat control are presented in Tables IV and V. The data on corn are not presented since germination and growth were normal at all depths in all leaching cycles.

Table IV - Leaching Cycles Used for Control of Wild Oats Shown in Table V

Time After EPTC Treatment (Hrs.)	Inches of Water Added Cycle A	Cycle B	Cycle C	Cycle D
0	1/4	1/2	1	16
24	1/4	1/2	1	0
48	3½	3	2	0
72	12	12	12	0
Total	16 in.	16 in.	16 in.	16 in.

Table V
Effect of Leaching on EPTC (10 lbs./Acre) Action on Wild Oats

	Per Cent Control			
Depth	Cycle A	Cycle B	Cycle C	Cycle D
0-3 in.	100	100	100	0
3-6 in.	100	100	100	0
6-9 in.	100	100	100	100
9-12 in.	100	100	100	100
12-15 in.	100	100	100	100
15-18 in.	100	100	100	100
18-21 in.	75	100	100	100
21-24 in.	0	0	50	100
24-27 in.	0	0	50	50
27-30 in.	0	0	50	50

Soil Types and Soil Temperatures: In field tests conducted to date, EPTC has been equally effective on a wide range of soil types as evidenced by the following two tests, one on a sand and the other on a muck (peat).

A. Sand:

Table VI - Pre-emergence Test on Corn With EPTC

	Six Weeks After Treatment	
Rate of EPTC/Acre	Growth of Corn*	Weed Control**
0	10	0
2.5 lbs./acre	10	39
5 lbs./acre	10	80
10 lbs./acre	10	92

*Growth is rated on a scale of 0-10 with 0 being no growth and 10 being normal growth compared to the check.

**The principle weeds were crowfoot grass and spiny amaranthus.

B. Muck (peat):

Table VII - Pre-emergence Test on Bush Beans With EPTC

Rate of EPTC/Acre	Five Weeks After Application	
	Growth of Beans*	Weed Control**
0 lbs./acre	10	0
2½ lbs./acre	10	62
5 lbs./acre	10	80
10 lbs./acre	10	82

*Growth is rated on a scale of 0-10 with 0 being no growth and 10 being normal growth compared to the check.

**The principle weeds were crowfoot grass and purslane.

In other field tests conducted to date, EPTC has been equally effective on light sandy loam, silty clay, medium sandy loam, heavy clay, and loam soils.

Various tests at temperatures ranging from 70°F. to 90°F. have been conducted in the greenhouse with no differences in the activity of EPTC being recorded. Table VIII summarizes the results of three tests where EPTC was applied at 1 lb. and 5 lbs./acre to soil at temperatures of 70°, 80°, and 90°F. The growth and per cent weed control data were obtained eight days after application.

Table VIII - Effect of Temperature on the Action of EPTC

Crops & Weeds	Rate of EPTC/A.	Effect On	Soil Temperature 70°F.	80°F.	90°F.
Snap beans	5 lbs.	Growth*	10	10	10
Corn	5 lbs.	Growth	10	10	10
Squash	1 lb.	Growth	10	10	9.3
Rye	1 lb.	% Control	97	99	100
Oats	1 lb.	% Control	99	98	100
Barley foxtail	5 lbs.	% Control	100	100	100

*Growth is rated on a scale of 0-10 with 0 being no growth and 10 being normal growth, compared to the check.

In field tests EPTC has been equally effective at soil temperatures ranging from 60°F. to 102°F.

PRE-EMERGENCE GREENHOUSE RESULTS

A. Control of Green and Giant Foxtail in Corn: EPTC was applied at rates of 1½, 2, and 3 lbs./80 gallons/acre as a pre-emergence treatment to field corn overseeded with green and giant foxtail. Five replications were used with each replicate consisting of one flat (14 in. x 20 in.) seeded to three rows of corn with half the flat overseeded to green foxtail and the remaining half to giant foxtail. The corn was seeded 1/2 in. deep and the foxtails 1/4 in. deep in Santa Cruz loam soil. Application was made twenty-four hours after seeding and the results (average of five replications) obtained $3\frac{1}{2}$ weeks after treatment are presented in Table IX.

Table IX - Control of Green and Giant Foxtail in Corn

Rate of EPTC/A.	Effect On Field Corn % Germ.	Growth*	Per Cent Control of Green Foxtail	Giant Foxtail
0 lb.	100	10	0	0
1 lb.	100	10	46	66
$1\frac{1}{2}$ lbs.	100	10	74	89
2 lbs.	100	10	92	94
3 lbs.	100	10	95	100

*Growth is rated on a scale of 0-10 with 0 being no growth and 10 being normal growth, compared to the check.

B. Control of Green Foxtail at Various Depths: EPTC was applied at $2\frac{1}{2}$ lbs./40 gallons/acre to green foxtail seeded 1/4, 1/2, 1, 2, and 3 inches deep in Santa Cruz loam soil. Two replications (one 14 in. x 20 in. flat/replicate) were used for each treatment including checks for each depth. Normal watering followed application and the results three weeks following treatment are given in Table X.

Table X - % Control of Green Foxtail at Varying Seeding Depths

Rate of EPTC/Acre	Seeding Depth 1/4 in.	1/2 in.	1 in.	2 in.	3 in.
0	0	0	0	0	0
$2\frac{1}{2}$ lbs.	100%	100%	100%	100%	100%

PRE-EMERGENCE FIELD RESULTS

A. Crop Resistance: EPTC was applied at 5 lbs./80 gallons/acre to twenty-five crops seeded in Sorrento loam soil. Immediately following application 2 in. of water was applied by sprinkler irrigation. Four replications, with each replicate consisting of 10 ft. of row were used. The data presented in Table XI were obtained three weeks after treatment.

Table XI - Resistance of Various Crops to 5 lbs./Acre of EPTC

Crop	Growth*	% Stand**	Crop	Growth	% Stand
Beets, Table	9	100	Pea	9	100
Buckwheat	6	52	Peppers	7	67
Cabbage	7	88	Radish	7	100
Cantaloupe	9	95	Snap beans	10	125
Carrot	10	100	Stock	8	128
Corn, Sweet	10	133	Soybeans	9	117
Cotton	10	123	Squash	9	75
Eggplant	8	100	Sugar Beets	10	100
Lettuce	7	100	Tomato	10	100
Lima (Sm. seeded)	10	80	Wheat	7	90
Onion	10	109	Zinnia	10	117

*Growth is rated on a scale of 0-10 with 0 being no growth and 10 being normal growth compared to check.

**% Stand is based on the stand in the checks being 100%.

B. Control of Green Foxtail and Wild Oats in Corn: Golden Cross sweet corn was seeded and then cross seeded with green foxtail and wild oats. EPTC was applied immediately after planting at 0, 5, and 10 lbs./acre. Each treatment was replicated six times with each replicate consisting of three rows 20 ft. long. Data on weed control and yields are presented in Tables XII and XIII respectively.

Table XII - Effect of EPTC on Corn, Wild Oats, Green Foxtail, and Red-root Pigweed

	2½ Weeks After Treatment				8 Weeks After Treatment		
			% Control		% Control		
Rate/A.	Corn		Green	Wild	Green	Wild	
of EPTC	% Stand	Growth*	Foxtail	Oats	Foxtail	Oats	Pigweed
0 lbs.	100	10	0	0	0	0	0
5 lbs.	109	10	100	100	85	100	88
10 lbs.	104	10	100	100	97	100	93

*Growth is rated 0-10 with 0 being no growth and 10 being normal growth compared to the check.

Table XIII - Effect of EPTC on Corn Yield*

	0 lbs./Acre		5 lbs./Acre		10 lbs./Acre	
	No.	Ave. Length	No.	Ave. Length	No.	Ave. Length
Picking	Ears	of Ears	Ears	of Ears	Ears	of Ears
1st	54	6.82 in.	99	6.56 in.	122	6.62 in.
2nd	38	5.95 in.	101	6.31 in.	79	6.18 in.
Ave.	46	6.38 in.	100	6.43 in.	100	6.42 in.

*None of the treatments were cultivated.

C. Control of Grasses and Broadleaf Weeds in Clover: EPTC was applied at rates of 0, 2½, 5, and 10 lbs./40 gallons/acre immediately after planting Crimson clover in Sorrento loam soil. Two replications were used with each replicate consisting of two rows 110 ft. long.

Twenty-four hours after application 1-1/4 in. of water was applied by sprinkler irrigation. Data on clover stand and growth and weed control six weeks after application are presented in Table XIV.

Table XIV - Control of Grasses and Broadleaf Weeds in Clover

		Rate of EPTC/Acre			
		0 lbs.	2½ lbs.	5 lbs.	10 lbs.
Clover	% Stand	100%	152%	150%	132%
	Growth	10	10.3	8.9	6.5
		Weeds/sq. ft.*			
Rye Grass		45.1	0.3	0.0	0.0
Oats		11.1	0.45	0.0	0.0
Pigweed, Red-root		10.1	1.5	0.0	0.0
Annual Blue Grass		96.5	1.6	0.0	0.0
Henbit (Dead Nettle)		5.0	0.0	0.0	0.0
Shepherd's Purse		4.5	0.0	0.0	0.0
Chickweed		3.5	0.75	0.0	0.0

*Average of six counts.

POST-EMERGENCE GREENHOUSE RESULTS

Eight crops and four weeds received a post-emergence application of EPTC at a rate of 5 lbs./80 gallons/acre. Two crops (two rows of each) were planted per flat and four flats of each pair of crops were used. Two flats of each pair were overseeded to rye grass and wild oats and the other two flats were overseeded to pigweed and buckhorn plantain. The flats overseeded with the grasses were sprayed ten days after planting and the flats seeded to pigweed and plantain were sprayed fourteen days after planting. Observations immediately after spraying showed that all plants were thoroughly wet with the spray. The eight crops sprayed were sweet corn, cotton, snap beans, oats, carrots, tomatoes, sugar beets, and radish. Growth and injury observations three weeks after application showed no reduction in growth and no injury to any of the crops or weeds.

POST-EMERGENCE FIELD RESULTS

In tests throughout the country the following crops have been sprayed at various stages of growth with EPTC at rates up to 10 lbs./acre without injury.

Crimson clover	Strawberries	Heather
Corn	Chrysanthemums	Stock
Cotton	Cyclamen	

* * * * *

A Bio-Assay for 3-p-Chlorophenyl-1, 1-dimethylurea (CMU) in Soils

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ABSTRACT 1/

The following technique for bio-assay of 3-p-chlorophenyl-1, 1-dimethylurea (hereafter referred to as CMU) in soils was adopted after conducting several preliminary experiments:

Five 3-inch pots are filled with each soil sample containing an unknown amount of CMU and are labeled. Using soil similar to the unknown, but which has never received CMU, a series of lots is prepared, each containing 0.2, 0.4, 0.6, or 0.8 pounds of CMU per-acre-four-inches of soil. (CMU per acre four inches deep was used here because we were taking soil samples from successive 4-inch layers in asparagus fields to study persistence and penetration of CMU). Each of these lots is prepared by thoroughly mixing with air-dry soil a calculated amount of talc containing 10 ppm. of CMU. Five 3-inch pots are filled with soil of each CMU level, as well as with a soil with no CMU, and labeled. Fifteen oat seeds are planted in each pot. Pots are placed at random on the greenhouse bench and are plunged an inch deep into soil with is kept watered at field capacity. This makes surface watering necessary every few days only, which predisposes excessive leaching of CMU. A week after seeding, seedlings are thinned to a maximum of 10 plants per pot.

Six weeks after seeding, green weight of tops is obtained for each pot. Using green weight of tops for soil containing known amounts of CMU, a growth response curve is plotted. CMU-content of the unknowns can be determined by relating the green weights to this curve.

When CMU levels of the unknowns are higher than 0.8 lbs. per-acre-four-inches, the unknowns should be diluted with the same kind of soil, but which has never received CMU. For example, if the CMU range of the unknowns is 0.8 to 3.0 lbs. per acre, a mixture of 1 part of unknown soil plus 3 parts of soil without CMU is satisfactory.

Bio-assays were usually much lower than chemical assays. However, bio-assays were thought to be more valuable in our studies on CMU persistance in asparagus soils since some soils containing as much as 2 lbs. of CMU per-acre-four-inches, according to chemical assays, were not phytotoxic to oats.

1/ Abstract of a manuscript to be submitted to WEEDS.

THE PLACE OF EXTENSION METHODS IN CHEMICAL WEED CONTROL

Donald A. Schallock*

The modern day era of chemical weed control began ten years ago. By a combination of rare acumen and good fortune, one of the first chemicals to be released on the post war market was 2,4-D. Versatile in the control of many broadleaf species of weeds, it was also selective at proper rates and times on these weeds in many crop plants. That these weeds could be controlled for several dollars per acre including chemical and labor, was equally startling.

Here, then, was a first-born baby of the chemical industry with a silver spoon in its mouth. Tell and show the people the way to control weeds with 2,4-D, and public acceptance will follow, prophesied the proud fathers. Ten years have passed. The sales of 2,4-D have risen to a point that justified the researchers and promotion and development people who put the product on the market. Nevertheless, the salesmen, dealers, custom operators, field servicemen, county agents and state extension specialists will agree with me that public acceptance of weed control with 2,4-D has not been fully accomplished. Farmers who need weed control most are not much more than aware that chemical weed control exists. Pre-emergence and post-emergence methods of control are terms not understood, and the amine and ester forms of 2,4-D are mysterious chemical terms. There are many cases where costly damage has occurred due to a lack of understanding about the chemical.

The users of chemical herbicides are a small minority of the public. It is conceivable that the unwise use of chemicals, the costly mistakes by ill informed users, might erect a barrier of prejudice, or even a legal obstruction to the general use of chemicals. Even if these extremes do not occur, the expansion of chemical weed control work will be hampered by a poor climate of public understanding.

This conference is charting the research and development of a new, more selective and more effective list of chemicals. Why sound the somber note of caution at this time? Because there is still a wide gap between what is known and what is done. Technological advances are setting a pace that the farmer and home owner are not matching. Picture the farmer who is confused about 2,4-D, facing triazole, monuron, diuron, propionics, butyl esters, and benzoics for example. The adoption of a chemical will take at least 5 years, and the adoption of the skill and technique necessary to use the chemical will require longer periods of time.

No one would advocate that technology be curbed to wait for the public to catch up a little more with research. Rather, let all of us who make up this conference, and the people we represent, give serious consideration to our responsibility as extension educators in the field of chemical weed control. The security and stability of our various activities ie., research,

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promotion and development, sales and service, depends upon customer security. Whatever we do will be judged in the light of public acceptance and understanding and measured in the security of the people we serve.

I would like to discuss the various processes by which ideas diffuse out to the farm and home owner from the conception of an idea, skill, or material to the adoption or acceptance.

BECOMING AWARE

Mass communications media are the most important means of aquainting people with new ideas, skills and techniques, or materials. This fact is supported by studies in different parts of the country on various inovations in agriculture (1). These studies also reveal that there were some products and some situations that did not respond to mass media or where other agressive means of making people aware of a new idea were used to a better advantage than the use of mass communications media. For example, salesmen of hybrid seed corn were most important in creating awareness of the use of hybrid seed corn, and another exception was that neighbors and friends were most important creators of awareness of new ideas among lower socio-economic groups.

The studies revealed that government agencies such as the Extension Service, Soil Conservation Service, and various other government agencies are the second most important contact for informing people of the existance of an idea. G. B. Gunlogson (2), Farm Communications Research Expert, reports from his survey that the extension service is gaining in acceptance and popularity in making people aware of a new idea.

The communication of information using mass media was accomplished through newspapers, magazines, radio, T. V., and circular letters or leaflets. No discrimination between the industrial or governmental origin of this information was made at this stage. Through these various media new ideas are reaching the farm and home owner at a much more rapid rate than any time in our history. Daily and weekly newspapers, weekly and monthly magazines, organizational house organs, trade publications, and farm journals are adequately placing the new ideas before the public. Apparently, the lag between what is known and what is done is not at this stage in the process of acceptance of a new idea, in fact; the wide coverage and the excellent readability of the information thus disseminated often creates problems for the other groups and agencies who make their contribution at other stages along the line. Generally, however, this is a favorable state of affairs because it reflects success of the first stage in the diffusion of information.

STIMULATING INTEREST

The evidence is that for the majority, mass media becomes less important as sources of information after the individual has become aware of the idea. At the interest stage, the individual obtains the general information about the idea. The various means of providing this type of information is about equally divided among the various means of conveying information. Mass media still plays an important role in providing information because they provide information which is timely and readily available from a wider range of sources than are available from more local channels. Many rely upon agricultural agencies at this stage while others rely upon neighbors and friends. The promotion and development sections of the chemical companies and the government agencies have the advantage because they can provide results of experimental research. There is a distinct advantage in being able to support the information which you supply by quoting qualified research of a recognized organization.

Farmers and home owners with outside contacts are also important in stimulating interest in new ideas and practices. This channel of communication provides general information which people will accept as valid because it comes from one of their own kind who is aquainted with the farm and home owner and the circumstances under which he operates. A number of companies have employed this approach by including in their organization, directors or servicemen who occupy agricultural enterprises in the area involved.

THE EVALUATION PHASE

The potential adopter eventually will evaluate the new idea in terms of his own situation. He weighs the possible return in terms of labor and capital required to adopt a new idea, and he also appraises it in relation to his personal preference in type of activity, his family resources, his family goals and interests, and if he is a public minded citizen, its effects upon his relationships with his neighbors and friends. The extension workers are finding it difficult to stimulate the farmer into thinking about the effect of his herbicide program on his relationships with his neighbors and friends. The lack of consideration for the welfare of others is one of the weak points in our weed control programs, a weak point that might seriously hamper our control efforts for several years in an area where some incident has occurred.

The data available from the studies conducted by the agricultural extension service indicates that as people are evaluating an idea for their own use, they consult with neighbors and friends whose opinions they respect. Early adopters tend to depend upon agricultural agencies during this stage because they consider the source of information to be dependable since it is disseminated by an impartial and technically competent source. These contacts only account for a small proportion of the contacts necessary to encourage a large number of potential users to evaluate the idea for themselves.

The sources from with which the farmer has a close personal contact occupy the important position at this stage of acceptance of a new idea. Neighbors and friends have already demonstrated their ability to consider new ideas in terms of the local situation. First hand observations and experiences can be obtained that are specific in nature and familiar in environment. The extension service generally favors the use of demonstrations, although there is some inclination at the present time to use mass media because time will not permit the proper and widespread use of demonstrations.

The lack of importance of mass media and salesmen at this and later stages of the adoption process are due to the fact that the information provided through these channels is too general, and the potential adopters mistrust some mass media information because they feel the information is tempered by the business interests of those who are in control of them.

THE TRIAL STAGE

The farm and home people preparing to try out a new idea are primarily concerned with getting information on how and when to do it and what precautions and hazards might be encountered. Agricultural agencies become more important at this stage because some techniques require technical know-how that the average individual does not have. Except for the more technical details the neighbors and friends continue to be important sources of information. Two-way information is often necessary in order for the technical advice to be specific to the situation in the field. Salesmen, dealers, and custom operators are important providers of information at this stage when a commercial product is involved. Servicemen rather than salesmen are employed by some commercial companies in order to provide technical information about the products which the farmer has decided to use. Should the responsibility for technical assistance fall in the hands of the salesman or dealer, an educational program of technical know-how must be directed toward these people in order that their information be correct. Mass media has been shown to be relatively unimportant as information sources in the trial stage, although many agencies are considering the mass media in order to reach the people they have been unable to reach due to lack of time and facilities for a more personal or direct contact.

THE ADOPTION OF THE IDEA

When the individual is satisfied with the use of a material or a technique under existing conditions, the greatest single influence in the continued use is the individuals personal satisfaction with the early trials. Future use depends upon the individuals success with the practice under varying conditions. Personal service and public relations at this point are extremely important in the interpretation of results should any doubt exist in the mind of the potential adopter, and in the prompt evaluation and correction of a technique that was not entirely successful.

This understanding of failures of new practices is as important as the interpretation of successes. "Bad news travels fast", and one unexplained failure will undo the acceptance and satisfaction gained by many successes. A case in point is the recent damage to strawberries using Chloro IPC on chickweed control. Potential users of Chloro IPC are discouraged from the use of this chemical on strawberries because of reported and unexplained damage. This reaction occurred in spite of the fact that the agricultural experiment station and extension service recommend the practice. Our extension responsibility should not permit us to turn our backs on trouble. Prompt and impartial evaluation will isolate the potentially bad publicity and serve our weed control project activity to better advantage

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Evaluation of Pre-emergence Spray and Granular Applications of CDEC on Vegetable Leaf and Cole Crops[1,2]

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The advent of CDEC (2-chloroallyl diethyldithio carbamate) as an herbicide offered new possibilities for weed control in vegetable crops. Trials by various research workers (1-8) have indicated that snap beans, red kidney beans, lima beans, beets, sweet corn, collards, Irish potatoes, kale, mustard greens, spinach, and turnip greens have a tolerance of weedkilling concentrations of CDEC. A summary of research to date indicates that pre-emergence applications of this chemical are effective in controlling crabgrass (Digitaria sp.), bullgrass (Eleusine indica), barnyard grass (Echinochloa Crus-galli), pigweed (Amaranthus retroflexus), ragweed (Ambrosia artemisiifolia), smartweed (Polygonum Hydropiper), galinsoga (Galinsoga parviflora), and purslane (Portulaca oleracea).

Procedure

Trials were organized in 1955 and 1956 to determine the effectiveness of pre-emergence spray applications of various acre-rates of CDEC at the Virginia Truck Experiment Station. Concurrently, small plot trials were conducted in various locations on farms in the coastal area of Virginia. Plantings of leaf crops were made on representative soil types at various seasons of the year to study the effect of soil texture and temperature on performance of the chemical. Pre-emergence treatments in spray form and in granular form on Attaclay were applied in these farm trials.

Results

Results of the trials on rates of application of CDEC at the Truck Experiment Station at two seasons of the year are presented in the reports in Trials I and II.

A summary of the results obtained in the small plot farm trials is presented without presenting the individual trial reports.

1/ Contribution from the Plant Physiology Department, Virginia Truck Experiment Station, Norfolk. Paper No. 127, Journal Series. Approved for publication November 5, 1956.

2/ Grateful acknowledgement of assistance in a portion of this work is made to the Monsanto Chemical Company, Minerals and Chemicals Corporation of America, the Zonolite Company, John H. Dulany & Son, Inc., and the Eberwine Bros. Canning Company

Results of Experiment Station Pre-emergence CDEC Rate Studies

Trial I. Results of Pre-emergence Sprays of CDEC on Fall Plantings of Leaf Crops and Cabbage.

Trial Location: Experiment Station field at Norfolk. Soil Type: Sandy clay loam.

Crop Varieties:

Turnip Greens	-	Seven Top
Mustard Greens	-	Giant Curled Mustard
Hanover Salad		
Kale	-	Vates Blue Scotch
Cabbage	-	Round Dutch
Spinach	-	Old Dominion Blight Resistant

Susceptible Test Crop: Italian Rye Grass. Exp. Design: 5 X Latin Square. Plot Size: 50 ft. of row. One row each of 3 crops on each 42-inch bed. Seeding Rate: Standard commercial. Planting Depth: Approx. ¼ inch. Planting Date: 10/5/55. Treat. Date: 10/6/55. Method of Application: All treatments applied in 50 gals. water per acre. Chemical: CDEC (2-chloroallyl diethyldithio carbamate). Chemical Rates: 0, 1, 2, 4, and 6 lbs. per acre. Data Collected: Yields and stand counts. Harvest Date: 3/22/56. Area Harvested: 10 ft. of row. Rainfall Record: For 3 wk. period following treatment. Soil moisture at treatment time - medium. 1st wk. 0.05 in., 2nd wk. 0.50 in., 3rd wk. 0 in. Total for 3 wk. period 0.55 in.
Temperature Record: For 3 wk. period following treatment in degree-hours above 0° F. 1st wk. 10205, 2nd wk. 9147, 3rd wk. 8600. Total for 3 wk. period 27952 degree-hours above 0° F.

Observations:

Crops — The 1 and 2 lb. per acre rates of CDEC were tolerated by all crops without any growth retardation or other signs of injury. The 4 and 6 lb. per acre rates of CDEC retarded spinach and mustard greens slightly.

Rye Grass — Italian rye grass was used as a sensitive test crop to indicate the herbicidal activity level of the chemical. Results showed that the 1 and 2 lb. per acre rates of CDEC were not sufficient to kill all of this grass. The 4 and 6 lb. per acre rates killed all of the rye grass.

Weeds — The 4 and 6 lb. per acre rates of CDEC controlled chickweed and henbit.

Yield and Stand Results:

(See table on following page)

Table I
Summary Table of Averages

Crop	Item	Lbs. CDEC Per Acre 0	1	2	4	6	L.S.D. 5%	1%
Turnip Greens	Yield-Tons/A.	6.8	6.3	6.1	6.6	5.2	0.7	1.4
	Wt./100 Plants-Lbs.	4.8	4.8	5.5	6.1	5.7	1.8	2.5
Mustard Greens	Yield-Tons/A.	5.7	8.0	8.5	6.1	4.7	0.3	0.7
	Wt./100 Plants-Lbs.	3.7	4.8	5.7	4.8	3.5	1.0	1.4
Hanover Salad	Yield-Tons/A.	6.6	6.6	6.3	6.8	7.1	1.2	2.3
	Wt./100 Plants-Lbs.	8.7	8.1	7.7	8.6	9.5	4.1	5.6
Kale	Yield-Tons/A.	5.6	5.9	5.4	5.2	5.2	0.3	0.7
	Wt./100 Plants-Lbs.	3.1	3.9	3.5	3.2	3.6	0.7	1.0
Cabbage*	Total Plant Wt.-Tons/A.	5.2	4.0	5.7	5.1	4.7	0.3	0.7
	Wt./100 Plants-Lbs.	5.7	4.0	4.7	5.0	4.8	1.3	1.8
Spinach	Yield-Tons/A.	4.2	3.7	3.1	3.7	3.5	0.2	0.3
	Wt./100 Plants-Lbs.	5.5	4.8	4.9	4.4	4.3	1.3	1.8

*Plants not mature. Leaf and stalk weight only.

Trial II. Results of Pre-emergence Sprays of CDEC on Spring Plantings of Leaf Crops and Cole Crops.

Trial Location: Experiment Station field at Norfolk. Soil Type: Sandy clay loam.
Crop Varieties:
- Spinach - Old Dominion Blight Resistant
- Turnip Greens - Pomeranian White Globe
- Mustard Greens - Giant Southern Curled
- Hanover Salad Greens - Early Hanover Salad
- Kale - Vates Dwarf Blue Curled Scotch
- Cabbage - Ferry's Round Dutch
- Broccoli - Early Green Sprouting Calabrese
- Brussel Sprouts - Catskill
- Cauliflower - Snowball

Susceptible Test Crop: Italian Rye Grass. Exp. Design: 5 X Latin Square. Plot Size: 1 row 20 ft. long. One row each of 3 crops on each 42-inch bed. Seeding Rate: Standard commercial. Planting Depth: Approx. ¼ inch. Planting Date: 4/2/56. Treat. Date: 4/3/56. Method of Application: All treatments applied in 50 gals. water per acre. Chemicals: CDEC (2-chlorallyl diethyldithio carbamate). CIPC (isopropyl-N-3-chlorophenyl carbamate). Chemical Rates: CDEC (2, 4, and 6 lbs. per acre). CIPC (1 lb. per acre). Data Collected: Yields and stand counts. Harvest Date: 5/24/56. Area Harvested: 20 ft. of row.
Rainfall Record: For 3 wk. period following treatment. Soil moisture at treatment time - medium. 1st wk. 0.23 in., 2nd wk. 0.59 in., 3rd wk. 3.19 in. Total for 3 wk. period 4.01 in.
Temperature Record: For 3 wk. period following treatment in degree-hours above 0° F. 1st wk. 9058, 2nd wk. 8700, 3rd wk. 8050. Total for 3 wk. period 25807 degree-hours above 0° F.

Observations:

Crops — All of the crops showed some retardation during the early stages of growth in all treatments. Retardation was outgrown in the 2 and 4 lb. per acre rates of CDEC in all crops but was still noticeable in some of the crops at harvest in the 6 lb. per acre rate. The retardation in the CIPC plots was much greater in all plots as compared to CDEC treatments.

Rye Grass — The 4 and 6 lb. per acre rates of CDEC and 1 lb. per acre rate of CIPC controlled the Italian rye grass.

Weeds — Acceptable control of chickweed and henbit was obtained with the 4 and 6 lb. per acre rate of CDEC. Chickweed was controlled by 1 lb. of CIPC per acre.

Yield and Stand Results:

Table II
Summary Table of Averages

		Chemical and Rate (lbs./A.)					L.S.D.	
Crop	Item	0	CDEC 2	CDEC 4	CDEC 6	CIPC 1	5%	1%
Turnip Greens	Yield-Tons/A.	7.2	6.7	7.6	7.6	6.7	1.6	2.2
	Wt./100 Plants-Lbs.	2.8	2.3	2.9	2.2	2.7		
Mustard Greens	Yield-Tons/A.	6.6	6.6	6.2	5.8	0	1.7	2.2
	Wt./100 Plants-Lbs.	1.9	2.4	1.8	1.7	0		
Hanover Salad	Yield-Tons/A.	4.8	4.5	5.0	5.9	4.0	0.5	0.7
	Wt./100 Plants-Lbs.	3.0	3.3	2.7	2.4	2.8		
Spinach	Yield-Tons/A.	3.3	3.0	3.1	2.4	2.9	0.3	0.4
	Wt./100 Plants-Lbs.	2.0	1.8	1.5	1.2	1.8		
Kale	Yield-Tons/A.	3.9	3.7	3.4	3.8	3.0	0.3	0.5
	Wt./100 Plants-Lbs.	2.6	2.7	2.2	2.9	2.6		
Cabbage*	Total Plant Wt.-Tons/A.	5.8	6.0	5.6	5.1	3.4	1.3	1.8
	Wt./100 Plants-Lbs.	3.4	4.4	3.2	3.1	2.5		
Broccoli*	Total Plant Wt.-Tons/A.	2.5	3.4	2.9	2.7	2.8	1.0	1.5
	Wt./100 Plants-Lbs.	2.8	3.7	3.1	2.4	2.7		
Brussel Sprouts*	Total Plant Wt.-Tons/A.	3.2	4.4	4.6	4.3	2.8	1.0	1.5
	Wt./100 Plants-Lbs.	2.4	2.8	2.7	2.3	1.4		
Cauliflower*	Total Plant Wt.-Tons/A.	2.8	3.5	3.8	3.4	1.5	1.0	1.4
	Wt./100 Plants-Lbs.	1.8	1.7	1.7	1.6	1.4		
Italian Rye Grass	Yield-Tons/A.	2.6	0.5	0.2	0	0	0.3	0.4

*Plants not mature. Leaf and stalk weight only.

Results of 1956 Replicated Small Plot Trials on Farms

Spinach, Turnip Greens, Kale, and Collards

A series of sets of replicated small plot farm trials on the use of CDEC involving both spray and granular pre-emergence applications on these crops confirmed the conclusions of earlier work that this chemical has practical possibilities for these crops.

Granular applications using 30-40 and 30-60 RVM Attaclay as the carrier for CDEC were as effective as sprays in controlling weeds. Results indicate that 50 pounds of either of these carriers is a sufficient amount.

Results of these trials indicate that rates of 3 to 4 pounds of CDEC per acre are effective during temperatures above 60° F. Lower rates of 2 or 3 pounds per acre appear acceptable at lower temperatures. Observations on the various soils involved indicate that very sandy soils require less CDEC for effective weed control than do heavy soils.

Observations of effects of these pre-emergence applications of CDEC on crop vigor and stand revealed some stand reduction and a retardation of growth in the early stages but were much less than those caused by CIPC and were not considered to be of practical importance. Data indicate that seeding rates of these crops should be increased when CDEC is used and the date of planting should be advanced one to two weeks to offset the retarding effect on the crops.

Effective control of chickweed, henbit, and annual grasses were observed in the majority of these trials when soil moisture was high enough at the time of application to give quick weed seed germination. Weed control failures were in large part associated with low soil moisture conditions. The optimum time for application was immediately after planting. Delayed applications with rain intervening which sealed the soil surface did not give satisfactory weed control.

Results of 1956 Preliminary Trials on Cole Crop Seed Beds

Broccoli, Brussel Sprouts, and Cauliflower

Observations on replicated plots of these crops treated with pre-emergence applications of CDEC in spray form and in granular form on No. 3 Vermiculite and on 30-60 RVM Attaclay indicated that all of these forms of application were practical in controlling annual grasses. Some reductions in stand and crop vigor were noted, indicating a need for earlier planting and increased seeding rates. Irrigation immediately following treatment was especially effective in giving acceptable weed control in dry weather. Irrigation before planting was not as effective. These trials indicated that 4 pounds of CDEC per acre would be an acceptable rate of application in the hot summer weather when these crops are planted.

Summary and Conclusions

CDEC was used in spray and granular form as pre-emergence applications on a number of vegetable leaf crops and cole crops.

Results indicated that CDEC applied immediately after planting on spinach, kale, collards, turnip greens, mustard greens, Hanover salad, cabbage, broccoli, cauliflower, and brussel sprouts has practical possibilities for control of annual grasses, chickweed, and henbit in these crops. Rates of 3 to 4 pounds in warm weather (above 60° F) and 2 to 3 pounds per acre in cool weather (below 60° F) appear feasible.

CDEC on granular carriers such as 30-40 or 30-60 RVM Attaclay and No. 3 Vermiculite were as effective as sprays of this chemical in controlling weeds in pre-emergence applications.

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Persistence and Penetration of 3-p-Chlorophenyl-1, 1-dimethylurea (CMU) in Asparagus Soils

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ABSTRACT 1/

Where CMU (3-p-chlorophenyl-1, 1-dimethylurea) has been applied to asparagus for weed control for 5 years at recommended rates (2 lbs. of Karmex W, 1.6 lbs. of CMU, both before and after cutting season), no CMU persisted over the winter in 1956, or in 1955 and 1954, in the top 8 inches of soil. A bio-assay, with oats as an indicator plant, was used to determine CMU levels in the soil, which was a Norfolk sandy loam.

CMU disappeared slowly during the first month after application (13% in the spring of 1956), after which disappearance became more rapid (65% disappearance by 7 1/2 weeks after the spring application in 1956). Disappearance was more rapid after the summer application than after the spring application (34% and 13% respectively a month after application in 1956). Cultivation accelerated disappearance of CMU considerably. Disappearance was slightly more rapid from soils with higher organic matter content.

A small amount of CMU penetrated to the 4 - 8 inch soil level. A maximum of 0.19 lbs. per acre at the 4 - 8 inch level was reached a month after the 1956 spring application of 1.6 lbs. of CMU. No CMU persisted over the winter at the 4 - 8 inch depth. There is no indication, so far, that penetration to this extent, to the 4 - 8 inch layer, is harmful to asparagus.

1/ Abstract of a manuscript to be submitted to WEEDS.

PROGRESS REPORT ON WEED CONTROL IN ONIONS, CRUCIFERS, AND SWEET CORN[1]

S. L. Dallyn, R. L. Sawyer and R. W. Robinson[2]

ONIONS

Previous work at this station on weed control in transplanted Sweet Spanish onions indicated the most promising materials to be C.I.P.C., monuron, and diuron. Directed application of these sprays was always preferable to overall application. The past season's work was largely a continuation of the promising aspects of the 1955 project, wherein the primary objective was to determine the maximum usefullness of herbicides in this type of production.

General Methods

C.I.P.C. was used at 4 pounds per acre, monuron and diuron at one-half pound per acre, per application. A split-plot design with four replications was used. The chemicals formed the three major plots with each of these divided into the following eight treatments:

(1) one application immediately after setting
(2) one application immediately after setting and again at 6, 9, and 12 weeks
(3) 3, 6, 9, and 12 weeks
(4) 6, 9, and 12 weeks
(5) 6 and 12 weeks (current suggestion for trial with C.I.P.C.)
(6) 3, 6, 9, and 12 weeks (50% higher rate on last application)
(7) 6, 9, and 12 weeks (50% higher rate on last application)
(8) check

Texas grown Sweet Spanish transplants were set April 24 and treatment 1 and the first application treatment 2 put on the same day. Subsequent treatments were applied at the intervals mentioned above. All plots were hand weeded immediately prior to chemical treatment.

Results

Pertinent data from the experiment are given in Table 1. Split plot analyses of these data indicated that the three chemicals were equally effective in controlling weeds. Differences between treatments were highly significant and in general, no chemical-treatment interactions occurred. This would indicate that the selection of the best combination would depend on the response of the onion crop.

Yield of onions was affected greatly by chemicals and treatments; in addition the chemical-treatment interaction was significant. Monuron was most injurious to the crop, followed by diuron. No C.I.P.C. treatment had any

[1] Paper No. 406, Department of Vegetable Crops, Cornell University

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Table 1. Performance of Various Herbicide Treatments in Transplanted Onions

Treatment	Yield Bus./A.	Weed Count[1] June 5	Weed Count June 26	Weed Count July 17	Weed Rating at[3] Harvest-Aug. 13
Monuron, April 24	665	1	10	32	5
" " " + 6,9,12 wks.	507**	1	2	3	3
" 3,6,9,12 weeks	537**	1	3	6	3
" 6,9,12 weeks	582*	--[2]	7	19	3
" 6 and 12 weeks	630	--	2	14	5
" 3,6,9,12 weeks (50% higher rate on 12 weeks)	456**	1	4	5	1
" 6,9,12 weeks (50% higher on 12 weeks)	539**	--	7	10	3
" Check	704	5	34	30	5
Diuron, April 24	647	1	35	31	5
" " " + 6,9,12 weeks	621*	2	1	2	3
" 3, 6, 9, 12 weeks	576*	1	1	0	2
" 6, 9, 12 weeks	651	--	3	4	3
" 6 and 12 weeks	685	--	5	9	4
" 3,6,9,12 weeks (50% higher rate on 12 wks)	616*	1	3	1	2
" 6, 9, 12 weeks (50% higher rate on 12 wks.)	622*	--	1	4	2
" Check	710	13	54	63	5
CIPC April 24	721	1	21	24	5
" " " + 6,9,12 weeks	738	1	9	5	2
" 3, 6, 9, 12 weeks	713	1	3	2	2
" 6, 9, 12 "	735	--	15	4	2
" 6 and 12 weeks	718	--	18	19	2
" 3, 6, 9, 12 weeks (50% higher rate on 12 wks.)	724	1	5	3	1.5
" 6, 9, 12 weeks (50% higher rate on 12 wks.)	724	--	22	7	2
" Check	702	7	85	58	5

* Yield different from check at 19:1 and 100:1**

[1] area 4' x 8" [2] no herbicide applied to this date [3] 1= no weeds 5 = very weedy

effect on yield. Treatment immediately after setting the plants did not reduce yields, but neither did it provide any advantage over the three week treatment in weed control. Treatment at three week intervals through the growing season, up until the time of layby, reduced the amount of hand weeding to approximately ten percent of that required in the checks.

The results of this year's work, in agreement with earlier findings, indicate that CIPC is the best material available at the moment and that several applications can be made without harming the crop. The first application should be made between the time of setting and the appearance of the first weeds--under our conditions normally two to four weeks. Subsequent applications can be made at three to four week intervals, depending on the weed problem involved. All treatments should be at the rate of three to four pounds per acre and preferably as band sprays directed towards the base of the plants.

CRUCIFERS

The general production practice for crucifers in this area is to produce the plants in seed beds, then transplant them to the field at five to six weeks of age. A main deterrant to direct field seeding is the problem of weed control during the period of plant establishment. Three experiments were conducted on this problem during the 1956 growing season. The first was on early planting of Danish cabbage, the second on a midseason planting, and the third on a commercial farm growing Chinese cabbage.

Experiment 1

Seed of Empire Danish variety was sown April 26 and the treatments listed in Table 2 put on immediately. Crop stand, injury ratings, and weed counts were made five weeks later.

Table 2. Effect of various pre-emergence treatments on weed control in direct seeded cabbage.

Treatment[1]	Stand Count[2]	Weed Count[3]	Injury Rating[4]
CDAA 2 lbs./A.	10	13	2.5
CDEC "	9	13	2
Crag DCU 5 lbs./A.	8	3	3
Crag DCU " (mixed into soil)	6	5	4
" " 10 "	6	4	4.5
CIPC 1.5 lbs./A.	6	10	3
5519 (Niagara) 1.5 lbs./A.	7	8	2
5521 " 1.5 "	10	9	2
Diuron .25 lb./A.	0	0	---
" .50 "	0	0	---
Neburon .50 "	10	2	2
" 1.0 "	7	0	4.5
" 2.0 "	0	0	---
Check	9	21	1
L.S.D. 5%	3	6	0.7

[1] active ingred. basis [2] per 8' row [3] area 4' x 8" [4] 1=no injury, 5= severe

The results from this experiment indicated that treatments 1, 2, 3, 6, 7, 8, and 11 were worthy of further study.

Experiment 2.

Materials which had looked promising in the earlier trial were studied in greater detail and two addition ones, Vapam and Geigy 444 were included. The seed was sown June 28 and the treatments put on in bands over the row the following day. One-half inch of water was applied immediately to the Vapam plots and the next day the entire area was irrigated with one inch of water. Two inches of rain fell during the period July 4-6. The Vapam plots were reseeded at one and two week intervals after the chemical had been applied. Weed and stand counts were made July 25 and are presented in Table 3.

Table 3 . Effect of several herbicides on cabbage seeded directly in the field June 28.

Treatment	Weed Counts* Broad	Weed Counts* Grass	Cabbage Stand**
CDAA 1 lb./A.	61	8	33
" 2 "	91	3	37
CDEC 1 "	63	25	29
" 2 "	49	17	22
DCU 3 "	123	11	26
" 5 "	119	13	29
CIPC 1 "	11	7	24
" 2 "	2	14	29
Niagara 5519 1 lb./A.	158	23	27
" " 2 "	82	8	25
" " 3 "	59	7	20
Niagara 5521 1 "	116	13	21
" " 2 "	71	21	23
" " 3 "	40	6	20
Neburon 1/3 "	74	13	24
" ½ "	83	16	36
Vapam 1 qt./100 sq. ft. seeded 1 wk. later	0	0	30
" " " " " " 2 wks. "	0	0	31
Geigy 444 2 lbs./A.	78	12	27
" " 4 "	70	6	29
" " 6 "	31	6	29
Check	117	16	31
Check	107	11	33
L.S.D. 5%	35	6	ns

* area 8" x 48" ** 10' of row

Several observations were apparent from this trial. None of the treatments were as effective as they had been earlier in the season in controlling weed growth. CIPC was definitely superior to 5519 and 5521 under the conditions of this test. CDEC was rated slightly above CDEA. Geigy 444 was not effective at the rates used. The performance of CIPC was satisfactory and crop damage negligible. The latter point has usually been the problem with this chemcial as the range of cabbage tolerance is relatively small. Vapam gave complete weed control for a period of 7 weeks; at the end of that time an occassional small weed came in. If the application of this material can be made economically feasible it could prove very useful.

Experiment 3.

Assistance was requested by a local Chinese farmer on a severe weed problem he had to contend with. The soil involved was a sandy loam and was extremely heavily infested with weeds, particularily lambs quarters and several species of summer grasses. His normal practice was direct field seeding in rows ten inches apart. His estimated cost of controlling the weeds (practically all hand work) under these conditions was in the vicinity of two hundred dollars per acre. After consideration of the factors involved the following materials were selected for trial: soil "fumigants" - methyl bromide, Vapam, and Crag 974; plus cyanamid, Niagara 5519, and CIPC.

The herbicides were applied July 12. Vapam treatments were watered in with three-fourths inches of water and the 974 and cyanamid raked thoroughly into the top one to two inches of soil. The methyl bromide was applied under polyethylene tarps. The grower's seed of Chinese cabbage was used and was planted on this date in the check plots and those receiving CIPC and 5519 treatments. A portion of each methyl bromide plot was sown July 17 and the rest July 20. The Vapam, 974, and cyanamid plots were seeded July 20 and 28. The following observations were made through the period to September 1 when the area was disked to prevent the grass from seeding. 1. Methyl bromide. This material was used at one and two pounds per hundred square feet. Weed control in both cases was good but not perfect. The crop from the July 17 seeding, i.e. five days after treatment, was definitely stunted.
2. Vapam. Rates used were one and one and one half quarts per hundred square feet. Both gave complete control of all weeds. The higher rate produced some crop injury, the lower little or none. Intervals after harvest (8 and 18 days) were not different from each other. The performance of this material was very satisfactory.
3. Crag 974 was applied at 100, 200, and 300 pounds per acre. The two higher rates gave complete and the lower excellent control of weeds. Crop injury was severe at 300 pounds, light to moderate at 200 pounds and nil at 100 pounds. Injury appeared to be somewhat greater at the 8 day interval than at the 18 day interval. The performance of this material was very satisfactory.
4. Cyanamid at 800 and 1200 pounds per acre was not satisfactory under the conditions of this test. The higher rate gave good weed control but injured the crop; the lower rate produced only slight crop injury but was only fair as a herbicide.
5. CIPC at 2 and 3 pounds per acre reduced the weed stand and gave a fair measure of control up to the 10th of August. No crop injury was noted.
6. Niagara 5519 at 3 pounds per acre performed about midway between the 2 and 3 pound rate of CIPC.

SWEET CORN

A block of Iochief sweet corn was planted July 26 with the primary purpose of comparing Simazin to the standard use of dinitro pre-emergence in this area. The following treatments were involved: Simazin at ½, 1 and 1½ pounds per acre; dinitro 1 gallon per acre immediately after seeding; dinitro 1 gallon per acre at comeup and check. Normal cultivation was given the middles but a one foot band over the rows was left undisturbed. Final observations were made on weed growth in the plots on October 10, just prior to harvest. Considerable grass was present at the lowest rate of Simazin and the pre-emergence dinitro. Dinitro at comeup was rated somewhat better than the two mentioned previously and could be considered satisfactory commercial control. One pound per acre of Simazin was still giving excellent control and the 1.5 pounds per acre plots were essentially weed free.None of the treatments affected yield. It is possible that higher rates would be required for comparable control in corn grown during the earlier part of the season.

SUMMARY

1. Monuron, diuron, and CIPC were found to be equally effective in controlling weeds in transplanted Sweet Spanish onions. CIPC is the preferable material, however, because of high crop tolerarance to it.

2. CIPC should be used at 3 to 4 pounds per acre, per application, under our conditions, and can be applied at 3 to 4 weeks intervals during the growing season. Band sprays directed towards the base of the plants reduce the cost and increase the effectiveness of the herbicide.

3. CIPC at 1 to 2 pounds per acre looked fairly good in direct seeded cabbage and Chinese cabbage. CDEC was considered worthy of further trial. Two soil "fumigants", Vapam and Crag 974 gave excellent weed control in soil heavily infested with weed seeds.

4. Simazin at 1.5 pounds per acre gave weed control superior to that of one gallon per acre of dinitro either pre-emergence or at emergence.

WEED CONTROL IN SWEET CORN - 1956

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The preliminary screening of chemicals for control of weeds has provided many potential weed killers for sweet corn. The extreme variation of soils, climate, and cultural methods found where this crop is grown, however, makes it imperative to subject these promising chemicals to wide scale tests before their general use can be approved. This paper presents the results of testing some of the newer materials at Amherst, Massachusetts during 1956.

Materials and Methods

Twenty-eight treatments, involving fourteen chemicals, were applied to plots of Seneca Beauty sweet corn; these treatments were replicated three times. Each plot consisted of four 24-foot rows. 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 one ton per acre. The corn was planted on June 25, 1956.

All the chemicals, except Treatments 2 and 3, were applied pre-emergence on July 26, the day after planting. Treatment 2 was applied just as the corn plants emerged on July 1, and Treatment 3 applied at the spike stage on July 3. The various chemicals with their respective per-acre rates are listed in columns 2 and 3 of Table I. 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 good condition for seed germination and growth.

The weed population consisted of purslane, smartweed, lamb's-quarters, chickweed, galinsoga, pigweed, and crab-

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grass. The readings on weed count, weed height, and crop height were made on August 1, and then the plots were all cultivated once prior to lay-by. Rainfall during July and August was only two-thirds of normal, and temperatures were just about normal for the period. The crop made just average growth until September 19, when the ears were harvested and weighed.

Results

The results of the tests are presented in Table I. It is readily apparent that all the treatments were effective in reducing the stand and size of the weeds as compared to the growth of weeds in the check plots; the differences were highly significant. The Neburon treatments (Plots 12 and 13) and the Karmex W and 2,4-D mixture (Plot 14) were especially outstanding, because no weeds grew there throughout the summer. Although the stand of weeds was sparse in all the treatments, the weeds grew to a height of 10 to 14 inches in all but plot 11 of the Karmex-treated plots, in plot 21 where 8 pounds of 5519 per acre were used, and also in plot 28 where one pound of ACP M-177 per acre was used.

Corn plants in the plots treated with Neburon were smaller through the growing season and significantly shorter than the plants in the plots receiving the other treatments when measurements were made on August 1. The yield of ears from these short plants was the lowest in the tests. The variability of yield was great enough so that only the six highest-yielding treatments were significantly greater than the two lowest-yielding Neburon treatments.

Summary

Reaction to Dinitro and 2,4-D treatments was about the same as that of former years. For several years TCB has appeared very promising as an herbicide for corn. Emid and CDEC also performed very favorably this year. When 3Y9 was used at 10 pounds per acre, results were good also. The Karmex W and 2,4-D mixture looks very promising, and variations of this mixture should probably be tried.

It is evident that yield was sacrificed in some of the treatments at the expense of good weed control. A reduction in the rate of some of the chemicals might provide good commercial control without reducing yields.

TABLE I. Effect of Chemicals on Weed Control, Growth, and Yield of Seneca Beauty Sweet Corn

Planted June 25, 1956 - Recorded August 1, 1956

Plot	Treatment	Rate per Acre Lb. active	Weeds per Sq. Ft.	Weed Height Inches	Crop Height Inches	Ear Weight Lbs.	Yield Marketable Ears Lbs.
1	DN (Premerge)	6.00	3.0	6.0	20.7	0.68	21.3
2	DN (Premerge)	4.50	.7	2.7	17.0	0.63	16.7
3	DN (Premerge)	2.25	2.3	4.7	16.3	0.68	18.1
4	Dow Form. 40	1.50	3.7	4.3	20.0	0.65	20.3
5	Emid	1.50	1.3	3.7	20.0	0.62	20.3
6	Karmex W	0.60	3.7	9.7	22.0	0.62	19.4
7	Karmex W	0.80	2.7	10.7	20.0	0.62	16.4
8	Karmex DW	0.60	4.0	12.3	19.3	0.56	16.2
9	Karmex DW	0.80	2.0	12.7	20.7	0.65	17.1
10	Karmex DL	0.60	4.0	14.3	21.3	0.67	22.3
11	Karmex DL	0.80	1.0	8.0	18.0	0.68	20.1
12	Neburon	5.00	0.0	0.0	14.0	0.61	15.4
13	Neburon	7.50	0.0	0.0	13.0	0.63	15.0
14	Karmex W +	0.60	0.0	0.0	18.0	0.65	19.5
	2,4-D amine	1.50					
15	TCB (H.C. 1281-AD)	1.00	0.7	3.3	19.3	0.61	19.3
16	PCB (ACP-M103A)	1.00	4.3	7.7	24.0	0.73	26.0
17	TCB +	0.75	1.3	1.3	22.0	0.73	25.6
	CDAA	6.00					
18	TCB +	0.75	0.66	3.3	21.3	0.72	24.7
	CDEC	6.00					
19	CDEC	6.00	1.3	3.0	20.0	0.69	25.0
20	CDEC	9.00	1.3	3.7	20.7	0.69	23.7
21	5519	8.00	4.0	12.0	20.0	0.66	21.6
22	5519	12.00	1.3	9.0	18.7	0.66	21.3
23	5521	8.00	1.3	6.7	20.0	0.70	25.0

(Continued)

Plot	Treatment	Rate per Acre Lb. active	Weeds per Sq. Ft.	Weed Height Inches	Crop Height Inches	Ear Weight Lbs.	Yield Marketable Ears Lbs.
24	5521	12.00	1.0	7.3	18.0	0.66	20.9
25	Check		22.0	20.7	22.7	0.62	18.9
26	3Y9	5.00	3.0	6.3	18.7	0.73	24.2
27	3Y9	10.00	1.0	1.3	19.3	0.67	20.7
28	PCB (ACP-M177)	1.00	3.3	10.0	22.0	0.72	25.0
L.S.D. @ .05			2.5	3.0	3.4	0.08	7.0
L.S.D. @ .01			3.3	4.1	4.5	0.11	9.3

WEED CONTROL IN CANNING PEAS

by J. J. Jasmin and L. H. Lyall

In order to compare some of the older recommended herbicides with newer introductions and especially MCPB (gamma-(4 chloro-2-methylphenoxy) butyric acid) and 2,4-DB (gamma (2,4-dichlorophenoxy) butyric acid), tests were carried out at the Horticultural Substation, Smithfield, Ontario, and the Horticultural Organic Soil Substation, Ste. Clothilde de Chateauguay, Quebec. At each location the tests were slightly different but for the sake of comparison they are both reported in this paper. Preliminary work on 2,4-DB and MCPB was reported by Wain (2), (3) and Carpenter and Soundy (1).

Horticultural Substation, Smithfield, Ontario

On May 7, Perfection W.R. peas were sown on Berrien sandy loam at normal width between the rows and the rate of seeding recommended for canning peas in the area. Plots 8 feet wide by 20 feet long were treated with pre-emergence herbicides on May 10 and with post-emergence herbicides on June 4. All treatments were applied at low pressure in approximately 30 gallons of water per acre.

A randomized block design was used for this experiment with five replications and ten treatments as follows:

1. Control, no herbicide nor any kind of weeding.
2. Amine DNBP (Premerge) at the rate of 6 lb. of DNBP per acre, applied at pre-emergence.
3. Amine DNBP (Premerge) at the rate of 1½ lb. of DNBP per acre, applied at post-emergence when the peas were approximately 4 inches tall.
4. MCPB (Tropotox), the sodium salt of gamma (4 chloro-2-methylphenoxy) butyric acid, at the rate of 24 oz. of MCPB acid per acre, applied at post-emergence.
5. MCP the amine form of (4 chloro-2-methylphenoxy) acetic acid, at the rate of 5 oz. of MCP acid per acre, applied at post-emergence.
6. MCPB the amine form of gamma (4 chloro-2-methylphenoxy) butyric acid, at the rate of 32 oz. of MCPB acid per acre, applied at post-emergence.
7. MCPB, the ester form of gamma (4 chloro-2-methylphenoxy) butyric acid, at the rate of 24 oz. of MCPB acid per acre, applied at post-emergence.
8. 2,4-DB, the amine form of gamma (2,4-dichlorophenoxy) butyric acid, at the rate of 32 oz. of 2,4-DB acid per acre, applied at post-emergence.
9. 2,4-DB the ester form of gamma (2,4-dichlorophenoxy) butyric acid, at the rate of 24 oz. of 2,4-DB acid per acre, applied at post-emergence.
10. 2,4-D the amine form of 2,4-dichlorophenoxy acetic acid, at the rate of 3 oz. of 2,4-D acid per acre applied at post-emergence.

Plots were left untouched until it was time to harvest them. Weed counts were taken on June 21 by counting the total number of weeds in 6 square feet taken at random in each plot. Stand was calculated two days before, on June 19, by counting the number of pea plants in four six foot sections of row taken in each plot. At harvest, the total weight of shelled peas per plot

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was measured, and texturemeter readings were determined from each plot by taking the average of three readings on samples lifted from the bulk lot of shelled peas from the plot. Results from all these are given in Table 1, together with average weight of shelled peas per plot taken on July 17.

Table 1. Effect of herbicides on Canning Peas at Smithfield

Treatments	Yield of shelled peas per plot (lb.)	Texture-meter reading at harvest	Stand of peas in 4 6-ft. section of row per plot	Comparative weed population in 6 square feet
1. Control	7.4	106	154	64
2. DNBP pre-em.	8.5	107	142	16
3. DNBP post-em.	10.1	115	145	17
4. Sodium salt of MCPB	8.0	100	137	31
5. Amine of MCP	7.5	102	139	27
6. Amine of MCPB	7.3	100	138	35
7. Ester of MCPB	7.4	105	144	34
8. Amine of 2,4-DB	6.5	100	141	29
9. Ester of 2,4-DB	7.0	95	135	42
10. Amine of 2,4-D	7.0	99	135	37
L.S.D. at $P = 0.05$	1.7	8	N.S.	9

Discussion:

DNBP was certainly much more efficient than any other herbicide on trial. It gave a weed count significantly lower than any other weed killer, a better yield of shelled peas, and an earlier crop. Stand was apparently not affected by any of the herbicides since the difference in number of pea plants per plot is not significantly different. It is interesting to note that post-emergence application of DNBP produced significantly earlier and better yield than any other treatment except the pre-emergence application of DNBP.

Next in line are the MCP's, then the 2,4-D's but the difference between the two is not significant. At the rates used in this experiment and under the conditions of the test it seems that the sodium salt of MCPB may possibly be a better herbicide for peas than any of the other MCP's or 2,4-D's used in this experiment, although further trial will be required before definite conclusions can be drawn.

Notes on general appearance, taken June 22, indicated that MCP and MCPB caused very slight twisting of the stem, darker color, and formation of narrow pointed leaves in some cases. Abnormalities were more apparent where the ester form of MCPB and the amine form of MCP were applied. Severe distortion of the stem, narrow pointed leaves, wrinkled leaves, and a dark bluish-green color of the upper leaves were found where 2,4-D and 2,4-DB were used. The symptoms were less severe with the amine form of 2,4-DB.

Horticultural Organic Soil Substation, Ste. Clothilde, Quebec

On May 8 Perfection W. R. peas were sown on marginal muck at normal width between the rows and rate of seeding recommended for canning peas in the area. Plots 11 1/3 feet wide by 60 feet long were treated with pre-emergence herbicides on May 11 and with post-emergence herbicides on June 12. All treatments were applied at 70 lb. pressure in approximately 30 gallons of water per acre.

A randomized block design was used for this experiment with four replications and eight treatments as follows:

1. Control, no herbicide nor any kind of weeding.
2. Amine DNBP at the rate of 6 lb. of DNBP per acre, applied at pre-emergence.
3. Amine DNBP at the rate of 1½ lb. of DNBP per acre, applied at post-emergence when the peas were approximately 4 inches tall.
4. MCPB (sodium salt) at the rate of 24 oz. of MCPB acid per acre, applied at post-emergence.
5. MCPB (sodium salt) at the rate of 36 oz. of MCPB acid per acre, applied at post-emergence.
6. 2,4-D amine at the rate of 3 oz. of 2,4-D acid per acre, applied at post-emergence.
7. MCP amine at the rate of 5 oz. of MCP acid per acre, applied at post-emergence.
8. Monuron at the rate of 3/4 lb. of active ingredient per acre, applied at post-emergence.

Plots were left untouched until it was time to harvest them. For various reasons which could not be controlled this season, it was impossible to harvest the whole experiment in one day. Harvesting started on July 31 and ended on August 4. During these few days the temperature was rather warm and the peas matured quickly. Texturemeter reading were 108 on the control when harvesting was started and 130 on the MCPB treatment, harvested on August 4. General readings on weed population, bloom, distortion and appearance were taken on July 3.

Treatments	Yield of shelled peas per plot (lb.)	Texturemeter readings at harvest	Date of harvest
1. Control	14.6	108	31-VII
2. DNBP pre-em.	22.2	123	3-VIII
3. DNBP post-em.	23.5	116	3-VIII
4. Sodium salt of MCPB	23.1	130	4-VIII
5. Sodium salt of MCPB	33.5	122	4-VIII

(Table continued)

Treatments	Yield of shelled peas per plot (lb.)	Texturemeter readings at harvest	Date of harvest
6. 2,4-D amine	29.1	115	2-VIII
7. MCP amine	25.0	116	3-VIII
8. Monuron	22.5	106	1-VIII
L.S.D. at P = 0.05	9.4	5	

Discussion:

The higher rate of the sodium salt of MCPB appears to be a suitable herbicide for canning peas grown on marginal muck. Yields were significantly higher than that of the control or any treatment except the 2,4-D amine and the MCP amine. The treatments with DNBP, Monuron, and the lower rate of MCPB sodium salt all gave yields which were not significantly higher than the control.

The differences in texturemeter readings undoubtedly influenced the yields obtained from some treatments, and in evaluating the treatment effects in the above table this should be kept in mind.

It was found from general observation notes made on July 3 that blooming was retarded quite appreciably by application of the sodium salt of MCPB and especially by the higher rates of application. No distortion was observed from any of the treatments, but the sodium salt of MCPB and especially the highest application produced a dwarfing effect on pea plants and the leaves of MCPB treated plots were smaller than normal pea leaves.

Conclusion:

By comparing results obtained from both of these tests it seems evident that in this season at least DNBP was much more efficient on mineral soils than on marginal muck. Sodium salt of MCPB should be tested more extensively as a selective herbicide on peas, at different rates, and on different varieties, since it is evident from both experiments that this chemical has appreciable qualities as a herbicide for peas.

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Progress Report on Chemical Weeding of Beets and Lima Beans[1]

Charles J. Noll[2]

The study of chemicals for weed control in beans and beets is a continuation of experiments run in previous years.

The two experiments described below were on Hagerstown silt loam soil under wet growing conditions and with a severe weed problem. Cultivation was practiced between the rows.

Procedure

The chemicals were applied with a small sprayer over the seeded row for an 8 inch width. Salt was applied at the rate of 400 gallons per acre of solution. All other chemicals were applied at the rate of 34 gallons per acre under a pressure of 35 pounds per sq. inch.

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.

Seeds of the lima bean variety Fordhook 242 were planted June 14, 1956 with a spacing between seeds of approximately 3 inches. Pre-emergence chemicals were applied two days after planting at the rates shown in Table I. Individual plots were 23 feet long and 3 feet wide. Treatments were randomized in each of 10 replicated blocks.

Beets were planted June 14, with a Planet Jr. hand seeder. Pre-emergence chemicals were applied the day following seeding at rates shown in Table II. The plots treated with salt were sprayed in a post-emergence application at the time the beets had 4-5 true leaves. Individual plots were 24 feet long and 2 feet wide. Treatments were randomized in each of 10 replicated blocks.

Results and Discussion

The results of the lima bean experiment are presented in Table I. All herbicide treatments gave increased weed control as compared to the untreated plot significant at the 1% level. Reduction in the stand of lima beans was obtained with 3Y9 at both the 1 and 2 gallon rates of treatment significant at the 1% level. The weight of beans in the pods was increased as compared to the unsprayed check by all chemical treatments significant at the 1% level.

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The results of the beet experiment are presented in Table II. All herbicide treatments except salt and Herbisan gave increased weed control significant at the 1% level, as compared to the untreated plot. Significant reduction in the stand of beets was obtained with Niagra 5519, Niagra 5521 and Karmex DW at their highest rate of treatment and Neburon, ACP M118, and ACP M119 at all rates of treatment. Weight of topped beets was increased as compared to the unsprayed check significant at the 1% level for the combination treatment of 10 lbs. of TCA and 6 lbs. of Endothal, with Karmex W at $\frac{1}{2}$ lb. per acre, with Karmex DW at $\frac{1}{2}$ lb. per acre and with CDAA at 6 lbs. per acre. Increases in weight of topped beets significant at the 5% level were found with the combination spray of 10 lbs. of TCA and 12 lbs. of Endothal, and CDAA at 9 lbs. per acre as compared to the untreated check plot.

Conclusion

In the lima bean experiment taking into consideration the amount of weed control, the stand of beans, and the yield of beans, the best treatments were Premerge at 4 and 6 lbs. per acre, Neburon at 4 and 6 lbs. per acre, ACP M118 and M119 at 2 lbs. per acre and Niagra 5521 at $1\frac{1}{2}$ and $2\frac{1}{4}$ gal. per acre. All treatments resulted in good weed control and increased yield as compared to the untreated check plot.

In the beet experiment, taking into consideration the amount of weed control and the stand and the yield of beets, the best treatments were the combination treatment of 10 lbs. of TCA and 6 lbs. of Endothal per acre, 10 lbs. of TCA and 12 lbs. of Endothal per acre, CDAA at 6 and 9 lbs. per acre, Karmex W at $\frac{1}{2}$ lb. per acre and Karmex DW at $\frac{1}{2}$ lb. per acre. Karmex W and DW treatments at 1 lb. per acre reduced the stand and yield as compared to the better treatments.

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.

Niagra 5519 sec. - Butyl N-(3-chlorophenyl) carbamate
Niagra 5521 (1-chloropropyl-2) N-(3-chlorophenyl) carbamate
3Y9 tris - (2,4-dichlorophenoxyethyl) phosphite
ACP M118 dimethylamine 4-(2,4-Dichlorophenoxy)-N-butyric
ACP M119 dimethylamine 4-(4-chloro 2 methylphenoxy)-N-butyric
CDAA a-chloro-N, N-diallylacetamide

Table I. The effect of chemical herbicides applied 2 days after planting on weed control and on stand and yield of lima beans.

Herbicide	Rate per Acre	*Weed Control	Average per Plot: Stand of Plants	Average per Plot: Weight of beans in pod - lbs.
Nothing	0	10.0	63	5.0
Premerge	4 lbs.	1.7	62	12.5
"	6 lbs.	1.5	68	13.7
Niagra 5519	$1\frac{1}{2}$ gal.	3.9	61	8.2
" "	$2\frac{1}{4}$ gal.	3.4	73	9.9
Niagra 5521	$1\frac{1}{2}$ gal.	2.7	67	10.0
" "	$2\frac{1}{4}$ gal.	2.1	68	12.8
3Y9	1 gal.	2.2	48	9.6
"	2 gal.	1.7	42	9.0
ACP M118	2 lbs.	3.1	58	11.8
" M119	2 lbs.	1.6	60	12.1
Neburon	4 lbs. active	2.2	72	12.0
"	6 lbs. active	1.4	71	14.1
Least Significant Difference 5%		1.0	10	2.2
" " " 1%		1.3	13	3.0

*Weed control 1-10: 1 perfect weed control
10 full weed growth

Table II. The effect of chemical herbicides applied the day following planting on weed control and on stand and yield of beets.

			Average per Plot	
Herbicide	Rate per acre - lbs.	*Weed Control	Stand of Plants	Weight of topped Beets - lbs.
Nothing	0	6.9	39.9	1.9
TCA and Endothal	10 and 6	2.7	51.0	4.8
" " "	10 and 12	1.8	36.2	3.8
+Salt	400	8.0	57.6	1.4
Niagra 5519	8	2.3	38.2	3.0
" "	12	1.3	15.6	1.7
Niagra 5521	8	1.6	34.3	2.7
" "	12	1.1	16.7	2.1
Karmex W	½	2.1	50.7	5.9
" "	1	1.1	22.2	2.3
Karmex DW	½	2.1	51.5	5.3
" "	1	1.9	16.1	2.6
Neburon	2	1.1	2.9	0.7
"	4	1.0	.7	0.3
ACP M118	1	2.5	14.0	1.2
" "	2	1.6	4.2	0.6
ACP M119	1	1.1	1.6	0.1
" "	2	1.1	.5	0.0
CDAA	6	3.0	52.8	4.3
"	9	1.9	40.4	4.0
Herbisan	2 gal.	6.5	47.7	0.9
"	3 gal.	6.7	37.1	0.9
Least Significant Difference	5%	1.1	22.3	1.7
" " "	1%	1.4	29.4	2.2

+Salt applied at 4 - 5 true leaf stage of beet
*Weed control 1-10: 1 perfect weed control
10 full weed growth

WEED CONTROL IN BUTTERNUT SQUASH - 1956

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Previous work at this station indicated that squash could be weeded successfully with pre-emergence dinitro sprays (1, 2). The natural sequence of events then was to try other weed killers that might be adapted to weeding fields of squash. The purpose of this paper is to present the results of applying varying amounts of seven pre-emergence weed killers to plots of Butternut Squash.

Materials and Methods

The treatments involved several rates of applications of seven weed killers. These are listed in columns two and three of Table I. 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 1,200 pounds per acre. The squash seed was planted on June 19, 1956, about one inch deep. Ten seeds were planted in each hill, and the stand was thinned later to three plants per hill.

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 fifteen feet apart. The weed killer was applied to a strip six-feet wide over the rows; weed control in the nine-foot section between the treated strips was dependent upon cultivation.

The weed killers were 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 sprays were applied to the plots on June 19, immediately after planting. The soil was rather dry during this period because only a trace of rain fell between June 10 and June 27, and then 0.49 inch of rain relieved the situation. Rainfall during July and August

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was less than two-thirds of that ordinarily expected. The weed population consisted of purslane, smartweed, lamb's-quarters, chickweed, pigweed, galinsoga and crab-grass.

Germination counts were made on July 2, and then the squash plants were thinned to a uniform stand of three plants per hill. Weed count and size were recorded on July 18 after which the plots were cultivated three times before lay-by. The crop was harvested on September 29.

Results

The results of these tests are presented in Table I. Germination appeared to be reduced by the ten-pound rates of Neburon 3Y9, but the differences among the treatments were not significant.

The weed stand varied from an average of one per square foot in the plots treated with ten pounds of Neburon and 6 pounds of CDEC up to twenty-three weeds per square foot in the check plot. Compared to the Check, all treatments were effective in reducing the weed stand significantly.

The few weeds present on many plots grew quite tall, probably because of a shortage of moisture shortly after treatment, reducing the effectiveness of the weed killers. The few weeds on the CDEC plot, however, were only 1.3 inches tall. The crop plants appeared normal for the most part on all plots except those treated with 3Y9 and Neburon. As might be expected, the 3Y9 caused a considerable epinastic response, especially where the 10-pound rate was used. The plants on the Neburon-treated plots showed reduced growth and vigor. Although plant damage on the 3Y9-treated plots resulted in seriously reduced yields, the production of squash was not impaired significantly by the Neburon treatment. Yields among the other plots did not differ significantly.

Summary

The pre-emergence application of 6 pounds of CDEC resulted in best weed control among the various treatments. Only Neburon affected yields adversely. Further tests of the materials used here should be made on squash before definite conclusions can be reached.

Table I. Effect of Chemicals on Weed Control, Growth, and Yield of Butternut Squash

Planted June 19, 1956 - Recorded July 18, 1956

Plot		Rate Per Acre Lb. Active	Weeds per Sq. Ft.	Weed Height Inches	*Plant Vigor and Appearance	Yield Lbs.
1	DN(Premerge)	4.5	5.3	7.0	9.0	76.6
2	DN(Premerge)	6.0	3.3	6.0	7.7	76.2
3	Karmex W	0.6	4.7	5.3	7.3	63.3
4	Karmex W	0.8	5.7	7.3	8.3	78.5
5	Neburon	5.0	6.3	6.3	7.3	61.3
6	Neburon	10.0	1.0	3.3	3.7	66.2
7	CDEC	6.0	1.0	1.3	8.0	73.7
8	5519	9.0	10.0	6.7	7.0	56.1
9	5521	9.0	10.0	6.0	6.3	63.8
10	3Y9	5.0	13.3	7.3	1.7	34.3
11	3Y9	10.0	6.7	5.3	1.0	7.1
12	Check		23.0	11.0	8.7	66.9
L.S.D. @ .05			5.2	2.0	1.3	27.5
L.S.D. @ .01			7.1	2.7	1.8	37.3

*Rated 1 to 9 with as most desirable.

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Results of 1956, Wet Season, Weed Control on Potatoes.

Preemergence Treatments		% Weeds at Digging Time 10/1/56	Yld. Bu. per Acre
Karmex D. W.	1 lb. per A.	95	231.5
Karmex W.	1 lb. " "	95	258.1
Karmex W.	2 lb. " "	85	232.0
Karmex F. W.	2 lb. " "	85	287.5
Sinox G.	3 pts. " "	25	276.3
Sinox W.	6 pts. " "	20	233.8
Sinox P. E.	8 pts. " "	25	291.0
Geigy 444E	6 lb. " "	10	285.0
Geigy 444E	12 lb. " "	5	298.0
Amino Triazole	3 lb. " "	70	233.2
Amino Triazole	5 lb. " "	50	249.4
Check		100	221.2

Katahdin variety used. Planted 5/28/56. Treatments sprayed across the row 6/11/56, replicated 4 times, 2 row plots, 50 ft. long. Monthly rainfall on plots, May - 6.65 in, June 5.0 in., July 6.0 in., August 9.0 in., Sept. 5.0 in.

No apparent top damage, stand good on all plots . Yields low due to late blight, no significant differences.

Quack Grass Control Treatments

Treatments applied on 12' x 20' plots of solid quack grass, 5 years stand, on 5/5/56. Two replications plowed 5/14/56, Rep. 1 & 4. Two replications plowed 5/21/56, Rep. 2 & 3. All planted 5/25/56. Stands on all plots about the same. Potatoes dug 10/1/56, yields poor and not recorded. Cooking tests made from amino triazole and Dalapon, no off-flavors found.

		% quack grass present at digging time.			
Treatment		Rep. 1	Rep. 4	Rep. 2	Rep. 3
Check		100	100	100	100
Dalapon	10 lbs. per A.	50	60	60	50
"	20 " " "	25	25	30	30
"	40 " " "	10	15	10	5
Amino triazole	1 lb. per A.	100	100	100	100
	2 " " "	100	95	90	95
	4 " " "	100	100	90	95
	8 " " "	80	90	50	80

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PROGRESS REPORT ON PRE-EMERGENCE AND LAY-BY WEED CONTROL WITH POTATOES[1]

R. L. Sawyer, S. L. Dallyn and G. Collin

The data presented here is a continuation of pre-emergence and lay-by work previously reported (1,2,3,4). Pre-emergence work was limited primarily to a comparison of several concentrations of the substituted ureas with dinitros. Lay-by work was limited to potato tolerance of materials which had previously given good grass control since the maturing season was one of the coolest in many years with grass control not a serious problem.

Material and Methods

Pre-emergence weed control

Katahdin tubers were planted April 20. Planting hills were worked down by spike tooth harrow and the soil mechanically weeded on May 8. Chemicals were applied on May 22 when ten per cent of the plants were starting to emerge. Chemical treatments were put out in a randomized block design with four replications. To account for uneven weed population a check plot was placed beside each chemical treatment. Individual plots were 24 feet long and four rows wide. Rainfall in inches for the three week period following application of materials was as follows: May 24, .03; May 26, .34; May 30, .16; May 31, .14; June 3, .10; June 4, .19; June 9, .12; June 11, .11; June 12, .56. Weed counts and vine tolerance ratings were made on June 6. Cultivation of check plots was initiated on June 11 and chemical plots on June 30. Plots were harvested on September 29 and specific gravities taken. Samples were saved for chipping and storage loss determinations.

Lay-by weed control

Katahdin tubers were planted April 8, and given the normal cultural treatments for Long Island until lay-by sprays and granular materials were applied on July 7. Rainfall and irrigation water received for the month following treatment was as follows: July 19, 1.00 irrigation; July 20, .04; July 26, .07; July 29, .15; August 3, 1.00 irrigation. Plots were four rows wide and 30 feet long with four replications of each chemical treatment in a randomized block design. There was a check treatment beside each chemical treatment to aid in accuracy of comparison. Potato vine tolerance ratings were made on July 31. Plots were harvested and specific gravity measurements made on September 17, 1956. Samples were saved for chipping and storage loss determinations.

Results and Discussion

The materials and dosages used in pre-emergence work are given in Table 1 which includes potato vine tolerance, yield and quality.

[1] Paper No. 406, Dept. of Vegetable Crops, Cornell Univeristy, Ithaca, N. Y.

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

Table 1. The effect of several pre-emergence sprays on weed control, yield and specific gravity of tubers.

Materials	Lbs./A.	Weed Count % of Check	Yield % of Check*	Specific Gravity
DNOSBP (amine salt)	3.0	23	82.2	1.0777
Monuron	.5	101	85.5	1.0757
Monuron	1.0	9	84.0	1.0800
Monuron	1.5	8	71.8	1.0742
Diuron	.5	59	87.1	1.0752
Diuron	1.0	36	91.2	1.0762
Diuron	1.5	13	86.8	1.0787
Neburon	.5	64	68.6	1.0772
Neburon	1.0	78	68.4	1.0792
Neburon	1.5	52	73.3	1.0775
7355	5.0	79	67.9	1.0772
7355	10.0	45	72.9	1.0772
L.S.D. 5%		35	16.5	NS

* average yield of all check plots 551 bushels per acre

As usual the dinitro at 3 pounds per acre gave good weed control. When check plots were first cultivated , the dinitros plots had started to break down in weed control but monuron at 1.0 and 1.5 pounds per acre and diuron at 1.5 pounds per acre were still holding nicely. At the time the weed counts were made there was an average of 217 weeds per 9 square feet of check plot. All chemical plots had decreased yield when compared with the checks. Probably this was partially due to the fact that cultivation was delayed on chemical plots for a longer period than check plots in order to get an indication of the longivity of weed control with the various materials. Neburon and 7355 gave unsatisfactory control at all dosages. Monuron at 1.5 pounds per acre followed a trend of yield reduction previously observed (4). None of the materials had an influence on potato quality as measured by specific gravity.

The lay-by weed control results are given in Table 2. CDEA at eight pounds per acre gave visible vine damage. Dalapon at both rates gave visible vine damage and decreased yields when compared with checks. Diuron at ½ and 3/4 pounds per acre gave vine damage as a spray but no noticeable damage as a granular material. Diuron as a spray depressed yields at both ½ and 3/4 pounds per acre and gave a lower specific gravity at 3/4 pounds per acre when compared with checks. Diuron as a granular material did not statistically depress yield or specific gravity. Although tubers from 3Y9 plots did not have a statistically higher specific gravity than checks, the trend of previous data is still apparent (1).

Storage results for the 1955 field work with lay-by materials are shown in Table 3. Field data for these materials were included in the 1956 report (1). Although there was no statistical significance among treatments in sprout weight or shrinkage it is interesting to note that Natrin has given the least sprouting of any treatment both in 1955 and 1954 (1).

Table 2. Potato vine tolerance, yield and specific gravity of tubers from plots treated with lay-by materials.

Material	Lbs./A.	Potato Vine* Tolerance	Yield U.S.No. 1 Bushels per acre	Specific Gravity
Natrin	4.0	8.5	563	1.0725
Natrin	7.5	8.7	581	1.0762
3Y9	3.0	8.0	623	1.0770
3Y9	6.0	9.0	595	1.0782
CDEA	4.0	8.5	589	1.0757
CDEA	8.0	5.0	557	1.0720
CDEC	6.0	8.5	612	1.0762
CDEC	9.0	9.0	677	1.0762
Dalapon	2.0	4.2	507	1.0770
Dalapon	4.0	3.0	533	1.0727
Alanap 2	4.0	8.5	602	1.0750
Alanap 2	6.0	9.0	582	1.0730
Alanap 3	4.0 Granular	9.0	593	1.0790
Alanap 3	6.0 "	9.0	591	1.0742
Diuron	½	6.2	545	1.0737
Diuron	3/4	3.5	438	1.0697
Diuron	½ Granular	8.5	587	1.0745
Diuron	3/4 "	9.0	565	1.0735
Check		9.0	621	1.0753
L.S.D.		1.0	72	.0042

* Potato vine tolerance rating------9 = no damage   1 = vines dead

Table 3. Sprouting and shrinkage of tubers treated with lay-by sprays after storage for 6 months at 50° F.

Material	Dosage	Grams of sprouts per kilogram of tuber	Percent Shrinkage
Craig I	4	7.5	5.6
Dalapon	4	6.0	4.4
Sesin	4	6.8	4.8
Natrin	4	5.1	5.0
Alanap 2	4	6.4	7.5
3Y9	3	5.7	5.5
CDAA	3	6.0	4.7
CDAA	6	6.4	4.6
CDEA	3	7.1	5.5
CDEA	6	7.0	6.7
CDEC	3	6.9	5.9
CDEC	6	7.3	5.1
Diuron	½	6.3	5.9
Diuron	3/4	7.3	5.2
Check		7.1	5.1
		NS	NS

Results and Discussion

The materials used and the effectiveness of kill are given in Table 1. All three scorers rated the materials similarly so only the average of the three scorers is given. No benefit was observed from the use of wetting agents. With the 5 treatments in which sodium arsenite was used at six pounds per acre and eight pounds per acre, sodium arsenite gave a better kill in each comparison at the eight pound rate.

Summary

The addition of wetting agents to sodium arsenite had no beneficial effects in the killing of potato foliage. Sodium arsenite at eight pounds per acre gave a better kill than six pounds per acre.

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EFFECT OF WETTING AGENTS ADDED TO SODIUM ARSENITE FOR POTATO VINE KILLING[1]

R. L. Sawyer, S. L. Dallyn and George Collin[2]

Arsenite mixtures have been used for over 20 years to kill potato vines and weeds before harvesting on Long Island. This experiment was conducted to determine if wetting agents added to sodium arsenite would give a quicker kill or allow a reduction in dosage.

Materials and Methods

Chemical sprays were applied on August 22 to Katahdin potatoes which had received the normal cultural treatments for Long Island. At this time the potato vines had started to die with lower leaves yellowed but terminal growth still an active green. Plots were single rows, 15 feet long with three replications.

Plots were rated by three people on effectiveness of kill according to the following chart 10 days after sprays were applied.

1. Poor kill of both leaves and stems
2. Most leaves killed - poor stem kill
3. All leaves killed - poor stem kill
4. All leaves killed - fair stem kill
5. Good kill of both leaves and stems

Table 1. Effectiveness of wetting agents added to sodium arsenite for potato vine killing.

Sodium Arsenite - Lbs. per Acre	Wetting Agents	Ave.
6		3.0
8		4.3
6	B1956, 4 oz./A.	2.8
8	" "	3.4
6	Dupont spreader sticker, 4 oz./A.	3.1
8	" " " "	3.6
6	disel oil, 6 lbs./A.	3.2
8	" " 8 "	4.0
6	114, 2 oz./A.	3.0
8	" "	3.8
8	ACP sticker, 8 oz./A.	3.9
8	Genifilm L 8 oz./A.	3.7
8	X77, 4 oz./A.	4.0
8	Tide, 4 oz./A.	3.6

1 Paper No. 407, Department of Vegetable Crops, Cornell University, Ithaca, N. Y.

2. Long Island Vegetable Research Farm, Cornell University, Riverhead, N. Y.

SUMMARY

1. Pound for pound monuron gave better weed control than diuron although diuron appears somewhat safer. This conclusion is based on results of the past three years.

2. From the standpoint of safety regarding yield and quality and taking into consideration the average necessity for a pre-emergence weed material DNOSBP still looks best for most situations.

3. Natrin and Alanap 2, after 3 years work and 3Y9, CDEA and CDEC after 2 years work still continue to look promising as lay-by overall sprays for control of late grass problems.

4. Diuron which gives too much reduction in yield and quality as a spray appears to have promise as a granular application. This is of particular importance since it has given very good results in grass control. Alanap 3 also appears to have promise as a granular material.

5. Dalapon as an overall spray does not merit further consideration in spite of it being a strong grass killer since it has consistantly given damage to either yield, quality or both.

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New York Vineyard Weed Control Trials in 1956

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Experimental work with Karmex W in Concord vineyards has been conducted at the Vineyard Laboratory of the New York Agricultural Experiment Station since May 1953. As a result of earlier work the following experiment was conducted on Howard gravelly loam in 1956.

All applications were made in a 24" band directly under the trellis wire. The sprayer used is described in Cornell Extension Bulletin 816. No attempt was made to avoid spraying vine trunks. The pressure was 50 p.s.i.; the speed was 2.0 miles per hour; the gallonage per acre applied was 200. Both Karmex W and Karmex DW were used early (Jan. 3, 1956) and in spring (March 27, 1956) at three rates of application on plots which had been hoed free of weeds and on plots not hoed prior to each application. There were three replicates for the "not hoed" condition and two for the "hoed" condition. Each of the 120 plots was 48 feet long and bounded by an unsprayed plot of 24 feet in length. The Concord vines were more than 10 years old and spaced eight feet in the row. All of the vines were balance pruned and annual yield and growth data are available for each vine since 1947.

Table 1 presents the weed control data. Particularly important is the footnote reporting chlorosis on only two treatments. With respect to weed competition only the June and August scoring data should be used. The superiority of control by the March 27 application is clear. The major weeds in the treated plots on June 27 were dandelion, milkweed and crabgrass. The major weed in the check plots was ryegrass which was seeded as the cover crop.

With respect to the "not hoed" plots there is no consistent difference between the two materials. The contrast in control between materials for the twelve-pound rate on August 14 is so large that comment is necessary. The difference is primarily one of greater crab grass control by the Karmex DW. The large decrease in ground cover by green plants on Nov. 14 (after a freeze) on these twelve-pound Karmex W plots suggests the growth of summer annuals at

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the August 14 scoring. Four pounds of either material at either time of application was insufficient for commercial weed control.

Table 1. The percentage of the treated soil surface covered by green weeds in Karmex plots. Fredonia, N. Y. 1956. Data are means of three replicates for not-hoed plots, two for hoed plots.

Tillage cond. at application	1956 Application date Date applied	1956 Scoring Date	Unsprayed checks	Per cent of soil covered by green weeds Lbs.Karmex formulation (80%)/A 4 W	4 DW	8 W	8 DW	12 W	12 DW
Not hoed	1/3	6/27	73	50	55	30	--	28	19
(weeds)	3/27	"	73	42	40	40	20	8	18
"	1/3	8/14	90	70	77	77	--	73	19
"	3/27	"	90	53	60	22	23	37	10
"	1/3	11/14	81	53	65	57	--	7	12
"	3/27	"	81	22	33	5	24	4	2
Hoed	1/3	6/27	31	20	8	10	--	2	12
(weed free)	3/27	"	31	12	1	0	0	2	2
"	1/3	8/14	92	80	58	65	40	42	20
"	3/27	"	92	60	10	1	1	2*	1*
"	1/3	11/14	8	0	2	2	10	1	10
"	3/27	"	8	2	3	1	0	2	1

* = grape foliage had 5 per cent of its area chlorosed by translocated herbicide.

In the hoed plots, the weed control problem is less and the data point to the adequacy of four pounds of Karmex W. A very small amount of leaf chlorosis appeared on plots receiving the 3/27 application of either material. Here the 11/14 scoring shows that the major weeds were summer annuals in both treated and untreated areas.

A list of the dominant weeds in each plot at each time of scoring is available for inspection at the office of the senior author. Orchard grass, quack grass, red fescue, rye grass and many other weeds are easily controlled with these materials. Bindweed, dandelion, sorrel, alfalfa and wild carrot are more persistent in plots which have received Karmex W or DW.

We are not impressed by the excellent control obtained in plots previously hoed. The major objective in the present use of vineyard herbicides is to eliminate the grape hoeing. The material should be evaluated where there is a weed problem.

Table 2. The median (M) values and ranges (R) for the percentage of ground covered by green weeds in the treated band in 32 vineyards. New York 1956.

	1956 date of				Per cent of soil covered by green weeds Pounds of Karmex W/acre					
Soil texture	Application	Scoring	No. of sites		0	2	4	8	12	grower control[a]
light	3/29-4/19	6/12-7/19	18	M	67	28	14	4	--	--[b]
				R	17-100	2-85	0-77	0-65	--	--
"	"	8/16-9/20	17	M	82	72	40	12		70
				R	53-100	23-93	3-83	0-53		0-100
heavy	"	6/12-7/19	14	M	80	--	40	16	7	--[b]
				R	58-100	--	12-100	2-97	2-100	--
"	"	8/16-7/19	12	M	97	--	60	32	17	80
				R	87-100	--	23-100	3-100	2-100	40-100

[a] This was grape-hoeing or weed spraying with oil-dinitro.

[b] Grower control scorings here were primarily dependent on the date of grape-hoeing.

The Vineyard Herbicide Survey

Following the very promising results obtained in New York experimental vineyards with Karmex W in 1953, 1954 and 1955, it was decided to study the material in a wider group of soils, weed problems, and vines. Accordingly, a randomized block design with three replications and four treatments was used in each of 34 vineyards. Each plot was 72 feet long and contained nine vines. For gravelly loams and sandy loams the treatments were 0, 2, 4, and 8 pounds per acre of Karmex W (80% formulation). For heavier textured soils, the rates were 0, 4, 8 and 12 pounds. Applications were made* with the equipment and procedure described for the first experiment in this report. There was no 1956 tillage in the treated area in any of these vineyards recorded here. All plots had some weeds at the time of application. Applications in the 29 Chautauqua County vineyards were on March 29-30, 1956. In the five Yates County vineyards, applications were on April 19, 1956. Each of the 12 plots in each of 32 vineyards was scored for percentage ground covered by green weeds and for the identity of these weeds. Mean values were obtained for each treatment in each vineyard and from these Table 2 is obtained.

* See footnote following Summary and Conclusions.

Table 3. The characteristics of vineyards varying in weed response to four pounds of Karmex W applied in early spring. New York vineyard survey plots. 1956.

	Weed Response Category	
	(a) High control	(b) Low control
Number of vineyards	9	7
with light soil texture	7	6
with heavy soil texture	2	1
Per cent green ground cover:		
at June scoring	20	17
at Sept. scoring	25	60
Per cent green ground cover		
in control plot: at June scoring	61	63
at Sept. scoring	71	91
Dominant and characteristic weeds of each weed response category	sorrell[1] rye grass annual blue grass quack grass	milkweed[2] crabgrass[3] barnyard grass ragweed[4]

1 Rumex Acetosella
2 Asclepias
3 Digitaria sanguinalis
4 Ambrosia artemisiifolia

The wide range in ground cover for the vineyards leads to an inspection concerning the cause. Restricting our attention now to plots receiving the four pound rate it is possible to sort two groups of vineyards: (a) those whose percentage of green weed cover increased less than 15 per cent from the June to the September scoring and (b) those whose cover increased more than 30 per cent. These are described in Table 3.

We can conclude from this that soil texture and the percentage of ground covered in June are not major factors in this weed response. The difference in ground cover change in the control plots indicates an important cause for these responses in weed control. In the vineyards showing high control, the weeds were present in spring and early summer and thus subject to the full application. Where there was low control, the weeds were mainly summer annuals whose germination and early growth could have taken place in the surface inches from which the herbicide may have been leached.

In 1956 the April through August rainfall at Fredonia was 22.75 inches, 40 per cent more than normal.

Eight vineyards in this survey had bindweed or wild morning glory. Where this was Convolvulus arvensis L. there was no control. Where the weed was wild morning glory, Convolvulus sepium L. there was an increase in the amount of growth of this weed due to the application of Karmex W, even through 16 pounds per acre. This growth increase was likely due to killing of other weeds by t. Karmex and there was then a pure stand of the wild morning glory. In some plots we had to record the wild morning glory growth over the tops of the grape vines six feet high. It can shade the vine and delay fruit maturity.

Vine Responses to Karmex W

In the light textured soils there was a trace of chlorosis in one vineyard at the eight-pound rate. Young vines (non-bearing) showed slightly more leaf chlorosis. There was no leaf chlorosis at any rate in any vineyard on heavy-textured soil. The first visible symptom of possible vine harm is leaf chlorosis. This appears where there is no decline in pruning weight, or yield, or measurable delay in grape maturity. Thus we assume that if the vine is free of the chlorosis which is characteristic for this herbicide that no vine harm has been done. We have not measured or observed a beneficial response beyond that due to weed removal.

In several vineyards, grape seedling growth in Karmex treated plots indicated these may become a weed problem and at the same time that they are tolerant of the applied herbicide.

Observations on Karmex W trials in New York Concord Vineyards in 1953-1956

As a result[1] of the CMU experiments in Ohio vineyards by Mr. George Still since May, 1951, we started our trials in May, 1953. The outstanding result of the 1953 trials was that Concord grapes on Howard gravelly loam could be kept weeded for more than two growing seasons by one application of Karmex W at the rate of 17 pounds of the 80% formulation per acre. There was no visible or measurable effect on the vines appearance, growth or yield. The vines were vigorous, mature, and in a perennial grass sod.

1954 work showed that serious chlorosis (50% of the leaf area) followed the application of eight pounds of Karmex W to mature Concord vines growing on an eroded phase of Howard gravelly loam that was not weedy.

In a study of the tolerance of Concord grapes to Karmex W 10, 20, and 40 pounds per acre were applied to vines in 1954 and the application reported in 1956. The soil was Howard gravelly loam. Serious chlorosis and necrosis followed by defoliation and loss of crop occurred at these high rates. Several weeks following the defoliation, chlorosis-free leaves were produced even on the vines most seriously affected.

[1] Correspondence of 4/24/53.

In April, 1956, more than thirty acres of Concord vineyard on sandy loam, gravelly loam, and silt loam were sprayed with an oil-dinitro emulsion to which three or four pounds of Karmex W were added. The weed control was approximately equal to that with eight to twelve pounds of Karmex W. Perennial grass control was better than by the recommended three sprays of oil-dinitro; crab grass control was less. This is the most promising chemical control of vineyard weeds we have tried. The oil-dinitro emulsion is described in Cornell Ext. Bul. 816.

Summary and Conclusions

Karmex W and DW applications are more effective in early spring than in early January for vineyard weed control.

There is a danger of increasing the wild morning glory problem by the use of Karmex W (or DW). These materials should not be used where Convolvulus sepium L. is present in the vineyard.

Where dominant weed is chickweed or annual bluegrass, weed control was easily achieved with four pounds per acre of Karmex W.

Where the dominant weeds are rye grass, quack grass or orchard grass, weed control was achieved with four to eight pounds of Karmex W on light soils. At least eight pounds per acre would be required for the average weed problem on heavy soil vineyards.

Dandelion, wild carrot (Daucus Carota), horse nettle (Solanum carolinense) and broadleaf dock (Rumex obtusifolius) are resistant to the herbicidal action of Karmex W and DW.

The combination of Karmex W and oil-dinitro emulsion is a very promising vineyard herbicide mixture.

The equipment worked very satisfactorily. In 1957 these herbicides will be applied in a strip at least 30" wide instead of the 24" width used previously. This will assure the overlapping of the disced area and the area treated with herbicide.

With the extraordinary cooperation of James Blodgett of Planters Cooperative; C. V. Flagg of Bedford Products; John Norton and Wm. Greveling of National Grape Cooperative; Lloyd Curtis of G. L. F. and County Agent Gilbert Smith.

A New Herbicide, Soil Fungicide and Nematocide Called Mylone,
by J. W. Keays and R. J. Zedler, Carbide & Carbon Chemicals Co., New York

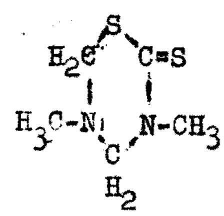
Introduction

CRAG Mylone, 85W is a temporary soil sterilant. Laboratory and field tests indicate that it will control most annual and perennial weeds, certain nematodes, soil fungi and soil insects. Mylone is a solid which can be applied dry or with water. The material is easy to handle and needs no plastic cover. Most any crop can be planted after a three week waiting period. Further field tests of Mylone as a pre-planting treatment for the control of weeds, nematodes, diseases and soil insects in tobacco, vegetable and conifer seed beds, ornamental propagating beds and turf should be made.

Chemical and Physical Properties

Mylone is a white crystalline solid. It is formulated as an 85% wettable powder. This formulation can be applied dry with a fertilizer spreader or suspended in water as a drench or spray.

The structural formula of Mylone, 3,5-dimethyltetrahydro-1,3,5,2H thiadiazine-2-thione is:



Properties of the active ingredient are:

Melting point. . . . . .99.5°C
Flash point, open cup tester. . . . . .280°F.
Reid bomb vapor pressure at 100°F. 1.0psia

Solubilities in Organic Liquids at 25°C.

Solvents	Solubility (% by wt.)
Trichlorethane	26
Ethylene dichloride	21
Acetophenone	16
Isophorone	6

Solubility in water and acetone at 30°C.

Water	0.12
Acetone	19.4

Performance

Herbicide:

In greenhouse herbicide testing Mylone at 100-lb./A gave 100% control of weeds (mustard, pigweed, crabgrass, foxtail) present in the top inch of soil.

Material	Lbs./A	Weed control after 2 weeks	3 weeks	4weeks
Mylone	10	0	0	0
	15	1	0	0
	25	2	0	0
	50	3	0	0
	100	3	2	1
	200	3	2	1
Control	-	0	0	0

0 = no weed control
1 = commercial control
2 = very few weeds germinated.
3 = no weeds germinated

In this test the material was hand-sprayed on the soil surface and drenched into the soil.

In field testing Mylone gave excellent results at recommended dosages against purslane, crabgrass, carpetweed and foxtail.

Material	Lbs./A	Total no. weeds/sq. ft., reps. I	II	III	IV	Totals	Average
Mylone	75	3	6	4	5	18	4.50
	150	9	2	5	5	21	5.25
	300	3	0	1	2	6	1.50
Control	-	26	18	22	26	92	23.00
						LSD 5%	3.50

The material was spread dry on the soil surface and rotovated into the top four inches of soil. The test was irrigated after treatment. Turnips planted two weeks after treatment showed no evidence of phytotoxicity.

In Bridgeton, N. J., on light sandy soil, a suspension of 300-lbs. in water sprayed on the surface and hand cultivated into the top three to four inches of soil gave 100% control of annual broadleaf and grass weeds.

Considerable evidence has been accumulated to indicate that Mylone will control perennial weeds such as bindweed, Bermuda grass, Johnson grass, wild artichoke and nutgrass. However, control of nutgrass has not been complete in all instances. Improved performance can be obtained by repeated cultivation prior to treatment.

Fungicide:

Mylone has given consistently excellent control of Pythium spp. in the greenhouse when drenched in 5" pots at 150-lbs./A.

A typical series of tests gave the following results:

Material	Lbs./A.	% Germination of peas Av. for three reps.
Mylone	18	16
	37	82
	75	89
	150	93
Control	-	24

In field testing at Boyce Thompson Institute, Mylone gave excellent control of cabbage club root when applied as a drench at 50-lbs./A.

Material	Infection rating
Mylone	0.6
Check	3.52

0= none
1= slight
2= moderate
3= severe
4= complete

In field tests Mylone has controlled Fusarium, Pythium, Phytophthora Stromatinia, Rhizoctonia and Verticillium spp.

Nematocide:

Laboratory tests indicate that Mylone gives excellent control of nematodes at rates less than those required for weed control. In greenhouse pot tests against the rootknot nematode (Meloidogyne incognita) Mylone gave the following results:

		Amount of galling lbs./A.				
Material	Repl. no.	180	90	45	23	12
Mylone	1	None	None	Mod.	Mod.	Mod.
	2	None	None	Severe	Mod.	Mod.
Vapam	1	None	None	Light	Mod.	Severe
	2	None	None	Mod.	Mod.	Mod.

Field testing throughout the country indicates that at rates from 100 to 300-lbs./A., Mylone controls the following nematode species:

Meloidogyne javanica
Rotylenchulus reniformis
Meloidogyne incognita
Paratylenchus minutus
Tylenchulus semipenetrans
Pratylenchus penetrans
Radopholus similis

Soil Insecticide:

In laboratory tests, Mylone has given high mortality of housefly (*Musca domestica* L.) and armyworm (*Prodenia eridania*) larvae.

In a field test conducted at Phelps, N. Y., against European Chafer (*Amphilmallon majalis*), the material gave excellent control and showed promise as a grass toxicant.

Material	Lbs./A.	No. chafers*/4 cu. ft.	% Control	Grass toxicity**
Mylone	150	2.0	98	1
	300	0.0	100	5
Control	-	67.5	0	1

*Average of two replicates
**Rating system: 1= no damage
5= complete kill

How to apply Mylone

Time of Treating and Planting: Mylone should be applied before planting. The soil should be tilled before treatment. Wait at least three weeks after treatment to plant. Under cool soil conditions (under 60°F.at two inch level) a longer waiting period may be necessary.

Dosage: Apply 300-lbs./A. (3/4-lb./100 sq. ft.) evenly over the ground.

Methods of Application:

1. Watering can: Use as much water as is necessary for even coverage. Mylone can be added directly to water. The suspension should be stirred occasionally to prevent settling.

2. Fertilizer spreader: Mylone can be applied in this manner if an accurate fertilizer spreader is available. It may be necessary to increase the bulk by adding a diluent.

3. Sprayer: Mylone is formulated as a wettable powder; use large nozzles and screens to prevent clogging. Use enough water to give even coverage and keep the sprayer agitated.

Mix with Soil: After Mylone has been applied to the soil, mix it into the soil to a depth of five to six inches with a rotary cultivator or a disc harrow. If mixing is impossible deep raking is required. The sterilant effects brought about by the slow dissipation of the material make intimate mixing, either by rotovating, discing or drenching extremely important for the best results.

Water: The treated area should be irrigated with about an inch of water soon after treatment. If the soil is moist when treated, the amount of water applied need not be so great.

Mode of Action and Effect of Environment

Tests have shown that upon contact with moist soil Mylone releases gaseous and water soluble active ingredients in the soil which will control weeds, nematodes, soil fungi and soil insects. Anderson and Okimoto of the Pineapple Research Lab. reported at the AIBS meeting in 1953 that Mylone suspended in flasks would kill *Phytophthora cinnamomi* cultured in the bottom of the flask. When air dry, 50 mg. of Mylone was the minimum effective dose. When the chemical was wetted, fumes from 10 mg. were effective even after 20 days. When redried 30 mg. of Mylone was necessary for kill.

It has been evident from many tests that most crops can be planted two to three weeks after treatment. In the following test Mylone was raked into the upper two inches of soil. Immediately after treatment and at the end of seven and fourteen days one row each of corn, bean, cucumber, radish and carrot was seeded in each of the plots.

Mylone in lbs./A.	Planting time after application	Rating of stand and vigor Corn	Bean	Cucumber	Radish	Carrot	Weeds
50	Immediately	Fair	Exc.	Exc.	Fair	Good	Good
	7 days	Fair	Good	Exc.	Good	Exc.	Fair
	14 days	Fair	Fair	Fair	Fair	Fair	Fair
100	Immediately	Poor	Poor	Poor	Poor	Poor	Poor
	7 days	Good	Exc.	Good	Exc.	Fair	Poor
	14 days	Good	Good	Fair	Good	Exc.	None
200	Immediately	Poor	Poor	Poor	Poor	Fair	Poor
	7 days	Exc.	Exc.	Exc.	Exc.	Exc.	Poor
	14 days	Exc.	Exc.	Good	Exc.	Good	None
Check	Immediately	Good	Exc.	Exc.	Exc.	Exc.	Exc.
	7 days	Good	Good	Good	Good	Good	Good
	14 days	Good	Good	Good	Good	Good	Good

The results indicate that under the conditions of this test a two week waiting period would be adequate for seeding any of the above vegetable crops.

Soil temperatures play a major role in insuring that Mylone will control weeds and other pests. This is shown by a test for the control of damping-off of peas. In this test pots with soil containing mixed damping-off organisms were put at their respective temperature levels for 24 hours prior to treatment. Forty-eight hours after treatment the peas were planted. The treated pots were then held an additional 24 hours at the respective temperatures. This allowed the two-day old Mylone residue to act upon the seed at the desired temperature. The entire test was then moved to a greenhouse and kept at 70° F. Following are the results:

Mylone lbs./acre	Average % Pea Germination 98°F	70°F	40°F.
37	4	2	0
75	67	16	0
150	84	91	0
300	87	93	18
600	98	87	0
Disease check	0	0	0
Sterile check	93	91	91

Another test determined that the peas did not germinate in the 40°F series because of toxicity from Mylone rather than from lack of disease control.

The effect of soil pH seems negligible. There is a relationship between soil type and Mylone activity as evidenced by the following test, a pea seed germination test for the control of damping-off.

Mylone in lbs./acre	% Germination (Av. 3 replicates) Orange County Muck	Greenhouse Compost Soil
75	29	67
150	53	91
Check	14	12

This indicates that rates should be increased on organic soils. Differences in performance on various mineral soil types have not been great.

Toxicology

Mylone is not a poison by any of the accepted definitions. The single oral dose LD_{50} of this material to rats is 0.5 gram per kilogram of body weight. Tests indicate that it is not readily absorbed through the skin and is not a primary skin irritant.

Status Under Miller Amendment

No tolerances, temporary or otherwise for Mylone, have been established under the Miller Amendment to the Food, Drug and Cosmetic Act. Residue studies from vegetable and field crops have shown little or no Mylone present. However, until adequate residue studies are completed crops grown in treated soil should not be used for food or feed.

CHEMICAL WEED CONTROL IN RHODODENDRONS

R. L. Ticknor and P. F. Bobula *

This experiment was undertaken to determine the weed control efficiency and plant toxicity effects of the most promising materials used in our 1954 pre-emergence screening trials. (1)

Procedure

The test planting consisted of 10 rows, 120 feet long, with 30 plants to a row. Each row was divided into three plots, 40 feet long and 2 feet wide, for this experiment. There were three rows of 4-year-old *Rhododendron catawbiense*, "E. S. Rand"; two rows of 10-year-old *R. catawbiense*, "Roseum Elegans"; and five rows of 10-year-old *R. catawbiense* hybrid seedlings. Because of the mixed nature of the planting, it was impossible to obtain growth records, although injury attributable to chemicals has not been observed to date. The plots in E. S. Rand will be continued, and new plots will be set up during 1957 with 2-year-old Roseum Elegans so that we may obtain growth records.

Chemicals were applied twice during the season, June 14 and August 3, to weed-free soil. Chemicals used were Alanap-3 at 6 lbs./A., a combination of Alanap-3 at 3 lbs./A. and SES at 3 lbs./A., SES at 10 lbs./A., Monuron at 1/2 and 1 lb./A., Diuron at 1/2 and 1 lb./A., CIPC at 4 and 6 lbs./A., and an untreated check. Each treatment was replicated three times.

Directed pre-emergent applications to the 2 x 40 foot plots were made using one-gallon jugs equipped with "Weedone Sprayer" nozzles. One gallon of water was used for each plot to insure even distribution of the chemicals. This is equivalent to 544.5 gallons to an acre.

Contribution No. 1078 of the University of Massachusetts, College of Agriculture, Experiment Station, Amherst, Mass.

* Assistant Research Professor and Research Assistant in Nurseryculture, Waltham Field Station, University of Massachusetts, Waltham, Massachusetts.

Weed counts were taken on four of the one-square-foot areas of each plot. Table I lists the number of each weed species in established Rhododendronsafter nine chemical treatments. Table II lists the average number of weeds, the fresh weight of the weed tops of each plot, and a rating number. A rating system of 0 to 5 was used with 0 signifying four weeds or less to one square foot; 1, 20-percent of surface weed covered; 2, 40-percent coverage; 3, 60-percent coverage; 4, 80-percent coverage; and 5, 100-percent coverage. Final records for the June 14 application were taken on July 30, 1956, and for the August 3 application on September 26, 1956.

TABLE I. Number of weeds of different species on 12 square feet in established Rhododendrons after treatment with 9 chemicals during the Summer of 1956.

		WEED SPECIES									
		Period 1					Period 2				
Chemical	Amt./A	A	B	C	D	E	A	B	C	D	E
1. Alanap-3	6 lb.	25	15	14	2	28	503	175	50	5	20
2. Alanap-3 SES	3 lb.) 3 lb.)	8	5	34		14	232	116	75	5	13
3. SES	10 lb.	3	20	27	5	30	170	270	35	11	33
4. Monuron	½ lb.	2	6	38		24	3	33	42		5
5. Monuron	1 lb.			5		1					
6. Diuron	½ lb.		1	8	5	26	16	12	14		5
7. Diuron	1 lb.	2				2					
8. CIPC	4 lb.	2		25	14	2	87	15	93	2	2
9. CIPC	6 lb.	1		26	15	1	41	7	82	1	1
10. Check		4	20	16	14	101	191	370	42	14	46

1 Period 1 -- June 14 - July 30, 1956
2 Period 2 -- August 3 - September 26, 1956

A. Grass sp.
B. Chickweed - *Stellaria media*
C. Henbit - *Lamium amplexicaule*
D. Carpet Weed - *Mollugo verticillata*
E. Purslane - *Portulaca oleracea*

TABLE II. Average number of weeds, fresh weight of the weed tops, and rating number for 4 square feet in established Rhododendrons after treatment with 9 chemicals during the Summer of 1956.

Chemical	Amt./A	Rating[1]	Rating[2]	Number of weeds[2] per 4 sq. ft.	Weight of weeds[2] per 4 sq. ft.
1. Alanap-3	6 lb.	2.58	3.68	251	276
2. Alanap-3 SES	3 lb.) 3 lb.)	1.08	2.93	147xx	255
3. SES	10 lb.	1.75	3.25	173xx	205
4. Monuron	½ lb.	2.00	.75xx	29xx	37x
5. Monuron	1 lb.	.08x	.00xx	0xx	0xx
6. Diuron	½ lb.	.93	.43xx	16xx	8xx
7. Diuron	1 lb.	.43x	.00xx	0xx	0xx
8. CIPC	4 lb.	.75x	1.68x	67xx	119
9. CIPC	6 lb.	.75x	1.75x	45xx	199
10. Check		3.83	3.33	221	330
L.S.D.5%		2.98	1.40	34.4	231.8
L.S.D.1%		4.10	1.93	47.3	318.0

x - Significantly different from the checks at the 5% level.

xx - Significantly different from the checks at the 1% level.

1 Period 1 -- June 14 - July 30, 1956

2 Period 2 -- August 3 - September 26, 1956

Results and Observations

Numerical records obtained in this experiment are presented in Tables I and II.

There are advantages and disadvantages in all methods of evaluating weed control plots. The rating system is apparently the most satisfactory and most rapid method for evaluating weed control plots, particularly when accompanied by an estimate of predominant weed types. Weed number is the least reliable method of estimating the weed coverage of the plots; however, the number of each weed species indicates any possible weakness of a chemical. Weed weight gives a fairly reliable estimate of the weed cover but is time-consuming to obtain.

Our trials this year indicate that CIPC does not give good control of Lamium amplexicaule, Henbit, and Alanap-3 failed to control grass-type weeds. Since both of these materials at times give very satisfactory weed control, combinations of different herbicides should be studied to obtain a wide spectrum of activity.

Monuron and Diuron continue to give the most satisfactory weed control in these Rhododendrons. To date, no injury that can be attributed to these chemicals has been found on the Rhododendrons. We will need several more years experience, particularly with young plants, before we can suggest that growers apply these chemicals to their more valuable plants.

Literature Cited

(1) Ticknor, R. L. and P. F. Bobula. Some results with pre-emergence applications of several herbicides around Rhododendrons and Taxus. Proc. NEWCC 9:211-215 (1955).

The authors wish to acknowledge the contribution of chemicals from the following companies:

Carbide and Carbon Chemicals Company, New York, N. Y.
Columbia-Southern Chemical Corp., Pittsburg, Pennsylvania
E. I. duPont deNemours and Company, Wilmington, Del.
Naugatuck Chemical, Naugatuck, Connecticut

CHEMICAL WEED CONTROL IN MISCELLANEOUS NURSERY STOCK

R. L. Ticknor and P. F. Bobula *

This experiment was undertaken to determine how toxic certain herbicides previously found effective under certain conditions, were to several representative types of nursery stock. (1,2)

Procedure

The test planting consisted of 21 blocks, 18 feet long and 20 feet wide. One row of each of the following types of plants was planted in each block: Cotoneaster divaricata, Spreading Cotoneaster, Juniperus chinensis Pfitzeriana, Pfitzer's Juniper, and Taxus cuspidata, Japanese Yew. All plants had been grown in lining-out beds for one year before setting up this experiment.

Chemicals were applied three times during the season, May 23, July 20, and September 7, 1956, to weed-free soil. Chemicals used were a combination of Alanap-3 and SES at 2 lbs/A. of each and at 4 lbs./A. of each; Monuron at 1/2 and 1 lb./A; CIPC at 4 and 6 lbs./A., and untreated check. Each treatment was replicated three times.

Directed pre-emergence applications were made with a knapsack sprayer in such a manner that the basal portions of the plants were usually contacted by the herbicides. The chemicals were applied in solution using one gallon of water to a plot, or approximately 120 gallons to an acre.

Gloucester fine, sandy loam was the soil type upon which our weed control experiments were conducted. The soil in these plots was kept moist either by natural rainfall or supplemental irrigation during the growing season.

Contribution 1079 of the University of Massachusetts, College of Agriculture, Experiment Station, Amherst, Mass.

* Assistant Research Professor and Research Assistant in Nurseryculture, Waltham Field Station, University of Massachusetts, Waltham, Massachusetts.

Weed counts were taken on four one-square-foot areas of each plot. Table I lists the number of each weed species on 12 square feet in lining-out nursery stock after treatment with 6 chemicals. Table II lists average number of weeds, fresh weight of the weed tops of each plot, and a rating number. A rating system of 0 to 5 was used with 0 signifying four weeds or less to a one-square-foot plot; 1, 20-percent of surface weed covered; 2, 40-percent coverage; 3, 60-percent coverage; 4, 80-percent coverage; and 5, 100-percent coverage. Final records for the May 23 application were taken on July 10, 1956, and for the July 20 application on August 27, 1956. A weed control rating of the September 7 application was made on October 29, 1956.

TABLE I. Number of weeds of different species on 12 square feet in lining-out size nursery stock after treatment with 6 chemicals during Summer 1956.

		WEED SPECIES									
		Period 1					Period 2				
Chemical	Amt./A	A	B	C	D	E	A	B	C	D	E
1. Monuron	½ lb.			185		48	1	2	128		92
2. Monuron	1 lb.	2		154		34	1		84		34
3. CIPC	4 lb.	6		327	4	7	3		341		17
4. CIPC	6 lb.	1		170	1	5	2		193		
5. Alanap-3 SES	2 lb.) 2 lb.)	4	1	125		5	34		323		95
6. Alanap-3 SES	4 lb.) 4 lb.)	6	2	84	1	15	14	3	121		77
7. Check		14		250		252	9		123		121

1 Period 1 -- May 23 - July 10, 1956
2 Period 2 -- July 20 - August 27, 1956

A. Grass sp.
B. Chickweed - *Stellaria media*
C. Henbit - *Lamium amplexicaule*
D. Carpet Weed - *Mollugo verticillata*
E. Purslane - *Portulaca oleracea*

TABLE II. Average number of weeds, fresh weight of the weed tops, and rating number for 4 square feet in lining-out size nursery stock after treatment with 6 chemicals during Summer 1956.

Chemical	Amt./A	Rating[1]	Rating[2]	Rating[3]	Number of weeds[1] per 4 sq. ft.	Weight of weeds[1] per 4 sq. ft.
1. Monuron	½ lb.	4.58	1.83xx	1.67xx	78.3x	1137.7
2. Monuron	1 lb.	2.43xx	.83xx	0.67xx	63.3x	377.3xx
3. CIPC	4 lb.	3.08xx	1.75xx	3.50	115.7	633.3xx
4. CIPC	6 lb.	2.58xx	.93xx	2.42xx	61.7x	312.3xx
5. Alanap-3 SES	2 lb.) 2 lb.)	0.68xx	2.25xx	3.67	45.0x	148.7xx
6. Alanap-3 SES	4 lb.) 4 lb.)	0.83xx	1.75xx	2.00xx	36.0xx	71.7xx
7. Check		5.0	4.75	4.00	174.7	1583.3
L.S.D. 5%		1.20	.80	.68	94.0	569.4
L.S.D. 1%		1.70	1.13	.95	132.0	799.3

x - Significantly different from the checks at the 5% level.

xx - Significantly different from the checks at the 1% level.

1 Period 1 -- May 23 - July 10, 1956

2 Period 2 -- July 20 - August 27, 1956

3 Period 3 -- September 7 - October 29, 1956

Results and Observations

Numerical records obtained in this experiment are presented in Tables I and II.

Advantages and disadvantages of different ratings were discussed in the previous paper (2).

Henbit, Lamium amplexicaule, has been our most common weed numerically at all periods of observation. Henbit can be controlled by cultivation, but cultivation only serves to propagate the next most numerous of our summer weeds, Purslane, Portulaca oleracea. Crabgrass, Digitaria sp. was a rather minor problem, but Annual Blue Grass, Poa annua was a problem with the advent of cool weather in the fall.

The Alanap-3 and SES combination gave the best weed control in the first application but seemed less effective in succeeding applications. Grass weeds, particularly Annual Blue Grass, were apparently the weakness in this combination.

CIPC was effective at the 6 lbs./A. rate at all three applications, but Henbit was not satisfactorily controlled by this material. CIPC was the most effective material for the control of Purslane.

Monuron gave better weed control results with each succeeding application. Purslane was the weed that was controlled least by Monuron. Monuron also produced the only visible injury to date. Ilex crenata convexa, Boxleaf Japanese Holly, turned extremely chlorotic when this material was used at either 1/2 or 1-pound-per-acre rates. Apparently none of the other plants in these plots were affected.

Literature Cited

(1) Ticknor, R. L. and P. F. Bobula. Some results with pre-emergence applications of several herbicides around Rhododendrons and Taxus. Proc. NEWCC 9: 211-215 (1955).

(2) Ticknor, R. L. and P. F. Bobula. Chemical weed control in Rhododendrons. NEWCC 11: (1957).

The authors wish to acknowledge the contribution of chemicals from the following companies:

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Columbia-Southern Chemical Corp., Pittsburg, Pennsylvania
E. I. duPont deNemours and Company, Wilmington, Del.
Naugatuck Chemical, Naugatuck, Connecticut

Granular Versus Miscible CIPC in Relation to Crop and Weed Growth in *Rosa dilecta* variety Miss Liberty

by A. M. S. Pridham, Cornell University

Previous tests with woody shrubs indicated little or no damage when CIPC herbicide was used in late winter before budbreak or at the close of the growing season. Directional spraying was used in previous tests. In present tests planting of cold storage grade 1 roses supplied by the Gardening Council, Newark, N. Y. was done May 14-21. The plants were set in rows in Dunkirk silty clay loam freshly rototilled. Plots 14 feet long were marked off and 10 feet used for planting 5 roses. Plots were 2 feet wide and 20 sq. ft. in area. The remaining 4 feet was buffer space between plots. Treatments were made May 24 overall, June 24 overall, and August 9 directionally at the ground line so that there was a minimum of contact with the foliage and stem of the rose plant. Prior to application of the herbicide, redtop (*Agrostis alba*) was sown by hand in the 20 ft. plot area.

Treatments were made at three specific stages of growth -- 1) dormant plants at time of planting, no further herbicide treatment; 2) during the first flush of growth, no further herbicide treatment; 3) at time of mature growth in early August.

CIPC formulations were supplied by the Niagara Chemical Division of Food and Machinery Corporation* Middleport, N. Y. CIPC was applied at three rates -- 8 pounds, 12 pounds, and 16 pounds per acre. Control plots received no herbicide. Each treatment was replicated 8 times for each of the three series.

The granular formulations (Atta clay base mesh 30-60 and essentially free of "fines") were applied with a Midget Duster from Jackson and Perkins Rose Growers, Newark, N. Y. Sprays were applied with a 1 gallon Unico garden sprayer. A T-jet 8002 nozzle was substituted for the nozzle supplied by Unico.

Estimation of plant growth of rose was based on green weight of tops at the close of the season, October 15. Weed control was based on the germination and growth of redtop by rating the amount of grass present on a scale of 0 to 10. Additional estimates were also made as appropriate. These include 1) counts of the number of shoots produced by the dormant plants during the first month following treatment; 2) green weight of perennial weeds present 6 weeks after first treatment; and 3) rating of annual weeds present in October in the August treated plots which had been kept free of weeds till August by hoeing. The October weeds rated were groundsel (*Senecio vulgaris*) and seedling annual bluegrass (*Poa annua*). Virtually no annual chickweed appeared in the plots.

Results

Analysis of variance for green weight of tops of rose plants indicated significance at the 1% level for variance 1) due to formulation (granular versus miscible), and 2) for interaction of formulation and rate of application. Significance at the 5% level occurred in variance 1) due to stage of rose growth at time of treatment, and 2) for the interaction of formulation and stage of growth. Analysis of variance for weed control as indicated by rating growth of redtop showed significance at the 1% level only for rate of application.

* Food Machinery and Chemical Corporation

Table 1. Average weight of 5 plant samples from 8 replicates. Measurements in quarter ounce units of green weight of stem and foliage.

Stage of growth when treated	Granular formulations of 4% CIPC on Atta clay				Miscible CIPC applied as spray directionally in July			
	Control	8 lb/A	12 lb/A	16 lb/A	Control	8 lb/A	12 lb/A	16 lb/A
Planting	46.87	58.75	51.25	50.75	54.50	47.87	43.00	35.50
First foliage	58.37	61.25	66.25	66.37	63.00	50.87	46.87	44.50
Mature growth	60.12	52.63	55.00	61.61	59.00	56.50	54.12	55.12
Mean value	55.12	57.54	57.50	59.58	58.83	51.75	48.00	45.04

LSD for mean values at 19:1 = 5.04
at 99:1 = 6.05

LSD for single items at 19:1 = 11.45
at 99:1 = 14.72

Reduction in growth of roses is associated on a statistical basis only with the miscible formulation of CIPC when applied during the early stages of growth but not as a directional spray during the latter part of the growing season (August). Reduction of growth is related to poundage of miscible CIPC in the early stages of growth. No reduction in rose growth followed from application of granular formulation of CIPC up to 16 pounds per acre as used in present treatments applied during bright days on dry foliage.

Table 2. Average number of shoots on a five plant plot of Rose var. Miss Liberty one month after planting. Plants were treated immediately after planting.

Formulation	Pounds per acre of CIPC			
	Control	8	12	16
Granular	74	76	71	76
Miscible	83	60	54	46

LSD 19:1 for individual means = 18
99:1 " = 28

Granular formulations show no indication of modifying shoot production from dormant plants treated immediately after planting. Miscible formulations show progressively larger depression of shoot production significant at 5% level to almost 1% with 16 pounds per acre in comparison with untreated control.

Table 3. Average green weight of tops of perennial weeds from plots treated in May and first cultivated in mid-July.

	Pounds per acre of CIPC			
Formulation	Control	8	12	16
Granular	63	44	51	32
Miscible	59	43	45	13

LSD 19:1 for mean values = 58

While the average weight of perennial weeds as regrowth was lower in all plots treated with CIPC only partial reduction in regrowth of quackgrass (Agropyron repens), sow thistle (Sonchus arvensis), and other perennial weeds was accomplished. Reduction of 50% or more possibly resulted from applications of 16 pounds per acre but populations of perennial weeds were not uniform over the entire field. Miscible rather than granular formulations appeared slightly better but without statistical significance.

Weed control from late season applications

Roses were cultivated twice during the summer by hoeing and hand weeding. Following the final clean up in August, CIPC was used directionally at the ground level to minimize contact with the plant stem and foliage.

Growth of redtop was eliminated in all treated plots as in previous treatments. No chickweed appeared during September or October but a large patch of groundsel (Senecio vulgaris) emerged in late August followed by a general infestation of annual bluegrass (Poa annua). These weed populations were rated on the basis of 0 to 10. No statistical difference was found though the rating for the treated plots was lower than for the control plots in all cases, being 3.4 and 2.7 for groundsel controls and 4.2 and 2.0 for the annual bluegrass. Treated plots averaged 1.0 and 1.5 for groundsel and 1.0 and 1.2 for annual bluegrass, the higher rating being for the miscible and the lower for the granular.

Summary

Granular formulations of CIPC used in these tests did not interfere with the growth of newly planted roses when applied at 16 pounds per acre or less and as indicated by response measured as green weight of top growth or as number of new shoots per plant. Miscible formulations did interfere with plant growth during the early stages from overall spraying but interfered less from basal directional application to mature plants.

Redtop planted as a weed was completely controlled. Senecio vulgaris and Poa annua were largely controlled with possibly better effect from granular formulations but without statistical significance.

The application of granular CIPC to dry rose foliage through the growing season for weed control purposes opens up new possibilities for retarding perennial weed growth and vastly reducing the population of annual weeds presently common in nursery plantings.

Granular versus Miscible CIPC in Relation to Crop and Weed Growth in Chrysanthemum morifolium

by A. M. S. Pridham, Cornell University

During the past five years tests with CIPC -- chloro-isopropyl-n-(3 chloro phenyl carbamate) have indicated that dilutions of 1/50 and 1/25 of the miscible formulations approximating 4 pounds of CIPC per gallon have given good control of annual bluegrass (Poa annua) and annual chickweed (Stellaria media). Applications were made directionally to field grown nursery stock, including narrow-leaved evergreens and deciduous woody nursery stock. The applications were of 100 gallons per acre for the area actually covered. Only the hoe space in the row was treated.

Numerous other herbicides have been used successfully under the dormant conditions for plant growth of late fall, winter or early spring. CIPC has resulted in relatively little plant injury and has given prolonged residual action as judged by delayed appearance of seedling weeds in spring till June.

A test was set up under greenhouse conditions in March 1956. Dormant nursery stock was obtained from storage through the cooperation of the Gardening Council, Newark, N. Y. These dormant divisions of perennials were set in flats of soil to simulate field planting. Treatments were applied immediately after planting. Redtop grass seed (Agrostis alba) was sown in each plot to give a standard weed of relatively certain germination and population density. Comparisons were made using CIPC at 16 pounds per acre of active ingredient miscible versus granular. Miscible was also used at 4 pounds per acre rate which is about the lowest limit for effective weed control under field conditions. Granular formulations were sprinkled on by hand from a coarse salt shaker. Sprays were applied from a Windex sprayer. Flats were isolated for treatment to avoid overlapping of herbicides during treatment. Six weeks after treatment all new growth was removed and weighed at once for green weight data. Redtop was also cut from each flat where germination and growth had occurred. The clippings were weighed and new grass seed sown. A second crop of grass was harvested two months later.

Table 1. Green weight (grams) of tops of Chrysanthemum morifolium at the end of 6 weeks growth in the greenhouse at 60°F night temperature. Data are from 5 plants each in two replications and two methods of watering (1) subirrigation, (2) top watering by hose only.

Method of watering	Untreated control	Granular 16 lbs./A CIPC		Miscible CIPC	
		8% source	2% source	16 lb./A	4 lb./A
Subirrigation	3.4	6.8	5.3	3.4	6.0
Top watering	8.1	13.8	11.0	4.0	9.7

LSD mean 5% level 3 grams

Growth as indicated by weight was better in the top watered group in each treatment.

Growth as indicated by weight was depressed by CIPC only at the 16 pound level where miscible formulations were used.

Table 2. Green weight (grams) of Redtop (Agrostis alba) after planting and treatment with CIPC formulations. Growth took place in the greenhouse with night temperatures of 60°F. First planting, 6 weeks; second, 8 weeks duration.

Method of watering	Untreated control	Granular 16 lbs.A CIPC 8% source	Granular 16 lbs.A CIPC 2% source	Miscible CIPC 16 lbs.A	Miscible CIPC 4 lbs./A
1st planting 0-6 weeks					
Subirrigation	56	0.0	2.0	0.0	1.6
Top watering	55	0.0	0.0	0.0	0.0
LSD mean 5% level 24.6 grams					
2nd planting 6-14 weeks after herbicide used					
Subirrigation	40	9.3	0.8	26.0	120.0
Top watering	91	2.2	0.0	0.0	92.0
LSD mean 5% level 22.4 grams					

The residual action was greater under top watering which simulates rain and permits some leaching. Residual action lasted 14 weeks at the 16 pound level of CIPC but was lost at the 4 pound level of miscible CIPC.

These initial data point up the fact that the granular formulations are effective in control of redtop grass seed (Agrostis alba) as an indicator weed. Anthemis sp. seed was present as an impurity in the redtop. It was much reduced in germination and growth at the 16 pounds of CIPC level but was present at the 4 pound and zero pound levels.

CIPC granular formulations at 16 pound level did not decrease the growth of chrysanthemums but miscible CIPC at the 16 pound level definitely reduced growth.

During July greenhouse chrysanthemums of the variety Christopher Columbus were set out at bud stage. The plants had been grown in pots in the greenhouse till planting in plots of 12 plants each replicated four times.

Immediately after planting, redtop grass seed was sown in the rows of chrysanthemums and the planting watered in. Once the foliage was dry (a half hour) the herbicide treatments were made over the entire area of the plot. Granular herbicides were applied with a Jackson and Perkins midget duster so that the granules fell over the tops and sides of the plants as well as on the ground. Miscible formulations were sprayed at the ground level to avoid contact with the plant top.

Results were based on total green weight of plant tops in October. Weed samples, 4 per plot, were taken in the plant row and counts made of groundsel (Senecio vulgaris) which had come up with some degree of uniformity in a relatively heavy stand. Ratings were made of the stand of redtop during the period of August 1 to October 30 and are shown as an average rating (0-10 dense stand).

Table 3. Response of Chrysanthemum Christopher Columbus and of weed growth August 1 to October 31, following applications of CIPC in granular* or miscible formulations.

Plant response	Control No treatment	Granular CIPC 8 lbs.	Granular CIPC 12 lbs.	Granular CIPC 16 lbs.	Miscible 8 lbs.	LSD mean 5% level
Green wt. of tops, $\frac{1}{4}$ oz. units	115	120	114	138	126	81
Wt. of weed sample, gr.	75	98	81	36	101	80
No. groundsel per sq. ft.	18	16	7	7	16	11
Redtop rating	9.7	0	0	0	0	5

* granular -- supplied by Niagara Chemical Co. CIPC 4% on Atta clay 30-60 mesh.

Growth of chrysanthemums during the latter stage of their growth did not show any deleterious effect from granular CIPC treatments or from miscible formulations applied at soil level. Growth of redtop grass seed was eliminated by CIPC treatments and the population density of groundsel (Senecio vulgaris) was reduced at 12 and 16 lb. levels of CIPC granular. Total weed population shows a trend toward reduction as the level of CIPC application increases but lacks statistical significance probably because of the lack of uniform weed infestation in the several plots replicated in the experiment.

A second comparison was made using plots in duplicate and including both CIPC and Endothal in granular and miscible formulation. Chrysanthemum Christopher Columbus was again used as a test crop from the same greenhouse grown crop of potted plants. Redtop(Agrostis alba) was used as a standard weed. Groundsel infestation occurred in relative uniformity. Otherwise weed infestation by late October was not uniform as to species or population density.

Table 4. Response of Chrysanthemum Christopher Columbus and of weed growth from August 9 to November 1 following applications of CIPC and of Endothal in granular and miscible form.

Plant response	Control Treatment	CIPC 8 lbs./A Granular	CIPC 8 lbs./A Miscible	Endothal $1\frac{1}{2}$ lb./A Granular	Endothal $1\frac{1}{2}$ lb./A Miscible	Mean LSD 5% lvl.
Mean wt. * chrysanthemum	94	76	72	95	89	84
Mean gr. wt. grs. weeds	99	26	38	63	66	308
Groundsel rating	5	2	3	2	1	3
Redtop rating	9	0	0	1	0	3

* $\frac{1}{4}$ ounce units

Chrysanthemum growth was not reduced by Endothal or by CIPC granular. Endothal as a contact herbicide did injure growth of seedling weeds. Miscible Endothal as a spray did a better job than granular in reference to both groundsel and to redtop. CIPC at the 8 lbs./A rate was comparable to Endothal in herbicidal properties within the conditions of this test.

Summary

Granular formulations on atta clay are effective herbicially and when applied on bright days to dry foliage were essentially without deleterious effect on herbaceous chrysanthemums in mature phases of growth either as dormant divisions largely protected by soil cover at planting time , or to developing flower buds and relatively mature foliage.

Granular CIPC at 12-16 pounds per acre eliminated establishment of germinating redtop and reduced the population in native seeiling stands of groundsel (Senecio vulgaris) though lower rates did not reduce the population. The contact herbicide Endothal in granular formulation did reduce the groundsel.

Anthemis sp. as an impurity in redtop grass seed (Agrostis alba) used in these experiments was reduced but not eliminated from granular CIPC at rates of 16 pounds per acre in greenhouse and in field tests.

The rates of CIPC and of Endothal were selected from past experience with these compounds as effective herbicides in fall for seedling weeds.

Response of *Artemisia vulgaris* to Amino Triazole in Amounts up to 16 Pounds Per Acre

by A. M. S. Pridham, Cornell University

Artemisia vulgaris, often spoken of as chrysanthemum weed by nurserymen because of the similarity in foliage, grows from stolons and is often spread by cultivation equipment and by inclusion in the soil ball in transplanting operations.

Where plowing is possible the practice of fallowing and cultivating the soil will help to eliminate this weed. Various chemicals have been used in conjunction with plowing so that the herbicide comes in direct contact with the roots. Good control has followed.

Evergreens and other nursery stock that remain in one location for a period of years sometimes become infested with artemisia. The control problem in this case is complicated by the fact that response of the crop as well as the weed must be taken into account.

Amino triazole was compared with CIPC and with CMU and later Karmex. Plots 10 x 10' in areas of heavy artemisia were sprayed with one quart of spray mix or approximately 100 gallons per acre. Two months after treatment $1\frac{1}{2}$ sq. ft. samples were taken and the stolons washed clean of soil and weighed. The stolons were then cut into 4" sections and planted in soil which had been steam sterilized. Obvious dead tissue was discarded. Live and turgid but discolored stolons were planted. Note was made of the regrowth from these stolons.

Results

Plots treated in June 1955 and sampled in September showed control plots 132 grams, amino triazole (AT) 8 lbs/acre 122 grams and 16 lbs./acre 88 grams of sound stolons, CMU 4 pounds/acre 155 grams. In November 1955 a second sampling gave control 225 grams, AT 8 lbs/acre 128 grams, and AT 16 lbs./acre 21 grams. Other plots sampled in November included CIPC 1/50 -- 247 grams and CIPC 1/50 AT 8 lbs/acre combination -- 29 grams.

Stolon samples grown under greenhouse conditions in pots of 10 stolons each resulted in the following as of December 1955.

Table 1. Growth of *Artemisia vulgaris* from stolon samples from plots treated with amino triazole June 1955 and sampled November 1955

Treatment	No. pots	Growth normal	Remarks
Control	26	26	
AT 8 lbs./A	20	0	Varied from few shoots pink or white to part green, later green
AT 16 lbs./A	20	0	Failed to grow
AT 8 lbs/A CIPC 1/50	20	0	1 plant emerging pink
CIPC 1/50	29	29	Slow to start
CMU 4 lbs	19	19	Some yellow green, later green

In August 1955 a second series of plots was set out to explore the possibility of using amino triazole alone and in combination with other residual type herbicides. In November samples were taken from plots in which regrowth of Artemisia was minor or not present. Twelve sound appearing rhizome sections were selected and planted in small paper machè pans, now called Market Pak. Concluding observations were made in January 1956 after six weeks growth period.

Table 2. Growth of Artemisia vulgaris from stolon samples from plots set up July 1955 and sampled November 1955. Observations January 1956.

Treatment	Stolons growing	Growth normal	Remarks
Control	12	12	
AT 8	3	0	Varied pink white green foliage
" 16	1	0	Small white foliage
CMU 8	12	12	
KW 16	12	12	
KDW 16	12	11	1 yellow foliaged shoot
K4A4C4	11	5	6 characteristic small white foliage
K6A6C6	7	0	All small white foliage
K6A6	5	0	All small white foliage

These several mixtures and others were used as basal spray in dormant nursery stock in which Artemisia vulgaris was present as a heavy infestation. Evergreens including arborvitae, juniper and pine responded quickly to contact with amino triazole in July on young or immature foliage which turned yellow or golden. Taxus did not respond so promptly but new late growth showed occasional "amino triazole white" foliage. Mature foliage aged and shed before winter.

Acer rubrum, Quercus palustris, Forsythia intermedia and Cornus florida did not show fall or spring response to combinations at the 4 or 6 pound level. Plants with large soft buds, including Magnolia kobus and Viburnum tomentosum, showed some yellowing in young spring growth.

In a planting of Taxus in which hoeing had been done in June 1955, light regrowth of Artemisia was treated in November 1955. Sprays were applied directionally so that contact with the spray was at a minimum. A mix of 6 pounds per acre each of amino triazole, chloro IPC and Karmex DW was used. Samples were taken in July and indicated 15 grams of stolons in the untreated part of the row, 4 grams in the treated part. Growth was poor with white Artemisia foliage in treated sample and of moderate amount and normal green in the control section. Taxus plants showed little or no injury.

On July 17, 1956 stolon samples were again collected. The untreated control yielded 130 grams of stolons, amino triazole 8 lbs./acre once yearly June 1955 and 1956, 58 grams. Subsequent growth of sample was characteristic small white foliage. Amino triazole 16 lbs./acre 2 years -- no roots or tops were found except at the plot margin. A sample here yielded 42 grams of stolons which grew fairly well but showed varied white and green foliage. Since growth from the untreated stolons was excellent it appears that even 16 pounds/acre amino triazole may not prevent reinvasion of treated areas. Amino triazole at the 16 pounds/acre rate in June 1956, sampled July 1956, yielded 39 grams of stolons which grew fairly well with a mixture of pink, white and green foliage, indicating effect within a month after treatment of rapidly growing Artemisia.

Summary

Amino triazole alone or in combination with a residual herbicide will reduce the population of viable vigorous Artemisia stolons from treatments made during the active growing season or in fall a month or more before killing frosts. Regrowth of Artemisia is slow and much of the shoot growth is dwarf in size and white or pink in color. Yearly applications without hoeing serve to keep the weed in check. Treatment of young regrowth following hoeing brought about a maximum reduction for a single treatment. In unhoed areas at least 8 pounds of amino triazole per acre is needed as a yearly treatment. The addition of a residual herbicide appears to aid in reducing invasion by annual weeds of an area cleared of Artemisia.

(Chemicals supplied by American Chemical Paint Co. -- amino triazole; Karmex group from DuPont Co.; CIPC from Niagara Chemical Division of Food Machinery and Chemical Corp.)

FURTHER RESULTS WITH MONURON (KARMEX-W) AND ITS EFFECT ON FLAVOR OF PROCESSED ASPARAGUS

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Preliminary results (1) indicated that Monuron, 3-p-chlorophenyl-1, 1-dimethylurea (formerly known as CMU and Karmex-W) produced a different flavor in frozen asparagus, compared to untreated control, in two of the eight comparisons made in 1954. No differences in flavor were detected among six comparisons of treated and untreated canned asparagus. Since these results were preliminary and inconclusive, it was deemed necessary to repeat the work, and to broaden the experimental basis on which comparisons were to be made.

The objective of the present study was to compare the flavor of untreated asparagus with asparagus which had been grown on land treated for more than one year and at different rates with Monuron. The study was conducted with frozen and canned asparagus.

METHODS

The experimental material was harvested in the spring of 1955, and came from two sources. One source was a replicated field experiment in Southern New Jersey, in which the treated plots received a total of four pounds of active Monuron per acre in 1954, and two pounds of the same neat material pre-emergence in 1955. Control samples were harvested from plots never treated with the herbicide. Samples from the various replications were harvested and composited on the following dates: May 4, 12, 19, 26, and June 3, and 16, 1955. These samples were collected and canned by a commercial canning company, and submitted to the Food Technology Department of Rutgers University for flavor evaluation. Evaluations were made after three months' storage and again after six months.

Flavor evaluations on the asparagus were made by a panel of seven to nine judges, using the triangle test technique. In a triangle test, two samples are alike and one is different. Each judge received three coded samples served at room temperature on a divided plate. He was asked to select the duplicate samples. Two triangle tests were made by the panel on each harvest of asparagus.

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Delaware Experiment.

Another series of samples was supplied from a replicated field experiment at the Delaware Experiment Station at Georgetown, Delaware. These samples were harvested and composited from the various replications in mid-May, the end of May and again in mid-June. Monuron had been applied to the field for three and one-half years prior to sampling dates, at annual rates of 2, 4 and 8 lbs. of Monuron per acre. Untreated control samples were included for comparison.

Samples were submitted to the Food Technology Department of Rutgers University for freezing or canning and subsequent flavor evaluation.

RESULTS

New Jersey Experiment.

No differences in flavor were detected with canned asparagus which had been treated with Monuron compared to the untreated control. This was true for all six harvest dates, after three months' storage and after six months' storage.

Delaware Experiment.

No differences in flavor between treated and untreated frozen asparagus were detected at either 2, 4 or 8 lbs. of Monuron per acre compared to the untreated control (Table 1). This was true at the early, mid-season and late harvest dates. Table 1 also shows that there were no significant differences in per cent acceptability of the various samples to the panel judges between treated and untreated samples. Panel acceptance is not to be construed as reflecting consumer preference.

(See page 3 for Table 1)

Table 1. Flavor of Frozen Asparagus Treated with Monuron in Relation to Untreated Control. Delaware Experiment, 1955.

Treatment	Flavor evaluation in relation to control	Acceptability of samples
Early harvest (May 19)		
Monuron 2 lb./A.	Similar	71%
Monuron 4 lb./A.	Similar	71%
Monuron 8 lb./A.	Similar	76%
Coded control	Similar	65%
Control	---	71%
Midseason harvest (June 2 & 7)		
Monuron 2 lb./A.	Similar	76%
Monuron 4 lb./A.	Similar	76%
Monuron 8 lb./A.	Similar	76%
Coded control	Similar	76%
Control	---	76%
Late harvest (June 16)		
Monuron 2 lb./A.	Similar	82%
Monuron 4 lb./A.	Similar	82%
Monuron 8 lb./A.	Similar	82%
Coded control	No sample available	--
Control	---	82%

Flavor evaluations of the canned asparagus from the Delaware experiment are shown in Table 2. No detectable differences in flavor were found between the various rates of Monuron and the untreated control at either the early or mid-season harvest dates. One significant flavor difference was detected at the late harvest, in which the 4 lb. rate of Monuron was different from the control sample. This difference in flavor, however, did not seem to affect its acceptability to the judges. As with the frozen asparagus (Table 1), there was no difference in acceptability of the samples associated with treatment.

Table 2. Flavor of Canned Asparagus Treated with Monuron in Relation to Untreated Control. Delaware Experiment, 1955.

Treatment	Flavor evaluation in relation to control	Acceptability of samples
Early harvest (May 16)		
Monuron 2 lb./A.	Similar	100%
Monuron 4 lb./A.	Similar	100%
Monuron 8 lb./A.	Similar	100%
Coded control	Similar	94%
Control	----	100%
Midseason harvest (May 31)		
Monuron 2 lb./A.	Similar	100%
Monuron 4 lb./A.	Similar	100%
Monuron 8 lb./A.	Similar	89%
Coded control	Similar	100%
Control	----	100%
Late harvest (June 13)		
Monuron 2 lb./A.	Similar	100%
Monuron 4 lb./A.	Different	100%
Monuron 8 lb./A.	Similar	100%
Coded control	Similar	100%
Control	----	100%

SUMMARY AND CONCLUSIONS

New Jersey Experiment.

Flavor of canned asparagus from plots treated with Monuron was compared with flavor of asparagus from untreated plots. Monuron had been used at 4 lbs. per acre one year prior to the test, and at 2 lbs. per acre pre-emergence during the current test season (1955).

Asparagus samples for flavor evaluation were collected six times at weekly intervals during May and early June in 1955. No differences in flavor were detected between treated and untreated asparagus at any of the harvest dates after three months' storage of the canned product. Flavor evaluations were repeated after a six months' storage period, and again no differences in flavor were detected.

Delaware Experiment.

Samples of asparagus from permanent Monuron plots were tested for flavor evaluation in relation to untreated control. Monuron had been applied at 2, 4, and 8 lbs. per acre for four years prior to the flavor test season. The herbicide was used at 1, 2 and 4 lbs. per acre pre-emergence during the current season of the test (1955).

Samples were gathered in mid-May, the end of May and again in mid-June, and were processed both as frozen and canned asparagus.

Flavor evaluations were made of the treated asparagus in relation to the untreated control samples. A difference in flavor between treated and untreated canned asparagus was found at only one harvest period and at only one rate of Monuron: the four lb. per acre rate, harvested May 13, 1955. No difference in flavor was detected between the two or eight lbs. per acre rates in relation to the control at any of the harvest periods.

No differences in flavor were detected among the frozen samples from the two, four or eight lbs. per acre rates of Monuron in relation to the control samples, at any of the harvest periods.

It was concluded that Monuron had no effect on canned or frozen asparagus flavor, even after the herbicide had been used at high rates for a period of four and one-half years.

REFERENCES

1. Ellison, J. H., R. J. Aldrich and W. A. Maclinn. Effect of Karmex-W on the flavor of canned and frozen asparagus. Proc. N.E.W.C.C.:137-139. 1955.

WEED CONTROL IN CORN AFTER THE LAST CULTIVATION[1]

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

Weeds which emerge after the last cultivation in corn frequently grow unchecked by weed prevention practices and may interfere with harvest and decrease crop yield.

Klingman and Davis (2) reported highly satisfactory weed control in corn with pre-emergence treatments of 2,4-D followed by treatments of solid ammonium nitrate applied as a top dressing and various combinations of ammonium nitrate, 2,4-D and FAB, a household detergent, applied as a directed spray at the time of the second cultivation. They concluded that ammonium nitrate applied as a spray was fully as effective as a fertilizing material as was the solid form of ammonium nitrate.

During 1955, biuret was applied in field corn at this Station at the time of the last cultivation for the purpose of controlling late germinating weeds. Biuret as herein referred to is an impurity of urea obtained as a result of temperatures encountered in the manufacture and processing of urea. Biuret has a molecular formula of $H_2N-\overset{O}{\overset{\|}{C}}-\overset{H}{\overset{|}{N}}-\overset{O}{\overset{\|}{C}}-NH_2$. The pelletized material used contained approximately 13.5% biuret.

Treatments of biuret at 40 and 60 pounds of biuret nitrogen equivalent per acre resulted in highly satisfactory weed control. Stover yield of biuret treated plots were comparable to yield of other treatments (1).

The 1956 study conducted at this Station had two main objectives: (a) to evaluate the efficiency of several chemicals for controlling weeds in corn after the last cultivation and (b) to measure the fertilizing value of biuret and ammonium nitrate applied as required to obtain weed control.

MATERIALS AND METHODS

In one experiment, four seeds of New Jersey #7 field corn per hill were planted in a sandy loam soil May 10, 1956. The plots were 2 hills in width and 11 hills in length with hills

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[1]Cooperative investigations between the New Jersey Agricultural Experiment Station and the Field Crops Research Bureau, Agricultural Research Service, U.S. Department of Agriculture. Acknowledgement is made to the Heyden Chemical Corporation and Allied Chemical & Dye Corporation for their support of this project.

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being spaced at 42 inch intervals. Yield data were taken on 2x10 hills in each plot. The experiment was laid out in a randomized block design with 4 replications. The chemical treatments were used at rates per acre indicated in table 1. The treatments were made June 26 and 27 to a weed-free soil with the exception of the NH_4NO_3 spray which was applied to weeds which ranged from 1-5 inches in height. The NH_4NO_3 spray treatment was made in two applications, one-half of the total rate of the NH_4NO_3 treatment being applied June 27 and the second half on June 30. The 2,4-D ester used in conjunction with the NH_4NO_3 was applied in the same manner.

All spray applications were made at a volume rate of 20 gallons of water per acre using a knapsack sprayer. The sprayer boom was fitted with two drop pipes spaced 22 inches apart. Nozzles which delivered a 110 degree fan were used to facilitate complete soil coverage when the nozzles were held at 10-12 inches above the soil surface. This amounted to a basal spray application which contacted 2 to 3 basal corn leaves. Biuret treatments were made using a small turf type spreader.

A second experiment was initiated on May 10, 1956 to study the fertilizing value of two forms of nitrogen. The nitrogen was applied in the form of biuret and NH_4NO_3, the NH_4NO_3 being applied both as a directed spray and as a granular side-dress. The same field plot procedure was followed as described above except the plots were 4 hills wide instead of 2.

The experimental area received 700 pounds per acre of a 5-10-10 fertilizer prior to planting. On June 22 all plots were side-dressed with 250 pounds per acre of a 0-12-24 fertilizer which was intended to supply the approximate total quantity of P and K recommended for use in New Jersey.

The nitrogen treatments compared included 20, 40, and 65 pounds of biuret nitrogen per acre, 65 pounds of NH_4NO_3 nitrogen per acre as a spray and 65 pounds of NH_4NO_3 nitrogen per acre as a conventional side-dressing. Applications were made June 28 and 29. The second half of the NH_4NO_3 spray treatment was applied July 2.

The treatment designated as no nitrogen received only the initial 35 pounds of nitrogen applied at the time the seedbed was prepared. Procedure for application was the same as described for the previous test. All plots were kept weed-free throughout the entire season by hand-weeding at weekly intervals. Such was intended to prevent weeds from becoming a competing factor with corn for nitrogen.

Evaluation of Herbicidal Efficiency

Weed control data are shown in table 1. The predominant weeds included carpetweed, Mollugo verticillata, pigweed, Amaranthus retroflexus and crabgrass, Digitaria sanguinalis. Satisfactory weed control was obtained with several chemicals, however, treatments of 2,4-D acetamide and 2,3,6-TBA plus CDAA were especially effective.

Table 1. Effect of chemicals applied after the last cultivation in corn on weed control and yield of New Jersey #7 field corn. New Brunswick, N. J. 1956.

Treatment	Weed Control as Percent of Check[1] Broadleaf	Grasses	Bushels of Corn per Acre at 15.5% Moisture
Biuret - 20 lbs. N	13.5	41.3	62.1
30 lbs. N	7.9	49.6	68.1
50 lbs. N	46.1	71.9	74.8
2,4-D Acetamide - 1 lb.	92.1	88.4	69.0
2 lbs.	91.0	90.1	69.6
CDEC[2] - 3 lbs.	71.9	60.3	70.4
6 lbs.	50.6	30.6	70.7
CDAA[3] - 3 lbs.	12.4	71.9	65.3
6 lbs.	50.6	79.3	68.7
2,3,6-TBA[4] - ½ lb.	78.7	72.7	71.6
1½ lbs.	93.3	86.8	66.7
2,3,6-TBA + CDEC - ½ + 1 lb.	77.5	68.6	63.3
½ + 3 lbs.	48.3	61.2	72.4
2,3,6-TBA + CDAA - ½ + 1 lb.	92.1	86.8	64.7
½ + 3 lbs.	85.4	86.8	76.1
NH_4NO_3 + 2,4-D + FAB 50 lbs. N + ¼ lb. + 10 g. FAB/gal.	85.4	14.9	65.0
Check (hand-weeded)			72.1
Check			67.9
L.S.D. .05	16.9	46.3	10.9
.01		28.1	

[1]Check plots averaged 8.9 broadleaved weeds and 12.1 grasses per 2.1 square feet.

[2]CDEC - 2-chloroallyl diethyldithiocarbamate.

[3]CDAA - Alpha chloro-N, N-diallyacetamide.

[4]2,3,6-TBA acid form of 2,3,6-trichlorobenzoic acid.

Satisfactory broadleaf control was obtained with 2,3,6-TBA at 1½ pounds and NH_4NO_3 at 50 pounds, however, the NH_4NO_3 was not effective in controlling grasses.

Highly satisfactory grass control was obtained with CDAA, 2,3,6-TBA and 50 pounds of biuret nitrogen.

Yield data are also shown in table 1 and as will be noted differences were not great. The highest yield was obtained with the treatment 2,3,6-TBA at ½ pound plus CDAA at 3 pounds per acre and was significantly higher than that from plots treated with biuret at 20 pounds of nitrogen, 2,3,6-TBA at ½ pound plus CDAA at 1 pound, 2,3,6-TBA at ½ pounds plus CDEC at 1 pound and ammonium nitrate. Observations throughout the duration of the test revealed no apparent injury to the crop plants from the chemicals.

Corn Responses to Biuret and NH_4NO_3 Applied to Simulate Herbicidal Treatments

Corn height measurements taken for seven consecutive weeks are shown in table 2. At the time of the initial measurement, approximately 2 weeks after treatment, all plants were about the same height, however, measurements at succeeding weekly intervals revealed a reduction in height of plants in plots treated with 65 pounds of biuret nitrogen.

No good explanation can be given to account for the excellent growth and yield of plants in plots which received only 35 pounds of nitrogen initially, for this quantity of nitrogen is ordinarily not adequate for good crop production. The experimental area was cropped in potatoes during the preceding 4 years and there may have been sufficient residual nitrogen in the soil to support adequately growth of the corn.

Yields were reduced significantly by biuret at 40 and 65 pounds of nitrogen.

SUMMARY AND CONCLUSIONS

Treatments of 2,4-D acetamide, 2,3,6-TBA and 2,3,6-TBA plus CDAA were highly satisfactory in controlling weeds in corn when applied after the last cultivation.

Combination treatments of 2,3,6-TBA plus CDAA were more effective in controlling weeds than CDAA alone. 2,3,6-TBA at ½ pounds plus CDAA at 3 pounds was apparently more effective in controlling weeds than ½ pound of 2,3,6-TBA alone, however, 1½ pounds of 2,3,6-TBA was more effective on broadleaf weeds and as effective on grasses as ½ pound of 2,3,6-TBA plus 3 pounds of CDAA.

Ammonium nitrate at 50 pounds of nitrogen equivalent plus 2,4-D and FAB gave highly satisfactory broadleaf control, but was not effective in controlling grasses.

Fifty pounds of biuret nitrogen appeared to be necessary for satisfactory weed control.

In a test designed to measure nitrogen benefits biuret at 40 or more pounds per acre of nitrogen resulted in a significant reduction in corn yield.

LITERATURE CITED

1. Collins, H. A. and R. J. Aldrich. Proceedings of the Tenth Annual Northeastern Weed Control Conference, pp. 1-5. 1956.

2. Klingman, G. C. and J. Clayton Davis. Ammonium nitrate solution, 2,4-D dinitro and "DuPont M" for weed control in corn. Proceedings of the Seventh Annual Southern Weed Control Conference, pp. 167-173. 1954.

Table 2. Effect of nitrogen compounds applied after the last cultivation in corn on the growth and yield of New Jersey #7 field corn. New Brunswick, N. J. 1956.

Pounds of Nitrogen per Acre	Height in Inches to Tip of Tallest Extended Leaf					Height in Inches to Tip of Tassel		Bushels of Corn per Acre at 15.5% Moisture
	7/12	7/20	7/26	8/1	8/8	8/17	8/24	
Biuret - 20 lbs. N.	71.4	83.0	94.3	100.3	101.4	98.3	100.1	93.4
40 lbs. N.	70.4	81.2	91.1	98.9	100.0	98.7	98.8	81.4
65 lbs. N.	70.8	81.0	86.7	93.9	95.5	92.7	93.2	55.5
NH_4NO_3 Spray - 65 lbs. N.	69.6	81.0	91.9	98.9	98.9	97.8	99.4	93.5
NH_4NO_3 Side-dress 65# N.	70.0	82.0	91.9	100.5	101.2	99.4	99.9	95.1
No nitrogen	71.3	84.0	95.2	102.1	102.9	102.3	102.2	98.4
L.S.D. .05								8.0
.01								11.1

WEED CONTROL IN FIELD CORN[1]

Jonas Vengris[2]

The main objective of the 1956 field corn weed control trials at the Massachusetts Experiment Station was to compare the effectiveness of new herbicides with dinitro and 2,4-D herbicides, which are widely accepted in practice. Both pre-emergence and post-emergence treatments were studied.

Procedure

Experiments were conducted on a fine sandy loam with only fair drainage. In Experiment I a randomized block design with four replicates was used. Each plot consisted of four corn rows 25 ft. long. Ohio M-15 was planted May 25, 1956. Four days later on May 29, pre-emergence treatments were applied. Dinitro was applied at emergence on June 4, i.e. ten days after planting. Dinitro was applied as pre-emergence treatment together with other treatments and also as post-emergence treatment when corn was in 4-leaf stage, 6-8 inches tall. When applying pre-emergence treatments the soil was moist and weather conditions were favorable. Twelve hours after the application of pre-emergence herbicide, it started to rain and rain continued with some interruptions for the following five days. In this period 3.08 inches of rain fell. The whole experimental area was soaked, muddy and partly flooded. At first it was thought that it was not worthwhile to continue the experiment. It was left, however, for observations in order to see what one could expect under such conditions. At the same time on an adjacent field, a seedbed was prepared and a similar Experiment II with only two replicates was laid out. Corn was planted June 13, and pre-emergence treatments applied on June 16. When applying pre-emergence treatments, the soil surface was dry and 0.49 inches of rain fell eleven days later on June 27. Then we got some rain on July 5. This experiment was characterized by dry soil and weather conditions. Both experiments were cultivated once five weeks after planting.

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-buthyl phenol (Dow Premerge)	DN
3. 2-chloro-4,6-bis (ethylamino)-S-triazine	Simazin
4. 2-chloro-4,6-bis (diethylamino)-S-triazine	Geigy 444
5. 3,(3,4-dichlorophenyl)-1,1-dimethylurea (Karmex DW)	Diuron
6. 2,3,6-Trichlorobenzoic acid (Du Pont TBA)	TBA
7. Polychlorinated benzoic acid (ACP)	M-103-A
8. Polychlorinated benzoic acid (over 80% of 2,3,6-trichlorobenzoic acid) (ACP)	M-177-A
9. 2,4-dichlorophenoxyacetamide (ACP)	2,4-D amide
10. Alpha-chloro-N, N-diallylacetamide	CDAA
11. Tris-(2,4-dichlorophenoxyethyl) phosphite	3Y9

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

The effect of different treatments on weeds and on corn was observed during the whole growing season. The weed population consisted mostly of crabgrass (Digitaria sanguinalis), yellow foxtail (Setaria lutescens), pigweed (Amaranthus retroflexus), and lamb's quarters (Chenopodium spp.). Annual weedy grasses were by far the most abundant.

Results and Discussion

Observations made seven weeks after planting are recorded in Table I. Treated plots are all rated relative to checks which were rated at 100. Injury to corn plants was recorded using a zero to 10 scale: zero-no visible effect; 10-all plants killed.

Table I. FIELD CORN WEED CONTROL, CORN INJURY AND CORN YIELDS (Relative Values. Checks = 100)

No. Treatments	Experiment I Weed Stand 7/12/56 Monocot	Dicot	Corn** Injury 7/12/56	Relat. Corn Yields	Experiment II Weed Stand 7/31/56 Monocot	Dicot	Relat. Corn Yields
1) Check	100	100	0	100	100	100	100
2) 2,4-D, 1 lb/A	52	40	2.8	174	32	45	118
3) 2,4-D, 2 lb/A	50	32	6.5	162	24	35	113
4) DN, 3 lb/A	41	16	0.6	228	42	43	86
5) DN, 6 lb/A	24	14	2.0	246	36	36	95
6) Simazin, 1 lb/A	15	14	0	214	21	31	105
7) Simazin, 3 lb/A	10	8	0	254	12	15	105
8) Geigy 444, 5 lb/A	59	51	0	186	39	12	97
9) Geigy 444, 10 lb/A	25	14	0	244	33	10	92
10)Diuron, 1 lb/A	39	32	0	212	29	32	105
11)Diuron, 2 lb/A	19	11	3.2	217	9	8	108
12)Diuron, 1 lb/A II*	44	15	2.5	211	28	15	94
13)Diuron, 2 lb/A II*	30	11	5.2	191	18	8	92
14)TBA, 3/4 lb/A	70	18	0	86	48	9	111
15)TBA, 1 1/2 lb/A	31	8	3	173	25	8	99
16)M-103-A, 3/4 lb/A	90	25	0	127	80	28	106
17)M-103-A, 1 1/2 lb/A	86	12	0	103	58	16	101
18)M-177-A, 3/4 lb/A	89	22	0	107	93	20	86
19)M-177-A, 1 1/2 lb/A	80	11	0	159	79	12	93
20)2,4-D amide, 1 lb/A	65	48	3.8	154	28	28	104
21)2,4-D amide, 2 lb/A	56	36	5.5	157	13	14	110
22)CDAA, 4 lb/A	59	66	0	137	19	32	97
23)CDAA, 8 lb/A	31	35	3.5	169	14	16	110
24)CDAA, 4 lb/A+2,4-D,1 lb/A	46	32	4.4	155	15	15	107
25)CDAA, 8 lb/A+1-D, 2 lb/A	21	21	5.5	171	9	9	115
26)3Y9, 3 lb/A	29	24	3.0	161	28	59	108
27)3Y9, 6 lb/A	22	14	6.5	104	23	41	100
L.S.D. at 5% level	20	13		51			
L.S.D. at 1% level	27	17		68			

* When corn 6-8 inches tall

** 0- no visible effect; 10- all plants killed

Weed survey made seven weeks after planting indicated (Table I) that all herbicides and all rates applied, significantly controlled broadleaved weeds. The addition of 1 lb/A of 2,4-D to CDAA increased broadleaved weed control significantly. With the exception of M-103-A and M-177-A, all herbicides effectively controlled monocotyledonous weeds also. Results of these trials together with results obtained elsewhere indicate that 2,3,6-trichlorobenzoic acid is more effective than other isomers of this acid. M-103-A and M-177-A did not differ significantly in effectiveness. In general, the best weed control was obtained with Simazin and Diuron (Karmex DW). All these plots remained relatively free of weeds during the whole growing season. Diuron was effective in pre-emergence and also in post-emergence treatments. All other treatments with the exception of M-103-A and M-177-A were effective in eliminating both monocotyledonous and dicotyledonous weeds.

In Experiment I, where shortly after the application of pre-emergence treatments, heavy continuous rain occurred, corn was injured by the following herbicides: 2,4-D, Diuron, TBA, 2,4-D amide, CDAA + 2,4-D, 3Y9, DN, and even CDAA. Diuron was more injurious when applied as a post-emergence treatment. In Experiment II (Table I) under relatively dry soil conditions, no pre-emergence treatment significantly injured corn plants. Diuron applied when corn was in four leaf stage, 6-8 inches tall, injured corn significantly -- corn was suppressed in growth and leaves were chlorotic. Seven weeks after planting on July 31, 1956, corn in check plots was 22 inches tall compared to 14 inches in Diuron 2 lb/A II post-emergence treatment plots. As the growing season progressed, all signs of injury disappeared completely.

During July and August 1956, the weather was rather dry and cool at Amherst. As a result of dry weather, competition between corn and weeds for moisture and for nutrients became strong on all weedy plots. Corn plants on weedy plots were pale, yellowish and greatly reduced in size. The highest yields were obtained where weeds were most effectively controlled. Therefore, all chemicals but 3Y9, 6 lb/A, which injured corn but performed relatively good weed control, did increase corn yields on treated plots over the checks.

Corn in the second experiment was fertilized with commercial fertilizer at the same rate as in Experiment I but got in addition a heavy application of manure. Corn growth was exceptionally lush and weed competition was not serious. As a result, yield differences between various treatments were not significant.

<u>Summary and Conclusions</u>

1. On adjacent fields, two field corn weed control experiments were conducted. In the first experiment, corn was planted on May 25 and in the second on June 13. In both experiments the same treatments were applied. In Experiment I heavy rains occurred after the application of pre-emergence treatments. In Experiment II rather dry weather conditions prevailed for 11 days after application of pre-emergence treatments. The weed population consisted of: crabgrass, yellow foxtail, pigweed and lamb's quarter. Annual weedy grasses were much more numerous than broadleaved weeds in both fields.

2. All chemicals were effective in controlling broadleaved weeds in both experiments. With the exception of M-103-A and M-177-A all herbicides

effectively controlled monocotyledonous weeds also. In both experiments the best weed control was obtained with Simazin, Diuron, CDAA + 2,4-D and Geigy 444. Plots treated with these herbicides were quite free of weeds throughout the growing season. No injury to corn plants was observed from the use of Simazin. This chemical is a most promising material for controlling weeds in corn.

3. In Experiment I, where heavy rains occurred shortly after the pre-emergence treatment application, the following chemicals significantly injured corn: 2,4-D, Diuron, 2,4-D amide, CDAA + 2,4-D, 3Y9, DN and CDAA. Due to good weed control all these treatments with the exception of the highest rate of 3Y9 significantly increased corn yields. Under the dry conditions in Experiment II, no pre-emergence treatment injured corn. Diuron applied when corn was in four leaf stage produced definite injury symptoms. Later, as the growing season progressed, plants regained a normal appearance.

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PRE-EMERGENCE WEED CONTROL IN CORN [1]

John A. Meade, Woodland Hurtt and Paul W. Santelmann [2]

At one time several years ago it was thought that 2,4-D had overcome the problem of weeds in corn. It soon became apparent, however, that such was not the case. Weed control after lay-by and controlling annual grasses at any time still presents a problem. Particularly of interest in Maryland is giant foxtail (Setaria Faberii Herrm.).

The purpose of this paper is to give the results of two years' work on the pre-emergence application of herbicides in corn. Of particular interest and worth repeating is an experiment concerning mixtures of herbicides. The data this year are limited but it seems that the principle is sound and promises to be of value. Unfortunately, the first year environmental conditions prevented the obtaining of yields, and the second year birds thinned the stands to the point where yields were unobtainable.

Procedure

In 1955 plots were established on a sandy loam soil at the University Plant Research farm. The same general area was used for the 1956 tests. In addition an experiment was put out on a Chester silt loam soil at the Grove Miller farm in Cecil County. These were intended for the control of giant foxtail. Most plots were 20 feet long by 4 rows wide, and were replicated 3 times.

All chemicals except 2,4-D and Emid (2,4-dichlorophenoxy acetamide) were applied with a bicycle sprayer in 40 gpa. These two were applied in 10 gpa. All plots were sprayed 1 or 2 days after seeding. Millet was overseeded to produce a uniform population of grass at the Research farm. On the Grove Miller farm chemicals were applied with a four nozzle hand sprayer. The plots were 10 by 13.5 feet.

Injury ratings were made as noted in Tables 1 and 2. Each figure is the average of the rating of two or three individuals on three replications. Injury ratings are on the basis of 0 = no injury to 10 = complete kill, and are relative to the nearest check plot.

Results and Discussion

In 1955 ratings at the Research farm were made at 1, 1½ and 3 months after treatment. CDAA, CDEA and CDEC at 3 lbs./A. gave poor weed control. CDAA at

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6 pounds gave good control of grasses for one month, but the effect was dissipated at the end of 1½ months. CDEA at 6 pounds was still effective after 1½ months, but was gone at the end of 3 months. CDEC was ineffective at 6 pounds.

Monuron at 3/4 and 1½ pounds exhibited good control of grass and broadleaved weeds over the entire period of three months. The 3/4 pound rate had lost some of its effectiveness on grasses at the end of three months. Fenuron showed considerably less toxicity to grasses than did Monuron, and at the end of 1½ months, grass control was negligible. Broadleaved weed control was still fairly good at both rates. Neither fenuron nor monuron injured the corn.

Amino triazole (ATA) at 6 pounds caused good control initially, but at the end of three months, broadleaved weed control was ineffective. Grass control was, however, still good. The 12 pound rate exhibited good control of both grasses and broadleaves for the entire period of the test. However, this rate injured the corn somewhat, but it appeared to outgrow the injury.

Trichlorobenzoic acid (TBA) at 3/4 and 1½ pounds caused severe injury to both grasses and broadleaved weeds initially, but at the end of 1½ months the grass control was decreasing and at the end of three months, no grass control was evident. However, the control of broadleaved weeds was still very good. The two rates of TBA were equally effective.

Dalapon at 3 pounds showed good control of grasses over the three-month period, but caused some corn injury. The 6 pound rate, while effectively controlling weeds, injured the corn rather severely. DNBP exhibited good control of both types of weeds for one month, but control rapidly tapered off after this period. 2,4-D LVE also controlled both types of weeds, but it was more residual, showing fair control of both at the end of three months.

In 1956 ratings at the Research farm were made 1½ and 3 months after spraying. The 2,4-D LVE treatment showed good control of both grass and broadleaved weeds, but its effects had disappeared at the end of three months. Emid at 1 and 2 pounds exhibited good initial control of both types of weeds, but at the end of three months only the 2 pound rate was showing any effect.

DNBP at 5 pounds caused little reduction in weeds at either of the ratings. CDAA also did not perform very well in this experiment. The 5 pound rate did have an effect on grasses at the end of 1½ months but it was slight and disappeared rapidly. ATA at 4 and 8 pounds caused severe injury to both grasses and broadleaved weeds at the 1½ month rating, but at the 3 month observation, only the grasses were controlled.

The 1½ pound rate of monuron exhibited excellent control of both types of weeds over the entire period. This chemical, however, caused injury to the corn. Neburon at 4 pounds was one of the best treatments in the test. Grass and broadleaf control was excellent with no damage to the corn.

TBA, XTB (ACP-M-103) and ACP-M-177 (polychlorobenzoic acids with at least 80% 2,3,6-TBA) exhibited very good control of broadleaved weeds throughout the entire test. TBA at 1½ pounds showed fair grass control throughout the 1½ month period. The 2 pound rate of XTB caused some corn injury.

TABLE 1. Injury ratings (average of 3 replications) of the effect of various herbicides on grass weeds (Gr.), and broadleaved weeds (Brlv.) in corn. Treatments were made at the Plant Research farm in 1955 and 1956, and at the Miller farm in 1956.

0 = no damage; 10 = complete kill

		Research Farm - 1955									Research Farm - 1956						Miller 1956	
		June 24			July 14			August 22			June 26			August 15			July 25	
Treat-ments	Rate lbs./A.	Corn	Gr.	Brlv.	Corn	Gr.	Brlv.	Corn	Gr.	Brlv.	Corn	Gr.	Brlv.	Corn	Gr.	Brlv.	Corn	Gr.
DNBP	5	0	8	9	1	4	4	0	1	2	0	3	4	1	2	0	-	-
2,4-D LVE	1½	0	9	10	0	8	9	0	6	7	0	8	9	0	3	2	3	8
EMID	1	-	-	-	-	-	-	-	-	-	0	8	7	0	0	0	0	8
	2	-	-	-	-	-	-	-	-	-	0	8	9	0	5	5	1	9
ATA	4	-	-	-	-	-	-	-	-	-	0	10	7	0	9	0	-	-
	6	0	10	9	0	10	10	0	9	3	-	-	-	-	-	-	0	2
	8	-	-	-	-	-	-	-	-	-	0	10	9	0	10	4	0	1
	12	1	10	10	0	10	8	0	10	8	-	-	-	-	-	-	-	-
Monuron	3/4	0	9	10	0	8	9	0	6	8	-	-	-	-	-	-	-	-
	1½	0	10	10	0	10	9	0	8	9	2	10	10	1	9	9	-	-
Fenuron	3/4	1	6	10	0	2	8	0	0	8	-	-	-	-	-	-	-	-
	1½	0	8	10	0	3	0	0	0	7	-	-	-	-	-	-	-	-
Neburon	4	-	-	-	-	-	-	-	-	-	0	9	10	0	9	9	-	-
Dalapon	3	1	10	2	1	8	0	0	8	0	-	-	-	-	-	-	-	-
	6	4	10	7	6	9	1	6	10	0	-	-	-	-	-	-	-	-
TBA	3/4	0	8	10	1	4	5	0	0	8	0	4	9	1	0	9	-	-
	1½	0	9	10	0	6	9	0	0	9	0	7	10	0	0	10	-	-
XTB	1	-	-	-	-	-	-	-	-	-	0	0	8	0	0	9	-	-
	2	-	-	-	-	-	-	-	-	-	0	3	10	1	1	10	-	-
ACP-M-177	1½	-	-	-	-	-	-	-	-	-	0	4	10	0	0	9	-	-
CDAA	3	0	4	3	2	2	0	0	0	0	0	2	1	0	0	0	-	-
	5	-	-	-	-	-	-	-	-	-	0	6	0	1	3	0	-	-
	6	0	8	6	1	2	1	0	1	0	-	-	-	-	-	-	0	2
CDEA	3	0	3	5	1	1	0	0	0	0	-	-	-	-	-	-	-	-
	6	0	8	9	1	8	1	0	2	0	-	-	-	-	-	-	-	-
CDEC	3	0	1	5	2	0	0	0	0	0	-	-	-	-	-	-	-	-
	6	0	5	8	0	0	0	0	0	0	-	-	-	-	-	-	-	-

An experiment was laid out involving combinations of herbicides which were thought to be either good grass killers or good broadleaved weed killers. It is a little difficult to say what effect the combinations produced. A combination of 2,4-D LVE and CDAA was similar to 2,4-D alone, but considerably better than CDAA alone. Addition of CDAA to TBA increased the grass control of TBA somewhat. CDAA plus Emid also increased control of both types of weed. ACP-M-177 with CDAA increased the grass control of ACP-M-177 alone. Since CDAA did not do very well alone, any of the chemicals added to it improved its effectiveness.

TABLE 2. Injury ratings (average of 3 replications), made 1½ months after treatment, of the effect of various herbicide combinations on grass weeds and broadleaved weeds (Brlv.) in corn. Plant Research Farm, 1956.
0 = no injury; 10 = complete kill

COMBINATION AND RATE					CORN	GRASS	BRLV.
2,4-D	1½ lbs.	+ CDAA	4	lb.	0	9	10
2,4-D	1½ "	+ CDAA	5	"	0	9	10
Emid	1½ "	+ CDAA	5	"	0	10	10
TBA	1½ "	+ CDAA	5	"	0	10	10
M-177	1½ "	+ CDAA	5	"	0	8	8
Monuron	½ "	+ ATA	1	"	0	9	9
Monuron	½ "	+ ATA	2	"	0	10	10
TBA	1½ "	+ ATA	1	"	0	9	9
XTB	2 "	+ ATA	2	"	0	6	9

Addition of ATA to XTB considerably improved the grass control of XTB alone. ATA at 1 pound plus monuron at 1/2 pound was as good as 1½ pounds of monuron or 8 pounds of ATA alone.

It is anticipated that this type of experiment will be expanded and repeated this year (1957).

The experiment at the Grove Miller farm was seeded June 6 and sprayed June 7. 2,4-D LVE at 1½ pounds slightly injured the corn but did give fair control of the giant foxtail as observed two months after treatment. ATA at 6 and 8 pounds had little effect on the foxtail, as was the case with CDAA at 6 lbs./A. However, in other trials around the state, CDAA did a good job of controlling giant foxtail, particularly on a high organic matter sandy soil on the Eastern Shore. Emid at 1 and 2 pounds did a very good job of controlling the foxtail with some corn injury at the 2 pound rate.

Summary

1. In 1955, 2,4-D and CMU produced excellent control of grasses and broadleaved weeds. TBA showed excellent control of broadleaves while ATA caused severe injury to the grasses.

2. DNBP at 5 pounds, dalapon at 3 pounds, and fenuron exhibited satisfactory weed control, while the results from CDAA, CDEC, and CDEA were poor. Dalapon at 6 pounds caused good weed control but injured the corn.

3. In 1956, monuron and neburon resulted in excellent control of grass and broadleaved weeds. TBA, XTB, and ACP-M-177 resulted in excellent control of broadleaves, while ATA readily controlled the grasses.

4. 2,4-D and Emid treatments caused satisfactory control, but DNBP and CDAA were unsatisfactory, as they had been in 1955.

5. Emid exhibited very good control of giant foxtail while ATA and CDAA were generally poor. 2,4-D LVE at 1½ pounds caused some injury to the corn.

6. All the mixtures tried produced good results.

PRE-EMERGENCE CONTROL OF WEEDS IN SOYBEANS [1/]

Woodland Hurtt, John A. Meade and Paul W. Santelmann [2/]

Introduction

Soybeans are a crop of major agronomic importance in Maryland, as is indicated by the fact that the acreage has increased from 57,000 acres in 1949 to 137,000 acres in 1955. This represents an increase of 140%.

Reduction in yields of soybeans from weed competition is one of the more important problems facing Maryland soybean growers. A composite estimate made from most of the counties in Maryland indicates that an average loss of 3 bushels per acre may be expected from weed competition in soybeans in spite of normal cultural procedures for controlling weeds (1). This represents an annual loss of $273,000 to Maryland growers. Staniforth and Weber in Iowa found that yield reductions in soybeans moderately infested with weeds averaged 3.7 bushels per acre, or roughly 10% less than the yields from weed-free soybeans (5).

The practices of seeding of soybeans in rows, and delaying the planting date so that one or two crops of weeds may be destroyed are two very useful cultural methods of controlling weeds in soybeans (3,4). Unfortunately there are many situations in which cultural practices cannot adequately control the weeds. The weeds growing in the rows are very difficult to control by mechanical practices. Often a wet period may occur after the emergence of the beans, which makes early cultivation difficult if not impossible, and results in the weeds getting a head start on the soybeans. Circumstances such as those given above often create a situation in which chemical weed control should be of help. However, the ideal herbicide for the control of weeds in soybeans in this area is yet to be found.

The following study gives some of the data obtained from two years research on weed control in soybeans at the Maryland Agricultural Experiment Station.

Procedure

Four row plots twenty feet long were sprayed pre-emergence with various herbicides. All treatments were replicated three times. The plots were sprayed with a bicycle-type sprayer similar to that described by Shaw (2). The chemicals were applied in 40 gpa of water at 2 mph. At intervals ranging from three to ten weeks after spraying, injury ratings were made of the soybeans and the

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2/Graduate Assistant, Instructor and Assistant Professor respectively, Agronomy Department, University of Maryland, Agricultural Experiment Station, College Park.

weeds. The ratings were as follows: 0, no injury; 1,2,3, slight injury; 4,5,6, moderate injury; 7,8,9, severe injury; and 10, complete kill. Usually two or three ratings were made independently by several workers and the results were averaged.

Because of the nature of the varying soils and growing seasons found in Maryland, the experiment was conducted at two different locations. The first location was at Upper Marlboro in Southern Maryland and the second location was at Linkwood on the lower Eastern Shore.

Results and Discussion

Upper Marlboro 1955 - On May 19, Perry variety soybeans were planted in an Adelphi fine sandy loam soil. Herbicides were applied the next day. Several hours after the application of the herbicides, a brief heavy thunderstorm occurred in which about .3 inches of rain fell.

As may be seen from Table 1, the rating made 17 days after spraying indicated that the substituted urea herbicides were more injurious to the soybeans than any other chemical applied. Both monuron and fenuron at 1/2 lb./A. caused moderate to severe injury to the beans.

CDEA and CDEC at 3 and 6 lbs./A., and CIPC at 6 lbs./A. resulted in good control of the weeds and no injury to the soybeans. CDAA at the same rate of application completely killed the weeds without harming the soybeans. PCP at 15 and 20 lbs./A., and DNBP at 5 lbs./A. also resulted in good weed control. Of all the treatments, CDAA and CIPC at 6 lbs./A., and DNBP at 7 lbs./A. were the most successful.

Thus, 17 days after spraying, the weed control was generally excellent and the crop injury, with the exception of fenuron and monuron, was zero to slight.

Approximately five weeks after the application of the herbicides, a second rating was made. The weeds in this rating were differentiated between grasses and broadleaved weeds. As was found at 17 days, only fenuron and monuron caused any appreciable damage to the soybeans. Both fenuron and monuron resulted in good control of the grasses.

Particularly noticeable at the end of five weeks was the fact that CDEC at both the low and high rates, and CDEA at the low rate had very little effect on the grasses. CDEA at 6 lbs./A. and CIPC at both 6 and 9 lbs./A. gave good control of the grasses with no effect on the soybeans. Neither of these two herbicides caused more than very slight injury to the broadleaved weeds. CIPC at 9 lbs./A. resulted in severe injury to the grasses with no visible injury to the soybeans.

Upper Marlboro 1956 - Soybeans were planted in a Monmouth fine sandy loam soil on May 10th, and four days later a series of herbicides were applied as pre-emergence sprays. Approximately 5 weeks later the first rating was made. As may be seen from Table 1, there is no column for broadleaf weeds. This was omitted because there were almost no annual broadleaved weeds present in the plot area. There was, however, a very heavy stand of crabgrass.

TABLE 1. Injury ratings (average of 3 replications) of grass weeds (Gr.), broadleaved weeds (Brlv.) and soybeans treated pre-emergence with various herbicides at two locations. The ratings were made 17 to 76 days after treatment, as indicated.

0 = no damage; 10 = complete kill

		Upper Marlboro - 1955					Upper Marlboro - 1956				Linkwood - 1956				
	Rate	17 days		40 days			40 days		76 days		27 days		41 days		
Chemicals	lbs./A.	Soy.	Weeds	Soy.	Gr.	Brlv.	Soy.	Gr.	Soy.	Gr.	Soy.	Weeds	Soy.	Gr.	Brlv.
Alanap-3	2	-	-	-	-	-	0	2	0	2	0	4	1	8	3
	4	-	-	-	-	-	1	4	0	2	0	6	0	8	3
CDAA	3	0	9	0	6	1	1	2	1	1	0	1	1	6	0
	4	-	-	-	-	-	0	6	0	2	1	2	1	6	0
	6	0	10	1	7	1	-	-	-	-	-	-	-	-	-
CDEA	3	0	8	0	1	1	-	-	-	-	-	-	-	-	-
	6	0	9	0	7	1	-	-	-	-	-	-	-	-	-
CDEC	3	0	8	0	2	1	-	-	-	-	-	-	-	-	-
	6	0	9	0	2	1	-	-	-	-	-	-	-	-	-
CIPC	6	0	9	0	7	0	4	6	1	2	0	5	0	5	0
	8	-	-	-	-	-	1	9	0	5	2	7	1	9	3
	9	1	10	0	9	1	-	-	-	-	-	-	-	-	-
4(2,4-DB)	3	-	-	-	-	-	2	7	0	4	-	-	-	-	-
4(MCPB)	3	-	-	-	-	-	1	4	1	1	-	-	-	-	-
4(2,4-DP)	1	-	-	-	-	-	0	2	0	1	-	-	-	-	-
	2	-	-	-	-	-	1	3	1	1	-	-	-	-	-
DNBP	3	0	7	0	5	4	-	-	-	-	-	-	-	-	-
	4½	-	-	-	-	-	0	3	0	0	0	3	0	5	1
	5	0	9	0	4	4	-	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	0	4	0	0	0	7	0	5	2
	7	0	10	0	6	4	-	-	-	-	-	-	-	-	-
PCP	15	0	8	0	1	1	-	-	-	-	-	-	-	-	-
	20	1	8	0	5	2	0	2	0	0	0	6	0	6	6
Fenuron	½	5	10	3	8	5	-	-	-	-	-	-	-	-	-
Monuron	½	5	9	3	6	4	-	-	-	-	-	-	-	-	-
	1	1	8	1	7	3	-	-	-	-	-	-	-	-	-
Neburon	2	-	-	-	-	-	0	3	1	0	0	2	0	7	0
	4	-	-	-	-	-	0	5	0	2	1	4	1	9	2
TBA	3/4	-	-	-	-	-	7	2	10	2	9	8	10	8	9

TBA at 3/4 lbs./A. killed most of the soybeans with only slight injury to the grass. Alanap-3, 4(2,4-DP), DNBP, 4(MCPB), PCP, and CDAA all were relatively ineffective in controlling grasses. CIPC at 6 and 8 lbs./A., 4(2,4-DB) at 3 lbs./A., neburon at 4 lbs./A. and CDAA at 4 lbs./A. were the only treatments which showed any promise of controlling the grasses.

Five weeks later another rating was made of the injury sustained by the grasses and soybeans. As was found from the previous year's data, the inhibitory effect of the herbicides was much less at the time of the last rating. Although CIPC, 4(2,4-DB), and CDAA at 5 weeks caused moderate to severe injury to the grasses, little or no injury was recorded at 10 weeks. Only CIPC at 6 lbs./A. still showed some crabgrass control. However, the herbicides that at least delayed the grasses may be of some use, as the farmer would have cultivated before they got very large.

Linkwood 1956 - On May 16th, soybeans were seeded in an Elkton loam soil. The chemicals were applied as pre-emergence sprays on the same day. Unfortunately, there was only a light stand of broadleaved weeds.

Severe injury was again noted on the soybeans as a result of 3/4 lbs./A. of TBA. With the exception of Alanap-3 at 4 lbs./A., CIPC at 6 and 8 lbs./A., and DNBP at 6 lbs./A. there was little weed control visible at the rating made approximately 4 weeks after spraying. CDAA as contrasted to the 1955 data, caused only slight injury to the weeds. At the time of this rating, DNBP at 6 lbs./A. and PCP 20 lbs./A. exhibited the best weed control.

Two weeks later the second ratings, which were differentiated into broadleaved weeds and grasses, were made on these plots. Alanap-3 at 2 and 4 lbs./A. CIPC at 8 lbs./A., and neburon at 2 and 4 lbs./A. resulted in very good control of the grasses. PCP at 20 lbs./A. and CDAA at 3 and 4 lbs./A. resulted in moderate control of the grasses. The best control of the broadleaved weeds was obtained by 20 lbs. per acre of PCP.

Summary

1. Alanap-3 varied in its effect upon grasses from one location to the other. It appeared to cause light to moderate injury to annual grasses.

2. CDAA, CDEA, and CDEC at 6 lbs./A. resulted in at least moderate control of the grasses. CIPC at 8 or 9 lbs./A. controlled the grasses very effectively with little or no injury to either the soybeans or the broadleaved weeds.

3. Not enough data is available to make any conclusions about 4(2,4-DB) or 4(MCPB), but they may have use in soybeans. 4(2,4-DP) seemed to be quite ineffective as an herbicide for use in soybeans.

4. DNBP was rather erratic in its behavior. Rates of 6 or 7 lbs./A. gave fair results. PCP at 20 lbs./A. seemed to result in fair control of the grasses and some control of the broadleaved weeds.

5. Fenuron and monuron at 1/2 lbs./A. caused light to moderate injury to soybeans, and TBA at 3/4 lbs./A. caused severe injury to soybeans, grasses, and broadleaved weeds. Neburon at 4 lbs./A. appeared to be selective for the control of grasses growing in soybeans.

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PRE-EMERGENCE WEED CONTROL IN SOYBEANS

H. W. Indyk[1]

Abstract[2]

Weed control is a major problem in the production of soybeans not only from the standpoint of reduced yields as a result of competition for moisture, nutrients, and light; but also as a factor seriously interfering with harvesting operations and invariably reducing soybean seed quality. The change in soybean culture from solid-planting to row-planting has proven to be effective in controlling the weeds between the rows but has not satisfactorily eliminated the weed problem in the row.

An economical and reliable means of chemical control to supplement cultural practices would be desirable. Because of the sensitivity of soybeans to present day herbicides, it appears that pre-emergence treatments would be more promising as compared to post emergence treatments.

The herbicides at the respective rates indicated in the accompanying table were evaluated as pre-emergence treatments on Wabash soybeans at two locations during the three year period, 1954-56. The soil type represented at the Newark location was a Sassafras loam and at Georgetown a Norfolk loamy sand. Treatments were applied one day after seeding the soybeans. The weed population consisted primarily of pigweed (*Amaranthus retroflexus*), lamb's quarters (*Chenopodium album*), ragweed (*Ambrosia artemisiifolia*), morning glory (*Ipomoea spp.*) and crabgrass (*Digitaria spp.*). The performance of the herbicides was evaluated on the basis of suppression of weed growth indicated by weed control ratings for broadleaves and grasses individually and the effect of the herbicide on soybean stand and yield. Weed control ratings and soybean stand counts were taken approximately 35 days after application of treatments. During the remainder of the growing season, all plots were cultivated as needed to control emerging weeds. Two check plots were maintained, one of which received

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2. Published as an Abstract of Miscellaneous Paper No. 259 with the approval of the Director of the Delaware Agricultural Experiment Station.

the same cultivation treatment as the chemically treated plots (designated as the check treatment in the table) and the other received cultivation as needed commencing at the time of seeding and continuing throughout the growing season (designated as the check - cultivated treatment in the table). The latter check treatment generally required two cultivations during the initial 35-day period before the other plots were cultivated.

Soybean samples for yield determinations were harvested in the fall.

The effectiveness and selectivity of NaPCP was outstanding among all of the herbicides evaluated at the two locations during the three year period. At 25 lbs. per acre excellent control of weed growth, broadleaves in particular, was obtained without any harmful effect on soybean stand or yield. The control of grasses was not as satisfactory as the control of broadleaves. On the basis of the results of these trials, NaPCP will be recommended for commercial application as a pre-emergence treatment for soybeans if and when residue tolerances for this material are established.

In the control of grasses, the superiority of CDEC and CDAA was most striking. However, differences in the performance of these two chemicals between the two locations was apparent. At Newark, CDEC at 8 - 10 lbs. per acre was more satisfactory than CDAA at the same rate. At Georgetown, CDAA at 4 lbs. per acre provided very good weed control and at 8 lbs. per acre the control was excellent without any reduction on soybean yield. On the other hand, CDEC at 8 lbs. per acre was not as effective as CDAA at 4 lbs. per acre and in addition seriously reduced soybean yields.

In the control of all weed growth, a mixture of 20 - 25 lbs. NaPCP and 8 - 10 lbs. of CDEC was slightly superior to either ingredient of the mixture when applied alone at comparable rates. No significant advantage in yield of soybeans was obtained. Excellent results were obtained with a NaPCP and 2,4-D mixture at Newark in 1954 when a prolonged dry period followed the application of chemical treatments. The weed infestation was predominantly morning glory.

In addition to the treatments indicated thus far, several other herbicides, although comparatively less effective, did show some promise. Included in this group was Premerge at 6 - 8 lbs.

per acre at both Newark and Georgetown. Alanap-3 at 4 lbs. per acre, 2,4-D amine at 1 lb. per acre, 2,4-D acetamide at 2 lbs. per acre, MCPB at 4 lbs. per acre, and Neburon at 4 lbs. per acre have given satisfactory weed control at both locations but at Georgetown have caused serious reductions in soybean stands and yields. At Newark also, soybean injury, characterized by epinasty and stunting, was evident particularly on the plots treated with the phenoxy compounds. However, these symptoms were outgrown during the early growth stages of the soybean plant. No serious reductions in yield were produced.

The cooperation of the following companies in providing chemicals for these trials is acknowledged:

American Chemical Paint Co., Ambler, Pennsylvania
Carbide and Carbon Chemicals Co., New York, New York
Dow Chemical Co., Midland, Michigan
E. I. duPont de Nemours and Co., Wilmington, Delaware
Monsanto Chemical Co., St. Louis, Missouri
Naugatuck Chemical Co., Bethany, Connecticut
Food Machinery and Chemical Co., Middleport, New York

Table 1. Herbicide Treatments Evaluated at Newark and Georgetown, Delaware, 1954-56.

Herbicide*	Rate Lbs./A.	Newark 1954	Newark 1955	Newark 1956	Georgetown** 1954	Georgetown** 1956
2,4-D Amine	1	x	x	x	x	x
2,4-D Ester	1	x			x	
2,4-D Acetamide	2			x		x
Silvex (Amine)	1	x			x	x
Silvex (Ester)	1	x			x	x
MCPB (ACP-M-119)	2			x		x
NaPCP	12.5	x	x	x	x	x
PCP (M-562)	12.5			x		x
DNBP (Premerge)	3	x	x		x	
DNBP (Premerge)	4			x		x
Alanap-1	2	x			x	
Alanap-3	2		x	x		x
CDEA	5		x			
CDAA	4			x		x
CDAA	5		x			
CDEC	4			x		x
CDEC	5		x			
IPC (T-515)	2	x			x	
CIPC (T-596)	2	x			x	
Niagara 5519	6			x		x
Niagara 5521	6		x	x		x
Karmex W	0.5	x			x	
Karmex DL	0.5	x			x	
Neburon	2			x		x
Natrin	2	x	x		x	
Sesin	2	x	x	x		
Endothal	3	x			x	
Amino Triazole	3	x			x	
3Y9	2			x		x
NaPCP +	12.5	x	x			
2,4-D (Ester)	1					
NaPCP +	12.5			x		x
2,4-D (Acetamide)	2					
NaPCP +	12.5		x	x		x
CDEC	8					
Check[1]		x	x	x	x	
Check - cultivated[1]		x	x	x	x	x

* Each herbicide was also applied at rate 2 times that indicated in table.

** No test at Georgetown in 1955.

1. Check -- received cultivation identical to chemically treated plots.
   Check - cultivated -- received cultivation as needed commencing at time of planting.

PERSISTENCE AND LEACHING OF CDEC AND CDAA IN SOIL

By R. J. Otten, J. E. Dawson, and M. M. Schreiber[1]

Introduction

One perplexing problem in agricultural research is relating the results of field experiments with results of laboratory and greenhouse experiments. This is especially important during preliminary screening of new chemicals for potential use as commercial herbicides. The limitations of time, space, labor, and expense mean that much testing must be done in greenhouse pots rather than field plots. But, pot tests can be meaningless unless they reflect the ultimate activity of these herbicides under field conditions. Since it is often difficult or impractical for lab and pot experiments to simulate field conditions, an investigator should understand the effects that any artificial deviations from field conditions may have on his results. Laboratory experiments can help define the relative importance of these deviations.

To cite a specific example, similar pot and plot experiments were carried out in 1955 by Schreiber (2). In the plot experiments, both CDEC and CDAA produced good weed control well on into the growing season. However, in pots receiving the same treatments and set up in an area immediately adjacent to the plots, CDEC and CDAA lost their effectiveness in a short time. The following laboratory experiments were set up to determine if watering the pots - through the effect of water on persistence and leaching - caused this difference in response.

Persistence Studies

Method and Materials: An introductory experiment was performed to determine the importance of soil moisture at the time of spraying. CDAA was made into a fine emulsion by mixing for 20 seconds in a Waring blender. Elongation of rice coleoptiles was the bio-assay used. All soils were incubated at 25° C.

The measurable activity of CDAA started disappearing after the third day and was completely gone by the seventh day in soils at 50, 100, or 150 percent M.E. (moisture equivalent). CDAA maintained its activity in an air dry soil for at least seven days. When this air dry soil was brought up to 100 percent M.E., coleoptile elongation was equal to that observed in the 100 percent M.E. soil immediately after treatment. Apparently, in air dry soil, with dormant seeds and a herbicide that is decomposing slowly if at all, growth inhibition will be produced as conditions are made favorable for seed germination.

Therefore, when considering technics to use in setting up a laboratory persistence study, it is permissable to spray the herbicide directly on an air dry soil, mix and divide the soil as required, bring the soil up to its different moisture contents, and have no measurable loss of CDAA activity. This is assuming that all operations are done without delay.

The following experiment was carried out applying CDEC in this manner.

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Soil treated with CDEC at eight pounds per acre were brought to zero, 50, and 100 percent M.E. and incubated at 8° C. and 25° C. Soil moisture was maintained throughout the length of the experiment.

Discussion of Results: The measurable activity of CDEC disappeared from both moist soils in less than five days when incubated at 25° C. On the other hand, there was no loss of activity in air, dry soils incubated at either temperature for the entire test period. See Figure 1.

By the 47th day, soils kept at 8° C and at 100 percent M.E. lost all CDEC activity. In the 50 percent M.E. soils, activity found at 47 days was comparable to that found after 20 days in the 100 percent M.E. soils.

These two incubation temperatures are admittedly higher and lower than usual soil temperatures during late spring. Incubation at 16° C. (61° F.) is closer to field temperatures and will probably increase the persistence of CDEC over those values found at 25° C.

The results of these two persistence tests suggest, as has been found with many other organic herbicides, that soil conditions favoring increased biological activity also favor the rapid breakdown of CDEC and CDAA. Therefore, this relation between soil moisture and persistence may be part of the explanation for the differences found in Schreiber's plot and pot experiments. A severe drought dried out the field plots and reduced microbial action in the soil surface; watering the pots kept soil conditions favorable for rapid microbial decomposition of CDEC and CDAA.

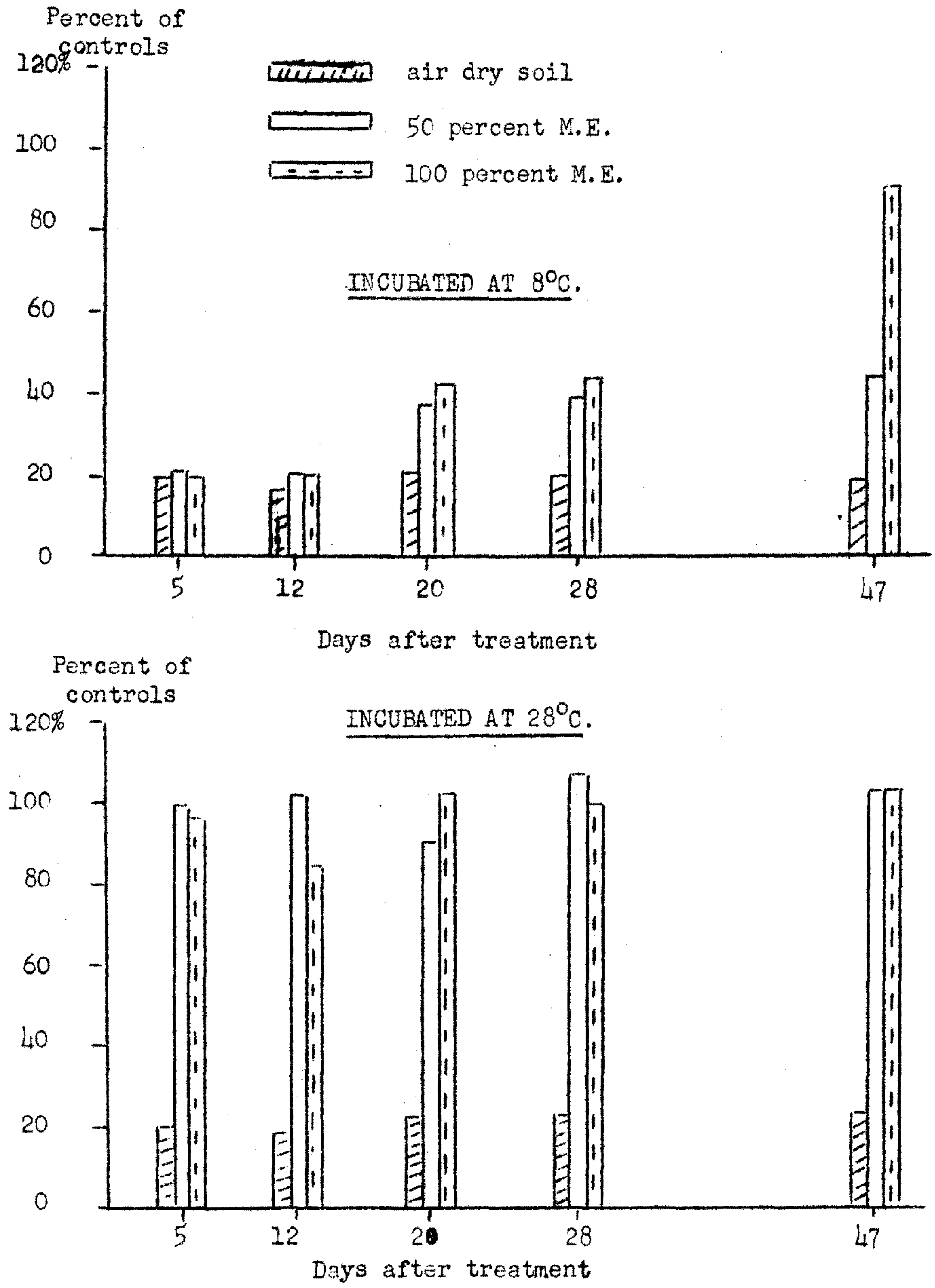
Leaching Studies

Introduction: Based on the technic described by Ogle and Warren (1), a laboratory method was developed to trace the path of a herbicide down through a column of soil. Several criteria were listed in an attempt to produce a method that was comparable to field conditions. (1) The column should have a reasonably large cross sectional area to minimize the error caused by channeled flow along the walls of the container. (2) The column should be easy to pack uniformly with soil of chosen moisture contents. (3) The amount and rate of rainfall should be in the range common in nature. (4) The rate of leaching down the column should be slow enough to establish a soil-water-herbicide equilibrium at each depth. In this way, the relative water solubilities of each herbicide and the degree of adsorption on soil particles may be expressed in the results. (5) The columns should be cut immediately after all the rain water has been applied. This shows the effects of the initial leaching motion only. If desired, two cutting times may be used on identically treated soils to show the effects of both initial leaching and secondary drainage. (6) The bio-assay used should be completed quickly. The persistence studies showed that CDEC and CDAA break down rapidly in warm moist soil. An assay performed on a decomposing herbicide is subject to many errors. For example, the portion of the decomposition curve actually tested may vary from experiment to experiment. Also the length of exposure to a given concentration of a herbicide may be as important or more important than the concentration itself.

Method and Materials: Cellulose dialyzer tubing was used as a container for the soil columns. The tube had an inflated diameter of three and one-quarter inches. A one-half inch deep section of the column provided just

FIG. 1.: THE EFFECT OF TEMPERATURE AND MOISTURE ON THE PERSISTENCE OF CDEC IN A SILT LOAM SOIL

As indicated by the growth of oat coleoptiles in treated soil.



enough soil for a bio-assay of the herbicide and a determination of the moisture.

The original roll of tubing was cut into sections 10 inches long. A number 12 rubber stopper, fitted with a short piece of glass tubing, was inserted into one end of the cellulose tubing. The narrow side of the stopper was flush with the end of the cullulose tube; the wide side was toward the inside. The slack tubing around the stopper was taken in, folded over, and secured to the stopper with a wide rubber band. A piece of filter paper was placed over the hole in the stopper to prevent soil loss through the glass tube.

Water was sprinkled on an air dry soil to bring the soil up to the desired moisture content. After a rough mixing in the pan, the moist soil was rolled on a heavy paper sheet. Fairly uniform and consistent columns were made by choosing moisture contents no higher than the moisture equivalent of each soil and by taking care in packing.

The assembled tube was placed in a quart Sealrite container that acted as a support for the sides of the cellulose tube during the filling process. About two inches of soil were added at a time. Gently dropping the quart container and the enclosed column tamped the soil after each addition.

CDEC and CDAA - made into a fine emulstion by mxing for 20 seconds in a Waring blender - were applied at the rate of four pounds per surface acre. Attempts to quantitatively spray this amount on the soil surface were unsuccessful. The nozzle had to be placed so close to the surface of the column that many of the treated soil particles were blown to the air and lost. Therefore, a diluted solution was applied dropwise from a pipette in enough volume - two ml. - to wet the entire column surface. Leaching was delayed two hours to allow the moisture to approach an equilibrium throughout the surface layer.

Prior to leaching, two thicknesses of filter paper were pressed onto a glass wool mat covering the soil surface. The glass wool mat distributed falling water over the entire soil surface. Water was allowed to drop on the filter papers from an inverted-flask reservoir. The flow of water was controlled by a screw clamp on a short piece of Tygon tubing connecting the flask to a piece of drawn glass tubing.

The soils were leached with one-half, one, and two inches of "rain". Water fronts produced at the slow rate of rainfall used - 0.1 to 0.2 inches per hour - were very uniform. This rate was far below the water absorbing capacities of the soils. Several runs were tried applying one-half inch of water per hour. Leaching was very erratic. Physical movement of undissolved particles may well have overshadowed the individual characteristics of the herbicides.

Elongation of oat coleoptiles was used as an index of the relative amounts of CDEC and CDAA present at each soil depth. Seventy-two hours before the oats were needed for an assay, an approximate quantity of seeds was wrapped in a paper towel, placed in a metal container, and thoroughly wetted. Shortly before the columns were to be cut, 20 uniformly germinated seeds were placed on moist filter disks in 9 cm. petri dishes. A sample of these seeds was opened and measured to determine the average initial length of the coleoptiles. This figure was later subtracted from the average final lengths.

Several root fibers emerged during the 72-hour incubation period but the coleoptiles were only three to five mm. long and still inside the oat hulls. Therefore, seeds could be handled rapidly without fear of mechanical injury to the coleoptiles.

The soil columns were sectioned immediately after all the "rain" had fallen. With the column erect, the cellulose tubing was slit horizontally at the first half inch depth. At this slit, one of the thin metal plates was pressed horizontally through the moist soil in a sawing motion. The half inch section was lifted off, with the ring of tubing still around it, and inverted into the bottom of a petri dish containing the assay seeds. In all cases, the original upper plane of each half-inch soil section was placed in contact with the assay seeds. The process was repeated at selected depths down the column. The tubing was then removed, part of the soil taken for a moisture determination, and the remainder spread to a uniform depth over the seeds. Those sections that received no leaching water were moistened.

The covered dishes were incubated for 48 hours at about 25° C.

Each dish was inverted before reading the assay. Gentle tapping loosened the soil from the filter paper so that the bottom part of the dish could be lifted out bringing only the seeds and filter paper disk with it. Measurements from the base of the coleoptile were made to the nearest millimeter. Each treatment was replicated four times. The standard deviation of the results was rarely more than five percent of the average figure for coleoptile elongation.

(Note: This type of leaching column is also very useful for demonstration purposes. Instead of cutting the column at different depths, lay the column on its side and make one deep cut down the entire length. Fold back the two longitudinal sections and plant assay seeds in a line down each axis. The seed growth will give an approximate indication of the amount of herbicide present at each depth.)

Discussion of Results

The soil used in this initial study was a Dunkirk fine sandy loam. The tests on heavier soils are incomplete and not given here.

As can be seen in the graphs, added water penetrated deeper in soils with a higher initial moisture content. With more moisture present in the soil, less of the added water was bound at each depth. Both CDEC and CDAA were leached down with the water front and produced inhibition at every depth the water reached.

Of the two chemicals tested, CDEC was the harder to leach. The measurable activity of CDEC in the surface of the column was reduced only when two inches of rain fell on soil at 100 percent M.E. All rainfall levels reduced the surface concentration of CDAA in moist soil. The higher rainfall reduced it in the dry soil column also.

Conclusions

The persistence and leaching studies reported here show that water can be one cause of observed differences in the herbicidal response of CDEC and CDAA as tested in similar pot and plot experiments. First, water added to the pots stimulated microbial growth and increased the rate of herbicidal decomposition in comparison to that found in relatively dry field plots. Second, both CDEC and CDAA were leached out of the soil surface by repeated watering of the pots.

The laboratory method used for the leaching studies was quite satisfactory. It seemed adaptable to a wide range of realistic soil textures, soil moistures and rainfalls. The bio-assay used in these experiments was tedious but gave consistent results. However, a good chemical test for any herbicide being studied may simplify this step in the process.

More intensive studies of this kind may provide part of the answer to the question, "Why do similar herbicide experiments in different parts of the country show so widely divergent results?" A chemical is very successful in one state while it is a complete failure in another! Realistic studies of persistence and leaching, taking into account soil texture, soil moisture, organic matter, temperature, and rainfall, can provide factual answers to this problem.

Acknowledgements

A portion of the funds supporting this research was supplied by the Cooperative Regional Project NE-12. CDEC and CDAA were supplied by Monsanto Chemical Company.

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FIG. 2.: LEACHING OF CDEC AND CDAA IN SOIL COLUMNS: ONE-HALF INCH OF RAIN APPLIED.

As indicated by the growth of oat coleoptiles at various depths.

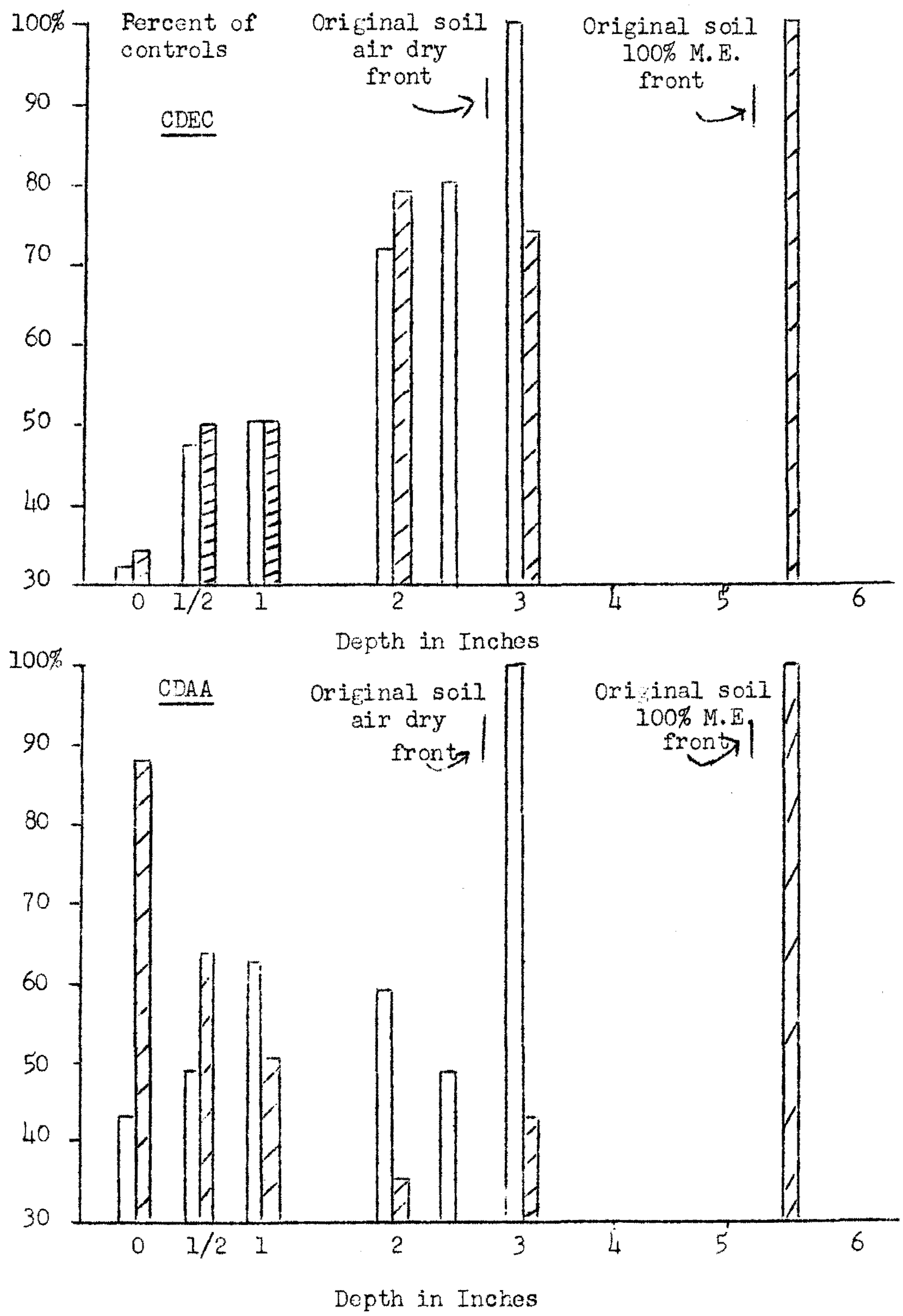
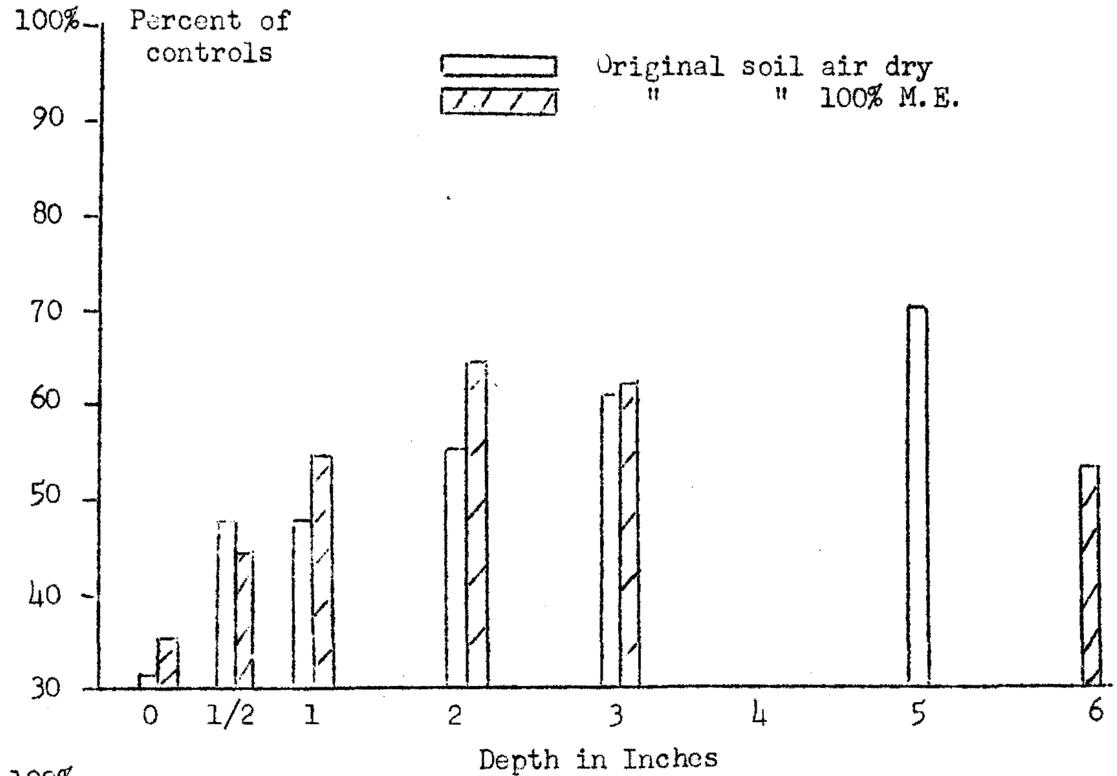


FIG. 3: LEACHING OF CDEC AND CDAA IN SOIL COLUMNS: ONE INCH OR RAIN APPLIED

As indicated by the growth of oat coleoptiles at various depths.



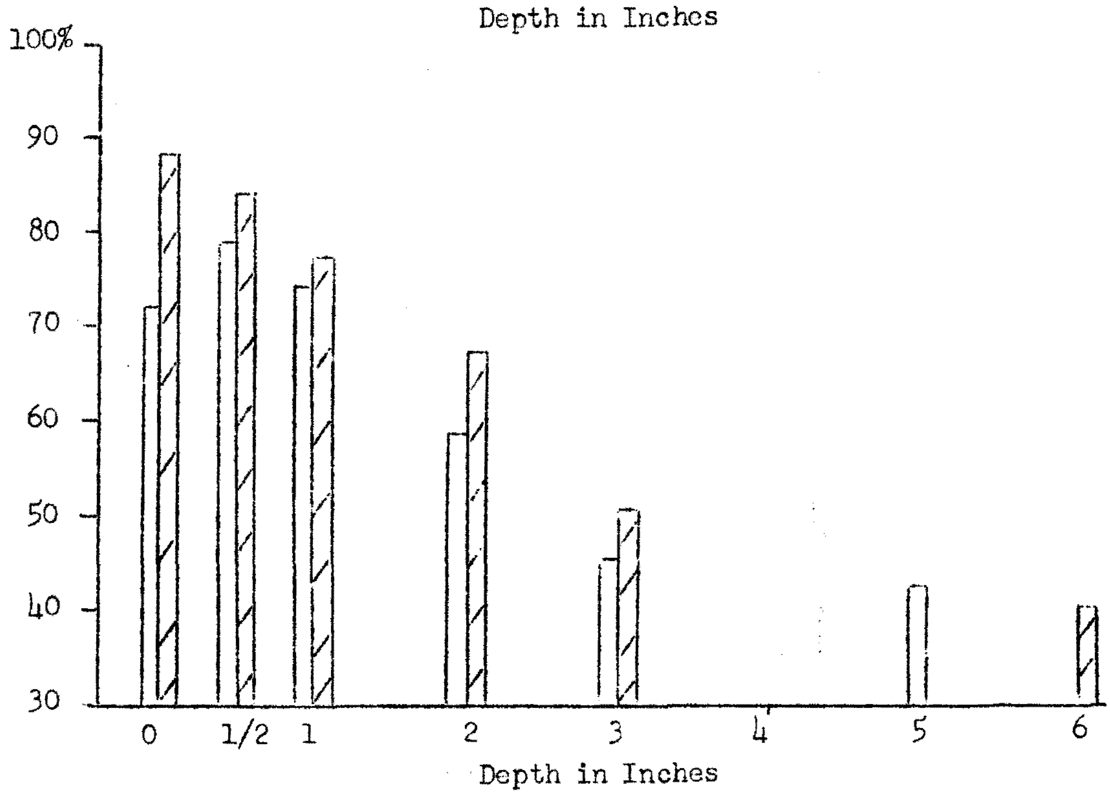
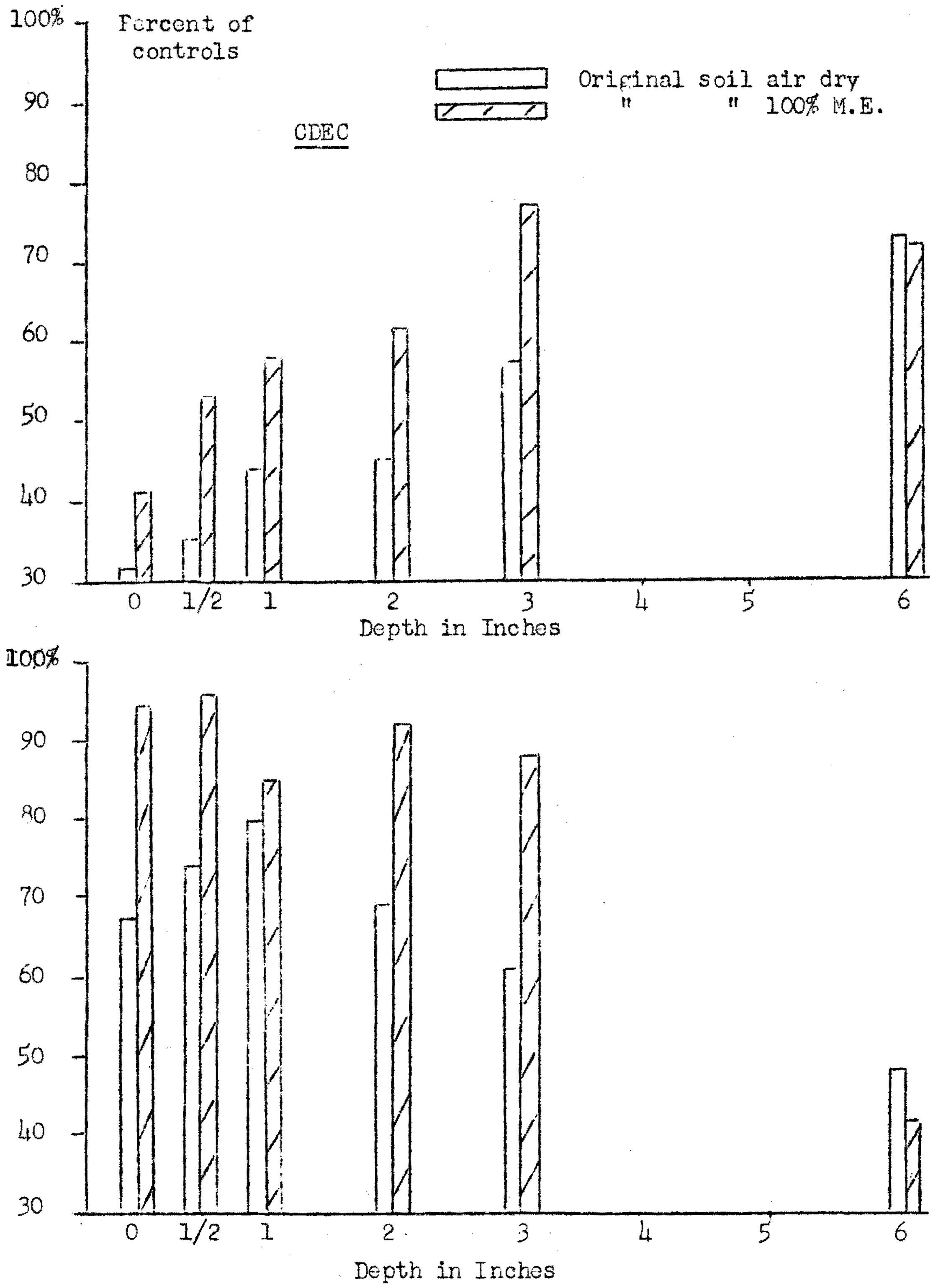


FIG. 4. LEACHING OF CDEC AND CDAA IN SOIL COLUMNS: TWO INCHES OF RAIN APPLIED.

As indicated by the growth of oat coleoptiles at various depths.



THE EFFECTS OF SEVERAL HERBICIDES ON NITRIFICATION IN SOIL

By R. J. Otten, J. E. Dawson, and M. M. Schreiber[1]

Introduction

Speaking from a fertility standpoint, it is important to know if herbicides have any effects on the soil organisms causing decomposition of organic residues, ammonification, nitrogen fixation, or nitrification. With very few exceptions, research to date has shown that repeated applications of commercial herbicides - at rates recommended for field use - have no permanent deleterious effects on the normal activity of soil microorganisms. Inhibition of certain groups has been shown in pure culture, but comparable results are difficult to find under field conditions. The laboratory studies to be reported here deal only with the effects of several herbicides on soil nitrification, i.e. the microbial oxidation of ammonium-nitrogen to nitrate-nitrogen.

Literature Review

Smith, Dawson, and Wenzel (9) found that strains of *Nitrosomonas* (nitrite forming bacteria) were more sensitive to very high rates of 2,4-D than were Nitrobacter (nitrate forming bacteria). However, both groups recovered in 10 to 40 days following applications of 200 pounds per acre of 2,4-D.

Jones (2) showed that 2,4-D has no significant effect on normal nitrate production in a prairie soil. However, when nitrogen was added in the form of urea, 2,4-D retarded the hydrolysis of urea to ammonia. Koike and Gainey (3) found that very high applications of CADE (67% diesel oil and 33% pentachlorophenol) and 2,4-D plus CADE temporarily depressed growth of nitrifying bacteria. Normal activity returned in 8 to 16 weeks. They did not find a comparable partial sterilization effect from 2,4-D alone.

Lees, Quastel, and Scholefield (4,5,7) report that very low concentrations of potassium chlorate prevented the proliferation of *Nitrobacter* while *Nitrosomonas* reproduction was unchecked. Normally, the oxidation of nitrite-nitrogen by *Nitrobacter* is more rapid than the oxidation of ammonium-nitrogen to nitrite-nitrogen by *Nitrosomonas*. Therefore, nitrite rarely accumulates in soils. Chlorate ions did not interfere with the oxidation of nitrite to nitrate by an established *Nitrobacter* population. However, when an extra ammonium-nitrogen source was made available to a chlorate treated soil, the population of *Nitrobacter* could not multiply and oxidize the additional nitrite produced by *Nitrosomonas*. Nitrite-nitrogen rapidly accumulated. Lees found that the bacteriostatic action of chlorate ions disappeared in time, possibly because the *Nitrobacter* became adapted to chlorate.

Among the other compounds found to inhibit nitrification in soil are sodium nitrite, sodium arsenite, sodium borate, ammonium sulfate (at pH 9), heavy metals, and certain chelating agents (5,7).

Experiment #1

Materials and Method: Fifty grams of air dry soil were placed in 200 ml

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Erlenmeyer flasks. The soil used was a Honeoye silt loam (pH 7.2, organic matter content 3.4 percent, cation exchange capacity of 14.1 milli-equivalents per 100 grams of soil).

Application rates for each herbicide are given in Figure 1. The low rate was chosen as approximating field applications while the high rate was double the low rate. Applications were computed on the basis of a surface acre. Polybor-Chlorate, dalapon, TCA, and ATA were water soluble. CDEC and CDAA were made into fine emulsions by mixing for 20 seconds in a Waring blender. Carbowax-1500 was used as a co-solvent to bring monuron (CMU) and CIPC into a water solution. As shown in Figure 1, Carbowax 1500 had no significant effect on nitrate-nitrogen production.

The soil in the flasks was about one-half inch deep. Nitrogen, in the form of $NH_4H_2PO_4$, was applied at the rate of 120 pounds of nitrogen per acre furrow slice or 10 pounds of nitrogen per surface acre one-half inch deep. The final moisture content of the soil was 20 percent by weight.

All flasks were loosely stoppered with cotton plugs and incubated for 14 days at 25° C. At the end of this period, a 20 gram moist soil sample was weighed out from each flask and analyzed. A moisture determination was also made at this time.

Nitrate-nitrogen (actually nitrite plus nitrate) was determined using a modification of the standard phenol-disulfonic acid method. In this, the acid was neutralized with a solution of sodium hydroxide and Versine instead of ammonium hydroxide. Known amounts of each reagent were added to 100 ml beakers instead of diluting the final solutions in volumetric flasks. Ammonium- nitrogen was determined by a modification of the Nessler's reagent technique. Nitrite-nitrogen, tested in the second experiment, was determined by a modification of the method for hydroxylamine (1). Each treatment was replicated three times. The standard deviation of the results was rarely greater than one percent of the test values.

Discussion of Results: As shown in Figure 1, the low rate of every herbicide but CDEC caused a significant reduction in the nitrate-nitrogen values observed. The high rate of each chemical produced a greater inhibition than its corresponding low rate. Polybor-Chlorate was the most toxic herbicide used. Only one-third of the nitrate-nitrogen found in the control was found in the treated soils.

The ammonium-nitrogen values, shown in Figure 2, were roughly the reverse of the nitrate-nitrogen values. That is, more ammonium-nitrogen remained in soil receiving the higher rate of each herbicide.

This type of experiment leaves several important questions unanswered. Are these reductions in nitrate-nitrogen values of agricultural significance - will they affect crop yields? Is this effect merely a suppression of bacterial growth from their inactive state in an air dry soil? How long will this effect persist in a warm moist soil?

The following experiment was set up to give a more complete picture of the effects that some herbicides have on nitrification in soil.

Figure 1: NITRATE-NITROGEN PRODUCED IN SOILS TREATED WITH SEVERAL HERBICIDES

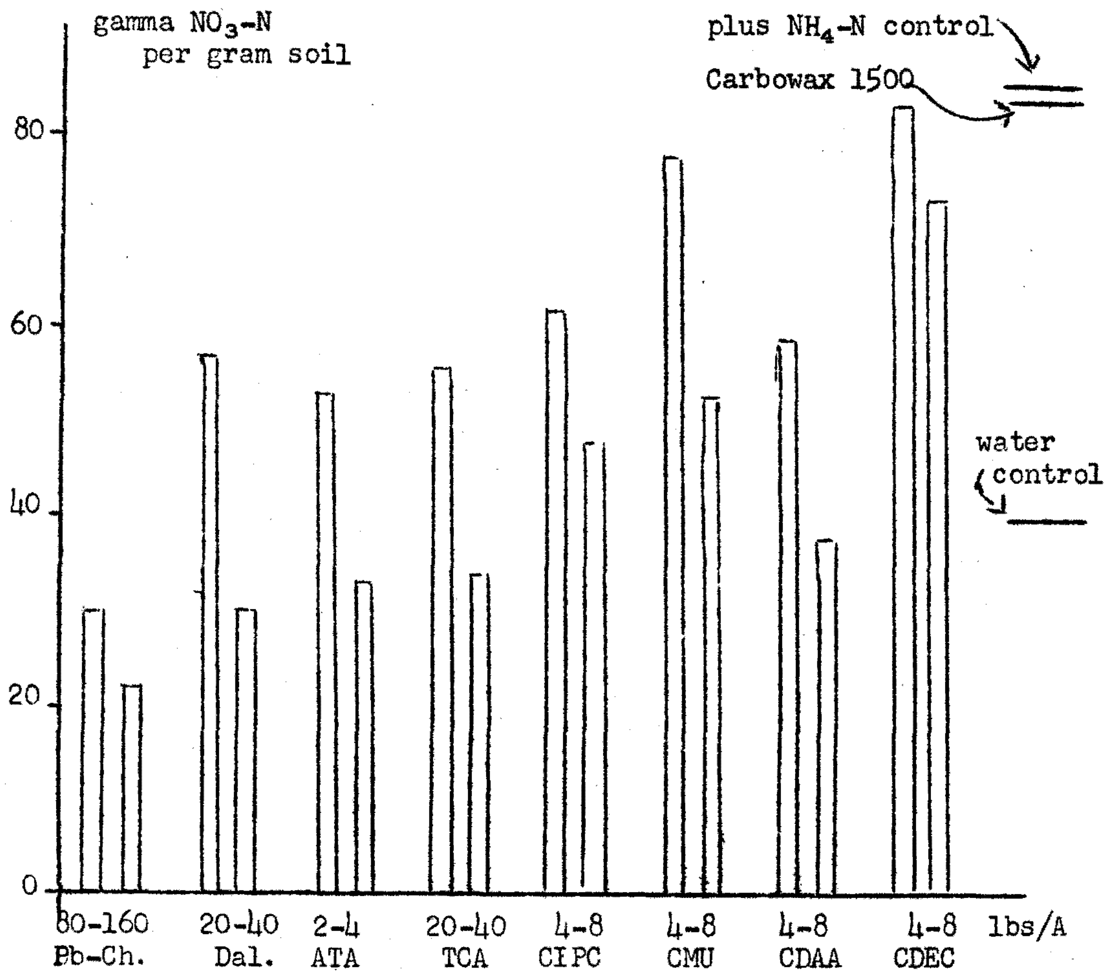
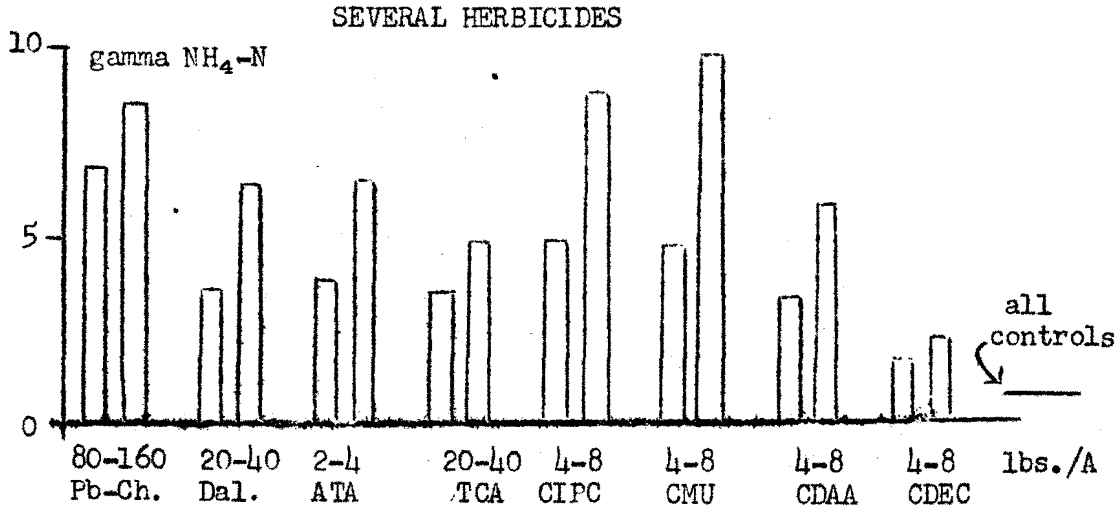


Figure 2: AMMONIUM-NITROGEN REMAINING IN SOILS TREATED WITH SEVERAL HERBICIDES



Experiment #2

Materials and Method: Eighty grams of the Honeoye soil were placed in 90 x 15 mm petri dishes. Fifteen ml of distilled water were added to each dish and all the dishes were incubated for 11 days at 25° C. This waiting period allowed an active population of nitrifying bacteria to develop. At the end of this time, solutions of the herbicides and ammonium-nitrogen were applied as in Experiment #1. 2,4-D Amide was applied using Carbowax 1500 as a co-solvent. The final soil moisture content was about 25 percent. Each treatment was replicated three times.

Periodic determinations were made of nitrate, nitrite, and ammonium-nitrogen using the procedures described in Experiment #1. Only one extraction was made from each dish; an entire set of dishes was sacrificed at each sampling date.

Discussion of Results: In the control soils, there was a linear increase in the nitrate-nitrogen values during the first few days after treatment. This indicated that a population of nitrifying bacteria had developed and was rapidly oxidizing the ammonium-nitrogen introduced into the system. Therefore, any observed inhibition of nitrate-nitrogen production was not merely a repression of organism proliferation.

CDAA and CDEC had no effect on either of the steps in nitrification. Even a reapplication of CDAA seven days after the first treatment caused no differences from the values observed in the control soils.

2,4-D Amide produced a slight but significant depression in nitrate-nitrogen values during the first 12 days of incubation, but equal or higher values thereafter. See Figure 3. Depending on the conditions of the experiment, 2,4-D acid is known to be detoxified in soils in 10 to 14 days. If this is also true of 2,4-D amide, the initial inhibition and later stimulation of nitrate-nitrogen production may be readily explained. 2,4-D Amide caused no accumulation of nitrite-nitrogen. A cloudy interference in the ammonium-nitrogen determinations made colorometric readings impossible.

It seems very doubtful that any herbicide that is subject to rapid microbial decomposition will cause any important effect on nitrification.

Polybor-Chlorate, on the other hand, caused a definite inhibition of both steps of the nitrification process in soil. First, there was a reduction in the amount of ammonium-nitrogen oxidized to nitrite-nitrogen - see Figure 5. The higher rate of Polybor-Chlorate produced the greatest effect. This explains the seemingly inconsistant second result that the lower application of Polybor-Chlorate caused a greater accumulation of nitrite-nitrogen than did the higher application- see Figure 6. Less ammonium-nitrogen was oxidized to nitrate-nitrogen under the high rate; therefore, less nitrite-nitrogen could accumulate. Thirdly, while nitrate-nitrogen production was greatly retarded, even the highest rate did not halt the process completely - Figure 4.

One important difference between the conditions in this test and conditions in the field is that there is no circulation of soil water in the petri dishes; there is no re-inoculation of active organisms from other regions of the soil. But, until Polybor-Chlorate is decomposed or leached out of a treated soil,

Figure 3: NITRATE-NITROGEN PRODUCED IN SOIL TREATED WITH 2,4-D AMIDE.

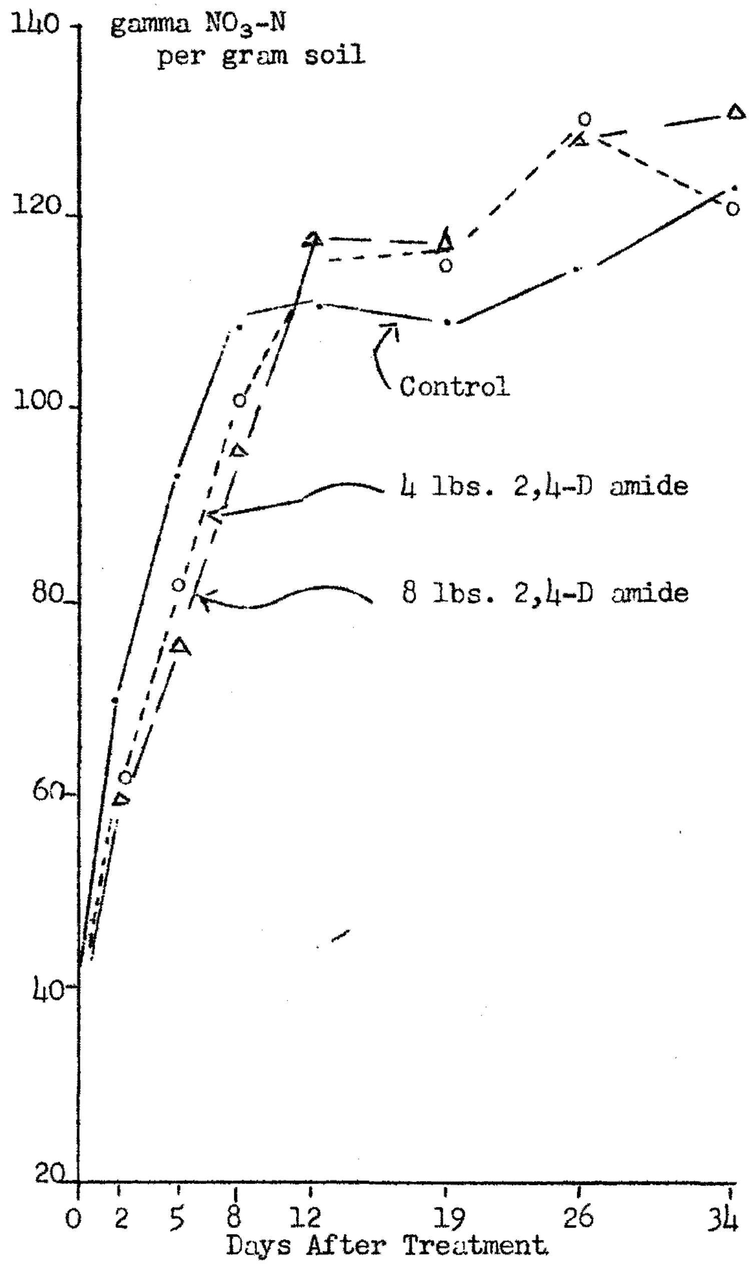


Figure 4: NITRATE-NITROGEN PRODUCED IN SOILS TREATED WITH POLYBOR-CHLORATE.

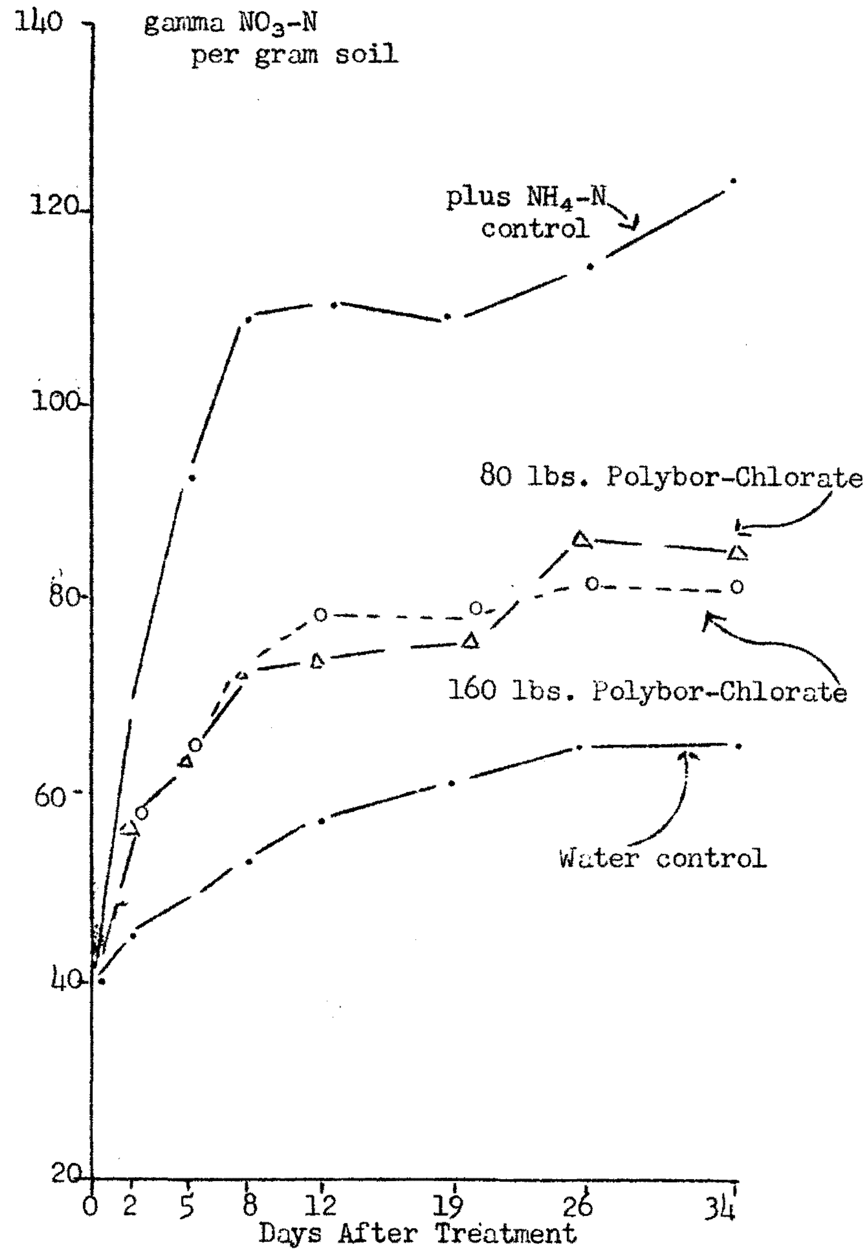


Figure 5: AMMONIUM-NITROGEN REMAINING IN SOIL TREATED WITH POLYBOR-CHLORATE

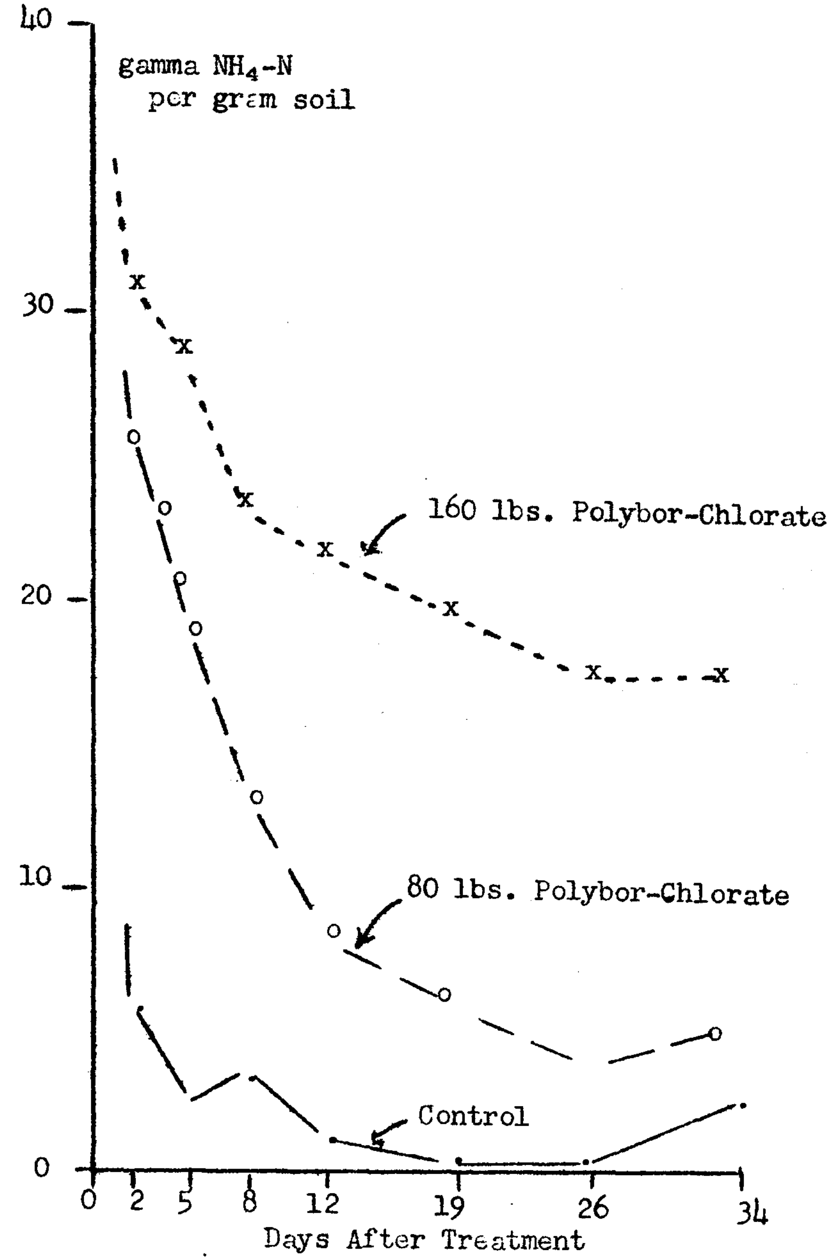
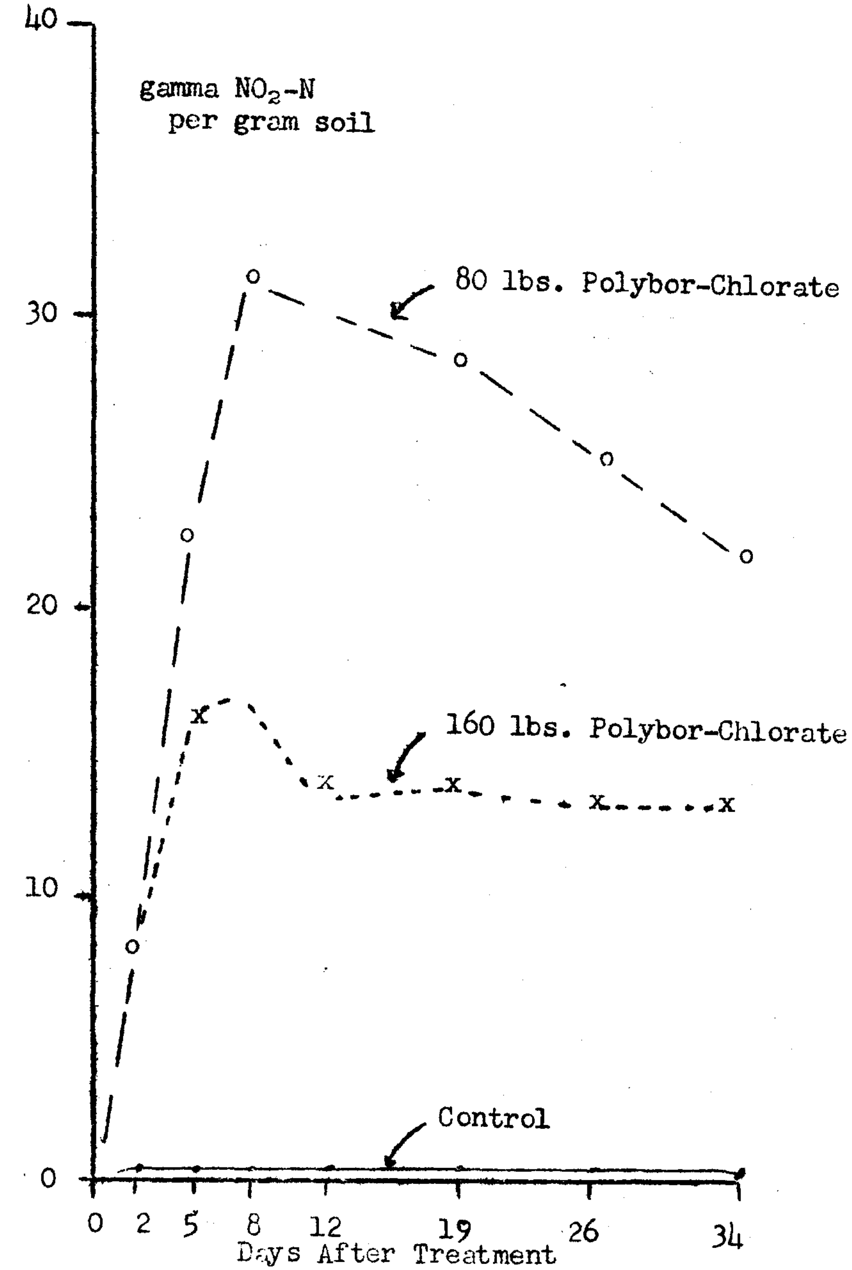


Figure 6: NITRITE-NITROGEN PRODUCED IN SOILS TREATED WITH POLYBOR-CHLORATE



fresh organisms will be affected in the same way as those originally present. Just what level of Polybor-Chlorate is required to inhibit soil nitrification has not been determined.

At present, Polybor-Chlorate is commonly used as a soil sterilent in non-agricultural areas. If, however, it is to be used in combination with other herbicides as a temporary soil sterilent in potential agricultural area, attention should be given to this inhibition of nitrification. Work with the original chlorate and borate herbicides indicates that normal productivity returns after these chemicals are gone from the soil.

What about other herbicides used as soil sterilents? Will their effect on nitrification be similar to that of Polybor-Chlorate? Which is important, the nature of the chemical molecule, the rate of application, or the relative water solubility of the different herbicides applied?

Rapid nitrification does not take place without water. It may be that the amount of each herbicide dissolved in soil water - a function of the application rate and the solubility of each - is more critical than the nature of the chemical itself.

Future work on this subject should consider these three factors in both the design of experiments and in the interpretation of results.

Acknowledgements

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American Chemical Paint Company	amino triazole 2,4-D amide
Monsanto Chemical Company	CDEC CDAA
Pacific Coast Borax Company	Polybor-Chlorate
The Dow Chemical Company	TCA dalapon
E. I. du Pont de Nemours and Company	monuron
Food Machinery and Chemical Corporation	CIPC

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Herbicidal Effectiveness of 2,4-DB, MCPB, Neburon and Other Materials as Measured by Weed Control and Yields of Seedling Alfalfa and Birdsfoot Trefoil

Albert J. Kerkin and Robert A. Peters*

Introduction

Competition from weeds during the seedling establishment stage is a very critical factor in obtaining good establishment of forage legumes. To diminish the effects of weed competition the usual practice is to seed the legume in a companion crop. However, the development of new selective weed killers offers the possibility of seeding pure stands without the dangers of severe weed competition and of a hay cut the seeding year.

Recent tests of these new materials show promise of increased selectivity in legumes. Phenoxy-butyric compounds are proving to be relatively safe on several legumes (2, 3). Their mode of action is explained as a biological selectivity operating by means of a beta-oxidation system (5, 6, 7). Neburon, a butyl-urea, shows promise of selectivity in alfalfa.

Materials and Methods

The experiment was established on May 17, 1956. The design was a randomized block consisting of three replications for each legume used. The individual plot size was 8 feet X 14 feet.

The following species were seeded: alfalfa (Vernal), birdsfoot trefoil (New York), and black mustard. All seedings were broadcast seedings made with a grain drill. While these seeded species had uniform stands, the volunteer weeds (ragweed, lamb's quarter and grasses) had irregular stands and it is likely that certain discrepencies in the following data are results of this condition. A high uniform level of fertility was established.

The chemicals were applied on June 13 and 14, 1956, with a sprayer modeled after that designed by Shaw (4). At this time the alfalfa was in the 4th true leaf stage and birdsfoot trefoil was in the 3rd. The mustard was just budding and was 2 inches tall. The lamb's quarter and ragweed were 2 inches tall. The grasses ranged from 1/8 inch to 4 inches with some germinating after spraying. There was no canopy effect. At the time of application, it was warm (maximum of 90 and minimum of 69) and clear with adequate soil moisture.

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The chemicals used were as follows:

1. 2,4-dichlorophenoxy acetic acid, alkanolamine form, (2,4-D)
   .2, .4 and .8 pounds acid equivalent per acre
2. 2,4-dichlorophenoxy butyric acid, dimethylamine form (2,4-DB)
   3/4, 1½ and 3 pounds acid equivalent per acre
3. 2, methyl - 4, chlorophenoxy butyric acid, dimethylamine form (MCPB)
   3/4, 1½ and 3 pounds acid equivalent per acre
4. 2, 2-dichloropropionic acid, sodium salt, (Dalapon)
   2 pounds acid equivalent per acre plus 2,4-DB amine 3/4, 1½ and 3 pounds acid equivalent per acre
5. 2,2-dichloropropionic acid, sodium salt (Dalapon)
   1, 2 and 4 pounds acid equivalent per acre
6. 3-(3,4 dichlorophenyl-1-methyl-1-N-butylurea) (Neburon)
   1, 2 and 4 pounds active ingredient per acre

All materials were applied in 40 gallons of water per acre.

Stand counts were made before and after spraying of the legumes and various weed species present. The day before spraying, counts were made at three locations in each replication. These were taken to represent the stand of the entire field. The counts after spraying were made in each plot on July 17-23, 1956, 34 days after spraying. The mustard was counted if it had blossoms or seed pods, but many such plants were so severely injured they were not competitive. Lamb's quarter and ragweed were counted if they were still persisting even though competition was no longer a problem. On the check plots there were 50% stands of mustard with the average plant being 3 feet tall and with the basal leaves covering a diameter of 8 inches to 12 inches.

Yield data were obtained by mowing a 39 inch swath from the middle of each plot. Yields of alfalfa were taken on July 27-31, 1956, 44 days after spraying and 10 days after the counts. Birdsfoot trefoil was harvested on August 6, 1956. Only the checks and plots treated with the high rates of each chemical were harvested because the effects on the weeds were similar to the alfalfa plots, trefoil stands in general were poor, and time and space were limiting. Hand separations were made on the sub-samples to obtain yield data for each species.

Results and Discussions

General Observations

Two days after spraying severe epinasty in mustard, ragweed and lamb's quarter was observed in all plots except the check and Dalapon plots. The Dalapon was slower acting and effected only the grasses. The 2,4-D, 2,4-DB and MCPB caused epinasty of the legumes as well as weeds. Alfalfa recovered satisfactorily from the 2,4-DB treatment but not from the 2,4-D nor completely from the MCPB. The MCPB injured the trefoil while 2,4-DB did not. Two,4-D injured the trefoil less than the alfalfa at comparable rates. The 2 and 4 pound rate of Neburon caused some burn of the trefoil leaves but this was temporary. There was no observable injury to alfalfa from the Neburon. Within four days the mustard was literally burned to the ground from all rates of Neburon. The Neburon retarded lamb's quarter and ragweed long enough for the alfalfa to get a good start and exerted a delayed effect on the grasses present.

Table I. Stands of Alfalfa and Weeds Following Early Post-Emergent Treatment With Herbicides.

Treatments (all rates in lbs. active ingredients per acre)		Stand Count Per 2 sq. ft. Quadrat				
		Alfalfa	Mustard	Lamb's Quarter	Ragweed	Grass[1]
2,4-D	.2	26.7	0.0*	2.0	2.3	52.3
2,4-D	.4	22.0	0.0*	1.7*	1.0*	51.0
2,4-D	.8	20.7	0.0*	0.7*	0.3*	45.7
2,4-DB	3/4	24.3	3.3	8.0	1.7*	35.3
2,4-DB	1½	26.0	2.7	1.7*	0.2*	30.0*
2,4-DB	3	26.7	1.7	0.3*	0.7*	43.7
MCPB	3/4	21.3	2.0	5.0	4.3	33.3*
MCPB	1½	22.3	1.0	2.7	4.3	43.3
MCPB	3	22.0	3.3	0.3*	2.7	42.0
Dal. and 2,4-DB	2 + 2/3	22.7	2.0	1.7*	6.7	6.3*
Dal. and 2,4-DB	2 + 1½	26.7	1.3	0.0*	5.3	5.3*
Dal. and 2,4-DB	2 + 3	30.0*	1.7	0.7*	1.3*	6.3*
Dal.	1	25.0	6.7	1.3*	6.3	9.3*
Dal.	2	21.7	7.3	5.7	2.7	0.7*
Dal.	4	20.0	7.7	5.0	4.0	0.0*
Neb.	1	23.7	0.3*	6.0	5.7	32.0*
Neb.	2	24.0	0.0*	0.7*	4.0	22.7*
Neb.	4	27.7	0.0*	0.7*	5.0	18.7*
Check - (before spraying June 13, 1956)		36.2	6.7	6.6	9.9	47.5
(after spraying July 17-23, 1956)		22.7	4.7	6.3	6.3	65.0
Average of all rates of each chemical						
2,4-D		23.1	0.0	1.5	1.2	49.7
2,4-DB		25.7	2.6	3.3	1.5	36.3
MCPB		21.9	2.1	2.7	3.8	39.5
Dal. + 2,4-DB		26.5	1.7	0.8	4.4	6.0
Dalapon		22.2	7.2	4.0	4.3	3.3
Neburon		25.1	0.1	2.5	4.9	24.2

[1]Principally foxtail and crabgrass; some quack and barnyard grass.

*Denotes significance from check at .05 level.

Table II. Stands of Birdsfoot Trefoil and Weeds Following Early Post-Emergent Treatment With Herbicides.

Treatment (all rates in lbs. active ingredients per acre)		Stand Count Per 2 sq. ft. Quadrat Birdsfoot Trefoil	Mustard	Lamb's Quarter	Ragweed	Grass[1]
2,4-D	.2	20.0	0.0*	13.7	4.7	56.7
2,4-D	.4	26.7	0.3*	4.0	1.7	45.7
2,4-D	.8	20.0	0.0*	0.3	1.0	56.0
2,4-DB	3/4	16.0	3.0	6.0	7.7	56.0
2,4-DB	1½	19.0	1.0*	3.3	6.3	39.7
2,4-DB	3	16.7	2.0*	1.3	4.7	68.3
MCPB	3/4	18.0	2.0*	7.0	7.3	49.7
MCPB	1½	10.7*	3.7	2.0	5.7	61.3
MCPB	3	9.0*	2.3*	0.3	2.3	87.3
Dal. and 2,4-DB	2 + 3/4	20.3	2.3*	5.0	6.7	11.7*
Dal. and 2,4-DB	2 + 1½	24.0	2.3*	2.3	7.0	6.7*
Dal. and 2,4-DB	2 + 3	24.0	1.3*	0.3	3.3	11.0*
Dal.	1	15.7	5.3	12.7	6.3	15.7*
Dal.	2	24.0	4.3	13.7	7.0	4.7*
Dal.	4	13.7	4.0	5.7	10.7	0.7*
Neb.	1	18.0	0.3*	12.3	7.0	41.3
Neb.	2	15.7	0.0*	7.7	8.3	18.3
Neb.	4	16.7	0.0*	0.3	5.0	26.7
Check - (before spraying June 13, 1956)		23.1	7.9	16.3	6.0	65.6
(after spraying July 17-23, 1956)		21.3	4.7	6.7	6.3	56.0
Average of all rates of each chemical						
2,4-D		22.3	0.1	6.0	2.5	52.8
2,4-DB		17.2	2.0	3.5	6.2	54.7
MCPB		12.6	2.7	3.1	5.1	66.1
Dal. + 2,4-DB		22.8	2.0	2.5	5.6	9.8
Dal.		17.8	4.5	10.7	8.0	7.0
Neb.		16.8	0.1	6.8	6.8	28.8

[1]Principally foxtail and crabgrass; some quack and barnyard grass.

*Denotes significance from check at .05 level.

Effects on Stands

Alfalfa - The analysis of variance on the alfalfa plots showed significance for treatments as measured by stands of alfalfa, mustard, ragweed, lamb's quarter and grasses. The stands of all species except alfalfa and ragweed were significantly different at the .01 level.

Table 1 represents the stand count averages on the alfalfa plots and indicates those significantly different from the check. Duncan's multiple range test was used to compare the averages (1). All comparisons were made at the .05 level. The combination of 2 pounds of Dalapon plus 3 pounds of 2,4-DB resulted in stands of alfalfa significantly larger than the check. This combination eliminated more of the weed species than any other single treatment. Chart IA shows the highly significant linear response of this combination on alfalfa stands and the significant linear response of 2,4-D. This decrease in stand from increasing 2,4-D concentrations is normally expected.

Birdsfoot Trefoil - The analysis of variance on birdsfoot trefoil plot counts showed significance for treatments on all the above mentioned species except ragweed.

Table 2 shows the data on individual treatment comparisons. Only the 1½ and 3 pound rates of MCPB had stands of trefoil significantly lower than the check. The MCPB showed a highly significant linear response on trefoil.

Weeds - A comparison of the chemicals (average of all rates) showed the following: Neburon and 2,4-D plot counts of mustard were significantly lower than the Dalapon plot counts; and Dalapon plot counts of grasses were significantly lower than 2,4-D on the alfalfa plots and MCPB on trefoil plots. Treatment comparisons substantiate these findings.

All the chemicals at all rates gave considerable control of mustard except for the Dalapon. The evidence on ragweed and lamb's quarter stands is not as clear cut. The higher rates of 2,4-D, 2,4-DB, MCPB and the combination Dalapon plus 2,4-DB gave a measure of control over these weeds. The high rates of Neburon gave control of lamb's quarter. Neburon gave a significant linear response on both trefoil and alfalfa plots (Chart IB). These data indicate that 2,4-DB and MCPB have a similar effect on the broadleaf weeds and that Dalapon plus 2,4-DB tends to be better than either 2,4-DB or MCPB on mustard and lamb's quarter. Visual observations also indicated that all chemicals except Neburon and Dalapon gave good control of lamb's quarter and ragweed at this stage. However, as previously stated, the Neburon retarded the weeds long enough for the alfalfa to become established. All plots treated with Neburon, Dalapon and the combination Dalapon plus 2,4-DB had less grass than the check. Neburon appeared to give better control of grasses on alfalfa plots than on trefoil plots since the alfalfa was competing while trefoil did not. MCPB caused a significant linear response on grasses on trefoil plots which cannot be explained. Both observation and error terms showed that the voluntee

Table III. Yields of Alfalfa and Weeds Following Early Post-Emergent Treatment With Herbicides

Treatment (all rates in lb. active ingredient)		Alfalfa	Mustard	Lamb's Quarter	Ragweed	Grass
2,4-D	.2	966.7	20.0*	146.7	12.0	1133.3*
2,4-D	.4	600.0	4.7*	24.0	3.7	1233.3*
2,4-D	.8	433.3	22.7*	7.7	3.3	1066.7*
2,4-DB	3/4	966.7	516.7*	120.0	134.0	733.3
2,4-DB	1½	1533.3*	466.7*	2.3	170.0	633.3
2,4-DB	3	1066.7*	500.0*	0.0	13.3	833.3
MCPB	3/4	1016.7*	866.7	130.0	236.3	800.0
MCPB	1½	833.3	666.7*	0.0	86.7	866.7*
MCPB	3	766.7	133.3*	0.0	26.7	766.7
Dal. 2,4-DB	2 + 3/4	1133.3*	536.7*	16.3	186.7	33.3*
Dal. 2,4-DB	2 + 3/4 2 + 1½	1100.0*	330.0*	1.3	130.0	60.0*
Dal. 2,4-DB	2 + 3	1500.0*	103.3*	0.0	60.0	70.0*
Dal.	1	366.7	1800.0	200.0	300.0	43.3*
Dal.	2	466.7	1600.0	500.0	460.0	20.3*
Dal.	4	466.7	1833.3	700.0*	413.3	19.7*
Neb.	1	1066.7*	160.0*	666.7*	690.0	600.0
Neb.	2	1766.7*	16.7*	220.0	666.7	366.7
Neb.	4	1766.7*	2.7*	0.0	400.0	303.3
Check		466.7	1533.3	280.0	350.0	533.3
Average of all rates of each chemical.						
2,4-D		666.7	15.8	59.5	6.3	1144.4
2,4-DB		1188.9	494.5	40.8	105.8	733.3
MCPB		872.2	555.6	43.3	116.6	811.1
Dal. + 2,4-DB		1244.4	320.0	5.9	125.6	54.4
Dal.		433.4	1744.4	466.7	401.1	27.8
Neb.		1533.4	59.8	295.6	585.6	423.3

[1] Includes all grasses present except barnyard grass.

* Denotes significance from the check at .05 level.

weed population was much more variable on the trefoil plots thus giving a less sensitive test.

The differences in the counts made before spraying and on the checks indicates severe mustard competition (50% stands) on the checks. This undoubtedly caused a retardation of most of the other species thus explaining why there were not greater differences between the treated and check plots.

Effects on Yields

Alfalfa - In the general analysis of variance yields of alfalfa and the other species were highly significant for treatments. The yields in general followed the pattern of the stand counts. Yields of the hand separated components are given in Table 3.

A comparison of chemicals (average of all rates) showed that yields of alfalfa treated with Neburon were significantly higher than 2,4-D or Dalapon. The combination of Dalapon plus 2,4-DB gave alfalfa yields significantly higher than Dalapon alone. This is attributed to the mustard control obtained with the added 2,4-DB.

The individual treatment comparisons showed that Neburon, the combination of Dalapon plus 2,4-DB and 2,4-DB were all significantly different from the check except at the low rate of 2,4-DB. The check and Dalapon plots had comparably low yields due to severe competition from the mustard. The 1½ and 3 pound rates of MCPB lowered alfalfa yields indicating injury although not showing significance. Chart II A shows the highly significant linear response of 2,4-D and Neburon and the significant quadratic response from 2,4-DB. This response indicates that the higher rate of 2,4-DB retarded the alfalfa. The exact significance of this response is not known since the same rates of 2,4-DB combined with Dalapon did not give a quadratic response.

Birdsfoot Trefoil - As previously stated only the high rates of the chemicals were harvested for yield data on the trefoil plots. Only two separates were used: birdsfoot trefoil and combined weeds. These yields are given in Table 4.

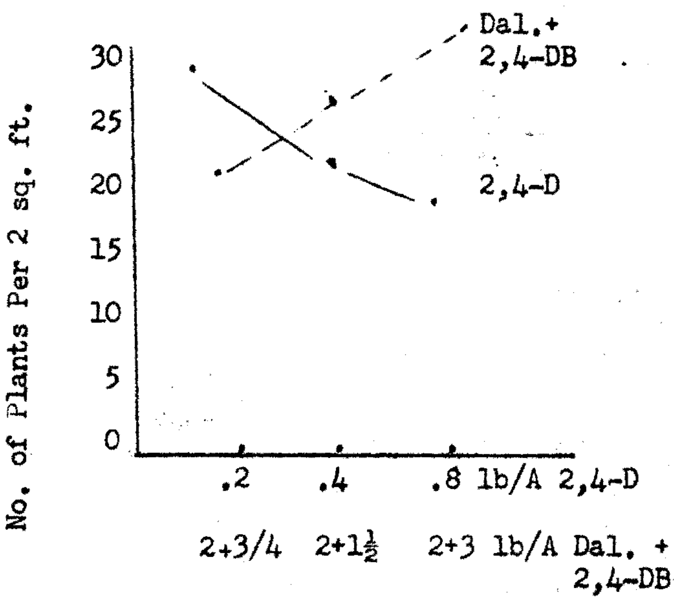
Either the combination of Dalapon plus 2,4-DB or Neburon treatments gave yields significantly higher than the check. The greater yields were clearly due to greater vigor per plant rather than due to a greater stand. This is an indication of the benefits of reduced competition on a crop which is extremely sensitive to competition. The lowest yields were from the MCPB treatment which gives further evidence along with counts and observations that it is not safe on trefoil. The 2,4-DB, MCPB and combination of Dalapon plus 2,4-DB resulted in significantly lower yields of combined weeds than any other treatment with the combination treatment being the lowest.

Weeds - Yields of the weed species were closely associated with the stands. A comparison of the chemicals (average of all rates) showed this clearly. The yields of mustard treated with the combination of Dalapon plus 2,4-DB, Neburon or 2,4-D were significantly lower than yields from the Dalapon plots. The yield of ragweed treated with 2,4-D was significantly lower than yields from Neburon plots. Dalapon, Neburon and the combination of Dalapon plus 2,4-DB significantly reduced grass yields as compared with 2,4-D.

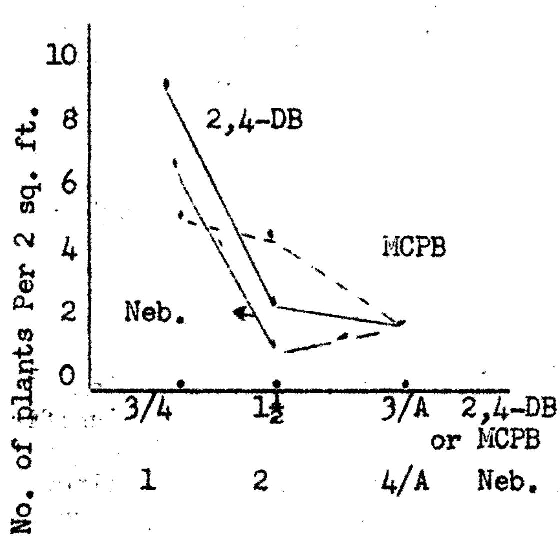
Table IV. Yields of B. F. Trefoil and Weeds Following Early Post-Emergent Treatment With the Highest Rates Used.

Treatments (all rates in lb. active ingredient		Pounds Air Dry, Per Acre B. F. Trefoil	Combined Weeds
Check		16.7	3,700.0
2,4-D	.8	43.3	1,933.3*
2,4-DB	3	33.3	1,666.7*
MCPB	3	6.0	1,666.7*
Dal. and 2,4-DB	2 + 3	250.0*	716.7*
Dal.	4	30.0	3,366.7
Neb.	4	126.7*	2,200.0*

*Denotes significance from the check at .05 level.



A. Alfalfa



B. Lambsquarter

Chart I. Effect of Rate of Chemical on Stands in Alfalfa Plots

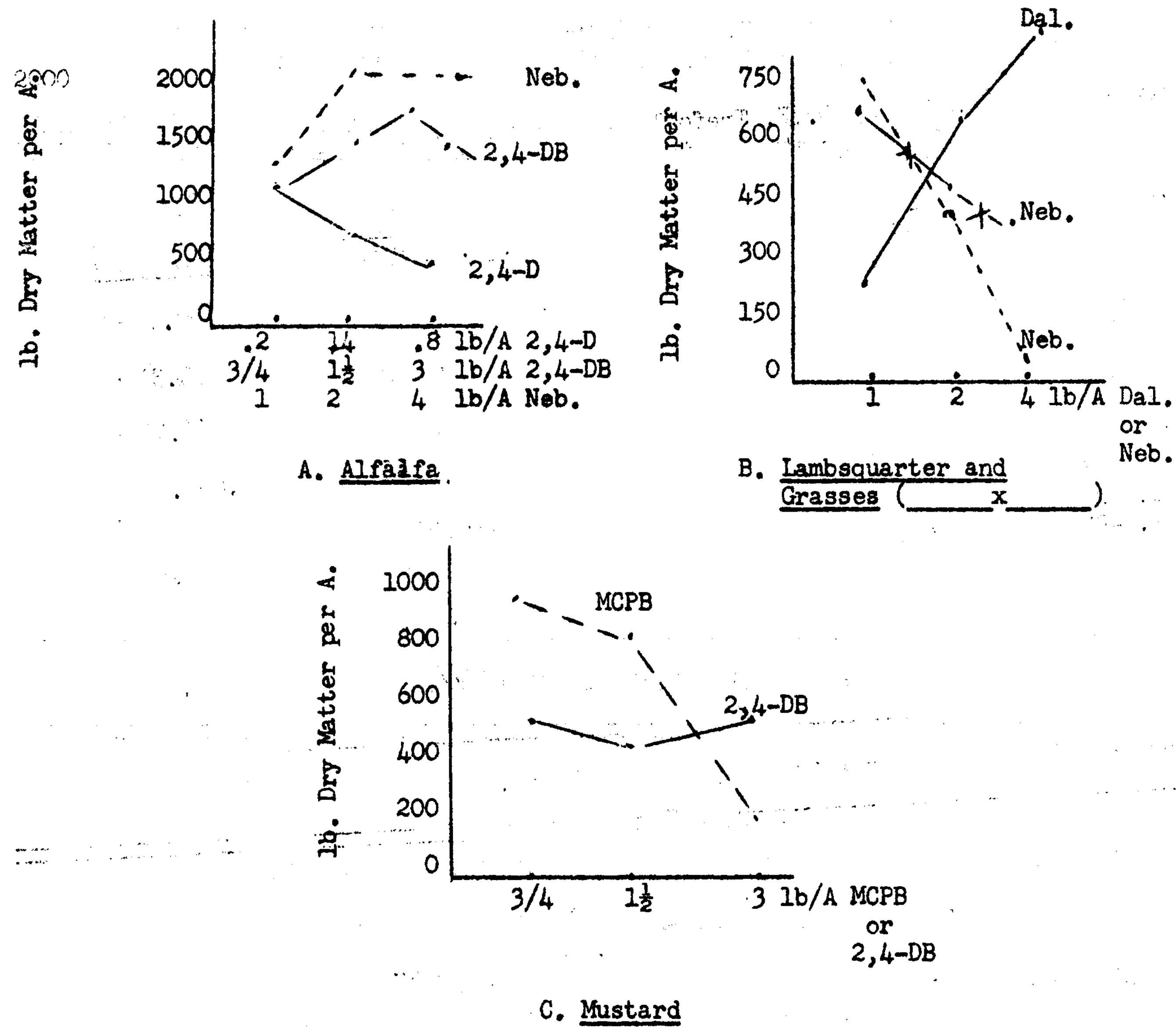


Chart II. Effect of Rate of Chemical
on Yields in Alfalfa Plots

Table 3 shows the comparisons of the individual treatments on the various weed species. All treatments on mustard gave significantly lower yields than the check except the low rate of MCPB and all rates of Dalapon. Chart II C shows no difference between rates of 2,4-DB but a significant linear response from MCPB on mustard. Yields of lamb's quarter and ragweed were lower than the checks on all treatments except the 2 and 4 lb. rates of Dalapon and 1 pound rate of Neburon. The 4 pound rate of Dalapon and the 1 pound rate of Neburon resulted in a significantly higher lamb's quarter yield than on the check. This was attributed both to lack of control and less competition from mustard than on the checks. Chart IIB shows the highly significant linear increase with Dalapon and decrease with Neburon on Lamb's quarter. The grasses were controlled by all Dalapon treatments and to a degree by the 2 and 4 pound rates of Neburon. Neburon gave a significant linear decrease (Chart IIB). The 2,4-D treated plots had grass yields significantly higher than the check and all other treatments. The high yields of grasses on these plots indicates the lack of competition from other species.

The data from the stand counts and yields indicates that 2,4-DB, Neburon and the combination of 2,4-DB plus Dalapon give the best results of those chemicals used on pure seedings of alfalfa and birdsfoot trefoil. To further test the trends indicated by this experiment a similar experiment was established in a summer seeding. The Dalapon treatment was eliminated and Erbon(2-(2,4,5 trichlorophenoxy) ethyl, 2,2-dichloropropionate) and Simazin (2-chloro-4,6-bis (ethylamino)-s-triazine) were included.

SUMMARY

1. Increased alfalfa yields were obtained by treatment with 2,4-DB, the combination of Dalapon plus 2,4-DB, or Neburon, with the increase in that order.

2. Increased yields of birdsfoot trefoil were obtained from the combination of Dalapon plus 2,4-DB or from Neburon. 2,4-DB was not effective since it did not control the grasses which proved to be particularly competitive to the trefoil.

3. 2,4-DB was not toxic to alfalfa or birdsfoot trefoil up to 3 pounds per acre.

4. MCPB Showed toxicity on birdsfoot trefoil at all rates and an indication of toxicity on alfalfa at the high rates.

5. 2,4-D was highly toxic to alfalfa but no more toxic than 2,4-DB on trefoil.

6. 2,4-DB and MCPB were similar in broadleaf weed control. However, both were only 1/3 as effective as comparable rates of 2,4-D on mustard and ragweed. They were as active on the lamb's quarter as the 2,4-D.

7. Dalapon alone or with 2,4-DB gave good control of grasses. Dalapon alone was unsatisfactory since no broadleaf weed control was obtained.

8. Neburon treatments had no effect on the legumes at the rates used. It was highly toxic to the mustard. It retarded lamb's quarter and ragweed but did not give a high degree of kill. The higher rates gave grass control.

9. The combination of Dalapon plus 2,4-DB and Neburon treatments were promising in cases where broadleafs and grasses are prevalent.

10. The results obtained suggest the possibility of seeding legumes without a companion crop and obtaining a hay cut the seeding year.

Acknowledgement is made to the Dow Chemical Company for supplying Dalapon, to Du Pont De Nemours and Company for supplying Neburon, and to the American Chemical Paint Company for supplying the other chemicals used.

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Downy Chess Control in Alfalfa[1]

Jonas Vengris[2]

Preliminary tests (1) indicate that Dalapon and CIPC are rather promising chemicals for controlling downy chess in established alfalfa sods. In order to work out practical methods for controlling this pest and also to check the potentialities of other chemicals, trials were continued in 1955 and 1956. The results were rather conclusive and also gave hints for controlling certain perennial grasses in alfalfa sods. Data from these trials are discussed below.

1954/55 Trials

Similar trials for downy chess control were conducted in Segreganset (Bristol County) and Halifax (Plymouth County). Chemicals were applied late in the fall of 1954 (12/3/54) and also early in the spring of 1955 (3/28/55). No replicates were used. Downy chess control, injury to alfalfa, and perennial grass control were observed all the growing season of 1955. No yield data were taken. A summary of the results are presented below:

December 3, 1954 Application:

Dalapon 3 lb/A	Downy chess control satisfactory (80%). Bluegrass and bentgrass injured slightly. No visible alfalfa injury.
Dalapon 6 lb/A	Downy chess eliminated 90%. Bluegrass and bentgrass controlled significantly and equal to CIPC 5 lb/A treatment. Alfalfa injury is observable but slight. On aftergrowth no injury marks observable.
CIPC 5 lb/A	Downy chess eliminated 90%. Bluegrass and bentgrass eliminated significantly. No visible alfalfa injury.
CIPC 10 lb/A	The best grass elimination treatment. Downy chess eliminated 95%. Bluegrass and bentgrass eliminated 80%, quackgrass and even orchardgrass injured significantly (stunted, shorter, delayed in heading and chlorotic). No visible alfalfa injury.
TCA 10 lb/A TCA 15 lb/A	Downy chess control 55%. Perennial grasses as well as alfalfa were not effected significantly.

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March 28, 1955 Application

Dalapon 3 lb/A Dalapon 6 lb/A	Downy chess eliminated 90-100%. Bluegrass and bentgrass eliminated 60-80%, timothy and orchardgrass injured significantly. Bare space on 3 lb/A plots about 40% and on 6 lb/A plots 60% of surface. Alfalfa looks slightly chlorotic, injury not significant. No visible injury to aftermath growth.
CIPC 5 lb/A CIPC 10 lb/A	Downy chess control not satisfactory (about 50%). Perennial grass injury not significant. Alfalfa not injured. Plants affected in the same way at both rates. Differences in degree only.
TCA 10 lb/A TCA 15 lb/A	Downy chess control poor, only about 20-40%. Perennial grasses are not significantly affected. No visible alfalfa injury. No observable differences between two rates used.

It is very interesting to note that CIPC when applied in late fall 1954 was in general more effective in controlling annual or perennial grasses than Dalapon rates applied at the same time. With the 1955 spring applications, the opposite is true. It is reasonable to think that Dalapon, when applied before winter on dormant plants, could not be taken in satisfactorily and as a result its killing effect was decreased significantly. On the other hand, CIPC applied in the spring during the warmer season decomposes too fast and is less effective (2) in comparison with late fall or winter applications.

1955-56 Trials

Procedure

In the fall of 1955, a downy chess control experiment was started in Bristol County on the Woods Farm. In these trials the chemicals were applied on December 7, 1955 and again the next spring on April 13, 1956. These tests included Dalapon, CIPC, Monuron (Karmex W) and TCA. The plot size was 200 square feet. A randomized block with three replicates design was used. In 1956 it developed that alfalfa stands on some plots were not satisfactory, so for observations and yield data only two replicates were used. When applying the December 7, 1955 treatments, alfalfa and downy chess were dormant, and when applying the treatments on April 13, 1956, alfalfa was dormant but downy chess and other grasses were already green. The downy chess stand consisted of seedlings that had germinated in the fall of 1955. Besides downy chess, the alfalfa stands were infested with some perennial grasses: bluegrass, bentgrass, smooth brome and orchardgrass.

Results and Discussions:

Downy chess control, injury to alfalfa, and alfalfa yield data are presented in Table I. The data speak for themselves. All chemicals and all the rates applied in late fall or early spring effectively controlled downy chess in an established alfalfa sod. It is interesting to note again that CIPC applied in the spring was not as effective as applied in the late fall of the previous year.

Table I. Effect of Herbicides in Controlling Downy Chess in Alfalfa
(Data Relative. Checks = 100)

Treatments	Time of Application	Downy Chess Stands 6/11/56	Perennial Grass Stands	Alfalfa Yields I Cutting 6/26/56	Alfalfa Yields III Cutting 9/13/56
1. Check	12/7/55	100	100	100	100
2. Dalapon 3 lb/A	12/7/55	2	80	125	111
3. Dalapon 6 lb/A	12/7/55	3	78	124	112
4. CIPC 3 lb/A	12/7/55	9	93	138	111
5. CIPC 6 lb/A	12/7/55	2	87	129	123
6. Monuron 2 lb/A	12/7/55	23	93	119	121
7. Monuron 4 lb/A	12/7/55	13	82	122	121
8. TCA 10 lb/A	12/7/55	2	95	109	130
9. TCA 15 lb/A	12/7/55	4	92	97	116
10. Dalapon 3 lb/A	4/13/56	0	9	120	132
11. Dalapon 6 lb/A	4/13/56	0	7	101	118
12. CIPC 3 lb/A	4/13/56	55	85	127	143
13. CIPC 6 lb/A	4/13/56	44	88	104	128
14. Monuron 2 lb/A	4/13/56	20	48	95	132
15. Monuron 4 lb/A	4/13/56	7	18	60	116
16. TCA 10 lb/A	4/13/56	9	60	95	105
17. TCA 15 lb/A	4/13/56	10	50	92	107

Although all treatments applied in the fall of 1955 suppressed perennial grasses in alfalfa sod, only Dalapon and Monuron significantly injured them. Bentgrass and bluegrass were most seriously effected and orchardgrass least. With the spring of 1956 applications, perennial grasses were more affected. Dalapon - both rates - and Monuron were the most effective treatments. In plots treated with Dalapon, over 90% of the grasses were eliminated. Orchardgrass, timothy and quackgrass were injured and suppressed but not killed. The CIPC treatments were least effective.

Only the fall application of Monuron 4 lb/A and Dalapon 6 lb/A rate injured alfalfa. Yields, from even the first mowing on June 26, 1956, were not affected. Because of the elimination of downy chess and certain perennial grasses, higher alfalfa yields were obtained with almost all fall treatments. Injury to alfalfa with 1956 spring applications were evident. Again injury from Monuron 4 lb/A and Dalapon 6 lb/A treatments was the most serious. Also alfalfa was significantly injured by both rates of TCA. Plants of Monuron treatments were pale, chlorotic and slightly suppressed in growth. No significant injury of alfalfa was observed with CIPC applications. Alfalfa yields from the first cutting (Table I) were significantly injured only by Monuron 4 lb/A. Later observations showed that alfalfa even on Monuron 4 lb/A and Dalapon 6 lb/A plots regained normal growth and appearance and no visible differences were noted between fall and spring treated plots. Dalapon 6 lb/A and Monuron 4 lb/A plots had almost a pure stand of alfalfa. Perennial grasses in the spring treated plots did not make much growth even late in the growing season.

On one end of the experimental site, a couple of plots had gravelly light sandy soil whereas the rest of the field had fine sandy loam. It is interesting to note that on that gravelly light soil, Dalapon 6 lb/A rate was by far more effective in killing grasses and injuring alfalfa than on the other replicates of this treatment.

Summary and Conclusions

1. Two year trials reveal that the best chemicals to control downy chess in alfalfa sods under Massachusetts conditions are Dalapon and CIPC. The best results were obtained when CIPC was applied in late fall just before winter (first part of December). Dalapon was more active when applied in early spring (March) before alfalfa starts to grow. The most practical Dalapon, as well as CIPC, rates were 3-6 lb/A of acid equivalent.

2. Alfalfa was injured by Dalapon, especially when applied in the spring and when higher rates were used. As the growing season progresses, the injury marks disappear and yields of second and third cuttings were not affected. Alfalfa was most injured by Monuron (Karmex W) 4 lb/A treatment applied in the spring but at the end of the growing season no visible injury marks were observed. Monuron was not as effective as Dalapon in controlling weedy grasses.

3. The infestation of alfalfa sods with bentgrass and bluegrass is an important cause of deterioration of alfalfa stands in Massachusetts. Downy chess control trials revealed that CIPC applied in late fall or especially Dalapon applied early in the spring, are very effective in eliminating weedy grasses and can be very useful in the management of alfalfa stands.

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Annual Weedy Grass Control in New Legume Seedings[1]

Jonas Vengris[2]

The objective of these trials was to determine the effectiveness and value of different herbicides in controlling weedy grasses in new legume seedings.

Preliminary Tests

Preliminary tests were conducted in 1953 at the Massachusetts Experiment Station on spring seedings of birdsfoot trefoil and alfalfa. Dalapon 3 lb/A and 6 lb/A rates were applied on August 7, 1953. Crabgrass was 6-8 inches tall and formed an excellent canopy over the legume seedlings. The control of crabgrass was good and later observations showed that both legumes benefited from the application of Dalapon with no signs of injury to either.

1954 Trials

On April 30, 1954 on a fairly well drained fine sandy loam infested with annual weedy grass seeds, strips of birdsfoot trefoil, alfalfa, ladino clover, red clover, smooth brome, orchardgrass and timothy were seeded. Across these parallel strips, plots were laid out. Each plot ran through all seven legume and grass strips. Treatments included Dalapon 1.5 lb/A, 3 lb/A, and 4.5 lb/A rates. Three replicates were used. Chemicals were applied at two different dates: June 3 and again July 6. Description of plant growth when herbicides were applied is given in Table I.

Table I. Stages of Plant Growth when Applying Herbicides

No.	Plants	First Application 6/3/54	Second Application 7/6/54
1.	Birdsfoot trefoil	2 true leaves; 1-2" tall	5-10" tall; under weedy grass canopy
2.	Ladino clover	2 true leaves; 1-3" tall	8-10" tall; vegetative growth
3.	Red clover	2 true leaves; 2-3" tall	10-12" tall; vegetative growth
4.	Alfalfa	3-4 true leaves; 3" tall	14-16" tall; before heading
5.	S.Brome	3-5 leaves; 3" tall	15" tall; before heading
6.	Orchardgrass	3-5 leaves; 3" tall	15" tall; vegetative growth
7.	Timothy	3-5 leaves; 2-3" tall	18" tall; heading
8.	Crabgrass and other weedy grasses	Seedlings 1-3" tall	8-12" tall; vegetative growth

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On June 19, 1954, 16 days after the first application of herbicides, the stands of cultural plants as well as weeds were surveyed. The summary of these data is presented below:

Dalapon 1.5 lb/A I	Birdsfoot trefoil and alfalfa were not injured. Ladino and red clover and grasses were signigicantly injured. Stand ratings were Ladino and Red clover -50*, S, Brome -25*, orchardgrass -70*, timothy -40*. Crabgrass and other annual weedy grasses -10*
Dalapon 3.0 lb/A I Dalapon 4.5 lb/A I	No apparent injury of birdsfoot trefoil. Alfalfa especially with 4.5 lb/A rate was slightly injured - plants were stunted and leaves were dark colored and rolled. In general, stands of alfalfa were good. Ladino, red clover as well as cultural grasses were almost eliminated. Annual weedy grasses were eliminated.

On July 22, observations of second application treatments revealed that cultural grasses as well as ladino and red clover were significantly injured, especially by higher Dalapon rates. Crabgrass even with the highest Dalapon rate was not killed but was significantly injured -- plants were chlorotic, stunted and shorter in comparison to checks. Injury was proportional to the rates applied. It is interesting to note that old witch-grass (Panicum capillare) was less affected than crabgrass.

On August 6, 1954 all plots were mowed and on September 15, 1954 all stands were surveyed again. These data are presented in Table II.

Table II Annual Weedy Grass Control in New Grass-Legume Seedings.
Relative values. Checks = 100

Treatments	Trefoil	Alfalfa	Ladino	Red Clover	S. Brome	Orchard Grass	Timothy	Annual Weedy Grass
1) Check	100	100	100	100	100	100	100	100
2) Dalapon 1.5 I	386	115	111	16	34	98	20	70
3) Dalapon 3.0 I	418	123	111	0	14	73	5	35
4) Dalapon 4.5 I	400	123	97	3	6	57	5	27
5) Dalapon 1.5 II	123	105	111	35	48	88	78	93
6) Dalapon 3.0 II	136	109	97	7	25	80	45	67
7) Dalapon 4.5 II	150	114	76	3	17	55	27	20
L. S. D. at 5%	77	12	27	15	34	35	22	37
L. S. D. at 1%	109	17	38	20	49	49	30	52

Dalapon was effective in controlling annual weedy grasses. With the first application, crabgrass control was effective with all three rates employed and better stands of trefoil resulted. On the check plots because of

* Check plot stand = 100; total elimination = 0

the smothering effect of crabgrass and other annual weedy grasses, birdsfoot trefoil seedlings were suppressed so that resulting stands were poor. Indications were that Dalapon should be applied early in the growing season. When applied on July 6, 1954 none of the rates used aided materially in establishing trefoil seedings. By this time, crabgrass and other weedy grasses had already greatly suppressed the growth of the legume seedlings.

Alfalfa is also rather resistant to low Dalapon rates. As shown in Table II Dalapon by suppressing grassy weeds was helpful in establishing alfalfa stands.

As an earlier survey showed, ladino clover was significantly injured by the Dalapon treatments employed, but later plants regained normal growth and made satisfactory stands (Table II). Red clover was most sensitive to Dalapon injury. Later applications (July 6, 1954) were almost as injurious as early ones (June 3, 1954).

Of the grasses studied, smooth brome was the most sensitive. Timothy was next, and orchardgrass was the least sensitive.

The best time to apply Dalapon under Massachusetts conditions is about 4-5 weeks after seeding when birdsfoot trefoil is in the 2-3 true leaf growth stage, and alfalfa 3-5 leaf growth stage. The most practical rates are 2-4 lb/A of acid equivalent.

In these annual weedy grass trials were also included CIPC, TCA and MH post-emergence treatments without replicates. These materials were not particularly effective.

1956 Trials

Experiment I

On a fairy well drained fine dandy loam infested with yellow foxtail and crabgrass seeds, long narrow plots of birdsfoot trefoil, alfalfa, ladino and red clover were seeded on May 14. Across these seeded strips both pre-emergence (May 14, 1956) as well as later post-emergence treatments made. Four replicates were used. The main objective was to the effectiveness of different herbicides in controlling weedy grasses in new legume seedings.

Table III   Annual Weedy Grass Control in New Legume Seedings by Pre-Emergence Applications of Herbicides.

Treatments	Birdsfoot Trefoil	Alfalfa	Ladino	Red Clover	Annual Weedy Grasses	Bare Space
1) Check	100	100	100	100	100	0
2) TCA 3 lb/A	95	55	45	28	22	48
3) TCA 6 lb/A	97	50	30	30	15	45
4) TCA 9 lb/A	98	47	17	15	14	60
5) CDAA 4 lb/A	80	88	52	55	17	52
6) CDAA 8 lb/A	75	80	37	47	17	55

A month after application of pre-emergence herbicides stand estimates were made. Results are presented in Table III on the previous page. Values are relative. Check plot stands = 100.

No injury of birdsfoot trefoil was observed by any rate of TCA used. Alfalfa, ladino clover and especially red clover were injured significantly. Seedlings were stunted, leaves malformed and badly rolled. CDAA caused slight injury to alfalfa and birdsfoot trefoil. Later on plants regained normal growth (cf Table V). Ladino and red clover were injured by both rates of CDAA significantly. The most prevalent annual weedy grass was yellow foxtail. Both chemicals at all rates applied significantly controlled this weed (TableIII). Treated plots in comparison to checks had about 50% bare area (Table III). Later a new crop of annual weedy grass seedlings germinated and filled in bare areas on the pre-emergence treated plots. Crabgrass predominated.

Dalapon was applied as a post-emergence treatment at two different dates -- on June 15 and on June 28. The stages of plant growth at these two dates are presented in the Table IV.

Table IV Stages of Plant Growth When Applying Herbicides

Plants	Stages of Growth on 6/15/56	Stages of Growth on 6/28/56
1) Birdsfoot trefoil	2 true leaves; 1-3" tall	6-8 true leaves; 5-8" tall
2) Alfalfa	4 true leaves; 2-3" tall	7-9 true leaves; 6" tall
3) Ladino clover	2 true leaves; 1-2" tall	3-4 true leaves; 3-4" tall
4) Red clover	2 true leaves; 2-3" tall	3-4 true leaves; 4" tall
5) Crabgrass	1-2" tall seedlings	6-7" tall
6) Yellow foxtail	4" tall seedlings	15-20" tall

The observations on July 8 showed that Dalapon was effective in controlling annual weedy grasses in legume seedings. The earlier (6/15/56) applications were especially effective. When applied on 6/28 weedy grasses were not killed but were suppressed significantly. Plants were chlorotic, stunted and short. At that time pre-emergence treated plots were again infested with small new seedlings of crabgrass. It is interesting to note that Dalapon post-emergence applications also suppressed smartweed (Polygomum pensylvanicum).

On July 9 all plots were mowed and aftermath stands were surveyed on August 20. These data are presented in Table V. Check plot stands were rated 100.

Birdsfoot trefoil stands were improved by all treatments applied. Alfalfa had on the whole better stands on the treated plots but the differences are not significant. It is interesting to note that injured ladino clover plants as in 1954 trials recovered completely. Red clover injury was most severe on plots treated with higher rates of TCA and Dalapon and plants failed to regain normal growth. On all pre-emergence treated plots new crabgrass seedlings came up and seriously suppressed new seedlings. Dalapon post-emergence treatments were most effective.

Table V Annual Weedy Grass Control in Legume Seedings
Survey on 8/20/56. Relative values; Checks = 100.

Treatments	Time of Application	Trefoil	Alfalfa	Ladino	Red Clover	Weedy Grass
1) Check		100	100	100	100	100
2) TCA 3 lb/A	5/16/56, pre-emrg.	135	118	120	108	91
3) TCA 6 lb/A	5/16/56, pre-emrg.	143	126	103	86	80
4) TCA 9 lb/A	5/16/56, pre-emrg.	155	120	124	66	78
5) CDAA 4 lb/A	5/16/56, pre-emrg.	133	133	124	121	84
6) CDAA 8 lb/A	5/16/56, pre-emrg.	141	118	130	123	81
7) Dalapon 2 lb/A	6/15/56, post-emrg.	169	115	115	116	58
8) Dalapon 4 lb/A	6/15/56, post-emrg.	147	144	115	68	14
9) Dalapon 2 lb/A	6/28/56, post-emrg.	167	115	131	114	26
10) Dalapon 4 lb/A	6/28/56, post-emrg.	157	150	118	68	20
11) Dalapon 6 lb/A	6/28/56, post-emrg.	149	148	120	34	9
L.S.D. 5%		33	N.S.*	N.S.*	34	20
L.S.D. 1%		45			46	26

*not significant

Experiment II

In the spring of 1956 an experiment was started to study the effects of phenoxy butyric acids on legumes and broadleaved weeds. However, it developed that the most prevalent and serious weed on the area was yellow foxtail. As a result the treatments were changed. For the control of yellow foxtail, Dalapon alone and Dalapon in mixtures with 2,4-4DB, MCPB and dinitro were used. Dalapon and phenoxy compounds were applied together in mixtures. On Dalapon plus dinitro plots Dalapon was applied first and then two days later dinitro was sprayed.

Treatments were applied four weeks after seeding on June 12. At the time of application the plants were in the following growth stages:

1. Birdsfoot trefoil 2-3 inches tall
2. Alfalfa with 2-3 true leaves; 3-4 inches tall
3. Ladino clover with 102 true leaves; 2-3 inches tall
4. Red clover with 2 true leaves, 2-4 inches tall
5. Yellow foxtail was 4 inches tall.

The canopy of weeds over the legume seedlings were poor, Three weeks after application of chemicals the stands of different plants were surveyed by estimation. Check plot stands were given value of 100. These data are presented in Table VI.

Yellow foxtail control by all treatments applied was excellent. This pest was eliminated almost 100%. All legumes at first showed signs of injury. Red clover was most injured. Dalapon plus dinitro (DN) treatments was especially effective on red clover, ladino clover and alfalfa. By applying Dalapon with phenoxy or dinitro compounds both monocotyledonous and dicotyledonous weeds were controlled effectively.

Table VI Annual Weedy Grass Control in New Legume Seedings
Values relative. Checks = 100

Treatments	Trefoil	Alfalfa	Ladino	Red Clover	Yellow Foxtail	Pig-weed	Lamb's Quarters
1)Check	100	100	100	100	100	100	100
2)Dalapon 3 lb/A+2,4-DB 1 lb/A	60	65	40	7	5	5	5
3)Dalapon 3 lb/A+MCPB 1 lb/A	48	57	42	25	10	10	10
4)Dalapon 3 lb/A+DN 1 lb/A	70	25	8	5	5	5	5
5)Dalapon 3 lb/A	78	52	45	13	5	80	85

On July 9 all plots were mowed. No yield data were taken but stand estimates were made on August 22. Check plot stands were given value of 100. The data are presented in Table VII.

Table VII Stands of Legumes on 8/22/56
Values relative. Checks = 100.

Treatments	Trefoil	Alfalfa	Ladino	Red Clover
1. Check	100	100	100	100
2. Dalapon 3 lb/A+2,4-DB 1 lb/A	238	156	183	119
3. Dalapon 3 lb/A+MCPB 1 lb/A	225	182	273	137
4. Dalapon 3 lb/A+DN 1 lb/A	242	118	117	23
5. Dalapon 3 lb/A	238	167	240	113
L.S.D. at 5%	70	N.S.*	N.S.*	68
L.S.D. at 1%	102			98

*not significant

Stands of birdsfoot trefoil and alfalfa were much better on treated plots,effective control of yellow foxtail provided aided in establishing this legume. Even ladino and red clover regained normal growth and benefited from treatment. Only Dalapon plus dinitro was too injurious to ladino and red clover for plants to recover and regain normal growth.

Summary and Conclusion

1. Dalapon 2-4 lb/A as post-emergence treatment controlled annual weedy grasses in new legume seedlings significantly. Slight injury to birdsfoot trefoil and alfalfa occured but plants regained normal growth. The best time for application was about 4 weeks after seeding when legumes were in 2-4 true leaf stage and weeds in small seedling stage of growth.

Ladino clover and particularly red clover were injured by Dalapon. Ladino clover because of its creeping form of growth recovered rapidly and produced good stands.

2. One years data indicate that in cases where annual weedy grasses and broadleaved weeds are present a mixture of 3 lb/A of Dalapon and 1 lb/A of

phenoxy butyric acid is promising. Make application: when legumes are in 2-3 true leaves. More research should be carried on before field recommendations can be made.

3. TCA at 6-9 lb/A and CDAA at 4-8 lb/A as pre-emergence treatments significantly controlled annual weedy grasses in new legume seedlings. TCA is promising in new birdsfoot trefoil seedings. The practicability of these pre-emergence treatments is questioned because new seedlings of weedy grasses emerge and fill up bare areas faster than slowly developing legume seedlings.

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CONTROL OF CHICKWEED, STELLARIA MEDIA, IN ALFALFA, A SUMMARY OF SEVEN YEARS' WORK

Richard J. Aldrich[1]

Chickweed germinates in late summer and frequently offers severe competition for late summer seeded alfalfa. Tests of chemicals for control of this weed were initiated in New Jersey in 1950. CIPC and DNBP were most promising of the chemicals used in the initial tests and were the only herbicides used in subsequent tests. Chickweed control, alfalfa stands, weight of alfalfa roots, and alfalfa yields were recorded to measure results. Not all measures were used in each test.

Best chickweed control and maximum benefit to alfalfa with DNBP were obtained with fall treatments. There was a tendency for alfalfa root weights to be reduced by $1\frac{1}{2}$ pounds of DNBP applied in October, whereas rates of 3/8, 1/2 and 3/4 pound had no apparent effect. Treatment with 1/2 and 3/4 pound of DNBP in early fall and again in winter provided complete chickweed kill. CIPC was less effective when applied in October than when applied in December, January and February. One pound of CIPC consistently controlled chickweed and 1/2 pound was usually sufficient in late fall and winter. Ten gallons for the application were somewhat less satisfactory than higher volumes with DNBP, whereas gallonage had no apparent effect on results with CIPC.

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

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This paper presents the comparative effectiveness of several materials that are presently being used for post-emergence crabgrass control and some that are currently in the experimental stage.

The effectiveness of phenyl mercuric acetate (2,5) for post-emergence crabgrass control has been previously reported based on results of studies conducted at the Rhode Island Agricultural Experiment Station. Effective control also has been reported with disodium methyl arsonate (4,5) potassium cyanate-sludge mixtures (1) and cacodylic acid (3).

Materials and Methods

The 1956 post-emergence crabgrass tests were conducted on lawn turf adjacent to Keaney Gymnasium located at the University of Rhode Island campus. The four-year old turf, composed of Astoria Colonial bent, Kentucky bluegrass, and Chewings fescue, was maintained at a one-inch height of cut and received no water other than natural rainfall. Crabgrass infestation within the area was somewhat variable and included both smooth crabgrass (*Digitaria ischaemum*) and hairy crabgrass (*Digitaria sanguinalis*).

The experiment consisted of four blocks with 24 chemical treatments and three check plots randomized within each block. In order to expedite the application of a large number of treatments, the following technique was employed: the first treatments were applied to plots 10 feet wide and 30 feet long. On the second date of application, two-thirds of each plot was treated. The third and final treatment was applied to one-half of the area that received the second application. The use of this method resulted in individual plots of 100 square feet in area receiving from one to three applications.

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The first treatments were applied on July 20, 1956, the sky was overcast and the temperature was 78 degrees. Plots receiving the second application were treated on July 26, a bright sunny day with the temperature at 84 degrees. The third and final treatments were applied on August 2, when clear skies prevailed and the temperature was 76 degrees. Soil conditions during the period were somewhat drier than normal since rainfall from the middle of July through August was rather meager. Precipitation amounted to 1.94 inches for the last two weeks of July and 1.07 inches during the month of August.

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

1. Crab-E-Rad (12.6% disodium methyl arsonate) at rates of 27 and 54 ounces per 1000 square feet.

2. PMAS (10% phenyl mercuric acetate) at rates of 1.75 and 2.5 ounces per 1000 square feet.

3. SAA-140 (20% sodium arseno acetate) at rates of 10, 20 and 27 ounces per 1000 square feet.

4. Neburon (18.5% 3-(4 dichlorophenyl-2-methyl-1-N-butylurea) at the rates of 1.5 and 3 ounces per 1000 square feet.

5. Tri-Basic copper. (tri-basic copper sulphate, 53% metalic copper) at the rates of 2, 4 and 8 ounces per 1000 square feet.

6. Cacodylic acid (10% cacodylic acid) at the rates of 1.7 and 3.4 ounces per 1000 square feet.

7. Scutl (Phenyl mercury salts of acetic, propionic and naphthyl phthalamic acids reported as 0.25% metallic mercury and 0.24% N-1 maphthl phthalamic acid impregnated in vermiculite) at settings of #7 and #9 on Scott's spreader.

8. Clout (2.5% disodium methyl arsonate hexahydrate impregnated in vermiculite) at settings of #7 and #9 on Scott's spreader.

9. Copper sulphate (copper sulphate reported a 25% metallic copper) at the rates of 3.7 and 7.4 ounces per 1000 square feet.

10. American Cyanamid mixture #1 (4% potassium cyanate plus 96% Milorganite) at the rates of 10 and 20 pounds per 1000 square feet.

11. Mil-Cyanate (4% potassium cyanate plus 96% Milorganite) at rates of 10 and 20 pounds per 1000 square feet.

Clout, Scutl, American Cyanamid mixture #1 and Mil-Cyanate were applied with a Scott's fertilizer spreader. All other chemicals were applied with a 15-gallon power sprayer using 5 gallons of water per 1000 square feet.

Notes on crabgrass infestation within each plot were taken prior to the first application and approximately 8 weeks after the last treatment. Turf discoloration notes were made one week after each treatment, and turf injury was estimated at the conclusion of the experiment.

Results and Discussion

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 and injury after the various treatments.

Crab-E-Rad at the 27- and 54-ounce rates provided 100 percent crabgrass control with two and three applications. Discoloration was more pronounced following the third treatment, being slight at the low rate and moderate at the heavy rate. Some turf injury was noted, primarily in the form of a reduced fescue population. With one application, however, control ranged from 0 at the low rate to 45 percent at the high rate.

PMAS at the 1.75- and 2.5-ounce rates with two and three treatments gave control that ranged from 99 to 100 percent. With one application the control was 41 and 46 percent, respectively. Slight discoloration was noted following each treatment. Where three applications of the material were made, a small amount of turf injury occurred.

SAA-140 with one application was ineffective at the three rates used in this test. With two and three applications the 20- and 27-ounce rates provided control that ranged from 33 to 84 percent. Discoloration varied from slight to severe and some turf injury resulted following the third treatment.

Neburo was ineffective at the 1.5-ounce rate with one and two applications. With three applications, however, 48 percent control was obtained. At the 3-ounce rate with 1, 2 and 3 applications the control was 14, 57 and 83 percent, respectively. No significent discoloration or turf injury was noted at either of the two rates used.

Tri-basic copper at the rates used was not effective in this experiment.

Copper sulphate used at the rates of 3.7 and 7.4 ounces with two and three applications provided variable control that ranged from 16 to 40 percent. For some unknown reason, better control was achieved at the lower rate. Discoloration was slight following the first two applications; however, no discoloration was observed following the third treatment.

Cacodylic acid at the 1.7-ounce rate with two and three treatments provided 61 and 72 percent control, respectively. Discoloration was moderate following the second application and severe following the third. Three applications of this material caused some turf injury. One application at the 3.4-ounce rate resulted in moderate discoloration. In anticipation of severe turf injury at this rate, the treatment was omitted on July 26. The second and final application was made on August 2 at the reduced rate of 1.7 ounces. Crabgrass control on plots receiving the two treatments was 40 percent. One application was not effective at either rate.

Scutl was effective with two treatments, resulting in 85 and 100 percent control at settings #7 and #9, respectively. With three treatments 76 and 97 percent control resulted. A single application at either rate was not effective. No objectionable discoloration or injury was noted.

Clout at setting #7 with two and three treatments provided 78 and 92 percent control. At setting #9 with two and three treatments 100 percent control resulted. With one treatment, Clout did not provide effective control. Only slight discoloration was noted following the third treatment.

Original plans called for the application of American Cyanamid mixture #1 at 10 and 20 pounds per 1000 square feet. The turf became badly discolored following the first application at the 20-pound rate. To prevent serious turf injury the two subsequent applications were reduced to 5 pounds per 1000 square feet. The third treatment of the 10-pound rate was also reduced to 5 pounds. No control resulted from a single treatment at either the 10- or the 20-pound rate. Two treatments at the 10-pound rate provided 59 percent control. Two treatments at 10 pounds plus the third treatment at 5 pounds resulted in 60 percent control. One 20-pound treatment plus two 5-pound treatments gave 88 percent control. Although discoloration with most of these treatments was rather heavy, no serious turf injury occurred.

Mil-Cyanate at the 10-pound rate with one, two and three applications provided 17, 57, and 84 percent control, respectively. The 20-pound rate with the same number of treatments as above, resulted in 77, 99 and 90 percent control. Only slight discoloration was noted following each treatment. No turf injury resulted.

The different behavior of American Cyanamid #1 and Mil-Cyanate is perplexing since both materials are made up of 4 percent potassium cyanate and 96 percent sludge.

Summary and Conclusions

Post-emergence crabgrass control tests were conducted at the Rhode Island Agricultural Experiment Station during the summer of 1956. Materials used were Crab-E-Rad, PMAS, Sodium arseno acetate, Neburon, Tri-basic copper sulphate, Copper sulphate, Cacodylic acid, Scutl, Clout, American Cyanamid mixture #1 and Mil-Cyanate.

Under conditions of this experiment one application of the various chemicals did not provide satisfactory crabgrass control.

Crab-E-Rad provided 100 percent control at both rates with two and three applications. Discoloration ranged from none to moderate and some turf injury in the form of a reduced fescue population resulted.

PMAS provided control that ranged from 99 to 100 percent with two and three treatments. Slight turf discoloration was noted following each treatment, and a small amount of turf injury followed the third treatment.

With two and three treatments on setting #7 both Clout and Scutl provided control ranging from 76 to 92 percent. At setting #9 control for these two materials ranged from 97 to 100 percent. No serious discoloration or injury was observed.

Sodium arseno acetate, tri-basic copper sulphate, copper sulphate, cacodylic acid, and Neburon were relatively ineffective in this study. However, Neburon shows some promise at the 3-ounce rate and should be included in future tests.

Some difficulty was encountered with American Cyanamid mixture #1 and it is suggested that this material undergo further study. Mil-Cyanate provided good control at the 20-pound rate without any serious discoloration or turf injury.

It appears, from the results of this study, that at least two applications of the effective materials are needed to provide satisfactory crabgrass control. These applications should be made when the crabgrass plants are young, and ordinarily between June 15 and July 15.

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Table 1. Post-Emergence Control of Crabgrass in Lawn Turf with Chemicals. Rhode Island Agricultural Experiment Station, 1956.

Material	Rate per 1000 sq.ft.	Percent Control			Discoloration**			Percent Injury***		
		After 1 trt.	After 2 trts.	After 3 trts.	After 1 trt.	After 2 trts.	After 3 trts.	After 1 trt.	After 2 trts.	After 3 trts.
Crab-E-Rad	27 oz.	0	100	100	0	0	1.6	0	0.5	2.5
Crab-E-Rad	54 oz.	45	100	100	0.3	1.0	3.0	0	1.4	5.0
PMAS	1.75 oz.	41	99	100	0.2	0.1	1.4	0	0	1.5
PMAS	2.5 oz.	46	100	100	0.3	0.9	2.0	0	1.3	2.9
SAA-140	10 oz.	0	0	0	0	0.2	1.0	0	0	0
SAA-140	20 oz.	0	60	70	0	1.2	2.9	0	0	1.3
SAA-140	27 oz.	0	33	84	0.3	2.6	3.9	0	0.3	4.1
Neburon	1.5 oz.	0	0	48	0	0	0	0	0	0
Neburon	3 oz.	14	57	83	0	0	0.5	0	0	0.2
Tri-Basic Copper	2 oz.	0	0	0	0	0	0	0	0	0
Tri-Basic Copper	4 oz.	0	0	0	0	0	0	0	0	0
Tri-Basic Copper	8 oz.	0	0	0	0	0	0	0	0	0
Copper Sulphate	3.7 oz.	0	26	40	0.5	0.4	0	0	0	0
Copper Sulphate	7.4 oz.	0	16	23	0.5	1.6	0	0	0	0.3
Cacodylic Acid[a]	1.7 oz.	0	61	72	0.8	3.0	4.4	0	0	3.3
Cacodylic Acid	3.4 oz.	0	40	--[a]	3	2.6	--	0	1.3	--
Scutl	7*	42	85	76	1.3	0.1	0.1	0	0	0
Scutl	9*	32	100	97	0	0	0.2	0	0	0
Clout	7*	15	78	92	0	0	0.4	0	0	0.3
Clout	9*	22	100	100	0	0.2	0.8	0	1.0	0.5
Am.Cyan.Mix#1[a]	10 lbs.	0	59	60	2.5	3	2.3	0	0	1
Am.Cyan.Mix	20 lbs.	0	60	88	3.8	1.8	2	0	0	1.1
Mil. Cyanate	10 lbs.	17	57	84	0.3	0.3	0.1	0	0	0
Mil. Cyanate	20 lbs.	77	99	90	1	1.3	0.8	0	0	0
Check	--	--	--	--	--	--	--	--	--	--

*Refers to setting number on Scott's fertilizer spreader.
**Discoloration index: 0 = none, 1 = very slight, 2 = slight, 3 = moderate, 4 = severe, 5 = very severe.
***Estimated bare area approximately 8 weeks after last treatment.
[a]See Discussion and Results for changes in rates.
Treatments were applied on July 20, July 26 and August 2, 1956.

PRE-EMERGENCE CONTROL OF CRABGRASS IN LAWN TURF WITH ONLY ONE APPLICATION OF VARIOUS CHEMICALS[1]

C. K. Mruk and J. A. DeFrance[2]

The prevention of crabgrass infestation with chemicals applied prior to the germination of the seed has been the newest approach to the crabgrass problem during the past few years. This method offers many possibilities for saving time, labor and materials; however, workers in the field such as Gallagher and Emerson (1), Gallagher and Musser (2), and Hart and DeFrance (3,4) found that results are variable and that continued study of the problem for more information was required. Likewise, study from the homeowners point of view is required as the homeowner is reluctant to accept the idea of several pre-emergence treatments with chemicals to a turf which appears free of crabgrass in the spring. Several pre-emergence treatments in the spring are comparable to several post-emergence treatments during the summer, thus the labor and expense involved is almost equal. King and Kramer (5) reported crabgrass to have a second period of flush growth, and that smooth crabgrass will germinate in three days in wet soil at 75°F. and that they had even observed seedlings of crabgrass in early October. With these facts in mind, the everlasting search for a one treatment chemical continues, which in the end will be the actual labor-saver and expense-saver to the homeowner.

The object of this paper is to report and evaluate the results obtained with only one application of the various chemicals for pre-emergence control.

Methods and Materials

The test area to which the chemicals were applied was located on a portion of the athletic field at the University of Rhode Island. The turf was a uniform blend of Chewing's fescue, Astoria Colonial bent, and Kentucky bluegrass. During the previous year, 1955, the area appeared to be uniformly infested with smooth crabgrass (*Digitaria ischaeum*) and a small amount of hairy crabgrass (*D. sanguinalis*). The area was kept under regular maintenance practice and mowed at a height of 1 inch.

A total of 88 plots, each measuring 100 square feet in area, were laid out in a consecutive series. Twenty-one treatments were applied which were replicated four times within the series. Four plots were used as check areas to which no treatment was applied.

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

1. Neburon (18.5% 3-(3,4-dichlorophenyl 1-methyl-1-n-butylurea) at 4.6, 6.1, 7.6 ounces per 1000 square feet (2,3 and 4 pounds per acre).

2. Alanap-1F (Dry formulation of 1% N-1 naphthyl phthalamic acid plus urea) at 9, 18, 27 lbs. per 1000 square feet (387, 774 and 1161 pounds per acre).

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[1]Contribution No. 906 of the Rhode Island Agricultural Experiment Station.

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

3. Alanap-IF (Concentrate 5% N-1 naphthyl phthalamic acid) 4 and 6 pounds per 1000 square feet (172 and 258 pounds per acre).

4. Scutl, mercury (in the form of phenyl mercury salts of acetic, propionic and naphthyl phthalamic acids) as metallic 0.25%. N-1 naphthyl phthalamic acid 0.24%. Applied at setting 5 and 7 on a Scott's Spreader.

5. PMAS (10% phenyl mercuric acetate) at 1 3/4 and 2 1/2 ounces per 1000 square feet (5 and 7 pints per acre).

6. Crab-E-Rad (12.6% disodium methyl arsonate) 9 and 18 ounces per 1000 square feet (25 and 50 pints per acre).

7. Chloro-IPC (10% granular isopropyl N- (3-chlorophenyl) carbonate at 10 2/3, 21 1/3, and 32 ounces per 1000 square feet (21 1/2, 43 and 86 pounds per acre).

8. Crag Herbicide-1 (90% sodium 2,4 dichlorophenoxyethyl sulfate) at 3.2 and 4 ounces per 1000 square feet (6 and 9 pounds per acre).

9. Chlordane (50% wettable powder) 2 and 4 pounds per 1000 square feet (86 and 172 pounds per acre).

Neburon, PMAS, Crab-E-Rad, Crag-1 and Chlordane were applied either as liquids or as suspensions in 10 gallons of water per 1000 square feet by means of a power sprayer. The two formulations of Alanap and Chloro-IPC were applied by means of a Scott's fertilizer spreader. The Alanap 5 percent concentrate and Chloro-IPC were mixed with activated sewerage sludge for ease of spreading. These were the only plots that received supplemental fertilization.

The chemicals were applied May 24, 1956. No crabgrass was visible at the time of application.

Observations for discoloration and injury were made one week after the application of the chemicals, during July, and at the termination of the test in October. The percent crabgrass per plot was estimated on the basis of the area covered by the crabgrass plants. The control was computed by taking the difference between the amount of crabgrass on the treated plots and that on the untreated plots.

Results and Discussion

The figures in Table 1 show the comparative effects at the end of July of only one treatment of the various chemical treatments applied May 24 for prevention of crabgrass germination and also their persistance in carrying over to early October which was after the first killing frost. With the exception of the 21 1/3 and 32 ounce rate of Chloro-IPC, no discoloration was noted one week after application of the materials. The severe discoloration caused by the Chloro-IPC resulted in 3 and 11 percent permanent injury to the basic turfgrasses at the respective rates used. By October 5 the injured areas had filled in with clover, dandelions, plantain and other weeds.

Neburon at 4.6, 6.1 and 7.6 ounces per 1000 square feet rate gave 62, 70 and 84 percent control respectively on July 30. By October 5 the 7.6-ounce rate showed only 50 percent control while the other rates were below 50 percent.

Alanap-1F at 9, 18, and 27 pounds affected 75, 91, and 93 percent control on July 30; however, they fell to 55, 71, 58 percent control respectively by October 5.

Alanap-1F concentrate provided 66 and 82 percent control for the 4- and 6-pound application respectively on July 30. On October 5 controls for both rates were below 50 percent.

Scutl at setting #5 and #7 produced 44 and 55 percent control respectively by the end of July, but by October 5 both rates had dropped to less than 40 percent control.

Chloro-IPC at 10 2/3, 21 1/3 and 32 ounces provided a July 30 control of 52, 66, 81 percent respectively. The latter two rates also produced 3 and 11 percent permanent injury to the basic turfgrasses. By October the control at the three rates used fell below 50 percent.

PMAS at 1 3/4 and 2 1/2 ounces gave less than 50 percent control on July 30. The 2 1/2-ounce rate on October 5 gave 58 percent control.

Chlordane produced 80 and 54 percent control for the 2- and 4-pound rate respectively at the end of July. By October 5 the controls leveled off at 70 and 63 percent for the respective rates used.

Crab-E-Rad and Crag-1 at rates used in this experiment were not effective in giving control above 55 percent in July or above 43 percent on October 5.

Summary and Conclusions

Under the conditions of this experiment and at the rates used with only one Pre-emergence treatment which was applied May 24, Neburon, Alanap-1F, Alanap-1F Concentrate, Scutl, Crag-1 and Chlordane all provided controls ranging from 53 to 93 percent up to July 30.

Chloro-IPC, although producing 52 to 81 percent control, caused severe discoloration of the turf which resulted in 3 to 11 percent injury. Crab-E-Rad and PMAS provided less than 50 percent control.

By October 5 most controls fell below the 50 percent level. Those chemicals producing 50 percent control or better were Neburon at 7.6 ounces per 1000 square feet and Alanap-1F at all three rates ranged from 55 to 71 percent control. PMAS at 2 1/2 ounces gave 58 percent control, and chlordane at both the 2- and 4-pound rate per 1000 square feet gave 70 and 63 percent control respectively.

The results of this experiment and the controls obtained with only one treatment compared very well with previous results reported by Hart and DeFrance (4) where two treatments were used at a 2-week interval for pre-emergence control. Their results range from 32 to 73 percent for two treatments while the results of this experiment gave a range of 22 to 71 percent control for only one treatment.

Indications are that further study is needed with respect to time and rates of application and that good control could become possible with only one application of chemicals. However, particular attention should be paid to the period between the end of July and the first of September for a follow-up with a post-emergence treatment if necessary; as this appears to be the time that crabgrass has its second flush growth. This second growth is similar to that which was reported by King and Kramer (5).

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Table 1. Pre-Emergence Control of Crabgrass in Lawn Turf with Only One Application of Various Chemicals. Rhode Island Agricultural Experiment Station - 1956.

Material	Rate[a] Per 1000 sq. ft.	% Crabgrass July 30	Percent Control July 30	% Injury July 30	% Crabgrass Oct. 5	Percent Control Oct. 5
Neburon	4.6 oz.	5.1	62	0	8.5	41
Neburon	6.1 oz.	4	70	0	9.3	36
Neburon	7.6 oz.	2.1	84	0	7.2	50
Alanap-1F	9 lbs.*	3.3	75	0	6.5	55
Alanap-1F	18 lbs.*	1.2	91	0	4.2	71
Alanap-1F	27 lbs.*	.96	93	0	6	58
Scutl	Setting #5**	7.4	44	0	9.5	35
Scutl	Setting #7**	6	55	0	9	38
PMAS	1 3/4 oz.	8	40	0	8	45
PMAS	2 1/2 oz.	7.6	43	0	7	58
Crab-E-Rad	9 oz.	8	39	0	8.3	43
Crab-E-Rad	18 oz.	8.9	33	0	10	31
Chloro-IPC	10 2/3 oz.*	6.4	52	0	8.5	41
Chloro-IPC	21 1/3 oz.*	4.5	66	3	10	31
Chloro-IPC	32 oz.*	2.5	81	11	11.3	22
Crag-1	3.2 oz.	7.1	47	0	9.8	32
Crag-1	4.0 oz.	6.3	53	0	8.3	43
Chlordane	2 lbs.	2.6	80	0	4.3	70
Chlordane	4 lbs.	6.3	54	0	5.4	63
Alanap-1F	4 lbs.*	4.5	66	0	9.8	32
Alanap-1F	6 lbs.*	3.7	82	0	9.3	36
None	---	13.3	--	-	14.5	--

[a]Rates given are based on 1000 square feet because most home lawns are under an acre in size.
*Applied by means of a Scott's spreader.
**Refers to setting on Scott's spreader.
Applied May 24, 1956

FIELD TESTING OF THREE HERBICIDES FOR CRABGRASS CONTROL

J.R. Haun[1]

As an organization concerned with custom weed control operations it is important that the Weed Control Division, ICR., Inc. acquaint itself with the newer developments in herbicides. The knowledge of new developments is required for most efficient custom weed control operations. Custom weed control service is based upon the production of results. Beyond the necessary safety requirements of a control agent, the client is more interested in the end results than in the product or method of application. Thus it is of prime importance in custom operations to use the products which will produce satisfactory results at minimal costs.

Inasmuch as the research of this organization must necessarily be objective from the standpoint of rigid use-cost requirements it was felt that this form of testing would be of interest to manufacturers of herbicides.

METHODS AND MATERIALS

The tests were conducted at the following locations in the Baltimore Area:

1. A pure stand of crabgrass (*Digitaria ischaemum*) that had developed in an area which had been cultivated and prepared for seeding and then given no further attention.

2. Fairway turf - composed primarily of Kentucky bluegrass (*Poa pratensis*) and fescue (*Festuca sp.*) prior to the development of crabgrass.

3. Apron of a putting green - composed of approximately equal amounts of *Poa annua* and Kentucky bluegrass.

4. A putting green - with a very large percentage (over 90%) *Poa annua* and the remaining part, bent grasses.

The following materials were applied as water diluted sprays at the concentrations recommended by the manufacturers: CRABGRASS AND CHICKWEED PREVENTER[2] /18.5% 1-n-butyl-3-(3,4-dichlorophenyl)-1-methylurea/, METHAR[3] /75% Disodium monomethylarsonate pentahydrate/, PMAS[3] /10% phenylmercuric acetate/. The treatments were applied with a 1.5 gallon Hudson hand compression sprayer equipped with an 8002 TeeJet nozzle. The plot dimensions were 2 by 6 feet and were enclosed with a wooden frame during the treatment period. Treatments were replicated three times.

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1. Director, Weed Control Division, Insect Control and Research, Inc. 1111 N. Rolling Road, Baltimore 28, Md.
2. Product of E.I. duPont deNemours & Co., Wilmington, Delaware.
3. Product of W.A. Cleary, New Brunswick, N.J.

The rates applied and dates of application ("x") were as follows:

			Area of treatment (see above)											
			1				2				3			4
Plot No.	Material	Rate per 1000 ft^2	Pure stand Crabgrass				Fairway Turf				Apron of Putting Green			Putting Green
			May 16	June 5	June 20	July 14	May 16	June 5	June 20	July 14	May 17	June 6	June 28	May 17
	CRABGRASS & CHICKWEED													
1	PREVENTER	113 g.	x				x				x			x
2	"	113 g.	x	x			x	x			x	x		
3	"	113 g.		x				x				x		
4	"	227 g.	x				x				x			x
5	"	227 g.	x	x			x	x			x	x		
6	"	227 g.		x				x				x		
7	"	340 g.	x				x				x			x
8	METHAR	75 g.	x	x	x	x	x	x	x	x	x	x	x	x
9	PMAS	75 ml.	x	x	x	x	x	x	x	x				
10	PMAS	52 ml.									x	x	x	
11	PMAS	30 ml.												x

In the Baltimore area, crabgrass (Digitaria ischaemum) began emerging on May 1, 1956, in open areas, i.e. soil with no vegetation, and in sparsely covered areas. In areas of more dense vegetation, emergence of crabgrass began from May 5 to 10.

In general, the observations of control were made visually by two persons. The extent of crabgrass control or retardation was estimated and the average of the observations to the nearest 5 per cent value were then recorded.

RESULTS AND DISCUSSIONS

Area #1, with a pure stand of crabgrass, did not represent a typical situation where a crabgrass herbicide would be used. Instead, it was chosen for comparing the inherent phytotoxicities of the test materials. Under these conditions the crabgrass was more difficult to kill than it would have been had there been other grasses competing for nutrients, water and other factors necessary for growth. Thus it may be seen that 90 per cent control was obtained only on the June 1 observation with PMAS, on June 20 with the 454 g. treatment of CRABGRASS AND CHICKWEED PREVENTER, and on August 8 with METHAR (TABLE 1).

TABLE 1 - Summary of per cent crabgrass control observations
(Pure stand crabgrass area)

Plot No.	Material	Rate per 1000 ft^2 & No.of applns.	Per cent control-Average of 3 Replications June 1	June 20	August 8
1	CRABGRASS & CHICKWEED PREVENTER	113 g.	25	7	0
2	"	113 g.x2	-	52	7
3	"	113 g.	-	40	3
4	"	227 g.	68	30	13
5	"	227 g.x2	-	93	65
6	"	227 g.	-	78	23
7	"	340 g.	80	67	20
8	METHAR	75 g.x4	45	58	92
9	PMAS	75 ml.x4	95	80	43

TABLE 2 - Summary of per cent crabgrass* retardation observations
(Pure stand crabgrass area)

Plot No.	Material	Rate per 1000 ft^2 & No.of applns.	Per cent Retardation-Average of 3 Replications June 1	June 20	August 8
1	CRABGRASS & CHICKWEED PREVENTER	113 g.	13	0	0
2	"	113 g.x2	-	0	0
3	"	113 g.	-	12	0
4	"	227 g.	52	0	0
5	"	227 g.x2	-	27	0
6	"	227 g.	-	18	0
7	"	340 g.	58	0	0
8	METHAR	75 g.x4	83	70	40
9	PMAS	75 ml.x4	95	0	3

* The crabgrass that had not been controlled by the treatment.

In contrast to these results are the data from the August 8 observations of the Area #2 - Fairway turf (Table 3). In this area highly satisfactory control was obtained with all treatments except the single 113 g. and 227 g. levels of CRABGRASS AND CHICKWEED PREVENTER.

By August 8 the per cent control for all treatments except METHAR was materially less than at the earlier dates of observation (Table 1). The per cent control resulting from METHAR increased materially over the same period of time. This extended period of herbicidal effectiveness of METHAR is also reflected in the retardation data (Table 2).

The per cent control data of TABLE 3 (Fairway Turf) indicates that under the conditions of thest tests, satisfactory control of crabgrass may be obtained with all of the treatments except several of the lower levels of CRABGRASS AND CHICKWEED PREVENTER. It should be noted that injury to the permanent grasses occurred on three of the CRABGRASS AND CHICKWEED PREVENTER treatments which were adequate for crabgrass control.

TABLE 3 - Per cent control of crabgrass August 8, 1956
(Fairway Turf Area)

Plot No.	Material	Rate per 1000 ft^2 & No.of applns.	Replication I	II	III	AV.
1	CRABGRASS & CHICKWEED PREVENTER	113 g.	60	0	5	22
2	"	113 g.x2	90	85*	90	88
3	"	113 g.	90	80	10	60
4	"	227 g.	75	75	40	63
5	"	227 g.x2	95	90*	95	93
6	"	227 g.	95	85	90	90
7	"	340 g.	95	90	85*	90
8	METHAR	75 g.x4	95	95	95	95
9	PMAS	75 ml.x4	95	90	80	88

*Marked reduction in vigor of blue grass. Where vigor reductions were present in CRABGRASS AND CHICKWEED PREVENTER plots, heavy infestations of Plantain (Plantago lanceolata)were present.

Since essentially no crabgrass developed on the apron to putting green and putting green areas, the observations of these plots provide only a measure of injury to existing grasses. It is evident from the data of Table 4 (Putting Green) that CRABGRASS AND CHICKWEED PREVENTER is an excellent control agent for Poa annua since this area was almost entirely covered with this species.

TABLE 4 - Turf injury observation June 15, 1956. Each value indicates the per cent of the plot with all vegetation dead.
(Putting Green Area)

Plot No.	Treatment	Rate per 1000 ft^2	Replication I	II	III	AV.
1	CRABGRASS & CHICKWEED PREVENTER	113 g.	30	25	15	23
4	"	227 g.	90	80	75	82
7	"	340 g.	95	85	90	90
8	METHAR	75 g.	0	0	0	0
9	PMAS	30 ml.	0	0	0	0

Note: Since the initial treatment of CRABGRASS AND CHICKWEED PREVENTER had such drastic effect on this turf, no further treatments were applied as the green was used for practice and had to be repaired in the areas of the injury.

The injury data of Table 5 (Apron to Putting Green) is also largely influenced by the effect of CRABGRASS AND CHICKWEED PREVENTER on <u>Poa annua</u>, however, since this species comprised no more than half the population, the treatments with readings of more than 50 per cent kill indicate injury to the Kentucky bluegrass as well.

TABLE 5 - Turf injury observations June 28 and August 8, 1956 - Each value indicates the per cent of the plot with all vegetation dead. Average of 3 Replications.

(Apron to Putting Green)

Plot No.	Material	Rate per 1000 ft^2 & No.of applns.	June 28	August 8
1	CRABGRASS & CHICKWEED PREVENTER	113 g.	2	0
2	"	113 g.x2	33	7
3	"	113 g.	20	0
4	"	227 g.	13	2
5	"	227 g.x2	92	58
6	"	227 g.	73	12
7	"	340 g.	40	18
8	METHAR	75 g.x3	0	0
9	PMAS	52 ml.x3	0	0

Under the conditions of these tests it would appear that CRABGRASS AND CHICKWEED PREVENTER is less desirable for crabgrass control than either METHAR or PMAS. The lower rates of CRABGRASS AND CHICKWEED PREVENTER did not give satisfactory control while the higher rates caused injury to the permanent grass.

SUMMARY AND CONCLUSIONS

Three materials were compared as crabgrass control agents on four different types of turf. The materials were applied as water diluted sprays and the treatments thrice replicated. Observations of control and growth retardation were taken at several intervals of time after the initial treatments.

Under the conditions of these tests, the following conclusions may be made:

1. In a pure stand of crabgrass, four treatments of METHAR are more effective herbicidally than four treatments of PMAS or any of the single or combination treatments of CRABGRASS AND CHICKWEED PREVENTER.

2. CRABGRASS AND CHICKWEED PREVENTER will cause occasional damage to turf grasses (such as Kentucky bluegrass) when used at levels which are sufficient to give crabgrass control.

3. *Poa annua* is readily controlled with CRABGRASS AND CHICKWEED PREVENTER.

4. METHAR and PMAS will give satisfactory control of crabgrass at levels which will not injure turf grasses.

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PRELIMINARY RESULTS IN CONTROLLING JOHNSON GRASS [1/]

Paul W. Santelmann and John A. Meade [2/]

Within recent years Johnson grass (Sorghum Halepense (L.) Pers.) has become a serious weed problem in Maryland. At present, it is found in 21 out of the 23 counties in the state, the two western mountain counties being the exceptions. In some counties on the Eastern Shore of Maryland, it is the major weed problem. Due to its rapid and vigorous type of growth, combined with large rhizomes that can go four feet deep in the soil, it is a very difficult weed to control. Land that is heavily infested with Johnson grass will not grow anything else.

Various cultural practices have been used to control this grass weed. All of them involve taking the land out of the rotation and following special practices for at least two years, often three. Unfortunately, even these methods do not work in a wet summer.

Many chemicals have been tried in an attempt to control Johnson grass, and some have been successful when used for spot treatment. However, to date, all chemicals have been too expensive for use on large areas of an acre or more. Also, most of the recommended chemicals are soil sterilants, and their use, therefore, renders the land unfit for crop use for a period of time ranging from two months to several years.

In 1955 and 1956 experiments were set up at several locations in Maryland, in an effort to find an economical chemical method of controlling Johnson grass in large areas.

Procedure

In 1955 and 1956 experimental plots were established in fields severely infested with Johnson grass near Cambridge, Easton and Salisbury on the southern part of Maryland's Eastern Shore. The plot size varied from 50 square feet to 200 square feet, depending upon the size of the infested area. In all instances several treatments were used, a randomized block with three replicates being the experimental design.

Most plots were sprayed with an experimental, compressed air, knapsack type sprayer. All treatments were applied in 40 gallons of water per acre at 30 or 40 pounds pressure. In some instances, the treatment was repeated after a stated interval had passed. At various periods after treatment, estimations of the percent kill of the Johnson grass were made by two or three persons. These estimations were then averaged.

1/Published with the approval of the Director of the Maryland Agricultural Experiment Station as Miscellaneous Publication No. 284, Contribution No. 2766.

2/Assistant Professor and Instructor respectively, Agronomy Department, University of Maryland, Agricultural Experiment Station, College Park.

TABLE 1. Percent control of Johnson grass at four different locations at various dates in 1955 and 1956. Average of 3 replications.

		1955 Experiment				1956 Experiments					
	Rate	Cambridge				Hebron		Salisbury		Easton	
Treatment	Lbs./A.	6/29	8/9	9/13	6/6/56	7/5	10/5	8/6	10/5	8/6	10/5
Dalapon	15	93	40	20	13	-	-	-	-	-	-
	30	100	33	0	10	100	85	80	65	90	90
	40	100	30	20	13	-	-	83	60	-	-
Dal.Retr.	5*	-	-	-	-	-	-	95	68	90	90
	10*	-	-	-	-	100	77	100	73	100	100
	15*	-	85	93	90	100	83	100	93	100	100
	30*	-	96	100	100	-	-	-	-	-	-
	40*	-	93	90	93	-	-	-	-	-	-
Dal + ATA	15 + 3	100	40	13	6	100	83	96	100	-	-
	30 + 8	100	46	17	16	-	-	-	-	-	-
Dal + ATA	15 + 3*	-	80	90	93	-	-	-	-	-	-
Retr.	30 + 8*	-	90	97	100	-	-	-	-	-	-
XTB	50	-	-	-	-	93	35	-	-	-	-
ATA	10	70	0	0	0	-	-	-	-	-	-
Chlorea	2½**	100	73	80	83	-	-	-	-	-	-
Atlacide	1½**	100	48	47	66	-	-	-	-	-	-
TCA	175	100	53	38	50	100	85	-	-	100	100
TCA Retr.	175*	-	100	100	100	-	-	-	-	-	-

*These treatments were repeated 10 to 40 days after the original treatment, thus the total amount of chemical applied per plot is twice that indicated.

**Rate in pounds per 100 square feet.

Results and Discussion

In 1955 an experiment involving 15 treatments was laid out near Cambridge. The plots were treated on June 1st, when the grass was about 8 inches tall. The treatments used are listed in Table 1.

Three rates (15, 30, 40 lbs./A.) of dalapon were used. With all rates there was a very high percentage of top kill by the time one month had passed. However, it was only top kill, as in each instance new growth appeared so that by the end of the season there was very little control evident. On the 19th of July, 49 days after the original treatment was made, one half of each plot of several chemicals was retreated with the same rate as was originally used. Therefore, the retreated half of the 15 lbs./A. plot actually received 30 lbs./A. in two increments. In these areas the regrowth died quickly, and apparently the roots were also killed as no more plants emerged, as evidenced by the ratings of June 6th the following spring. Fifteen pounds retreated was as satisfactory as 40 pounds in a single treatment. Dalapon was also used in combination with Amino triazole (ATA), but the results were identical with the dalapon treatments alone.

TCA at 175 lbs./A. resulted in only a 50% kill, but where it was retreated 49 days later, the kill was 100%. The only treatment that gave a relatively high percent kill with one treatment was Chlorea (a mixture of monuron, sodium chlorate and sodium metaborate) at 2½ pounds per 100 square feet. There was about 83% control when the plots were inspected the following year. Sodium chlorate (Atlacide) alone was not as good. ATA alone did not give satisfactory control.

In 1956 similar treatments were applied at several locations. Several of the treatments were re-applied as in 1955. The locations, dates, and height of Johnson grass at time of first treatment were:

Location	First Treatment	Retreatment	Height
Hebron	June 1	June 14	10 to 14"
Salisbury	June 11	July 5	18 to 24"
Easton	June 25	July 2	25 to 30"

In most instances where the dalapon was used once, the results were similar to those obtained in 1955. Retreatment again appeared to yield better results than just one application of the chemical. Retreatment with 5 pounds was probably too little, and 10 pounds was questionable at most locations. However, at Easton where the grass was taller when sprayed, the control was better with the lower rates. Apparently we do not yet know the optimum growth stage for treatment. Retreatment with 15 pounds again appeared to be very satisfactory. It is realized that final indications of control cannot be ascertained for certain until the spring of 1957. However, in the 1955 experiments, the ratings made on the 13th of September told the same story as the ratings made the following spring.

A dalapon plus ATA mixture was again no improvement over dalapon alone. XTB at 50 lbs./A. resulted in an initial kill of top growth but there was rapid recovery.

Summary

Several chemicals were tried for their effectiveness for controlling Johnson grass. Dalapon appeared to be the most promising, particularly when the expense of the chemical was taken into account. Single treatments of dalapon at 15 to 40 lbs./A. resulted in rapid kill of top growth and then almost complete recovery of the plant from the roots. Where the dalapon treatments were re-applied 7 to 40 days after the original treatment, the results obtained were much more satisfactory. Five and 10 pounds of dalapon per acre, retreated, did not appear to be sufficient. A mixture of dalapon and ATA retreated was also satisfactory. For single treatment, Chlorea appeared to be best, but it sterilized the soil for some time. Atlacide, TCA, ATA and XTB were less satisfactory.

PROGRESS REPORT ON WILD GARLIC (ALLIUM VINEALE L.) INVESTIGATIONS[1]

Charles M. Allmond, III [2]

Wild garlic, Allium vineale L., is a serious weed problem in Delaware. It is particularly troublesome in small grains and in dairy pastures. Garlic infested pastures produce an undesirable odor and flavor in milk and the milk is unsaleable. The plant causes a greater monetary loss to Delaware dairymen than any other weed.

Wild garlic in small grains may be controlled rather easily with the use of herbicides. Also, spring applications of chemicals to pastures have given fairly good control. However, these chemicals have often been injurious to legumes in the pasture mixtures. In addition, wild garlic is a problem in the fall as well as in the spring in Delaware pastures.

The present study, begun in the fall of 1955, includes an evaluation of various herbicides in both fall and spring applications and an investigation of the reproduction and development of the plant.

Wild garlic propagates in several ways. The plant matures in June or July and forms a head of aerial bulblets. In Delaware, many of the plants flower and produce seeds. The top growth dies back in the summer and the aerial bulblets and seeds germinate in the late summer or early fall. Two to eight hard shelled bulblets are formed around the underground soft shelled bulb. These hard shelled bulblets germinate in the fall or spring or may remain dormant and germinate sometime during the following two or three years.

The fact that some of the hard bulblets remain dormant for so long a period makes a control program difficult.

Fall applications of 2,4-D ester and MCP on field plots of a garlic infested Ladino clover - mixed grass pasture were investigated in 1955. Both materials were used at rates of 1/2, 3/4, and 1 pound per acre. Half the plots were treated October 3 and the other half November 8. The treatments were evaluated April 16, 1956. The results are summarized in Table 1.

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1. Published as Miscellaneous Paper No. 260 with the approval of the Director of the Delaware Agricultural Experiment Station.
2. Graduate Assistant, Department of Agronomy, Delaware Agricultural Experiment Station.

Table 1. Effect of Time and Rate of Application of 2,4-D and MCP on Garlic and Clover Stands

Treatment	Rep. 1		Rep. 2		Rep. 3		Average	
Applied 10/3/55	Clover	Garlic	Clover	Garlic	Clover	Garlic	Clover	Garlic
1/2# MCP	5	2	6	2	9	9	6.7	4.3
3/4# MCP	4	6	6	7	7	7	5.7	6.7
1# MCP	9	6	8	4	8	6	8.3	5.3
1/2# 2,4-D	5	1	4	6	4	4	4.3	3.7
3/4# 2,4-D	4	5	4	8	5	3	4.3	5.3
1 # 2,4-D	4	4	8	2	6	1	6.0	2.3
Untreated Check	10	10	10	10	10	10	10.0	10.0
Applied 11/8/55								
1/2# MCP	3	2	5	1	3	2	3.7	1.7
3/4# MCP	3	1	6	5	6	2	5.0	2.7
1# MCP	7	2	7	2	6	1	6.7	1.7
1/2# 2,4-D	6	1	1	2	0	1	2.3	1.3
3/4# 2,4-D	5	3	5	6	6	4	5.3	4.3
1# 2,4-D	3	3	5	5	5	4	4.3	4.0
Untreated Check	10	10	10	10	10	10	10.0	10.0

0 = Complete kill
10 = No injury

The November treatments seemed to give a slightly higher garlic kill than the October applications. However, the damage to the clover was also more severe, and none of the treatments gave 100% control. The one pound rate of MCP appeared to be most effective in controlling garlic without destroying clover.

Other herbicides were tried in the spring of 1956. In addition to the ester form of 2,4-D, both 2,4-D and MCP butyric acid compounds were used. The applications were made April 30 and were evaluated October 19. The results of this experiment are shown in Table 2.

Table 2. Effect of Rate of Application of 2,4-D ester, 2,4-D Butyric and MCP Butyric on Garlic and Clover Stands

Treatment	Rep. 1		Rep. 2		Rep. 3		Average	
	Clover	Garlic	Clover	Garlic	Clover	Garlic	Clover	Garlic
1/3# 2,4-D Butyric	6	6	9	10	4	9	6.3	8.3
2/3# 2,4-D Butyric	4	8	8	10	2	10	4.7	9.3
1# MCP Butyric	10	4	8	8	9	8	9.0	6.7
2# MCP Butyric	4	10	10	7	4	7	6.0	8.0
1/2# 2,4-D Ester	3	5	7	7	2	10	4.0	7.3
1# 2,4-D Ester	8	4	9	9	5	10	7.3	7.7
Untreated Check	10	10	10	10	10	10	10.0	10.0

0 = Complete kill
10 = No injury

Observations indicate that the butyric compounds are somewhat less damaging to clover than the ester form of 2,4-D, but none of the treatments gave better than a 30% reduction in garlic stand. There was a marked reduction in plants arising from soft shelled bulbs in the treated plots compared with the checks. Evidently, the shoots from the soft shelled bulbs were killed, while there remained a large population of ungerminated hard bulblets in the soil, which obviously were unaffected by the herbicides. This demonstrated the necessity of further treatments, either in the fall or the following spring.

This experiment will be continued, and additional fall, spring, and combined fall and spring chemical treatments will be investigated.

A study to determine the effects of various times and rates of application of herbicide on garlic stand and on hard bulblet formation was undertaken in the fall of 1955. Pots containing samples taken from a garlic infested pasture were set out in the field. These samples were sprayed with 2,4-D ester at two rates and there were four times of application. Garlic shoot counts were made before spraying and the samples were removed and shoot and hard bulblet counts made one year after planting. See Table 3.

Table 3. Effect of Rate and Time of Application on Garlic Stand and Hard Shelled Bulblet Formation.

Treatment and Date Applied	Average Number / Pot Normal Shoots Above Ground			Average No./Pot Hard Bulblets		Ave. No./ Pot Soft Bulbs
	10/18/55	5/1/56	10/1/56	Germi-nated	Ungerm-inated	
None	3.4	7.4	4.2	6.8	18.8	2.3
1/2# 2,4-D 10/20/55	4.4	4.2	5.0	9.0	24.8	2.0
1# 2,4-D 10/20/55	4.8	7.0	5.6	11.4	14.6	1.6
1/2# 2,4-D 11/9/55	4.4	5.4	3.8	5.6	16.6	2.8
1# 2,4-D 11/9/55	4.6	2.4	2.8	6.8	8.2	.4
1/2# 2,4-D 4/12/56	2.4	.8	4.8	5.6	12.8	3.2
1# 2,4-D 4/12/56	3.6	0	.4	1.6	11.0	.4
1/2# 2,4-D 10/20/55 4/12/56	5.3	1.0	5.7	8.3	20.0	2.7
1# 2,4-D 10/20/55 4/12/56	3.3	0	0	3.0	7.7	0

It is evident from this work that 2,4-D at the one pound rate applied in November or in the combined fall and spring treatment was fairly effective in reducing the garlic stand. It is also evident, however, that even though the stand had been reduced, there were still several hard bulblets left to grow which were not touched by the chemical. With the one pound rate applied both fall and spring, for example, there was still an average of 10.7 prospective plants per pot. These results indicate that hard bulblets remain dormant for some time in Delaware, and that even when a fall treatment is followed by one in the spring, there is still a rather significant population of wild garlic in the soil.

A study was made to determine the percentage of hard bulblets germinating throughout the winter growing period of 1955-56. Samples consisting of a six inch core of soil eight inches deep were taken in October, November, and March. These were examined and the hard bulblets counted. The results are summarized in Table 4.

Table 4. Percentage of Hard Bulblet Germination; Winter 1955-56.

	10 Samples 10/55	5 Samples 11/55	10 Samples 3/56
Average hard ungerminated bulblets per sample	22.7	8.5	22.2
Average hard germinated bulblets per sample	8.1	7.0	50.0
Average soft bulbs	4.9	2.4	16.5
% hard ungerminated bulblets	73.7%	54.5%	30.7%
% hard germinated bulblets	26.3%	45.5%	69.3%

These data would indicate that a spring herbicide application would kill more plants than a fall application as nearly 70% of the plants would be growing by March. However, there would still be 30% unaffected by the treatment. Perhaps a spring treatment followed by a fall or another spring treatment might be more effective in controlling wild garlic than a fall treatment followed by one in the spring.

No definite conclusions can be made until the investigations of spring followed by fall and spring herbicide applications are completed.

Response of Quackgrass, *Agropyron repens*, to Amino Triazole When Applied Directly to Growing Plants

by A. M. S. Pridham, Cornell University

Agropyron repens, quackgrass or couch grass, is often a weed of those nursery crops which remain in the soil for a period of two to five years before the planting is removed and the land plowed. Removal of *Agropyron repens* from among nursery plants is largely a matter of hand hoeing or of repeated treatment with appropriate chemicals at times when injury to nursery stock will be at a minimum.

Preliminary treatment of established patches under autumn dormant season conditions in 1955 indicated that amino triazole might be useful either alone or in combination with other herbicides used at relatively low rates.

Two infestations of *Agropyron repens* were treated in 1956. The first was a moderate stand of regrowth following June plowing under of a 5 year old infestation. Treatments were made July 10-17 when the regrowth was a foot to 18 inches in height. Plots were 10 x 10 feet and treatments in quadruplicate. One quart of mix was used per plot or approximately 100 gallons of mix per acre.

The second stand was a heavy one of mature quackgrass 3 years old and in seed head stage. Treatments were the same in both stands. The dates of application overlapped. Plots were not plowed or cultivated after treatment.

Observations were made periodically and sampling of the stolon-like roots in a $1\frac{1}{2}$ sq. ft. block was taken at random from each plot. The roots were washed clean of soil, sorted for purity and weighed. Four samples of 12 stolon sections 4 inches long were planted in steam sterilized soil and grown for 30 days under greenhouse conditions when the tops were harvested and green weights taken.

Table 1. Treatments made (July 10-17) to Quackgrass, *Agropyron repens*.

	Stand of vigorous regrowth plants after June plowing					Stand of mature plants in seed head	
	Regrowth measured as green weight *			Plot rating 0-10		Regrowth measured as green weight*	
Treatment	Roots	Tops	No. of shoots	Quack grass	Annual weeds	Roots	Tops
Control	19	11	35	9	1.5	122	6
TCA 10	19	8	24	7	2.0	103	5
Dalapon 4	12	8	23	5	2.0	95	4
" + AT 4	11	3	8	4	3.0	83	6
" + AT 8	9	2	8	3	4.0	104	5
" + AT16	6	0	2	2	5.0	105	6
Baron 1/10	18	1	1	1	0.5	55	0.3
" + AT 4	11	0	1	2	0.5	65	2
" + AT 8	5	0	0	0	0.2	100	1.3
" + AT 16	12	0	0	0	2.0	59	1
TCA 10 + AT 4	4	1	3	2	3.0	72	4
" + AT 8	8	0	4	2	3.0	90	3
" + AT 16	8	0	1	1	4.0	26	4

continued

* grams

Table 1 -- continued

Treatment	Stand of vigorous regrowth plants after June plowing: Regrowth measured as green weight Roots	Tops	No. of shoots	Plot rating 0-10 Quack grass	Annual weeds	Stand of mature plants in seed head: Regrowth measured as green weight Roots	Tops
Dalapon 4							
+ AT 4	14	1	15	3	4.0	83	3
" + AT 8	10	0	1	2	4.0	84	3
" + AT 16	14	0	0	1	5.0	87	4
LSD 5%	5.2	6	16	3	2.6		
LSD 1%	7.5	8	22	5	3.7		

Results

The green weight of the stolon-like roots harvested from plowed plots does not indicate any marked reduction due to treatment. Regrowth from uniform samples of these stolons grown in the greenhouse does indicate statistically significant reductions in top growth in the test used. These reductions are greatest in plots treated with Baron 1:10 dilution applied at the rate of 100 gallons per acre and in combinations of amino triazole with Baron. Reductions were also evident in treatments with TCA in combination with amino triazole 4 pounds and more per acre. Reductions were also evident with Dalapon 4 pounds in combination with amino triazole 8 pounds/acre.

Regrowth of quackgrass in the field plots took place after spraying and two weeks later mowing off the tops of the grass and weeds. This second flush of growth following the June plowing, occurred during September and October. The amount of regrowth was estimated in November and rated on a basis of 0 to 10.

The data correlates closely with that of new growth from root samples.

By November 1 seedling growth of many fall weeds had appeared except in check plots where the quackgrass canopy was dense and seedling growth minor. The amount of seedling growth was rated 0 to 10. The largest amounts of seedling growth appear in the amino triazole plots. Few, if any, of the seedlings showed the white or pink foliage characteristic of regrowth following amino triazole treatment of perennial weeds. The presence of seedlings is taken to be an indication of freedom from lethal residues of amino triazole. Seedling weeds were few in plots receiving Baron and also germination and growth of red-top (Agrostis alba) and of cucumber seed in soil samples tested under greenhouse conditions was poor. It would appear that in present tests there is a definite residual action associated with the application of Baron 1:10 dilution at the rate of 100 gallons per acre on Dunkirk silty clay loam.

Preliminary tests were set up August 8 on selected areas of Agropyron repens following plowing in June. In these tests amino triazole was compared with Simozin and Geigy 444-E. The stand of August 8 was not injured by Geigy 444-E in dilutions of 1/25 - 1/50 or 1/100 compared to adjacent untreated controls. Simozin at 4 to 12 pounds per acre resulted in death of existing foliage as did amino triazole used at 4 to 16 pounds of active ingredient per acre. Regrowth of Agropyron repens was rated in November.

Table 2. Regrowth of *Agropyron repens* on basis of 0-10 rating of foliage present in November following August treatment of regrowth after plowing in June. Average ratings based on three replicates. Control 10.

Herbicide applied	Pounds of herbicide per acre				
	16 lbs.	12 lbs.	8 lbs.	6 lbs.	4 lbs.
Amino triazole	2.6	0.1	3.3	3.3	4.3
Simozin	--	0.0	1.3	3.6	10.0

Table 3. Ratings for population of annual bluegrass (*Poa annua*) present on plots treated with amino triazole and Simozin for *Agropyron repens* control. Ratings on basis of 0 to 10 Nov.15, 1956, following treatments August 8, 1956. Controls free of *Agropyron repens* -- 6.

Herbicide applied	Pounds of herbicide per acre				
	16 lbs.	12 lbs.	8 lbs.	6 lbs.	4 lbs.
Amino triazole	2.6	4	2.6	2.3	0
Simozin	--	0	0.0	0.0	0

Soil samples taken from these plots and planted with redtop (*Agrostis alba*) and cucumber under greenhouse conditions showed normal growth over a three weeks period for samples at the surface, 1 inch and 2 inch depths in Dunkirk silty clay loam. This would indicate that the apparent residual effect of the Simozin is a surface one at best in present tests.

Treatment of mature quackgrass

The green weight of stolon-like roots harvested from mature quackgrass (Table 1) vary but do not show significant trends.

Regrowth from stolon-like roots is lowest in all plots treated with Baron. Combinations of amino triazole with either TCA (sodium salt of trichloroacetic acid) or with Dalapon show only moderate reduction in regrowth.

Baron 1:10 dilution at 100 gallons per acre was the only treatment to reduce regrowth from stolons when mature unplowed stands were treated at seed head stage in midsummer.

Summary

Baron at a dilution 1:10 at the rate of 100 gallons per acre was the only herbicide in present tests effective in treating mature uncut *Agropyron repens*. Regrowth from plowing responds to several herbicide combinations with amino triazole as well as to Baron 1:10, amino triazole 16 pounds/acre or Simozin 12 pounds/acre. The possibility of using Baron, amino triazole or Simozin as a basal spray or granular formulation in nursery stock has yet to be established. All three have been used successfully in limited tests.

QUACKGRASS CONTROL IN FIELD CORN[1]

Jonas Vengris [2]

Our 1954 preliminary tests (1) showed that quackgrass (Agropyron repens) can be significantly suppressed by some herbicides applied before corn planting. The trials were continued in 1955 and 1956. During these two years four separate field plot experiments were conducted. In this progress report we present the principle results of these tests.

1955 Spring Applications

Two similar quackgrass control experiments were started in the spring of 1955: one at Amherst, Mass., on a fine sandy loam with only fair drainage and the second at Leverett, Mass. on a well drained gravelly sandy loam. Both areas had good uniform stands of quackgrass. Each plot comprised four corn rows 50 ft. long. Two replicates were used. All treatments on both experiments were applied on June 3, 1955. Quackgrass at that time was 7-9 inches tall. On June 8, five days after application of chemicals, all plots were thoroughly disked. At that time plants treated with amino triazole were chlorotic. Field corn was planted seven days after application of herbicides on June 10. At corn emergence all plots were sprayed with 6 lb/A of Dow Premerge. Later on blocks were split into two halves; one half was cultivated three times and another left uncultivated. Each plot consisted of four corn rows 25 ft. long.

Results and Discussion:

Quackgrass control and corn injury were estimated on July 19. Corn was harvested as silage September 13. Yield data of the Amherst experiment are presented in Table I and the Leverett experiment in Table II. Check yields are represented by 100. Yields from treated plots are expressed in percentages of the checks.

Only Dalapon gave satisfactory results in suppressing quackgrass. Under conditions of our trials adding amino triazole did not increase Dalapon effectiveness. Amino triazole alone as well as maleic hydrazide did not control quackgrass satisfactorily. No significant differences were observed between cultivated and uncultivated plots. Also there were no observable differences in the results from both experimental locations.

Treated corn was more significantly injured in the Leverett trial (Table II), than in the Amherst one (Table I). The sandier texture of the Leverett soil is probably the reason. Only a few hills were significantly injured at Amherst and yields were not adversely affected. In both locations cultivated plots were more seriously injured than uncultivated plots. The cultivated plots treated with Dalapon at Leverett showed appreciable injury.

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1. Contribution No.1089 of the University of Massachusetts, College of Agriculture, Experiment Station, Amherst, Massachusetts.

2. Assistant Professor of Agronomy, University of Massachusetts, Amherst, Massachusetts.

Table I. Quackgrass Control in Field Corn. Amherst, Mass.
Relative Values. Checks = 100.

Treatments	Cultivated Plots Quack Grass Stand	Cultivated Plots Corn Stand	Cultivated Plots Corn Yield	Uncultivated Plots Quack Grass Stand	Uncultivated Plots Corn Stand	Uncultivated Plots Corn Yield
1. Check	100	100	100	100	100	100
2. Dalapon 4 lb/A	59	90	102	70	95	115
3. Dalapon 8 lb/A	51	86	93	47	92	106
4. Dalapon 4 lb/A + A. triazole 2 lb/A	66	87	105	78	97	108
5. Amino triazole 3 lb/A	88	100	96	90	100	97
6. Amino triazole 6 lb/A	76	100	99	88	97	102
7. MH 3 lb/A	73	100	99	90	100	91
8. MH 6 lb/A	73	100	106	75	100	99

Table II. Quackgrass Control in Field Corn. Leverett, Mass.
Relative Values. Checks = 100.

Treatments	Cultivated Plots Quack Grass Stand	Cultivated Plots Corn Stand	Cultivated Plots Corn Yield	Uncultivated Plots Quack Grass Stand	Uncultivated Plots Corn Stand	Uncultivated Plots Corn Yield
1. Check	100	100	100	100	100	100
2. Dalapon 4 lb/A	45	65	81	58	85	91
3. Dalapon 8 lb/A	35	25	54	33	72	88
4. Dalapon 4 lb/A + A. triazole 2 lb/A	55	55	81	50	77	92
5. Amino triazole 3 lb/A	90	100	112	91	100	91
6. Amino triazole 6 lb/A	90	100	102	86	100	97
7. MH 3 lb/A	80	100	108	80	100	97
8. MH 6 lb/A	80	100	110	78	100	102

1955 Fall Applications

Plots 10' by 60' in size were laid out in the fall of 1955 in Leverett, in an area uniformly infested with quackgrass. No replicates were used. Herbicides were applied on foliage 10-12 inches in height in September, November and December. Spring treatments were made in May 7, 1956. Seventeen days later on May 24 all plots were plowed, a seedbed prepared and planted to corn. On June 1, 1956 all plots were sprayed with 5 lb/A of Dow premerge.

During the growing season, the corn was cultivated twice. Observations on quackgrass control were made August 3. Results are presented in Table III.

Table III. Quackgrass Control in Field Corn.
Relative Values. Checks = 100

Treatments	Time of Application	Quackgrass Stand 5/23/56	Quackgrass Stand 8/3/56	Relative Yield
1. Check	9/14/55	100	100	100
2. Dalapon 5 lb/A	9/14/55	20	30	100
3. Dalapon 10 lb/A	9/14/55	15	10	102
4. Dalapon 10 lb/A + Amino triazole 3 lb/A	9/14/55	5	8	98
5. Dalapon 15 lb/A	9/14/55	10	8	98
6. Dalapon 5 lb/A	10/20/55	25	65	92
7. Dalapon 10 lb/A	10/20/55	20	60	97
8. Dalapon 10 lb/A + Amino triazole 3 lb/A	10/20/55	20	60	108
9. Dalapon 15 lb/A	10/20/55	20	60	96
10. Dalapon 10 lb/A	12/5/55	40	80	106
11. Dalapon 10 lb/A + Amino triazole 3 lb/A	12/5/55	25	80	98
12. Dalapon 15 lb/A	12/5/55	20	70	107
13. Dalapon 5 lb/A	5/7/56	60	60	102
14. Dalapon 10 lb/A	5/7/56	40	40	106
15. Dalapon 10 lb/A + Amino triazole 3 lb/A	5/7/56	30	50	99
16. Amino triazole 3 lb/A	5/7/56	40	65	102

Although quackgrass was significantly killed by all fall treatments (Table III), treatments made September 14, 1955, were the most effective. It is reasonable to postulate that treatments made later in the fall on dormant vegetation did not significantly effect the rhizomes. Of the spring treatments the best results were obtained with the 10 lb/A of Dalapon. In general, early fall applications were by far more effective than spring applications.

The addition of amino triazole to Dalapon (10 lb/A rate) helped to kill grass tops but final quackgrass control was not improved.

No injury from fall treatments was observed. Less than 3 percent of the hills showed slight injury from spring applied Dalapon (10 lb/A rates).

Later in the season plots were heavily invaded by curled dock (Rumex crispus) and annual weedy grasses. Any possible yield increases due to quackgrass control were thus eliminated.

1956 Trials

In 1956 quackgrass control trials were conducted in Granby, Mass. on a fairly well drained fine sandy loam. The area was heavily and uniformly infested with quackgrass. In 1955 the area was seeded to spring oats. In late November 1955, half of the experimental area was plowed and another half left unplowed. At the time of herbicidal application (5/17/56) plowed area had a 5 to 6 inche growth of quackgrass. The unplowed area had a relatively thick growth of quackgrass 10 to 12 inches in length. Plots were 12' by 94' in size. Only two replicates were used. Eight days after the application of herbicides (5/25/56) all treatments with the exception of amino triazole 2 lb/A and 4 lb/A were plowed. On June 6, i.e. 20 days after spraying, the amino triazole treatments were plowed. Field corn was planted on all treatments on June 7. From the time herbicides were applied and corn was planted 3.78 inches of rain fell. Four days after planting all experimental was sprayed with 6 lb/A of Dow Premerge. Quackgrass control was determined by counting quackgrass shoots on August 4. On every plot, nine one-square-foot areas were taken at random and the tillers were counted. Results are presented in Table IV. None of the treatments produced really good quackgrass control.

Table IV. Quackgrass Control in Field Corn
Relative Values. Checks = 100.

	Tiller Number	
Treatments	Plowed Nov. 1955	Not Plowed Nov. 1955
1. Check	100	100
2. Dalapon 4 lb/A	62	56
3. Dalapon 8 lb/A	45	35
4. Dalapon 4 lb/A + Amino triazole 2 lb/A	47	51
5. MH 3 lb/A	77	67
6. MH 6 lb/A	64	43
7. M-177-A 4 lb/A	63	52
8. M-177-A 8 lb/A	44	51
9. Amino triazole 2 lb/A	62	67
10. Amino triazole 4 lb/A	69	65

Taking into consideration both the fall and spring plowed areas, the best quackgrass control was obtained from Dalapon 8 lb/A and M-177-A* 8 lb/A rates.

A number of plants on Dalapon treatments showed some stunting and curvation. However, the number of malformed plants never exceeded 1-2 percent of the total number of plants on these treatments.

According to our experience at present, Dalapon is one of the most effective herbicides for quackgrass control in corn. Possible injury to corn from Dalapon is one hazard attending the general use of this chemical. Tests were laid out in 1955 and 1956 to study the nature and extent of injury from Dalapon applications in corn.

* This polychlorinated benzoic acid contains about 80 percent of 2,3,6-trichlorobenzoic acid (ACP)

On May 17, 1955 an area infested with lush growth of quackgrass 6-9 inches tall was treated with Dalapon 5 lb/A and 10 lb/A. Plots were 12' by 60' in size. No replicates were used. Results are presented below in Table V.

Table V. Corn Injury from Different Rates of Dalapon

No.	Dalapon Rates	Date of Application	Days between Treating and Plowing	Days between Treating and Planting	Inches of rain between Treating and Planting	Percent of Corn hills showing injury 7/6/55	7/20/55	Relative yields Checks=100
1	Check					0	0	100
2	Dalapon 5 lb/A	5/17	6	7	0.08	16	6	104
3	" 10 lb/A	5/17	6	7	0.08	24	13	95
4	Dalapon 5 lb/A	5/17	6	14	2.17	6	3	100
5	" 10 lb/A	5/17	6	14	2.17	16	10	94
6	Dalapon 5 lb/A	5/17	14	14	2.17	2	1	104
7	" 10 lb/A	5/17	14	14	2.17	3	1	102

Injury even when corn was planted seven days after application of Dalapon was not severe. Plants regained normal growth later in the season and yields were not affected. In these tests corn was less injured when both plowing and planting were made 14 days after application of the chemical in comparison to plowing 6 days after treating and then planting 8 days later. A possible reasonable explanation might be that the earlier plowing delayed the decomposition of the chemical and thereby prolonged the period of toxicity.

In 1956 a field infested with quackgrass was sprayed with 10 lb/A of Dalapon. For comparison half of the field was not sprayed. Six days after application the field was plowed and field corn planted 10,15,20,25, and 30 days after spraying. Between applying Dalapon and these planting dates, 0.37, 0.70, 3.81, 3.81 and 4.04 inches of rain fell. The soil was a fine sandy loam. Close observations during the growing season showed that even when planting 10 days after spraying, not more than 2-3 percent of the hills had corn plants showing Dalapon injury marks. Yields were not affected.

<u>Summary and Conclusions</u>

1. Dalapon is rather effective in suppressing quackgrass when applied as a preplanting treatment for field corn on quackgrass foliage 6 to 12 inches tall. A rate of about 10 lb/A of Dalapon is suggested. Applications can be made either in spring or fall. Preliminary data indicate that fall applications before October 1 are very effective. Spring applications should be made at least a week before plowing. Corn can be planted two-three weeks after applications of Dalapon. Injury is more likely to occur on sandy soils. The time between spraying and planting on such soils should be at least three weeks. After fall applications, plowing can be delayed until spring.

2. Amino triazole and trichlorobenzoic acids are also rather promising in quackgrass control but should be investigated further.

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QUACKGRASS CONTROL 1956

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The quackgrass control in 1956 was much poorer than the same treatments in 1954 and 1955.

A total of 294 plots were established. The first plots were sprayed May 9, when the quackgrass was 4-6 inches tall. The spring was cool with frequent light showers. There was 3.85 inches of rainfall from May 9 to June 8, consisting of 12 showers with 1.06 inches being the heaviest rain.

The treatments were 1 and 2 pounds of amino trizole with 2, 4, and 6 pounds of dalapon; 1 and 2 pounds of CMU and 1 pound of 2,3,6, trichloro-benzoic acid; 1, 2, 4, and 8 pounds of amino trizole; 2, 4, 6, 10 and 20 pounds of dalapon; 2, 4, and 8 pounds of 2,3,6,trichloro-benzoic acid, and 20 pounds of TCA. The largest test was applied May 10, using 4 replications, two of which were plowed May 15, and the other May 22. Corn was planted the same day as the plots were plowed. The 10 and 20 pound rate plots of dalapon were replanted by hand on June 12, which was 3 and 4 weeks after plowing. There was some corn injury on the dalapon 10 and 20 pound plots when planted 4 weeks after plowing.

The 4 pounds of amino trizole gave 41.25% and 8 pounds 43.75% control of quackgrass. Ten pounds of dalapon 40.0% and 20 pounds of dalapon 50.0% control. Two pounds of 2,3,6 trichloro-benzoic acid gave 42.25%, 4 pounds 72.5 and 8 pounds 82.5% control.

In the same field where we were studying the persistance of amino trizole, corn was planted very thick by going over the row twice with the corn planter. The check plots on this area had less quackgrass than the rows treated with the heaviest rates of amino trizole or dalapon where the corn was planted with the regular seeding rate.

A TEST OF 2,4,5-TP, 2,4,5-TA AND ATA ON MIXED OAKS AND ASSOCIATED SPECIES

W. R. Byrnes, W. C. Bramble and D. P. Worley[1]

A series of plots to determine the relative effectiveness of 2,4,5-trichlorophenoxy propionic acid (2,4,5-TP), 2,4,5-trichlorophenoxy acetic acid (2,4,5-TA) and 3-amino-1,2,4 triazole (ATA) on mixed upland oaks and associated species were established during the summer of 1954. The specific purpose of this preliminary test was to learn more about the potential of the new chemicals 2,4,5-TP and ATA in relation to their adaptability to a brush control program. Also, to learn more about the specificity of these chemicals, particularly the ATA, which has been reported to be very effective in killing certain species such as bear oak and poison ivy and relatively ineffective on others. At this point it may be well to emphasize that this series of tests was designed for the specific purpose of determining the reaction and effectiveness of these chemicals on brush composed of mixed oak and associated species. No effort was made or intended in these tests to compare the commercial value of these applications with other chemicals in general use. This will be done later.

The experimental area for this series of tests is located on a 1500-foot section of the Pennsylvania Electric Company 180-foot wide right-of-way extending through Gamelands 33 on the Allegheny Plateau in Centre County, Pennsylvania. The forest cover on this particular portion of the right-of-way had been removed during the winter of 1951-52. During the two growing seasons following cutting, the regrowth of tree species had attained a height of approximately 2 to 8 feet and consisted primarily of compact well distributed sprout clumps with few scattered individual seedlings. This treatment area was divided into six plots, each approximately one acre in size.

A permanent sampling unit for vegetation analysis consisting of one strip transect 33 feet wide by 165 feet long (1/8 acre) was randomly located within each one acre plot. A tally of the tree species present on each transect prior to spraying gives an indication of the species composition and abundance on each of the six plots (Table 1). The major species present on the test area were common upland oaks, with chestnut oak predominant, red maple and sassafras.

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Table 1. Abundance of Tree Species on Each Plot as a Per Cent of the Total Number of Stems.

Species	Plots 1	2	3	4	5	6
	%	%	%	%	%	%
Chestnut oak	45.5	41.0	30.0	30.0	31.5	31.0
White oak	2.0					
Red oak	2.5	5.0	0.5	0.5	6.0	1.5
Black oak	2.5	2.0	1.0	2.5	0.5	6.5
Bear oak	6.0	2.0	2.5	0.5	0.5	6.0
Red maple	11.0	9.5	15.0	15.0	29.5	14.5
Sassafras	28.0	39.5	41.0	42.0	14.0	33.0
Aspen	1.5	0.5	1.0		1.0	0.5
Black & Fire Cherry			0.5	0.5	0.5	0.5
American chestnut	0.5	0.5	3.5	1.5	1.0	0.5
Juneberry	0.5		0.5	0.5	0.5	
Witch-hazel			4.5	7.0	15.0	6.0
Total	100	100	100	100	100	100

Treatments

The test design consisted of six treatments and involved the use of three different chemicals and three different spray techniques. The spraying was done using local labor and power spray equipment during the period July 19 through 22, 1954. Each of the six treatments was mechanically assigned to one of the acre plots previously established on the right-of-way. This design, which allowed only one test area for each treatment with no replications, did not permit a statistical analysis of plots, however, because of the relatively large size of each sample plot (1 acre) and length of period of observation (3 years), reliable observations were possible. On a per plant basis the tests were considered adequate for an initial evaluation (Table 5).

The treatments applied are summarized in Table 2 and may be described as follows:

Treatment 1 - a <u>selective stem-foliage</u> spray using an ACP formulation of 2,4,5-trichlorophenoxy propionic acid, containing 4 pounds active ingredients per gallon. This material was applied at a concentration of <u>4 pounds</u> active ingredients per 100 gallons in a water carrier.

Treatment 2 - a <u>selective stem-foliage</u> spray using Weedone 2,4,5-trichlorophenoxy acetic acid containing 4 pounds active ingredients per gallon. This material was also applied at a concentration of <u>4 pounds</u> active ingredients per 100 gallons in water.

Treatment 3 - a selective foliage spray using the ACP laboratory formulation #981, which is 3-amino-1,2,4-triazole containing 100 per cent active ingredients. This material was applied at a concentration of 4 pounds active ingredients per 100 gallons in water.

Treatment 4 - a selective foliage spray using the ACP formulation #981, at a concentration of 6 pounds active ingredients per 100 gallons in water.

Treatment 5 - a selective foliage spray using the ACP formulation #981 at a concentration of 9 pounds active ingredients per 100 gallons in water.

Treatment 6 - a broadcast foliage spray using the ACP formulation #981 at a concentration of 9 pounds active ingredients per 100 gallons in water.

Table 2. Summary of Chemicals, Spray Techniques, Concentrations and Rates of Application.

Treatment	Chemical	Spray Technique	Rates of Application (Active Ingredients)	Concentration AHG
1	2,4,5-TP	Selective Stem-Foliage	6.4 lbs./acre	4 lbs.
2	2,4,5-TA	Selective Stem-Foliage	5.8 lbs./acre	4 lbs.
3	ATA-4# AHG	Selective Foliage	6 lbs./acre	4 lbs.
4	ATA-6# AHG	Selective Foliage	9 lbs./acre	6 lbs.
5	ATA-9# AHG	Selective Foliage	13 1/2 lbs./acre	9 lbs.
6	ATA-9# AHG Broadcast	Broadcast Foliage	29 1/4 lbs./acre	9 lbs.

As indicated under description of treatments, the three spray techniques were (1) selective stem-foliage, (2) selective foliage, and (3) broadcast foliage. Treatments 1 and 2 received the selective stem-foliage spray in which the spray material was applied directly to the scattered sprout clumps using every effort to preserve the ground cover. Sufficient pressure was used to penetrate the clumps, thoroughly wetting the foliage and interior stems.

Treatments 3,4, and 5 received the foliage spray, which was also applied in a highly selective manner to the scattered sprout clumps with particular care to avoid spraying the ground cover. Since ATA is reported to be dependent on leaf absorption for effective action, no effort wasmade to spray the stems.

Treatment 6 received the broadcast foliage spray, in which no effort was made to avoid a coverage of the ground vegetation. ATA appears to have a high degree of specificity, therefore, it was deemed desirable to compare the selective versus broadcast application as to their effects on the species comprising the ground cover.

Brush Density and Volume of Spray Applied

To further characterize the condition of the brush before spraying, densities were determined on the basis of total number of plants per acre and total number of stems per acre (Table 3). This brush which occurred primarily as well distributed sprout clumps was highly adapted to a selective type of spray application. In comparison with the arbitrary classification of brush densities listed below, the vegetation on this test area could be considered as having light to medium density.

Brush Density Classification

Density Class	No. Plants/Acre
Very Light	< 500
Light	500 - 1000
Medium Dense	1000 - 3000
Dense	3000 - 5000
Very Dense	5000 and over

For treatments 1 through 5, in which the spray material was applied selectively so as to cover only the woody brush, it was possible to calculate the average volume applied to a unit plant or stem. Asshown in Table 3, the average volume applied per plant for the 2,4,5-TP was almost twice that for the 2,4,5-TA due to the fact that the higher volume per acre was associated with fewer plants on the former plot. On the areas receiving the ATA treatments, the spread was much narrower, ranging from 15 to 20 ounces of spray material applied per plant.

Table 3. Brush Density on Each Treatment Area and Volume of Spray Solution Applied.

Treatment	Chemical	No. Plants[1] per acre	No. Stems[2] per acre	Vol. of Spray Applied per acre (gal.)	Av. Vol. of Spray Applied per plant (oz.)	Av. Vol. of Spray Applied per stem (oz.)
1	2,4,5-TP	624	15,832	160	33	1.3
2	2,4,5-TA	952	21,320	145	19	0.9
3	ATA-4# AHG	1,072	17,880	150	17	1.1
4	ATA-6# AHG	1,208	18,400	150	15	1.0
5	ATA-9# AHG	960	13,608	150	20	1.4
6	ATA-9# AHG Broadcast	568	14,232	325	—	—

[1] Includes all plants having stumps 2 inches and larger

[2] Includes all seedlings and suckers as well as stump sprouts.

Results Three Growing Seasons After Treatment

Effect on Woody Brush:

In the late summer of 1956, three growing seasons after spraying, a complete evaluation of the experimental area was conducted. To determine the effectiveness of treatment on the woody brush an actual tally was made of the total number of living plants and stems remaining or resurging on each treatment area. This data along with a calculation expressing the per cent reduction for all species combined is presented in Table 4, and for the more prominent individual species in Table 5.

Table 4: Total Number of Living Plants and Stems per Acre Before Spraying (1954) and Three Growing Seasons After Spraying (1956) for All Species Combined.

		Plants per Acre			Stems per Acre		
Treatment	Chemical	1954 (No.)	1956 (No.)	% Reduction	1954 (No.)	1956 (No.)	% Reduction
1	2,4,5-TP	624	16	97	15,832	1,536	90
2	2,4,5-TA	952	32	97	21,320	832	96
3	ATA-4# AHG	1,072	304	72	17,880	11,728	34
4	ATA-6# AHG	1,208	528	56	18,400	12,216	34
5	ATA-9# AHG	960	488	49	13,608	7,880	42
6	ATA-9# AHG Broadcast	568	184	68	14,232	3,888	73

For all species combined, the 2,4,5-TP and 2,4,5-TA both produced highly acceptable top kill as evidenced by the 97 per cent reduction of living plants. Also, on the basis of individual stems for all species combined the reduction was 90 and 96 per cent respectively. Because of the selective nature of the spray, aimed at the more outstanding sprout clumps, it is likely that a number of the inconspicuous single seedlings and suckers were missed.

When considering the more prominant individual species shown in Table 5, the 2,4,5-TP and 2,4,5-TA were highly effective on oak, red maple, and sassafras.

Under the specific conditions of this investigation on mixed oak and associated species it may be stated that the 2,4,5-TP was just as effective as the 2,4,5-TA and that there appears to be little difference in reaction between them. According to the report of Coulter and Gibson (2), 2,4,5-TP was less effective than 2,4-D and 2,4,5-TA on white ash, green ash and aspen, but is more effective on oak and maple. They also indicate that 2,4,5-TP appears to be more effective when applied as a foliage-stem spray on oak. Elwell,et al (3) in aerial applications on oak in Oklahoma report that when applied in equal amounts, the 2,4,5-TP usually gave better control of oaks than the 2,4,5-TA alone or the 2,4-D-2,4,5-TA mixture.

Table 5. Plant and Stem Tally by Individual Species Before Spraying (1954) and Three Seasons After Spraying (1956).

Treat-ment	Chemical	Species	Living Plants Per Acre			Living Stems Per Acre		
			1954	1956	%Reduction	1954	1956	%Reduction
1	2,4,5-TP (4 lbs AHG)	*Oak	376	8	98	9304	616	93
		Red Maple	80	0	100	1712	40	98
		Sassafras	152	0	100	4432	480	89
2	2,4,5-TA (4 lbs AHG)	*Oak	464	24	95	10704	304	97
		Red Maple	112	8	93	2048	120	94
		Sassafras	360	0	100	8480	312	96
3	ATA (4 lbs AHG)	*Oak	328	144	56	6000	2408	60
		Red Maple	152	104	32	2656	1720	35
		Sassafras	400	32	92	7440	7104	5
4	ATA (6 lbs AHG)	*Oak	344	120	65	6126	2832	54
		Red Maple	344	296	14	2792	2400	14
		Sassafras	408	16	96	7760	5904	24
5	ATA (9 lbs AHG)	*Oak	288	24	92	5224	752	86
		Red Maple	328	328	0	4016	3160	21
		Sassafras	160	24	85	1888	2120	-12
6	ATA (9 lbs AHG) Broadcast	*Oak	224	56	75	6464	848	87
		Red Maple	160	112	30	2096	1288	39
		Sassafras	136	16	88	4696	1552	67

* Chestnut, White, Black, Red and Bear Oaks.

Inspection of Table 4 reveals that, in comparison with 2,4,5-TP and 2,4,5-TA, the amino triazole treatments were generally much less effective and that the results produced by the three different concentrations were very erratic. Careful examination of Table 5 gives us an indication of the reasons for this apparent inconsistency. A definite pattern was evident in treatments 3, 4 and 5 which represents the different concentrations for the selective foliage spray when applied to oak plants. The 4 pound ATA concentration produced a reduction of 50 per cent of the oak plants while the 6 and 9 pound ATA applications reduced them 65 and 89 per cent respectively.

On the other hand, the ATA selective foliage applications appear to be consistently ineffective on red maple at any of the rates applied and showed highly erratic results, ranging from 0 to 32 per cent reduction of woody plants. In all cases, the partially killed red maple clumps sprouted profusely and after three growing seasons exhibit vigorous growth.

The activity of ATA on sassafras was also somewhat erratic, but in general produced acceptable reductions in plants, ranging from 85 to 96 per cent. While the sassafras did not sprout, it did produce an abundance of suckers and accounted for most of the stems on these plots.

The broadcast foliage application of ATA at the 9 pound concentration showed the same general pattern as the selective application at the same concentration. A greater reduction in plants and stems per acre was obtained for the oaks and sassafras with red maple being more resistant. A greater reduction of individual seedlings and suckers was obtained by the broadcast application, as might be expected, than by the selective spray.

To summarize, the ATA at all rates and techniques of application was much less effective than 2,4,5-TA and 2,4,5-TP. The selective foliage treatment of ATA at 9 pounds per 100 gallons was more effective than the lower rates on oaks, slightly less effective on sassafras and inconclusive with red maple. The broadcast foliage treatment of ATA at 9 pounds gave poorer results than the selective treatment at the same rate, but was more effective in reducing single seedlings and suckers.

Effect on Ground Cover:

Prior to treatment in 1954 tallies were made, by the system of Braun-Blanquet (1), of the abundance and grouping of species comprising the vegetative ground layer along with an estimate of their combined cover values. Throughout the entire experimental area this ground layer consisted predominantly of the woody shrubs such as blueberry, huckleberry, and mountain laurel, and to a lesser extent of bracken and sedge. The total cover value for the six treatment areas before spraying ranged from 75 to 95 per cent as shown in Table 6.

Evaluation of the effect of spraying three seasons after application has shown that none of the six treatments applied had materially affected the composition or abundance of species in the ground layer. The total cover value showed a slight decrease for treatments 2 and 4, remained the same for treatment 1 and increased for treatments 3,5 and 6.

Table 6. Total Cover Value of the Ground Layer Before Spraying (1954) and Three Seasons After Spraying (1956).

Treatment	Chemical	Per Cent of Ground Area Covered	
		1954	1956
1	2,4,5-TP	95	95
2	2,4,5-TA	95	80
3	ATA-4# AHG	90	95
4	ATA-6# AHG	80	75
5	ATA-9# AHG	75	85
6	ATA-9# AHG Broadcast	80	85

For the selective-stem foliage sprays of treatments 1 and 2 and the selective foliage sprays of treatments 3,4 and 5 the ground vegetation in the immediate vicinity of the sprayed sprout clumps was killed. This is probably due to the high volumes of material concentrated in the sprout clumps. In most instances this void was immediately filled with fireweed which was present but inconspicuous on the area before spraying. Sweetfern, another typical invader, also showed an increase in abundance, occurring primarily on areas where the original cover had been killed.

The broadcast foliage, amino triazole treatment showed a high degree of selectivity in reference to species affected. During the first season after spraying theblueberries exhibited a chlorotic condition but at the end of three seasons they had regained their normal appearance and actually had increased in numbers to form a dense compact ground cover. Huckleberries on the other hand showed a marked decrease in numbers, indicating that they may be susceptible to the ATA.

In general it may be stated that, although there were a few minor changes in the ground layer, the dominant species composition and distribution were not changed by any of the treatments of this test.

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Chemi-Thinning of Hardwoods During the Dormant Season

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Thinnings in young and middle-aged forest stands are desirable to increase the growth rate of the better trees. Where markets for small or poor quality wood are unavailable, thinning by chemical means may be the best means of implementing this cultural work.

Basal Sprays--Beech

In 1953, preliminary results of dormant basal sprays on Cornell's Arnot Forest were reported (4) for nearly 200 beech (Fagus grandifolia) trees, mostly 4-12" D.B.H. The principal results were as follows:

1. Amount of top kill was usually doubled between the end of the first growing season and the middle of the second growing season after dormant spraying.
2. Good results were obtained on trees up to 6" D.B.H. with a solution of 20# ahg (acid equivalent per one hundred gallons of diluent) 2,4,5-T in kerosene. Solutions containing 2,4-D gave more variable and usually less effective results.
3. Larger trees required higher concentrations and results were sometimes erratic.
4. There were no apparent differences due to height sprayed on trunk, season (dormant) of application, nor volume of spray within the limits tested.
5. Some sprouting occurred, similar in intensity to untreated areas.
6. The cost of chemicals for killing a 5-inch tree (150 ml. of 20# ahg 2,4,5-T in kerosene) is about three cents.

During parts of the dormant seasons between December 1952 and March 1955, some replications were made on approximately 100 additional trees on the Arnot Forest. These were mostly made at higher elevations on Lordstown soil. Some sites are poorer because of previous land use and exposure to wind at high elevations. Some trees are in a younger age class.

The weather for 1949-1956 has been marked by at least one severe drought usually during part of the growing season, in three of every four years. It has been suspected that beech is relatively susceptible to drought damage (6). It is not known whether droughts of the last decade have influenced the study. In 1953, however, some beech trees were defoliated in south central New York, apparently by unseasonably hot weather in late August in the middle of an August-September drought. Even though the areas of treated beech were not visibly affected by this extreme weather, some physiological influences must be expected. How such influences might affect the treatments is unknown.

All treated trees, including those of 1951-52, were examined in September

1956. The first-treated trees had passed through six growing seasons. The results, without regard to possible weather influences, are as follows:

1. In general, results checked with those of 1953.
2. The basal spray appeared to kill by causing a chemical girdle. Where top kill was incomplete, there was at least a small area of live tissue connecting the roots with the tree top. In many trees, three to five years elapsed before complete top kill. With such slow kill, there was little or no bark loosening from the chemical, as compared with the quick kill and bark separation following sodium arsenite treatment.
3. Near the end of the second growing season after treatment, the future of the tree can often be predicted. If it is three-fourths or more dead in the crown, it probably will continue to die. There are exceptions, however, and some trees retained most of their foliage for 2-3 years before succumbing. On the other hand, a few trees were heavily defoliated at first, then made seemingly miraculous recoveries. Such recoveries were made possible by formation of new callous tissue under the old bark, and appeared most prevalent in younger, fast-growing trees.
4. Good results (75% of trees top-killed, some crown reduction in remaining trees) were obtained on forest-grown trees up to 3-4" D.B.H. with a solution of 12# ahg 2,4,5-T in kerosene, while 20# was required for 4-6" trees, and even heavier concentrations for larger trees. Again there are exceptions, and one 14" tree was killed with only 4# ahg 2,4,5-T (same volume). After six years, the influence of tree size appeared to be somewhat less important than after two years, thus indicating that in some cases the bigger, more vigorous trees merely took longer to succumb. Where younger trees under semi-open conditions were treated, poorer results were obtained.
5. Sprays to a height of 8-10" were just as effective as two foot high sprays when the same volume was applied. While some trees were killed with smaller volumes, results were more sure when 35 ml. per inch D.B.H. was applied.
6. Some root sprouts followed treatment and growth of sprouts may be more vigorous because of greater light intensities on the forest floor following thinning. However, the stump and root collar sprouts, which ordinarily follow cutting, were eliminated.

Basal Sprays--Other Hardwoods

Dormant basal spray treatment of over a hundred trees showed that sugar maple (Acer saccharum) is similar to beech in its reaction to 2,4,5-T. At 12# ahg, spotty results were obtained for trees larger than 3-4" D.B.H. At 20# ahg, however, top kill of maples up to 7" D.B.H. was often faster and surer than in beech when similar volumes (35 ml. per inch D.B.H.) were used. As with beech, lack of top kill was associated with incomplete girdling.

Detailed results of dormant basal sprays of nearly 200 aspen (Populus grandidentata and Populus tremuloides) were reported (4) in 1953. Nearly 200 additional trees have been treated since, with similar results. The most important finding is that forest-grown aspen up to 8" D.B.H. were top-killed with only 4# ahg 2,4,5-T in kerosene when applied at the rate of 35-40 ml. per inch of D.B.H. Other workers (referred to in 1953 report) have shown that higher concentrations are needed where younger aspen in the open is treated; also summer treatments are best where sprouting is a problem.

Trees found to be resistant to basal sprays (20# ahg 2,4,5-T in kerosene) were white ash (Fraxinus americana), basswood (Tilia americana), and black birch (Betula lenta). The resistance seemed to be associated with poor penetration of the bark by the chemical. Penetration appeared to be determined as much by qualitative differences in bark as by bark thickness. When cut into, it was found that the outer bark of white ash was discolored, indicating chemical penetration of at least one-quarter inch but insufficient to cause a good girdle. On the other hand, the very thin bark of black birch appeared alive and healthy practically to the outer surface, perhaps indicating that certain oils or resins prevent chemical penetration.

Frilling-Beech

While basal sprays will kill most beech trees if sufficient chemical is applied to assure a complete girdle, they are expensive, especially for trees larger than 4" D.B.H. Frills are expensive for trees less than 4" D.B.H. because such small trees are relatively difficult to frill when compared to larger trees, but frills are cheaper than basal sprays for the larger trees.

In March 1951, frilling and poisoning treatments were made adjacent to the basal spray areas, using the Cornell tool to make shallow frills and inject the chemical. These treated areas were inspected in June 1953 and the results reported (4) along with those of the basal sprays. At that time most frilled trees still retained a large amount of foliage and the treatments seemed to hold little promise. However, after six growing seasons (September 1956) the following observations were made (treatments listed also) with regard to the above ground parts of the tree:

a. 40# ahg 2,4,5-T in kerosene applied at rate of about 1½ ml. per inch D.B.H. Eight trees (4-14" D.B.H.) dead, two alive. The two live trees had complete girdles (dead wood) in the frill area with the exception of one callous on each tree. The callous formed over a vertical inseam which caused an incomplete frill.
b. Same concentration and volume, but mixture of 2,4,5-T and 2,4-D. One tree dead, four alive. The live trees had one or more callouses over the girdles usually located where the frill was incomplete because of poor use of the frilling tool, inseams, or location of the tree so close to another tree that the frilling tool could not be used effectively.
c. 80# ahg 2,4-D in kerosene applied at same rate of volume. Nine trees alive, but two are completely girdled and expected to die. Again callouses were formed where the frill was incomplete. When the frill was incomplete on large dominant trees, there was sufficient growth energy to form new wood for as much as six inches over dead wood, thus bridging areas where the girdling was complete. Such trees appeared very healthy in the crowns.

d. Frill only, no chemical. Five trees alive, none dead. All frills, even when complete, were calloused over.

These results indicate that lateral translocation of chemicals was negligible. For successful chemical girdling of beech, it appears that (1) shallow frills, completely encircling the tree, are necessary and (2) some chemical is needed which will deaden the area around the frill to prevent callousing. The 2,4,5-T in kerosene killed more wood, both up and down from the frill, than the other chemicals and insured a good top kill where the frilling was complete.

Further frilling tests were made in October 1953. Frills were made with an axe and chemical was applied with a hydraulic oil can. When a light (2 or 2½#) axe is used, there are several advantages over the Cornell tool. The frill can be made higher up the trunk in order to avoid seams, fire scars, or other deformities commonly found at the base of beech trees. A careful, complete frill can be made with a light axe--something nearly impossible to accomplish with the jabbing of the heavy Cornell tool. Furthermore, the time required by the two methods is about the same. After three growing seasons (September 1956), the following results were observed (three trees for each treatment listed, except as noted):

a. 20# ahg 2,4,5-T in kerosene at rate of 2-3 ml. per inch D.B.H. Two small trees dead. One nine inch tree completely girdled and expected to die.
b. 40# ahg 2,4,5-T in kerosene at rate of 2-3 ml. per inch D.B.H. (8 trees). Three trees dead. Five trees (5-13" D.B.H.) completely girdled and expected to die.
c. 80# ahg 2,4-D in kerosene at rate of 3-4 ml. per inch D.B.H. (6 trees). All trees half defoliated, all completely girdled and expected to die.
d. Gasoline only at rate of about 3 ml. per inch D.B.H. Three trees half defoliated, all completely girdled and expected to die.
e. Kerosene only at rate of about 3 ml. per inch D.B.H. Three trees half defoliated, all completely girdled and expected to die.

In all these treatments, the frills were shallow but complete, and tops of all trees were dead or dying after three years. In general, the big dominant trees held on longer, reflecting their great vigor. This limited test suggests that some kind of oil alone is sufficient to prevent callousing where the frill is complete. The results bear some similarity to those of Roberts (5), who found that good frills with no chemical gave better top kill of several of the southern hardwoods than poor frills with 2,4,5-T in water added. Carnes and Walker (1) also emphasized the importance of a complete frill for southern hardwoods. In the Arnot study, however, the hormones did appear to cause a wider girdle of dead wood, thus making the kill more sure and perhaps hastening it. In this respect, trees treated with gasoline had an average of one-half inch of dead wood above the frill and one inch below it. The respective figures for kerosene were 1" and 3"; for 2,4-D, 2" and 12"; and for 2,4,5-T, at least two feet in each direction. Since most of the cost of killing trees by this method is labor, the addition of 2,4,5-T may be justified for the purpose of obtaining a more sure kill.

In January and March 1954, thirteen beech trees (4-8" D.B.H.) were frilled and treated with 20 to 40# ahg 2,4,5-T in kerosene at rate of 2-3 ml. per inch D.B.H. Results were similar to the previous October 2,4,5-T treatments; i.e., seven trees top-killed and six completely girdled and expected to die. A few more trees have been treated from time to time, using higher volumes, and all have been top-killed.

In comparing frill treatments with basal sprays (without regard to weather influences):

1. Frilled (complete frills necessary) trees usually took longer for top kill, but results were more sure when the frilling was good. There was some evidence that 2,4,5-T in the frill hastened top kill.
2. Both methods top-killed trees by means of a chemical girdle. Therefore, death was slow, there was little bark loosening before decay, and stump and root collar sprouts were largely eliminated. There was no evidence of control of root sprouts, although their vigor may be less than if the trees were cut.
3. Whereas higher chemical concentrations were needed for larger trees with the basal spray, this was not true when good frills were made. With both treatments, the large dominant trees were generally last to succumb.
4. Preliminary cost estimates indicate that the basal spray is cheaper on stems up to 4" D.B.H., while frills are cheaper for larger trees. In the examples below, the labor figures are intended to indicate trends only, not absolute values. Tree marking time, delay time, and time for chemical preparation and transport are not considered. Labor is figured at $1.50 per hour (results would not differ greatly if labor was $1.00 an hour).

Ex. Two hundred 3" trees per acre to be thinned.

a.	Basal spray labor - 80 minutes	- $2.00
	12# ahg 2,4,5-T in kerosene, 5 gal.	- 2.70
	Total	$4.70
b.	Frill labor -- 240 minutes	- $6.00
	20# ahg 2,4,5-T in kerosene, ½ gal.	- .40
	Total	$6.40

Ex. One hundred 6" trees per acre to be thinned.

a.	Basal spray labor -- 70 minutes	- $1.75
	20# ahg 2,4,5-T in kerosene, 5 gal.	- 4.00
	Total	$5.75
b.	Frill labor -- 145 minutes	- $3.63
	20# ahg 2,4,5-T in kerosene, ½ gal.	- .40
	Total	$4.03

Frilling-Other Hardwoods

Several hardwood species were treated in October 1954 with 40# ahg 2,4,5-T in kerosene in shallow axe frills at a rate of 3-4 ml. per inch D.B.H. All frills completely encompassed the tree. Observations (September 1956) with regard to top kill were as follows:

a. Thirty sugar maples (4-13" D.B.H.) appeared to be dying slowly, much more slowly than the basal sprayed trees of the same date.

Most trees will not be defoliated until the third or fourth growing season. Results and costs are expected to be similar to beech.

b. Twelve of 16 black birch (5-11" D.B.H.) were dead at the end of the second growing season. The four remaining trees are expected to die within a year. Thus frilling gave excellent results, compared to basal treatment, for black birch.

c. Seven of 17 basswood (4-11" D.B.H.) were dead at the end of the second growing season, and the remaining trees are expected to die. Only three white ash were treated, and they are also expected to die.

Other tests have indicated that aspen can be top-killed slowly with frills and 2,4,5-T concentrations as low as 4# ahg. With aspen, however, basal sprays are probably cheaper than frills up to 8-10" D.B.H., since the former treatment requires a much lower chemical cost than is required for other species.

Partial Frills

In an attempt to lower the cost of chemi-thinning, approximately 40 beech trees were only partially frilled and treated with an amine salt formulation, 2-4 Dow Weed Killer, Formula 40 in undiluted form. Gleason and Loomis (2) and Westing (7) have tried this method in the Midwest. The former had success with elm, willow, hickory, and oak, especially at the time of full leaf development and activity. Dormant treatments gave poor results. They found that amines were better than esters and that the amine of 2,4-D was better than that of 2,4,5-T. Westing found similar results, but with September and April treatments of red and white oak. On the other hand, Leonard (3) reported on good year-round results, especially winter and spring, in oak woodlands in California.

In this experiment, made in January 1954, the results were less successful. Two axe cuts per three inches D.B.H. were made. Volume of chemical was 2-3 ml. per cut or 1-2 ml. per inch D.B.H. (comparable to amounts used with success by the above-named workers). The time required to treat a tree was about half that for frilling and about equal to that for basal spraying. The wood was sometimes killed for several feet vertically up and down from the axe cut, but the wood in between cuts remained in a vigorous growing condition in most trees. This resulted in nearly parallel vertical ridges of growing wood alternating with depressions of dead wood. In most trees, these gradually merged into all live wood. Only about ten per cent of the trees, usually the smaller ones, were completely top-killed. Again the vigorous growth ability and toughness of beech was demonstrated.

Similar treatments were tried on sugar maple, basswood, white ash, and aspen in October 1954. A few small sugar maples and basswood died, but many trees appeared still fairly healthy. If they are killed, it will be slowly, and final evaluation must come later. In the case of aspen, however, 7-9" D.B.H. trees were top-killed at about the same cost for labor and chemical as in the basal spray method.

Summary

The results emphasize that the various tree species react in marked variance, not only to different kinds and amounts of chemical, but also to the manner of application. Knowledge of tree physiology and ecology becomes important in evaluating and interpreting results.

The general results indicate that it is most efficient, within limits of the investigation, (a) to use basal sprays for beech and sugar maple up to 4" D.B.H. and to use frills for larger trees, (b) to use frills only for black birch, basswood, and white ash, and (c) to use either basal sprays or an amine of 2,4-D in partial frills for aspen, a very easy tree in which to obtain top kill.

Under certain circumstances these methods of deadening trees may be preferable to other means. As such they may be useful tools for better forest and farm woodlot management.

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The Connecticut Arboretum Right-of-way Demonstration Area Progress Report

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INTRODUCTION

In recent years many public utilities have turned to chemicals as a means of controlling the vegetation along their rights-of-way. However, much spraying has been done indiscriminately, thus arousing considerable public concern. Indiscriminate spraying with little or no regard for aesthetic values or ecological principles prompted the establishment of a right-of-way demonstration area in 1953 on a 1500-foot sector of the Connecticut Power Company easement that crosses the Arboretum. The right-of-way is 125' in width with a 50' strip directly under the wires and the remainder (75') equally divided as strips along either side beyond the outer wires. Here the vegetation is being manipulated by various methods in order to produce those cover types with maximum wildlife benefits, greatest stability with lowest cost over the years which still answer the requirements of the utility companies. It is anticipated that this demonstration area will eventually show results of considerable value to those concerned with right-of-way management.

The primary objective is to eliminate only that vegetation which is undesirable; that which will grow into the lines or impede access. As much of the existing vegetation as possible will be preserved in order to form a tight ground cover aimed at keeping out newly invading trees. This would tend to lower management costs in that only part of the vegetation is treated - namely, that which is undesirable. More specific objectives are given under the various communities.

On any right-of-way, vegetationists recognize various plant communities all of which must be analyzed for species composition before attempting to manage with herbicides. This is the approach utilized on this demonstration area. Two major community types are recognized: the shrubland and sprout hardwoods communities. In these, different management techniques are used, (1) directly under the wires and (2) in the strips beyond. In addition, the forest margin is another area needing special consideration. In these communities over thirty sample plots have been established to date and subjected to various techniques at different seasons of the year. In general, the plots are 50' x 50'. However, their size depends upon the variability of the vegetation. In the community descriptions 2,4-D and 2,4,5-T* are referred to as D & T. Oil carrier refers to fuel oil. All chemicals refer to 4 lbs. total acid equivalent per gallon.

SHRUBLAND COMMUNITY

<u>Description of vegetation</u> -- at least 1/3 of the line is covered with a dense shrubby vegetation 3-6' high dominated by greenbrier and sumac with small trees of similar height intermixed. Herbaceous cover is sparse. Occasional openings are dominated by grasses. This area was probably a pasture at one time and since abandonment has become dominated by this thicket complex.

Primary shrubs

Greenbrier	Smilax rotundifolia
Sumac	Rhus copallina

*The chemicals are being furnished by American Chemical Paint Company, Dow Chemical Company and E.I. Dupont de Nemours and Company.

Secondary shrubs

Sweet fern	Comptonia peregrina
Bayberry	Myrica pensylvanica
High bush blueberry	Vaccinium corymbosum
Sawbrier	Smilax glauca
Japanese honeysuckle	Lonicera japonica

Scattered trees

Black cherry	Prunus serotina
Red maple	Acer rubrum
Black gum	Nyssa sylvatica
Gray birch	Betula populifolia

Dominant herbs--Broomsedge (Andropogon scoparius) occurs primarily in openings.

Management objectives -- directly under the lines - dense areas of greenbrier and other dense shrub masses 3' or higher will be reduced or removed in order to permit ready access to any area under the wires. Low shrubs and herbaceous cover, where possible, will be preserved. In this region of Connecticut a special problem species, the shrubby greenbrier (Smilax rotundifolia), occurs as a dominant. Therefore, many of the usual low valuable shrubs found directly under the lines on most rights-of-way are wanting. This naturally necessitates a different management approach. An open road will be maintained for easy access. Only low vegetation will be permitted around the bases of the poles. Beyond the outermost wires a dense shrub cover will be maintained and within these strips only potential danger trees removed. With this vegetational pattern it is anticipated that the unsprayed vegetation, consisting of low shrub masses directly under the lines and continuous shrub strips beyond the outer lines, will tend to keep out invading tree seedlings, provide good wildlife food and cover and involve application of less spray since only the ecologically undesirable species are removed. The data to follow involve results of various techniques within this vegetation type. Specific treatments listed here and later are based on data after at least two growing seasons. Since different vegetation types are desired the test plots are presented in two categories: (1) directly under the wires and (2) in the strips beyond the outer wires.

Techniques directly under the wires:

1. Stem-foliage - plot F, commercial type application-power wagon, 1:100 D & T aqueous, applied late summer, 9/29/54. Stems and foliage covered except in very dense continuous sumac areas where foliage primarily covered.
   Greenbrier--over 90% stem-kill, approximately 40% resurge.
   Sumac-stems 4-6'--good stem-kill, 100% resurge now forming dense cover over area with stems 3-5' high. Merely stimulated by foliage treatment.
   Other shrubs--Bayberry, high bush blueberry-root-killed.
   Tree species--scattered trees, black cherry, black gum, red maple, gray birch, appear root-killed except for cherry which is resuckering to some extent.
   Present composition--Greenbrier and sumac still abundant; other shrubs rare. Herbaceous cover increasing especially in openings. Retreatment required.

2. Winter stem spray-plot K, knapsack, 1:20 D & T oil, applied 2/25/55. Stems covered completely.
   Greenbrier--originally 100% cover, after two growing seasons 100% stem-kill; 5% resurge 1-2' high. Immediate follow up should result in nearly complete root-kill.

3. Early spring basal spray--plot E, knapsack, 1:40 D & T oil, applied 4/10/54, vegetation still dormant. Bases of stems sprayed up 12-18".
   Greenbrier--few stems killed-relatively ineffective. The intermixed sawbrier appears more resistant than greenbrier. Probably due to glaucous nature of the stems and leaves of the former.
   Other species--relatively ineffective.
   Ineffectiveness may be correlated with inadequate chemical and season of application, early spring just prior to outburst of new growth.

4. Electronic treatment--plot N, electronic tool encircled stems and then subjected them to 8,000 volts for 1 second. Applied 4/4/55. Negative results on black cherry, sumac, black gum, rose and common barberry. These results may be correlated in part with mechanical difficulties encountered when applied during stormy conditions.

5. Other treatments--less than two growing seasons--In controlling greenbrier in this community one of the more promising techniques is a carrier of oil and water (1:3) and high concentration of the herbicide (1:20 D & T).

Techniques in strips beyond outer wires to forest edge:
Here the dense shrub matrix is being preserved and only potential danger trees removed. Selective treatment (1:20 D & T oil) is being used to remove red maple, black gum, black cherry 3-8' high. On aspen, a root suckering species, summer basal is being used in order to prevent suckering.

SPROUT HARDWOODS COMMUNITY
(Upland and lowland phases)

Description of vegetation--On approximately 2/3 of the right-of-way a dense sprout growth of oak, black birch and red maple 4-10' in height predominates. Shrubs occur either scattered among the sprouts or in relatively continuous masses. Greenbrier is ubiquitous and presents a special problem in management. Herb cover is sparse. A section of this line was clear-cut by a regular clearing crew in the spring of 1954. A stream and several smaller brooks cross the line, resulting in upland and lowland variations in the vegetation.

Tree Species

*Black oak	Quercus velutina
*White oak	Quercus alba
*Black birch	Betula lenta
*#Red maple	Acer rubrum
Hickory	Carya spp.
Big-toothed aspen	Populus grandidentata
Gray birch	Betula populifolia
Black cherry	Prunus serotina
Flowering dogwood	Cornus florida
Sassafras	Sassafras albidum
White ash	Fraxinus americana
Tulip	Liriodendron tulipifera

Shrubs

*Greenbrier	Smilax rotundifolia
High bush blueberry	Vaccinium corymbosum
Sumac	Rhus copallina
Sweet fern	Comptonia peregrina
Huckleberry	Gaylussacia baccata
#Witchhazel	Hamamelis virginiana
#Alder	Alnus rugosa
*#Sweet pepperbush	Clethra alnifolia

Herbs

Broomsedge	Andropogon scoparius
Bracket fern	Pteridium aquilinum
Hay-scented fern	Dennstaedtia punctilobula
Sedges	Carex spp.

*dominants #lowland phase

Management objectives--here management will be similar to plan under shrubland community. Directly under the lines dense, tall, woody vegetation will be removed by various techniques. Where valuable low shrubs are present selective techniques will be used. Scattered taller shrubs, low shrub masses (less than 2') and herbaceous cover will be left if they do not impede access. Road will also be maintained. Beyond the wires all shrubs listed above and low trees such as flowering dogwood will be preserved to form densest possible vegetation. Same values as previously listed will be derived.

Techniques directly under the wires:

1. Dormant basal--plots A,B,C,M, knapsack, 1:20 D & T oil. In first two plots bases of stems soaked up to 12"; in plot M, root-collar at ground level only. Applied 12/53, 12/53, 1/2/54, 2/25/55 respectively.
   Black birch--dominant, 6-10' and over. In plots B and C growth was restricted the first season after treatment, basal bark peeled on larger stems but few large specimens killed. Smaller sprouts 3-5' in height over 90% root-kill. Apparently chemical did not penetrate sufficiently due to large size of sprouts. This is evident by effectiveness of root collar treatment (plot M) in which 100% root-kill was ascertained. This may be a more effective basal treatment for other species especially in the larger size classes.
   Other species--oak, hickory, gray birch, black cherry--all responded as above.

2. Dormant basal--plot D, knapsack, 1:20 D & T oil. Soaked bases of stem 12" above ground line-lowland phase of community. Applied 2/16/54.
   Red maple--dominant 6-20' high (1-2" in diameter) 100% root-kill--very susceptible.

3. Dormant basal--plot L, knapsack, tree stump sprouts, 1:20 D & T oil. Applied 2/25/55. One of a series of lots on cleared section of line to evaluate best time to eliminate resurge following clearing.
   Tree species--after one season's resurge--black birch sprouts dominant 2-3'; in addition black oak, gray birch, aspen, hickory. Excellent root-kill--over 90%.

Present cover--herbs cover 95% of plot with hay-scented fern and sedges most conspicuous. Scattered shrubs present.

4. Stem-foliage vs. basal--plot G, stem-foliage, commercial type application-power wagon, 1:100 D & T aqueous. Applied late summer 9/29/54. Stems and foliage covered except where density of shrubs prevented penetration to tree stems. Dormant basal-plots H and I, 1:30 D & T oil, soaked stem bases up 12" from ground line. Applied 12/20/54 and 1/8/55. Only tree species treated. Vegetation primarily mixture of dense oak sprouts and greenbrier.

Tree species--% root-kill excluding species missed

	Stem-foliage	Basal
Black oak	95% (23)	99% (123)
White oak	13% (29)	35% (102)
Black birch	83% (12)	98% (145)
Aspen	78% (21)	none present
% root-kill of all treated stems	53%	78%

total number of stems in parenthesis.

There was slightly higher percentage of misses in basal treatment than in stem-foliage. This was partly due to the tremendous density of stems (456 in 50' x 50' area) in basal plot in contrast to stem-foliage (119 in 50' x 50').

Shrubs--few desirable shrubs present. Greenbrier abundant, good stem-kill with stem-foliage but resurge will necessitate retreatment. Scattered high bush blueberry and mountain laurel root-killed. Scattered shrubs preserved in basal plot.

Herbaceous cover--considerable increase in both plots. Grass, sedges, goldenrods, pokeberry and ferns, primarily bracken, most common.

Techniques in strips beyond the outer wires:

Selective elimination--of potentially large tree species in order to maintain dense shrub layer including understory trees already present. Continuous strips dominated by sweet pepper bush and other species being maintained beyond the wires in this manner.

Techniques within forest edge:

Danger trees--selective elimination of large forest trees just before they attain a height higher than the wires in order to prevent them from falling into the lines.

1. Notching--two notches at base of tree 3-4" in diameter, 1/27/55. Teaspoon of Ammate in each notch.

   Black birch--dominant--all living and vigorous except one.
   Oak and hickory--still vigorous.

2. Swain-tabs--involves slipping arsenite saturated tab under bark. No data as yet.

SUMMARY AND TRENDS

(1) A right-of-way demonstration area was established in 1953 on a 1500' sector

of the Connecticut Power Company easement that crosses the Connecticut Arboretum.

(2) Here the vegetation is being manipulated by various techniques in order to produce those vegetation cover types with maximum wildlife benefits, greatest stability with lowest cost over the years which still satisfy the requirements of the utility.

(3) On the right-of-way two types of plant communities are recognized--a shrubland and sprout hardwood community. Different management techniques are used (1) directly under the wires, (2) in the strips beyond the outer wires and (3) in the forest edge paralelling the lines.

(4) The main objective is to remove only that vegetation which will grow into the lines or impede access. In general, low shrub masses and herbaceous cover will be preserved directly under the wires. Beyond the outer wires only the potential danger trees will be eliminated. In the forest edge potential danger trees will be treated before they reach a height higher than the wires.

(5) In the shrubland community greenbrier, the dominant species, has been stem-killed with numerous techniques. Good stem coverage with high concentration of chemical appears necessary for root-kill.

(6) In the sprout hardwoods community tree data on stem-foliage vs. basal techniques show 53% root-kill for stem-foliage and 78% root-kill with basal treatments. White oak appears particularly resistant to both techniques. Unless carefully supervised the stem-foliage technique results in the destruction of many desirable species.

(7) A modification of the traditional basal technique appears promising. This involves application of the herbicide directly to root-collar region at ground level. The stem above ground need not be wetted.

(8) Selective removal of potentially large trees from the strips of vegetation beyond the outer wires serves as an inexpensive technique since most of the shrubby cover is unsprayed--this cover also serves as good wildlife habitat. From present evidence shrub masses here as well as directly under the wires where permissible tend to prevent tree invasion and thereby provide a natural maintenance control. This stability will be followed over the years.

(9) From plots involving less than two-growing seasons the following trends are evident: oil-water emulsions with 2,4,5-T most promising on greenbrier; dormant stem spray with T in dense sprout-greenbrier cover, 95% stem-kill and possibly equal root-kill; summer stem spray most effective on root-suckering species.

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The Effect of Carrier, Formulation of Phytocide, and Time of Treatment on the Percentage Kill of Certain Woody Plants /1

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INTRODUCTION

The use of chemicals to reduce the growth of woody plants has been found to be cheaper and more efficient than hand cutting (Waldron, 1954; Coffey, 1955; Fisher and Meadors, 1955). Chemicals are being used to remove mesquite trees from thousands of acres of potentially good grazing land in the southwestern United States (Fisher and Meadors, 1955; Hull, 1956) and to remove certain trees and shrubs from competition with timber crops (Peevy, 1954). Utility companies are using chemicals to suppress the growth of woody plants on rights-of-way (Waldron, 1954; Coffey, 1955; White, 1955).

2,4-Dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) are the phytocides most commonly used for the control of woody plants (Melander, 1948; Behrens et al., 1955). Different formulations of 2,4-D and 2,4,5-T produce different effects on woody plants and some new formulations appear to give better results than old ones (Meyers et al., 1955). Season of treatment and stage of growth of the plant are also important factors affecting the reactions of woody plants to phytocides (Suggitt, 1952; Fisher et al., 1956). Recent reports indicate that phytocides are more effective when applied in a carrier consisting of nine parts water and one part diesel oil than when applied in water alone (Beatty, 1955; Bramble and Byrnes, 1955).

In the present investigation an experiment was designed to compare sprays applied during four different months of the growing season, to compare two different formulations of a phytocide, and to compare a water carrier with an oil-water carrier.

METHODS AND MATERIALS

The experimental area was located on a 100 foot transmission line right-of-way of the Appalachian Electric Power Company in Montgomery County, Virginia. The site of the experiment was an east facing slope and flat area with an average elevation of approximately 2400 feet above sea level. The area was cut, burned, and stump sprayed in 1952 but abundant sprouting occurred. Oak-hickory is the climax forest type of the area and various

/1 These studies were supported largely by a research grant from the Bartlett Tree Research Laboratories, Stamford, Connecticut. Chemicals were furnished by the American Chemical Paint Company, Ambler, Pennsylvania.

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stages of succession existed at the time of the experiment. The woody species recorded on the area are listed in Table 1.

In the investigation, an experimental phytocide formulation, ACP-L-578, was compared with a commercial phytocide formulation, Weedone Industrial Brushkiller. These two formulations differed in the kinds and amounts of emulsifying agents and solvents they contained but not in the amount or form of the active ingredients, 2,4-D and 2,4,5-T. Both formulations contained the acid equivalent of 2 pounds of 2,4-D and 2 pounds of 2,4,5-T per gallon in the form of butoxy ethanol esters. An oil-water carrier was compared with a water carrier by applying ACP-L-578 in each of these carriers. The three sprays used were as follows:

"A" - ACP-L-578
6 pounds acid equivalent in 10 gallons of No. 2 fuel oil and 90 gallons of water.

"B" - ACP-L-578
6 pounds acid equivalent in 100 gallons of water.

"C" - Weedone Industrial Brushkiller
6 pounds acid equivalent in 100 gallons of water.

To compare the differences in time of treatment, the three spray materials were applied in May, June, August and September of 1955 between the 23rd and 26th of each month.

Table 1. A list of the species of woody plants recorded on the transects. Names taken from Gray's Manual of Botany, 8th edition (Fernald, 1950).

COMMON NAME	BOTANICAL NAME
Chestnut oak	Quercus Prinus
White oak	Quercus alba
Red oaks	Quercus rubra, Q. velutina Q. coccinea
Bear oak, scrub oak	Quercus ilicifolia
Sassafras	Sassafras albidum
Hickory	Carya spp.
Black gum	Nyssa sylvatica
Shadbush	Amelanchier canadensis
Aspen	Populus grandidentata
Pine	Pinus virginiana, P. pungens, P. ridfida
Chestnut	Castanea dentata
Red Maple	Acer rubrum
Smooth sumac	Rhus glabra
Staghorn sumac	Rhus typhrina
Dogwood	Cornus florida
Chinquapin	Castanea dentata
Sourwood	Oxydendrum abordum
Black locust	Robinia pseudoacacia

The sprays were applied with a gasoline powered pump delivering seven gallons per minute at 350 psi. The pump and motor were mounted on a four wheel drive truck and equipped with 300 feet of hose. Thorough wetting of the aerial portions of all woody plants on the experimental area was accomplished by applying an average of 275 gallons of spray material per acre.

The experiment was designed as a 3 x 4 factorial in randomized blocks (Cochran and Cox, 1953) with 12 treatments and four replications making a total of 48 experimental plots. The right-of-way was divided into 33 foot strips which were subdivided into 132 foot lengths making each experimental plot 4356 square feet or 1/10th acre in area.

The vegetation on the experimental area was sampled by running transects and tagging individual sprouts or sprout clumps on each of the experimental plots. Transects covering 1/10th the area of each plot were run in the summer of 1955 before spraying and again in the summer of 1956, one year after spraying. The transects were used to sample the sprouts which were randomly distributed such as the sprouts of all species together or the sprouts of the root suckering species, sassafras (Sassafras albidum) and black locust (Robinia psuedoacacia). Sprouts of chestnut oak (Quercus Prinus), red oaks (Quercus spp.), red maple (Acer rubrum), and black gum (Nyssa sylvatica) which arises principally from the root crown area are clumper rather than randomly distributed and could be sampled more accurately by tagging individual sprouts or sprout clumps. Other species present were few in numbers and were not studied separately. Five sprouts or sprout clumps of chestnut oak, red oaks, red maple, and black gum were tagged on each plot with numbered aluminum tags attached with aluminum wires. The tags were applied in the summer of 1955 and inspected again in the summer of 1956.

In collecting the data, the condition, i.e. living or dead, of a sprout was determined by using a pocket knife and making several cuts at various heights on the sprout through the external tissues into the xylem. If all of the tissues exposed by these cuts three inches above ground level were brown and dead, the sprout was recorded as dead. If any of the tissues three inches above the ground appeared green and living, the sprout was recorded as living. Any new growth occurring along the sprout below a point three inches from the ground or from some point on the root system was considered a resprout.

The data on red maple and black locust could not be analyzed statistically. Red maple was not present on 10 of the 48 experimental plots and the data on this species were considered insufficient for analysis. Most of the black locust sprouts in the plots sprayed in June, August, and September were defoliated by drift from earlier treatments. Since the effects of prior defoliation on the reaction of black locust to the intended treatment could not be determined, no attempt was made to measure the effectiveness of the treatments on this species. Spray drift had no noticeable effect on any other species.

All figures for percentage killed were transformed to arc sine values according to Table 16.8 in Snedecor (1948) and analysis of variance. Significant means were compared by the multiple range and multiple F tests as described by Duncan (1955). A comparison of the number of resprouts per plot could not be made without considering the original number of sprouts per plot. Therefore, the resprout data were analyzed by the analysis of co-variance with the number of sprouts before spraying as the X-variable and the number of resprouts as the Y-variable. A multiple range and multiple F test was performed on significant means.

All tests for significance were made at the 5% level.

RESULTS AND DISCUSSION

The results of this investigation are summerized in Table 2. To aid the interpretation of the table, the number of resprouts is expressed as a percentage of the original number of sprouts under the column "% Resprout".

All of the species or groups of species, except black gum, were most susceptible to the sprays at the time of the May treatments. Black gum was most susceptible at the time of the June treatments. The poorest results in every instance resulted from the September treatments. These results support the conclusions of Suggitt (1952) and Fisher et al. (1956) that season of treatment and stage of growth of the plant have a major effect on the reactions of woody plants to 2,4-D and 2,4,5-T. Season of treatment and stage of growth must affect the absorption, translocation, or physiological activity of the phytocides and produce the variations in the effectiveness of the phytocides.

2,4-D and 2,4,5-T applied as foliage sprays enter plant leaves principally by passage through the cuticle (Weaver and De Rose, 1946). Therefore, the thickness and composition of the cuticle affect the absorption of the phytocide. Crafts (1953) states that young leaves have a thin cuticle which is very permeable to applied materials, but as leaves mature the cuticle becomes thicker and less permeable. Possibly the cuticles of young, growing leaves posses permeable, immature zones which phytocides can penetrate rapidly (Schieferstein and Loomis, 1956). Differences in the permeability of the leaf cuticle may have resulted in greater absorption of 2,4-D and 2,4,5-T by young leaves than by old, thus bringing about the variations between times of treatment.

Season of treatment and stage of growth may cause variations in the effectiveness of 2,4-D and 2,4,5-T by influencing the movement of carbohydrate transport system of the phloem (Mitchell and Brown, 1946; Linder et al., 1949; Weintraub and Brown, 1950), any seasonal variations in the rate or direction of carbohydrate transport would be expected to affect the transport and distribution of applied phytocides. Meyer and Anderson (1952) state that when active growth is occurring, the majority of the carbohydrates are transported downward and accumulate in the stem. The meristematic activity in most woody plants lasts for 46 to 113 days and declines sharply after the middle of August in most temperate regions (Busgen et al., 1929). Therefore, phytocides applied in the early part of the summer should be transported to the regions of meristematic activity while those applied late in the season should accumulate in storage tissues. Also, young, incompletely differentiated, actively growing tissues are more susceptible to 2,4-D and 2,4,5-T than mature storage cells (Leopold, 1955) and it seems logical that destruction of meristematic tissues would have a greater permanent effect on a plant the destruction of certain storage cells. On the basis of these facts, the high percentages killed by the early season treatments and the low percentages killed by late season treatments are understandable. Black gum which reacted differently from the other species may begin active growth later and continue such growth longer than most other species, thus being more susceptible to mid-season treatments than to early or late season treatments.

There were no significant differences in the effectiveness of the oil-water spray, "A", and the water spray, "B", used in this investigation. Also, the interactions between time of treatment and spray were not significant, indicating that the sprays were equally effective at each time of spraying.

These findings do not agree with other investigators (Crafts, 1953; Beatty, 1955) who concluded that an oil-water spray was superior to an aqueous spray. Experimental results presented by Bramble (1955) indicated that an oil-water spray gave better results than an aqueous spray, but the oil-water spray used by Bramble contained 4 pounds of 2,4-D and 2,4,5-T in ester form. The advantages of the oil-water spray could have been due to the concentration or form of the phytocide. Gertsch (1953) reported that 2,4-D was more effective when applied in an oil-water emulsion than when applied in water alone. The oil used by Gertsch, however, was a non-phytotoxic horticultural oil which may have produced different results from the No. 2 fuel oil used in the present investigation. Fisher et al., (1956) found that 2,4,5-T applied in a No. 2 fuel oil-water emulsion was not appreciably more effective than 2,4,5-T applied in water alone.

It has been shown that the absorption and translocation of 2,4-D and 2,4,5-T are greater if the phytocides are applied in an oil carrier rather than in a water carrier (Penfound and Minyard, 1947; Rice and Rohbaugh, 1953; Leonard, 1956). Increased absorption is probably due to a saturation of the lipophilic capacity of the leaf cuticle by the oil which leaves the phytocide free to enter the leaf (Crafts, 1953) while the increased translocation may be due to the intercellular creeping of the oil and phytocide independent of the vascular system (van Overbeek, 1956). These reports indicate that an oil carrier is superior to a water carrier for 2,4-T and 2,4,5-T but they do not mean that an oil-water emulsion carrier combines the effectiveness of an oil carrier with the economy of a water carrier. No oil-water emulsion has the affinity for plant surfaces that oil has (Crafts and Reiber, 1948).

In order to be effective, an oil-water carrier must separate rapidly

Table 2. Summary of the percentages killed and percentages resprouting [1/] by species for all treatments

Month of Treatment	Chestnut oak % Killed	Chestnut oak % Resprout	Red oak % Killed	Red oak % Resprout	Black gum % Killed	Black gum % Resprout	Sassafras % Killed	Sassafras % Resprout	All species [2/] % Killed	All species [2/] % Resprout
May	29.0 a	75.4 a	86.2 a	22.3 a	78.3 b	32.6 b	100.0 a	61.9 a	94.1 a	44.1 a
June	28.0 a	95.8 a	59.8 b	61.0 b	98.0 a	0.0 a	100.0 a	46.6 a	87.8 b	42.3 a
August	6.3 b	24.8	10.0 c	10.2	88.4 ab	0.0 a	92.3 a	126.9 ab	77.5 c	46.5 a
Sept	2.4 b	6.9	2.0 c	3.8	50.0 c	0.0 a	72.0 b	172.6 b	63.7 c	59.6 a

Spray	Chestnut oak % Killed	Chestnut oak % Resprout	Red oak % Killed	Red oak % Resprout	Black gum % Killed	Black gum % Resprout	Sassafras % Killed	Sassafras % Resprout	All species % Killed	All species % Resprout
"A"	16.0 a	55.9 a	38.5 a	22.7 a	81.3 a	2.1 a	92.3 a	112.7 a	81.8 a	48.0 a
"B"	17.6 a	51.0 a	36.2 a	22.7 a	76.5 a	7.2 a	87.5 a	110.1 a	79.9 a	48.0 a
"C"	15.6 a	62.6 a	43.9 a	22.4 a	78.1 a	13.9 a	93.3 a	85.0 a	80.0 a	48.6 a

Two figures followed by the same letter are not significantly different, while two figures followed by different letters are significantly different. Comparisons of significance should be made within the columns and not between the columns. Figures in the % Resprout columns which are not followed by a letter are not comparable with the other figures in that column due to the low corresponding percentages killed.

1/ Percentage resprouting was derived by dividing the number of resprouts by the number of sprouts before spraying and multiplying by 100.

2/ Except black locust (Robinia pseudoacacia).

upon reaching a plant surface, leaving most of the 2,4-D and 2,4,5-T in a film of oils (Crafts, 1953). Strong emulsions such as those formed by ACP-L-578 break slowly, often requiring several hours for complete separation (Carter, unpublished). Also, most of the 2,4-D and 2,4,5-T may not remain with the oil when the emulsion breaks. The esters of 2,4-D and 2,4,5-T are soluble in oil and in the emulsifier used in ACP-L-578, but the emulsifier is only slightly soluble in the oil. When an oil-water emulsion of ACP-L-578 breaks, three separate layers appear - a top layer of oil; a middle layer of a thick, creamy emulsion; a bottom layer of cloudy water (Carter, unpublished). Since most of the emulsifier is probably in the middle layer, most of the 2,4-D and 2,4,5-T may also be in the middle layer and not in the oil. If this occurs, the advantages of an oil carrier are eliminated.

The phytotoxicity of many oils is increased by emulsifying them in water (Dallyn and Sweet, 1951). Since No. 2 fuel oil is quite phytotoxic (Crafts and Reiber, 1948), the oil-water emulsion of this oil used in the present investigation may have been so phytotoxic that the conducting tissues of the treated plants were damaged to a point that translocation of the phytocide was impeded.

If an oil-water emulsion is a more effective carrier of 2,4-D and 2,4,5-T than water, the differences in effectiveness are not apparent one year after treatment in the present investigation. The root kill on the plots receiving the oil-water spray may improve until they are significantly better than the root kill on the plots receiving the water spray; however, more work should be done with an oil-water emulsion before it is accepted as superior to water as a carrier for 2,4-D and 2,4,5-T used for foliage sprays.

Meyers et al. (1955) found that Weedone Brushkiller L-329, a chemical very similar to ACP-L-578, gave better results on certain woody plants than Weedone Industrial Brushkiller. The results of the present investigation do not support the conclusions of Meyers et al. because Weedone Industrial Brushkiller proved equally as effective as ACP-L-578. Weedone Industrial Brushkiller and ACP-L-578 contained equal amounts of the butoxy ethanol esters of 2,4-D and 2,4,5-T and were applied at the same concentrations. The two formulations differed in the types and amounts of additives - such as emulsifying and wetting agents - that they contained. Hull (1956) showed that such additives may either increase or decrease the effectiveness of 2,4,5-T amine depending upon the amount and chemical structure of the additives used. Gertsch (1953) found that each of several emulsifying agents increased the effectiveness of 2,4-D amine, but had no influence on the effectiveness of 2,4-D ester. Leopold (1955) reported that emulsifying and wetting agents, " - - apparently permit the entry of polar acids and salts by normally non-polar pathways" - through the cuticle "such carriers have no beneficial effect upon the absorption of non-polar formulations such as esters - -". On the basis of these findings, the large amounts of emulsifying and wetting agents contained in ACP-L-578 would not be expected to increase the effectiveness of the butoxy ethanol ester of 2,4-D and 2,4,5-T in the formulation.

SUMMARY

The time of treatment greatly influenced the reactions of woody plants to the phytocides used in this investigation. In general, all of the species of woody plants studies were more susceptible to 2,4-D and 2,4,5-T at the time of the May treatments than they were at the time of any other treatments. The only exception to this statement was black gum which appeared to be more susceptible to 2,4-D and 2,4,5-T in June and August than in May.

The oil-water spray, "A", did not prove to be more effective than the water spray, "B", one year after treatment. The two sprays were equally effective at each of the four times of treatment and on each of the species studied.

No differences were apparent between ACP-L-578 and Weedone Industrial Brushkiller. These two formulations gave similar results at each of the times of spraying and on each of the species studied.

Further observations of the experimental area are planned for 1957 and 1958, and the final results of the investigation will be reported later.

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PROGRESS REPORT NO. 4. EFFECTS OF CERTAIN COMMON BRUSH CONTROL TECHNIQUES AND MATERIALS ON GAME FOOD AND COVER ON A POWER LINE RIGHT-OF-WAY

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Six brush control treatments were applied in the spring of 1953 to a three-mile section of a Penelec right-of-way in central Pennsylvania(1). This line had been given an initial clearance in the winter of 1951-52 through a typical upland oak forest. The major objectives of research carried out in conjunction with these tests have been, (1), to determine the effects of chemical spraying on game food and cover plants, (2), to study game usage of the various treatment areas, and (3), to study the effectiveness of the sprays in controlling woody brush while producing a low plant cover that will be resistant to invasion by tree species.

A distinctive feature of the experimental layout has been that the spraying was carried out by a regular commercial crew using standard equipment. Also, the treatment areas were large enough for use of commercial techniques, a step which has been found necessary in converting small research plot data over into practical recommendations. One major difference to be noted between the spray applications in the tests and similar techniques commercially applied is that in the tests very thorough applications were made using larger volumes of spray than is usual in commercial applications. This was done intentionally in order to produce a maximum kill of brush and to cause a maximum disturbance of ground cover for each technique. The net result has been a brush kill which is above the usual commercial standards at the present time.

In order to obtain more information on the relative effectiveness of the large volumes of sprays used in the 1953 tests, a new series of plots designed to compare volumes sprayed on a uniform mixed oak-maple brush was set up in the spring of 1956. Spray volumes of approximately 100, 200, 300, 400 gallons per acre were applied in 4 replications on 1/2 acre plots as D+T foliage applications. All applications were made as thoroughly as possible by spraying the material directly onto the brush which was 3-10 feet in height, and not broadcasting it over the ground cover. Where volume permitted, stems were sprayed as well as leaves. The results of this new work will be reported next year when top kill can be more accurately assessed.

Another line of research supplementary to the original tests has been an application of a follow-up basal spray to one-half of each original treatment area. This was done to test the effectiveness of a quick follow-up basal as a brush control tool to get a right-of-way into the best possible condition for subsequent light maintenance sprays.

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The original treatments and follow-up sprays were as follows:

A - Unsprayed
B - Broadcast foliage spray of 2,4-D plus 2,4,5-T butoxy ethanol esters, half and half; at a concentration of 4 pounds combined acid equivalent per 100 gallons of water. Applied June 1953.
C - Oil-water, semi-basal spray of emulsifiable acids of 2,4-D plus 2,4,5-T, half and half; 3 gallons of spray material to make a concentration of 6 pounds of combined acid equivalent per 100 gallons spray in an oil-water carrier consisting of 10 gallons of No. 2 fuel oil in 87 gallons of water. Applied June 1953.
D - General summer basal spray of emulsifiable acids of 2,4-D plus 2,4,5-T, half and half, at a concentration of 12 pounds of combined acid equivalent per 100 gallons of spray, No. 2 fuel oil being used as a carrier. Applied June 1953.
E - Selective winter basal spray of 2,4,5-T butoxy ethanol esters at a concentration of 12 pounds of acid equivalent per 100 gallons of spray, No. 2 fuel oil being used as a carrier. Applied February 1954.
F - Broadcast foliage spray of Ammate at a concentration of 3/4 pound per gallon of water; 4 ounces of DuPont sticker-spreader were added per 100 gallons of spray. Applied June 1953.
B-D, C-D, D-D, E-D, F-D - A follow-up basal spray (D) applied in July 1954 (June 1956 for E-D) to one half of each replication of treatments B, C, D, E, and F. The follow-up consisted of a summer basal spray using the ACP formula 1054-E and techniques as in D, described above. The 1054-E concentrate contained 2 pounds of 2,4-D and 2 pounds of 2,4,5-T per gallon and was diluted at the rate of 4 gallons in 96 gallons of fuel oil.

Effect of Sprays on Woody Brush:

Top kill

An acceptable top kill was obtained with all chemicals used owing to thorough applications of high volumes of spray. In all cases, a top kill of 94 per cent, or more, was obtained on woody plants on the treatment areas by the end of the second growing season after spraying (2).

Resurge

As a comparison of the relative effectiveness of the various spray applications in control of woody brush, data is given (Table 1) on the number of woody plants that have stems extending above the ground layer of herbs and grasses which reaches about 3 feet in height on this area. These taller plants are the forerunners of the resurge that may require subsequent treatment in a few years.

As Shown in Table 1, a high degree of brush control has been maintained for the 4 years following spraying on all spray areas. In no case does the sparse woody brush extending above the ground layer merit retreatment, either on the basis of brush density or height, at this time.

Table 1. Number of living woody plants and stems attaining a height of 3 feet or more, 4 growing seasons* after spraying.

Treatment	Replication	No. of Woody Plants with Living Stems (per acre): Scrub Oak	Other Oaks	Red Maple	Sassafras	Other Hardwoods	Total Per Acre	Total No. of Living Woody Stems Per Acre Over 3 Feet In Height	Average Height of Living Woody Stems Over 3 Feet (feet)
B	I	0	8	0	0	0	8		
	II	8	8	0	0	0	16		
	III	0	24	0	0	0	24		
	IV	48	8	0	0	0	56		
					Treatment Average		26	316	4.5
C	I	0	0	0	0	0	0		
	II	0	8	0	0	0	8		
	III	0	0	0	0	0	0		
	IV	0	8	24	0	24	56		
					Treatment Average		16	60	4.3
D	I	0	0	0	0	0	0		
	II	0	0	0	0	16	16		
	III	24	0	0	0	0	24		
	IV	24	0	0	200	0	224		
					Treatment Average		66	112	4.6
E	I	8	0	0	0	0	8		
	II	0	0	0	0	0	0		
	III	0	0	0	224	0	224		
	IV	8	0	0	64	0	72		
					Treatment Average		76	144	4.2
F	I	0	0	0	0	0	0		
	II	0	0	32	0	0	32		
	III	0	0	8	0	0	8		
	IV	0	0	0	0	0	0		
					Treatment Average		10	106	5.2

*Three Growing Seasons for E.

Indicative of the relative effectiveness of these sprays, however, is a notable difference in the number of stems per acre for the various treatments. The broadcast treatment with 2,4-D + 2,4,5-T (B) has been the least effective in controlling the upland oaks which are dominant in this forest type, however, it has been outstanding in the control of suckering species such as sassafras. Foliage sprays, have also been found effective in controlling other suckering pecies such as black locust, and, where follow-up sprays were made within a year after the original sprays, they have been effective in controlling and eliminating black locust for at least 5 years (4). Ammate foliage spray gave excellent control on the oak species, but red maple showed considerable resurge and will need a follow-up treatment if complete brush control is to be maintained.

The oil-water, semi-basal sprays gave good all around results in this oak-maple brush, and, when properly applied, can be expected to give maximum kills on brush of either high or low density. To get this kind of kill with an oil-water spray, however, it is necessary to use proper D-T formulation, the right mixture of oil and water, and the right technique of application. Anything short of these will give increasingly inferior results.

The basal sprays, both summer and winter, gave excellent kill of oak and maple with minimum resurge. The only areas where resurge was troublesome was in locations where sassafras thickets occurred. These were scattered along the right-of-way to form a minor proportion of the total cover. In the case of winter basal spraying, considerable difficulty was encountered in finding all low seedlings and suckers in the ground layer during the winter season. Summer basal has proved to be superior to winter applications both in the matter of finding smaller plants and efficiency of application.

When the follow-up, summer basal sprays were applied one year after application of both broadcast and basal sprays, marked reduction of brush was obtained (Table 2). These follow-up basal sprays were particularly effective following broadcast applications where they were successful in eliminating some of the hard-to-kill species such as the various oaks and the red maple not killed by the original broadcast foliage spray. A combination of high volume, broadcast foliage sprays, which were effective on such species as sassafras and scattered seedlings, with a quick follow-up basal has been markedly successful (Table 2).

Effects of Sprays on Plant Cover of the Ground Layer

During the 4 years following the various chemical treatments, several major differences were brought about in the ground layer as a result of spraying. The low cover on the broadcast foliage spray areas underwent sudden and drastic changes following spraying as a result of heavy killing of low shrubs, herbs, and grasses. This was in contrast with a slight disturbance of the ground layer on basal spray areas (Table 3). The most striking cover changes that occurred were the sudden development of a solid fireweed cover after broadcast foliage spraying with Ammate and the development of a sedge-grass cover on the D+T broadcast spray areas.

Table 2. Comparison of single sprays (B, C, D, E, F) with similar sprays to which a follow-up summer basal was applied one year after original sprays (B-D, C-D, D-D, E-D, F-D). Data taken 3 growing seasons* after the follow-up basal.

Treatment	No. Living Woody Plants per Acre over 3 Feet in Height	No. Living Woody Stems per Acre over 3 Feet in Height
B - Broadcast foliage	26	316
C - Oil-water	16	60
D - Summer basal	66	112
E - Winter basal	76	144
F - Ammate	10	106
B-D Treatments	0	0
C-D as above	2	2
D-D followed	2	2
E-D by a sum-	1	2
F-D mer basal	0	0

* One growing season for E.

A major trend in plant cover after the initial disturbance by spraying was the gradual progression on the broadcast areas towards stable community. From Fireweed as a dominant, the cover has changed in the succeeding 3 years towards a cover dominated by sedge, grasses, and bracken fern. It is probable that eventually the ground layer on these areas will develop into the same community as that which has persisted on the basal spray areas for the past 4 years. However, it is important to emphasize the instability created by the broadcast sprays for the period immediately following spraying and to contrast this with the stability of cover on the basal spray areas.

A major development on the unsprayed control areas has been the gradual suppression of the ground layer by tree sprouts as they have grown larger and increased in density. This suppression has not affected the species composition of the ground layer, but it has reduced its density and will probably change it into the sparse ground cover typical of the surrounding closed forest stands if the brush is not cut. It is expected that the unsprayed brush will need retreatment in 1957 at the end of the fifth year following cutting.

Usage of Treatment Areas by Game Species:

The effect of chemical spraying upon game food plants and usage by game animals has been followed closely (2,3), and continues to be a point of major interest in the tests (Table 4). Usage of all treatments by deer has continued. While this game species commonly bedded down in sedge or grass spots of sprayed sections in other seasons, it concentrated upon the brushy unsprayed areas in the winter when snow covered the ground. Rabbits also used the control areas heavily in winter months. During the early spring and summer season, however, the deer browsed heavily in the sprayed areas upon young shoots of bracken fern, and upon herbs such as the whorled loosestrife.

Table 3. Changes in dominant species and in area covered by ground vegetation, under 3 feet in height, as a result of chemical spraying.

Treatment in 1953	Dominant Plants in 1953	1954	1955	1956
A Unsprayed	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry
Per Cent of Ground Covered	79%	96%	84%	80%
B Broadcast Foliage (D+T)	Bracken Sedge Herb Blueberry	Sedge Grass Herb	Sedge Grass	Sedge Grass
Per Cent of Ground Covered	10%	79%	88%	96%
C Oil-Water	Bracken Sedge Herb Blueberry	Fireweed Bracken Grass Sedge	Bracken Sedge Herb	Bracken Sedge Herb
Per Cent of Ground Covered	25%	79%	91%	95%
D Summer Basal	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry
Per Cent of Ground Covered	75%	95%	96%	98%
E Winter Basal	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry	Bracken Sedge Herb Blueberry
Per Cent of Ground Covered	75%	95%	95%	97%
F Broadcast Foliage Ammate	Bracken Sedge Herb Blueberry	Fireweed Sedge Grass	Fireweed Sedge	Sedge Fireweed Bracken
Per Cent of Ground Covered	10%	71%	84%	85%

Table 4. Number of times common wildlife species or signs were observed on treatment areas from October 1, 1955, through October 1956.

Wildlife Observed	A	B	C	D	E	F	Total
Deer	47	8	17	26	33	24	155
Rabbit	38	2	1	5	16	1	63
Grouse	0	0	2	3	1	4	10
Turkey	0	0	0	0	0	9	9
Squirrel	2	1	0	4	1	8	16

Ruffed grouse used all but one of the chemical treatments, while turkey usage was observed only on Ammate spray areas. These latter birds were using open spots for dusting and probably also found the insect life of the open right-of-way attractive. Young turkey poults, in particular, are known to feed upon insects such as grasshoppers in the early summer months.

Squirrels crossed and used the right-of-way adjacent to the timber edges in all treatments without any particular pattern of usage being evident. Efforts are being made to study the food production, particularly the production of acorns along the edge of the right-of-way as compared to production by trees in the interior of the forest.

Summary

Four years after spraying, a comparison of 5 spray techniques has indicated that by use of basal sprays a stable ground cover can be maintained with minimum disturbance. Such cover has proven useful to several important game species. On the other hand, broadcast spraying resulted in drastic alterations of the low plant cover which has been slowly progressing towards a more stable condition. The broadcast spray areas are also used by several important wildlife species.

All techniques produced a 94 per cent or higher top kill of woody brush owing to thorough applications of high volumes of spray. Summer basal spray proved to be effective on the mixed oak and maple brush and produced a maximum control of brush coupled with minimum disturbance of low plant cover. It also preserved several valuable wildlife shrubs that were nearly eliminated by broadcast and semi-basal sprays. Winter basal spraying gave excellent kills on oak and maple brush, but was difficult to apply effectively on scattered single stems in the winter months. The oil-water, semi-basa spray and the broadcast Ammate spray proved to be highly effective treatments that produced a minimum resurge on all woody brush. The Ammate and D+T broadcast foliage sprays were particularly effective when coupled with a follow-up summer basal spray made the year after the broadcast applications.

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CHEMICAL SPRAYS FOR THE EARLY RELEASE OF SELECTED HARDWOOD SPROUTS OF HIGH QUALITY STEMS IN A HARDWOOD SPROUT FOREST

David P. Worley, W. C. Bramble, W. R. Byrnes[1]

Many of the low quality hardwood forests in the Eastern United States are the result of sprout growth from an earlier high quality forest which was destroyed by clearcutting or fires. These new forests are low in quality for a number of reasons. In the first place, they are often characterized by poor species composition due, in part, to the fact that many of the less desirable species grow rapidly during the first few years suppressing trees of the more desirable species. Secondly, many of the new sprout origin trees are seriously infected by decay forming fungi from the stump of the parent. Finally, some of the sprout growth trees break near the ground or uproot because of weak unions to the parent root system.

Foresters have shown that low quality juvenile sprout growth can be materially improved through a process called cleaning, usually undertaken in the first few years of the life of the new forest. By cleaning is meant the removal of undesirable stems competing with potentially high quality stems. In the past, cleanings have been performed mechanically by cutting or hacking these undesirable stems. This hand cutting process, while successful in eventually producing a better forest stand, is expensive and often considered uneconomical since a long time must elapse before returns accrue from this large investment. Labor costs for mechanical cleaning vary from 1/2 day to several days per acre depending upon terrain, density, type of cover and intensity of the operation.

Experience with tests using 245-T esters in oil as basal sprays indicated that successful cleanings might be made chemically at a reduced cost by carefully choosing proper techniques and seasons of application. It was felt that this type of operation could best be accomplished by chemically girdling all the stems in a sprout clump except one or two stems of outstanding quality. Earlier investigations with aspen and bear oak showed that translocation of these esters in lethal quantities from one stem to another when applied as a basal spray was negligible during late summer. By treating at this season then it was expected that untreated stems in a sprout clump would not be seriously injured by translocation of the chemical from the treated stems. More detailed studies with bear oak revealed, too, that high volumes which completely covered the root collar were necessary to insure complete top kill without resprouting. Reasoning from this evidence, it was believed that a low volume application which just girdled particular stems but did not run down to the root collar could be applied in late summer and affect only those stems treated while leaving untreated stems of the same plant or sprout clump in a good growing condition.

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DESCRIPTION OF THE FIELD TESTS

The area chosen in which to conduct chemical and mechanical cleaning tests lies on a moderate to steep slope with a southern exposure and further characterized by Morrison soils predominately loam and sandy loam. The original forest stand was burned over in 1947 and at that time contained about 1200 cubic feet per acre of 4 to 14 inch d.b.h. white pine, white oak, red maple, black cherry and red oaks. Following the fire all the timber was cut in a salvage operation making way for a sprout growth forest of white oak, red oak (scarlet oak, black oak, red oak), black cherry and red maple. In 1950, twelve acres of this area were subdivided into 6, two-chain wide strips lying across the slope. Two of these strips were randomly chosen to remain untreated as a control, two others were chosen to receive a mechanical treatment, and the two remaining strips were set aside for chemical treatment. The mechanical cleaning was made in August of 1950 using brush hooks and axes. All woody vegetation was cut which it was felt would interfere with selected high quality stems for two to three years after treatment. The crop stems selected to be saved for the eventual forest were chosen on the basis of tree form, and origin. Seedlings and seedling sprouts were favored as were those stump sprouts located well away from the stump. Selected trees had to have good form. This treatment resulted in releasing 490 stems per acre and covered 4.3 acres. It took 42 man hours per acre or, at the nominal labor cost of $1.00 per man hour, it cost $42.00 to make this cleaning. These costs are high because dense thickets of blackberries which interfered with the workers had to be cut before actually releasing the crop stems. The chemical treatment was made in August 1953. First, high quality crop stems to be favored were marked with yellow paint. All the stems which, it was felt, would interfere with these crop stems were treated by basal spraying with a 3 per cent by volume (12 pounds active ingredient per 100 gallons) solution of 245-T esters in oil on the lower 12 inches of the stem. Garden type hand sprayers were used and operated at low pressures so as to produce a stream rather than a spray. Low volumes (in the magnitude of 1/20 ounce per stem treated) were used so that the treating solution would not run down toward the root collar. In cases where stems needing treatment were located so close to the crop stem that it was feared that the spray might splatter onto the crop stem the chemical was applied with a 2 inch paint brush. Only 285 stems per acre were released on an area of 4.2 acres. They were marked with yellow paint prior to treatment which took 4 man hours per acre. The actual chemical treatment took 6 man hours per acre. Allowing $2.50 per hour for technical marking services and $1.00 per hour for treating, the total labor cost becomes $16.00 per acre. Only 7.32 gallons of chemical solution were used per acre and this was valued at $2.97 making a total per acre cost of $18.97 for the chemical cleaning.

Marking costs formed a large proportion of the chemical cleaning costs and these were not present in the mechanical cleaning costs. Marking crop stems was resorted to for the chemical cleaning because it was felt that the mechanical cleaning was too intensive and that this would be corrected by careful marking before cleaning. Since the areas treated by both methods were comparable, the costs associated with the mechanical cleaning can be altered to conform to the intensity of the chemical cleaning. If only 285 stems per acre were treated it would cost 285/490 x $42 = $24.40 for treating plus $10.00 for marking making a total of $34.40 or 1.75 times more expensive than the chemical cleaning. Since the chemical treating costs are materially lower, the use of chemicals for such work may make the practice of cleaning economically feasible. It remains only to be seen if the chemical technique is successful in releasing the high quality stems. The rest of this paper will deal with evaluating this release of crop stems.

EVALUATION OF THE RESULTS OF CHEMICAL CLEANING

Three growing seasons have elapsed since treatment; the growing seasons of 1954, 1955, and 1956. In 1954 and 1955 data were taken from the untreated or crop stems and from the treated stems in sufficient detail so that they could be classed as follows:

1. Normal - A stem was classed as normal if it showed no damage to either the crown and foliage or to the bark and stem so that it appeared in every respect similar to stems of the same species in the surrounding areas.

2. Dead - A stem was so classed if it was completely defoliated and the bark was killed as ascertained by lightly scraping or shaving the bark with a knife.

3. Damaged - A tree was classified as damaged when it showed abnormalities in any one of several respects.
   a) crown and foliage damage - This involved the defoliation of parts of the crown so as to produce a thin foliage appearance or a stagheaded appearance.
   b) bark and stem damage - This classification required that bark proliferations and discolorations be present on the stem.
   c) Both crown and stem damage - This requires that both types of abnormalities described in (a) and (b) above be present.

By 1956 conditions had changed so that only a small percentage of the stems remained in a damaged condition and the narrower subclasses described under (3) above were discarded.

Only four of the different species which were evaluated will be reported because the other species were not represented by enough individuals to permit careful analysis. The effects of chemical treatment of these four species, white oak, red oaks, black cherry, and red maple are based on data collected from the following number of stems:

Species	Number of Crop Stems Which Were Not Treated	Number of Stems Which Were Treated
White oak	399	1232
Red oaks	297	1290
Red maple	191	1685
Black cherry	74	368

Results of the chemical treatment are shown in the tables that follow and are presented in terms of the per cent of the total number of stems which show the particular characteristics described above.

EFFECT OF THE CHEMICAL TREATMENT ON THE TREATED STEMS

The detailed results of the chemical cleaning treatment on treated stems appear in table 1. Following table 1 is a discussion of these results.

Table 1

Effect of Basally Applied 245-T Esters in Fuel Oil on the Sprayed Stems in Sprout Clumps When All Stems in the Clump Were Not Sprayed

Per Cent of Sprayed Stems Showing the Effects Listed

Effect	White Oak			Red Oak			Black Cherry			Red Maple		
	1954	1955	1956	1954	1955	1956	1954	1955	1956	1954	1955	1956
Normal	1	18	19	1	20	23	7	17	21	1	12	14
Dead	65	69	74	15	60	73	51	69	68	50	74	75
Damaged	34	13	7	84	20	4	42	14	11	49	14	11
Crown-foliage	15	4		43	5		30	3		23	2	
Stem-bark	-	3		3	4		2	4		3	4	
Crown-stem	19	6		38	11		10	7		23	8	

First Growing Season

Only 1 to 7 per cent of the treated stems appeared normal leaving from 93 to 99 per cent of them either dead or damaged. Over half of the stems of all species except red oaks were killed while only 15 per cent of the red oak stems were dead. The damaged red oak stems were severely affected though with a large proportion having bark and stem damage.

Second Growing Season

Twelve to 20 per cent of the treated stems had become normal by the end of the second growing season but 64 to 70 per cent had died. This accounts for from 80 to 87 per cent of the sprayed stems. Of the 13 to 20 per cent still damaged the numbers exhibiting the more serious damages have increased. It is interesting to note that death or recovery of damaged stems, hence the pattern of chemical effects, has crystalized during this second growing season.

Third Growing Season

The reduction in the damage column continued during the third growing season though at a lower rate. Sixty-eight to 75 per cent of the treated stems had died while 14 to 23 per cent had recovered so as to be classed normal. This high survival is possibly due to incomplete encircling of the stem with the chemical, caused possibly by cautious application in an effort to avoid splattering chemical on the marked crop tree stems.

EFFECT OF CHEMICAL TREATMENT ON CROP STEMS

The details of the effects of the chemical treatment on the untreated stems of sprout clumps which were to be reserved as crop trees are shown in table 2 and summarized below.

Table 2

Effect on the Untreated Stems in Sprout Clumps When Treating Other Stems with Basally Applied 245-T Esters in Fuel Oil in August 1953

Per Cent of Untreated Crop Stems Showing the Effects Listed

Effect	White Oak			Red Oak			Black Cherry			Red Maple		
	1954	1955	1956	1954	1955	1956	1954	1955	1956	1954	1955	1956
Normal	32	82	94	47	91	93	57	83	82	22	61	64
Dead	-	4	3	-	-	2	-	1	4	-	9	12
Damaged	68	14	3	53	9	5	43	16	14	78	30	24
Crown-foliage	65	3		50	1		41	4		65	6	
Stem-bark	1	7		-	6		2	11		1	12	
Crown-stem	2	4		3	2		-	1		12	12	

First Growing Season

From 40 to 65 per cent of the crop stems suffered damage to the crown and foliage. This may be due to translocation from treated stems or to volatility which brought the chemical into contact with the foliage. From 1 to 12 per cent of these stems were found to have abnormal bark proliferations or discolorations. These it is felt are due to inadvertent splattering of the chemical onto the crop stems while spraying those requiring treatment. It is important to note that no mortality was evident in any of the species but in general red maple crop stems seemed most susceptible inasmuch as they had by far the largest bark and stem injury.

Second Growing Season

Most of those showing damage after the first growing season had recovered so that 80 to 90 per cent of the white oaks, red oaks, and black cherry trees were classified as being normal. Only 60 per cent of the red maples were normal at this time. Some marked crop stems had died and more showed bark and stem damage. This was most serious in the case of red maple where one third were either dead or exhibited the more severe damage.

Third Growing Season

It is interesting to note again that very little change occurred during the third growing season. For all practical purposes the effect of the treatment can be gauged after the second season. In general the least damage occurred to the marked red and white oak stems in which only 7 to 8 per cent are either dead or damaged. Sixteen to 36 per cent of the black cherry and red maple crop trees were so classified. These facts clearly point out the importance of differences in species susceptability to the hormone chemical in this type of work.

RELEASE OF CROP STEMS

Before the chemical cleaning treatment can be considered successful, a large proportion of the crop stems must be released by freeing them from competition of undesirable stems. In order to classify a stem as released it must be first of all a normal stem, and secondly a dominant stem. Crop stems showing any damage whatsoever are disqualified. To be dominant their crowns must receive light from the sides as well as from above. In the third growing season the release of favored stems was as follows:

Species	Per Cent of Crop Stems Released
White Oak	85
Red Oak	73
Black Cherry	59
Red Maple	57

GENERAL CONCLUSIONS

It can be concluded that this chemical cleaning technique shows promise when used with the oaks but that it results in only marginal success with the thin-barked northern hardwoods of red maple and black cherry. Careful comparison of the percentages of released crop trees with the percentages of the marked trees remaining normal after 3 years shows that a high proportion of the normal trees were released. A change in technique for use with red maple, for example, which would increase the proportion of normal crop trees may improve the release picture. For red oak and white oak, though, the proportion of normal trees is very high and those crop trees not released are still in direct competition with the treated stems which did not die. A more severe treatment is called for in such cases. In general it can be said that the forestry practice of cleaning in young stands can be done with chemicals. Specifically it can be concluded that the technique outlined above will produce satisfactory results with the oaks and that a modification of the treatment is required to be successful with the thin-barked species of red maple and black cherry.

Chemi-Thinning in Plantation Pine

By
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With the great interest in reforestation of recent years, there has come to foresters and landowners a tough problem. How can the first thinning in plantations best be made? In the Northeast, the vast areas planted to red pine in the 1930's have already demanded thinning attention.

The crux of the problem is this. In order to maintain good growth rates on desirable trees, the first thinning should be made at the time when natural dying (through shading) of the lower branches reaches to one-half of the tree height. With the plantation spacing of six feet by six feet, commonly used in the past for red pine, most trees are only 4-5" D.B.H. when the first thinning is due. With the more recently adopted spacing of eight by eight feet, most trees are still only 5-7" D.B.H. at this time. Often there is no market for such small wood, and even where there is a market, labor may be either too high priced or too inefficient to produce the wood at the roadside at a profit.

Clearly then there is a place for using chemicals to make the first thinning. However, the nature of plantations imposes severe limitations on the method of application. At the time the first thinning is desirable, there appears to be a mass attack of dead branches aimed at the head and eyes. The very lowest branches, however, are much smaller and less dangerous since they have been shaded by upper branches and never permitted to grow big. Consequently heavy spraying machinery is out of the question. Even basal spraying equipment is too heavy (basal spraying has been largely unsuccessful with conifers anyway), for the best way to move through the plantation is either in a stooped position or on hands and knees. Frilling is difficult because of the dead branches which obstruct the swing of the axe.

Use of Partial Frills

With these things in mind, an experiment was made near Ithaca, New York in October 1954 in a plantation of red pine and another of Scotch pine. Replications of the red pine treatment were made in November 1955 and March 1956. An amine salt formulation, 2-4 Dow Weed Killer, Formula 40 (4# acid equiv./gal.) was poured in undiluted form in axe cuts. This chemical was used because of previous reports that amines were superior to esters and the amine of 2,4-D was better than the amine of 2,4,5-T when hardwoods were treated with partial frills. Most of the treated trees were 4-5" D.B.H. and received 2 or 3 cuts per tree. The cuts were only deep enough to reach the outer sapwood. They were easily made since the cuts were located fairly evenly around the tree at points where branches did not greatly interfere with the axe swing. A hatchet or light axe is best and can be swung with one hand while the chemical is easily applied by the other hand carrying a hydraulic oil can. Since much of the labor involved is getting through the plantation, rather than the actual chemical treatment, it would seem undesirable to use a two man team (ome axe-man and one sprayer) in preference to one man doing the whole job.

Altogether there were 84 red pine, averaging 3-4" D.B.H., treated with 2 cuts each. All trees in a row were treated, thereby saving tree marking costs. One-sixth gallon of chemical was used (3-4 ml. per cut or 2 ml. per inch D.B.H.), and the work was done in 45 minutes.

Forty Scotch pine, averaging 5" D.B.H., received a total of 110 cuts or nearly 3 cuts per tree. These trees were treated on a marked tree basis and the time was longer than for the red pine treated in rows. Less than one-tenth gallon of chemical was used (3 ml. per cut or 1-2 ml. per inch D.B.H.) and the time required was 35 minutes (including 10 minutes for selection of trees).

Considering the results of these treatments in unpruned plantations, it is estimated that 400-500 four-inch trees per acre could be treated in dense, unpruned plantations at a cost of about one gallon of chemical and one man-day of labor under most conditions. If, in using marked trees, pruning of some crop trees precedes thinning, or if row treatments are made, the labor cost should be reduced.

Results

In the case of red pine, the terminal leader and uppermost whorl of lateral branches died back by June in the first growing season after treatment. By the end of summer the whole tree was top-killed. This was true for all application dates, and there was no apparent difference between treatments made at the base of the tree or those made at breast height. Check trees, in which cuts without chemical were made, had their wounds pitched over and appeared healthy.

Despite the clear differences between treated and check trees, however, the weather prior to and during the study makes it impossible to draw exact conclusions. In 1954, there was a severe drought during June and July. This was followed by about a ten week period of drought in early and mid-summer of 1955 when the rainfall was only about one-fourth of normal. The soil is well-drained Lordstown, but underlying rock prevents root penetration below two feet in some places. There are a few small groups of dead untreated trees near the treated trees. These are believed to have been killed by the combination of shallow soil (low soil moisture reserve) and two years of drought. This raises the question of possible predisposition toward a dying condition of the trees which were chemically treated. It must be admitted that such spectacular results on the treated trees might not have been obtained under more normal weather conditions.

The picture is further complicated by the presence of some few dead trees adjacent to treated trees. These could also be drought victims, but it is also possible that they were killed by movement of chemical through root grafts from treated to untreated trees. Even though such a movement might not be expected under ordinary conditions, the special moisture stress on the tree during drought may have caused a pull of moisture and chemical from an adjacent dying tree. Whether or not adjacent trees were killed by transfer of chemical through root grafts was not established in this study.

In Scotch pine, also located on well-drained Lordstown soil, the trees were much slower in dying. The terminal leader and uppermost whorl of lateral branches were mostly dead by June in the first growing season after treatment. In October 1956, however, only about half the trees were completely top-killed after two growing seasons. Trees on the edge of the stand soon recovered. Nevertheless, the chemical treatment has effected a successful thinning within the stand, for height growth has been stopped sufficiently long to allow neighboring trees to overtop and eventually shade out any treated trees which are still alive.

The Scotch pine, located on a similar soil and aspect (facing east) as the red pine, showed no evidence of drought injury or movement of chemical from one tree to another. This is not unexpected since Scotch pine is much more drought resistant than red pine. Nevertheless, it is possible that results would have been poorer if more normal weather conditions had prevailed in 1954-55.

Some of the Scotch pines, which still had some life in the tops, were partially debarked in an attempt to learn more of how the chemical was translocated. The outer sapwood was marked by a narrow vertical strip of discolored wood extending above each cut. For most of the height of the tree, these strips were considerably less than an inch wide. Discolored wood was also found a few inches below the cut, but did not seem to go as far as the root collar (most cuts were made at a height of 2-3 feet). These morphological observations offer only suggestive evidence concerning translocation.

When the results of these amine treated partial frills on Scotch pine are compared with results of similar treatments on various hardwoods, there seems to be considerable similarity in tree damage. The practical results are different, however, since Scotch pine is relatively intolerant of shade and has excurrent branching with only one terminal leader. Many of the hardwoods, on the other hand, are tolerant of shade and have a deliquescent branch system capable of supplying many new leaders. Thus the technique can be much more effective in the pine plantation.

In summary, this paper is presented, not because of any firm conclusions, but because it is believed the technique and chemical described is so promising that some foresters will want to use it on a trial basis for thinning the commonly planted conifers.

Observations on the Effectiveness of Polychlorobenzoic Acid for Pasture Brush Control

Robert A. Peters[1]

Trichlorobenzoic acid and tetrachlorobenzoic acid have proven to display herbicidal effects on a wide range of plants. These compounds have shown promise as a translocated herbicide for use on herbaceous perennial and woody weeds which recover from subterranean vegetative structures. Phenoxyacetates have given poor control of many of these species since translocation along horizontal roots or rizomes has been shown to be quite limited.

The following progress report gives the results obtained from applications of polychlorobenzoic acid, a mixture of tri and tetra chlorobenzoic acids, during the 1956 season on several perennial species. The species selected were in large part weeds commonly found in pasture areas which increase by vegetative means. Phenoxyacetates have frequently proven ineffective in preventing regrowth from such species.

A. Dormant Application on Woody Species

A comparison was sought between basal dormant application of Brushkiller and polychlorobenzoic acid. The Brushkiller (a 1:1 combination of 2,4-D and 2,4,5-T) was applied at rates of 8 and 16 pounds acid equivalent (a.e.) per hundred gallons of oil. The chlorobenzoic was applied at 8 and 16 pounds (a.e.) per hundred gallons of water with Dupont Spreader-sticker added. Both materials were applied as basal treatments on April 19, 1956 before dormancy had broken, on sweet fern (Comptonia peregrina) hardhack (Spirea tomentose) and bayberry (Myrica pensylvanica). Overall applications were made on huckleberry (Gaylussacia). Observations were made on September 27, 1956. Both materials killed the tops of the sweet shrub but numerous suckers occurred from the plants treated with Brushkiller while none occurred following treatment with the chlorobenzoics. Hardhack showed no indication of recovery from either material. While some suckering of bayberry occurred from the plots treated with Brushkiller, top kill was definitely superior to that following the use of chlorobenzoic acids. Leaves developed on the plants treated with polychlorobenzoics but they were quite abnormal being elongated, strap-like, and twisted. Huckleberry showed no response to the polychlorobenzoic. The Brushkiller killed the tops but suckers were numerous.

Control of Evergreens

Overall foliar applications of chlorobenzoic acid at rates of 8 and 16 pounds (a.e.) per hundred gallons of water were made on ground juniper (Juniperus communis) red cedar (Juniperus virginiana) and white pine (Panus strobus). The applications were made on April 19, 1956. By mid-summer all the treated species had been completely killed.

Control of Herbaceous Perennials

Horsetail (Equisetium) was effectively controlled by applications of 4 lb. (a.e.) per hundred gallons of H_2O of chlorobenzoic applied June 6, 1956. Kill was rapid with the tops turning black soon after spraying. No regrowth had occurred as of September 20, 1956. Much less satisfactory control was obtained with 4 lb. (a.e.) of amino-triazole. Bracken fern treated with 4 lb. of chlorobenzoic showed considerable die back and no regrowth as of September 20.

Control of Mexican Bamboo

Mexican bamboo (Polygonum cuspidatum) control appeared more promising from polychlorobenzoic treatment than from treatment with Brushkiller, Ammate or amino-triazole. Prevention of regrowth from suckers was the principal advantage. Pennsylvania smartweed (Polygonum pennsylvanicum), a closely related species was readily killed by chlorobenzoics.

Poison Ivy Control

Polychlorobenzoic acid was compared with Brushkiller and amino triazole for poison ivy (Rhus toxicodendron) control, growing on a stone wall. The first applications were made on June 6, 1956 soon after the ivy leaves were fully expanded. Four pounds (a.e.) per hundred gallons were applied of Brushkiller and chlorobenzoic acid respectively and 2 pounds (a.e.) per hundred gallons of amino triazole. By July 9, 1956 complete kill had been obtained with the Brushkiller, near kill with the amino-triazole and rather poor control from the chlorobenzoic.

An application was also made late in the season as the leaves were assuming fall coloration. Rates of 8 pounds (a.e.) per eighty gallons of H_2O of chlorobenzoic and amino-triazole and 4 pounds (a.e.) per hundred gallons of Brushkiller were applied. In contrast to the lesser control obtained in June, the best control was obtained with the chlorobenzoic. The leaves became scorched and wrinkled within hours after treatment. The amino-triazole caused most of the ivy to quickly wilt to a dark green color. Those leaves which were red at the time of spraying were only slightly effected. The Brushkiller had little effect at this stage of application. The degree of control from this application especially cannot be entirely assessed until the regrowth is observed in the spring of 1957.

Summary

Polychlorobenzoic acid has shown promise in 1956 trials at Storrs of giving excellent kill of evergreens, of controlling horsetail and bracken fern and of preventing regrowth of a stoloniferous woody species, sweet fern, more effectively than 2,4-D and 2,4,5-T Brushkiller.

Basal dormant applications were found to be effective on at least two species, sweet fern and hardhack.

Other species which were markedly effected by the polychlorobenzoics were Japanese bamboo and smartweed.

Response of Poison Ivy, Rhus toxicodendron, to Amino Triazole in Amounts of 1 to 16 Pounds per Acre

by A. M. S. Pridham, Cornell University

In June 1955 a good size American elm tree stood adjacent to some plots in which amino triazole was being used. A lush growth of poison ivy covered the ground adjacent to the tree and several climbing stems of ½" diameter and more were growing up the trunk so that ivy foliage reached into the top of the tree. Several lateral branches were within 8 feet of the ground.

Case history of large vine of Rhus toxicodendron

A space 10 x 10 feet was marked off and sprayed with amino triazole at the rate of 1 quart of spray -- 16 lbs. amino triazole/100 gallons/acre. The soil surface, the vines and branches of the poison ivy as far as could be reached (8-9') were sprayed from a hand operated Unico one gallon sprayer.

Observations in July and October indicated discolorations and defoliation of leaves directly contacted by the spray but no change in growth of the foliage of the poison ivy or of the elm tree. The soil about the tree remained undisturbed. By November 1955 much of the poison ivy about the base of the tree was dead as indicated by dry brittle twigs. The trunk-like stems of ¼" or more in diameter remained alive.

In 1956 normal foliage appeared on the elm tree and on the unsprayed part of the poison ivy. A second application of amino triazole was used over the same 10 x 10' space and lower trunk. Grass and weed growth were largely eliminated but the poison ivy continued to flourish though the bark on the stems had split and an exudate appeared.

As noted by the author for *Fraxinus americana*, *Acer rubrum*, *Quercus palustris* and *Taxus cuspidata*, the use of amino triazole on undisturbed soil about the base of these trees has not resulted in injury to the trees. A similar case is reported in Cyanograms in the fall of 1956 in which the successful use of amino triazole for control of poison ivy in an orchard is described.

Treatment of shrub and ground cover Rhus toxicodendron

Two locations were found in which extensive stands of poison ivy were present. In the first the plants were of low ground cover type with fruiting stems of 8 to 10" in height growing in woodland shade. These were treated July 31. The second location was an open sunny one in which vigorous growth 2 feet deep on ¼" diameter stems predominated. Treatments were made September 21 while foliage was still green. Plots were 100 sq. ft. in extent.

Observations were made August 17 and samples of twigs were taken November 10 to check the extent of twig injury.

Table 1. Relative injury to poison ivy, Rhus toxicodendron, from summer and autumn treatment with amino triazole.

Pounds of AT per 100 gallons	August treatment		September treatment	
	Foliage response 8/17	% twigs dead	% twig tips injured* Repl. 1	Repl. 2
1	Dried brown	50		
2	Dried brown	100	.22	.37
4	Dried brown	100	.15	.24
6	Aging yellow	100		
8	Green brown	100	25	.80
16	Dried brown	100	.30	.55
Control	Green	cambium green	cambium green	cambium green

* Injury -- tissue of cambium region pink or dull green. Twig tips only were injured.

Where applications were made in July good top kill to the ground was obtained with as little as 2 pounds of active amino triazole per 100 gallons of spray mix. Some response was noted at 1 pound. Adjacent wood vegetation whose stems only came in contact with amino triazole retained green foliage till leaf fall in autumn. Plot lines were quite sharp indicating limited translocation beyond contact with amino triazole. Where applications were made late in the summer little injury to even small current year's twig tips were evident. Discoloration of the cambium region by intensified pink and dull green of yellowish cast was not evident on twigs over approximately 1/8" diameter and on small twigs did not extend more than 3 inches back from the terminal bud. Cambium in control twigs was bright olive green. Localized pink color was found near buds.

For effective control of poison ivy, applications appear most likely to be effective when made to foliage during spring and early summer. Since contact rather than translocation seems to be an important initial phase of control, good coverage would seem advisable. The tendency for larger twigs and branches to remain functional while young shoots are killed would indicate the need of adequate amounts of amino triazole for heavy growth. Selective killing of low ground cover type growth along paths and in parks, etc. appears to be possible with amounts of 2 pounds per acre which tentatively discolor many grasses and other herbaceous vegetation.

(The amino triazole was supplied by the American Cyanamid Co.)

WEED CONTROL IN DUCK MARSHES

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Making the most of what is left is the broad aim of marsh weed control programs. During past centuries, civilization has taken over more and more of the places where ducks feed and breed, and now the nation's wetlands have been reduced to about one half of the estimated former total of 150 million acres. To make matters worse, populations of duck hunters have grown in the meantime. These trends make it essential that remaining waterfowl habitat be kept as productive as possible if duck hunting is to continue a popular recreation for millions of Americans. This is why herbicides are becoming increasingly important in marshlands.

Marsh weed control work has expanded rapidly within the past few years. In Florida recently, undesirable plants were cleared away from 20,000 acres of ponds and lakes. New York, Massachusetts, Vermont, and Maryland have active programs against the particularly hard-to-control pest, waterchestnut. Other States are conducting control campaigns of varying extent against marsh weeds such as cattails, phragmites, hibiscus, needlerush, waterhyacinth, water-primrose, and alligatorweed. And each year, several thousand acres of marsh weeds are sprayed with herbicides on the Federal wildlife refuge system. Extensive additional activity is suggested by recently drafted Congressional bills proposing large-scale attacks on particularly important weeds such as waterchestnut, waterhyacinth, and alligatorweed.

While scores of investigators at agricultural experiment stations and elsewhere are busy finding how to capitalize on the products of chemical science in the control of farm weeds, similar research on a much smaller scale is paving the way for more effective and extensive programs of marsh weed control. As conducted by the United States Fish and Wildlife Service, such studies usually begin with an extensive series of small test plots to get leads on the best chemicals for the purpose and to learn the best time for treatment. Later, the herbicides that gave the most encouraging results are tried again on 1/40 acre or other medium-small units, sometimes with replications of the tests in different States. Finally, if a herbicide passes these two stages satisfactorily, attempts are made to arrange large-scale practical demonstrations by land or aerial spraying.

Studies on marsh weeds are complicated by several factors. Since most of the plants are perennials, success or failure of their control cannot be judged accurately before the following year. Furthermore, after a stand of weeds is actually killed, there still may be a problem in replacing it with useful plants. If, for example, methods have been found to kill cattails, there is also the question of how to assure good crops of valuable plants, such as smartweeds or wild millet, without opening the door to thousands of seedlings of cattails or other weeds. This necessitates detailed studies on both the desirable and undesirable plants and their responses to various environmental factors.

In some instances, the weed-control objective might be termed marsh landscaping since it aims only at reduction of plant abundance in certain places rather than at elimination. This is the case when channels or other openings useful to waterfowl -- and to duck hunters -- are created in dense stands of marsh vegetation. In some places, extensive solid growths of phragmites, needlerush, or other non-food plants can be made useful for cover if their density or continuity is reduced.

Whereas the advent of 2,4-D and 2,4,5-T formulations about a decade ago marked the beginning of a new era in marsh weed control, the foundations for another major advance appear to have been laid by several new herbicides such as amino triazole and dalapon. Present evidence indicates that for some marsh plants, these new agents will soon outdate the phenoxy compounds and other older herbicides.

One example of this is in cattail control. Treatment of these plants with various 2,4-D formulations has generally been rather unsatisfactory since several applications have been required, usually in the course of two or more years. Recent findings, obtained independently in California and Maryland, have shown that amino triazole, either alone or in combination with dalapon, is much more effective as a means of killing cattails. Investigations in Maryland by the Fish and Wildlife Service have demonstrated 100% control on small plots treated with amino triazole at five pounds of active ingredients per acre in early July, when heads were well developed. Good results were also obtained with combinations of amino triazole and dalapon. In California during 1956, an amino triazole-dalapon combination has been used on an operational basis covering about 100 acres. Adequate information on the best dosage for different cattail species in different situations and in different growth stages will require considerable more study.

Phragmites control has also become much more feasible since the arrival of new and more effective herbicides. On relatively dry sites in the Middle Atlantic States, during stages of growth varying from three feet in May to full height in mid-September, this plant has been controlled effectively by 30 pounds acid equivalent of dalapon per acre. In dry sites, amino triazole at 4 pounds active ingredient per acre can also be used with 15 pounds of dalapon. Used alone, amino triazole is effective at 16 pounds provided it is applied during the pluming-flowering period. In moist or flooded sites, dalapon alone was not effective. However, good results were obtained in wet places when 25 pounds of dalapon were combined with 8 pounds of amino triazole, applied during the flowering period.

Recent studies by different agencies in different parts of the country have led to tentative recommendations for the control of about 25 marsh or swamp weeds. In the Northeast, attention has been given to cattails, phragmites, waterchestnut, hibiscus, waterlilies, spatterdock, pickerelweed, decodon, and such woody growths as buttonbush, willows, and alder. Some of these species require additional study to determine their responses to new chemicals or to broaden the base of present conclusions on their control

A weed that appears particularly deserving of more attention is one which is confined at present to the Northeast. It is the Asiatic waterchestnut, a spiny seeded pest that ruins areas for ducks, fishing, and swimming and sometimes interferes with navigation. Add to this the facts that years and years of expensive work are required to control the plant in any locality and there is no telling where it may appear next. The four States which have been struggling with waterchestnut infestations have been spraying with formulations of 2,4-D, plus cutting or pulling of plants. Unfortunately, however, 2,4-D is not doing the job well enough to prevent reproduction of some of the treated rosettes. This, together with the weed's importance, has recently led to the decision to make a new series of studies on waterchestnut control, with emphasis on new chemicals. These investigations will probably be started in the summer of 1957 in the infested area of the Gunpowder River, northeast of Baltimore.

SOME EXPERIENCES WITH THE AQUATIC WEED PROBLEM IN THE STATE OF NEW JERSEY

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During the last six years the Agricultural Experiment Station at Rutgers, the State University of New Jersey, has been receiving an increasing number of requests for assistance with aquatic weed problems. During certain seasons, for example, requests are received almost daily, and these requests reflect a wide variety of situations--from filamentous algae at the margins of farm ponds on the one hand, to weed-choked lakes of 100 acres or more, on the other.

The problem is complicated by: (1) the fact that most of New Jersey's many lakes and ponds are shallow and well eutrophicated, (2) the fact that they are used intensively for a wide variety of purposes; and (3) the fact that they are often connected by waterways that are themselves subject to multiple use.

Let me cite some examples:

Example No. 1. A 30-acre development lake with 150 homes may have been formed by heightening the dam of a former estate pond. Its mean depth may be 4 to 10 feet, and it may be used for swimming, fishing, boating and, in some instances, irrigation.

If the lake is artificially fertilized, the consequent bloom may be highly distasteful to the swimming interests; cause severe stratification, fish kills and obnoxious "purgings"; and fail to combat an overabundance of sunfishes. In fact, the swimming interests, which nearly always have priority, usually have the lake treated with copper sulfate at regular intervals.

Within a very few years the progressive encroachment of rooted vegetation in the lake may be noticed by the residents. Indeed, it may progress so swiftly as to become a source of major concern to the development corporation before the home building program has been completed.

Example No. 2. A one-acre farm or farm-estate pond may have been constructed for fire protection, swimming, fishing, irrigation, increased equity and, perhaps, for watering livestock. Here again artificial fertilization may bring about distasteful conditions for swimming--i.e. severe stratification, and "pea soup" water that is irritating to the eyes--promote growths of filamentous algae, and fail to prevent an overabundance of the ubiquitous bluegill sunfish. Indeed, a bottom visibility of three feet or more may be desired, despite the increased threat of rooted aquatic plants.

Example No. 3. A public lake of more than 100 acres, with a mean depth of less than 5 feet, may become so severely choked with several species of aquatic plants by midsummer that swimming and boating become almost impossible. The odor from the vegetation may become obnoxious to nearby residents, and the lake may temporarily become all but worthless as a natural resource.

These are but examples of untold numbers of such situations in New Jersey, and the problem will become progressively more serious as more waters become invaded and more are impounded.

II.

The aquatic weed problem in New Jersey is further complicated by serious shortage of the equipment and trained personnel that are necessary for applying even the somewhat meager knowledge we now possess for the control of rooted aquatic plants.

Suppose, for example, one of the very few professionally qualified persons in New Jersey is able to find the time to visit a pond or lake and make some recommendations for temporary relief that will not risk a suit for damages (real or fancied) and a line of other suits forming behind the first one. The first question usually involves equipment, and the second a person or company skilled in using same for dispensing the recommended chemical.

Finally, if such qualified personnel, adequate equipment, and skilled operators were available--or would be in the near future--there comes the problem of costs for the seasonal or temporary relief that may be expected.

III.

This brings us to the very serious problem of the dearth of knowledge on the control of aquatic vegetation and of how this problem might be solved in the not too distant future.

At the present writing, we have, possibly, only one chemical that has been meticulously "screened" over a period of time for its potentialities and limitations. I refer, of course, to "Old Reliable", i.e. copper sulfate. We have, also, several other chemicals and compounds that have been subjected to a bit of this "screening" or "shotgun" research; but even these have not been systematically subjected to this type of treatment despite its potentially great value.

Meanwhile, unlike the terrestial plants, we know but little concerning the nutritional and other ecological requirements of the higher aquatic plants. Further, we do not even know the mode of entry--or the factors influencing the mode of entry--into these plants by the chemicals we are now employing. Nor do we know what factors in the biomass may enhance or inhibit the growth of specific, higher aquatic plants.

Finally, we do not know, with accurate predictability, the possible effects of zoological controls--e.g. the introduction of carp or goldfish--upon either the flora or fauna of particular situations.

IV.

If the aquatic weed problem in the state of New Jersey, (as we have briefly reported it) is representative of other geographic regions and their future development--and we have reason to believe that it is--how then could the obviously needed fundamental research be financed under the present conditions of our "quick dollar", highly competitive economy?

The answer would appear obvious, and not new: Remove the necessary, fundamental research from the competitive category and pool financial contributions from interested industrial concerns. The results of the researches would be made equally available to all, and competitive interests could consider it as such.

In this way a great share of our nation might be benefitted: The landowner could invest in a pond with increased confidence; the buyer of a home at a lake development could make his investment with increased confidence; corporations could develop a lake, or form a new one, with increased confidence; and municipalities, park commissions, and states could look upon what they have and what they would like to have with increased confidence.

Indeed it is not unlikely that this very evening, after these words have been spoken, more than one solid citizen will be seated in a newly acquired home with a picture window looking out over a lake or pond, while he watches a television program extolling the miracles of scientific research--radioisotopes et al. Perhaps this citizen will wonder why, with all the knowledge of this atomic age, no one can tell him how, cheaply and effectively, to get rid of a mess of aquatic weeds that have been challenging his swimming, fishing, equity, and peace of mind.

This has been our experience with the aquatic weed problem in New Jersey.

North Easter Weed Control Conference
January 10, 11, 12, 1956
Aquatic Weed Section
Robert T. Harrington

The Use of Air-Propeller Outboard Motor
In The Spraying of Water Chestnut (Trapa natans)

In the spring of 1956, the New York State Conservation Department in conjunction with the Dingell-Johnson Project on eradication of water chestnut purchased an air-propeller driven outboard motor for the express purpose of spraying this aquatic weed with preparations of 2,4-D. Only one motor was purchased at this time on an experimental basis. The evidence, after a summer of spraying, proved conslusively that the motor was perfectly suited for the job.

In the spraying of this weed an aluminum boat was used and equipped with a 25 gallon skid-mounted power sprayer delivering about $1\frac{1}{2}$ qpm. at 200 pounds pressure placed in the bottom of the boat. Two men were required to handle the operation, one man seated in the bow and spraying from the side according to the direction of wind drift, another man was required to operate the motor. Although the 30 inch propeller does not permit a high speed, this is not required in spraying. It will push a boat of this type with all equipment aboard through the thickest of aquatic vegetation. Also the lack of any under-water propeller enables operation in any waters deep enough for an ordinary rowboat.

Before the purchase of this motor the boat was manually operated while spraying. The slowness of spraying this way was a handicap as the spray pattern would not be uniform. The air-propeller driven motor, because of the even speed, provided a good uniform spray pattern and is excellent for this type of job, permitting coverage of approximately one acre per hour. Wind velocity, if high, will create some trouble on open water because of the tenency for the boat to drift, also the noise and vibration will create some discomfort to the person handling the motor. The guard around the propeller is fairly flimsy and the crew spraying this year had trouble with the narrow bands on the guard breaking from vibration. This was finally eliminated by splitting a half inch rubber hose and putting it around the outside rim of the guard; this seemed to cut down the vibration to a minimum. In conclusion we believe this motor would probably work in the spray of any dense aquatic weed if the load it had to carry did not exceed its pushing power. The best performance was carried out with an aluminum boat with a fiarly flat bottom. This motor has been a great help and a step forward in controlling water chestnut.

Equipment for the Application of Liquid Herbicides

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For a number of years, Connecticut has been using 9-1/2 pound sodium arsenite for the control of submerged aquatics. These operations were somewhat small, requiring no elaborate equipment. This year, under a Federal Aid project, several larger bodies of water had to be treated and these required a large amount of herbicide. The capacity of the old equipment was not sufficient to do the job properly. Therefore, a new rig was constructed from which a large volume of chemical could be distributed in a relatively short time. In order to apply the weed killer at a rapid rate, the following conditions had to be incorporated into the new equipment:

1. Facilities for carrying a large supply of sodium arsenite.
2. Rapid application of large volumes of sodium arsenite.
3. Ability to navigate weedy areas.
4. Portability.

To meet the above requirements, a barge was constructed by building an 8' x 12' plywood platform which was bolted to the gunwales of two scow type 16' Feathercraft Riverboats. A one and one-half inch centrifugal pump was piped so that water was drawn from the lake and mixed with the sodium arsenite before discharging the mixture from a spray boom. A 15-horsepower outboard motor with neutral and reverse was used for propulsion.

The 8' x 12' platform was made in two sections of 4' x 12' out of 3/4-inch exterior plywood with a two by four frame. The two sections were bolted together and this, in turn, was bolted to the two boats as shown in Figure 1. A two-inch by eight-inch oak plank 11 feet long was clamped to the sterns of the two boats and the outboard attached to the plank between the boats.

When encountering an extremely weedy situation, a weed guard made of curved 3/8-inch iron rods as shown in Figure 2 was clamped onto the stern end of the platform in front of the outboard motor. In all cases thus far encountered, it has proved entirely satisfactory in keeping weeds out of the propeller.

The centrifugal pump for distributing the herbicide was bolted to the rear center of the platform. The pump housing and impeller were made of cast iron instead of aluminum and bronze because of its greater resistance to the corrosive action of sodium arsenite. Figure 3 shows a diagram of the plumbing. At the suction end, a tee was installed with two one and one-half inch gate valves. A one and one-half inch pipe with a strainer was attached. The strainer protected end of the pipe entered the water between the two boats just forward of the outboard motor and to the rear of the weed guard and served as the water intake. The other valve was attached to the arsenite drum by a six-foot 3/4-inch hose. At the discharge end, a tee was also installed with two one and one-half inch gate valves. Both of these valves had male hose fittings attached so that a hose could be connected to one and a flexible line to the spray boom from the other. The hose was used to apply the arsenite in areas too shallow for the outboard motor.

The spray boom, Figure 4, was constructed with two outlets about 6 feet apart and so designed that it clamped onto the stern of the boats and went around the outboard motor. The weed killer was discharged underwater through two 3/4-inch pipes which, with the aid of wind and thermal currents, provide effective dispersal.

After the equipment was put together, the drums of arsenite were loaded onto the platform. A drum was set on end with the small bung up. A 3/4-inch gate valve was inserted and the drum placed on its side in a cradle. The 3/4-inch hose from the suction end of the pump was attached to the valve. The pump was started, the valve on the drum opened and the water intake adjusted to give the proper mixture. With this arrangement, it was possible to apply a drum of arsenite in 15 minutes.

The concentration of the arsenite in the discharge solution was controlled by the water intake valve and not by the valve from the arsenite drum. This arrangement appeared to give the best control over the discharge mixture.

After starting the pump the other bung should be opened to let air in. If this is not done, the drum will collapse.

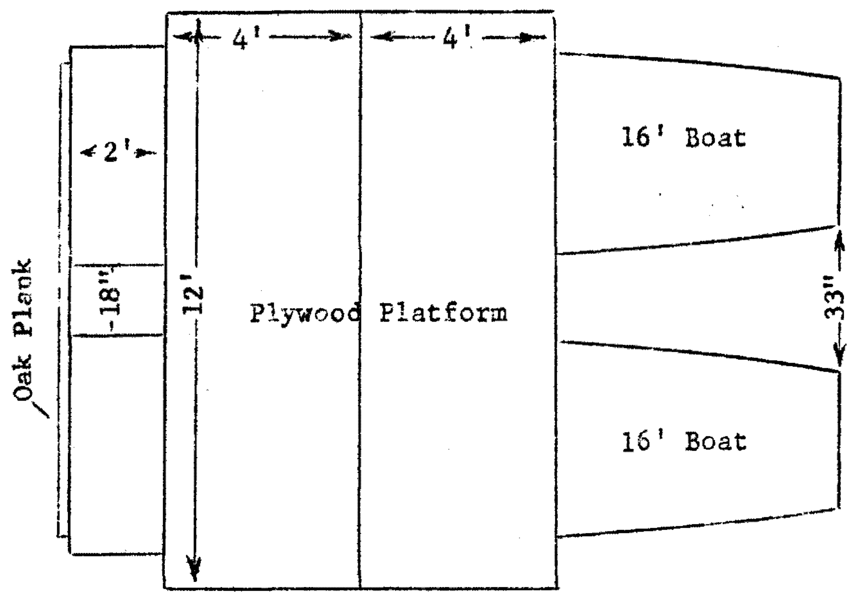
With this rig it is possible to carry eight 30-gallon drums of 9-1/2 pound sodium arsenite and five men, so that the barge is capable of carrying a load in excess of two tons. The 15-horse-power motor manuevers the barge well and provides sufficient power to move the loaded barge at a speed of four or five miles per hour.

The equipment could be improved by installing a steering wheel and remote controls for the outboard motor at the forward end of the platform. This would enable the person who is operating the outboard to get a better view of his forward progress more safely and comfortably.

Under the present set-up, it is necessary to stop the outboard motor when the drum is empty, hook up another drum and begin again. This delay could be eliminated very easily by having two drums so piped that when a drum is emptied the full one could be valved in and the empty one replaced. This process could be carried on until all the drums on board are used up. In order to accomplish this, it would be necessary to install a Y or a tee at the chemical intake end of the pump. To the terminal ends of the Y or tee, two 3/4-inch gate valves should be installed. These, in turn, would be connected by hoses to two valved drums. The double valving for the two connections would be necessary to prevent the escape of the liquid while the drums are being turned over into the cradles and to retain suction on the drum being pumped.

The approximate cost of the equipment is as follows:

Two boat trailers	$213.00
Two boats	450.00
Wood for platform	55.00
Pump	90.00
Outboard motor	232.00
Plumbing supplies	70.00
Hardware	25.00
Hose	25.00
Total	$1160.00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12'
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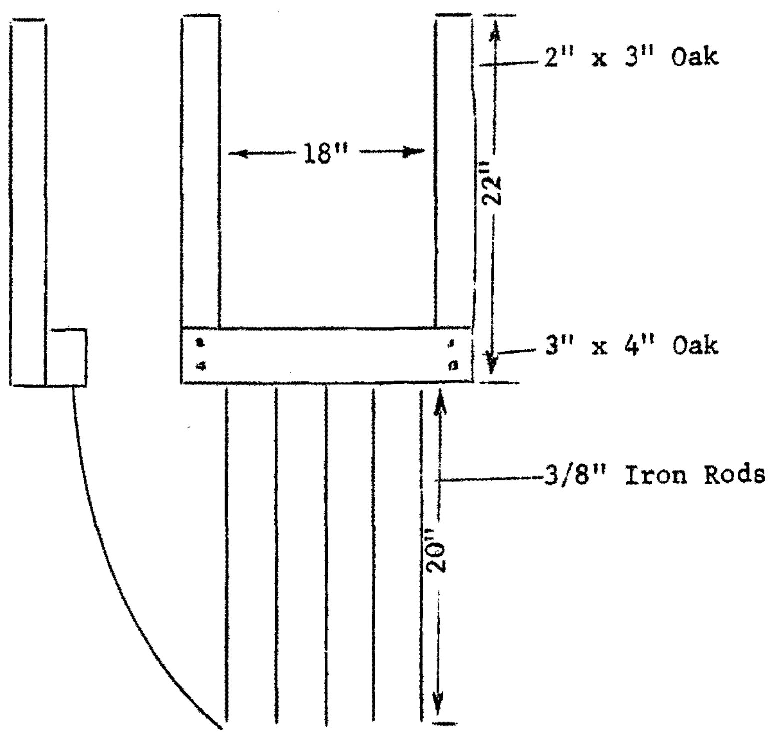
Plywood Platform
16' Boat
33"
16' Boat

Fig. 1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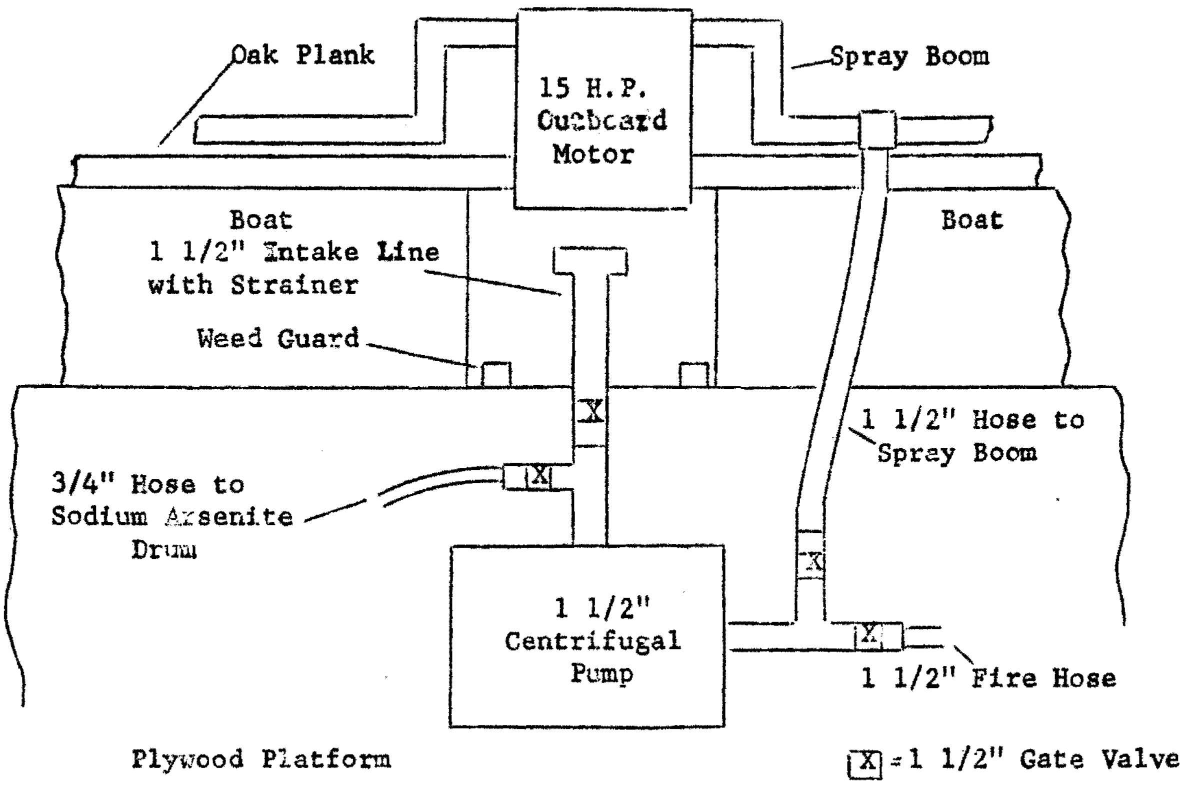
3/8" Iron Rods
20"

Fig. 2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Outboard
Motor
Spray Boom
Boat
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with Strainer
Boat
Weed Guard
1 1/2" Hose to
Spray Boom
3/4" Hose to
Sodium Arsenite
Drum
1 1/2"
Centrifugal
Pump
1 1/2" Fire Hose
Plywood Platform
X = 1 1/2" Gate Valve

Fig. 3

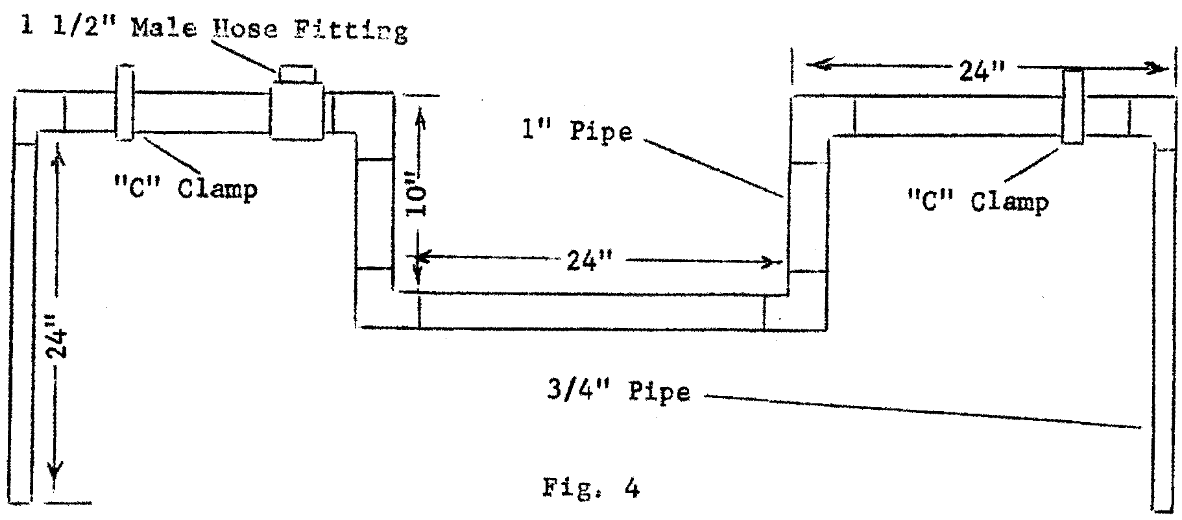

1 1/2" Male Hose Fitting
24"
1" Pipe
"C" Clamp
10"
"C" Clamp
24"
24"
3/4" Pipe

Fig. 4

WEED CONTROL ACTIVITIES IN NEW YORK STATE

Donald B. Stevens

Before I get into specific weed control activities in New York State, I would like to review briefly our pollution laws and show how these are tied up with this matter of weed control. The water pollution control act was passed in 1949 and has become Article 12 of the Public Health Law. I have here a few reprints of that article and, if these are used up, I can send you one upon request.

In this article, the declared public policy of the State is "to maintain reasonable standards of purity of the waters of the State consistent with public health and public enjoyment thereof, the propagation and protection of fish and wild life, including birds, mammals and other terrestrial and aquatic life, and the industrial development of the State....." Thus health, recreation, conservation and commerce must be considered when evaluating water uses. To that end, a Water Pollution Control Board was created to administer this law and it is composed of the Commission of Health as Chairman, Commissioner of Conservation, Commissioner of Agriculture and Markets, Commissioner of Commerce and the Superintendent of Public Works.

One of the duties of this Board was to draw up and adopt standards of quality and purity for the various waters of the State. This was done after a series of public hearings throughout the State and became effective on October 25, 1950. These "Rules and Classifications and Standards of Quality and Purity for Waters of New York State", copies of which are here for distribution have a very important bearing on weed control activities as I will discuss a little later.

Another duty of the Board is to classify all the waters of the State which are defined to include "lakes, bays, sounds, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic Ocean within the territorial limits of the State of New York, and all other bodies of surface or underground water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or effect a junction with natural surface or underground waters), which are wholly or partially within or bordering the State or within its jurisdiction". In order to classify the waters, certain steps must be taken which are as follows:

1. A survey of a watershed.

2. A published report containing a recommended classification of waters within the watershed.

3. A public hearing on the recommended classification.

4. Adoption of an official classification and filing the same with the Secretary of State.

This program was started in the Fall of 1949 and as of July 1, 1956 approximately 21,000 square miles of the State representing approximately 44 percent of the State had been surveyed. Reports had been published or were in the process of printing covering 17,500 square miles or 37 percent of the State. Public hearings on due notice to consider the recommended classifications had been held on 16,700 square miles or approximately 35 percent of the State and official classifications covering about 9,700 square miles or 20 percent of the area of the State have been adopted and filed with the Secretary of State.

These figures have been somewhat increased by the work of the last six months and the current status of the program is shown on this map as well as delineating the actual areas and their respective stage in the over-all program. Two additional stages in the program are depicted on the map dealing with the pollution abatement phases which do not need to concern us here.

Let us now return to the matter of the classification of the waters which was referred to earlier and see how it may affect the weed control program. In this regard, I think we should confine ourselves to the fresh surface waters. Here we have seven classes which are designated respectively as AA, A, B, C, D and E. As stated in the public policy of the law, consideration of the water usages in terms of health, recreation, conservation and industrial development, must be considered in assigning classifications. While all of these aspects are considered, for Class AA and A waters, the best usages of the waters are considered to be "Source of water supply for drinking, culinary or food processing purposes and any other purposes".

In quality standards for these classes is the following: "Toxic wastes, deleterious substances, colored or other wastes or heated liquids. None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the water unsafe or unsuitable as a source of water supply for drinking, culinary or food processing purposes or impair the waters for any other best usage as determined for the specific waters which are assigned to this class". Continuing "Note No. 1: In determining the safety or suitability of waters in these classes for use as a source of water supply for drinking, culinary or food processing purposes after approved treatment, the Water Pollution Control Board will be guided by the standards specified in the latest edition of "Public Health Service Drinking Water Standards", published by the United States Public Health Service.

Sodium arsenite is becoming quite popular as a weed control chemical. The drinking water standards referred to above state ".... arsenic in excess of 0.05 p.p.m....... shall constitute grounds for rejection of the supply". This can usually be construed to apply to the water drawn into the treatment plant for processing rather than in the actual body of water from which it is drawn. However, this does impose some rather stringent restriction as to doses of this type of weed control chemical and the location of the areas treated with reference to the water intake.

Classes AA and A quality standards also have prohibition with reference to oil. This could be applied with reference to the oils used to disperse some of the organic weed control preparations.

In the standards, you note it states"made the water unsafe or unsuitable as a source of water supply". Thus, any material which would increase noticeably the taste or odor of the water and thus render it unpalatable would not be permitted.

While these drinking water standards contain a copper standard, this will not be discussed as a much lower value is used where fish are concerned.

Turning now to other classifications of waters besides those for domestic water supply purposes, we have Class B, "Bathing and any other usages except as a source of water supply for drinking, culinary or food processing purposes" and Class C, "Fishing and any other usages except for bathing or as a source of water supply for drinking, culinary or food processing purposes". In the quality standards for these waters is the following: "Toxic wastes, oil, deleterious substances, colored or other wastes or heated liquids. None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life or impair the waters for any other best usage as determined for the specific waters which are assigned to this class". The specification for Class B is amplified to include the phrase "Make the water unsafe or unsuitable for bathing". The specifications for Class D waters modify this standard to "to prevent fish survival or impair the waters for agricultural purposes".

In addition, it should be mentioned that Section 180 of the Conservation Law specifies that no deleterious or poisonous substance shall be allowed to run into any waters, either private or public, in quantities injurious to fish life. Under this law, there is no provision for exception of the killing of fish incidental to use of chemicals for weed control purposes.

All of the above means that the material used to control the weeds must not, either because of dosage, method of application or composition, kill fish. No consideration is given to the argument that the few fish killed during the operation to control the weeds will be more than compensated forthe increase in size of the remainder or by the improvement to fishing in general.

As mentioned earlier, Class B has prohibitions against anything that would render the water "unsafe or unsuitable for bathing". The bathing season is usually considered from May 15 to September 15. Thus, consideration for that aspect would only have to be between these dates. As far as known, there has not been any specific standard set for arsenic concentration in bathing waters. However, in one area treated with sodium arsenite, a maximum concentration of 1.0 p.p.m. was set and the public warned against bathing until the level fell below this point in the lake outlet.

Before leaving these items which should be considered before attempting to control weeds, especially by chemical means, I would like to mention one other point. The chemicals should be applied to the early spring growth of weeds so that the decay of the killed weeds will not lower the dissolved oxygen of the water to levels which will be harmful to fish life. This could also apply to the cutting of weeds if the cut material is not removed.

The material presented so far has been done for the express purpose of showing that any program for the control of weeds in New York State must be considered in the light of the pollution control law and not as an isolated incident unconnected to anything else.

I would now like to report on some specific cases in New York State where weed control measures have been taken.

The New York State Legislature in its 1955 session passed a bill authorizing and directing the Conservation Commissioner to carry out several controlling, regulating and restorative measures on Chautauqua Lake. The work in 1955 was limited to investigation and analysis of the problems from which to make recommendations for future full scale efforts at control and restoration. One phase of this was to regulate, control or remove excessive growths of eel grass and other aquatic weeds and plants which render certain areas of Chautauqua Lake unsuitable for recreation purposes.

To carry out this program, several means of aquatic weed control were considered. The two methods that appeared most promising were weed cutters and chemical control using sodium arsenite. Cutting has been practiced in the past. This appears successful as a temporary measure in giving a clear water depth of five feet. However, it has to be done usually more than once in a single growing season and the cut portions can spread weed growth to new areas. Also, if the cut weeds are left in the water, they are blown ashore causing annoyance and inconvenience to owners of shore property.

Certain specific areas in the lake were cut during 1955 so that the effect of the cutting could be observed over the following years.

Two areas were selected for using chemical weed control. One was in shallow water (three feet average depth) and the other in deep water (nine feet average depth). The chemical used was a special preparation of the Applied Biochemists and Associates of Butler, Wisconsin. This is a patented preparation consisting of 90% sodium arsenite and 10% wetting agents. The material was sprayed on the plots selected. In the shallow area, the sodium arsenite concentration was held to 8 p.p.m. as As_2O_3 while in the deep area it was 10 p.p.m. As_2O_3.

Since this lake is used as a source of water supply by some of the cottages bordering the lake as well as Chautauqua Institution, these sources were asked to refrain from using the water from the time of spraying until the arsenic concentration dropped below 0.05 p.p.m.

The shallow area was treated on August 16th and the next day about 120 dead fish were observed in that area. They were all the young of that year. No additional dead fish were reported from this area and there were no reports of any dead fish in the area of the deep water.

On August 17, the deep water area was sprayed. By September 9, it was reported that the weeds were down in the deep water area and the water was very clear. In the shallow water area, the weeds were down in general but there were appearances of re-growth.

As a result of this activity, the organization of property owners on Findley Lake, which is in the same general area, decided to spray that lake for weed control. In this case, instead of hiring a professional to do the work, the group purchased the materials and applied it themselves. Here the areas selected were around the edge of the lake rather than plots out in the lake itself.

There was only one known cottage where this lake was used as a water supply and arrangements were made for water from other sources. All other supplies were obtained from wells located near the shore and arrangements were made to sample these frequently to check on arsenic concentrations. Since this is a recreational lake, a ban was placed on swimming until such time as the health officer for that area felt that the waters might be safely used again.

The spraying operations started on June 2, 1956 and lasted three days. Spraying was mainly confined to the shore areas but, since some material was left over, a channel down the middle of the lake was sprayed. The concentration used was 7 p.p.m. as arsenic. The concentration of arsenic in the lake was followed by collecting daily samples at the outlet where it flows over a dam. The concentration of arsenic here rose to 7 p.p.m. 24 hours after spraying and then began to drop off. However, 12 days after spraying, the concentration was 1.5 p.p.m.

Seventeen days after spraying, the concentration at the outlet had dropped to 0.7 p.p.m. and the ban on swimming was removed. However, samples 35 days after spraying still showed arsenic of this concentration in the lake outlet. The concentration of arsenic in the bottom mud was not checked and this might be the source of the continuing arsenic in the lake outlet.

There were no reports of any dead fish resulting from this operation.

The data on this operation were obtained from the engineer with the State Health Department located in this area. It is hoped that he will have a chance to write this up and have it published.

THE EFFECT OF TEMPERATURE ON ALGAE GROWTH

By W. D. Monie, Chief Engineer
Portland Water District, Portland, Maine

Around 1920, Dr. Setchell, Botanist of the University of California, in a study of plants found definite temperature ranges within which various flowering plants began to grow and higher ranges at which they will flower.

These critical temperatures were found to be close to 5°, 10°, 15°, 20°, and 25° C., (41°, 50°, 59°, 68°, and 77° F.). He found that as the temperature passed the critical point certain species were stimulated to activity.

Hydrobiologists find that these critical temperatures hold for algae and protozoa. Because of the slower temperature changes in water, these ranges are more pronounced than is the case with land plants.

Since these critical temperatures were first pointed out to the author by Dr. Nelson, Professor of Zoology at Rutgers University, in 1941, special attention has been given to this phase of algae study.

Practically all of the author's experience in algae control was obtained at the Canoe Brook Reservoir of the Commonwealth Water Company, located in Millburn, N. J. While chemist for this company, I found that the thermometer was an important aid and companion to microscopic examination. By keeping close watch on the water temperature, especially surface temperature, the growth of different types of organisms can be anticipated. When the water temperature is approaching any of the critical temperature points, that is the time to pay particular attention to microscopic examination.

I would like to point out that we in the water supply business are interested in the control of algae growth. Our treatment is a preventive measure, not a cure. We would rather treat a supply before the telephone rings with taste and odor complaints, not after. Thus, in water supply treatment careful attention is made to microscopic examination.

Figure No. 1 is a chart showing total algae count by weekly average for a typical year in the Canoe Brook Reservoir, together with surface temperature of the reservoir water. The samples were prepared for microscopic examination by the Sedgwick-Rafter method. The algae counts consist of counting 10 fields at 100x magnification and recording the total number of organisms in each. The sum of the organisms in the 10 fields examined make up the daily algae count. The curve marked "Total Algae Count" in figure No. 1 is the weekly average of the daily counts.

An ocular micrometer was not used in making these counts; the entire field was counted. Therefore, the counts shown on figure No. 1 are about 15 per cent higher than a count in standard units.

You will note in figure No. 1 that the horizontal temperature division lines are the critical temperature points of 41°, 50°, 59°, 68°, and 77° F.

In examining this chart we see that there is a marked decrease in algae as the temperature drops below the first critical temperature point of 41° in January. In fact, when the temperature of the water dropped to around 35°, to all practical purposes there were no algae present.

I do not wish to create the impression that alga does not grow in waters with temperatures below 35°. Organisms do grow in this cold water and are found in the waters of ice-coated reservoirs. One very troublesome organism, Synura, grows in this cold water. This particular specie is important to the water works operator because its presence in even small numbers causes a very disagreeable taste and odor in water.

In March we note a large increase in algae as the temperature passed the critical point of 41° F. Then note the drop as the second critical point of 50° F. is approached, followed by a marked increase immediately after passing this point around the latter part of April.

High counts at this time were due largely to Asterionella, which could be tolerated, so no treatment was made.

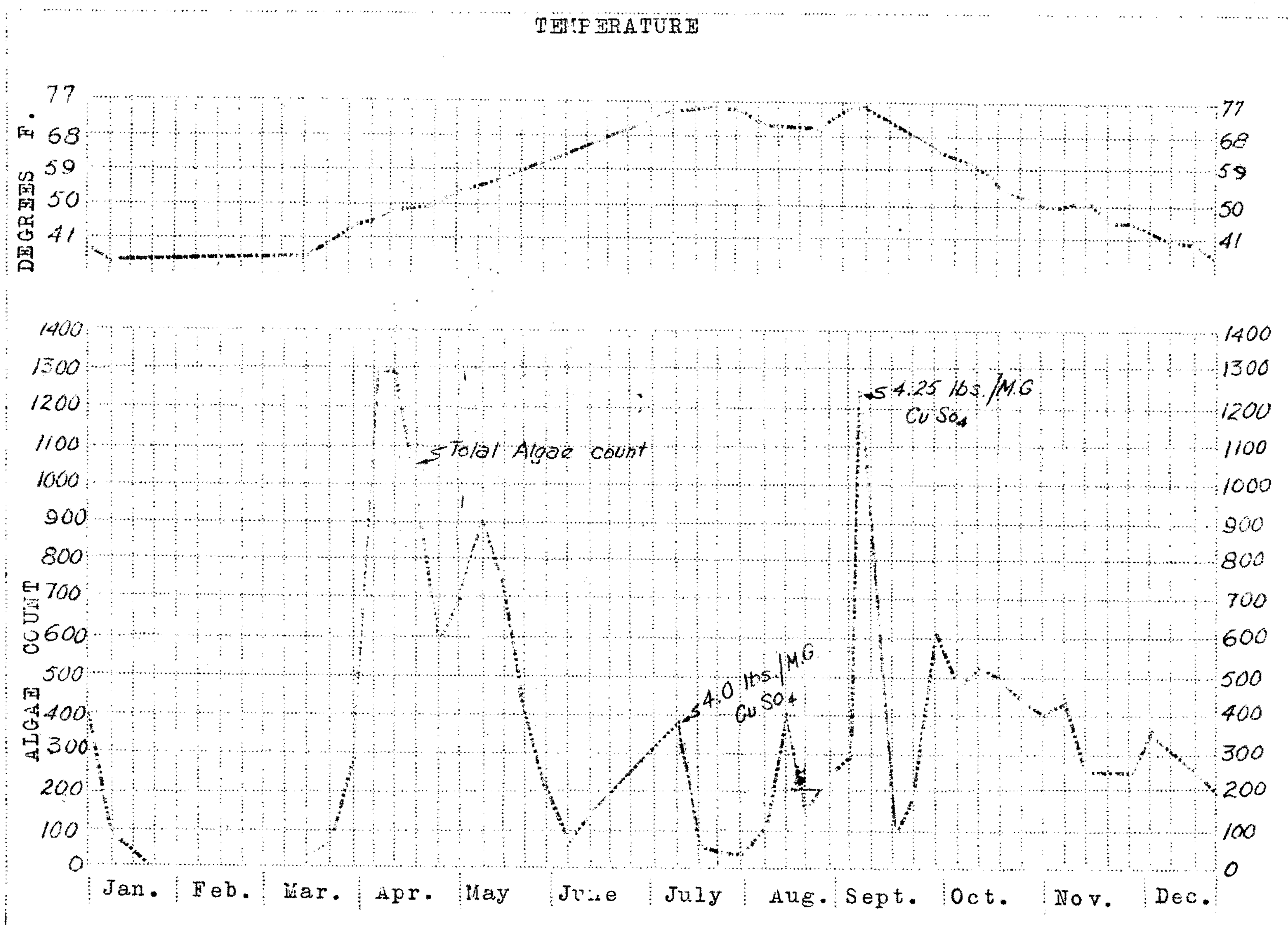
As the temperature increased through May, the algae count decreased and continued to decrease until the fourth critical temperature point of 68° F. was approached in the middle of June, followed by a marked increase as the fifth critical point of 77° was reached in the middle of July.

The increase in July was due mostly to Aphanizomenon, which is a trouble maker. Therefore, the increase was stopped by a 4.0 lb. per m.g. treatment with copper sulphate.

Notice the increase in the middle of August, when the temperature dropped close to 68°, and then the large increase when the temperature again approached 77°. This increase was due to Aphanizomenon and Anabaena and again was squelched with a 4.25 lb. per m.g. treatment of copper sulphate.

As the temperature of the water began to cool in the latter part of September, the algae decreased with some rise near the critical temperature points and with a sharp drop after passing below 41° F.

As a doctor by keeping a frequent check on his patient can stop a serious illness before it develops, so can a water works operator keep his reservoir in good condition by constant examination. If regular care is not given, serious trouble can and will develop. A check on the water temperature can be of immense value in algae control just as the doctor's thermometer is of great value to a doctor in his check on his patient.



TEMPERATURE
DEGREES F.
77
68
59
50
41
ALGAE COUNT
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Tolat Algae count
4.25 lbs./M.G
Cu So4
4.0 lbs./M.G
Cu So4
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

Figure # 1

THE NECESSITY OF WEED AND ALGAE CONTROL IN THE POTABLE WATERS OF THE NORTH EAST

M. C. Rand

Wherever surface waters serve as a source of public water supply, there exists the possibility that algae or higher aquatic plants may become a nuisance. The relatively small population of mixed species characteristic of many waterways is not a serious problem. It is when one or a few species proliferate to enormous numbers that difficulties arise.

The problems which may result from such unwanted or excessive growths are various. The most important, or at least the most frequent, from the standpoint of potable water supply, are those which have their basis in the load of organic matter newly created by photosynthesis and introduced directly into the water. Added from almost any other source, this material would be considered pollutional. The total quantity may be quite large. When a considerable proportion of it decomposes simultaneously, following a mass kill brought about by a change of weather or the application of a chemical, the resulting oxygen demand may seriously tax the aeration capacity of the waterway. Fish kills from this cause are a well-known occurrence.

Problems of this acute type are fortunately not the most prevalent in potable water sources. They serve only to illustrate the quantitative significance of photosynthesis in the addition of organic matter to surface waters. It is hardly surprising, then, that the more subtle properties of the water, such as taste and odor, may be rather seriously affected.

Unpleasant tastes and odors are, in fact, among the most frequently noted effects of heavy plant or algae growths. The problem is apt to be intensified as the organisms die and decompose. However, many of the algae, particularly, produce aromatic products in their normal metabolic processes. These species, then, may cause taste and odor problems during their lifetime as well as after death. The tastes and odors produced have been variously described, in terms ranging from "very offensive" or "fishy" to "violet" or "muskmelon". To the water plant operator, however, the nature of the taste and odor makes little difference. The senses of taste and smell are so highly subjective that the same compound often smells pleasant to some persons and unpleasant to others. Furthermore, many feel that even the odor of violets is out of place in a drink of water. Consequently, a water plant can expect complaints any time the taste of the water changes.

It should be noted in this connection that on occasion the tastes and odors resulting from uncontrolled growths prove very difficult to remove. Moreover, when these organic compounds are subjected to chlorination, their tastes and odors are likely to become both more intense and more unpleasant.

Sometimes, growths which are not heavy enough to cause taste and odor problems at the time of their development nevertheless cause a gradual accumulation of decaying organic matter at the bottom of a lake or reservoir. During the spring and fall turnover, these accumulations may be resuspended and cause rather acute problems at those times.

While tastes and odors are the most frequently encountered problems caused by the organic matter introduced by heavy growths, there are other categories also serious enough to merit consideration. It has already been implied that the organic matter reacts with chlorine, which is added to control the bacteriological quality of the water. Since the reaction products are seldom good bactericides themselves, this necessitates the addition of more chlorine, increasing the cost of treatment.

Again, if the organic matter is high enough in concentration so that its decomposition more or less depletes the dissolved oxygen, several undesirable effects upon the water quality may result. Most directly, the absence of dissolved oxygen gives a "flat" taste to the water. A part of the oxygen is converted to carbon dioxide, which tends to make the water more acid and corrosive. Also, the conditions of low dissolved oxygen and high carbon dioxide favor the solution, from the submerged soil, of iron compounds, which in themselves are undersirable constituents of a water supply.

Finally, it has been seriously suggested that certain of the organic compounds released to the water may have a physiological effect on persons using the water. It is known that some of the compounds present are powerful drugs. There are only a few cases on record of acute effects - gastroenteritis, for example - related to the existence of algae blooms. But possible chronic effects of long-term ingestion of small amounts of the physiologically active metabolic products of algae are currently under study at several laboratories. The questions raised are the possible relationship of such compounds to longevity, incidence of cancer and geriatric disorders, etc.

Most of the foregoing discussion has centered around matters concerned primarily with the organic matter in true solution. Naturally, that in suspension contributes to the same effects. In addition, suspended organic matter, in the form of algae or broken parts of higher plants, may be a serious nuisance in the operation of sand filters. The trouble is especially serious on slow filters, since no means of backwashing is provided, and growth may actually occur on the filter if light is available. But in rapid sand filters also, the more frequent backwashing required by high turbidity in the raw water reduces the net production of treated water and increases operating costs.

Not only may the decomposition of organic matter lead to difficulties, but the processes involved in its production may also be troublesome. While photosynthesizing actively, algae and aquatic plants utilize large quantitites of carbon dioxide. In bright sunlight, heavy growths are even capable of decomposing dissolved carbonates and bicarbonates. In darkness, on the other hand, carbon dioxide is released by respiration. As a result, the concentration of dissolved carbon dioxide, the pH, and in extreme cases even the hardness and alkalinity of the water vary through a daily cycle. This constant variation makes it very difficult for a water plant to know the correct dosage of chemicals to add for treatment. For best results, frequent testing of the water and readjustment of the chemical feed becomes necessary. To complicate matters further, the variations of water quality are not regular from day to day, being much greater in clear, sunny weather than when sunlight, and consequently photosynthesis, are reduced by cloudy skies.

In reservoirs, siltation is always a problem. Heavy growths of rooted aquatic plants tend to aggravate the situation, both by adding their own bulk to the deposits and by creating quiescent areas which favor the sedimentation of suspended matter from the water.

From what has been said, it is evident that excessive aquatic plant or algae growths may produce several problems for the operators of a water plant. When such a situation arises, the water company is faced with a choice among three alternative courses of action. The first and simplest is to do nothing - to merely endure the imparied quality of the finished water and hope that the trouble will not be of long duration. The second possibility is to provide special treatment at the plant to cope with the situation. Finally, it may be necessary or desirable to deal with the problem at its source - to control or prevent the troublesome growths in the lake or reservoir from which the water is drawn.

The choice among these alternatives is influenced by several factors. First, the decision to act or not to act usually depends upon the frequency, duration, and severity of the periods of trouble, and therefore, upon the number and the vehemence of the complaints received by the water company.

Having decided that something must be done, the next question is whether it is better to control the growths, or to counteract them and their effects by special treatment at the water plant. Here the answer is usually dictated by economic considerations, which in turn bear upon the intensity of the growth and the relationship between the total volume (and area) of water in the reservoir and the volume treated daily. To give an example in which the conclusion is fairly obvious, treating a hundred million gallons for algae control all summer may well prove more expensive than activated carbon treatment of half a million gallons per day over the same period. Thus each case must be individually judged by its own merits. In many cases, however, treatment of the water source to control the development of excessive growths is the best course, especially if treatment is begun early in the growing season with the emphasis on preventing the development of a problem situation.

County Agent-Industry Relationships and Why

E. R. Marshall [1/]

Let us start out this discussion by asking two questions: Why should a County Agent or extension worker be interested in maintaining a good working relationship with Industry and in return why should agricultural chemical companies encourage their representatives to maintain a close working relationship with County Agents and extension workers. Unless we can resolve these questions there is little need for exploring how this is to be done.

Perhaps one way to approach these questions would be to outline some of the objectives of each group. We're all familiar with the function of County Agents and extension personnel. One of their basic aims is to carry information to the farmer so that he can apply this knowledge in operating his farm more efficiently and profitably. In other words they are interested in making money for the farmer. Another vital function is that of a trouble shooter. If a farmer runs into a particular problem in his operations, extension personnel stand by to help him solve the problem thus preventing him from taking a loss. In other words help the farmer keep the money he already has.

The agricultural chemical industry on the other hand has one basic objective - make money for the stockholders. This of course implies that people such as salesmen, technical representatives, and others in line in the company will be remunerated just as the County Agent expects to be paid for his efforts.

At this point the objectives of the two groups seem a long way apart - but are they? The surest and quickest way of selling a product to a farmer is to show him that this product will do one of two things - either make more money for him or prevent him from losing money he already has. These are broad general terms and could be made more specific by referring to prevention of crop loss, etc. But, the ultimate result is interpreted by what it does to the farmers' financial condition. What has happened to the difference in purpose now? The breach has closed and we find the two groups attempting to do the same thing - make money for the farmer. County Agents do this because it is their job while Industry does it because it is a necessity if they are to obtain their objective of making money for the company.

Since both groups desire to accomplish the same purpose and since they are not in competition with each other, why should they not cooperate in accomplishing this purpose so long as this cooperation does not infringe upon other basic purposes of each group.

How can this cooperation be mutually attractive and what is the key to its success? The key to success is the mutual desire of each group to assist the other in obtaining the principal objective - make

1/ Carbide and Carbon Chemicals Co. Fellowship
Boyce Thompson Institute for Plant Research Inc., Yonkers, N.Y.

money for the farmer. This does not mean that a County Agent should become an unpaid salesman for a chemical company nor does it mean that industry's representatives should become self-styled County Agents. It merely means that each group should work with the other on ideas and goals which will help attain their mutual goals. The agricultural chemical representative must offer the extension worker some return for his interest just as he in turn will depend on the County Agent to assist in carrying the chemical story to the farmer.

Let's look at ways in which a County Agent can cooperate with industry.

A recent survey has shown that the most popular sources of information for the farmer are the Extension Service and popular articles and advertisements in papers, magazines, etc. This means that farmers are relying heavily on the Extension Service for information on new practices and products. This is becoming more evident each year as our Extension Service becomes more effective and farm practices become more technical and complicated. As a consequence industry must depend on the Extension Service to carry its story or products to the farmer. Industry knows well the problem of trying to sell a product in a county where the Agent is disinterested. This does not mean that County Agents should be "beating the drums" for any particular chemical manufacturer or distributor, but, if a company or companies have a product which will save or make money for a farmer, then the County Agent should make every effort to inform farmers of the availability of such material. Likewise, if a farmer has obtained information about a new chemical or practice, a County Agent should be familiar enough with the commodity and its uses or restrictions so that he can verify or nullify the advisability of the farmer incorporating this practice into his farming operation. In referring to new practices it should be kept in mind that we are talking only about practices which have received the approval of the Central Extension Service System.

It is a well-known fact that in many cases farmers receive information on new agricultural chemicals before this information has been transmitted down through the various channels to the County Extension Service. County Agents, through contact and cooperation with industry, have an opportunity to get this same information before it reaches the grower level. This can be done by cooperating with industry during the early exploratory or field testing phases of chemical development.

Another function which County Agents can and often do perform is the locating of field testing cooperators. With the greatly increased demand for more information on crop residues and tolerances, comes an increased need for more farm testing of chemicals before they can be registered for sale. Chemicals need to be tested in many different areas on a number of crops. In determining where and how a chemical is to be tested a County Agent can play a very vital part. He is intimately familiar with the crops and problems that exist in his particular area. He knows what farmers would be willing and effective cooperators. He should be a real contact for companies wishing to test their chemicals under actual farm conditions. In this same regard industry should not enter a county and set up farm tests without the knowledge of the County Agent if in turn they expect him to cooperate with them in publicizing any favorable results which may arise from such a test.

The County Agent can act as a guide for industry in determining how to introduce a particular program in his area. On the other hand if a program which a particular concern feels should be rolling is not, then the County Agent should be in a particularly good position to help determine why the program is not a success.

Industry is continually looking for new or different problems that it might work on. The County Agent is in direct contact with farmers' problems from day to day. He is in an excellent position to determine new problems as they arise and the seriousness of each. He can be of real service to industry in making these problems known to industry as they develop.

Another area where a County Agent can be of value to a chemical company is in cases where a particular product has not performed satisfactorily. By acting as a clearing house for farmers' problems the County Agent can be of real service to industry by notifying them of any particular cases where a product did not perform as it should be expected to on the basis of label claims and literature. In this way the source of the trouble can be tracked down before a good product may get an unjustified"black name". In case of trouble one of the things a County Agent can do to promote good relations with Industry is to notify a company representative immediately after hearing of trouble with one of the company's products. Only too often these problems get kicked around for weeks or even months before the company is informed. By this time details are lost which might have prevented a re-occurence of the trouble. In order to do this effectively a County Agent must have good liaison with company representatives so that he knows who to contact on each particular problem.

Now let's look at Industry and see what they can offer County Agents in return for their cooperation. One of the most important factors is information on new or promising chemicals and practices. The County Agent is continually faced with the problem of getting the information on products before the farmer faces him with questions. In general, Industry's representatives are looking at Agriculture in a much broader scope than is the County Agent. Therefore by close contact with County Agents the activity and effectiveness of chemicals in other areas will be brought out. This in turn may give ideas for new uses in the local area.

In supplying information to County Agents, Industry also has certain responsibilities. It must supply useful and reliable information. In the field of agricultural chemicals the day of the fly-by-night salesman who streaked through a territory selling a bill of goods from farmhouse to farmhouse never to return again is passe'. Today a farmer with his huge investment cannot afford to try something strictly on the basis of some glib salesman's remarks. He must be fairly certain that a material will do the job he wants it to do and make money for him if he is going to invest in it.

On the other hand, with the millions of dollars spent in developing an agricultural chemical today, Industry cannot afford to market a poor product which will not do a job or will not make money for farmers. Industry must provide compounds which will do a job economically and when these compounds fail or others replace them they must have been truthful enough in their relations so that their next product will be received with enthusiasm. In order to do this it is imperative that Industry supply the County Agent with a realistic look at any program it is proposing.

It is Industry's responsibility to keep County Agents informed on whom to contact in case of trouble with a particular product. Furthermore, it is Industry's responsibility to see that follow-up calls are made on complaints coming from County Agents. If we are going to request that we be informed when trouble spots occur then we must do everything we can to help solve these problems.

Let me emphasize to Industry that the County Agent is an extremely busy person with many other interests than agricultural chemicals. His office should not be a place to pass a half-day on a regular routine call. If you have something of value for him, give him the story and move on. He'll pay more attention next time.

In most cases Industry is ready and willing to cooperate with the Extension Service in pushing various production programs. This may involve supplying chemicals for demonstrational purposes or supplying technical personnel for meetings of various types. A close working relationship between Industry and County Agents guarantees the maximum cooperation on programs of this type. It is common practice for Industry when introducing a new program to contact County Agents in areas where this program will do the most good. This of course means such programs move ahead sooner in these areas. A County Agent who has maintained a close working relationship with Industry will get top priority in cases such as this. When a farmer in a community realizes that the County Agent is keeping ahead of him on new practices he will turn to him for guidance in preference to other sources of information.

In my associations with Industry and County Agents I have seen many cases where material benefits were gained from good working relationships between the County Agent and Agricultural Chemical Representatives. When new weed control chemicals or weed spraying equipment are introduced the retail points which lead in sales are invariably those in counties where the Agent is in close liaison with the Agricultural Chemical Industry. It might be added that there are many examples of County Agents who have moved into Industry as a direct result of such cooperation.

In closing, we may summarize it this way. Both Industry and the Extension Service have a mutual goal in helping farmers produce crops more efficiently. This may be by saving time, labor, money, or simply by doing a better job. The County Agent wants to make money for the farmer. Industry has to make money for the farmer or it does not have a product. Thus by close cooperation these money-making programs can be brought into fulfillment sooner and more effectively. The net result will be more money for the farmer, a more effective County Agent, and greater returns for Industry.

WHAT IS A USEFUL WEED CONTROL DEMONSTRATION FROM A COUNTY AGENT'S POINT OF VIEW?

by

James A. McFaul
Nassau County Associate County Agricultural Agent

The Agricultural Agent has many techniques for getting information into the hands of farmers and growers. Personal visits, circular letters, radio, television, meetings and tours, are all methods at his disposal for disseminating the results of research and up-to-date agricultural information.

In addition to these methods, there is the demonstration. This is a widely used, very effective means for getting across a new approach or encouraging a grower to change his normal practice.

The demonstration can be a very simple one involving the use of one or two weed control materials, or it can be an extremely complex array of chemicals at different rates of application applied in successive years for the control of certain weeds. Whether it be simple or complex, its purpose is the same -- to show farmers, nurserymen, and the public, what happens when a weed control material is applied at a specified rate of application. It may successfully control that weed without injuring the crop, or it may do a poor job of weed control and even cause some damage to the crop. In any event, it's the County Agent's technique for showing farmers what can be expected from a material.

Demonstrations are better educational techniques than other means because people can actually see, in many cases on their own farms or nurseries, the performance of a material. During the course of the demonstration, they can watch the action of a herbicide, see how it was applied, and determine with the Agent, what problems are encountered in its use.

In order for a demonstration to be useful, it must be well planned and efficiently conducted. It is the County Agent's responsibility, not only to test and show weed control materials that we know are useful, effective, and will economically fit into the farmer's program, but also weed control materials that might be widely advertised and sold, but which don't measure up to claims!

A demonstration is most useful if it is arranged on the farm or place of business of the individual who is seeking information about that particular weed control material. Generally, this farmer will be more than glad to set aside an area for the purpose of conducting the demonstration, he'll have enough interest in it to watch it carefully and protect it from normal cultivation and maintenance practices on the farm which would render the demonstration useless. Also, if the material is effective, then the farmer will pass along the results of this work to surrounding farmers and, in effect, do an Extension job.

(Continued)

Features of a Good Demonstration

Good demonstrations require a lot of planning. They don't just happen, and usually, it is advisable for the County Agent to work closely with the Extension specialist so that he is sure his plots will be set out properly with the most effective materials and the recommended rates of application. Demonstrations should be simple, and concise, to be effective. It is the research worker's duty to try new materials on many crops at various rates of recommendation. Once he has determined, within reason, the optimum rates for specific crops, he should then pass this information along to the Agricultural Agent whose responsibility it is to show farmers, nurserymen, and others, just how this material works under local conditions. There is no need to repeat the work of the specialist. Don't try to work with too many materials, methods of application, or crops at one time. It is better to try one material at two or three rates of application on one specific crop. As an example, if research determines that Chloro IPC is most effectively used in evergreen nursery stocks at eight pounds per acre in one hundred gallons of water, set up your demonstration using this material at the optimum rate of application, and include at least two other plots -- one at a light rate of application (four pounds per acre) and another at a high rate of application (twelve pounds per acre). This way, the County Agent can show growers what happens not only when the material is used at the recommended rate of application, but also the results obtained when the material is used at lighter and heavier than recommended rates. He'll see the effect on control of weeds, and also the effect on the nursery stock. Make your plots all the same size. If you expect that some injury to the crop may occur as a result of your treatments, be sure that the farmer understands this before you apply materials.

Demonstration Site

Select a location that is convenient to the growers who will want to see your demonstration. If all the onions are grown in the southern part of the county, then this is where your onion weed control plots belong. Also, if you have a choice, pick a grower that is well thought of and respected in the community. Such a man will be a better drawing card than if you conducted your work on a farm that is inefficiently operated and considered to be one of the poor ones. The demonstration, if conducted on a successful farm, will have an air of success about it even before people see the results of your work. Mark your plots clearly and use terminology that is understandable to the grower. If possible, use pints, quarts, gallons or pounds, and stay away from labelling your plots and chemicals with grams, cc's and liters. Such terminology means little to a farmer.

Public Inspection

All demonstrations should be planned and staged so that the public can be invited to view the results of your work. County Agents can increase the effectiveness and quality of this work by setting up demonstrations carefully and accurately so that growers, other than the one where the demonstration has been set up, can see the results of these trials and take advantage of these results.

(Continued)

As you show growers the plots, make sure that you carefully explain the procedures used and results obtained. Also give your visitors an opportunity to ask questions as you go along. Most people think of a question just once; and if asked to wait until the end of the program, they will not remember it. It is advisable to have the apparatus or equipment on hand that was used to apply the weed control materials. Also have small quantities of the herbicides on hand so that growers can actually see what they look like.

Farmers find it helpful if you also demonstrate how materials were applied.

Turn the group over to a fellow worker who will go through the mechanics of applying the materials. This way, farmers not only see weed control results, but also methods of application. This is particularly important with herbicides that must be applied with certain specified equipment, or in accordance with somewhat unusual directions.

And finally, make sure that your demonstration is widely publicized. When you set up your demonstration, erect a sign announcing that this is an Extension Service County demonstration. If known, put the date of your public showing on this sign. In New York, these signs are available to Agents.

County Agents interested in weed control materials for demonstration purposes can usually get these materials free of charge from the chemical firms making them. Most of the companies are more than glad to supply demonstration quantities for Extension purposes.

Summary

In one paper of limited size, it is not possible to include all the points and important considerations that make demonstrations effective and useful. Demonstrations that are planned carefully and set up according to good teaching practices will be effective. These include keeping your demonstration simple, concise, meaningful, and economically sound. Agents must remember that it will probably be necessary to repeat the demonstration, in some cases, several times and in several localities, before the new weed control materials, or the new practice becomes a standard operating procedure on the farm. If a herbicide is good, the grower who has seen it demonstrated on a successful farm will probably, the next year, with a little encouragement, try it on his own place on a small scale. If the results are favorable, it is quite likely that the new material will be fitted into his regular practice. Surely then, this will be the end result of a successfully conducted County Agent demonstration.

The action of 2,4-D on Mustard as Modified by Six Different Light Qualities[1]

Subhash C. Datta and Stuart Dunn[2]
New Hampshire Agricultural Experiment Station

A previous report (4) showed that the light from fluorescent lamps of different colors exerts a considerable effect on the action of 2,4-D (sodium salt of 2,4- dichlorophenoxyacetic acid) with mustard plants. Certain standard procedures also were established with respect to photoperiod, age of plant, length of light treatment, etc.

The results here reported embody the best of those procedures and are based upon a set of experiments which included use of additional lamp colors. This provided a more complete representation of the different parts of the visual spectrum, compared with effects of a standard white fluorescent light, warm white. The emphasis here was upon decrease of dry weight yield of mustard plants by 2,4-D action under the various lights compared to that of control plants (untreated with 2,4-D) under identical conditions.

Experimental Procedures

Starting seedlings. Seeds of mustard (*Brassica juncea*) were germinated in vermiculite in plastic square containers in the greenhouse. About six days after planting the plants were large enough to be thinned. This was done to leave a standard number of 20 plants per container.

Placement under lamps. After 17 days' growth in the greenhouse the plants were placed under the lamps for a conditioning period of growth by the various light qualities. This required exactly 72 containers to allow four for each of the 18 rotating tables. They were taken from a total of 90 containers by a method of pre-selection. In this method they were arranged in order of average size of plants in a given container and then a small, a large, and two medium-sized ones were placed by mathematical arrangement on each table. At this time a representative number of plants was harvested to give the fresh and dry weight levels at this stage.

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Preprinted from Proceedings of the Eleventh Annual Meeting, Northeastern Weed Control Conference, New York, January, 1957.
This study was part of Northeast Regional Project NE-12, Influence of Environmental Factors on the Effectiveness of Herbicides; a cooperative study involving agricultural experiment stations in the Northeastern Region and supported in part by regional funds.

[2] Graduate Research Assistant and Plant Physiologist, respectively.

Light quality and photoperiod. The colors of lamps used were blue, green, gold (yellow light), pink, red, and warm white. The effects of three sets of lamps could be tested at one time. They were placed in three different luminaires (fixtures), each containing six lamps. These luminaires were hung by ropes and pulleys for height adjustment, each above a row of six rotating tables. Opaque plastic curtains were hung between the luminaires to keep the light of each separate. The lamps were all General Electric 96 inch, T-8 slimline types, and all save the red were of standard commercial origin. The red lamps were of higher intensity than ordinary commercial red lamps and were specially made in the Laboratory of the General Electric Company for experimental use. They contain magnesium arsenate as a phosphor, and give a very narrow and fairly sharply delimited band of emission in the red part of the spectrum. The chief portion of the spectrum emitted by each lamp may be seen in the graphs of results in Figures 1 and 2. There the width of the columns has no significance as to yield, but does show this feature. There is some overlapping of light regions with some lamps, especially in the green, gold, and pink.

The plants received a standard photoperiod of 16 hours of light daily.

Light intensity. Each lamp was placed above the plants at such a distance as to give a corrected average light intensity of 565 foot candles at plant level for its entire length. These represented light intensities after being multiplied by the correction factor furnished to us by the General Electric Company for each kind of lamp.

A considerably higher light intensity could be attained with some of the lamps, but within the limits imposed by those of lowest intensity, and the distances of the lamps from the plants, this was about the highest possible intensity attainable which would be equal for all the lamps. Elsewhere (1,2,), results have shown that some plants are more sensitive to herbicide action at lower intensities than at higher ones.

Supply of nutrient. A standard nutrient solution (Hoagland's), as used in the Earhart Laboratory, was supplied to all plants at the rate of 20 ml per container twice a week. In addition watering with tap water was done as needed.

Herbicide treatment. The plants were placed under the lamps at the age of 17 days. At this time a harvest of representative plants (other than the number necessary to fill the space under the lamps) was taken to provide a measure of the level of development at this stage and to provide a point of reference for the effects of the different lights. Fresh and dry weights of tops of the plants were taken. Earlier in the work harvest of roots had been made, but it indicated scarcely any differences. Also, at this age of the plants it was difficult to get a good separation of the roots and the medium.

After the plants had been under the lamps for a conditioning period of 20 days the herbicide was applied. From each of the six tables under a given light color a container of plants was selected and removed to the laboratory above the light chamber. There the sodium salt of 2,4-D was applied to the foliage as a fine spray at a concentration of 1000 ppm (parts per million) in water. Another similar set was treated with 5000 ppm of the chemical. Both sets of plants were then returned to their positions under the lamps for further light exposure. At the same time that these were treated with the herbicide a similar set of control plants was harvested to give a measure of the level of this stage of growth. There remained one more container of untreated plants per table. These were harvested at the end of the additional light period of 10 days, along with the plants treated with 2,4-D. Thus a simultaneous measure was provided of the parallel development (mostly photosynthetic) of herbicide treated and control plants at each stage.

Method of harvest. The number of plants and the method was the same with each harvest. For each group of plants there were six containers, each with 20 plants. The 120 plants were divided into 12 groups of 10 plants each and separate weights were taken for each of the 12 groups. Thus, the results could be analyzed statistically on the basis of 22 degrees of freedom for comparison of the results from the colored lamps with those from warm white lamps as a standard.

As shown by previous results (4) a standard of comparison with constant conditions, such as light from a standard white lamp, is preferable to the variable results of greenhouse-grown plants with natural daylight.

Results and Discussion

The dry weight yields for all of the different conditions require too much space to be presented here in detail. The means of these yields, representing 10 plants for each of 12 samples, together with certain differences derived from them, are presented in Table 1.

In line A appear the weights of the control plants at the time the other plants were first placed under the lights. Actually only two samples were taken of these, but the weights were equal. This represents the threshold level of development for all the subsequent treatments. The weights of the control plants taken at the time of application of 2,4-D to other plants are given in line B and for those taken 10 days later (end of 2,4-D treatment for other plants) in line C. The difference between C and A (line C-A) represents the increase in dry weights of the control plants during the entire light period of 30 days. The difference between C and B (line C-B) equals the increase in weight of controls during the 10 day light period only, during which sprayed plants were also under the lights. Lines D and E give the dry weights of the plants first treated with 1000 and 5000 ppm of 2,4-D respectively and harvested after 10 days of light. Likewise, the difference between these and the controls yields at total length of light exposure, C-D, and C-E, represents the decrease in dry weight yields which may be ascribed to 2,4-D action as modified by light quality effects.

In order to indicate the extent of the reducing effect of 2,4-D under these conditions more fully and adequately, this effect may be compared to the increase of the corresponding controls in the form of ratios or percentages. These ratios were calculated for each individual measurement and subjected to analysis of variance. The means of these ratios together with their significance are given in graph form in Figures 1 and 2. The size of the ratios presented there, we believe, show fairly accurately the extent of 2,4-D injury as represented by reduction in dry weight yield. The larger the ratio the greater is the comparative effect of 2,4-D in reducing yield. The extent of action of each concentration of 2,4-D (1000 and 5000 ppm) is measured against two different bases; in Figure 1, that of the increase of the controls during the total light period; in Figure 2, that of the increase of the controls during the spray period of 10 days only. These ratios were calculated for each separate measurement as follows: ratio of decrease, 1000 ppm to increase of controls in total light period of 30 days, C-D/C-A; ratio of decrease, 1000 ppm to increase of controls during spray period of 10 days, C-D/C-B; ratio of decrease, 5000 ppm to increase of controls in total light period of 30 days, C-E/C-A; ratio of decrease, 5000 ppm to increase of controls during spray period of 10 days, C-E/C-B. These graphs also show the relation of the 2,4-D effect to the spectral values of the lamps involved. They are arranged there in the order in which the main emission of the lamps occurs in the spectrum.

There are several conclusions that may be drawn from these results:

1. The lower concentration of 2,4-D, that of 1000 ppm, has comparatively little effect. The ratio of reduction for any of the lamps except red is not significantly greater than that of warm white. However, the general pattern of response is quite similar to that of the higher concentration.

2. The higher concentration, 5000 ppm, has a much greater effect, showing significance over warm white at the 1 per cent level under three of the lamps.

3. The effect of light quality on 2,4-D action is very marked. With warm white light the increased effect of the higher concentration is relatively slight, whether on the basis of the longer or on the shorter light period. The same is true of the effects of green and gold (yellow) light. Some ratios for these colors are less than those for warm white, but none is significantly different.

The effects of red and blue light are markedly great in promoting reduction of dry weight yield by 2,4-D, as is that of the light of pink lamps to a somewhat less extent. All three of these lights produced reductions in yields which were highly significant in comparison with that of warm white, on both bases of calculation with the higher concentration. The light from the pink lamps might actually be considered to be close to an orange since it overlaps portions of the red and yellow parts of the spectrum. It is probably the red portion that produces the chief effect in this instance. Since light from these three lamps is rather strongly promotional in photosynthesis and the general contours of the graphs in Figures 1 and 2 rather closely resemble that of a graph for dry weight yields in photosynthesis (3), the results indicate that one effect of 2,4-D may be an interference with, or inhibition of, photosynthesis, or some part of its mechanism.

In this connection it is interesting to note that the yields for the control plants only, when plotted for the various lamps in the same manner, give a graph very closely resembling that of the photosynthetic yields of tomato seedlings.

Summary

Mustard seedlings were subjected to a conditioning period of 20 days under lights of various colors in a controlled-environment chamber. The light was supplied by fluorescent lamps which provided a separation of the major portions of the visible spectrum. Samples of these plants were then treated with two concentrations of 2,4-D and returned to the same light conditions for 10 days more. At the end of this period the treated plants were harvested along with untreated controls. Controls also were harvested at the start of the light period and the start of the herbicide treatment.

The reduction in dry weight by 2,4-D in comparison to the controls was strongly promoted by red and blue light, and to a somewhat less extent, by orange light. Since these are the regions of the spectrum chiefly effective in photosynthesis, the results suggest an interference by the herbicide in that process.

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Table 1

The Means (mgms) of the Dry Weights of Mustard under Six Qualities of Fluorescent Light

Kind of Lamps		Warm White	Blue	Green	Gold	Pink	Red
A	Control at start of light period	25	25	25	25	25	25
B	Control after 20 days under light	100	240	70	80	170	320
C	Control 10 days after spray	200	510	110	180	370	690
C-A	Increase of control in total light period-30 days	175	485	85	155	345	665
C-B	Increase of control in spray period 10 days	100	270	40	100	200	370
D	10 days after spray - 2,4-D 1000 ppm.	130	300	90	130	260	370
E	10 days after spray - 2,4-D 5000 ppm.	130	220	80	110	180	280
C-D	Decrease due to 2,4-D at 1000 ppm.	70	210	20	50	110	320
C-E	Decrease due to 2,4-D at 5000 ppm.	70	290	30	70	190	410

Fig. 1 DRY WEIGHT REDUCTION IN MUSTARD BY 2,4-D
AS INFLUENCED BY LIGHT QUALITY

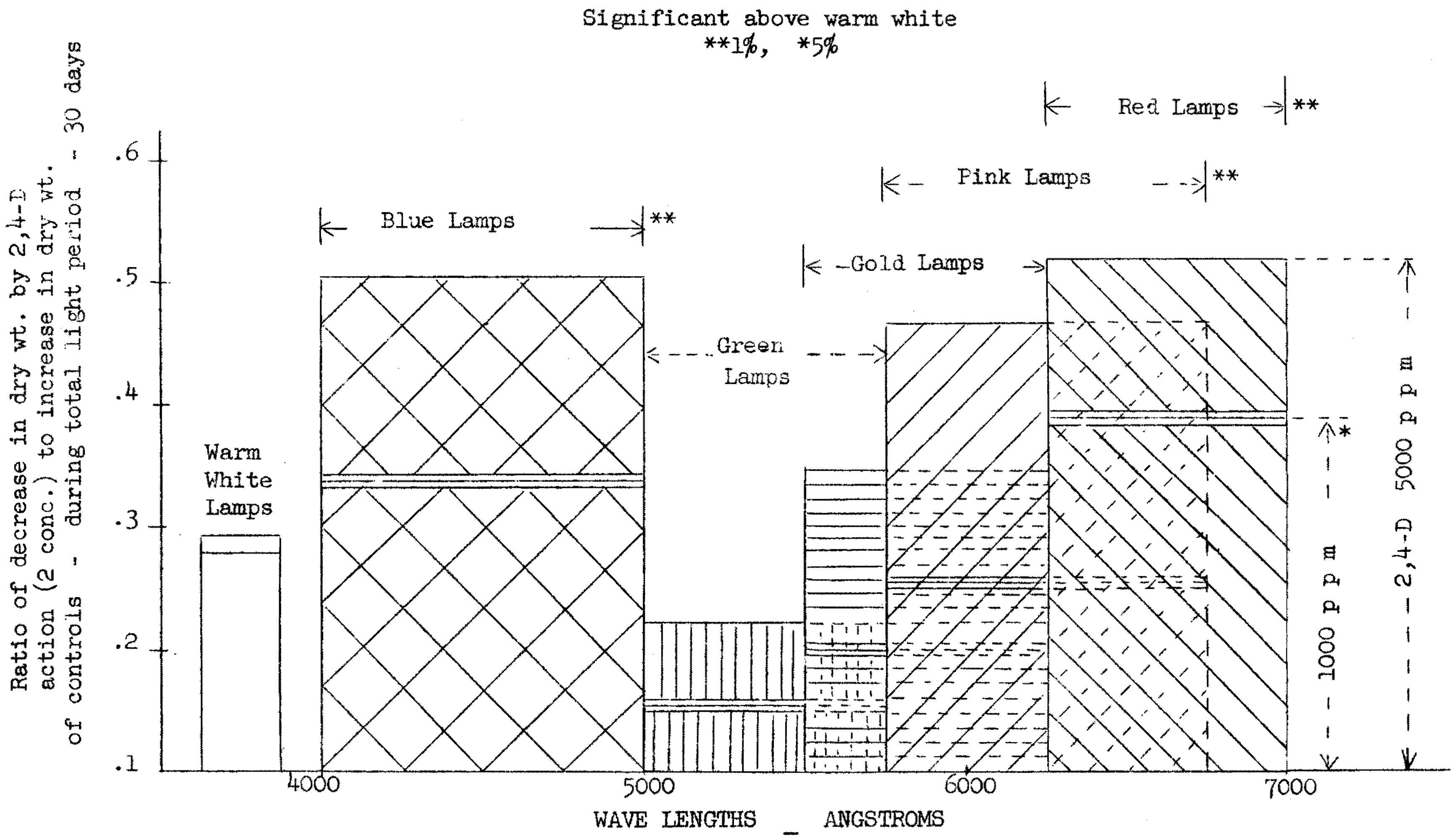
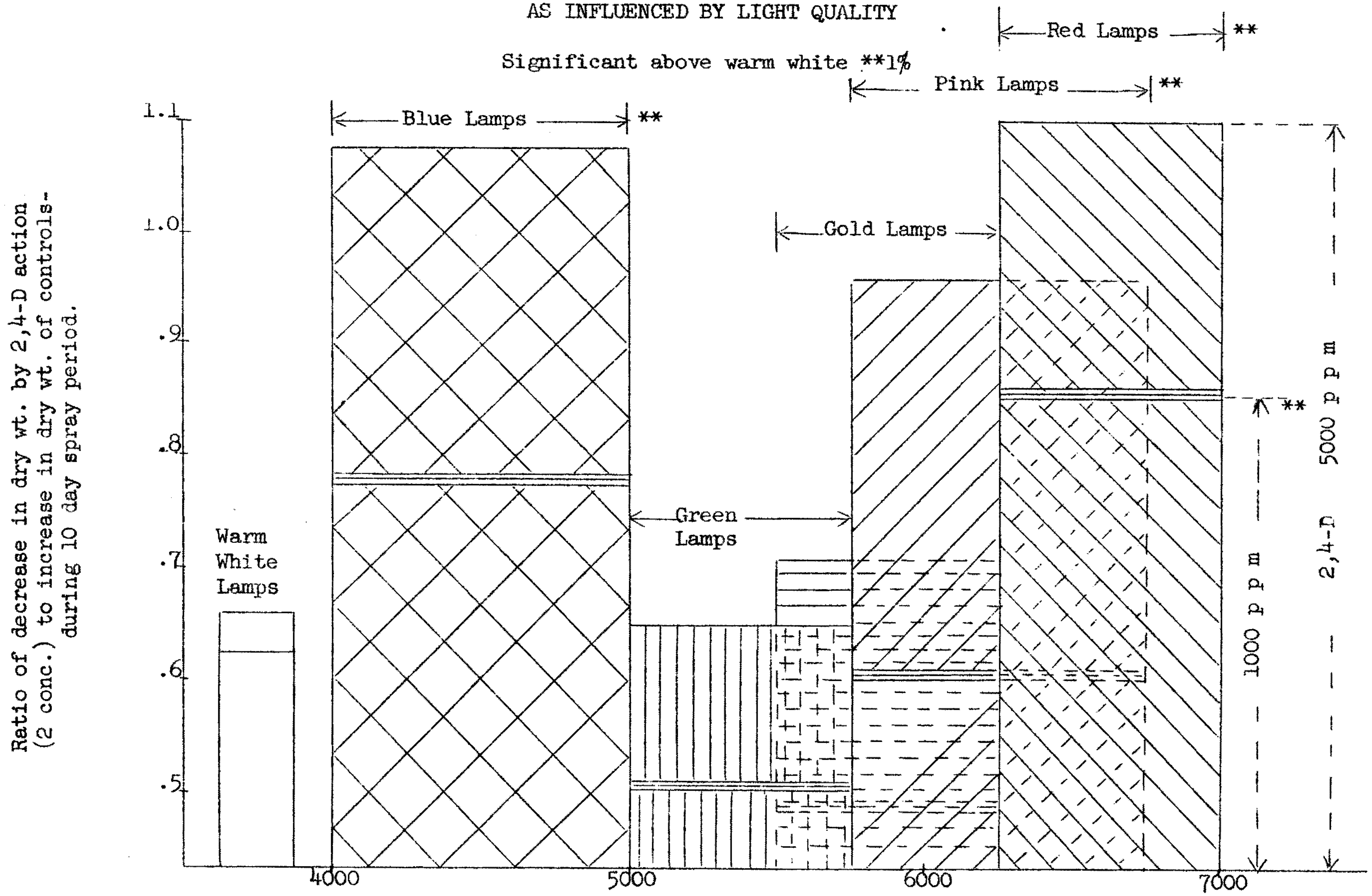


Fig. 2. DRY WEIGHT REDUCTION IN MUSTARD BY 2,4-D
AS INFLUENCED BY LIGHT QUALITY



Notes on Simazin As An Herbicide On Corn Compared With Several Other Materials

Robert A. Peters[1]

During the 1956 season the following herbicides were tested for pre-emergent and post-emergent weed control in corn. All rates are given in terms of pounds acid equivalent or active ingredients per acre.

Pre-Emergent

1.	2,4-D LV ester	1½
2.	Polychlorobenzoic acid	3/4
3.	" "	1½
4.	2,4-dichlorophenoxy acetamide - (Emid)	1
5.	" "	2
6.	3 (3,4-dichlorophenyl)-1,1-dimethylurea (Karmex DW)	1
7.	"	2
8.	2-chloro-4, 6 bis (ethyl amino-s-triazine (Simazin)	2
9.	"	4

Post-Emergent

1.	Simazin	4
2.	"	8
3.	Emid	1
4.	"	2
5.	2,4-D Alkanolamine salt	1
6.	"	2
7.	Dinitro amine	2

All chemicals were applied in 40 gallons of water per acre.

Pre-Emergent Applications

Penn. 602 corn was hill planted June 6. The chemicals were applied six days later on June 12 as the corn was breaking the surface. No rain of importance fell for several weeks after application and weed growth was limited on all plots. The observations made on weed control were principally on control of late germinating weeds and included the perennial species dandelion and buckhorn. Table I gives the stand ratings of weeds on the plots on September 25, 1956.

TABLE I. Ratings of Weed Stand on Corn Following Pre-Emergent Spraying.

Chemical Treatment (lbs. active ingredients per acre)		Weed Control Rating	Chemical Treatment (lbs. active ingredients per acre)	Weed Control Rating
2,4-D LVE	1½	1.7	Karmex DW 1	2.2
Polychlorobenzoic acid	3/4	5.0	Karmex DW 2	1.7
"	1½	3.7	Simazin 2	0.6
Emid	1	3.8	Simazin 4	0.2
Emid	2	2.2	Check	5.6

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The data indicate the distinct superiority of the Simazin plots with even the 2 lb. rate giving nearly complete control of weed growth for the entire season. Satisfactory control was obtained from Karmex DW, the high rate of Emid (2 lb.) and the 2,4-D ($1\frac{1}{2}$ lb.) treatment. None of the other treatments gave satisfactory control.

None of the treatments had any apparent effect on the corn.

Post-Emergent Treatments

Treatments were applied on a separate area from the pre-emergent plots, an area where the weed population was relatively great. The chemicals were applied over-all on July 8, 1956, when the corn was 10 inches tall. The ragweed was 3-4 inches tall and the lambsquarter, 6 inches tall. Pigweed and foxtail were also present in the plots.

Notes and weed density ratings were made on July 27, 19 days after treatment. Simazin was again the outstanding material. The 8 pound rate killed all the annual weeds present without injury to the corn. The 4 pound rate did not give complete control but was better than any of the other materials. While the DN (2 pound) treatment caused only temporary injury to the corn, it gave rather incomplete weed control since the weeds were advanced at the time of application. The 2,4-D caused some onion-rolling of the corn and the development of numerous strap-like brace roots. Weed control from this material was rated as poor especially on pigweed.

Emid was the least effective material used in terms of weed control. The lambsquarter and ragweed showed marked epinasty, stem callusing and formation of adventitious roots but recovery was general.

The corn was sampled for yield determinations on October 1 as given in Table II.

Table II. Comparative Yields of Silage Corn Following Post Emergent Application of Herbicides

Chemical Treatment (lb. per acre active ingredients)		lb. air dry weight per plot (average of duplicate plots)
Simazin	4	20.3
Simazin	8	23.1
Emid	1	18.4
Emid	2	18.5
2,4-D	1	19.4
2,4-D	2	15.0
DN	2	18.4
Check		12.0

The highest yields were obtained from the plots treated with Simazin with the yield from the 8 pound rate approaching twice that obtained on the check. All treatments gave a somewhat greater yield than the check, however, the injury from the high rate of 2,4-D was reflected in a yield below that from the 1 pound rate.

Summary

Simazin was without question the outstanding material in controlling weeds in corn as compared to 2,4-D, Emid, Karmex DW or Dinitro. Both pre- and post-emergent weed control was obtained but a rate four times as great was required to obtain control of annual weeds 4 to 6 inches tall as was required for pre-emergent treatment.

Simazin showed no visible effect on corn up to rates of 8 pounds per acre.

Acknowledgment is made to the following companies for supplying the chemicals used: Geigy Agricultural Chemicals, American Chemical Paint Company and E. I. du Pont de Nemours and Company.

2,4-D RESIDUES IN SPRAYERS[1/]

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Extreme differences between plant species in their susceptibility to 2,4-D contributes to the value of the chemical as a selective herbicide, but is also a source of practical problems. Amounts of 2,4-D that are minute in relation to the amount applied as a herbicidal treatment can have pronounced effects on many plants. Research workers, noticing 2,4-D symptoms in most unexpected places, were soon aware of the insidious nature of the chemical. Among their first sources of trouble were the sprayers that had been used for applying 2,4-D sprays.

Sprayers that are well cleaned by ordinary standards may retain enough 2,4-D to do serious damage to sensitive crops. In recognition of this fact, most recommendations to users have urged that a separate sprayer be reserved for applying 2,4-D. However, in spite of the inexpensive equipment that is an important companion of weed spray developments, operators often find it necessary to divert a 2,4-D sprayer to use with other crop sprays. The demand for advice on cleaning methods has compelled research workers to offer suggestions (1, 2, 5).

Two contrasting impressions may be gathered from current recommendations. One is the fear that a 2,4-D sprayer could never be used for crop sprays; the other is confidence that a suggested cleaning solution will assure freedom from any possible 2,4-D injury. This situation poses a great need for quantitative data on residues.

MATERIALS AND METHODS

Estimation of 2,4-D Concentration. A biological assay, depending on growth responses of germinating radish seed, was employed. About 20 radish seed were placed on two sheets of filter paper in a Petri dish, and 10 ml. of the 2,4-D solution was added. The dishes were then placed in a dark cabinet or incubator. After two to five days, when the primary seedling roots were about 2 cm long in check cultures lacking 2,4-D, concentration in unknown solutions was estimated by comparison with cultures grown with known concentrations of 2,4-D. Routinely, two radish cultures were run with each unknown solution and two with a 0.1 dilution of the unknown.

Length of seedling root is distinctly reduced by 2,4-D concentrations of 0.1 ppm or more; with concentrations in the order of 1 ppm, reduced root length and compression of the root hair zone imparts a bulbous appearance to the root; at 5 ppm or more the roots show practically no growth and are devoid of root hairs. Table 1 shows the root growth resulting when radish seeds are germinated

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1/ Approved by the Director of the New York Agricultural Experiment Station for publication as Journal Paper No. 955.

in solutions containing 2,4-D. No comparison between the series should be implied, because they involve different varieties as well as differences in temperature and other culture conditions. The data do serve to illustrate that the several different 2,4-D formulations in concentrations of about 0.1 ppm to 10 ppm have very pronounced effects on root growth of several radish varieties. The recorded figures do not reflect the equally conspicuous response in shortening or delayed formation of the root hair zone.

Table 1. Root lengths of radish seedlings germinated on solutions containing 2,4-D.

Series	2,4-D formulation	Culture Condition	2,4-D concentration, ppm 0.0	0.1	0.3	1.0	10
			length of primary root, mm				
1	sodium salt	3 days at 20°C.	15	12	-	2	0.3
	" "	6 days	28	19	-	6	3
2	acid-Carbowax	4 days at 22°C.	37	13	9	5	2
3	amine salt	2 days at 27°C.	18	11	6	3	-
4	amine salt	2 days at 27°C.	38	30	13	-	-
	isopropyl ester	"	38	23	-	-	-
5	amine salt	5 days at 20°C.	21	9	-	-	1
	245-T, isopropyl	"	21	17	-	-	4

As a method for detecting 2,4-D residues in sprayers or other containers, response in radish seed germination has advantages in simplicity, speed, and in very obvious responses that occur in the range of 2,4-D concentrations that may be hazardous to the more sensitive crops. A potentially dangerous level of 2,4-D can be detected within two or three days by comparing growth on the unknown solution with that on a water check. This assay estimates 2,4-D concentrations in a range intermediate between the very low concentration detectable by cucumber root growth (6) and the higher concentration required for response in the tomato leaf modification test (7).

Equipment. The test sprayers were five-gallon knapsack sprayers of the "E-Z" type produced by D. B. Smith and Co. The galvanized steel body of the sprayer serves as a reservoir. Spray is discharged through a small brass pressure chamber, into which the solution is forced by operation of the pumping lever. A brass tube, reaching to the bottom of the pressure cylinder, connects to the outlet hose. The two sprayers employed had been used intermittently for several months with dilute aqueous sprays of growth regulators, but did not show any obvious scale of rust or spray residues. When pumped empty the total volume of solution retained, including that wetting the inner surfaces, was 0.15 gallon or 3% of sprayer capacity.

Procedure. Prior to each cleaning test, the sprayers were filled with five gallons of 2,4-D solution at concentration of 1000 ppm acid equivalent. The solution was circulated through the pressure cylinder, then allowed to stand for at least one hour before emptying. Two contrasting formulations of 2,4-D were used. One was sodium salt; the other was 2,4-D acid dissolved in sufficient melted Carbowax 1500 to make the final Carbowax concentration 0.5%.

The volume that was used for each rinse was 0.5 gallon (10% of sprayer capacity). The rinse water or solution was shaken in the sprayer to thoroughly wet all interior surfaces, then pumped out through the pressure cylinder.

At the end of a cleaning routine the sprayer was filled with water (5 gallons) and allowed to stand for the indicated period, then shaken to mix the contents of the tank before sampling. The sample for 2,4-D determination consisted of solution discharged through the pressure cylinder after one gallon of the sprayer contents had been discharged.

RESULTS

Data in Tables 2-5 show mean effects of several contrasting factors. Comparisons between tables are not necessarily valid, because the studies extended over a period of several weeks and because, with two sprayers, only two variables could be compared in any single test. As is the case with most exploratory studies, some variables were included with too little replication to be reported singly. The several pairs of tests contributing to any pair of means were made under several conditions, but the data in each table refer to conditions that were comparable except for the factors that are contrasted within the tables.

Table 2. 2,4-D concentration found in solution from contaminated sprayer. Sprayer rinsed three times after emptying original 2,4-D, and immediately refilled. Each figure is the mean of 6 tests.

	Formulation of original solution	
Time of sampling	Sodium salt	Acid in Carbowax
1/4 hour after filling - - -	0.4 ppm	0.5 ppm
16 hours after filling - - -	2.0 ppm	3.8 ppm

The evidence of Table 2 suggests that residues of 2,4-d are retained in a sprayer with some tenacity. The 2,4-D content of the water in the filled sprayer increases markedly with time of standing. Had the original 2,4-D residue been completely soluble and freely mixed with the rinse water the final concentration, calculated from the volume of rinse and the volume retained after emptying, would have been no more than 0.4 ppm. The less soluble compound, acid in Carbowax, leaves more potential residue than does sodium salt. This difference between formulations was noticed in other results not recorded in the tables.

Even exhaustive rinsing will not suffice to remove 2,4-D if only a few minutes of time are devoted to each rinse. Table 3 shows that ten rinses were not much more effective than three. The extra seven rinses could theoretically have diluted the residual 2,4-D to 2/10,000 of the amount left after three rinses or to about 0.0004 ppm. Evidently the 2,4-D residue remaining after a sprayer is emptied is not promptly dispersed through the volume of water that is added.

Table 3. Effect of repeated rinsing on 2,4-D contamination. Sprayer filled immediately after rinsing cycle, sampled 5 to 16 hours later. Means from 4 comparisons; -3 with sodium salt, one with acid.

Number of rinses	2,4-D conc. found
3	2.2 ppm
10	1.6 ppm

Certain solution rinses were tested, with results as shown in Table 4. None had any considerable effect, as compared with water rinses, in reducing the final 2,4-D found when the sprayer was refilled.

Table 4. Effect of solution rinses on 2,4-D contamination. One solution rinse plus two water rinses compared with three water rinses. Samples taken 5 to 16 hours after filling.

Solutions	No. comparisons	2,4-D in sprayer, ppm Solution rinse	Water rinse
Ammonia (0.03 to 0.14% NH_3)	8	4.1	3.6
4% Washing soda (2% Na_2CO_3)	8	3.2	3.1
2% Trisodium phosphate	5	1.7	2.6
Soap	3	1.6	2.7

The concentration of 2,4-D found after some miscellaneous rinsing procedures is shown in Table 5. These data give further information on the amount of 2,4-D likely to occur in sprayers that are well-cleaned by ordinary standards, and may also offer hints for reducing the amount in the final spray. The 2,4-D residue remaining after preliminary rinses seems to be partly released as the sprayer stands empty with wet interior surfaces (Table 5A, 5C). Three additional rinses, given just before the sprayer is filled after standing empty overnight, do much more (Table 5A) to reduce the final 2,4-D concentration than do seven additional rinses given soon after the original 2,4-D solution is emptied(Table 3).

Table 5. 2,4-D concentrations found in sprayers following several rinsing procedures. Original 2,4-D spray solution was composed of sodium salt in D; of acid-Carbowac in all other series. Each series includes 3 or 4 replications.

Series	Procedure after emptying original 2,4-D spray	2,4-D ppm
A	Rinse 3 times; leave empty 16 hr; fill for 2-5 hr:	
	1) no rinse before filling - - - - - - - - - -	5.0
	2) rinse 3 times just before filling - - - - -	0.7
B	Rinse 3 times; fill for 16 hr:	
	1) sample - - - - - - - - - - - - - - - - - - -	7.0
	2) empty; fill for 2-5 hr. - - - - - - - - - -	0.4
C	Rinse 3 times; leave empty for 16 hr; rinse once:	
	1) rinse water (1/2 gal. volume) - - - - - - -	22
	2) fill for 5 hr. - - - - - - - - - - - - - - -	5
D	Rinse 2 times; fill; empty; fill for 5 hr. - - - -	0.8

DISCUSSION

A slow release of residual 2,4-D into the rinse water seems largely responsible for the concentrations of 2,4-D observed after the various cleaning procedures. This could result from adsorption, from deposition of insoluble 2,4-D compounds, and from mechanical retention of solution in recesses within the sprayer for sufficient time to prevent complete dilution by the rinse water. Retention on metal surfaces is one factor in the phenomenon(4). Regardless of the cause, or causes, this behavior of residual 2,4-D must be considered in practical attempts to reduce 2,4-D contamination to a minimum. Results with sprayers used in these laboratory tests cannot be applied with precision to other sprayers or to larger commercial sprayers; but it is probable that commercial sprayers will present at least as great a contamination problem.

It is not implied that this behavior of residual material in a sprayer is a unique property of 2,4-D. Certain other materials, such as dinitros and synthetic emulsifiers, are noticeable in high dilution; workers with these are aware of the difficulty in removing all traces from a sprayer. Still other material may behave similarly, without being noticed. 2,4-D is unique in the fact that such small traces, amounting to below 1% of the original spray concentration, can have profound effects on plants.

The lack of benefit from use of the solutions as cleaners does not mean that they are of no value in aiding more thorough cleaning. But it does indicate that these solutions will not, by themselves, assure freedom from 2,4-D residues.

Various 2,4-D concentrations have been found in the above investigation. Their importance as crop hazards can be evaluated only in terms of crop sensitivity. Unfortunately, the many reports on accidental crop damage from use of contaminated sprayers cannot refer to the quantity of 2,4-D involved. More information comes from studies of growth regulator action in which 2,4-D served as one of the materials. From these it is evident that "2,4-D sensitive" crops differ extremely in their tolerance, depending on species, variety, and stage of growth. No tolerance level can be suggested without reference to a particular crop and to the stage of development when sprayed. A discussion of the literature for individual crops is obviously not in order here, and it would still provide only a fragmentary and tentative listing of "safe" concentrations. As a rough generalization it seems that the more sensitive crops are likely to suffer damage in their more sensitive stages by 2,4-D sprays containing in the order of one to 10 ppm.

Thus the 2,4-D concentrations observed in this investigation are in a range that is significant in terms of crop hazard. The higher levels would be potentially dangerous to sensitive crops, though not certain to produce obvious or serious damage. The lower levels would be much safer, yet not altogether safe. In other words, those procedures which are observed to reduce 2,4-D contamination are highly desirable in avoiding crop damage, but even they are not sufficient to eliminate all chance of injury. As little as 0.0001 microgram in 0.1 ml (0.001 ppm) applied to a newly opened leaf of a rapidly growing grape shoot may cause conspicuous symptoms on several later leaves (3).

SUMMARY

A method for detecting potentially dangerous levels of 2,4-D, or for quantitative estimation of concentrations, is described.

Data are given for the 2,4-D concentrations found in contaminated sprayers after various cleaning procedures.

Washing procedures that would be expected to reduce the residual 2,4-D spray solution to negligible concentration by dilution do not have corresponding effects on the concentration found later in the filled sprayer. Concentrations of 2,4-D ranging from 0.4 ppm to nearly 10 ppm were found where the washing could have diluted the original spray to small fractions of these amounts. This seems to result from retention of a certain amount of 2,4-D that is not immediately dispersed through the rinse water or solution, but is released gradually over a period of hours.

The practical implications of the observations are that, in addition to thorough rinsing of all sprayer parts to dilute the original volume of original spray to negligible concentrations, other precautions are necessary if a 2,4-D sprayer is subsequently used for other sprays. These are:

1) The subsequent crop spray should stand in the sprayer for the shortest possible time before application.
2) Even if the sprayer was well-washed after emptying the 2,4-D spray, it should be washed again just before adding the crop spray.

3) Long and thorough contact of the wash water is desirable, such as by filling, then emptying after standing overnight or longer.
4) Cleaning solutions, such as trisodium phosphate or ammonia water, are not a substitute for these precautions.
5) Traces of 2,4-D, sufficient to produce symptoms on the most sensitive crops, may occur even after these precautions have been observed.

It is pleasing to note that the more detailed published suggestions for cleaning 2,4-D sprayers (1,2,5) are fairly satisfactory in light of the above findings.

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Influence of Herbicides and Fertilizers on Stump Decay

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The possibility of chemical treatments aiding in the destruction of unwanted stumps has long been an appealing one. A method often considered is the use of oxidizing chemicals to render the wood more easily burned. Actual tests with such methods have not been encouraging (3). Another intriguing possibility is the use of chemicals to hasten natural decay. Laboratory studies with timber-decay species on seasoned timber have shown only slightly increased activity with added nitrogen (1,2). But effects of greater magnitude might occur on stumps in contact with soil and in the presence of other nutrients.

Herbicides might logically be applied to freshly cut stumps, if only to reduce the nuisance of continued sprouting. They have a further potential advantage in that killing of the stump tissues might hasten invasion by saprophytic organisms.

This paper reports exploratory trials with differential herbicidal treatment followed by continuing differential fertilizer treatment over the subsequent three years.

Methods

Stumps of 12-year-old seedling pears and apples were used for the tests. All trees had been felled by a horizontal saw cut about three inches above the soil surface. During the growing season after cutting, stumps with sucker growth and of uniform size were selected for experiment. Suckers were cut back to their point of origin on the stump or to the soil surface in August, then the herbicide applied. The first fertilizer application was made two weeks later. About two thirds of each chemical dose was deposited on the stump surface and the soil-bark juncture; the remaining one-third was distributed over a one-foot band surrounding the stump. Half of the stump population was later covered with soil.

Evaluation of the degree of stump decay was made by improvised methods of measuring resistance to penetration, crushing and breakage. These are described in the tables or appropriate sections of text.

The data in the tables summarizes results from factorial combinations of the listed herbicide variables and the listed fertilizer treatments. Only the main effects are recorded. Space would not allow, nor would the amount of replication justify a complete listing of individual treatments. There was little indication that any particular combination was notably more effective than is suggested in the pattern of main effects.

Results

Over the first full year after treatment began there was no outward sign of decay; the exposed stump surfaces were hard and the stumps seemed rigidly anchored in the soil. The only visible response was in the failure of sucker renewal from stumps treated with herbicides. Table 1 shows the effectiveness of the herbicides in preventing resprouting for three years after treatment. The rare suckers recorded for treated stumps were usually root sprouts arising a foot or more distant from the stump. The heaviest fertilizer applications had a marked killing effect, particularly when repeated twice each year; this lowers the average survival under "no herbicide" as compared with "no herbicide or fertilizer".

Table 1. Resprouting from stumps in the herbicide-fertilizer experiments; means for herbicide treatments. Suckers removed at end of each growing season.

Herbicide Treatment (1949) 1/	No. stumps	Percent with suckers 1950	1951	1952
APPLE STUMPS (5-inch diameter)				
Ammate, 40 gm per stump	18	6	6	6+
Ammate, 120 gm per stump	18	0	11	11+
2,4-D+2,4,5-T, 7 ahg	18	11	6	0
No herbicide	18	61	44	28
No herbicide, no fertilizer	14	86	71	50
PEAR STUMPS (3½-inch diameter)				
Ammate, 30 gm per stump	18	11	6	0
Ammate, 90 gm per stump	18	0	0	0
2,4-D+2,4,5-T, 7 ahg	18	0	0	0
2,4-D+2,4,5-T, 21 ahg	18	0	0	0
No herbicide	18	44	6	6
PEAR STUMPS (3-inch diameter)				
Ammate spray, 4 lbs./gal.	15	0	0	0
No herbicide	15	67	20	7

1/ Ammate is 80% ammonium sulfamate
2,4-D + 2,4,5-T used as ethyl and isopropyl esters respectively, mixed in kerosene with each contributing half of the indicated ahg (pounds equivalent acid per 100 gallons); sprayed at about 0.02 gal. per stump.
Ammate spray sprayed at about 0.04 gal. per stump.

\+ Suckers recorded for these stumps arose two feet distant from the stumps.

During the second year visible fungous growth appeared on the stumps in amounts that varied widely with fertilizer treatment. The chief response was in a lesser population of sporophores on stumps that had received a second (midsummer) application of fertilizer (Table 2). The trend for more fungous growth on stumps treated with herbicide is probably a real one, for it was much more pronounced in comparisons on unfertilized stumps. The sporophores noted were predominantly of a leathery, annual bracket type (possibly Lenzites sp.).

Table 2. Indications of decay on stumps treated with herbicides and fertilizers. Means from 4x9 factorial with 2 apple and 2 pear stumps in each of the 36 chemical treatments.

Chemical treatments	No. stumps	% Surface with fungous sporophores Nov. 1951	Surface hardness Nov. 1952 1/
HERBICIDES: applied 1949 2/			
Ammate; 30 gm per stump ---	36	24	5.0
Ammate; 90 gm per stump ---	36	28	5.8
2,4-D+2,4,5-T; 7 ahg ------	36	28	5.4
No herbicide --------------	36	21	6.2
FERTILIZERS: grams/stump and times applied/year; 1949-1952 3/			
50 $(NH_4)_2SO_4$; 25 P; 1/yr. -	16	30	6.2
2/yr. -	16	15	6.1
150 $(NH_4)_2SO_4$; 75 P; 1/yr. -	16	45	5.8
2/yr. -	16	10	6.9
30 NH_4NO_3; 25 P; 1/yr. -	16	41	4.7
2/yr. -	16	14	4.9
90 NH_4NO_3; 75 P; 1/yr. -	16	23	4.5
2/yr. -	16	4	5.6
No fertilizer -------------	16	44	5.6
Mean	144	25	5.6
Apple stumps	72	30	5.1
Pear stumps	72	20	6.1
Stumps covered with soil -----	72	19	5.1
Stumps not covered -----------	72	31	6.1

1/ Resistance of transverse cut surface to penetration by a dull axe under a light blow; 0 = blade deeply embedded, 10 = no penetration.

2/ Herbicide applications as listed in Table 1.

3/ Amounts applied to 3½-inch diameter pear stumps; 50% more used on the 5-inch apple stumps. P is superphosphate (20% P_2O_5) applied with each application of nitrogen salt.

Conspicuous softening of the surface of some stumps had also occurred by the end of the second year. An axe swung to deliver a light blow drove deeply into some stumps, but found others nearly as resistant as recently cut stumps. The trend for soft stumps under certain treatments was similar to that recorded a year later and summarized in Table 2. Analysis of the data indicates that significant differences occur among herbicides, among fertilizers, between apples and pears, and in response to soil cover.

At the end of the third year attempts were made to remove all stumps. The point of a pick was driven into the stump about three inches below the soil level, then leverage was applied to pry the stump from the soil. More than half of the stumps could be pried out with moderate effort. The majority of them came free as a result of breakage just above the level of root attachment, but a few showed breakage of main roots. The relative force required to break the stump was estimated on a scale of 0 to 10. At the same time the relative hardness of the underground stump body was rated according to its resistance to penetration when prodded with the point of the pick.

Table 3 summarizes the final results on the population of pear stumps, expressed as three different measures of resistance to removal or mechanical destruction. All herbicide treatments resulted in less resistant stumps. The lighter fertilizer applications show a tendency for less resistant stumps, but the heavy applications repeated twice each year had a preservative effect. The combination of no herbicide and no fertilizer, which was repeated on a few extra stumps as checks, seemed to result in more resistant stumps than any other treatment.

It will be noted in Table 3 that surface hardness does not necessarily parallel the resistance of the underground portion. Stumps with soft upper surfaces were usually relatively soft below; but those with hard surfaces often showed little resistance in underground portions. Discrepance between the two measures is particularly noticeable in comparing the heavy application of ammonium sulfate with ammonium nitrate and in judging the effect of soil cover. A part of the discrepance derives from the variability in stumps and methods; but some may reflect differential effects within the stumps. The different response to ammonium vs nitrate could result from different rates of penetration through stump tissues and soil. The effect of soil cover in providing softer upper surfaces is not surprising. Its effect in hindering underground breakage seemed only partly due to the additional support, and may reflect the presence of conditions less suitable for decay in the root crown region when soil cover is added.

Table 3. Resistance of pear stumps as affected by herbicides and fertilizers. Means from a 5x9 factorial with two stumps in each of the 45 chemical treatments; 1952 results after three years of treatment on stumps of 3½-inch diameter.

Chemical treatments 1/	No. stumps	Surface hardness 2/	Resistance index 3/	Percent not removable 4/
HERBICIDES: applied 1949				
Ammate; 30 gm per stump -	18	5.3	6.0	33
Ammate; 90 gm per stump -	18	5.9	6.1	33
2,4-D - 2,4,5-T; 7 ahg --	18	5.9	6.0	22
2,4-D - 2,4,5-T;21 ahg --	18	6.4	5.9	33
None; suckers cut annually	18	7.2	7.6*	67
FERTILIZERS: grams/stump and times applied/year				
50 $(NH_4)_2SO_4$; 25 P; 1/yr.-	10	7.2	5.6	40
2/yr.-	10	6.6	5.8	20
150 $(NH_4)_2SO_4$; 75 P; 1/yr.-	10	6.2	5.4	20
2/yr.-	10	7.6	6.8	50
30 NH_4NO_3; 25 P; 1/yr.-	10	5.4	5.1	10
2/yr.-	10	5.4	6.3	30
90 NH_4NO_3; 75 P; 1/yr.-	10	5.4	6.5	20
2/yr.-	10	6.0	8.3*	70
No fertilizer - - -	10	5.8	7.1	50
Mean	90	6.2	6.3	37
No herbicide or fertilizer, suckers cut annually ---	6	7.5	9.2*	67
Stumps covered with soil --	45	5.8	7.6*	53
Stumps not covered --------	45	6.5	5.0	20

1/ Applications as detailed in Tables 1,2.

2/ Resistance of the transverse cut surface to penetration by an axe blade.

3/ Resistance to removal expressed as mean of (a) resistance to underground breakage when pried with a pick, and (b) relative hardness of stump body. Rated from 0=very soft, to 10-little less resistant than freshly cut stump.

4/ Not easily pried loose; rating 9 or 10 under (a) above.

* More resistant than the remainder of population at P=0.05.

The block of apple stumps with treatments paralleling those on the pears was destroyed when final readings were complete on less than half of the stumps. The partial record showed a similarity to the pears in that untreated stumps were more resistant than those treated with herbicides and/or fertilizers, and in resistant stumps when heavy fertilizer treatments were repeated twice each year. But there was no average difference between herbicide treatments and no herbicides.

Populations of smaller stumps were employed to determine possible benefits of phosphorus in promoting stump decay. The results in Table 4 suggest that nitrogen alone is of little benefit in reducing stump resistance unless at least phosphorus is also applied. In the pear population the effect of herbicide is also reflected. The only stumps in the pear group that were not easily removable were those that received no herbicide with either no fertilizer or nitrogen alone.

Table 4. Stump resistance as affected by herbicide and by nutrients in addition to nitrogen.

Treatment	No. stumps	Resistance index 2nd year 1/	Percent not removable 2/ 2nd year	3rd year
PEARS. Stumps of 3-inch diameter in 2x3 factorial.				
No herbicide	15	8.8	67	40
Ammate spray, 4 lb./gal.	15	5.9	13	0
No fertilizer	10	7.5	50	30
NH_4NO_3 20 gm twice yearly	10	7.9	60	30
10-10-10 65 gm twice yearly	10	6.5	10	0
APPLES. Stumps of 4-inch diameter, sprayed with 2,4-D+2,4,5-T esters.				
No fertilizer	8	8.7	75	38
NH_4NO_3, 30 gm twice yearly	8	8.8	63	38
" +25 gm superphosphate	8	6.6	25	12

1/ Resistance to removal expressed as mean of (a) resistance to underground breakage under light blows with an axe, and (b) relative hardness of stumps body. Rated from 0= very soft, to 10= little less resistant than freshly cut stump.

2/ Not easily broken out; rating 9 or 10 under (a) above.

In 1952 further exploratory trials were started to determine if decay was promoted by nutrients in addition to nitrogen and phosphorus, by treatments with differing possible residual effects on pH of the medium, or by nitrogen sources. The treatments included 10-10-10 with and without lime, urea with phosphate, sodium nitrate with phosphate, and a complete fertilizer with minor elements ("Rapidgro"). This block was also lost before the end of the second year. Up to that time, however, none of the treatments showed any spectacular sign of hastened decay.

Summary

Stumps of apples and pears were treated with Ammate, or with 2,4,5-T plus 2,4-D in oil. Various fertilizer applications were then repeated over a three-year period during which the resistance of the stumps to mechanical breakage and penetration was rated.

Moderate applications of nitrogen salts with phosphate promoted softening of the stumps. The heaviest applications used, however, had a preservative effect. Unless phosphate was included, the nitrogen salts had no measurable effect in promoting softening.

The herbicides used also tended to hasten softening. Thus their obvious value in ameliorating the nuisance of resprouting is in no degree offset by any possible preservative effects.

The majority of the stumps under favorable treatments could easily be broken up with hand tools, and would offer no obstacle to heavy tillage equipment. On the other hand, the time required to reach this condition was a matter of years rather than months. There was no indication of rapid dissolution occurring under any of more than 100 different combinations. A further deterrent to thought of these treatments providing prompt eradication of all stumps is the presence of natural decay inhibitors in the wood of some species (4).

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DINITRO, TRICHLOROBENZOIC ACID, SIMAZIN AND OTHER HERBICIDES FOR PREEMERGENCE WEED CONTROL IN SWEET CORN

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This paper is a report of 1956 tests of herbicides applied preemergence to sweet corn.

Procedure and Materials

Variety Marcross sweet corn was planted June 11, 1956 at two locations (Blocks A and B), one inch deep in sandy loam soils containing 3-4% organic matter. Herbicides were applied with a small plot sprayer, at 40 pounds pressure and 50 gallons per acre volume. Treatments were replicated eight times in Block A and twelve times in Block B. Single row plots were used. All plots were cultivated throughout the season, but during cultivation the soil was not disturbed six inches on either side of the crop row. Corn was harvested at the soft dough stage of maturity.

The principal broadleaf weeds were: Black Mustard (*Brassica nigra* Koch.), wild mustard (*Brassica arvensis* Ktze.), Lambsquarters (*Chenopodium album* L.), and red-root pigweed (*Amaranthus retroflexus* L.). Barnyard grass (*Echinochloa Crus-galli* Beauv.) and Foxtail (*Setaria viridis* (L.) Beauv.) were the principal annual grasses. Weed counts were made four weeks after the herbicides had been applied.

Table 1 contains rainfall data for corresponding periods following the application of herbicides in 1955 and 1956. Sources of herbicides are listed in Table 2. Tables 3 and 4 contain the acre rates of herbicides applied and the results of treatment in Blocks A and B respectively. Figure 1 summarizes a test of combination treatments of DN and CDEC.

Experimental Results

Block A.

Four pounds of Simazin applied at planting, and 4.5 pounds DN applied at emergence (six days after planting) resulted in the highest percent reduction in both broadleaf weeds and

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annual grasses of all the herbicides applied in Block A (Table 3). Two pounds of Simazin and one pound of TCB resulted in a greater reduction of annual grasses, but a smaller reduction of broadleaf weeds, than planting applications of 4.5 pounds DN, or 9 and 15 pounds of Triazine. Two pounds of Emid and 4 pounds of SD 1369 applied at planting resulted in unsatisfactory broadleaf weed control and annual grass control.

For weeds other than Brassica species, TCB appeared to be an excellent herbicide, since it markedly reduced the number of weeds per square foot and dwarfed survivors to competitive insignificance. However, Brassica species were sufficiently poorly controlled to indicate a serious defect in the chemical if it were to be used preemergence in fields with a high Brassica count. The improved grass control resulting from emergence application of DN compared to planting application indicates that deferred application of DN is essential to maximum effective use of this herbicide.

Crop injury due to herbicide use was not observed. The 4 pound Simazin and emergence DN plots were harvested, plots treated with other herbicides were not harvested because of obviously unsatisfactory weed control. Yields which averaged 4.5 tons of snapped ears per acre for the Simazin plots, and 4.94 tons per acre for the DN plots, did not differ significantly at the 5% level.

Block B.

Four and one-half pounds of DN applied at planting resulted in significantly better broadleaf weed control than 0.2 and 0.4 pounds of Monuron, 1 pound of 2,4-D, 1.5 pounds of Emid and 0.5 pounds of TCB (Table 4). In this block (B) as in Block A the relatively poor weed control following the application of TCB was due to the presence of Brassica species.

The low order of broadleaf weed control obtained with 0.2 and 0.4 pounds of Monuron is the consequence of a protracted drought following application (Table 1). On the other hand, in 1955 when 1.3 inches of rain fell in the five day period immediately following application of 0.4 pounds of Monuron, (Table 1) broadleaf weed control was 109 percent of that due to 4.5 pounds DN applied at planting.1/

Crop yield (Table 4) increased with increasing effectiveness of herbicides in controlling broadleaf weeds. Yields from the DN plots were significantly higher at the 5% level than all other chemical treatments except 0.5 pounds of TCB.

1/ Trevett, M. F. Preemergence Weeding of Sweet Corn. Proceedings of the Tenth Annual Meeting of the Northeastern Control Conference. 1956. Pages 172-177.

Combination treatments of DN and CDEC were made preemergence when the first broadleaf weeds were observed emerging, with the objective of enhancing the extent of control of annual grasses obtained by either chemical alone. Results in 1956 were similar to those obtained in 1955[1/]: mixtures of DN and CDEC are complementary rather than additive when applied preemergence (Figure 1).

Summary

Dinitro applied at the rate of 4.5 pounds per acre at emergence of sweet corn, and 4 pounds of Simazin applied at planting, were superior at the rates used to all other herbicides applied preemergence in the current test. The rates, and the herbicides applied included: 6 and 8 pounds of CDEC; 0.5 and 1.0 pounds of TCB; 9 and 15 pounds of Triazine; 4 pounds of SD 1369; 0.2 and 0.4 pounds of Monuron; 1.5 and 2.0 pounds of Emid; 1.0 pounds of 2,4-D.

DN added to CDEC sprays improved broadleaf weed control but did not increase annual grass control, thus leading to the conclusion that mixtures of these two herbicides are complementary rather than additive in their action.

1/ Trevett, M. F. Preemergence Weeding of Snap Beans with Amino Triazine CDEA, CDEC, and Dinitro. Proceedings of the Tenth Annual Meeting of the Northeastern Weed Control Conference. Pages 132-136.

Table 1. Rainfall, June 1955 and 1956.

JUNE			
1955	Inches of Rain	1956	Inches of Rain
June 9	Corn planted		
June 10	.19 (Herbicides applied)		
June 11	.50	June 11	(Corn planted, herbicides applied in Block B)
June 12	.26	June 12	(Herbicides applied in Block A)
June 13	.44	June 13	
June 14	.09	June 14	
June 15	.01	June 15	
June 16		June 16	(Herbicides applied in Block C)
June 17		June 17	(Corn emerged, DN applied, Block A)
June 18		June 18	
June 19	(Corn emerged)	June 19	
June 20	.25	June 20	
June 21	.04	June 21	.04
June 22	.02	June 22	
June 23	.13	June 23	.23
June 24		June 24	.18
June 25	.19	June 25	
June 26	.01	June 26	.33
June 27		June 27	
June 28		June 28	.01
June 29		June 29	
June 30		June 30	

Table 2. Herbicides used in Sweet Corn in 1956.

Abbreviation	Active ingredient	Manufacturer
CDEC	2-chloroallyl diethyldithiocarbamate	Monsanto
DN	Dinitro ortho secondary butyl phenol	Dow
Emid	2,4-Dichlorophenoxyacetamide	American Chemical Paint
Monuron	3-(p-chlorophenyl)-1,1-dimethylurea	DuPont
SD 1369	P,P-dibutyl-N,N-diisopropylphosphinic amide	Shell
Simazin	2-chloro-4,6 bis (ethylamine(-S-tiazine	Geigy
TCB	2,3,6-trichlorobenzoic acid (Na SALT)	DuPont
Triazine	2-chloro-4,6-bis(diethylamino)-S-triazine	Geigy
2,4-D	2,4-Dichlorophenoxyacetic acid (ester)	Dow

Table 3. Annual broadleaf and annual grass control, Block A. Expressed as percent of check plots.1/

Herbicide and acre rate	Percent Control2/ Broadleaf Weeds	Annual Grasses
(Herbicide applied one day after planting)		
9 lbs. Triazine	98.5	10.8
4 lbs. Simazin	98.4	71.2
15 lbs. Triazine	98.3	10.1
4.5 lbs. DN	95.3	12.5
2 lbs. Simazin	86.2	39.2
2.0 lbs. Emid	73.5	8.5
1 lb. TCB	71.8 3/	35.2
4 lbs. SD 1369	53.9	21.5
Emergence Application (Herbicide applied 6 days after planting)2/		
4.5 lbs. DN	98.8	54.9

1/ In check plots: 95.6 broadleaf weeds per square foot, and 7.3 annual grasses per square foot.
2/ Weed counts made 4 weeks after treatments were applied.
3/ TCB did not control Brassica species present. Other broadleaf weeds remaining in TCB plots were stunted.

Table 4. Annual broadleaf weed and annual grass control, and yield per acre of snapped ears of Marcross sweet corn following the application of various herbicides. Block B. 1956.

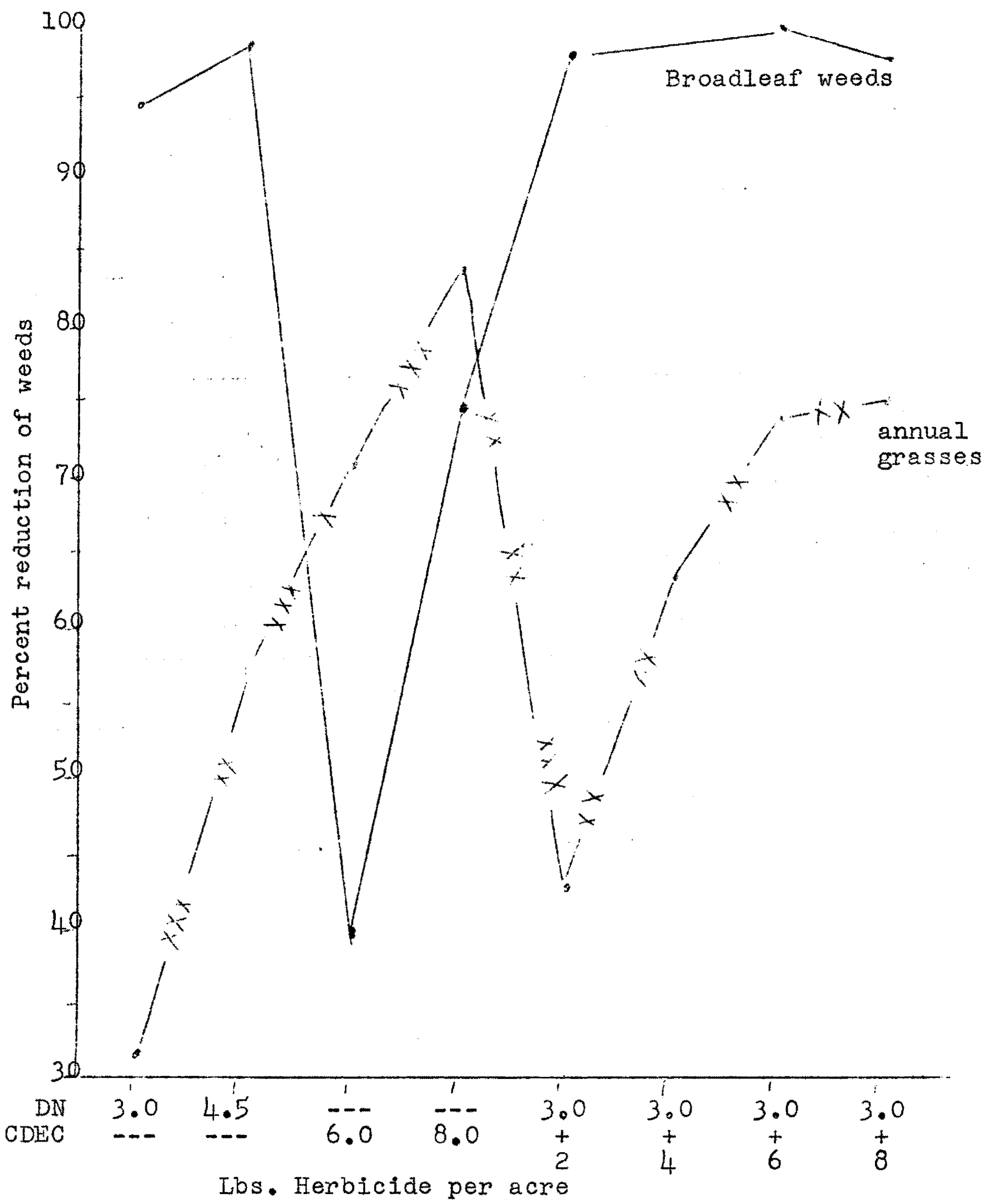
Herbicide & acre rate	Number of weeds per square foot Broadleaf	Grasses	Tons of snapped ears per acre
(Herbicides applied at planting)			
0.2 lbs. Monuron	14.3 1/	1.4	4.42
1.0 lbs. 2,4-D	13.1 1/	1.3	4.91
0.4 lbs. Monuron	12.5 1/	1.2	5.06
1.5 lbs. Emid	10.9 1/	1.4	5.64
0.5 lbs. TCB	8.4 1/ 2/	1.6	6.23
4.5 lbs. DN	2.0	1.4	6.36
Hand hoed	-	-	7.29
LSD 5%	2.49	n.s.	.66

1/ By Duncan's Multiple range test these numbers are all significantly higher at the 5% level than treatment "4.5 lbs. DN".

2/ TCB did not control Brassica species.

3/ Harvested at soft dough stage of maturity.

Figure 1. Broadleaf weed and annual grass control following application of various combinations of DN and CDEC.



Chemical Herbicides as They Effect Stand and Yield of Beets, Onions and Carrots[1]

Charles J. Noll[2]

An experiment to study the effect of herbicides on three vegetable crops was conducted in the summer of 1956. The three vegetables, beets, onions and carrots, were treated with what was considered the best weed control treatments for that crop. Records were taken of stand and yield.

Procedure

Vegetables were seeded May 1 in Hagerstown silt loam soil, three rows per treatment. Each plot, 30 feet long with 2 feet between rows, was randomized in each of 8 replicated blocks. The herbicides were applied with a small sprayer over the row for a width of one foot. Weeds between the rows were controlled through cultivation.

The middle row of the three row plot was harvested for record.

Beets were treated with the TCA and Endothal combination of herbicides 3 days after planting and with salt June 9 a little more than a month after planting when the beets had 4 to 5 true leaves. One plot was untreated. When harvested July 13, a stand count was made and the untopped beets weighed. (Table I)

Onions were sprayed with CIPC 6 days after planting and KOCN 11 days after planting. One plot was untreated. When harvested August 24 a stand count was made and the untopped onions weighed. (Table II)

Carrots were sprayed with Stoddard Solvent June 4 a little more than a month after planting at the time the carrots had their first true leaves. When harvested July 30 a stand count was made and the topped carrots weighed. (Table III)

Results and Discussion

The results of the beet experiment are presented in Table I. The treatments had no effect on stand of beets as compared to the untreated plot. All chemical treatments were significantly better in weight of beets than the untreated plot at the 1% level. There was no significant difference between the chemically treated plots.

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[1] Authorized for publication on Nov. 23, 1956, as Paper No. 2103 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

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

The results of the onion experiment are presented in Table II. The treatments had no effect on stand of onions as compared to the untreated plot, a difference of 78.4 was necessary for significance. Treatment differences in weight of untopped onions at harvest compared as follows: CIPC at 5 lbs. per acre was significantly better at the 1% level than CIPC at 10 lbs. per acre, CIPC at 10 lbs. per acre was significantly better at the 1% level than KOCN at 16 lbs. per acre and KOCN was significantly better at the 5% level than the untreated plot.

The results of the carrot experiment are presented in Table III. The treatments had no effect on stand of carrots as compared to the untreated plot. All rates of Stoddard Solvent were significantly better as measured in weight of topped carrots at the 1% level than the untreated plot. There was no significant difference between chemical treatments.

Conclusion

Under the condition of this experiment, chemical treatments had no significant effect on stand but significantly increased the yield as compared to the untreated plots. The yield of beets was doubled with either TCA and Endothal combination or with salt. The yield of onions was doubled with KOCN and increased ten fold with CIPC at 5 lbs. per acre. The yield of carrots was more than doubled with Stoddard solvent used at 40, 80 or 120 gallons per acre.

Table I. The effect of chemical herbicides on stand and yield of garden beets.

		Average per Plot	
Herbicide	Rate per Acre lbs.	Stand of Plants	Weight of untopped beets - lbs.
Nothing	0	102	9.6
TCA and Endothal	10 and 16	107	16.8
" " "	10 and 12	99	17.5
Salt	400	104	16.5
Least Significant Difference 5%		N.S.D.	6.0
" " " 1%			8.2

Table II. The effect of chemical herbicides on stand and yield of onions.

		Average per Plot	
Herbicide	Rate per Acre lbs.	Stand of Plants	Weight of untopped onions - lbs.
Nothing	0	205	4.0
CIPC	5	234	39.2
"	10	162	18.6
KOCN	16	192	7.2
Least Significant Difference 5%		N.S.D.	2.9
" " " 1%			4.0

Table III. The effect of Stoddard Solvent on stand and yield of carrots.

		Average per Plot	
Herbicide	Rate per Acre gal.	Stand of Plants	Weight of topped carrots - lbs.
Nothing	0	258	8.4
Stoddard Solvent	40	326	18.7
" "	80	314	19.9
" "	120	288	18.0
Least Significant Difference 5%		N.S.D.	3.5
" " " 1%			4.8

USE OF A SYSTEMIC GRASS KILLER IN HIGHWAY ROADSIDE MAINTENANCE OPERATIONS

By

William C. Greene
Landscape Engineer
Connecticut State Highway Department

It has been requested that a brief summary be prepared concerning the experiences and use made of a systemic grass killer in highway roadside maintenance operations. These experiences relate to our use made on the Connecticut State Highway System.

First, I should like to present these questions: Is a large sum of cold cash worth saving? Why should it be undertaken? Are there other factors over and above the conservation of funds that are evident?

The answer to all these questions is obviously "Yes"! Any amount of the taxpayers' money that can be saved or channeled into other more valued uses is a most important factor.

And if the end result is that we have a cleaner, healthier, and more attractive roadside, it is important.

Connecticut has about the most rigid guide rail law of any state in the country. On our approximately 3,000 miles of state highways, it is conservatively estimated there are about 2,000 miles of cable guide rail.

Under this railing the growth of vegetation has been such that it obscures the railing, causes a build-up of the sand from winter maintenance operations and thus impedes the drainage from the shoulder. In addition to the unattractive appearance, this vegetation is the cause of many traffic and fire hazards.

The two-foot strip under the railings has been a very difficult and hazardous location to maintain. It has meant the use of a great deal of scarce manpower to hand-cut these areas.

Fortunately, it was brought to the attention of our department that this area could be sprayed with a systemic grass killer and 2,4D. A considerable test section in the state was made and the results proved most satisfactory.

After this original test, equipment was designed so that the materials could be applied efficiently and economically. (Slides illustrating the equipment making the application will be shown.)

During the growing season of 1956, approximately 2/3 of our guide rail mileage was treated with this method. The final results were most gratifying and the saving in manpower was tremendous.

It is therefore proposed that this item of work be expanded throughout the entire system, thus eliminating practically all the hand cutting required.

In addition to the use under railings, it is proposed to spray the material at the base of signs, delineators, poles, and other obstructions where hand trimming has been necessary. This, in turn, will improve the appearance and eliminate the use of considerable manpower.

Tests have been made, but no conclusions reached, in the use of the material adjacent to the base of shrubs where grass has gown in, requiring hand trimming. This promises to be a very definite use that will be of tremendous benefit in improving the appearance, as well as removing the grasses that encroach upon the shrubs and use up the moisture and food from the soil.

In conclusion, may I state that a systemic grass killer has a very definite place in highway maintenance operations, and it is becoming a very important tool in our work. We feel that it has saved us a great deal of money and manpower, and it will definitely improve the safety and appearance of the highway roadsides.

. . . .

A few slides illustrating its use and effect are presented.

Response of Ash, Fraxinus americana, to Amino Triazole at the Rate of 5-20 Pounds per Acre Applied Basally to Trunks and as Foliar Spray to Seedlings and Sprout Growth

by A. M. S. Pridham, Cornell University

A stand of young ash, Fraxinus americana, in which both single trunk plants (½ to 6" diameter trunk at the soil surface) and 2 year old sucker growth was present from stumps (½ to 6" diameter at the soil line).

All sucker growth was treated by foliar spraying. All trees or saplings were given basal spraying to a height of approximately 1 foot above the soil line. Sprays were applied to the run-off stage and either contained 1% Nonic 218 (Sharples) or were without added wetting agent. Foliar treatments were without wetting agent.

Amino triazole 98% active ingredient supplied by the American Cyanamid Company was used at the rate of 10 pounds per 100 gallons of water. Foliar treatments included mixes of 5 pounds, 10 pounds and 20 pounds per acre as well as untreated controls. Treatments were made July 22, 1955.

Response in 1955 was noted only in the plots of sucker growth. Premature aging and early defoliation took place by October 24. Terminal sections of many shoots which were immature in July were killed by the treatment as compared to nearby untreated growth which showed no dieback.

Observations were made June 14, 1956 and again August 1 at which time half of each of the sapling and tree groups were cut back to 4 to 6 inch stumps so that sprout growth from the base would follow during 1956. Observations were made again in September and in November 1956.

Response of sapling ash to basal treatment with amino triazole 10 lbs./100 gallons, July 22, 1955

In 1955 scattered response in small (½" diameter) ash was noted as aging and early defoliation by a day or two over untreated plants of comparable diameter. Plants of larger size did not show clear cut response.

In June 1956 many young ash trees in the treated groups showed the typical white or small pink foliage. For small trees this effect was general but in larger trees of 2" or more trunk diameter at the soil line, the effect was confined largely to the lower branches or to individual branches. Untreated trees produced normal foliage.

On August 1 the situation had changed. The tops of many young trees were dead or abnormal in tissue color as well as defoliated. Trees of larger size now had less white color and no indication of serious injury.

The tops of these live trees were removed to within the area of basal treatment, usually 4 to 6" above the soil line, so that any sprout growth which developed would come from a section of trunk subjected to application of amino triazole in 1955. Some growth was noted in September. Final observations were made in November while budbreak or young growth was still progressing as normal uninjured tissue except for browsing by deer.

Table 1. Response of Fraxinus americana, June 1956 to basal treatments of amino triazole (AT), 10 lbs./100 gallons in July 1955 and as indicated by foliage color in trees of varied sizes. Controls all normal green.

Treat-ment	Base diameter ½"		Base diameter 1"		Base diameter 2+"		Total	
	Fol. norm.	Fol. AT	Fol.norm.	Fol. AT	Fol.norm.	Fol. AT	Norm.	AT
Water mix	2	7	6	4	21	5	29	16
Water nonic mix	2	10	4	5	18	3	24	18
% AT response	81		47		17		53	
% stand./size	24		22		54			

Table 2. Regrowth November 1956 from stumps of 1" or more diameter of Fraxinus americana in November following cutting in August 1956 of trunks treated basally with amino triazole, 10 lbs./100 gallons in July 1956.

Treatment	Regrowth normal	No regrowth	Total	% response
Water mix	14	3	17	82
Water nonic mix	10	6	16	62
Mean per cent regrowth				77

The data indicate that the amino triazole though it did modify the growth of the ash as indicated by foliage color, amino triazole did not entirely inhibit budbreak when the tops were cut back during midsummer. The fact that the shoots were of normal color and form further indicates that basal spraying as used in present tests does not present much if any possibility of controlling ash. Conversely, amino triazole used at 10 pounds per acre and concentrated around the base of ash trees did not result in permanent damage. Casual observation indicates that herbaceous plant growth in the region of the trunk was virtually eliminated during the two growing seasons. The herbaceous material included Plantain, Plantago major; Goldenrod, Solidago canadensis; Painted Daisy, Hieracium aurantiacum; Strawberry, Fragaria virginiana; Oxalis, Oxalis stricta; New England Aster, Aster novae-angliae; Ragweed, Ambrosia artemisifolia; Bluegrass, Poa pratense; Moss sp.

1956 response of sucker growth in Fraxinus americana to foliar treatment with amino triazole in July 1955

Treatment in July 1955 was with amino triazole, 5 pounds of active ingredient to 100 gallons of water, as compared to 10 pound and 20 pound rates. Untreated adjacent plants were observed as controls. Sucker growth was 2 years in age at the time of treatment. Initial response was discoloration and aging of the foliage followed by defoliation some 3 to 4 weeks in advance of the untreated plants. Tips to as much as 8 inches of 1955 season's stem elongation were killed in some cases. Occasionally plants were noted in September 1955 as dead and have not resprouted from the base. These are as follows: 5 lb. rate -- 1 plant 1" diameter; 10 lb. rate -- 3 plants ½" diameter; 20 lb. rate -- 3 plants ½" diameter. In a population of 54, 7 is 12%, but when small plants only are considered this becomes 25% in base diameter 1" or less.

In spring 1956 discoloration of foliage was extensive and was accompanied by deformed leaflets scarcely beyond budbreak state. Later in the season foliage approximating normal size and color developed on some plants. Deformed foliage died and no new foliage developed from these buds.

Table 3. 1956 response of sucker growth from stumps of *Fraxinus americana* receiving foliar spray of amino triazole in July 1955 stated as number of stump colonies responding to treatment.

Rate AT lb./100 gallons	Stump base ½"		Stump base 1"		Stump base 2+"		Total		Def.
	Dead or deformed	Other	Dead or deformed	Other	Dead or deformed	Other	Def.	Not	%
5	1	1	3	0	4	11	8	12	40
10	8	3	1	1	0	3	9	7	56
20	2	4	4	0	2	6	8	10	44
% dead or deformed	58		80		25		46		

These data follow the pattern of response of the plant to amino triazole as it relates to the size of the plant treated as indicated by the diameter of the trunk or stump at the soil line. The numbers of plants used do not provide any clear indication of interaction between the size of the stump and the poundage of amino triazole applied.

Plants rated as dead on the basis of no new sucker growth in 1956 and of tops dead with dry discolored wood to the soil line in November 1956 were 5 lb. rate -- 4 plants or 20%; 10 lb. rate -- 9 plants or 56%; 20 lb. rate -- 8 plants or 44%; total -- 21 plants or 40%.

The remaining sucker growth shows injury in varying degrees. It can only be assumed at this time that injured growth will recover through production of additional suckers from crown portions that are still alive even though such production of suckers was noted in only one case during 1956. In this case the sucker growth was not from the stump but from live wood on a ½" diameter sucker below the tip portion originally killed by foliar spray.

Summary

Response of ash, *Fraxinus americana*, to amino triazole is limited to young growth of less than 1" trunk diameter and is more likely to be lethal when applied as a foliar spray than as basal treatment when all treatments are made in July. Amounts of amino triazole in excess of 5 pounds per 100 gallons of spray mix do not appear to be justified on the basis of present tests. Amino triazole definitely killed and seriously injured stands of ash suckers in a cut over area where stump diameters of 6" or less were present. Since the use of amino triazole in amounts of 10 pounds of active amino triazole per 100 gallons of mix did not seriously injure ash of over 1" trunk diameter, the use of amino triazole among ash for selective control of herbaceous and other weeds is a practical possibility since the contact of the amino triazole is with the well barked trunk and not with the foliage.

THE EXISTENCE OF 2,4-D - RESISTANT STRAINS OF WILD CARROT*

By Clayton M Switzer

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Wild carrot (Daucus carota L.) has been classified as susceptible to intermediate in its response to 2,4-D (1,2). Based on reports from Halton County in Southern Ontario that carrot was not being controlled by 2,4-D, an investigation was started to determine if this poor control was due to strains of wild carrot resistant to 2,4-D, or due to climatic or mechanical considerations.

METHODS

A survey, by means of questionnaires, was conducted among county weed inspectors and agricultural representatives (county agents) throughout Southern Ontario. Information concerning population, control measures used, and the adequacy of these measures on wild carrot, was sought in order to determine if the problem was more widespread than the one county.

Collections on seedlings and second-year plants were made in 21 different localities and transplanted into our plots at Guelph in May, 1956. One month later a few plants from each locality were sprayed with 2,4-D ester, 1000 ppm, as a preliminary test of susceptibility, and seed was gathered from other plants in each group in October. This seed will be used in greenhouse experiments this winter in a more comprehensive test of the susceptibility of the plants from different localities to 2,4-D, 2,4,5-T and other herbicides.

One-tenth acre plots were layed out in May, 1956 along a heavily infested roadside in Halton County, in an area from which reports had been received of inadequate control of wild carrot by 2,4-D Sprays of various concentrations of 2,4-D low volatile ester, 2,4,5-T, and 2,4-D - 2,4,5-T mixtures were applied with a 4 nozzle boom sprayer on June 7. Each treatment was replicated 3 times. Wild carrot seedlings were well-emerged by this time and the second year plants were growing vigorously.

Seed that had been collected in this same area in Halton County in October, 1955, and seed collected in an area near Guelph where little difficulty in controlling wild carrot with 2,4-D had been reported, was grown in the greenhouse during the winter of 1956. Seedlings were grown in 3-inch pots and sprayed with 2,4-D amine, 2,4-D low volatile ester or with 2,4,5-T. In May, 1956, seedlings from each group (Halton and Guelph) were transplanted in the field where they were sprayed with similar chemicals as in the greenhouse. Injury to the plants was assessed on a 0-9 basis with 0 indicating no effect, and 9 indicating most severe response (plants dead or dying).

*The financial assistance of the Dominion Rubber Co. is gratefully acknowledged.

RESULTS

Of the 35 counties in Southern Ontario from which replies to the questionnaire were received, 22 reported extensive infestations of wild carrot, and 13 considered themselves relatively free. Of the 22 badly infested areas, 5 reported satisfactory control with 2,4-D and 8 reported that 2,4-D was inadequate. In all counties where 2,4-D - 2,4,5-T mixtures were used, it was felt that wild carrot was being satisfactorily controlled.

Preliminary work on the plants collected from different areas and transplanted into our plots at Guelph has indicated varying responses to 2,4-D. Seven groups of plants showed markedly less curvature response from 1000 ppm low volatile ester 2,4-D than did the other 14 groups. Most of the plants in the latter groups were dead 6 weeks after treatment whereas none of the plants in the other seven groups was dead and only a few showed slight epinasty.

The results of spraying a heavily infested roadside in Halton County in the area from which reports of inadequate control of wild carrot by 2,4-D had been received are shown in Table 1.

Table 1: - Effect of various concentrations of 2,4-D, 2,4,5-T and 2,4-D - 2,4,5-T mixtures on wild carrot in one-tenth acre roadside plots in Halton County, S. Ontario.

Treatment	Oz. Per Acre	Response* 0-9	% Control**
2,4-D Low Volatile Ester	16	0	0
	32	2	25
2,4,5-T	8	6	95
	16	8	99+
	24	8	99+
2,4-D - 2,4,5-T (1:1)	16	6	95
	24	8	99+
	32	8	99+

* Estimated 12 days after treatment; 0 = no effect
9 = plants dying

** Estimated 10 weeks after treatment.

The 2,4-D treatment at 32 oz./A brought about characteristic curvature responses but there was no evidence of chlorosis and most of the plants recovered. There was little or no response, even of the seedlings, to the 16 oz./A rate of 2,4-D. Plants treated with all rates of 2,4,5-T or with the 2,4-D -

2,4,5-T mixture became badly twisted, then chlorotic, and finally died. Essentially perfect control was obtained with the higher rates of 2,4,5-T and 2,4-D - 2,4,5-T mixtures.

Plants were grown in the greenhouse from seed collected in the Halton County area and from the Guelph area. These plants were sprayed with 2,4-D (amine or ester) or with 2,4,5-T. The results of this experiment are presented in Table 2.

Table 2: - Effect of 2,4-D and 2,4,5-T on plants grown from seed collected in two different areas.

Treatment	Concentration (ppm)	Response (0-9)*		% Kill***	
		Guelph**	Halton**	Guelph**	Halton**
2,4-D amine	200	6.1	0.9		
	500	7.9	4.3	85	0
2,4-D Low Volatile Ester	200	7.5	1.2		
	500	8.0	4.5	93	6
2,4,5-T	200	8.3	6.7		
	500	8.8	7.9	95	90

* Average of 10 pots estimated 9 days after treatment; 0 = no effect, 9 = plants dying.

** Guelph plants grown from seed collected near Guelph, and Halton plants grown from seed collected in Halton County.

*** Calculated 6 weeks after treatment.

The Halton plants were markedly more resistant to both the amine and ester form of 2,4-D than were the Guelph plants. This difference showed up within 2 days after treatment and became more pronounced with time. It appeared that the Halton plants recovered from the effects of the 2,4-D whereas the Guelph plants reacted in the way a plant susceptible to 2,4-D usually acts - curvature and twisting, followed by chlorosis, followed by death. There was little difference between the Guelph and Halton plants when 2,4,5-T was used. Similar results were obtained by spraying Guelph and Halton plants growing in the field.

SUMMARY

The unsatisfactory control of wild carrot obtained by spraying with 2,4-D in certain areas of Southern Ontario is being investigated. The presence of one or more strains of wild carrot that are resistant to 2,4-D - but not to 2,4,5-T - has been demonstrated. The physiological basis for this resistance is under study at the present time.

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A Comparison of Several Phenoxyacetates as Herbicides on Seedling Alfalfa and Ladino Clover

Robert A. Peters[1]

Following the advent of 2,4-D and MCP it was soon found that these materials were of value for weed control in pasture and hay crops which were predominately grass. Legumes in general, however, proved to be injured by these chemicals at rates which were effective in weed control. Species-chemical interactions have been shown to exist, e.g., MCP has generally been less injurious to red clover than 2,4-D while with birdsfoot trefoil the reverse situation prevails.

Recommendations for the use of the 2,4-D and MCP phenoxyacetates have been largely confined to seedings made in a companion crop. The latter gives mechanical protection by providing a canopy over the legume which intercepts the spray. This procedure has definite limitations. If weeds are below the small grain canopy, poor contact is made because of canopy interception. In many situations if weed control could be obtained by spraying legumes directly, the companion crop could be eliminated permitting much more rapid establishment of the forage crop.

Dinitro-ortho secondary butyl amine (DN) has proven to be an effective herbicide on pure seedings but its use is restricted. It is generally effective only on very small seedlings and requires warm, dry weather for maximum activity.

Several materials within the past three years have been suggested as herbicides which are less toxic to legumes than 2,4-D and MCP (1,2,3,5). The following is a report on three phenoxyacetates; MCP, 4-chloro, 3,4-D; compared to 2,4-D as a standard on seedling alfalfa and Ladino clover seeded in pure stand and in a companion crop.

A related chemical, a phenoxybutyric acid derivative, (MCPB) was included in the 1955 year test. The 1954 text included DN as well as the above mentioned phenoxyacetates.

EXPERIMENT I - 1954 SEEDING

Procedure

Parallel seedings with and without a companion crop (Clinton oats) were made on May 25, 1954. One experiment was seeded to Narraganset alfalfa, the other to Ladino clover. The experimental design was a randomized block replicated three times within the individual plots measuring 7 by 8 feet.

The chemical treatments are given below. All rates are in terms of acid equivalents or active ingredients per acre.

1. 2,4-dichlorophenoxyacetic acid, alkanolamine salt $\frac{1}{4}$ lb.
2. 2,4-dichlorophenoxyacetic acid, alkanolamine salt $\frac{1}{2}$ lb.

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3.	2 methyl, 4-chlorophenoxyacetic acid, alkanolamine salt	¼ lb.
4.	2 methyl, 4-chlorophenoxyacetic acid, alkanolamine salt	½ lb.
5.	3,4-dichlorophenoxyacetic acid, triethyl amine salt	¼ lb.
6.	3,4-dichlorophenoxyacetic acid, triethyl amine salt	½ lb.
7.	4-chlorophenoxyacetic acid, alkanolamine salt	½ lb.
8.	4-chlorophenoxyacetic acid, alkanolamine salt	¼ lb.
9.	Dinitro-o-sec-Butyl-phenol, alkanolamine salt	1 lb.
10.	Dinitro-o-sec-Butyl-phenol, alkanolamine salt	2 lb.

The phenoxyacetates were applied on July 1, 1954 when the oats were in the early boot stage. The oats were 17-19 inches tall, alfalfa 7-8 inches, and the Ladino clover 4 to 5 inches tall. The alfalfa was in the 6th true leaf stage while the Ladino was in the 3rd to 4th true leaf stage.

The dinitro treatments were applied earlier, June 25, when the weeds were still small. The oats were tillering and 10 inches tall. The alfalfa was 4 inches and the Ladino 1 to 1½ inches tall. Both species were in the 3rd true leaf stage.

Oat growth was poor due in part to the late date of seeding (May 25). As a result the oats afforded a relatively poor canopy over the legumes.

The predominate volunteer weeds were lambsquarter and ragweed.

The treatment on the no oat plots were applied at the same time as previously stated for the oat plots.

Results and Discussion

An injury rating of each plot made 8 days after spraying as given in Table I.

The greater epinasty and growth restriction of the alfalfa from 2,4-D and MCP is expressed by the greater injury rating. The effect obtained with the 3,4-D and 4-chloro was considerably less. In contrast there was little difference between the phenoxyacetates on the effect on Ladino. Dinitro caused less damage than any other material on either legume. The 3,4-D and 4-chloro were relatively more active on the weeds as compared with 2,4-D and MCP than on the alfalfa.

The trends shown by the estimates of initial injury were substantiated by stand counts made on August 6, 37 days after treatment as given in Table II.

TABLE I. Estimate of Initial Injury of Pure Stand Alfalfa Following Treatment with Several Phenoxyacetates, 1954.

(Rating on basis of 10 for complete kill, 0 for no injury)

Treatment lb. active ingredients per A.		Alfalfa	Ladino	Broadleaf Weeds
2,4-D	¼	8.6	3	9.0
2,4-D	½	9.0	3	9.0
MCP	¼	7.3	3.5	7.7
MCP	½	9.0	3.0	9.0
3,4-D	¼	2.0	1.5	5.3
3,4-D	½	4.3	2.5	7.7
4-chloro	¼	2.1	1.5	4.3
4-chloro	½	5.0	2.0	7.0
Dinitro	1	1.0	1.0	No Data
Dinitro	2	1.0	1.0	No Data

TABLE II. Stand Counts of Alfalfa Seeded as Pure Stand Following Treatment With Phenoxyacetates, 1954[1]

(All rates in lb. active ingredients per acre)

Check	2,4-D		MCP		3,4-D		4-chloro		Dinitro	
	¼	½	¼	½	¼	½	¼	½	¼	1
515	307	205*	419	242*	679	642	611	611	735	781*

LSD at .05 level = 263

[1]Each entry is a mean count of three replications.

The significantly greater stand count on the plots treated with 1 pound of dinitro reflects both the excellent weed control obtained and the lack of injury to the alfalfa. The two higher rates of 2,4-D and MCP caused a significant reduction in the alfalfa stand. Therefore, while 2,4-D and MCP gave good weed control, they were quite obviously not a satisfactory herbicide on pure stand alfalfa. At comparable rates neither 4-chloro nor 3,4-D had an effect on the alfalfa stand.

Stand counts of Ladino were not made as the Ladino had recovered from any initial injury and had spread by means of stolons making individual stand counts meaningless. All the oat plots were clipped to six inches on August 12, 1954. On September 2, stand density estimates were made of all plots, as given in Table III.

TABLE III. Estimates of Stand Density Two Months Following Treatment with Phenoxyacetates.[1]

(10-Uniform cover, 0-No cover.)

Treatment (lb. active ingredients per acre)		Alfalfa		Ladino		Broadleaf Weeds		Grassy Weeds	
		Oats	No Oats	Oats	No Oats	Oats	No Oats	Oats	No Oats
CK		8.2	8.3	5.3	4.2	2.7	6.1	1.0	0.6
2,4-D	¼	1.0	7.3	9.0	9.3	0.7	0.3	1.3	5.7
2,4-D	½	0.3	2.0	4.2	10.0	0.3	0.3	3.0	5.0
MCP	¼	2.0	7.7	5.7	8.3	3.0	0.7	2.0	3.0
MCP	½	0.0	2.7	3.0	10.0	0.7	0.3	1.7	7.7
3,4-D	¼	8.3	7.0	8.0	10.0	3.0	5.0	1.3	2.7
3,4-D	½	7.3	10.0	8.0	10.0	2.0	2.0	1.3	3.7
4-chloro	¼	7.6	10.0	---	---	1.3	1.7	0.7	2.0
4-chloro	½	7.6	9.3	---	---	1.0	1.3	1.0	5.0
Dinitro	½	8.7	8.7	5.0	9.3	0.7	2.6	1.0	1.0
Dinitro	1	5.0	10.0	3.0	9.3	0.0	1.3	2.0	.3

[1] Each entry is an average of estimates in three replications.

Alfalfa injury was generally greater in the oat plots. As previously mentioned the canopy present at the time of spraying offered relatively little protection to the legumes. The legumes in the oats were, therefore, subject to both herbicide injury and the competitive effect of the companion crop. The higher rate of 2,4-D or MCP caused severe stand reduction of alfalfa with or without oats. Injury from 3,4-D, 4-chloro or MCP was much less.

Ladino clover in pure stand benefited markedly from the weed control obtained from the herbicide treatments on the pure stands. The initial injury from treatment was no longer evident; in fact, the stands of all treated plots were at least twice that of the check. The excellent recovery obtained is attributable to the growth habit of Ladino clover. If only a few vigorous plants survive, a plot free of weed competition will soon become revegetated because of the stoloniferous growth characteristic of Ladino clover. The Ladino plots seeded to oats as a companion crop did not show the degree of recovery of the pure stand plots presumably due to competitive effect of the oats on the weakened plants. However, all treatments resulted in a greater density except the high rate of 2,4-D, MCP and dinitro.

Earlier, 3,4-D and 4-chloro promised a greater degree of weed control, as shown in Table I, than was obtained. Characteristically, the terminal buds were killed in ragweed and lambsquarter but recovery occurred from development of numerous lateral buds. Such a temporary set-back of weeds, may of course permit the legumes to gain the ascendency.

Observations of 1954 Seeding the First Hay Year.

Heaving was serious during the winter of 1954-1955 on both alfalfa and Ladino clover plots. Heaving was least on those plots seeded to oats in 1954 which was attributable to the protection afforded by the oat stubble. The pure stand Ladino plots had nearly a complete cover prior to the winter but this was reduced 75% in the spring due to heaving. All the Ladino plots showed marked recovery by stolon spread during the 1955 season. Any variation in Ladino stand was associated with winter heaving rather than with any herbicide treatment the previous year since the stand was uniform on all plots at the end of the first season.

Yields of alfalfa were obtained from the first cutting the year following treatment. The yield samples were cut on July 5, 1955 and are given in Table IV.

TABLE IV. Second Year Yields of Alfalfa Following Treatment with Several Phenoxyacetates, 1954 Seeding.

Chemical Treatment lb. acid equivalent per acre.		Yield in lb. (air dry weight) per acre Oat Companion Crop	No Companion Crop
Check		3960	3802
2,4-D amine	¼	2534	3168
2,4-D amine	½	2059	2218
MCP amine	¼	3485	3326
MCP amine	½	TRACE*	1901
3,4-D	¼	4276	3326
3,4-D	½	4276	3643
4-chloro	¼	4752	3802
4-chloro	½	4752	3326
Dinitro	1	4594	2693
Dinitro	2	3643	2693

LSD = 1584 at .05 level.

The difference between treatments apparent in the seeding year were much less obvious the second year of growth. The only treatments giving a significantly different yield than the check was the high rate of 2,4-D and MCP in the pure stand. The yields were not, however, based on hand separations and grass composed a good part of total on some plots low in alfalfa which tended to equalize the yields. In general the plots seeded in the companion crop had the highest yields which was attributed to less loss from winter heaving in the stubble.

EXPERIMENT II - 1955 SEEDING

Procedure

Parallel seedings of alfalfa and Ladino clover were made on May 2, 1955 as in 1954. In addition black mustard at a rate of 2 pounds per acre was broadcast over all plots. A plot size of 14 by 16 feet was employed in a randomized block design replicated four times.

Since the 1954 results indicated a relative resistance of alfalfa to 3,4-D and 4-chloro the rates of these materials was increased to a higher level in the 1955 test. A new material was added based on promising results obtained by Wain (4). This material was MCPB, 4-chloro 2-methyl phenoxy n-butyric acid, used as the dimethyl amine salt.

TABLE V. Injury Rating Following Application of Phenoxyacetates on Pure Stand Alfalfa - 1955.

(Rating; 10 for injury similar to 1 lb. 2,4-D; 0 - check)

Treatment lb. acid equivalent per acre.		Alfalfa	Mustard	Lambsquarter
2,4-D	¼	7.7	7.0	8.0
2,4-D	½	9.0	6.3	9.0
2,4-D	1	10.0	10.0	10.0
MCPB	¼	0.7	1.3	2.0
MCPB	½	2.0	5.0	7.7
MCPB	1	2.0	1.3	5.3
3,4-D	½	2.3	4.7	3.0
3,4-D	1	1.7	4.7	5.7
3,4-D	2	2.0	4.7	6.0
4-chloro	2	2.0	4.3	3.7
		Chemical Averages		
CK		0.0	0.0	0.0
2,4-D		26.0	23.3	27.0
MCPB		4.7	7.6	15.0
3,4-D		6.0	14.1	15.4

The treatments were as follows. All rates are in terms of acid equivalents.

1. Check
2. 2,4-D ¼ lb. per acre
3. 2,4-D ½ lb. per acre
4. 2,4-D 1 lb. per acre
5. MCPB ¼ lb. per acre
6. MCPB ½ lb. per acre
7. MCPB 1 lb. per acre
8. 3,4-D ½ lb. per acre
9. 3,4-D 1 lb. per acre
10. 3,4-D 2 lb. per acre
11. 4-chloro 2 lb. per acre

The treatments were applied on June 20, 1955. At this time the oats were just beginning to emerge from the boot. The alfalfa was 8-10 inches tall and the Ladino 6-8 inches tall. The alfalfa was in the 7th true leaf stage while the Ladino was in the 5-6th leaf stage and was beginning to produce rhizomes. The mustard was advanced beyond the first bloom stage with several seed pods formed on each plant.

Results and Discussion

Mustard control was unsatisfactory at the stage treated. While epinasty was evident in several treatments, pod development frequently continued. Epinasty of the alfalfa was severe following all 2,4-D treatments but only the high rate of MCPB, 3,4-D and 4-chloro showed marked epinasty.

Table V gives estimates of injury to the alfalfa and contained weeds 25 days following the herbicide application.

It is readily noted that none of the newer materials were as injurious to the alfalfa as the lowest rate of 2,4-D. The low activity on the alfalfa can be attributed in part to the extensive canopy effect of the mustard over the alfalfa. While showing very little activity on the alfalfa, the former materials gave some weed control with no marked difference discernable between MCPB, 3,4-D and 4-chloro. The data do indicate a greater activity of MCPB on lambsquarter than on the mustard. All of the materials were applied on weeds which were too far advanced, especially in the case of mustard. It is indicated, however, that rates over twice as great as 2,4-D rates commonly used will be required for satisfactory weed control.

While some initial epinasty was observed on the Ladino plots treated with 2,4-D, no differences between any of the plots were observed on October 11, 1955, nor in the spring of 1956. None of the other materials caused more than temporary injury to the Ladino.

On September 11, 1956, selected alfalfa plots were harvested for yield data by mowing a swath through each plot. Hand separations of the alfalfa were made and the dry weight determined. These data are given in Table VI.

Irregularity in stands at the time of sampling resulted in an insensitive test as indicated by the large LSD. The yields substantiate the observations made during the seedling year which indicate the relative safety of MCPB, 4-chloro and 3,4-D on alfalfa as compared to 2,4-D with yield from the high rate of 2,4-D being significantly lower than the yield of any other chemical tested.

TABLE VI. Second Year Yields of Alfalfa Following Treatment with Several Phenoxyacetates - 1955 Seeding.

Chemical Treatment lb. acid equivalent per acre.	Yield in lb. (air dry weight) per acre
Check	2227
2,4-D amine	1807
2,4-D amine	1549
2,4-D amine	870*
MCPB	2937
3,4-D	2937
4-chloro	3033

LSD = 1419 lb.

Summary

1. While 2,4-D and MCP were highly toxic to alfalfa, no permanent reduction in Ladino stand was obtained. Any initial reduction in stand was eliminated a few weeks after treatment by stoloniferous growth of the Ladino.

2. When an incomplete oat canopy was present as in Experiment I, legume injury from 2,4-D and MCP was more severe than in pure stand where companion crop completion was not a factor.

3. 3,4-D, 4-chloro and MCPB are all considerably less toxic to alfalfa than 2,4-D or MCP. These materials were all less active on the weed species at equivalent rates than 2,4-D or MCP. Characteristically, 3,4-D and 4-chloro caused kill of the terminal buds with subsequent recovery from lateral growth.

4. MCPB was more active on mustard than 3,4-D but it was similar on lambsquarter.

5. Stage of growth of mustard at time of treatment was found to be critical. None of the phenoxyacetates or MCPB treatments prevented continued seed pod development when applications were made at the bloom stage.

6. Dinitro was the most satisfactory material used under the conditions of this experiment with good control of both broadleaf and grassy weeds being obtained in Experiment I without injury to alfalfa or Ladino clover.

7. Differences between treatments based on yields of forage the first hay year were less apparent than in the seedling year.

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CHEMICAL CONTROL OF CONIFERS ON UTILITY RIGHT-OF-WAY

J. M. Bennett[1]

During the past few years conifers have become a serious maintenance problem on thousands of acres of utility right-of-way in Canada. This problem has developed following the change from mechanical cutting to the use of herbicides, for the control of woody growth on right-of ways. The herbicides most widely used, 2,4-D and 2,4,5-T, have been effective in controlling the deciduous woody growth, but have had little effect on conifers. These chemicals are, in fact, used for selectively eliminating deciduous species from conifers in forest management operations. The conifers, because of reduced competition for light, moisture and nutrients, grow much more rapidly than "normal" and on many right-of-ways they are now the dominant vegetation. The high cost of maintenance by mechanical cutting has prompted the search for an economical chemical control.

Little published information is available on the chemical control of conifers and only limited research work on this subject has come to our attention. Oil-borne sprays of 2,4-D - 2,4,5-T have been used for conifer control with considerable success in the Northeastern States and by the British Columbia Electric Company, the Shawinigan Water and Power Company in Quebec and, on a limited scale, by the Ontario Hydro. Recent work in the Northeastern States has shown that applications of 2,4-D - 2,4,5-T in an oil-water carrier, the oil fraction ranging from 10 to 25 per cent, are effective for conifer control. The objections to extensive use of oil for spraying under Canadian operating conditions are many, the most outstanding being the cost and difficulty of transporting the required oil volumes into remote areas. More suitable control measures were desirable and a research program was undertaken.

Preliminary Studies

Investigational experiments conducted during May 1953 showed that applications of monuron (3-(p-chlorophenyl)-1, 1-dimethylurea) to the soil in the root area gave excellent control of balsam fir and spruce at rates as low as 15 lb/A of formulation (12 lb active ingredient). Ammonium sulphamate at 120 lb/A applied in like manner resulted in severe injury but the majority of the trees survived. Water borne foliage sprays of sodium trichloroacetate (sodium TCA) at 120 lb/A applied in August of the same year were effective but not economical at that rate. CIPC (isopropyl N-(3-chlorophenyl) carbamate) at 75 lb/A as a water borne spray produced

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only slight to moderate foliage injury with no appreciable kill.

In further work during 1954 sodium TCA and monuron continued to be promising and dalapon (2,2-dichloropropionic acid) sodium salt, was found to be active against conifers. It became apparent that there were several chemicals which were herbicidally active on confiers and a more extensive program was undertaken to select the most suitable.

1955 Studies

Experiments conducted during 1955 were designed to study the activity of various chemicals, the optimum rate of application and the effective time of year for treatment.

Methods and Materials

The test site was a section of high tension right-of-way near Haliburton in Northern Ontario, where a dense stand of conifers, predominately balsam fir, Abies balsamea (L.) Mill., and black spruce, Picea mariana (Mill.) BSP., had survived a water-borne spray of 2,4-D - 2,4,5-T during 1953. Tree height ranged from four to ten feet. The site was swampy, almost verging on a sphagnum bog with several outcroppings of sand covered rock.

A tagged-stem plot technique was used whereby each tree was marked with a numbered metal tag. Each plot consisted of forty individual trees. Applications were made with a compressed air knapsack sprayer giving complete coverage of all foliage and stems. About two gallons of spray solution were used for each plot of forty trees. One hundred and sixty plots, comprising over six thousand stems were treated with applications made at four times of the year - April, late May, July and October. Observations were made in October, 1956. Only those stems which had no living cambium above ground level were classed as dead. For summary purposes no rating was given to those stems not completely killed, consequently, the percentage kills as presented represent a conservative evaluation of the treatments.

The herbicides used were 2,3,6-TBA (2,3,6-trichlorobenzoic acid, free acid solution, Heyden HC1281WD), monuron (3-p-chlorophenyl)-1, 1-dimethylurea, 80 per cent wettable powder, TCA (trichloroacetic acid, sodium salt, 79.3 per cent acid equivalent), dalapon (2,2-dichloropropionic acid, sodium salt, 74 per cent acid equivalent), 2-(2,4,5-TP) (2-(2,4,5-trichlorophenoxy) propionic acid, propylene glycol butyl ether esters), ammonium sulphamate (80 per cent active ingredient), ATA (3-amino-1,2,4-triazole), erbon (2-(2,4,5-trichlorophenosy) ethyl 2,2-dichloropropionate), sodium chlorate mixture, 2,4-D2,4,5-T (2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid 1-1 mixture, isooctyl esters), 2-(MCPP) (2,(2-

methyl-4-chlorophenoxy) propionic acid, butoxy ethanol esters), 4-CPA (4-chlorophenoxyacetic acid, butoxy ethanol esters) and waste transformer oil. The rates as used throughout this paper are expressed in pounds per 100 Imperial gallons, those of 2,3,6-TBA, 2-(2,4,5-TP), erbon, 2,4-D-2,4,5-T, 2(2,4-DP), 2-(MCPP) and 4-CPA are of acid equivalent, those of ATA and sodium chlorate are of active ingredient and those of monuron, TCA, dalapon and ammonium sulphamate are of formulation. Not all materials were applied at the four application periods. Unless otherwise specified the diluent was water.

Observations

The results of the more effective treatments are presented in Table 1. The 2,3,6-TBA was one of the most effective chemicals used. Treatment during May and July at 5.75 lb, the lowest rate applied, gave 87 and 100 per cent kill and at 10.0 lb 100 and 100 per cent. The 30.2 lb rate during October gave only 42 per cent kill. On this latter plot the living stems were almost completely defoliated and ultimately a much higher kill is expected. The 2,3,6-TBA was not applied during April.

Monuron applied at 3.31, 5.75 and 10.0 lb in May gave 50, 77 and 100 per cent kill and in July 95, 100 and 100 per cent kill. In October 17.4 lb gave only 10 per cent kill. Much of the vegetation in the immediate vicinity of the treated stems was also killed. Although the application was an overall foliage treatment, it is probable that much of the effectiveness on conifers was due to root absorption rather than foliage absorption. No application of monuron was made during April.

TCA at 5.75, 10.0, 17.4, 30.2 and 52.5 lb applied in May gave 15, 45, 90, 97 and 92 per cent kill. These same rates in July gave kills of 50, 82, 100, 100 and 100 per cent. For the April treatment 52.5 lb gave 17 per cent kill while in October only moderate to severe foliage injury resulted from the same treatment.

Dalapon was less effective than TCA at comparable rates. No complete kill was produced with 10 lb at any of the four application periods. Rates of 17.4, 30.2 and 52.5 pounds in May gave kills of 67, 92 and 90 per cent and in July 12, 83 and 95 per cent. During April 52.5 lb gave 22 per cent kill and in October only moderate foliage injury was produced by that rate. Spruce is more resistant to dalapon than is balsam fir. Satisfactory control of spruce was not obtained with less than 30.2 lb. An ester formulation of dalapon was applied at 17.4 pounds acid equivalent during May. Only slight foliage injury resulted.

The addition of small amounts of ATA to dalapon sprays has significantly increased the effectiveness. Ten pounds of dalapon plus 2-1/2

TABLE 1

CONIFER CONTROL WITH VARIOUS HERBICIDES
APPLIED DURING 1955 - OBSERVED OCTOBER 1956

Herbicide	Rate lb/100 Imp gal H_2O	Date of treatment			
		April 12	May 30	July 20	October 20
2,3,6-TBA*	5.75		87	100	L
	10.0		100	100	M
	17.4		100	100	22
	30.2		100	100	42
Monuron**	3.31		50	95	0
	5.75		77	100	L
	10.0		100	100	M
	17.4		100	100	10
Sodium TCA**	5.75	0	15	50	
	10.0	0	45	82	L
	17.4	L	90	100	M
	30.2	L	97	100	M
	52.5	17	92	100	M-S
Dalapon**	5.75	0	L	L	0
	10.0	0	M	M	
	17.4	L	67	12	L
	30.2	M	92	83	
	52.5	22	90	95	M
Dalapon plus***	10.0			97	
amino triazole	17.4			100	0
2(2,4,5-TP)*	3.31	0	20	67	
	5.75	10	47	97	0
	10.0	M	70	92	L-M
	17.4				M-S
Ammonium** sulphamate	17.4	0	M		
	30.2	0	S	M-S	0
	52.5	0	67	57	0
Amino triazole*	5.75	L	L	M	0
	10.0	M	M	M-S	
	17.4	M	S	S	0
	30.2	S	VS	VS	
	52.5	VS	VS	15	L
Sodium Chlorate**	25.0		L	27	
	37.5		L	77	

Each value in table represents per cent kill for a 40-stem plot. L, M,S,VS indicate slight, moderate, severe and very severe foliage injury.

* - Rate in pounds acid equivalent or active ingredient.

** - Rate in pounds formulation.

*** - Dalapon plus amino triazole used at 4-1 ratio. Rate is given for dalapon.

lb of ATA applied in July gave 97 per cent kill compared to 83 and 95 per cent kill with dalapon alone at 30.2 and 52.5 lb. Dalapon at 17.4 lb plus 4.35 lb of ATA (the same 4 to 1 ratio) gave 100 per cent kill.

Treatments with 2-(2,4,5-TP) at 3.31, 5.75 and 10.0 lb gave kills of 20, 49 and 70 per cent in May and 67, 97 and 92 per cent, in July. April treatment at 10.0 lb and October treatment at 17.4 lb were relatively ineffective. As with dalapon, spruce is more resistant than balsam. Only the 5.75 and 10.0 lb rates applied in July gave more than 50 per cent kill of spruce.

Ammonium sulphamate at 30.2 lb produced only moderate to severe foliage injury in May and July. Kills of 67 and 57 per cent were obtained with 52.5 pounds in May and July respectively. April and October treatment at 52.5 pounds produced no appreciable injury.

Amino triazole produced very interesting effects on both balsam and spruce but as yet there is little in the way of complete kill even at 52.5 lb. Treatment during July produced the most severe effects. The 5.75 lb rate gave slight to moderate chlorosis of the new growth with many terminal shoots completely defoliated. At 10.0 lb the only foliage remaining was on the lower part of the trees. At 17.4 lb the wood of the terminal shoots was dead but still some lower foliage remained healthy. Almost complete foliage kill with all terminal wood dead resulted from 52.5 lb treatment. A high degree of kill is expected on this plot eventually. Treatments during May and April gave similar but less severe results. October treatment produced only slight chlorosis of outer foliage even at 52.5 lb.

Sodium chlorate was ineffective at 37.5 lb in May. In July kills of 27 and 77 per cent were produced at rates of 25.0 and 37.5 lb.

In July 2,4-D-2,4,5-T gave 32 per cent kill at 5.75 lb, but in October 17.4 lb produced only slight foliage injury.

Erbon at 19.1 lb in July produced only slight curling of the needles with no permanent injury. 4-CPA, 2-(MCPP) and 2-(2,4-DP) at 10 lb were ineffective in October, the only time of application.

Waste transformer oil gave 95 per cent kill in April and 100 per cent in October. Oil-water emulsion, without herbicide, in ratios of 1-9, 3-7 and 5-5 gave 50, 75 and 95 per cent kill during October. Oil-water (1-9) spray of 2,4,5-T at 5.75 and 10.0 lb gave kills of 72 and 50 per cent during October.

Field Trials

Field trials using conventional power equipment have been carried out with the more promising chemicals. During June 1955 dalapon at 15, 20 and 30 lb/100 Imp gal was applied to a total of fourteen acres of a mixed stand of white cedar, red and white pine and white spruce. At 15-20 lb severe injury resulted with many trees surviving; only the 30 lb rate effected complete control.

During July 1956 2,3,6-TBA, TCA, dalapon and monuron were applied at various rates to more than thirty acres of conifers. Preliminary observations indicate 2,3,6-TBA to be outstanding in these trials although final evaluation cannot be made until next year. Application of 2,3,6-TBA was also made from a helicopter, however no observations have been made of this test. It has been demonstrated in these field trials that very thorough coverage of the conifers is essential for a high degree of kill.

Discussion

Of the six materials applied during April and the fourteen applied during October only oil, or treatments with an oil carrier, produced satisfactory kill. The 2,3,6-TBA is the only other material with significant kill at these two periods - 42 per cent at 30.2 lbs. At the time of the April treatment the conifers were still dormant with no noticeable bud activity. By late May the buds had broken and the new shoots ranged up to three inches in length. By July 20th. shoot elongation for the season was virtually complete and the growth was maturing. All growth for the season had stopped before October treatment. It appears that with the exception of oil, the chemicals investigated in this study are effective for conifer control only during the growing season. Whether the period of susceptibility of conifers corresponds to that of deciduous brush is not known but a close correlation is expected. At the outset of this investigation it was hoped that a material could be found which would be effective during September and October in order to extend the spraying season and better utilize men and equipment. Such has not been the case.

The effect of the various chemicals on vegetation other than conifers is an important consideration in selecting a material for extensive use on right-of-ways. Control of both deciduous and coniferous woody growth with one treatment is desirable. Also, the maintenance of a ground cover is important. The soil sterilizing effect of monuron and the grass killing powers of such materials as TCA and dalapon must be considered. Observations of field trials will aid in evaluating these factors. Other considerations are corrosiveness to equipment, cost of transportation, hazards to spray crews, public relations policies involving wild life and adjacent vegetation, and last but not least, cost. At the present time TCA and 2,3,6-TBA are considered the most suitable for extensive use.

Conclusions

(1) The most effective materials for killing conifers and the rates of application suggested for trial use are:

monuron 3-4 lb active ingredient per 100 Imperial gallons of water

2,3,6-TBA 4-6 lb acid equivalent " " " " " "

silvex 6-8 lb acid equivalent " " " " " "

TCA 8-10 lb acid equivalent " " " " " "

dalapon 15-20 lb acid equivalent " " " " " "

(2) The effective application period for controlling conifers with water-borne sprays corresponds closely with that for control of deciduous brush with the same type of sprays.

(3) Of the two species dominant in these studies, black spruce and balsam fir, black spruce appears to be the more resistant.

(4) The suitability of these materials for general use will be dependent on such factors as cost, corrosiveness to equipment, effect on other vegetation, hazards in use and ease of application.

(5) TCA and 2,3,6-TBA were considered the materials most suitable for expensive use.

Summary

During 1955 fourteen herbicides were evaluated for conifer control in one hundred and sixty plots comprising more than six thousand tagged stems. Effective control of the conifers balsam fir and black spruce was obtained with water-borne sprays of monuron, 2,3,6-TBA, silvex, TCA and dalapon applied during the growing season. With the exception of treatments incorporating an oil or oil-water carrier, no treatment gave satisfactory control during April or October. TCA and 2,3,6-TBA are considered the most suitable materials for extensive use.

AUTHOR INDEX

SUBJECT INDEX

NORTHEASTERN WEED CONTROL CONFERENCE

MINUTES OF THE BUSINESS MEETING

January 11, 1957

The meeting was called to order by the President, L. L. Danielson.

The Secretary read pertinent parts of minutes from the previous business meeting which were approved as read. A registration of 540 was reported with the final registration totaling 574. This is the largest number to attend a Northeastern Conference.

The report of the Treasurer was given in brief and it was indicated that the complete report would appear in the Supplement.

Mr. C. O. Cartwright, county agricultural agent in Essex county, Massachusetts was introduced as winner of the extension award by S. N. Fertig. Mr. Cartwright has been working in weed control for the past 10 years. During that time he has cooperated with industrial and extension personnel. In 1956, 72 demonstrations of weed control were established by him.

J. G. Van Geluwe announced two awards for outstanding progress reports in research. A. J. Kerkin and R. A. Peters received one award of $100.00 for their paper entitled, "Herbicidal Effectiveness of 2,4-DB, MCPB, Neburon and Others as Measured by Weed Control and Yields of Seedling Alfalfa and Birdsfoot Trefoil". W. C. Bramble W. R. Byrnes, and D. P. Worley received an award of $100.00 for the paper entitled, "Effects of Certain Common Brush Control Techniques and Materials on Game Food and Cover on a Power Line Right-of-way".

Mr. Aldrich reported for the balloting committee consisting of G. H. Ahlgren, R. E. Engel and R. J. Aldrich. C. L. Hovey was elected president; S. N. Fertig vice-president; D. A. Schallock treasurer, and; R. J. Aldrich secretary.

President Danielson announced the appointment of L. R. Reed and R. E. Engel as an auditing committee.

President Danielson commended all those who had a part in making the meeting a success before turning the meeting over to the new president, C. L. Hovey.

The following committee appointments were announced by president Hovey:

Program Committee Chairman - J. R. Havis

Coordinating Committee Chairman - E. M. Rahn

Sustaining Memberhip Committee Chairman - E. D. Witman

Public Relations Committee Chairman - L. G. Utter

Awards Committee Chairman - L. L. Danielson

Publications Committee Chairman - R. J. Aldrich

Richard J. Aldrich

Richard J. Aldrich, Secretary

Proceedings Published by

Northeastern Weed Control Conference

Copies available from
Dr. Richard J. Aldrich, Secy.
Farm Crops Dept., Rutgers University
New Brunswick, New Jersey

Price $3.00 per copy, postpaid

NORTHEASTERN WEED CONTROL CONFERENCE
Treasurer's Report
February 12, 1957

Receipts

Cash on Hand, February 7, 1956	$ 1,943.52	
Sustaining Membership	1,510.00	
Sale of 1956 Proceedings after Conference	796.12	
Sale of 1957 Proceedings at Conference	1,012.00	
Registration	846.00	
Luncheon tickets	675.00	
Payment for Weed Society Abstracts	181.92	
Payment for photo	5.00	
		$ 6,969.56

Expenses

General		
Travel of Executive Committee	$ 393.44	
General Correspondence	312.97	
Telephone	4.49	
Pictures	15.00	
Weed Society Abstract	158.57	
Total		$ 884.47
Publications		
1956 Supplement	361.43	
1957 Supplement (partial)	65.00	
Coord. Committee Report	365.00	
News letter	247.75	
1957 Proceedings	1,019.69	
Total		$2,058,87
Meeting		
Clerks	$ 116.12	
Awards	300.00	
Travel	71.75	
Radio Tape Service	58.00	
Pictures	40.00	
Mixers	164.02	
Luncheon	663.73	
Luncheon tickets	8.75	
Typewriter rental	13.30	
Name cards	18.40	
1956 Carry-over costs	15.98	
Miscellaneous	35.85	
Total		$1,505.90

Total Expenditures	$ 4,449.24
Cash on Hand, February 12, 1957	2,520.32
Total	$ 6,969.56

D. A. Schallock
D. A. Schallock, Treasurer

We have examined the foregoing financial statement of the Northeastern Weed Control Conference and find it correct as submitted.

R. E. Engel
R. E. Engel

Leslie R Reed
L. R. Reed

REPORT OF THE RESEARCH COORDINATING COMMITTEE OF THE NORTHEASTERN WEED CONTROL CONFERENCE FOR 1957

The following report is based upon a survey of all Agricultural Experiment Station and industrial personnel actively engaged in weed work in the northeastern area.

The materials, rates, and methods given here are not recommendations of this Conference for general or local use, and shall not be construed as such.

The report is a compilation of experimental and practical trial results which may be used as a guide in establishing weed control methods for local trials.

Public Law 518, commonly know as the Miller Amendment, places responsibility on any agency or person making specific recommendations for use of herbicides on crops to be used in interstate commerce. 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 illegal residue may be legally liable. For this reason actual recommendations for commercial use must be made by local Extension agencies and by the Chemical Companies who market the herbicides. The status of a given herbicide on any crop can be determined through correspondence with the manufacturer.

<u>Practices in this report are on the basis of biological activity only. No attempt has been made to designate useages which will insure residues below the limits set under Public Law 518.</u>

No part of this Report may be reprinted under the name of the Northeastern Weed Control Conference without the expressed permission of the Executive Committee of the Conference.

John R. Havis, Chairman
Waltham Field Station
University of Massachusetts
Waltham, Massachusetts

VEGETABLES GROUP I
Carrot Family, Cole Crops, Salad Crops and Green Crops

R. D. Sweet
Cornell University
Ithaca, N. Y.

Contributors

1. Maine
2. Mass.
3. Mich.
4. New Jersey
5. N. Y. (Cornell)
6. N. Y. (Long Island)
7. Penn.
8. Virginia

Carrots

In General Use

Stoddard Solvent 75-100 gals. (2,7), 80-120 gals. (8), 60-80 gals. (4), 60-100 gals. (5),
Conditions:
When carrots and weeds are small (4)
When carrots have 1 or more true leaves (2,5,7,8)
"Apply on cool, still, cloudy day" (2)
"Apply to dry foliage" (2,8)
"Do not allow solvent to stand in sprayer more time than is needed for actual spaying, because minute quantities of fungicides and insecticides will be dissolved and will be very toxic" (5)

Promising in Trials

CIPC + Stoddard Solvent - 1 or 2 lbs. + 75 - 100 gals. Tests for 2 yrs. promising, but exact proportions not yet determined. Tends to give longer residual weed control. (5)

Problems Needing Special Study

A longer lasting cheaper herbicide needed. (2,5)
Control for ragweed and galensoga. (5,8)

Parsnips

In General Use

Same as carrots - except:
"Only 1 application" (2)
"Use minimum dosages" (5)

Promising in Trials

No work reported.

Problems Needing Special Study

Same as carrots.

Celery

In General Use

Same as carrots - except:
Not safe on emerged celery. (2)
Not safe after transplanting. (5)

Promising in Trials

Directed sprays of Stoddard Solvent. (5)

Problems Needing Special Study

A good selective herbicide for celery.

Parsley

In General Use

Same as carrots. (8)

Promising in Trials

No work reported.

Problems Needing Special Study

Same as carrots.

Spinach

In General Use

CIPC 2 lbs/A warm weather
1 lb/A cool weather (below 50°-60° F)
Immediately after planting - (2,3,4,5,6,7,8)

Promising in Trials

CDEC 4 lbs/A
3 lbs in cool weather. (8)

Remarks: less stunting than with CIPC
2 years screening and yield trials.

Problems Needing Special Study

Better chemical for control of warm weather weeds such as lamb's quarters, pepper grass. (2,5,8)

Seed beds of: Cabbage, Cauliflower, Broccoli, Brussel's Sprouts, Mustard Greens.

In General Use

Cabbage - same as for spinach. (8)

Promising in Trials

CDEC 4 lbs/A immediately following planting. Cut rate to 2-3 in cool weather.
Best results when ½ to 1" irrigation water added after treating. (8)

Problems Needing Special Study

"A chemical that will control lamb's quarters" (5,8)

Transplanted Cole Crops: Cabbage, Cauliflower, Broccoli and Brussel's Sprouts.

In General Use

Nothing

Promising in Trials

No reports

Problems Needing Special Study

A good selective needed.

Leafy Crops: Kale, Collards, Turnip Greens, and Hanover Salad

Same as spinach. (8)

Lettuce

Same as for spinach. (5)

VEGETABLE CROPS II
Tomatoes, Peppers, Asparagus, and Sweet Corn

S. K. Ries
Department of Horticulture
Michigan State University
East Lansing, Michigan

Contributors

1. American Chemical Paint Co.
2. American Cyanamid Co.
3. Carbide & Carbon Chem. Co.
4. Univ. of Connecticut
5. Univ. of Delaware
6. Dow Chemical Co.
7. DuPont
8. Grange League Federation
9. Univ. of Maine
10. Univ. of Maryland
11. Univ. of Massachusetts
12. Michigan State University
13. Monsanto Chemical Co.
14. Naugatuck Chemical Co.
15. Univ. of New Hampshire
16. New Jersey
    a) Extension Service
    b) U.S.D.A., Rutgers
17. New York
    a) L. I. Res. Farm
    b) Madison County
18. Penn. State University
19. Univ. of Vermont
20. Va. Truck Exp. Sta.
21. Virginia Agr. Exp. Sta.

Tomatoes

In General Use

None

Promising in Trials

1. Natrin, 3 lbs. one month after transplanting and at lay-by (5), 2-4 lbs. after tomatoes are established (2), 2-4 lbs. when tomatoes have 2 " cluster (19).

2. CDAA, 6-8 lbs. after setting in the field (13).

3. CIPC, 2 lbs. at lay-by (20).

4. CDEC -
   (a) 6-8 lbs. after setting in field (13)
   (b) 6 lbs. at lay-by (20)

5. Neburon, 2-4 lbs. at lay-by or after first cultivation (7,20,10).

6. DCU, 3 lbs. after first cultivation (10).

7. DNOSBP, 9 lbs. preplanting and avoid disturbance of soil (21).

Problems Needing Special Study

1. Find a good selective weed killer.

2. New chemicals should be screened, including granular forms.

Peppers

In General Use

None

Promising in Trials

1. Natrin, 3 lbs. one month after field setting and lay-by (5), 2 lbs. 5 weeks after setting (19).

2. CDEC, 4-6 lbs. pre-emergence and after setting in field (13).

3. Granular CIPC, 2 lbs. after first cultivation (10)

4. DNOSBP -
   (a) 3 lbs. before setting plants (19)
   (b) 9 lbs. before setting; avoid disturbance of soil (21).

Problems Needing Special Study

1. Find a good selective weed killer

Established Asparagus Beds

In General Use

1. Monuron, before discing in the spring and after the cutting season. Rates up to 2 lbs. (5,9,12,16a, 16b, 17a, 18, 21). Rates up to 3 lbs. (4,7,11). Rates up to 1 lb. (10). Rates up to 1½ lbs. (19). 2 lbs. before cutting season, 1 lb. after cutting season (20).

2. SES, 2-4 lbs. before or after cutting season (3), 2-2½ lbs. before spear emergence (19).

3. 2,4-D, 1½ lb. before spears emerge (4). 1 lb. before spears emerge (18).

4. Alanap-3, 3-6 lbs. before and after cutting season (14).

5. Granular cyanamid, 150-300 lbs. just before cutting season over the row or 400-800 lbs. during or after cutting season (16a), 200 lbs. either before or after cutting season (19).

6. DNOSBP, 3-6 lbs. before spear emergence (19).

7. Dalapon, 13 lbs. summer or fall preplanting treatment on actively-growing quack grass (6,12).

Promising in Trials

1. ATA, 4 lbs. before and after cutting season for control of susceptible perennial species.

2. Dalapon, 9-13 lbs. either before or after cutting season when quack grass is 6-8 inches tall (6,12), 10-15 lbs. after cutting season for Bermuda grass (16b,21).

3. 3Y9, 2-4 lbs. before and after cutting season (14).

Problems Needing More Work

1. Control of perennial weeds such as quack grass, bindweed, Bermuda grass, milkweed, horse nettle and Canada thistle.

2. Control of asparagus seedlings.

3. Soil incorporation of herbicides.

4. Study of granular forms of herbicides.

Asparagus Seedbed

In General Use

1. Stoddard solvent, 75-100 gals. prior to emergence (4,12,19). 25 gals. over row when sprouts 2 inches high (16a).

2. PCP, 6 gals. (10% emulsifiable) in 60 gallons just before seedlings emerge (5,19).

3. DNOSBP, 3 lbs. just before asparagus emerges (6,12).

4. Monuron, 1½ lbs. within 7 days of planting (11,19), 1½ lbs. after seedlings are 6 inches high (5).

Promising in Trials

1. Monuron, 3/4 to 1½ lbs. before seedlings emerge (12,16a).

2. DNOSBP, 3 lbs. before seedlings emerge (16a).

Problems Needing More Work

1. Safer, better method of control

Sweet Corn

In General Use

1. 2,4-D. ½ lb amine from emergence to 6 inches high (6,10, 11,17b,18,19,21). 1 lb in spike stage (12). 1-1½ lbs. ester before emergence (4). 1-1½ lbs. amine before emergence (20). ½ lb amine when weeds an inch high (5). ½ lb. 2,4-D acid post-emergence (9). 1/3 - ½ lb. from planting to come-up (17a). 1 lb. just before emergence (18). ¼ - ½ lb. early post-emergence (20).

2. DNOSBP. 3 lbs. at emergence (5,12,6,9,11,16a). 4½ to 6 lbs. at planting (6,11,16a). 3 lbs. pre-emergence (10, 16b, 17a). 1-1½ lb. at emergence (16b). 4 lbs. before or at emergence (12,17b,19). 3-6 lbs. after planting to emergence (18). 1½-3 lbs. from emergence until corn 2 inches high (18). 6 lbs. pre-emergence (21). 4-8 lbs. pre-emergence (4).

3. Dalapon. 9 lbs. fall preplanting on actively growing quack grass (6).

Promising in Trials

1. Simazin, 1-4 lbs. immediately after planting (1,21), 2-5 lbs. immediately after planting (17a); ½ - 2 lbs. before emergence (8); 4 lbs. Simazin at emergence (12).

2. ATA, 4 lbs. ten days before plowing and planting for control of susceptible perennial species (2).

3. Dalapon, 8-12 lbs. fall or spring application at least 6 weeks before planting for control of quack grass (12). 4-6 lbs. for seedling grasses with drop nozzles as a directed spray after corn is 3 feet tall (6).

4. Diuron, .75 to 1.0 before emergence (7).

5. Neburon, 3 lbs. in 4 to 5-leaf stage (10).

6. TCB, 1 lb. before emergence (11), 2 lbs. at emergence (12).

7. Emid, 1.5 lb. before emergence (11), 2 lbs. at emergence (12), 1 lb. pre-emergence (16b).

8. PCB, 1 lb. before emergence (11).

9. CDEC, 6 lbs. before emergence (11,16b).

10. CDAA, 3-5 lbs. before emergence (13).

11. 3Y9, 2-6 lbs. before emergence or when 2-4 inches high (14). 444, 3-6 lbs. before emergence (16b).

12. Monuron, 1 lb. at emergence of corn.

Problems Needing Special Study

1. Lower cost herbicide, non-hormone type.

2. Soil incorporation.

VEGETABLE CROPS III
Vegetable Legume and Bulb Crops

William Lachman
University of Massachusetts
Amherst, Mass.

Contributors

1. American Cyanamid Co.
2. Conn. Agric. Ext. Serv.
3. Columbia-Southern Chem. Corp.
4. Delaware Agric. Expt. Sta.
5. Dow Chemical Company
6. DuPont
7. Geigy Agric. Chemicals
8. Maine Agric. Expt. Sta.
9. Maryland Agric. Expt. Sta.
10. Mass. Agric. Expt. Sta.
11. Naugatuck Chemical Co.
12. N. J. Agric. Ext. Serv.
13. N. Y. Agric. Expt. Sta.
14. Niagara Chemical Div.
15. Penn. Agric. Expt. Sta.
16. Vermont Agric. Expt. Sta.
17. Virginia Agric. Expt. Sta.
18. Michigan Agric. Expt. Sta.

Beans (Lima, Snap, and Dry Edible)

In General Use

1. DNOSBP - 3-9 lbs. in 25-40 gal. water per acre at planting or just before emergence. (2,4,5,8,9,10,12,13,15,16,17)
2. Pelleted Santobrite - 20-25 lbs. in 30-50 gals. per acre just after seeding (4).
3. Chloro IPC - 4 lbs. before emergence of beans in 40 gals. of water. (14).

Promising in Trials

1. ATA - 4 lbs. active per acre 10 days before plowing and planting for control of Canada thistle, milkweed, quack-grass, horse nettle etc. (1)

2. Chloro IPC - 4-6 lbs. per acre - occasional injury (3).

3. CDAA - 6 lbs. for control of annual grass and giant foxtail. (4).

4. Chlorazin - 4-6 lbs. pre-emergence per acre. (7)

5. Niagara 5521 - 1½-2¼ gals. per acre. (15)

6. ACP M118 - 2 lbs. per acre. (15)

7. ACP M119 - 2 lbs. per acre. (15)

8. Neburon - 3-6 lbs. active per acre. (6,15)

Problems Needing Special Study

1. Late germinating grasses such as green and yellow fox-tail. (13)

2. A post-emergence treatment for weed control during fruiting is needed. (17)

Peas

In General Use

1. DNOSBP - 3-6 lbs. at planting in 30-50 gals. water. Soil must be moist. (2,5,8,9,10,16,17)

2. DNOSBP - 1½-3 lbs. at emergence in 30-50 gals. water. (2,5,8,16)

3. DNOSBP - 1-2½ lbs. peas 3-8 inches tall. Use 50-75 gals. water. Temp. at 65°-80°F. (4,9,10,12,13,15,16,17)

4. Chloro IPC - 4-6 lbs. miscible per acre in 40 gals. water at planting time. (14)

Promising in Trials

1. DNOSBP amine - air application using 5-10 gals. spray per acre. (5)

2. Neburon - pre-emergence at 3-4 lbs. active per acre. (6)

3. Chlorazin - pre-emergence at 4-6 lbs. per acre. (7)

Problems Needing Special Study

1. Selective that can be applied post-emergence from the air. (4)

2. A more selective chemical is needed for this crop for post emergence application. (13,17)

Onions

In General Use

1. KOCN 1% spray at 100 gals. per acre on seed onions at emergence or after flag stage. Same for sets until 6" high. 2% spray at 100 gals. per acre after 6" high or larger on both seed and set onions. (1,8,12,16,17)

2. Chloro IPC - 2-6 lbs. active ingredients in 20-60 gals. of water per acre in pre-emergence applications. (2,3,9,10,13,14,15,16,17)

3. Aero Cyanamid Special Grade - 75 lbs. pre-emergence. (16)

Promising in Trials

1. Neburon - pre- or post-emergence application at 3 or 4 lbs. active per acre. (6)

2. Chlorazin - 4 to 6 lbs. per acre both pre- and post-emergence. (7)

3. CDAA - 4-8 lbs. looked good on muck only. (13)

4. CDEC - 4-8 lbs. looked good on muck only. (13)

Problems Needing Special Study

1. Grass and lambs quarters control without damage to onions. (13)

2. A more effective post-emergence weed killer needed for seeded and set onions. (17)
3. A good pre-harvest herbicide is needed. (10,18)

VEGETABLES GROUP IV
Cucumber, Muskmelon, Watermelon, Squash Pumpkin and Sweet Potato

A. W. Feldman
United States Rubber Company
Bethany, Connecticut

Listed below are the states that submitted reports and the assigned code number to designate each state.

1. Connecticut
2. Delaware
3. Maine
4. Massachusetts
5. Maryland
6. Michigan
7. New Hampshire
8. New Jersey
9. New York (Long Island)
10. Pennsylvania
11. Vermont
12. Virginia
13. West Virginia

Cucumber, Muskmelon and Watermelon

In General Use

A. Pre-Emergence

Alanap-3 2-6 lbs/A (1,2,3,6,8,10,11,12,13)
Dinitro 2-4 lbs/A (1,4,7)

B. Post-Emergence

Alanap-3 2-4 lbs/A (2,10)

Promising in Trials

CDEC 4 lbs/A (1)
Alanap Granule 4 lbs/A (1)
DN Granule 2-3 lbs/A (12)
Dinitro (2,9)
Alanap-3 2-3 lbs/A (9) (Post-Emergence)
C&C 9500 8 lbs/A (1) (Post-Emergence)

Squash and Pumpkin

In General Use

Pre-Emergence

Alanap-3 2-4 lbs/A (1;6;8;10,11,12,13)
Dinitro 2-4 lbs/A (1,3,4,7,9)

Promising in Trials

Dinitro 3 lbs/A (2,9)

Sweet Potato

In General Use

A. At Planting

Alanap-2 (6)

B. Lay-by

Alanap-2-4 lbs/A (12,6)
CIPC 2 lbs/A (12)

Problems Needing Special Study

1. Effect of weather on herbicides.
2. Proper timing of Alanap-3 for post-emergence use.
3. Investigate use of granular herbicide for pre- and post-emergence use.
4. How to make herbicides more dependable.

VEGETABLE CROPS V
Potatoes and Root Crops

Richard L. Sawyer
Long Island Vegetable Research Farm
Riverhead, New York

Contributors

1. American Cyanamid Co.
2. Carbide & Carbon Chem. Co.
3. DuPont
4. Cornell University
5. Dow Chemical Co.
6. G.L.F. Soil Building Service
7. Long Island Veg. Res. Farm
8. Niagara Chem. Co.
9. Ontario Dept. of Agric.
10. Penn. State University
11. Rutgers University
12. University of Delaware
13. University of Maine
14. University of Maryland
15. University of Massachusetts
16. University of Rhode Island
17. University of Vermont
18. Virginia Truck Exp. Sta.

Irish Potatoes (Pre-emergence)

In General Use

1. DNOSBP from Amine Salts: 3-6 lbs./A
   In general agreement (5,7,8,10,11,12,13,14,15,16,17)
2. DNOSBP from "generals" water oil emulsion, 3-5 lbs/A
   In general agreement (8,12,16)
3. SES, 2-4 lbs/A   In general agreement (2,18)

Promising in Trials

1. Karmex DW, ½-3/4 lbs/A (7,3yrs.;12,2yrs, and 3)
   1-1½ lbs/A (16)
2. Quack grass control Amino triazole 4 lbs/A and plow down (1,2yrs)
3. Neburon, 2-4 lbs./A (3,2yrs.)
4. Geigy 444E, 8 lbs/A (10)
5. Amino Triazole, 5 lbs/A (10)

Problems Needing Special Study

1. Nut grass control (16)
2. Relation of cultivation to use of chemicals (10)
3. Relation of moisture to effect of chemicals (10)

Irish Potatoes (Post-emergence)

In General Use

1. SES, 2-4 lbs/A
   In general agreement (2,14,18)

Promising in Trials

1. CDEC, 6 lbs/A (4, 1 year; 7, 2 years)
2. Crag, 3-4 lbs/A (4, 1 year; 7, 3 years)

3. Natrin, 3-4 lbs/A (4,1 year; 7,3 years)
4. 3Y9, 2-6 lbs/A (7,2 years; 16, 1 year)
5. CDIC, 6 lbs/A (4, 1 year)
6. 2,4D, 1 lb/A (4,1 year)
7. Dalapon, 5 lbs/A (11,3 years)
8. DNOSBP, 1½-3 lbs. plus Dalapon 2-4 lbs. (5,2 years)

Problems Needing Special Study

1. Grass control particularily annuals (4,6,7,10,13,15)
2. Comparison of granular versus spray applications of strong weed killers (7,18)
3. Effect of Dalapon on quality of potatoes
4. Evaluation of low rates of Dalapon

Root Crops

Beets

In General Use

1. NaCl, 200 lbs/A post-emergence (9,17)
2. Karmex W, 3/8 - 5/8 lb/A pre-emergence (4)
3. Sodium TCA, 8-12 lbs/A pre-emergence (9)

Promising in Trials

1. Dalapon, 3-6 lbs/A (5)
2. CIPC, 2 lbs/A (7,3 yrs.)
3. Karmex W, 1/3 - ½ lb/A (7,3 yrs.)
4. CDAA, 5 lbs/A (9, 1 year)
5. CDEC, 3-6 lbs/A (11, 2 years; 12, 1 year)

Problems Needing Special Attention

1. Safer chemicals than Karmex W (4)
2. Grass control (6)

SMALL FRUITS

Ernest R. Marshall
Carbide and Carbon Chemicals Company
1086 N. Broadway
Yonkers, N. Y.

Contributors

1. Dow Chemical Co.
2. Eastern States Farmers Ex.
3. Hort. Exp. Sta. Ontario Dept. of /Agr.
4. Naugatuck Chemical Co.
5. New York Agr. Exp. Sta., Geneva
6. Ohio State University
7. Standard Agricultural Chem. Co.
8. U.S.D.A.
9. University of Delaware
10. University of Maine
11. University of Maryland
12. University of Massachusetts
13. Virginia Agr. Exp. Sta.
14. Virginia Truck Exp. Sta.
15. American Cyanamid Company
16. Michigan State University
17. DuPont
18. Carbide & Carbon Chem. Co.
19. Penn. State University

Strawberries

In General Use

1. Sesone (SES) 2-4 lbs. as needed except during rooting of runners. In first year plantings do not apply until plants are well established. (1,2,4,6,7,8,9,10,11,12,13 14,16,18)
2. NH_2DNOSBP 3 lbs. when strawberries are strictly dormant. (1,2,4,7,8,10,11,13,14,16,18)
3. 2,4-D (amine) 1-2 lbs. immediately after harvest. (1,4,7,8,9,10,12,13,14,16,18)
4. 2,4-D (amine) 0.5 lbs. per acre for emerged small weeds in new plantings. (1,4,6,7,8,9,10,13,14,18)
5. CIPC 1½-2 lbs. for common chickweed during October, November. 1 lb. during December when strawberry plants are strictly dormant. (4,7,8,9,10,11,13,14,18) Note: Serious injury to strawberries has occurred in local areas of Michigan and New Jersey from the above practice.

Promising in Trials

1. Dalapon 10-15 lbs. for quackgrass in the summer or fall prior to spring planting. (1,4,7,8,10,14,16,18)
2. CIPC and Sesone (SES) 2 lbs. each 7-10 days after planting before runner set, pre-dormant and late winter. (4,7,8,10,11,13,14,18)
3. CDEC 2-6 lbs. before weeds emerge during growing season (4,7,10,13,14,18)
4. Methyl bromide (odorized) 1 lb. per 100 cu. ft. as a straw fumigant before mulching. The straw needs to be moist and covered with polyethylene plastic. The exposure period should be 24-48 hours at a temperature above 65°F. and for a minimum of 48 hours at a temperature below 65°F. (4,7,10,13,14,18)
5. CIPC 1.5 lbs. and 2,4-D 0.5 lbs. 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. (4,7,10, 13,14,18)
6. Dalapon 2-4 lbs. repeat fall pre-plant treatment for quackgrass control at 7 to 10 days interval 2 and 3 times. (4,7,10,13,14)
7. Neburon 4 lbs. per acre. (9,17)
8. DNBP 8 lbs. per acre pre-planting treatment. Plant 10-14 days after treatment. (8)
9. 2,4-D amide 1 lb. per acre in Spring. (13)
10. 3Y9 2-4 lbs. per acre pre-emergence to weeds. May retard runner establishment if used at time of rooting. (4)
11. Karmex W 8-12 lbs. per acre for serious weed problem. (19)

Problems Needing Special Study

1. Weed Control in established beds to prolong life. (8)

2. (a) Study effects of reducted rates of CIPC miscible
   (b) Study performance of granular CIPC
   (c) Study use of IPC miscible as a substitute for CIPC

Grapes

In General Use

1. DNOSBP 2 lbs. plus 15-20 gallons fuel oil in a row application after weeds are 4" - 8" or as needed in established vineyards. (1,3,5,6,7,13,16)

2. CMU 2-6 lbs. during spring or fall for control of broad-leaved weeds and young grasses in established vineyards. (3,5,7,13)

3. Amino Triazole 4-8 lbs. as a directed row application when weeds are actively growing for control of persistent weeds and grasses. (3,7,13,15)

Promising in Trials

1. Dalapon 2-4 lbs. as repeat row application in fall and late spring for control of quackgrass and other grasses. (1,7,13)

2. CDEC, CDAA, CDEA for weeds and grasses before they emerge. (7,13)

3. CIPC 8-16 lbs. as row application before weeds and grasses emerge in the spring. (7,13)

4. Sesone (SES) 2-4 lbs. before weeds emerge. (7,13)

5. Karmex DW 2-5 lbs. on light textured soils and 3-5 lbs. on heavier soils early in spring. Use 2 foot band sppli-cations, apply accurately. Will not control bindweed. (5,17)

6. Dalapon 2-4 lbs. plus DNOSBP amine 3 lbs. in two appli-cations as needed. Directed spray to control both weeds and grasses. (1)

7. Dalapon 15 lbs. per acre. (3)

Brambles

In General Use

1. DNOSBP 2-3 lbs. + 20 gallons diesel or fuel oil per acre (if Amine DNOSBP used the oil should be omitted) for control of grasses and weeds except during suckering or tip layering. (1,6,7,11,16,18)

2. Sesone (SES)3-4 lbs. before weeds emerge. (1,7,11,18)

3. 2,4-D up to 1 lb. for broadleaved weeds. (1,7,16,18)

4. CIPC 5-8 lbs. for control of grasses and chickweed in the fall or early spring. (1,6,7,18)

5. Amino Triazole 2-6 lbs. in fall and/or spring for grass and weed control. (1,7,15,18)

Promising in Trials

1. Dalapon 10-15 lbs. fall application prior to spring planting for control of quackgrass and annual grass. (1,7,18)

2. Dalapon 2-8 lbs. as needed throughout season for grass control. (1,7,18)

3. Diuron 2 lbs. per acre in spring prior to emergence of annual weeds. If chickweed a problem apply 1 lb. Diuron in the autumn. (17)

4. Sesone (SES)2-4 lbs. per acre at monthly intervals after cultivation. (18)

Blueberries

In General Use

1. Sesone (SES)2-4 lbs. in spring or before weeds emerge. (1,7,11,12,16,18)

2. Karmex W 1-3 lbs. as a row application in early spring before weeds emerge. Do not use 2 lbs. on Atlantic variety. (1,7,11,12,16)

3. DNOSBP 3-4 lbs. during summer and fall. (1,7,12,16)

4. Amino Triazole 4-6 lbs. for grass and weed control during spring, summer and fall. (1,7,15,16)

Promising in Trials

1. Dalapon 10-15 lbs. fall pre-plant treatment for quackgrass control. (1,7,16)

2. Dalapon 2-6 lbs. repeated 2-3 times at 10-day intervals in the fall or spring. (1,7,16)

3. CIPC 6-12 lbs. as a row application before weeds emerge. (1,7,16)

4. Neburon 3-4 lbs. per acre applied prior to weed emergence. (17)

CRANBERRIES

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Contributors

1. Massachusetts   2. New Jersey

Cranberries

In General Use

1. Water White Kerosene -- 400-800 gals. per A. (1)
2. Iron Sulfate -- 20-50 lbs. per square rod. (1)
3. Stoddard Solvent -- 400-500 gals. per A. (1)
4. Copper Sulfate -- 10 lbs. per A in flood water and 20 lbs. per 100 gals. of water, 400-600 gals. per A. (1)
5. Nitrate of Soda -- 2-3 lbs. per square rod. (1)
6. Salt (Sodium Chloride) -- 3/4 - 1 lb. per gal. of water, 200 gals per A. (1)
7. 2,4,5-T (low volatile ester) -- 1½ pints per 100 gals. of water, 300 gals. per A. (for shores and dikes only). (1)
8. 2,4-D-2,4,5-T (ester) -- 1 gal. per 50 gals. of kerosene, 300 gals. per A. (for brush on shores only). (1)
9. Kerosene- Stoddard Solvent (1-1 ratio) - 600 gals. per A. (1)

Promising in Trials

1. Amino Triazole - 4-12 lbs. per acre in 300 gals per A. (1) 1 lb. in 40 gals water per acre per year applied mid-May and early Sept. (2)
2. Dalapon -- 20 lbs. per 100 gals of water (shores only). (1)
3. 2,4,5-TP (Silvex) -- 1 gal. to 50 gals. of water, 300 gals. per A. (for shore bramble only). (1)
4. Iron Sulfate and Salt (5-1 ratio) -- for use as direct weed application for ferns and sphagnum moss, asters, and wild bean. (1)
5. Trichlorobenzoic acid -- ½-4 lbs. per A., 300 gals. of water per A. (for morning glory). (1)

Problems Needing Work

1. Inexpensive and effective ditch weed control.

2. Selective control of briers and brambles.

3. More satisfactory control of nut grass, loosestrife, and several sedges.

ORCHARDS

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4. Dow Chemical Co.
5. DuPont
6. Eastern States Farmers Ex.
7. G L F Soil Building Service
8. Mass. Agr. Exp. Sta.
9. New Jersey Agr. Exp. Sta.
10. Penn. Agr. Exp. Sta.
11. Standard Agr. Chem., Inc.
12. Virginia Agr. Exp. Sta.
13. New York Agr. Exp. Sta.
14. West Virginia Agr. Exp. Sta.

Woody Plants

In General Use

Poison Ivy

1. 3 amino-1,2,4 triazole (hereafter referred to as ATA) at 1 to 2 lbs. per 100 gals. of water. Thoroughly wet all foliage when ivy is in full leaf and actively growimg. (1,2,6,7,14)

2. Ammate, 3/4 to 1 lb. per gal. of water plus spreader-sticker. Thoroughly wet all foliage when ivy is in full leaf and actively growing. (5,6,8,9,13)

3. 2,4-D plus 2,4,5-T as the amine salt or low volatile ester, 2 to 3 lbs. of acid equivalent in 100 gals. of water. Thoroughly wet all foliage when ivy is in full leaf and actively growing, preferably late July or early August. (4,11,12,13)

   As low volatile ester in oil at manufacturers suggested rate as a dormant treatment. (8)

Japanese Honeysuckle (Lonicera japonica)

1. 2,4-D as amine salt or low volatile ester; 2 lbs. acid equivalent per 100 gals. water, thoroughly wet honeysuckle foliage. Apply while plant is actively growing (June-July). (4,11,12)

Chokecherry

1. Ammate; 3/4 lb. per gal. of water plus spreader-sticker. Apply when choke cherry is in full leaf and actively growing. May require second application. (8)

2. 2,4-D plus 2,4,5-T as low volatile ester; follow manufacturers' suggested rate for dormant treatment using oil as diluent. (8)

Promising in Trials

Poison Ivy

1. ATA; 1 to 4 lbs. in 100 gals of water. Apply when ivy is actively growing and has fully expended leaves. (8,9,10,13)

   ATA; 4-8 lbs., same conditions as immediately above. Apply Between June 15 and July 15. (12)

2. 2,4,5-T propionic acid; as low volatile ester, 1 lb. acid equivalent per 100 gals. water. Apply when ivy is actively growing and has fully expended leaves. (10)

Honeysuckle

1. ATA; 4-6 lbs. per acre in sufficient water for adequate coverage. Apply when plants are actively growing. (2)

Cautions: It is well to observe the precautions set forth in last year's report which read as follows: "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 type herbicides, use spot spraying only. Peaches and other stone fruits are particularly susceptible to chemical injury. DO NOT use the orchard sprayer for weed spraying."

Herbaceous Weeds (Ground Cover Suppression)

In General Use

1. ATA; 2-4 lbs. per acre in 50 to 100 gals. water as a blanket or spot treatment. For Canada thistle, apply between 4 inch height and pre-flower bud formation. (1,2)

2. DNOSBP as the amine salt at 3 lbs. per acre in sufficient water for adequate coverage. Apply as needed during growing season. (4,11)

   Oil soluble DN at 1½ to 2¼ lbs. per acre in 15-20 gals. oil plus water to make 100 gals. of spray. If vegetation is very heavy, increase amount of water to give adequate coverage. (11,13)

3. 2,4-dichlorophenoxy ethyl sulfate; as the sodium salt; apply 2 lbs. per acre on clean, freshly cultivated soils of newly planted orchards for annual weed control. (3)

Promising in Trials

1. ATA; use 2-4 lbs. per acre for broad-leaved species, both annual and perennial. Use 4-6 lbs. per acre for perennial grass control. (9)

   Use 10 lbs. per acre for perennial grass control, thoroughly wet the foliage, apply during June. (12)

2. Dalapon; 4-6 lbs. per acre in sufficient water for adequate coverage. Usually 2 applications per growing season are adequate. (4)
   10 lbs. per acre in 100 gals. water for perennial grass control. Thoroughly wet the foleage, apply during June. Do not use on peaches. (12,14)

3. Neburon (3-(3,4 dichlorophenyl)-1 methyl-1-N-butyl urea); 4 lbs. per acre on freshly cultivated, clean soil of newly planted orchards for annual weed control. (3)

4. Apples; Monuron (3-(p-chlorophenyl)-1,1-dimethyl-urea); 1-4 lbs. per acre. Apply before weeds emerge or while very small, preferably early spring. (13,14)

   Peaches; same material at 1-2 lbs. per acre. (13)

5. Apples; Dalapon; 5-10 lbs. per acre.(14) Use in combination with or to supplement Monuron. (13)

   Peaches, same material at 5 lbs. per acre to supplement Monuron if necessary. (13)

Cautions: In general, avoid direct contact of spray with trees and drift of spray onto tree foliage. Wetting of trunks is safe with DN, Dalapon and the substituted urea compounds.

Problems Needing Special Study

1. Lowest rate of 2,4,5-T which will consistently give satisfactory control of ivy?

2. Under what conditions is ATA better suited for poison ivy control? Under what conditions are the phenoxy type compounds better fitted?

3. Is ATA absorbed, transolcated and stored in the fruit of apples, pears, etc.?

4. What is the minimum effective rate of Dalapon that can be used in repeated applications for the control of various grass species?

5. What is the place of CIPC for weed control in newly planted orchards?

ORNAMENTALS

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6. DuPont
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8. Univ. of Maryland
9. Md. Dept. of Forests & Parks
10. Michigan State University
11. New York (Cornell)
12. New York (Long Island)
13. Ohio State University
14. Standard Agric. Chemicals
15. University of Vermont
16. Virginia Agric. Exp. Sta.

Herbaceous Ornamentals

Gladiolus

Pre-emergence

In General Use

1. AERO cyanamid, granular broadcast on moist soil at 600-800 lbs/acre several days before emergence. (1)

2. SES - 2-4 lbs. per acre applied immediately after planting. (3) - liquid, 4 lbs/A (7) - 4 lbs. per acre (12) - 2-4 lbs/A pre-emerge 1-2 gals. per A. (15)

3. DNBP - 7-10 lbs./acre in 25-40 gals. of water/A as an overall spray preferably just before emergence (5), 3-6 lbs. (7,10), 4-8 lbs. (12), 3-12 lbs. per acre amine salt (14).

4. Sodium TCA, 10 lbs./A to control germinating and yound grass seedlings (5).

5. 2,4-D low volatile ester, 2-3 lbs/A (5), 2,4-D ester 1 lb. (10)

6. Monuron - 1-2 lbs/A. (6)

7. Diuron - 1½ lbs/A. (12)

8. CIPC - 6-8 lbs. per acre (liquid or granular). (12)

Promising in Trials

1. Neburon - 3-4 lbs. active ingredient/A. (6)

2. DNBP (vermiculite) 6 lbs/A - (clay) 6 lbs/A. (7)

3. CIPC (liquid) 6 qts/A - (vermiculite) 6 lbs/A. (7)

4. Monuron - 1 lb. (10)

5. Polychlorobenzoics - 1 lb. (10)

6. Geigy 444 - 2 lbs. (10)

Post-Emergence

In General Use

1. AERO cyanate, weedkiller, at 10-20 lbs. per acre in 60 gals. of water per acre as a directed spray. (1)

2. SES - 2-4 lbs. per acre (15), as needed after clean cultivation. (3)

Promising in Trials

1. Neburon - 3-4 lbs. active ingredient per acre. (6)

2. Crag 974 - 85% w.p. (liquid). (7)

3. Diuron - 1 lb/A. (7)

4. Alanap 3 - 6 lbs./A. (7)

5. CIPC Granular - 6-8 lbs/A. (12)

6. SES - 4 lbs./A. (12)

Perennials

In General Use

1. SES - 2-4 lbs./A after clean cultivation. (3,15)

2. DNBP amine salt - 3-6 lbs/A applied in the late fall following emergence of winter annual weeds. Can be used on daffodils, tulips and similar fall treated bulbs. (5,14)

3. SES - 4 lbs./A + Monuron - ½ lb/A, no injury to perennials. (13)

Promising in Trials

1. ATA - 4 lbs. active ingredient per acre 1-2 weeks before planting for control of chrysanthemum weed, horse nettle, quack grass and other perennials.
Three year field tests and limited commercial use. (1)

2. Crag 974 - 300 lbs./A 3 weeks before planting, 2 year field plots. (3)

3. CIPC granular directional basal 6-12 lb. active. (11)
4-8 lbs./A liquid and granular. (12)

4. SES - 4 lbs./A. (11,12)

Annuals

In General Use

1. Methyl bromide - 1 lb/100 sq. ft. pre-planting treatment will also control weed seeds, nematodes and some soil insects and fungi. (5)

Promising in Trials

1. ATA - 4 lbs. active ingredient per acre, 1-2 weeks before planting for control of chrysanthemum weed, horse nettle, quack grass and other perennials. Three year field tests and limited commercial use. (1)

2. Crag 974 pre-planting application, 300 lbs/A, 3 weeks before planting, 2 year field plots. (3)

3. CIPC granular directional basal 6-12 lbs. active to transplanted annuals. (11)

Woody Nursery Stock

Preplanting in beds for seedlings or liners

In General Use

1. AERO Cyanamid, granular at 2,000 lbs/A on surface of finished seed bed for control of germinating annuals. Wait 3 weeks to seed. (1)

2. Dalapon sodium salt - 15 lbs/A for control of perennial grasses such as quack grass, Bermuda grass and Johnson grass. (5)

3. Methyl bromide - 1 lb./100 sq. ft. (5,12,15)

4. Chloropicrin - 1 lb. to 100 sq. ft. (12)

5. SES - 3 lbs./A. (15)

6. Vapam - 1-3 pts./100 sq. ft. - no injury to tomatoes and chrysanthemums planted at 5,7,8 and 10 days after treatment. 1,2, and 3 pts./100 sq. ft. in seed beds. No injury to ornamental seedlings. (13)

Promising in Trials

1. ATA at 4-6 lbs. active ingredient in 50 gals. of water as foliar spray on chrysanthemum weed, quack grass and certain other perennials. Apply 1-2 weeks before preparing soil. Three year field tests and limited commercial use. (1)

2. Crag 974, 85W at 300 lbs. per acre applied three weeks before planting - 2 year field plots. (3,7)

3. Vapam - 1 qt./100 sq. ft. 2 weeks before planting. (7,12)

4. SES - 2 lbs./A removed about 50% of weeds, no damage to seedlings - 4 lbs./A eliminated about 75% of weeds - little or no damage to seedlings. (8)

5. Geigy 444 - 2 lbs./A. (10)

6. DNBP amine salt at 6-9 lbs. per acre. Minimum disturbance of soil makes for better weed control. (14)

Pre-Emerbence in Beds

In General Use

1. AERO Cyanate. Weedkiller at 10-20 lbs./A in 60-100 gals. of water several days before nursery plants emerge. (1)

2. SES - 3 lbs/A. (15)

3. Mineral spirits. (15)

Promising in Trials

1. ATA at 4-6 lbs. active ingredient in 50 gals. of water as foliar spray on chrysanthemum weed, quack grass and certain other perennials. Apply one to two weeks before preparing soil. Three year field tests and limited commercial use. (1)

2. PCP (10% emulsifiable) 6 gals. in 60 gals, just before rose seedlings emerge. (Screening test). (4)

3. DNBP amine salt - 3 lbs./A applied when the seeds are in the two-leaf stage and before come-up of the nursery seedlings. (5)

4. Geigy 444 - 2 lbs./A (10)

5. CIPC granular 8-16 lbs./A active ingredient - has little if any crop injury and better weed control than spray of miscible CIPC 100 gals. per acre at same poundage. (11)

Post-Emergence for Seedlings

In General Use

1. Varsol - 10-20 gals. per acre as seedlings are emerging.(9)
2. Stoddard Solvent - 40-60 gals. per acre. (10)
3. Mineral spirits. (15)

Promising in Trials

1. CIPC granular 8-16 lbs./A active ingredient has little if any crop injury and better weed control than spray of miscible CIPC 100 gals. per acre at same poundage. (11)

Liners

In General Use

1. SES - 2-4 lbs./A, (15), after clean cultivation and well established. (3)

Promising in Trials

1. Dalapon sodium salt 5 lbs./A plus DNBP amine salt 2 lbs./A applied as a directed spray. (5)

2. Neburon - 3-4 lbs. active ingredient per acre. (4,6) 8 lbs./A (10)

3. Monuron - ½-1 lb. (7)

4. CIPC - 6 lbs. (7), granular directional. (11)

5. SES - 2 lbs. + Alanap 3 - 2 lbs.; SES - 4 lbs. + Alanap 3-4 lbs. (7)

6. 2,4-D amide 2 lb./A. (10)

7. TCA - 10 lbs./A, slight burning with Dalapon 10 and 6 lbs./A (13)

8. NaPCP - 30 lbs. per acre in 20 lbs. vermiculite per acre. (16)

9. DNBP, water soluble, 9 lbs. per acre in 20 lbs. vermiculite. (16)

Established Evergreens

Arborvitae

In General Use

1. SES - 2-4 lbs. per acre. (8)

2. SES - 4 lbs. per acre + Monuron - ½ lb. per acre. (13)

Promising in Trials

1. Neburon - 4 lbs. per acre, screening test. (4)

Taxus

In General Use

1. SES - 2 lbs./A, 6 year old plants. (8) 4 lbs./A, 6 year old plants. (8,12)

2. CIPC - 6-12 qts./A or granular 6-12 lbs. actual per acre. (12)

3. SES - 4 lbs./A + Monuron - ½ lb./A. (13)

4. DNBP amine salt - directed spray - 6-12 lbs./A depending upon weed population. (14)

Promising in Trials

1. MH at .75%. (2)
2. Neburon - 4 lbs. active screening test. (4) 8 lbs. (10), 2 lbs./A. (13)
3. Monuron - ½-1 lb. (7)
4. Diuron - ½-1 lb. (7)
5. CIPC - 4-6 lbs. (7)
6. 2,4-D amid, 2 lbs. (10)
7. Geigy 444E - 4,6, and 8 lbs./A. (13)
8. Natrin - 6 lbs./A (13)
9. Simazin - 2 lbs./A (13)

Evergreens

In General Use

1. DNBP amine salt at 3 lbs./A applied as a directed spray. (5) 6-12 lbs./A depending upon weed population. (14)
2. SES - 2 lbs./A and 4 lbs./A. (3,8,12,15)
3. CIPC - 6-12 qts./acre or granular 6-12 lbs. actual per acre. (12)
4. SES - 4 lbs./A + Monuron - ½ lb./A. (13)

Promising in Trials

1. ATA at 4-6 lbs. active ingredient in 50 gals. of water as spot or directed spray on chrysanthemum weed, quack grass, thistle, horse nettle and certain other species. Three year field tests and limited commercial use. (1)
2. MH at .75%. (2)
3. Neburon - 3-6 lbs. active ingredient per acre. (4,6) 8 lbs. (10) 2 lbs./acre. (13)
4. Monuron - ½-1 lb. (7)
5. Diuron - ½-1 lb. (7)
6. CIPC - 4-6 lbs. (7), granular summer directional (11)

7. Geigy 444 - 2 lbs. on Juniper only. (10) 4,6 and 8 lbs./A (13)

8. 2,4-D amid, 2 lbs. (10)

9. Natrin - 6 lbs./acre (13)

10. Simazin - 2 lbs./acre (13)

Established Deciduous Plants

In General Use

1. SES - 2-4 lbs./A after clean cultivation and well established during summer. (3,8,15,12)

2. DNBP amine salt - 3 lbs./A applied as a directed spray, in oil 3 lbs./A applied as a directed spray. (5) - 3-12 lbs. per acre. (14)

3. CIPC - 6-12 qts./A or granular 6-12 lbs. actual. (11,12)

Promising in Trials

1. ATA at 4-6 lbs. active ingredient in 50 gallons of water as spot or directed spray on chrysanthemum weed, quack grass, thistle, horse nettle and certain other species. Three year field tests and limited commercial use. (1) 2,4,6,8,10 lbs./A, slight yellowing and browning of foliage where contacted, used as post weed emergence. (13)

2. DNBP amine salt, 2 lbs./A plus dalapon, 5 lbs./A applied as a directed spray. (5)

3. Neburon - 3-4 lbs. active ingredient per acre, (4,6); 8 lbs. (10)

4. 2,4-D amid, 2 lbs. (10)

5. CIPC granular summer directional. (11)

6. Geigy 444E - 6 lbs./A as pre weed emergence. (13)

Problems Needing Special Study

1. Susceptibility of various species of nursery stock at various ages to different herbicides. (3)

2. Susceptibility of woody ornamentals to directed applications of dalapon. (5)

3. Use of dalapon as a directed spray on the base of the stems of the woody ornamentals or as a pre-planting treatment. (5)

4. Methyl bromide fumigation of planting sites-including nursery and flower seed beds. (5)

5. Study combinations of herbicides to overcome the weaknesses of some individual herbicides against particular species. (7)

6. Study seasonal rotations of herbicides to determine the most effective herbicide program. (7)

7. Post emergence for perennial beds. (10)

8. Pre-emergence for annuals. (10)

9. Better spray and dust equipment for directional application. (11)

10. Survey of species and variety tolerance to CIPC granular and measure of duration of residual action also response of specific weeds, galansoga, purslane, groundsilt, foxtail and other summer grasses. (11)

11. Survey of Karmex and ATA in granular forms, crop and weed response. (11)

12. Estimate or survey of tolerance of ornamentals at fall mature stage to ATA 2-8 lbs. active per acre directional treatment. (11)

13. In late summer, CIPC must be as high as 10 lbs./A to control galansoga which Crag #1 can control easily at 4 lbs./A. Some perennials and annuals are sensitive to CIPC or Crag #1 and this is being studied but need more workers on the problem. (12)

TURF

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7. DuPont
8. University of Maryland
9. Naugatuck Chemical
10. University of Rhode Island
11. Rutgers University
12. Michigan State University
13. Stauffer Chemical Company

Broadleaf Weeds

Dandelion - Taraxacum officinale

In General Use

2,4-D Acid, Salt, or Ester - $\frac{1}{4}$-$1\frac{1}{2}$ lbs./A. in 5-200 gals. of water. Post-emergent applications, spring or fall, when weed and turf are in an active stage of growth. Bent grasses are susceptible and rates of $\frac{1}{4}$-$\frac{1}{2}$ lb. should be used. One to two applications. (1,3,6,8,10,11)

Promising in Trials

1. 2,4,5-T Ester - $\frac{1}{4}$-1$\frac{1}{2}$ lbs/A in 200 gals. of water. Post-emergent treatment spring or fall. Bents and fescue grasses are susceptible. One application. (10)

2. 2,4,5-TP Ester - 1.5 lb/A in 25-40 gals. of water. (6)

Narrow-leaf plantain - Plantago lanceolata

Broadleaf Plantain - Plantago major

In General Use

2,4-D, 2,4,5-T and 2,4,5-TP rates and application requirements are the same as for dandelion. (1,3,6,8,10,11)

Promising in Trials

Alanap 1F Acid - 8 lb/A dry formulation. Pre- and post-emergent early spring application. Bentgrass susceptible, two applications. (9)

Wild Garlic - Allium vineale

Wild Onion - Allium canadensis

In General Use

2,4-D Ester - 3/4 - 2 lbs/A in 5-40 gals. of water. Post-emergent applications spring and fall when weeds and turf grasses are in an active stage of growth. Bent grasses are susceptible and rates above 1 lb/A are not recommended. 2-3 applications for a period of 2-4 years needed for control. (1,3,6,8,11)

2,4-D Amine Salt - 1-2 lbs. (6)

Common Chickweed - Stellaria media

Mouse-ear chickweed - Cerastium vulgatum

In General Use

KOCN-8-16 lbs in 100-200 gals. of water. Post-emergent applications early spring and late fall when chickweed is in an active stage of growth. 1-3 applications. Bent grasses and fescue grasses susceptible, treat only at the 8 lb/A rate. (1,2,8)

Promising in Trials

1. 2,4,5-TP Ester - 1.5 lb/A in 25-40 gals. of water. Post-emergent when temperatures are 60-70°F. Spray prior to flowering. Bent grasses are susceptible, two applications. (6)

2. 2,4,5-T Ester - 1-1½ lbs/A in 200 gals. of water. Post-emergent application spring or fall - cool weather required. Bents and fescue susceptible. One application.

3. 2,4-D plus DNBP - 3/4 lb. plus 1 lb/A in 10 gals. of water. Post-emergent on young plants. Bent grasses are susceptible. One application. (3)

4. Neburon - 2 lbs. in 200 gals. of water. Pre- or post-emergent applications in spring or fall. Two treatments - no cultural limitations. (7)

5. DNBP - 1 lb. in 20-40 gals. of water. Post-emergent applications spring or fall, apply before flowering. Two applications. (8)

6. Alanap 1F Acid Formulation - 8 lbs/A pre- or post-emergent applied in early spring. Bent grasses are susceptible, two applications. (9)

7. MCP - 1 lb./A - fall or early Spring (12)

Annual Grass Weeds
Smooth crabgrass - Digitaria ischaemum
Hairy crabgrass - Digitaria sanguinalis

In General Use

1. KOCN - 8-16 lbs/A in 100-200 gals. of water. Post-emergent in late summer. Apply prior to seed set. Apply when soil moisture is adequate. 1-3 applications. Bents and fescue grasses susceptible. Use only the 8 lb/A rate. (1,3,10,11)

2. DSMA - 4-8 lbs/A in 40-200 gals. of water. Post-emergent applications late spring to early fall. Apply when soil moisture is adequate. 2-4 applications. Fine leaf fescue grasses susceptible. Use low rate with high temperatures. (1,3,8,11)

3. PMA 10% - 5-10 pts/A in 40-200 gals. of water. Post-emergent applications in spring to early summer. Apply when soil moisture is adequate. 2-4 applications. For putting greens, use 2 pts/A repeat treatments. (1,3,10,11)

Promising in Trials

1. Neburon - 4 lbs/A in 200 gals. of water. Pre- and post-emergent applications in spring. One application. (7)

2. Alanap 1F Acid - 8 lbs/A applied dry. Pre-emergent applications in spring. Three applications. Bents are susceptible. (9)

3. Na As_2O_3 - 3/4 - 1½ lbs/A in 100 gals. of water. Post-emergent applications in fall. 2-4 applications. Apply when soil moisture is adequate and use low rates with high temperatures. (11)

4. Radapon - Sodium Salt 5 lbs/A in 25-40 gals. of water. Post-emergent applications spring and fall. For spot treatment only. All turf grasses susceptible. (6)

Silver crabgrass - Elusine indica

Promising in Trials

1. PM-2,4,-D Salt - 1 lb/A in 40-200 gals. of water. Use only as early post-emergent. Bent grass susceptible, use ½ lb/A at weekly intervals. Apply when soil moisture is adequate. 3 applications. (5)

2. Radapon - Sodium Salt 5 lbs/A in 25-40 gals. of water. Post-emergent applications early summer or fall. For spot treatment only. All turf grasses susceptible. (6)

3. TCA - 1 lb/A in 2 gallons of water. Post-emergent applications in spring. Spot treatments only. All grasses susceptible. One application. (8)

Clover (last year's recommendations)

In General Use

2,4,5-T at ½-1½ lbs/A. Spring and fall applications.

Promising in Trials

Polychlorobenzoic Acid at 1 and 2 lbs/A
(1957 report) 2,4,5-TP - 1-1½ lbs/A. Do not use on bent grass (12)

Pre-seeding Treatments

In General Use

Granular cyanamid - 50 lbs/1000 sq. ft., two step treatment. Mix 25 lbs/1000 sq.ft. in top 1½" soil and 25 lbs/1000 sq. ft. on soil surface. Keep soil moist for a three week period before planting. (2)

Promising in Trials

1. Crag mylone - 85W - 300 lbs/A. Fall or spring application. Mixed in top 6" of soil. Wait 14 days before seeding. Promising in screening trials. (4)

2. Vapam - 100 gals/A. applied as a drench to penetrate soil 2-4 inches. Time interval prior to planting, 2-3 weeks. (13)

General Agreement

That all cultural practices such as proper fertilization, watering, mowing, disease and insect control and choice of adapted turf grass be considered as part of any weed control program.

Problems Needing Further Study

1. Control of perennial grasses - selective control or eradication prior to seeding muhlenbergia, Bermuda grass and orchard grass. (1,2,8)

2. Control of silver crabgrass - Elusine indica. (1,3,10,11)

3. Control of annual bluegrass - Poa annua. (1,3,10,11)

4. Control of chickweed - Stellaria media and Cerastum vulgatum. (1,8,10,11)

5. Control of oxalis, knotweed - Polygonum aviculare; spurge-Euphorbia maculata; and sheep sorrel - Rumex acetosella. (1,8,10)

6. Continued evaluation of arsenical preparations and other chemicals with respect to basic turf grasses - rate of application, time interval between treatments, etc. (1,10,11)

7. Pre-emergence crabgrass control. (1,10,11)

8. Fundamental basic studies. (10)

9. Better equipment for application. (10)

FIELD CORN AND SOYBEANS

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8. Delaware
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Field Corn

Pre-emergence

In General Use

1. 2,4-D LV ester, 1-1½ lbs. per acre, 10-20 gals. water, lower rate on light soil (5,2,3,9).
2. DNBP, amine salt, 3-6 lbs. per acre (4,9).

Promising in Trials

1. Simazin, 2-4 lbs. per acre, 1 year (9).
2. DNBP, amine salt, 4 lbs. per acre, 3 year field tests. (7)
3. CDAA, 3/4 - 1 lb. per acre, 20-40 gals. of water (2).
4. TBA, very effective on smartweed, ½ lb. per acre (5), 1 lb. per acre (4), 1½ lbs. per acre (2,9), 3 lbs. per acre (6).
5. Neburon, 4 lbs. per acre, 1 year field test. (2)
6. 2,4-D amide, 1-2 lbs. per acre, 1 year field test (4,2). 2 year field test. (3)
7. CDAA, 3 lbs. per acre + TBA, ½ lb. per acre, 2 year field test. (3)
8. Karmex DW, 1-2 lbs. per acre, 1 year field test (9).
9. Geigy 444, 8-10 lbs. per acre, 1 year field test (9).
10. Naugatuck 3Y9, 3-5 lbs. per acre, 1 year field test (9).

At Emergence

In General Use

1. DNBP, amine salt, 3 lbs. per acre, sandy loam or heavier soils, 40-50 gals. water per acre when 5% corn is up (1). 4.5 lbs. per acre when grasses are problem (1). 3-5 lbs. per acre (9). 3-6 lbs. per acre (8).

Promising in Trials

1. DNBP, amine salt, 4 lbs. per acre - 2 year trial (7).
2. 2,4-D, 1 lb per acre - 2 year trial (7).

Post-emergence

In General Use

1. 2,4-D amine, ½ lb. per acre, directed spray if corn over 12", (3,1,8,9), in 30-100 gals. water/A (1). ¼-1½ lbs. per acre, corn over 12" (2).
2. 2,4-D any form ¼-½ lb. per acre, corn 3-12", (6,5,4,2,9).

Promising in Trials

1. 2-4-D amide, ¼-1 lb. per acre, 1 year field test (2,4). 2 lbs. per acre at final cultivation. (3)
2. CDAA, 3 lbs. per acre + TBA, ½-2 lbs. per acre at final cultivation. (3)
3. DNBP, amine salt, 3 lbs. per acre, directed spray for nutgrass (7).

4. Karmex, 1-1½ lbs. per acre when corn is 6"-7" tall and in 3-4 leaf stage. (9)

Problems Needing Special Study

1. Possibilities of soil incorporation of herbicides to improve control in dry weather. (3)
2. Further evaluation of combinations for broadleaf and grass control. (4)
3. Further evaluation of granular applications. (4)
4. Use of drop pipes to evaluate directed sprays for grass control. (4)
5. Control of established annual grasses. (5,8)
6. Control of nutgrass and quack grass. (7,9)

Soybeans

Pre-emergence

In General Use

1. DNBP, 4½-6 lbs. per acre, 20-40 gals. water, lower rate on sandy soil, band application is cheaper (2,5). 3 lbs. per acre (10).

Promising in Trials

1. CIPC, 6-8 lbs. per acre, 15-30 gals. water, 1 year test (2).
2. CDEC, 3-4 lbs. per acre, 20-40 gals. water, 2 year test.(2)
3. Neburon, 2-3 lbs. per acre, 20-40 gals water, 2 year test. (2)
4. Alanap 3, 2-4 lbs. per acre, 20-40 gals. water, 2 year test (2,5)
5. PCP, 20 lbs. per acre, 2-4 year tests. (5,8)

Post-emergence

In General Use

None

Promising in Trials

1. 2,4-D, 1/8 - ¼ lb. per acre at emergence to 10 days (5).

Problems Needing Special Study

1. Effective pre-emergence treatments that are less expensive than dinitro. (5)
2. A selective post-emergence treatment. (3,5,8)
3. Defoliation treatments for beans and weeds at harvest (3).

SMALL GRAINS

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7. University of Vermont
8. University of Massachusetts
9. University of Delaware
10. University of Maryland
11. University of Connecticut

Spring Grains - not seeded.

General Use

1. 2-4-D amine at ¼ to ½ lb. per acre, at the fully tillered stage, prior to jointing (1,2,3,5,6,7,8,9,10,11).

Promising in Trials

1. 4(2,4-DB) at 1 lb. per acre, stage same as above (8).

Spring Grains - underseeded

General Use

1. DNBP, amine salt, at 3/4 to 1½ lbs. per acre. To be used when weeds are seedlings (1,2,3,5,6,8,10,11). Use lower amount if temperature is over 75°F. Use in at least 30 gals. per acre, if amine salt, 75 gals. per acre if ammonium salt (5).
2. 2,4-D or MCP, amine salt, ¼-½ lb. per acre. Weeds and grain must form a canopy over the legume. Use MCP on red clover (5,6,7,11). Use MCP on oats over 6" tall (3).

Promising in Trials

1. 3,4-D, ½ lb. per acre, where alfalfa is the legume (1).
2. 4(2,4-DB), 1 lb. per acre, when weeds are small (8).

Winter Grains - not seeded.

General Use

1. 2,4-D amine salt, ¼-½ lb. per acre, at the fully tillered stage, before jointing (1,2,3,5,6,7,9,10,11).
2. MCP, amine as above for 2,4-D (6,9).

Promising in Trials

1. 2,4,5-TP, 1½ lbs. per acre pre-emergence, for control of *Scleranthus annus* (4).
2. DNBP, 2 lbs. per acre, when grain is about in 3-4 leaf stage in December, for control of *Scleranthus annuus* (10).

Winter Grains - underseeded

General Use

1. DNBP, amine salt, 3/4 - 1½ lbs. per acre, when weeds are small and grain is less than 6" tall (2,3,5,6,10).
2. 2,4-D or MCP, amine salt ¼-½ lbs. per acre. Use in early spring when weeds are small(5,6,7,9,10,11). Use MCP if red clover is present (9).

Wild Garlic Control in Winter Grain

1. 2,4-D, ester form, ½-1½ lbs. per acre. Use in the early spring (March) on a day when the temperature is over 60°F. Grain should be fully tillered but not to the joint stage (1,2,6,10).
2. MCP, ½ lb. per acre in March (9).

Problems Needing More Work

1. Complete evaluation of butyrics on small grains.
2. Complete evaluation of 2,4-D on small grains.
3. Interrelationship of herbicide and clipping (ensiling or grazing) where grain is not to be harvested for seed.
4. Control of *Scleranthus annuus*, German knotgrass.

PASTURE AND HAY CROPS

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Permanent Pastures

Control of summer annual broadleaf weeds

In General Use

1. 2,4-D amine or MCP, ½-1 lb. in spring. (2,3,5,6,7,8,9,10, 11,12) Use of mower. (1,7)

Promising in Trials

1. 4(2,4-DB) 1-2 lbs. per acre. (3)

Problems Needing Special Study

1. Evaluation of MCPB and 2,4-DB where legumes are present (5).

Control of brambles and woody plants

In General Use

1. 2,4,5-T ester or in combination with 2,4-D ester. (1,2,3,4,6,8,9,10,11,12)
   Silvex, 4 lbs. in 100 gal. (12)
   Control of coniferous weeds, Dalapon, 15 lbs. in 100 gals. (12)

Promising In Trials

1. 2,4,5-T, 4 lbs. per 100 gals. water on foliage. (9)
2. Polychloro benzoic acid-same as above. (11)

Control of Wild Garlic (Allium spp.)

In General Use

1. 2,4-D ester, 1-2 lbs. per acre in early spring. Repeat yearly until control is effective. (1,2,3,5,6,9,12)

Horse nettle (Solanum carolinense)

In General Use

1. 2,4,5-T or mixture with 2,4-D esters at 1.5 to 2 lbs. per acre. (1,2,5,8,9,12) Will not give complete control.

Promising in Trials

1. ATA, 4 lbs. per acre. (2,5)

Control of perennial and winter annual broadleaf weeds

In General Use

1. 2,4-D for perennials (1,2,3,7,8,9,12)
2. DNBP and CIPC for winter annuals (1)
3. Mowing, fertilizing and proper grazing (1,10).

Promising in Trials

1. 2,4-DB (3,11)
2. ATA (9,11)
3. Silvex, 1.5 - 2 lbs. per acre. (12)

Semi-Permanent Pastures - Legume or Grass-Legume Mixtures

Control of broadleaf weeds

In General Use

1. Same as for permanent pastures above. (1,6,11)
2. Mowing, fertilizing and proper grazing. (2,3,7,9,10)
3. DNBP, 1.5 - 3 lbs. per acre. (12)

Promising in Trials

1. 4(2,4-DB), 1-1½ lbs. per acre. (3,5)
2. MCPB. (5)
3. ATA on milkweed and Canada thistle. (6)

Problems Needing Special Study

1. Neburon in alfalfa, 2 pounds per acre. (11)

Alfalfa and Clover, Seedling Stage

Control of Chickweed (Stellaria media)

In General Use

1. DNBP, 1-1½ lbs. per acre in Nov. or Dec. (2,3,6,7,11,12)
2. DNBP, ½ lb. when chickweed first appears in fall followed by ½ - 3/4 lb. if necessary. (5)
3. CIPC, 1-3 lbs. (if no grass in mixture) (2,3,6,9,11)

Control of Other Annuals

In General Use

1. Clipping (7).
2. 2,4-D, ½ pint per acre with plant canopy over legume (8,11).
3. DNBP, ½ lb. per acre with plant canopy over legume, weeds 3"-5", temperature below 80°F. (3,11,12)

Promising in Trials

1. DNBP, 5 lbs. per acre on Scleranthus annuus. (2)
2. 2,4-DB and MCPB, 1-2 lbs. per acre. (2,3)
3. Dalapon, 2 lbs. per acre on grassy weeds. (11,12)

Alfalfa, Established Stands

Control of Chickweed (Stellaria media)

In General Use

1. DNBP, ½ pound when chickweed appears in fall followed by ½ - 3/4 lb. later if necessary (5).
2. DNBP, 1-1½ lbs. Nov. or Dec. (2,5,11)
3. DNBP, 1-3 lbs. after frost or in spring. (3,6,12)
4. CIPC, 1-3 lbs., if no grass desired. (2,3,5,6,11)

Control of Downy Brome (Bromus tectorum)

In General Use

1. CIPC, 3-6 lbs. in late fall. (3)
2. Dalapon, 3-5 lbs. early in spring. (3,12)
3. Sodium TCA. 10-15 lbs. per acre (12).

Promising in Trials

1. Dalapon, 2-3 lbs. early in spring or fall. (6,11)
2. CIPC, 5-8 lbs., early in spring or fall. (6)

Control of Yellow Rocket (*Barbarea vulgaris*)

In General Use

1. Cut first crop early (silage) (6,7)
2. MCP amine, 0.2-0.5 lb. when in bloom (4,12)

Promising in Trials

1. 2,4-DB, 1-2 lbs. when weeds are young. (2)
2. MCPB, 1-2 lbs. when weeds are young. (2)
3. 2,4-D or MCP, ¼-½ lb. in February. (2)

Alfalfa and Birdsfoot Trefoil

Control of Annual Weedy Grasses

In General Use

None

Promising in Trials

1. Dalapon, 2-3 lbs. when legumes have 2-3 leaves and weeds are 1"-3" tall. (3)
2. Dalapon, 2-3 lbs. plus 2,4-DB, 1 lb. per acre when legumes have 2-4 leaves. (3)
3. Dalapon, 3-5 lbs. per acre applied to grass foliage. (12)

Birdsfoot Trefoil-Established Stands

Control of Bedstraw (*Galium molluga*)

In General Use

None

Promising in Trials

1. Dig out spotted plants in Stand. (6)
2. Dalapon, 8-10 lbs. per acre in fall. (8,12)

Chemical Renovation of Pastures

1. Dalapon, 5 lbs. per acre. Repeat applications at 2 week intervals. Make last applications at least 5 weeks before reseeding, using 2,4-D if necessary to kill broadleaved weeds. (12)

Problems Needing Special Study

1. Killing old sod before reseeding. (3)
2. Evaluation of proprionic derivatives as overall and spot treatments for control of bedstraw. (6)
3. Control of weeds in trefoil. (8)
4. Control of *Scleranthus annuus* in alfalfa. (2)
5. Control of German moss, gromwell and summer annuals. (9)
6. Earlier fall applications of DNBP using lower amount with follow-up spray. (12)

AQUATIC WEEDS

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A-N.Y. State Conservation Dept.
B-N.Y. - Cornell University
C-Board of Game & Fish
Dover, Delaware
D-Public Health Dept.,
Madison, Wisconsin
E-Va. Agr. Exp. Sta.
F-Naugatuck Chemical Co.
G-N. J. State Fisheries Lab.
H-Jackson & Perkins Company
Newark, New York
I-Niagara Chemical Company
J-Vassar College
K-Delaware, Lackawanna and Western
Railroad
L-Conn. State Board of Fisheries
& Game
M-Medford Lakes Colony Club
New Jersey
N-American Cyanamid Corp.
O-Dow Chemical Co.
P-USDA Soil Conservation Service
Tappahannock, Virginia
Q-Chipman Chemical Company
R-U.S. Dept. of the Interior
Laurel, Maryland
S-U.S. Dept. of the Interior
Washington, D.C.

Emergent Rooted

All Common Broad Leaved Weeds

For General Use

1. 2,4-D and 2,4,5,-T in combination (no rates given). (C)

Promising in Trials

1. Delrad - no rates given (C)

Aquatic Weeds and Algae (General)

For General Use

1. Phygon XL - 20 lbs. per acre. (H)

Water chestnut, Trapa natans

For General Use

1. 2,4-D Amine Salt, 8 lb. acid equivalent per acre in 50 gals. total solution per acre in either water or fuel oil. Two sprayings per season for several years required. (A)

Cattail, Typha latifolia and other species

For General Use

1. Amino triazole, 10 lbs. in minimum of 300 gals. per acre. Apply just before or at heading stage. (N) 5 lbs. per acre during flowering and early fruiting stage. (R)

2. Radapon - 25 lbs. per acre. Control range 9-10 (1 season) sprayed in accordance with manufacturer's recommendations. (G)
3. Dalapon - 20-25 lbs. per 100 gals. water-spray to wet. (O) (R)

Promising in Trials

1. Dalapon - 15 lbs. per acre in water, spray after complete emergence to wet foliage. (D)
   Dalapon - 25 lbs. per acre at flowering periods on dry sites. (R)
2. Erbon - 20-40 lbs. per 100 gals. water. Spray actively growing foliage 2-3 ft. tall. (O)
3. Dalapon 5 lbs. per acre and ATA 2-3 lbs. per acre. (R)

Yellow water lily or Spatterdock, Nuphar spp.

Promising in Trials

1. Amino triazole (ATA) 4-12 lbs. per acre. Control range 5-9 (1 season). (G)
2. Kuron* - 1 to 2.5 ppm - control range 3 to 9 (1 season).(G)
3. Baron* - 1 to 2.5 ppm - control range 1 to 5 (1 season).(G)
4. Silvex - 1 ppm in pond water (O)
5. Erbon - 2 ppm in pond water (O)

White or Pink Waterlilies, Nymphaea odorata)

Promising in Trials

1. Kuron * (no rates given) (G)
2. Baron* (concentration was a 16 to 1 by weight mixture). Incidentally, sprayed in connection with water treatments, considerable activity shown. (G)
3. 2,4-D and wetting agent - 2 lbs. 2,4-D acid per acre. (S)
4. Mixed trichlorobenzoic acids (HC-1281-AN.) - 6 lbs. or more per acre. Complete Kill. (S)

Reed Grass, Phragmites maximus and P. communis

For General Use

1. Dalapon - 100 lbs. dry in 500 gals. water. Excellent Control. (K)
2. Radapon - 25 lbs. per acre. Control range 9-10 (1 season) (sprayed in accordance with manufacturer's recommendations. (G)
3. Dalapon - 20-25 lbs. per 100 gals. Spray actively growing foliage when 2-3 ft. tall. (O) (S)
   Dalapon - 30 lbs. per acre - apply when 3 ft. high to early fruiting. (R)
   Dalapon - 15 lbs. per acre and 4 lbs. ATA per acre. (R)
   Dalapon - 25 lbs. per acre and ATA 8 lbs. per acre during initial tasseling to early fruiting in wet sites.(R)

4. Amino Triazole - 10 lbs. active in minimum of 300 gals. water per acre and apply just before or at heading. (N)
   Amino Triazole - 16 lbs. per acre - apply during initial tasseling to early fruiting in dry sites. (R)
   Amino Triazole - 20 lbs. per acre in wet sites. (R)

Promising in Trials

1. Erbon - 40 lbs. per acre in dry sites not subject to wash (R).
2. TBA - 24 to 48 lbs. per acre in oil or water stages of growth. (R)
3. Urox - 100 to 150 lbs. per acre of commercial product - use in areas not subject to wash or water movement. (R)

Bur Reed, Sparganium spp.

Promising in trials

1. Silvex - 1 ppm in pond water. (O)

Arrow arum, Peltandra spp.

Promising in Trials

1. Erbon - 80 lbs. per acre. (O)
2. Dowpon - 40 lbs. per acre gave 90% kill. (P)

Arrow head, Sagittaria spp.

Promising in trials

1. Silvex - 1 ppm in pond water. (O)
2. Baron - 1 pint per sq. rod. (P)

Alligator weed, Alternanthera spp.

Promising in Trials

1. Erbon - 20 lbs. per acre. (O)

Giant cord grass, Spartina spp.

Promising in Trials

1. Dalapon - 10-20 lbs. per acre. (O)
   Dalapon - 30 lbs. per acre (R).
2. Baron - 1 pint per sq. rod. (P)
3. Dowpon - 10 lbs. per acre. (P)

Rose Mallow, Hibiscus spp.

Promising in Trials

1. Dowpon - 10-40 lbs. per acre. All rates gave 100% kill. (P)

Needlegrass Rush, Juncus roemerianus

For General Use

1. 2,4-D at 20 lbs. per acre and TCA 30 lbs. per acre. Apply during flowering and early fruiting period. (R)

Maidencane, Panicum hemitomon

Promising in Trials

1. Dalapon - 20 lbs. and above. Complete kill and almost complete eradication in plots 1 to 2 ft. above water level. Rates lower than 20 might be effective (Florida) (S)
2. ATA - 20 lbs. per acre - 95% kill. (S)

Free Floating Plants and Algae

Algae General

For General Use

1. Copper Sulfate - 1 ppm upper 2 ft., 5.4 lbs. per acre. Methyl orange alkalinity greater than 50 ppm. (D) 0.3 ppm (0.9 lbs. per acre). Methyl orange alkalinity less than 50 ppm. (D)
2. Sodium Arsenite - 5 to 10 ppm As_2O_3 equivalent (Q)

Promising in Trials

1. Delrad - 0.5 ppm active ingredient. Spot or marginal treatments. (D)
2. Phygon XL - 0.15 ppm. (F)

Filamentous algae (various spp.)

For General Use

1. Copper Sulfate - (0.5 to 1.0 ppm) (A)
2. Delrad (no rates given). For species which cannot be controlled with copper sulfate (A).
   Delrad - 0.2 to 1.0 ppm (Q)

Promising in Trials

1. Phygon (no rates given). For species which cannot be controlled with copper sulfate (A).

Bloom Producing blue green algae

For General Use

1. Phygon XL - 0.05 ppm (F)

Pithophora and Hydrodictyon

Promising in Trials

1. Delrad (no rates given) (C)
2. Copper sulfate (no rates given) (C)

Problems for Further Study

1. The control of algae on plant and flower pots (H).
2. The control of algae on greenhouse pathways and benches (H).

Submersed Rooted

For General Use

1. Sodium Arsenite - 2½ to 10 ppm As_2O_3 equivalent (B) (G) (Q).
   5 to 10 ppm As_2O_3 equivalent (except on species with waxy coated leaves) (D)
   4 ppm As_2O_3 (I)

Promising in Trials

1. Kuron* - 1 to 2½ ppm (G)) effect on fish not fully known
2. Baron* - 1 to 2½ ppm (G))

Water milfoil (Myriophyllum exalbescens and other spp.)

For General Use

1. Sodium Arsenite - 5 to 10 ppm As_2O_3 equivalent (A) (C) (G) (L)

Promising in Trials

1. Phygon XL - 2 lbs. per acre foot or 0.75 ppm (F)
   0.75 to 1 ppm (G)
2. Silvex - 1 to 2 ppm (O)
3. Erbon - 1½ to 3 ppm (O)

Pondweeds (Potamogeton several spp. including crispus, ampli folius, natans longiligulatus)

For General Use

1. Sodium Arsenite - up to 7 ppm As_2O_3 equivalent (A) (L)

Promising in Trials

1. Phygon XL - 2 lbs. per acre foot or 0.75 ppm (F) (G)
2. Kuron* - 1 to 3 ppm (G) - effect on fish not fully known.
3. Sodium arsenite - 10 ppm As_2O_3 equivalent (J) - pot trials.
4. CMU - 10 ppm to 30 ppm (J) - pot trials.

Wild Celery (Vallisheria americana)

For General Use

1. Sodium arsenite - no rates given (A)

Stoneworts Chara

For General Use

1. Delrad (no rates given) (A) - (some fish kill likely).

Promising in Trials

1. Phygon (no rates given) (A) - Possibly too costly under high alkalinity conditions.
2. Delrad - 1 ppm (D) - use with caution if fish present.

Coontail, Ceratophyllum spp.

For General Use

1. Sodium arsenite 7 ppm. As_2O_3 equiv. (C) (L)

Promising in Trials

1. Sodium arsenite 5 ppm As_2O_3 equiv. (E)
2. Kuron* - 1 to 3 ppm. (G)?
3. Phygon 0.75 to 1 ppm. (G)

Bushy Pondweed, Najas flexilis

For General Use

1. Sodium arsenite - up to 7 ppm As_2O_3 equiv. (L)

Promising in Trials

1. Kuron* - 1 to 3 ppm. (G)
2. Phygon XL - 0.75 to 1 ppm. (G)

Fanwort, cabomba caroliniana

For General Use

1. Sodium arsenite 5 to 10 ppm. (As_2O_3 equiv.) (G)

Promising in Trials

1. Kuron* - 1 to 3 ppm. (G)
2. Phygon Xl - 0.75 to 1 ppm. (G)

Waterweed, Elodea canadensis

For General Use

1. Sodium arsenite up to 7 ppm. As_2O_3 equiv. (A) (C) (L)

Promising in Trials

1. Phygon XL - 2 lbs. per acre foot or 0.75 ppm. (F) (G)
2. Kuron* - 1 to 3 ppm. (G)

Bladderworts, Utricularia

Promising in Trials

1. Sodium arsenite up to 7 ppm. As_2O_3 equiv. (L)

Pond Lake Bottoms

For General Use

1. Sodium arsenite applied to exposed lake bottoms. (M) 20 lbs. per acre As_2O_3 equiv.

For Further Study

1. Erbon (O)
2. Silvex (O)

* The final recommendation for extensive use for materials marked * must await determination of their effects and compatability to health standard for recreational water. (G)

HERBACEOUS PERENNIAL AND BIENNIAL WEEDS

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Contributors

1. Maine
2. New Hampshire
3. Vermont
4. Massachusetts
5. Connecticut
6. Rhode Island
7. New York
8. New Jersey
9. Delaware
10. Maryland
11. West Virginia
12. Virginia
13. G. L. F. Coop.
14. American Chem. Paint Co.
15. American Cyanamid
16. U.S. Borax
17. Eastern States Farmers Ex.

Bedstraw (Galium mollugo)

Spot Treatment

In General Use

1. Dalapon, 10 pounds per acre in fall. (3,10)

Promising in Trials

1. Dalapon, 10 lbs. per acre. Early spring repeated. (17)
2. ACP 688 Kuron 5 lbs. per acre. (7)

Problems Needing Special Study

1. Combinations with 2,4-D for broadleaf control. (3)
2. Chem. rate and time of application with new materials (7).

Bermuda Grass (*Cynodon dactylon*)

Spot Treatment

In General Use

1. Dalapon, 10 lbs. per acre, June-July; Dalapon, 1 lb. to 4 gals. water or TCA, 1 lb. to 2 gals. water. (10,12)
2. ATA, 6 lbs. per acre on active growth. (15)
3. Polyborchlorate, 3-4 lbs. per 100 sq. ft. (16)
4. Conc. Borascu, 8-12 lbs. per 100 sq. ft. fall or spring (16).

Promising in Trials

1. ATA, 10 lbs. per acre (12).

Overall Treatment

In General Use

1. TCA, 75-100 lbs. per acre without tillage, 20-30 lbs. per acre with tillage. (10)
2. Dalapon, 10-15 lbs. repeated 15-20" tall. (10,12)
3. ATA, 6-8 lbs. per acre on active growth. (14,15)

Promising in Trials

1. ATA, 10 lbs. June-July. (12)

Problems Needing Special Study

1. Repeated treatments at various intervals with TCA (10)

Canada Thistle (*Cirsium arvense*)

Spot Treatment

In General Use

1. ATA, 4 lbs. per acre early summer. (3,5,14,15,17)
2. 2,4-D or MCP ½-1½ lbs. per acre at bud stage. (4,5,6,7, 8,10,13)
3. DB granular, 2-3 lbs. per 100 sq. ft. (16)
4. Polyborchlorate, 3-4 lbs. per 100 sq. ft. in fall or spring. (16)

Promising in Trials

1. ATA, 2 lbs. per acre pre-bloom (7,8,10)

Problems Needing Special Study

1. ATA retreatment. (7)

Overall Treatment

In General Use

1. 2,4-D + 2,4,5-T, 4 lbs. per acre in spring. (3,5)
2. MCP or 2,4-D, 3/4 - 1½ lbs. per acre pre-bloom. (7,10,13)
3. ATA, 4 lbs. per acre bud stage. (14,15,17)

Chicory (Chichorium intybus)

Spot Treatment

In General Use

1. 2,4-D, ½-1 lb. per acre, veg. stage (3,4,5,7,10,13)

Problems Needing Special Study

1. Control in Birdsfoot Trefoil. (17)

Overall Treatment

In General Use

1. 2,4-D, ½-1 lb. per acre, veg. stage (3,4,5,7,10,13)

Horsenettle (Solanum carolinense)

Spot Treatment

In General Use

1. 2,4-D or 2,4-D + 2,4,5-T, 2-4 lbs. per acre. Early bloom stage. Repeat on regrowth. (4,5,6,7,10,12,13)
2. ATA, 4 lbs. per acre bud stage. (15)
3. DB granular, 3-4 lbs. per 100 sq. ft., spring. (16)

Overall Treatment

In General Use

1. 2,4-D or 2,4-D + 2,4,5-T, 2-4 lbs. per acre. Early bloom-repeat. (4,5,6,7,10,12,13)
2. ATA, 4 lbs. per acre bud stage (15).

Problems Needing Special Study

1. Effect of age of plant (7)
2. Factors affecting root kill (7)

Johnson Grass (Sorghum halepense)

Spot Treatment

In General Use

1. TCA, 1 lb. to 2 gals water, 6" tall. (10)
2. Dalapon, 10-15 lbs/A applied twice when grass is 15-30" tal
3. Polyborchlorate, 4 lbs/100 sq. ft.
4. Conc. Borascu, 8 lbs/100 sq. ft.

Promising in Trials

1. Dalapon, 10-15 lbs. per acre (9) 2 applications 10" high.

Problems Needing Special Study

1. Proper time for Dalapon treatment. (10)

Overall Treatment

In General Use

1. TCA, 50-100 lbs. per acre prior to or at emergence; TCA, 150-200 lbs. per acre during growing season.

2. Dalapon, 30-50 lbs. per acre with tillage. (10)

Problems Needing Special Study

1. Dalapon plus plowing
2. Time of application
3. Time interval for retreatment. (10)

Milkweed (Asclepias syricaca)

Spot Treatment

In General Use

1. ATA, 4 lbs. per acre early summer. (3,4,5,7,15)

Promising in Trials

1. ATA, 4 lbs. per acre pre-bloom 100 gals. water (1,5)
2. ATA, 10 tablespoons per gallon of water.

Problems Needing Special Study

1. ATA evaluation, rate and time. (7)

Overall Treatment

In General Use

1. ATA, 4 lbs. per acre. (10,13,15)

Nutgrass (Cyperus esculentus)

Spot Treatment

In General Use

1. TCA, 50-100 lbs. per acre when shoots are 2-6" tall; follow by discing. (4)
2. DNBP, 3 lbs. per acre when less than 6" growth (11)
3. ATA, 2-4 lbs. per acre on active growth. (15)

Promising in Trials

1. DNBP, 6-9 lbs. per acre, July and August. (12)
2. ATA, 4-8 lbs. per acre on regrowth. (17)

Problems Needing Special Study

1. Method of killing nuts. (5,7)

Overall Treatment

In General Use

1. TCA, 50-100 lbs. per acre when shoots are 2-6" tall followed by discing. (4,7,13)

Promising in Trials

1. ATA, 10 lbs. per acre + Karmex W, 5 lbs. per acre applied before nutlets formed. (6)
2. ATA, 4-8 lbs. per acre on regrowth. (17)

Problems Needing Special Study

1. Dalapon evaluation. (7)

Quackgrass (Agropyron repens)

Spot Treatment

In General Use

1. TCA, 75-100 lbs. per acre to soil. (2,4,5,8)
2. Dalapon, 10 lbs. per acre fall to foliage. (3,5,6,8)
3. ATA, 4 lbs. per acre spring and plowed 2 weeks after (3,15,17)
4. Ureabor, 1-2 lbs. per 100 sq. ft. fall or spring.
5. Polyborchlorate, 3-4 lbs. per 100 sq. ft. fall.

Promising in Trials

1. Dalapon, 30-50 lbs. on vegetation followed by plowing, (4).
2. ATA, 4 lbs. per acre, (5,6).
3. MH 30, 10 lbs. (6)

Problems Needing Special Study

1. ATA and TCB preplanting. (5,7)
2. Timing, moisture, fertility and size of plant evaluation (7,14,15).

Overall Treatment

In General Use

1. TCA, 50-100 lbs. per acre in early summer or fall; apply to soil, (1,2,4,7,13).
2. * Dalapon, 10 lbs. per acre, fall application. (3,4)
3. ATA, 4 lbs. per acre spring applied to foliage, plow 2 weeks later. (14,17)

Promising in Trials

1. * Dalapon, 20-25 lbs. per acre, veg. stage. (1) Dalapon, 5-10 lbs. per acre preplanting. (1,7)
2. ATA, 4 lbs. per acre, spring. (1,11)

Problems Needing Special Study

1. Factors affecting pre-planting control. (5,7)

Wild Onion and Garlic (Alliim spp)

Spot Treatment

In General Use

1. 2,4-D ester, 3/4 - 2 lbs. per acre early spring, repeat in fall. (4,5,6,8,10,12,13,17)

Problems Needing Special Study

1. MH 40 evaluation (5)

Overall Treatment

In General Use

1. 2,4-D or MCP, 1-2 lbs. per acre early spring; repeat in fall. Takes 2 yrs. (4,5,6,7,9,10,12,13,17)

Curled Dock (Rumex crispus)

Spot Treatment

In General Use

1. 2,4-D, 1 lb. per acre fall or spring. (3,6,12)

Promising in Trials

1. ATA (6)

Overall Treatment

In General Use

1. 2,4-D, 1 lb. vegetative stage. (7)

Promising in Trials

1. 2,4-DB, 2 lbs. per acre or MCPB, 1 lb. per acre anytime. (8)

Goldenrod (Solidago nemoralis)

Problems Needing Special Study

1. ATA evaluation (7)

Wild Carrot (Daucus carota)

Spot Treatment

In General Use

1. 2,4,5-T, ½-3 lbs. per acre early summer repeated (3)

Overall Treatment

In General Use

1. 2,4-D, ½ lb. per acre seedling stage. (7)

Yellow Rocket (Barbarea vulgaris)

Spot Treatment

In General Use

1. 2,4-D, ½-1½ lbs. per acre in fall. (3,4)

Promising in Trials

1. MCP or 2,4-D, ¼-½ lb. per acre. (5,17)

Overall Treatment

In General Use

1. 2,4-D ½ lb. per acre, veg. stage. (7)
2. MCP, ¼-½ lb. per acre, veg. stage. (10,14)

Promising in Trials

1. 24-DB, ½ lb. veg. stage (10)
2. MCP, ½-1 lb. fall or early spring. (17)

Problems Needing Special Study

1. More work with Butyrics. (7,10)

Butter and Eggs (Linaria vulgaris)

Spot Treatment

In General Use

1. DB Granular, 1-2 lbs. per 100 sq. ft.
2. Polyborchlorate, 3-4 lbs. per 100 sq. ft. fall or spring. (16)

Bindweed (Convolvulus arvensis)

Spot Treatment

In General Use

1. DB granular, 2-3 lbs. per 100 sq. ft.
2. Polyborchlorate, 3-4 lbs. per 100 sq. ft., fall application (16)

Promising in Trials

1. Benzoic acids, 4-8 lbs. per acre on young vegetation (14)
2. 2,4-D, 3/4-1 lb. young vegetation (17)

Problems Needing Special Study

1. Timing and rate studies. (14)

Overall Treatment

In General Use

1. 2,4-D, ½-3/4 lbs. per acre vegetative stage (7,10)

Promising in Trials

1. 2,4-D, 3/4 - 1 lb. young vegetation (17).

SOIL STERILIZATION 1/

Reed W. Varner
Grasselli Chemicals Department
E. I. du Pont de Nemours & Co., Inc.

Contributors

1. Maine
2. Maryland
3. Massachusetts
4. New Jersey
5. New York
6. Rhode Island
7. Vermont
8. Virginia
9. Allied Chemical and Dye
10. American Potash and Chemical
11. Arboreal Associates
12. California Spray-Chemical
13. Chipman
14. Dow
15. Du Pont
16. Geigy
17. Niagara
18. Penn Line Service
19. Socony Mobil
20. Standard Agr. Chem.
21. U.S. Borax and Chem.
22. U.S. Rubber. Co.
23. General Aniline

In General Use

Boron Compounds

Conc. "Borascu" (sodium borate) (1,3,5,6,7,18,20,21,22,23) 2/

Apply 6 - 9 lbs./100 sq. ft.

"Tronabor" (borax pentahydrate - sodium borate, minimum 44% B_2O_3) (3,5,6,7,10,18,20,22,23)

Apply 7.5 - 12 lb./100 sq. ft. Spot retreatment of some areas at about one-half normal dosage may be advisable later.

"Gerstley Borate" (sodium-calcium borate) (3,5,6,7,18,20, 21,22,23)

Apply 10 - 14 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

"Atlacide" (58% sodiumchlorate) (2,3,4,5,6,7,13,18,20,22,23)

Apply 1½ - 3 lbs./100 sq. ft. either dry or in 200-300 gals. water per 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.

1/ "Soil sterilization" is considered to encompass only the application of those treatments designed to kill all existing vegetation and prevent regrowth for an extended period.

2/ Numbers in parentheses indicate specific contributors that expressed agreement with the practice in question. Sources that manifested satisfaction with 1955 report are included where the practice was unchanged.

Borate-Chlorate Combinations

Polybor-Chlorate (disodium octaborate plus sodium chlorate) (3,4,5,6,7,18,20,21,22,23)

Apply 1-4 lbs./100sq. ft. On annuals, apply as a water spray early in spring when plants are young and tender (1 to 4 inches high). On perennials, apply dry or as a spray when plants are in dormant stages, or in fall months.

Chlorax 40 (40% sodium chlorate; 58% sodium metaborate) (3,5,6,7,13,18,20,22,23)

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 lb. sodium chlorate and 2 lbs. 2-methyl-4-chlorophenoxyacetic acid/100 gals.) (3,5,6,7,13,18,20,22,23)

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. For track areas 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) (2,3,5,6,7,13,18,20,22,23)

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.

Ureabor /sodium borate, 3-(p-chlorophenyl)-1,1-dimethyl-urea complex/ (3,5,6,7,18,20,21,22,23)

Apply ½ - 2 lbs./ 100 sq. ft. dry. On annuals, applications should be made in early spring when plants are 1-4 " high. Fall applications are preferable for deep-rooted perennials.

Sodium Arsenite (2,3,5,6,7,12,13,17,18,20,22,23)

Apply ½-2½ lbs. As_2O_3/100 sq. ft. as a water spray at any time except when ground is frozen. If ground is dry, moisten before treating. Control of deep-rooted perennials depends on rainfall to carry chemical down to roots.

Substituted Urea Herbicides

"Telvar" W /3-(p-chlorophenyl)-1,1-dimethylurea - 80%/ (1,2,3,4,5,6,7,11,15,18,20,22,23)

Apply 20-60 lbs./acre as a spray. For optimum results apply shortly before growth begins. Up to 80 lbs./acre may be required for certain deep-rooted perennials.

"Telvar" DW /3-(3,4-dichlorophenyl)-1,1-dimethylurea - 80% 7 (1,2,3,5,6,7,15,18,20 ,22,23)

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 before growth begins. Up to 80 lbs./acre may be required for certain deep-rooted perennials.

"Urox" /22% 3-(p-chlorophenyl)-1,1-dimethylurea tri-chloroacetate7 (9)

Apply 80 to 320 lbs./acre dry at any time.

Sodium TCA 90% (sodium trichloroacetate) (14)

For control of grasses only. Apply 80 to 100 lbs./acre to soil when moist. Heavy rain after application may leach this material out of the top soil layer. Application should be made to the soil preferably prior to foliage growth. Regrowth may occur.

"Baron" (erbon) /2-(2,4,5-trichlorophenoxy)ethyl-2,2-dichloropropionate (4 lbs./gals./ (2,3,5,6,7,14,18,23)

Apply 30-40 gal./acre. Mix one part of "Baron" with 4 parts of water and apply as a thorough, drenching spray. Use enough spray to cover all vegetation and exposed soil. Apply in spring after growth is well established.

"Radapon" (sodium salt of 2,2-dichloropropionic acid) (14)

For control of grasses only. Apply 30-50 lbs./acre to foliage of actively growing grass in sufficient water to wet foliage thoroughly. (100 to 200 gals./acre). In long growing season areas, regrowth may occur.

Agronyl R (aromatic oil, 100% active) (19)

Apply 80-100 gals. per acre as a spray when weeds are 6-8" tall. Suitable for railroad rights-of-way and similar areas.

Promising in Trials

"Simazin" /2-chloro-4,6-bis(ethylamino)-s-triazine7 (16)

Apply 10-20 lbs./acre. Apply as a spray or dry powder and follow with sufficient water for penetration to root system of weeds. Applications should be made either at emergence or during the early post-emergence period.

"Baron" (8)

Apply 50 gals. in 800 gals. water/acre. See same material above.

"Baron" plus "Radapon" (14)

Apply 15-25 gals. Baron plus 15-30 lbs. Radapon per acre. See above for details. Rates and length of control should be studied.

WOODY PLANTS

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Dow Chemical Company
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Contributors

1. Norfolk & Western Railway Co.
2. N.Y. State Cons. Dept.
3. Yale University
4. Central Vt. Public Ser. Corp.
5. Va. Agric. Expt. Sta.
6. Northeastern Forest Expt. Sta. Upper Darby, Pa.
7. University of Delaware
8. Penn. Electric Company
9. N. Y. State Dept. of Public Works
10. Penn Line Service
11. Central Maine Power Co.
12. Central Hudson Electric Co.
13. N.E.T.&T. Co.
14. U.S. Dept. of Agric. Soil Conservation Ser.,Va.
15. Davy Tree Expert Co.
16. West Virginia University
17. Connecticut College
18. Cornell University
19. Oscar Warner Tree Exp. Co.
20. American Cyanamid Co.
21. Penn. State University
22. The Hydro-Electric Power Commission of Ontario
23. Ontario Agric. College
24. Dow Chemical Company
25. Fish & Wildlife Service U.S. Dept. of Interior

Deciduous

1. Root sprouting ("suckering")-(sassafras, black locust, tree-of-heaven, sumac, aspen, etc.)

In General Use

2,4,5-T plus 2,4-D LV ester at 4 to 6 lbs./100 gals. water as leaf stem spray treatment (1,8,9,10,15,19,24,26,27)

2,4,5-T LV ester at 3 to 5 lbs./100 gals. water as leaf-stem treatment (4,11,15,19,24,27)

2,4,5-T LV ester at 12 to 16 lbs./100 gals. fuel oil as basal treatment (9,11,12,17,19,21,24,27)
Summer basal more effective than winter basal (12,21)

2,4,5-T or 2,4,5-T plus 2,4-D LV ester at 4-6 lbs./10 gals. oil plus 90 gals. of water as a leaf stem treatment (5,13,27

Ammonium sulfamate as a leaf-stem spray (15) 3/4 to 1 lb. per gallon plus spreader sticker (28)

Deciduous (con't)

Promising in Trials

Leaf stem treatment with 2,4,5-T was more effective than basal application for the control of resprouting of black locust (16)

Tree-of-heaven and sumac resprouting was controlled better by summer basal treatments compared with dormant basal treatments (17)

ATA at 6-9 lbs./100 gals. of water as a leaf-stem spray appeared to be effective on black locust (5,20)

Silvex at 4 lbs./100 gals. of water as a leaf-stem treatment (24)

2,4,5-T amine salt 4 lbs./100 gals. of water as a leaf-stem treatment (24)

Root collar sprouting

In General Use

2,4,5-T plus 2,4-D LV ester 4-6 lbs./100 gals. water applied as a leaf-stem treatment (8,9,10,15,22,23,24,26,27)

2,4,5-T LV ester 3-5 lbs./100 gals. water as a leaf-stem treatment (4,11,15,24,27)

2,4,5-T ester at 12 to 16 lbs./100 gals fuel oil as basal treatment (3,6,9,10,11,12,15,19,21,22,24,25,27)

2,4,5-T or 2,4,5-T plus 2,4,-D LV ester - 4 to 6 lbs./10 gals. oil plus 90 gals. of water as a leaf-stem treatment (5,13,27)

2,4,5-T plus 2,4-D ester at 14-16 lbs./100 gals. fuel oil as basal treatment (5,8,21,27)

2,4,5-T at 12 to 16 lbs./100 gals. of fuel oil as a stump treatment (8,24)

2,4,5-T at 8 to 12 lbs/100 gals. of fuel oil as a frill treatment (6,24)

Silvex LV ester 4 to 6 lbs./100 gals. of water as leaf-stem treatment for control of oak and maple especially (24,27)

Ammonium sulfamate for treatment in notches (6)

Ammonium sulfamate as a leaf-stem treatment (15,27)

Promising in Trials

Amine salt of 2,4,5-T at 4 to 6 lbs./100 gals. of water as a leaf-stem treatment (24).

2,4,5-T LV ester at 6 lbs./10 gals fuel oil plus 90 gals. of water applied as a leaf-stem treatment to the lower 4/5ths (13).

ATA at 6 to 9 lbs./100 gals. water leaf-stem treatments for white oak, scrub oak, prickly ash, poison ivy and buck brush (9,15)

ATA at 2 to 4 lbs./100 gals water as leaf-stem treatment for control of poison ivy (20)

2,4,5-T ester 8-12 lbs/100 gal. fuel oil applied as basal treatment to Bear oak was more effective as a dormant application than in other seasons (21)

Coniferous

In General Use

2,4,5-T or 2,4,5-T plus 2,4-D LV ester at 4 to 6 lbs./10 to 20 gals. fuel oil plus 80 to 90 gals. water applied as a leaf-stem treatment (5,10,13,15,24,27)

2,4,5-T or 2,4,5-T plus 2,4-D at 4 to 6 lbs./100 gals. fuel oil applied as a leaf-stem treatment (8,12)

2,4,5-T or 2,4,5-T plus 2,4-D at 12 to 16 lbs./100 gals. fuel oil as a basal treatment (8,10,14)

Dalapon, sodium salt at 15 to 20 lbs./100 gals. of water as a leaf-stem treatment (22,24)

Sodium arsenite applied in frills (2)

Promising in Trials

2,3,6 TBA at 6 lbs./100 gals water as leaf-stem treatment (22,27)

TCA sodium salt 8 to 12 lbs./100 gals. water as a leaf-stem treatment (22,27)

2,4,5-T LV ester 6 lbs./10 gals. fuel oil plus 90 gals. of water qpplied as a leaf-stem treatment to the lower 4/5th (13)

Problems Needing Special Study

1. To develop a uniform terminology for reporting results of brush control research, preferably on the national level.

2. Physiological aspects of the effects and translocation of the various compounds and how translocation can be improved.

3. Comparisons of the various compounds and methods of applications in their effectiveness on individual species growing under the same conditions.

4. Methods of control for root sprouting species such as sassafras, black locust, aspen, beech and thornapple.

5. Aerial and mist blower applications to control hardwood brush or low quality trees for the establishment or release of pine and the establishment or improvement of wildlife habitats.

6. Methods of control for conifers, ash, basswood.

7. A formulation is needed which is equally or more effective with lower volumes of spray solutions (12)

8. Suppression of vegetation on rights of way to reduce fire hazard and establish fire breaks (13).

9. Investigations to determine reasons for extreme variability in results from herbicide application.

10. Prepare a species susceptibility table of the chemicals used today considering methods of application.

11. Development of new techniques to fully exploit the potential of herbicides in fields such as forestry, conservation, Christmas tree production, etc. (21)

12. Need additional field tests to determine the effects of different volumes, concentrations and seasons of application with the various treatment techniques on individual species.

13. Use of ATA in mixtures with other herbicides for broad spectrum control of mixed growth containing species susceptible to one herbicide but not to another (20).

14. The development and promotion of herbicide formulations and techniques which will reduce the danger of injury to desirable plants and crops off the right of way and cause slower browning of the treated vegetation. (15)

PUBLIC HEALTH WEED CONTROL

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New York State Health Department
White Plains, New York

Contributors

1. University of Delaware
2. University of Vermont
3. Virginia Truck Experiment Sta.
4. University of West Virginia
5. University of Maine
6. University of Maryland
7. University of Massachusetts
8. American Chemical Paint Co.
9. American Cyanamid Co.
10. Dow Chemical Company
11. Du Pont (Grasselli Chemicals)
12. Standard Agric. Chemicals Inc.
13. Unsigned Experiment Sta. Report

In General Use

Poison Ivy

1. 2,4-D plus 2,4,5-T, water spray in summer, oil-water emulsion for dormant winter spray application (1)

2. 2,4-D plus 2,4,5-T, 1 gal/50 gals., on active growth (2) (6) (7) (13). Add spreader-sticker (11)

3. 2,4-D plus 2,4,5-T in oil-water emulsion (2 Gals., plus 2 gals., plus 10 gals., oil in 100 gals., water), wet foliage in early growing season (3)

4. Ammate, 3/4-1 lb. per gal., of water, wet foliage early in growing season (3) (4) (6) (13). Add spreader-sticker (11)

5. 2,4,5-T, 2-3 lbs., acid per 100 gals., water when leaves fully expanded (5) (8) (10) (12)

6. ATA, use 1-2 lbs., active per acre. For spot treatment use 1 lb., ATA in 50 gals., water, apply when ivy is in full leaf stage, thorough wetting of plant to ground level is important for optimum kill. There is no volatility problem with this compound (8)

7. ATA 1 lb., active in 50 gals., of water sprayed to thoroughly wet foliage after plant is in full leaf. (Caution: wash spray thoroughly immediately after each use (9)

8. Ammonium sulfamate 3/4-1 lb. per gal., of water as a drenching spray when leaves fully expended (12)

Ragweed

1. 2,4-D, (amine or ester) ½ to 1½ lb., active per acre (1) (2) (3) (6) (10) (12)

2. Ammate 3/4 lb., to gallon of water with added spreader-sticker. Wet foliage to run off (11)

Poison Sumac

1. 2,4,5-T 2-3 lbs., (low volatile esters or amine salt) in 100 gallons of water. Use as a wetting spray in August or preferably in full leaf (10)

Black Nightshade

1. Silvex, (low volatile ester) 2-3 lbs., to 100 gallons water. Apply as wetting spray when plant is in full leaf (10)

Hemp

1. 2,4-D (low volatile esters or amine salt), ½ to 1 lb., per acre in sufficient water for coverage. The lower rate can be used with the ester folmulations (10)

Water Hemlock

1. Same as Hemp above (10)

Poison Hemlock

1. Same as Hemp above (10)

Promising in Trials

Poison Ivy

1. ATA 4 lbs., (active) in 100 gallons water when leaves expanded (5)

2. Amino triazole 1 lb. (50% formulation) to gallon. Wet the foliage in early growing season and repeat if needed (3)

3. ATA (3-amino-1,2,4-triazole) is highly efficient at a rate of 4 pounds active ingredient per acre. Application should be made anytime after the leaves have reached full size until they change color in the fall. Thorough coverage is important. There appears to be a high degree of selectivity and it is possible to spray poison ivy growing under such sensitive trees as dogwood without injurying them and also to spray poison ivy growing up the trunks of trees without damaging the trees. (8)

4. ATA 2 lbs., (active) in 100 gallons of water. Apply when plant is in full leaf with low pressure and coarse droplets to get full coverage (7) (12)

5. ATA spot treatment 10 tablespoons (50% formulation) per gallon of water (6)

6. ATA 1 lb., (50% formulation) per 25 gallons on active leafy growth (2)

Problems Needing Special Study

1. Methods of destroying dead poison ivy after spraying (3)

2. Acquainting people with the identity of poisonous weeds and how they can be controlled (10)

3. How to emphasize to Public Health authorities that herbicides such as 2,4-D, 2,4,5-T, dalapon and erbon are non-toxic to warm-blooded animals at rates used for controlling weeds (10)

4. Ecological and physiological studies of both poison ivy and ragweed to better understand the life cycle of each (12)

Tabular Summary of the 1957 Report
Research Coordinating Committee
Northeastern Weed Control Conference

The purpose of the following tables is to provide a ready reference to the most effective weed control measures reported in the general research report. For most crops, the treatments given are those in general use. Where general use practices are not availabel, treatments showing promise in trials are given.

The uses of chemicals in the following summary are based on biological activity only. No designation of usage is given that will insure residues below the limits set under Public Law 518.

John R. Havis
Chairman

Weed Control in Specific Crops

Crop	Ref. Page	Chemical	Use*	Lb/Acre unless Specified	Comments
Alfalfa (Seedling)	41	DNBP	(1)	1-1½	Nov. or Dec.
		CIPC	(1)	1-3	If no grass seeding
Alfalfa (Established)	41	DNBP	(1)	1-1½	Nov. or Dec.
		CIPC	(1)	1-3	If no grass desired
Arborvitae	28	2,4-DES	(1)	2-4	After clean cult.
Asparagus (Cutting beds)	9	Monuron	(1)	1-3	Before and after cutting season
		Dalapon	(1)	13	Summer or fall for quack grass
Asparagus (Seed beds)	9	Stod. Solv.	(1)	75-100 G	Pre-Em.
		PCP	(1)	6 G	Pre-Em.
		DNBP	(1,2)	3	Pre-Em.
		Monuron	(1,2)	3/4 - 1½	Pre-Em.

* (1) General Use (2) Promising in Trials

Crop	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Beans (Lima & Snap)	11	DNBP	(1)	3-9 in 25-40 G	Pre-Em.
Beets	16	NaCl	(1)	200	Post-Em.
		Monuron	(1,2)	1/3-5/8	Pre-Em.
Blueberries (Cultivated)	19	2,4-DES	(1)	2-4	Before weed em.
		DNBP	(1)	3-4	Sum. & Fall
		Monuron	(1)	1-3	E. Spr. less than 2 lbs. on Atl. var.
		ATA	(1)	4-6	Spr. Sum, fall
Brambles (Blackberries & Raspberries)	18	DNBP	(1)	2-3	Except during suckering, layering
		2,4-DES	(1)	3-4	Before weed em.
		CIPC	(1)	5-8	Fall or E. spr.
		2,4-D	(1)	to 1	For B.L. weeds
		ATA	(1)	2-6	Fall or spr.
Cantaloupes	14	Alanap-3	(1)	2-6	Pre-Em.
		Alanap-3	(1,2)	2-4	Post-Em.
		DNBP	(1)	2-4	Pre-Em.
Carrots	5	Stod. Solv.	(1)	75-120 G	After true leaves. Apply on cool, cloudy days.
Celery	6	Stod. Solv.	(1)	75-120 G	Seed beds only
Clover (Seeding)	34	DNBP	(1)	1-1½	Post-Em.
Cole Crops (Seed beds)	6	CIPC	(1)	1-2	Low rate cool weather. High rate above 60°F.
Corn (Field)	36	DNBP	(1)	3-6	Pre-Em. or at Em.
		2,4-Dlve	(1)	1-1½	Pre-Em.
		2,4-DA	(1)	½	Post-Em. Drop nozzles when corn 1 ft. tall
Corn (Sweet)	10	DNBP	(1)	3-6	Pre-Em.
		DNBP	(1)	1-3	At em.
		2,4-DA	(1)	1-1½	Pre-Em. Less than ½ lb. on sandy soil
		2,4-DA	(1)	½	Em. to 6 in. high
Cranberries	20	Wh. Kerosene	(1)	400-800 G.	
		Stod. Solv Kerosene	(1)	400-500 G.	
		Stod. Solv.	(1)	1:1 ratio 600 G/A	
		Fe Sulfate	(1)	1½-4 tons	

Crops	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
cont.					
Cranberries	20	Cu Sulfate	(1)	10 20 lbs/100G	In flood water 400-600 G/A
		Na NO_3	(1)	300-500	
		Na Cl	(1)	3/4-1 lb/G	200 G. per A.
		2,4,5-TLVE	(1)	2¼ in 300 G	Shores & dikes only
		2,4-DE + 2,4,5-TE	(1)	1:50 dil. in	Kerosene for brush on shores
Cucumbers	14	Alanap-3	(1)	2-6	Pre-Em.
		Alanap-3	(1,2)	2-4	Post-Em.
		DNBP	(1)	2-4	Pre-Em.
Gladiolus	24	DNBP	(1)	3-12	Pre-Em.
		2,4-DES	(1)	2-4	Pre-Em.
				2-4	Post-Em. after clean cult.
		2,4-D	(1)	1-3	Pre-Em.
Grapes (Established)	18	DNBP	(1)	2	with 15-20 G fuel oil - row appl.
		Monuron	(1)	2-6	Spr. or fall
		ATA	(1)	4-8	Weeds in active growth
Lettuce	Pr.Yr	CIPC	(1)	1-1½	1 wk. after transp. Delays maturity
	Pr.Yr	CIPC	(1)	½-1	At time of seeding
Nursery stock, woody					
(Pre-planting in beds)	26	Me Br	(1)	1 lb/100 sq. ft.	
		Vapam	(2)	1 qt/100 sq. ft.	2 wks pre-pl
(Pre-em in beds	27	KOCN	(1)	10-20	
		2,4-DES	(1)	3	
		Mineral spirits	(1)		
(Post-em. for seedlings)	27	Stod. Solv.	(1)	40-60 G	
(Liners)		2,4-DES	(1)	2-4	After clean cult.
(Est. evergreen	28	2,4-DES	(1)	2-4	After clean cult.
		DNBP	(1)	3-12	Directed spray
		CIPC	(1)	6-12	Spray or granular
		2,4-DES + Monuron	(1)	4 + ½	(mixture)
(Est. deciduous)	30	2,4-DES	(1)	2-4	After clean cult.
		DNBP	(1)	3-12	Directed spray
		CIPC	(1)	6-12	Spray or granular

Crops	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Onions	13	CIPC	(1)	2-6 in 20-60 G	Pre-Em.
		KOCN	(1)	1% in 100 G	Seed-At em. or after flag Set-until 6" high
		KOCN	(1)	2% in 100 G	Seed & set more than 6"
Orchards (Poison Ivy)	21	Ammate	(1)	3/4-1/G	With spreader Growing season
		2,4-D + 2,4,5-T	(1)	2-3/100 G	Growing season
		ATA	(1,2)	1-8/100 G	Growing season
(Honeysuckle)	21	2,4-D	(1)	2/100 G	Growing season
(Herbaceous weeds)		DNBP	(1)	3	Growing season
		DNBP(o.s)	(1)	1½-2¼	in 15-20 G oil plus water
		ATA	(1,2)	2-4	Esp. for Canada thistle
		2,4-DES	(1)	2	Pre-em. on new orchards
Ornamenta ls, Herbaceous	24				
(Perennials)	25	2,4-DES	(1)	2-4	After clean cult.
		DNBP	(1)	3-6	Late fall for winter annual weeds
(Annuals)	26	Me Br	(1)	1 lb/100 sq. ft.	Pre-pl.
Parsnips	5	Stod. Solv.	(1)	75-120 G	After true leaf, 1 appl.
Pastures, permanent (Sum. annual weeds)	39	2,4-DA	(1)	½-1	Spr.
		MCP	(1)	½-1	Spr.
(Brambles and woody plants)	40	2,4,5-TE	(1)		Spot treatment
		2,4-DE + 2,4,5-TE	(1)		Spot treatment
(Wild garlic)	40	2,4-DE	(1)	1-2	E. spr. & repeat
(Horsenettle)	40	2,4-DE + 2,4,5-T	(1)	1½-2	
(Perennials)	40	2,4-D	(1)		
Pastures, Semi-permanent	40	2,4-DA	(1)	½-1	Spring
		MCP	(1)	½-1	Spring
		Mowing, fertilization & proper grazing.			
Peas	12	DNBP	(1)	3-6	At planting, soil moist
		DNBP	(1)	1½-3	At em.
		DNBP	(1)	1-2½	3-8 in. tall. Temp. 65°-80°F.

Crops	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Peppers	8	DNBP	(2)	3-9	Pre-setting
		2,4,5-TES	(2)	2-3	1 mo. post-setting
		CDEC	(2)	4-6	Pre-Em & Post-setting
		CIPC Gran.	(2)	2	After 1st cult.
Potatoes, Irish	15	DNBP	(1)	3-6	Pre-Em.
		DNBP (o.s)	(1)	3-5	Pre-Em.
		2,4-DES	(1)	2-4	Pre-Em. & Post Em.
Potatoes, Sweet	14	Alanap-2	(1)		At planting
		Alanap-2	(1)	2-4	Lay-by
		CIPC	(1)	2	Lay-by
Pumpkin	14	Alanap-3	(1)	2-4	Pre-Em.
		DNBP	(1)	2-4	Pre-Em.
Raspberries	18	DNBP	(1)	2-3	Except during suckering & layering
		2,4-DES	(1)	3-4	Before weeds em.
		2,4-D	(1)	to 1	For B.L. weeds
		CIPC	(1)	5-8	Fall or E. spr.
		ATA	(1)	2-6	Fall or spr.
Small Grain, Spring (Not seeded)	38	2,4-DA	(1)	$\frac{1}{4}$-$\frac{1}{2}$	Post stooling, pre-joint
(Seeded with forage)	38	DNBP	(1)	3/4-1$\frac{1}{2}$	When weeds small
		2,4-DA	(1)	$\frac{1}{4}$-$\frac{1}{2}$	Use when weeds and grain form a canopy
		MCP	(1)	$\frac{1}{4}$-$\frac{1}{2}$	For red clover, oats over 6" tall
Small Grain, Winter (Not seeded)	38	2,4-DA	(1)	$\frac{1}{4}$-$\frac{1}{2}$	Spring, post-stooling, pre-joint
		MCP	(1)	$\frac{1}{4}$-$\frac{1}{2}$	Spring, post-stooling, pre-joint
(Seeded to forages)	39	MCP or 2,4-DA	(1)	$\frac{1}{4}$-$\frac{1}{2}$	Early spring
		DNBP	(1)	3/4-1$\frac{1}{2}$	Weeds small, grain less than 6"
(Wild garlic and onion control)	39	2,4-DLVE	(1)	$\frac{1}{2}$-1$\frac{1}{2}$	In March when t over 60°F
		MCP	(1)	$\frac{1}{2}$	Post-stooling, joint

Crop	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Soybeans	37	DNBP	(1)	3-6	Pre-Em. Low rate on sandy soil
Spinach	6	CIPC	(1)	1	Temp. below 50°-60°F.
				2	Warm weather
Squash	14	Alanap-3	(1)	2-4	Pre-Em.
		DNBP	(1)	2-4	Pre-Em.
Strawberries	17	2,4-DES	(1)	2-4	After plants est. Not while runners are rooting.
		2,4-DA	(1)	1-2	Immed. after harvest
		2,4-DA	(1)	½	Small weeds, new plantings
		DNBP	(1)	3	Strictly dormant
		CIPC	(1)	1-2	Chickweed- Oct., Nov., Dec.
Taxus	28	2,4-DES	(1)	2-4	6 yr. old plants
Tomatoes	8	2,4,5-TES	(2)	2-4	Plants established
		Neburon	(2)	2-4	After 1st cult. or lay-by
		CDEC	(2)	6-8	Post setting or lay-by
Turf					
Dandelion & Plantain	31	2,4-D	(1)	¼-1½	Post-Em. Spr. or fall
				¼-½	On Bent grasses
Wild Garlic & Wild Onion	32	2,4-DE	(1)	3/4 -2	Spr. or fall, active growth, Repeat appl.
Chickweed	32	KOCN	(1)	8	E. spr. and late fall. Bent and fescues susceptible
Crabgrass	33	KOCN	(1)	8-16	Post-Em. Bents and fescues susceptible
		DSMA	(1)	4-8	Post-Em. Fescue susceptible
		PMA 10%	(1)	5-10 pts/A	Post-Em.
				2 pts/A	On putting greens
Clover	Pr Yr	2,4,5-T	(1)	½-1½	Spr and fall
Watermelons	14	Alanap-3	(1)	2-6	Pre-Em.
		DNBP	(1)	2-4	Pre-Em.
		Alanap-3	(1,2)	2-4	Post-Em.

Aquatic Weeds

Weeds	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Emergent Rooted					
(Cattail					
Typha latifolia)	43	Dalapon	(1,2)	15-25	Spray to wet
Water chestnut		ATA	(1,2)	5-10	At heading stage
(Trapa natans)	43	2,4-DA	(1)	8	in 50 G water or oil/A. Repeat appl.
Reed Grass	44	Dalapon	(1)	15-30	Active growth
(Phragmites maximus & communis)		ATA	(1)	10-20	300 G+/A. Heading Stage.
Giant Cord Grass	45	Dalapon	(2)	10-30	
(Spartina Spp.)					
Submersed Rooted					
Water Milfoil	47	Na As	(1)	5-10 ppm	
(Myriophyllum spp.)		Dichlone	(2)	2 lb/A ft.	
Pondweeds	47	Na As	(1)	to 7 ppm	
(Potamogeton spp.)		Dichlone	(2)	2 lb/A ft.	
Coontail	48	Na As	(1)	7 ppm	
(Ceratophyllum spp.)					
Water weed	48	Na As	(1)	7 ppm	
(Elodea canadensis)		Dichlone	(2)	2/A ft.	
Algae-General	46	$CuSO_4$	(1)	0.3-1.0 ppm	

See Coordinating Report for Aquatic Weeds not listed here.

Herbaceous Perennial and Biennial Weeds

Weed	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Bedstraw	49	Dalapon	(1)	10	Fall
(Galium mollugo)					
Bermuda Grass	50	Dalapon	(1)	10-15	June, July
(Cynodon dactylon)					Repeated
		TCA	(1)	20-30	with tillage
				75-100	Without tillage
		ATA	(1)	6-8	Active growth
		Poly-borchlorate	(1)	3-4 lbs/100 sq. ft.	Spot treatment
		Conc. Borascu	(1)	8-12 lbs/100 sq. ft.	Spot treatment Fall or spring

Weed	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Canada Thistle (Cirsium arvense)	50	ATA	(1)	4	E. summer
		2,4-D or MCP	(1)	½-1½	Bud stage
		2,4-D + 2,4,5-T	(1)	4	Spring
Chicory (Cichorium intybus)	51	2,4-D	(1)	½-1	Veg. stage
Horse Nettle (Solanum carolinense)	51	2,4-D or 2,4-D + 2,4,5-T	(1)	2-4	E. bloom. Repeat
		ATA	(1)	4	Bud stage
Johnson Grass (Sorghum halepense)	52	TCA	(1)	50-100	Pre-Em. or at Em.
				150-200	Growing season
				1 lb/2 g	6" high-spot tr.
		Dalapon	(1)	30-50	With tillage
				1 lb/4 g	15" high-spot tr.
		Poly-borchlorate	(1)	4 lbs/100 sq. ft	Spot tr.
		Conc. Borascu	(1)	8 lbs/100 sq. ft	Spot tr.
Milkweed (Asclepias syricaca)	52	ATA	(1)	4	E. summer
Nutgrass (Cyperus esculentus)	53	TCA	(1)	50-100	2-6" high with tillage
		DNBP	(1)	3	Less than 6" high Spot tr.
		ATA	(1)	2-4	Active growth, spot treatment
Quack grass (Agropyron repens)	53	TCA	(1)	50-100	Sum. or fall to plowed soil
		Dalapon	(1)	10	To foliage in fall
		ATA	(1)	4	To foliage in spr. Plow 2 wks. later
		Ureabor	(1)	1-2 lb/100 sq. ft.	Spr. or fall, spot tr.
		Poly-borchlorate	(1)	3-4 lb/100 sq. ft.	Fall spot tr.
Wild Onion and Garlic (Allium spp.)	54	2,4-DE or MCP	(1)	1-2	Spr. and fall
Curled Dock (Rumex crispus)	54	2,4-D	(1)	1	Vegetative stage

Weed	Ref. Page	Chemical	Use	Lb/Acre unless Specified	Comments
Wild Carrot (Daucus carota)	55	2,4-D	(1)	½	Seedling stage
		2,4,5-T	(1)	½-3	E. sum. repeat
Yellow Rocket (Barbarea vulgaris)	55	2,4-D	(1)	½	Vegetative stage
				½-1½	Fall
		MCP	(1)	¼-½	Vegetative stage

Public Health Weed Control

Weed	Ref. Page	Chemical	Use	Lb/100 gals unless Specified	Comments
Poison Ivy	64	2,4,5-T	(1)	2-3	Wet foliage when leaves fully expanded
		2,4-D + 2,4,5-T	(1)		Active growth
		Ammate	(1)	75-100	Wet foliage early in growing season.
		ATA	(2)	2-4	Thoroughly wet when leaves fully expanded
Ragweed	64	2,4-D	(1)	½-1½ lb/A	

Soil Sterilization

(All practices listed are in "General Use" category)

Chemical**	Ref. Page	lb/100 sq. ft. Unless Specified	Comments
Boron compounds			
Conc. Borascu	57	6-9	Apply dry. Pre-Em. or
Tronabor	57	7½-12	early Post-Em. Cut and
Gerstley Borate	57	10-14	remove growth before tr.
Sodium Chlorate	57	1½-3	Dry or 200-300 G/A
Atlacide			Dorm. or E. growth
Borate-Chlorate Combinations			
Polybor-chlorate	58	1-4	For annuals-as spray in spr. For perennials-dry or spray dorm.
Chlorax 40	58	4	Dry or spray. Annuals in spr. Perennials-fall or winter.

Chemical**	Ref. Page	lb/100 sq. ft. Unless Specified	Comments
Other Combinations			
Methoxone/Chlorax liquid	58	85 G/A	With equal part water Active growth
Chlorea	58	1-3	Dry or spray. Annuals in spr. Perennials-fall or winter.
Ureabor	58	½-2	Dr. Annuals in spr. Perennials fall.
Sodium Arsenite	58	½-2½	Spray. Moisten soil before tr.
Substituted Ureas			
Monuron	58	20-80/A	Spray. Pre-growth.
Diuron		20-80/A	Spray. Pre-growth.
Erbon	59	30-40 G/A	Foliage drench in spr.

** Refer to Coordinating Report for chemical composition of compounds listed.

Woody Plants

(All practices listed are in "General Use" category)

Type of Plant	Ref. Page	Chemical	lbs.	Gallons in Oil	Gallons in Water	Method
Deciduous (Root sprouting)	60	2,4,5-TLVE	3-5		100	Leaf-stem
		2,4-DLVE + 2,4,5-TLVE	4-6		100	Leaf-stem
		2,4,5-TLVE	12-16	100		Basal
		T or D + T	4-6	10	90	
(Root collar sprouting)	61	2,4,5-TE	12-16	100		Basal
		2,4-DLVE + 2,4,5-TLVE	4-6		100	Leaf-stem
		2,4,5-TLVE	3-5		100	Leaf-stem
		2,4-DE + 2,4,5-TE	14-16	100		Basal
		T or D + T	4-6	10	90	Leaf-stem
		2,4,5-T	12-16	100		Stump
		2,4,5-T	8-12	100		Frill
Coniferous	62	T or D + TLVE	4-6	10-20	80-90	Leaf-stem
		T or D + T	12-16	100		Basal
		T or D + T	4-6	100		Leaf-stem
		Dalapon	15-20		100	Leaf-stem

Table of Abbreviations Used in Summary

Chemicals

Alanap-2	Amine salt of N- naphthyl phthalamic acid
Alanap-3	Sodium salt of N- 1 naphthyl phthalamic acid
Ammate	Ammonium sulfamate
ATA	Amino triazole
CDEC	2-chloroallyl diethyldithiocarbamate
CIPC	Isopropyl-N-(3-chloro-phenyl) carbamate
$CuSo_4$	Copper sulfate
Dalapon	Sodium salt of 2,2-dichloropropionic acid
Dichlone	2,3-dichloro-1,4-naphthoquinone
Diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea
DNBP	Dinitro-o-secondary butyl phenol, water soluble
DNBP (o.s.)	Dinitro-o-secondary butyl phenol, oil soluble
DSMA	Disodium methyl arsonate
KOCN	Potassium cyanate
MCP	2,methyl 4 chlorophenoxyacetic acid
Mc Br	Methyl bromide
Monuron	3-(p-chlorophenyl)-1,1-dimethylurea
Na Cl	Sodium Chloride
Na As	Sodium arsenite
Neburon	3-(3,4-dichlorophenyl)-1-methyl-1-n-butylurea
PCP	Pentachlorophenol
PMA	Phenyl mercuric acetate
Stod. Solv.	Stoddard solvent oil
TCA	Trichloroacetic acid (salts)
2,4-DA	Amine salts of 2,4-D
2,4-DE	Ester forms of 2,4-D
2,4-DES	Sodium 2,4-dichlorophenoxyethyl sulfate
2,4-DLVE	Low volatile ester forms of 2,4-D
2,4,5-TA	Amine salts of 2,4,5-T
2,4,5-TE	Ester forms of 2,4,5-T
2,4,5-TES	Sodium, 2,4,5-trichlorophenoxyethyl sulfate
2,4,5-TLVE	Low volatile ester forms of 2,4,5-T

Other Abbreviations

A	Acre
Appl.	Application
B. L.	Broad-leaved
Cult.	Cultivation
Directed	Directed application to base of crop
Dorm.	Dormant
E.	Early
Em.	Emergence
Est.	Established
Ft.	Foot or feet
G.	Gallons
Gr.	Granular
Post-Em.	Post-emergence

Other Abbreviations (continued)

p.p.m.	Parts per million
Pr. Yr.	Previous year's report
Pre-Em.	Pre-emergence
Pre-Pl.	Pre-planting
Spr.	Spring
Sum.	Summer
Tr.	Treatment
Var.	Variety
Wk.	Week

REGISTRATION LIST

NORTHEASTERN WEED CONTROL CONFERENCE

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Ashland, Kentucky

Williams, Myron
Barker Chemical Corp.
Alton, New York

Wilson, C. E. Jr.
Du Pont Co.
RD Box 96
Allendale, New Jersey

Wiltse, Mark G.
The Dow Chemical Co.
916 Shoreham Bldg.
Washington, D.C.

Winton, R. P.
Norfolk & Western Ry. Co.
2110 Carolina Ave.
Roanoke, Virginia

Wise, E. Spencer
John H. Dulany & Son Inc.
P.O. Box 8
Exmore, Virginia

Wisniewski, Adam J.
University of Rhode Island
Kingston, Rhode Island

Witman, E. D.
Columbia-Southern Chem. Corp.
One Gateway Center
Pittsburgh, Pennsylvania

Wolf, Dale E.
Du Pont Co.
308 E. Lancaster Ave.
Wynnewood, Pennsylvania

Woodbury, E. N.
Hercules Powder Co.
Wilmington, Delaware

Woodson, Nelson B.
A. P. Woodson Co.
1313 H. St. N.W.
Washington 5, D.C.

Woofter, Darrell
Chemagro Corp.
1761 N. Drudid Circle
Decator, Georgia

Wormley, George W.
Farm Journal
Washington Square
Philadelphia 5, Pennsylvania

Wyman, Oscar L.
Soule Glass & Paint Co.
89 Hildreth St.
Bangor, Maine

Young, Dale W.
Rohm & Haas Co.
Washington Square
Philadelphia 5, Pennsylvania

Young, W. E. Jr.
John Bean Div. F M & C Corp
32 Mountain
Summit, New Jersey

Zaharchuk, Alexander
G.L.F.
California Ave. Ext.
Middletown, New York

Zedler, R. J.
Carbide & Carbon Chem. Co.
30 E. 42nd St.
New York 17, New York

Zieschang, G. H.
N.J. Bell Tel. Co.
540 Broad St.
Newark, New Jersey

Zeigler, J. C.
A T & T Co.
195 Broadway
New York, New York

Zemlansky, John
N.J. State Dept. of Health
2608 Nottingham Way
Trenton 9, New Jersey

Zimmerman, P. W.
Boyce Thompson Inst.
Yonkers 3, New York

Zuzek, Richard
General Chemical Div.
12 S. 12th St.
Philadelphia, Pennsylvania