OPPORTUNITIES IN WEED WORK

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I appreciate the invitation of your executive committee to participate in this seventh annual Northeastern Weed Control Conference. Shortly after accepting the invitation, however, I ran across the Italian proverb which says "Think much, speak little, and write less." The truthfulness of the statement created considerable doubt as to the desirability of my preparing this paper. In my despair I could think of many reasons why I should not proceed with my assignment and few that insisted that I should. Then my wife, being an English major, reminded me that Byron once said, "A drop of ink may make a million think." With due apologies to the great Byron let us humbly think together of some of the opportunities in our field.

All of us have our "off days" when the experiment is a failure, the weather is uncooperative or the sales prospect switches his interest to some other product. At the close of that day we may truthfully ask ourselves where are the opportunities in this field. Another day brings the needed rain, the welcome sun, a performance of the new herbicide even beyond our stretch of the imagination and a sale where heretofore we had thought it to be impossible. Once again we are capable of living and enjoying life as life is intended to be enjoyed. With this concept let us examine our opportunities.

Chemical weed control as we know it today is relatively new. Ten years ago 2,4-D was unknown to us as a herbicide. Today we are using between 25 and 30 million pounds annually. Increases in the use of other herbicides have been less fantastic but spectacular nevertheless. Last year your Conference Research Coordinating Committee reported general agreement for at least certain aspects of chemical weed control in small grains, turf, pastures, corn, tree nurseries, brambles, tree fruits, blueberries, strawberries, potatoes, cranberries, aquatics, woody plants and vegetables including asparagus, beans, beets, carrots, lettuce, onions, peas, spinach, and vine crops. They also listed general agreement for the control of quackgrass and nutgrass and recognized seven broad steps for the place of herbicides in a public health program. This 21 page report is a real tribute to this Conference and no doubt the one that you will develop next Friday will be even more complete. But that is not enough.

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There are two reasons why I make this statement. In the first place we are not fully utilizing our know how and in the second place we have far too many gaps in our sections entitled "problems needing further study." Before commenting further we might ask ourselves why are we in weed control work.

Most of the text book reasons can be summarized in one statement--the need for more economical crop production. I can think of no cropland weed that cannot be killed with the crudest tools that our forefathers possessed a hundred years ago. However, the demands of our civilization the world over are far too great for us to accept anything less than the full pail of weed knowledge that is available. The slow, tedious, and back breaking method of cotton chopping and hoeing to remove seedling crabgrass that I knew as an Alabama farm boy is now obsolete.

The consistent way in which 2,4-D can be used for the control of weeds in the small grains is one of the most beautiful stories we have in the herbicidal world. Yet in 1949 we sprayed only 18,500,000 acres. That is not enough. What happened to the 127,500,000 other acres? Certainly many of these acres needed spraying. The use of 2,4-D for the post emergence control of weeds in corn is now an accepted practice yet our best estimate is that no more than 5,000,000 of our 85,000,000 acres are being treated.

A farmer friend of mine told me this fall that he saved $50 per acre on the cost of producing his onions last year. This saving applied to our 134,000 acre onion crop in the United States would mean an annual saving of more than six million dollars in the cost of producing one of our many so-called minor crops.

The tremendous strides that have been made in the control of vegetation rights-of-ways by herbicides is an accomplishment that can be pointed to with pride. Yet the unsprayed mileage is many, many times longer--and rougher too in many areas!

Now let us return to our "problems needing more work." I am confident that these problems will be reduced when your Coordinating Committee reports Friday. All of us are realistic enough however not to expect that all problems will have been solved since we convened one year ago. Two years ago I attempted to outline my conception of the weed research man of the future. I shall not attempt to review those comments here except to say that I am more convinced now than then that the cream has been "skimmed off" in many instances and that from now on to the end of the row the hoe hand that is trained in fundamentals will be the one most

likely to succeed. Charles F. Kettering once said, "Keep on plugging, and the chances are you will stumble on something, perhaps when you are least expecting it. I have never heard of anyone stumbling on anything while sitting down." I believe he was talking to us. Dr. P. V. Cardon, until one year ago, the Administrator of the Agricultural Research Administration, U. S. Dept. of Agriculture has developed quite a philosophy of research over the years, as many of you know. If I leave no other thought with you I would like for you to remember what he calls his check list for researchers. The list is as follows:

1. An insatiable hunger for clear understanding.
2. An incessant curiosity about things not understood.
3. The gift for patient, close observation.
4. An unfettered imagination.
5. Initiative and an impelling urge to exercise it.
6. Devotion to orderly procedures.
7. Objective interest in results.
8. Integrity in the interpretation of results.
9. Clarity in reporting results.
10. Basic Training conducive to proficiency.
11. Tolerance of conflicting viewpoints.
12. Willingness to cooperate with others.

I am sure I need not comment further on these basic truths except to urge you to use them in your search for weed knowledge. These truths will enable us to produce more food, feed and fiber which the world so greatly needs and by an easier way than was known a generation ago. Furthermore they will enable us as a population to make more money--a development that is acceptable to most individuals. The opportunities are here--in this Northeastern Region and throughout the United States--yes throughout the world.

This opportunity can be illustrated by an example of a crop not grown in your region but one familiar to many of you. Experiments have shown that we can conservatively save $8 per acre in the annual cost of producing cotton. A herbicide that could be successfully applied to our 20,000,000 acres of cotton could effectuate an annual saving of $160,000,000. Such a sum could improve the standard of living of many farmers and still permit a reasonable percentage to be plowed back into public and private research to provide more improvements. The only sad part of such a story is that we do not have the best combinations of herbicides and cultural practices for all conditions yet, and I would emphasize the yet because I believe that a satisfactory solution is coming.

We are not fighting a back yard brush fire with a five gallon knapsack sprayer. We are confronted with an honest to goodness forest fire with a terrifying heat and a choking smoke. To preserve the forest will require more than a few amateur firefighters on the rear of an obsolete truck. It will require the combined efforts of all. The teacher, the researcher and the public relations expert must all do his part in making this program effective.

I mention the teacher. You are accustomed to hearing references to the researcher and those charged with the development work but what of the teacher. Have any of you tried to employ any really outstanding individuals within the past few months? I am certain that under the circumstances you have learned that as an enterprise we have not sold ourselves to the college faculties and students to the extent of attracting the number and quality of students necessary to do the job that we are facing. Students have opportunities in weed control. I hope those of you that are privileged to instruct them will not deny them this future.

I hope you have not gotten the impression that I am advocating a ballyhooing program that is not built on sound principles. Far from it. Our weed research must be increased but not at the expense of quality or depth. Our selling program, whether by representatives of public or private institutions, must be enlarged but this must be accomplished by informing the public of facts not by high pressuring them into buying something that has not been thoroughly evaluated. In my opinion to know that a given herbicide usually kills weeds is not enough. Until we know how it kills plants or why it occasionally fails to kill them we have not done the job. We owe it to our constituency to give them better than that. This may mean delaying the marketing of a particular product. It must mean that we know the basic characteristics of a new compound and the effects on weeds, crops, the soil and man before such a material is placed on the sales shelf or so beautifully illustrated in the trade journals.

Yes, we have a wonderful opportunity of working in a field in which so many of the tools are new and in which so much of the public is ready to buy. Whether or not that opportunity is perpetuated is dependent upon our vision, sweat and integrity. I thank you for this opportunity of appearing on your program.

CONTROL OF AQUATIC WEEDS

Robert B. Balcom, Bureau of Reclamation

Mr. Chairman, members and guests of the Northeastern Weed Control Conference. It is indeed a pleasure to attend your conference. I have had the opportunity of attending 10 of the 13 Western Weed Control Conferences and one North Central Conference but this is the first time I have had the privilege of meeting with you.

The topic I have been asked to discuss concerns the control of aquatic weeds. The experience of the Bureau of Reclamation in aquatic weed control has been confined to irrigation systems in the West, so our discussion will cover principally the problems and work done in that part of the country. However, many of the results obtained in the West should apply favorable to the Northeast as well.

While irrigation canals are not needed in the East, some of our findings should be applicable to drainage systems and other waterways which both East and West have in common. It should be possible also to adapt to lakes and ponds some of the methods used for controlling waterweeds in the flowing water of irrigation channels.

To give you a clearer picture of problems waterweeds cause in irrigation systems and the methods used to solve these problems, I would like to illustrate my remarks with some colored slides.

(The following is a summary of the remarks made in connection with the slides but written without reference to the slides)

Water has a special value in the arid and semi-arid West--the value of scarcity and need. Every precaution must be taken to keep the irrigation water flowing and to prevent waste. The people of the United States have erected huge dams which control entire rivers and they have built thousands of miles of canals to place water on western soil. Twenty -two million acres of productive land are watered artificially through private and public irrigation projects. Almost two billion dollars have been spent on Bureau of Reclamation projects designed primarily to irrigate land. The family-sized farms thus created repay these efforts by producing five hundred million dollars worth of specialized crops each year. However, at the very point where water should be ready to do its important work, weeds create numerous operation problems and maintenance costs. There are two kinds of weed problems on irrigation systems. One problem relates to weeds on the banks and rights of way. The other--the problem we will discuss--concerns weeds growing in the water. These plants, often called moss, reduce the capacity of canals, slow up the current and cause silt to be deposited. They sometimes make it difficult to deliver sufficient irrigation water. Knowing the kinds of weeds with which you must deal will help in choosing the best control methods. The simplest forms of waterweeds are the Algae which form a scum on the surface or are attached to canal linings or objects in the water. They reproduce by spores. Of the seed producing submersed weeds, the sago pondweed (Potamogeton pectinatus) is perhaps the most widespread. However, several others including Richardsons pondweed (P. Richardsonii) and American pondweed (P. Americanus),

horned pondweed (Zanichellia palustris), coontail (Ceratophyllum demersum), anacharis (Anacharis canadensis), and water buttercup (Ranuncules spp.) are among those which cause considerable trouble.

Emergent waterweeds--those growing up through the water--are particularly troublesome in drains. Of these, Cattails (Typha spp.) are the most widespread and troublesome but tules or bulrushes (Scirpus spp.) also must be controlled on several irrigation projects. Cattails and tules are often confused with each other but cattails are easily identified by the seed heads. Watercress (Nasturium officinale) is another emergent offender commonly found in drains. Parrot feather (Myriophyllum proserpinacoides) has gained a foothold in drains in the Southwest as has water primrose (Jussiaea diffusa).

Both mechanical and chemical means are used to control waterweeds. If the weeds have a big head start, we may have to use heavy equipment like draglines. The Ruth dredger is also effective. This is an endless chain arrangement with buckets which cut out the weeds and shape the bank at the same time. The new Peerless dredger has been adapted from the Ruth and is considered more flexible in its operation. Both the Ruth and the Peerless can be used for maintaining drains as well as distribution canals.

One of the most common methods of pulling submersed weeds loose from the bottom of canals or drains is known as chaining. This is accomplished by dragging through the channel a long loop of chain with the ends fastened to tractors on each bank. In many instances, heavy ship anchor chains weighing as much as 30 pounds per foot are used. On some projects, sharp nosed plates connected by swivels are used in place of a chain. Chaining is most effective when the plants begin to mature, as they become brittle and can be broken off more easily at that stage of growth. When the weeds must be eliminated in earlier stages, sections of discs may be pulled ahead of the chain to help cut the plants loose. Small ditches with a road on only one side may be chained with a side arm boom attached to a tractor. Another handy implement for cutting submersed waterweeds in small channels is a cart arrangement with wheels which guide the cutting or scraping bars made from iron rails. Water-propelled frames with adjustable scraping blades may be used to remove silt and waterweeds from concrete lined canals. The scraper is pushed by the water or pulled by a truck.

When waterweeds have been dislodged, they must be removed to prevent clogging of structures. They can be diverted into drains from flumes or steered into wasteways by floating log booms. If wasteways are not handy, the floating weeds are collected at temporary pipe racks and forked out by hand. In large channels where the racks are collecting greater quantities of weeds, draglines may be employed to transfer the weeds to the banks. Cane forks with extra tines added are more efficient in removing the weeds than the regular dragline bucket. Other types of mechanical forks have been built for this purpose in project shops.

One of the most economical methods for controlling submersed waterweeds in irrigation channels is to shut off the water in a whole lateral system for a few days and allow the weeds to dry. This "dry out" method requires advance planning and cooperation from the farmers but the savings are worth the extra trouble. When the plants have dried, the water can again be turned into the system. If the ditch bottom is uneven, it may be necessary to make a groove

lengthwise of the channel to obtain complete drainage so the sun and air can dry the weeds quickly. The groover is a "V" blade with a platform on which two workmen ride. It is pulled by a truck or tractor and is guided by one of the men by means of a rolling coulter.

While mechanical methods still are necessary under some conditions, the advancement made in chemical weed control has opened up a whole new field in the control of aquatic weeds as it has for land weeds. Several herbicides have been developed and each has its advantages and methods of applying. One of the first to be found effective for controlling waterweeds was copper sulphate or bluestone. It is an economical method for controlling Algae if the water is not too hard.

In small ditches, copper sulfate is placed in sacks and suspended in the water. For large canals, ponds and lakes, sacks of the chemical are pulled through the water by boats in a definite crisscross pattern to assure complete coverage. The concentration used depends on the kinds of Algae to be treated and the kinds of fish present. In some waters, a new chemical formulation--Rosin Amine D Acetate, or Rada for short--has given good results in Algae control. It is mixed with water and sprayed into the canal.

While copper sulfate and Rada will kill Algae, they are not so effective in controlling seed-producing plants like the pondweeds. Recent research by the Bureau of Reclamation and the Bureau of Plant Industry, Soils and Agricultural Engineering has disclosed that aromatic solvents derived from coal tar and petroleum can be employed to control these higher type plants. To be certain that the aromatic solvents would not be harmful to crop plants, it was introduced directly into an irrigation headditch at a Bureau of Plant Industry field station. The treated water was then used for irrigating various crops and it was found that they were not injured by solvent concentrationsnecessary for controlling waterweeds.

Aromatic solvents are sprayed under the water. Any spraying apparatus developing 50 or more pounds pressure per square inch will do the job. Oil resistant synthetic rubber hose must be used as the solvents quickly deteriorate natural rubber. The solvents mix better with the water if they are applied at structures known as drops, which are constructed to carry the water from a higher to a lower canal level. The chemical formulation is applied at the rate of 5 to 8 gallons for each cubic foot per second of flow which gives concentrations of 370 to 592 parts per million when applied over a period of 30 minutes. Less chemical is required if the flow can be reduced so just sufficient water remains to cover the weeds. In large channels, a manifold of nozzles is needed to assure proper distribution. If a drop is not available, the solvent can be mixed by making the water turbulent with compressed air forced through a perforated pipe. The pipe is placed in the water a few feet downstream from the nozzle boom.

Where chemical control of submersed waterweeds can be used, it has decided advantages over mechanical methods. The treated weeds usually turn brown within a few hours, settle to the bottom and slowly disintegrate. No plants are set loose, as with chaining, to start new infestations or clog structures.

A chlorinated hydrocarbon product known as Benoclor was used for controlling submersed waterweeds before the aromatic solvents were tested and found to be effective. It is understood that Benoclor still is used widely in the East for controlling aquatic vegetation in lakes and ponds. It is applied like the solvents, but being heavier than water settles down over the beds of weeds and is especially adapted to quiescent waters. Both aromatic solvents and Benoclor are toxic to fish. It should be mentioned also that in our experience these formulations do not give permanent control of waterweeds. The roots remain alive to put out new growth which must be retreated. In areas where the growing season is limited to a few months, one treatment during this period usually is sufficient to keep the weeds under control. In the South, several treatments may be required each year.

In early tests on cattails, it was found that 2,4-D was effective but required 3 or 4 applications each year for two years to get a complete kill. Tests made later in the Imperial Valley, California, showed that the addition of TCA to the sodium salt of 2,4-D increased the percentage of kill. The formulation now used in that area is one pound of sodium 2,4-D and 10 pounds of TCA plus an ionic emulsifier in 100 gallons of water. This is applied at the rate of 300 gallons per acre of plants at the early heading stage.

In research conducted by Mr. F. L. Timmons of the Bureau of Plant Industry at his Logan, Utah, station his best results in the early growth stages (June 7) was obtained with 4 pounds of 2,4-D as a low volatile ester plus 10 gallons of diesel oil in 320 gallons of water applied to an acre of plants. A second treatment on the regrowth on August 30 resulted in a 95 percent kill. It has been the experience of most investigators that high volume applications give the best results. On the Rio Grande project in Texas, good results have been obtained on cattails with contact oils fortified with 2,4-D or with pentachlorophenol.

Airplanes are often employed for spraying areas hard to reach with ground equipment but for economical applications, low volumes must be used. In tests made this past summer by the Fish and Wildlife Service, it was observed that when a product known as VL-600 was added to their low volume airplane mixes, nearly 100 percent kill was obtained with one application. The formulation used was one of 2,4-D isopropyl ester, 3 gallons of water and one quart of VL-600 per acre. We have been informed that VL-600 is manufactured by the B. F. Goodrich Company and was formerly called Geon Latex. It is believed that VL-600 might well be considered in other weed control work where 2,4-D is used. Indications have been noted also that this product reduces the volatility of 2,4-D esters.

Many types of spraying equipment are used for applying herbicides. Some are commercially built and others are constructed in project shops to suit local conditions. Where ditchbank roads are available and the channel is not too wide, the swinging boom type, adapted from weed burners, is often used for spraying cattails and other emergent waterweeds as well as ditchbank weeds. This is a counterbalanced 30 foot pipe boom with a manifold of nozzles at the end. The boom is mounted on a truck and can be swung in a complete circle and raised or lowered to the desired height above the plants being treated.

Where ditchbank roads are not available and for large canals, this same type of boom may be mounted on a wartime vehicle known as a Duck which can be operated in the water like a boat or driven on land for spraying from the top of the bank.

Before a special study was made of weed problems on irrigation systems by the Bureau of Reclamation, many expensive hand labor methods were used which gave only temporary control. The results of the study showed a definite need for methods which would be more economical and give more permanent results.

While all of our problems have not been solved, much progress has been made in cooperation with the Weed Control Investigations Division of the Bureau of Plant Industry whose staff has conducted the principal research work. This cooperative program is continuing in five weed research stations in the West, under the Direction of Dr. Roy L. Lovvorn and Dr. Warren C. Shaw whom many of you know. In the Denver weed laboratory, a Plant Physiologist of the Bureau of Plant Industry is working closely with our chemists and other scientists to develop more permanent and economical methods of solving weed problems. One interesting investigation now under way there concerns the use of radio active materials to trace the movement and concentration of herbicides in cattails and submersed waterweeds. Extensive root reserve studies also are being made on cattails.

We are convinced that even greater weed control progress will be made in the future through the concentrated and coordinated efforts of Federal agencies, State Departments of Agriculture, State College Experiment Stations, and Chemical Companies, all being backed and aided by such organizations as the Northeastern Weed Control Conference.

Progress Report On The Crop Toxicity Period Of CMU In a Sandy Loam Soil

by

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Introduction

This progress report is intended to demonstrate a method of studying such problems under field climatic and drainage conditions.

Experimental Procedure

Drainage tile 30 inches long and 15 inches in diameter up-ended and sunk in the soil so that the upper edge was approximately 3 to 4 inches above the surrounding soil were filled with a uniform soil mixture. This was done by screening and thoroughly mixing sufficient sandy loam soil to fill all of the tiles. The soil was packed as it was filled into each tile with the exception of the top six inches which was allowed to lay loose. The various rates of CMU were then added to each tile on an area basis suspending the weighed amount in a liter of water in each case with careful rinsing of the container to insure complete transfer of weighed amount. The soil was then allowed to dry for one week and was then thoroughly mixed to a depth of 5 inches to distribute the chemical uniformly in this layer of soil in all tiles. Twelve treatment levels of 10 replications each were established. Five replicates of each treatment level were irrigated at weekly intervals with an inch of water. The remaining five replicates received only rainfall.

Approximately one month after treatment, 10 Top Crop snap bean seed, 10 Aristogold sweet corn seed, 25 Vates Dwarf Blue Scotch kale seed and 25 Old Dominion Blight Resistant spinach seed were planted in each tile. Emergence stand counts were compared with final stand counts made in approximately three weeks. Surviving plants were weighed and measured at the time of final stand count. This method of planting and harvesting was repeated at monthly intervals. Soil was thoroughly mixed to a depth of five inches before each planting to simulate deep field disking or shallow plowing.

Thermographic records of air temperature and rainfall records are being maintained on a continuous basis for the duration of the experiment.

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Treatment date for treatments 1 through 7 was June 6, 1952, and for treatments 8 through 12 was June 9, 1952. Planting dates were July 11, August 12 and September 11, 1952.

Discussion of Results

The experimental record for the first three month period is presented here in Tables 1 through III which follow. The results on plant weight and stand have not been analyzed and are presented as averages only due to the lack of time to complete the analysis. Certain trends are, however, apparent from these data. Sweet corn appears to be less tolerant of CMU than snap beans. Kale is less tolerant than spinach. Results in general indicate a gradual diminution in toxicity to the crops with the passage of time during the experimental period. The rates of treatment involved and the 5-inch depth to which these were incorporated into the soil offer many possibilities for extrapolation of results. Thus, a rate of five pounds per acre worked into a depth of five inches represents a rate of one pound per acre per inch of soil depth. Should this five pound rate prove effective in a general way in weed control, treatment for control of weeds germinating in the top half-inch of soil would require one-half pound per acre. Treatment for control of weeds such as smart weed, morning glory, and cockle burr which may come from a depth of three inches might require three pounds per acre. Deep treatments for nutgrass, Johnson grass, and wire grass would be treated on a corresponding basis according to depth. This five pound rate is conjectural as yet.

Results on growth in Table II show a limiting effect due to lack of moisture by comparison of irrigated and non-irrigated plots. Table III shows that rainfall during the early part of the period was slight and that high temperatures prevailed.

Table 1. Effect on Average Stand of Sweet Corn, Snap Beans, Kale and Spinach of the Application of Various Amounts of CMU to Soil 1, 2 and 3 Months Prior to Planting.

Treat. No.	Lbs. CMU Per Acre	Sweet Corn			Snap Beans			Kale			Spinach		
		1 Mo.	2 Mo.	3 Mo.	1 Mo.	2 Mo.	3 Mo.	1 Mo.	2 Mo.	3 Mo.	1 Mo.	2 Mo.	3 Mo.
1	0	8.0	8.8	8.5	5.8	7.8	7.0		10.0	11.8		6.8	8.2
1+W *	0	7.6	9.6	9.6	6.2	8.0	7.6		14.4	10.2		5.8	7.0
2	0.5	8.2	8.6	8.4	5.8	7.8	7.4		11.4	11.4		7.4	5.4
2+W	0.5	9.0	9.8	9.6	6.4	8.4	8.6		10.0	9.2		4.2	7.2
3	1.0	6.6	9.6	8.6	4.0	8.4	7.0		12.2	8.8		6.8	9.6
3+W	1.0	8.4	9.8	8.8	7.6	7.8	9.0		12.6	7.8		6.8	12.6
4	2.0	7.8	9.4	8.8	5.2	7.0	6.4		7.0	13.0		4.6	12.6
4+W	2.0	8.4	9.4	8.6	7.2	8.4	6.6		10.2	9.0		4.8	6.4
5	3.0	4.4	9.6	9.4	4.0	8.4	8.8		4.4	6.2		4.4	11.0
5+W	3.0	7.6	8.4	9.4	6.2	7.6	8.8		5.2	6.8		2.8	7.4
6	4.0	1.8	8.4	8.0	4.6	8.0	7.6		1.2	4.8		0.6	12.6
6+W	4.0	7.0	9.6	9.4	5.4	8.2	7.2		3.0	8.4		1.4	4.4
7	5.0	3.4	9.0	9.0	5.0	7.0	7.8			4.2		1.8	13.4
7+W	5.0	3.4	9.0	9.6	3.6	7.8	7.2		0.6	6.4		1.2	12.4
8	10.0	0.4	2.6	8.2	1.6	2.2	6.2						6.2
8+W	10.0	0.2	5.4	8.8	0.4	4.2	4.4			0.6			5.2
9	15.0		0.8	4.8	1.4	0.6	1.8						2.4
9+W	15.0	0.4	0.8	5.6		0.6	3.4						1.2
10	20.0			1.2	0.2		1.2						
10+W	20.0			3.2	0.2	0.2							0.8
11	25.0				0.6								
11+W	25.0			1.2			0.4						
12	50.0												
12+W	50.0												

* "W" indicates irrigation series receiving one inch of water per week in addition to rainfall.

Table II. Effect on Average Weight Per Plant of Sweet Corn, Snap Beans, Kale and Spinach of the Application of Various Amounts of CMU to Soil 1, 2 and 3 Months Prior to Planting.

Treat. No.	Lbs. CMU Per Acre	Sweet Corn			Snap Beans			Kale			Spinach		
		1 Mo.	2 Mo.	3 Mo.	1 Mo.	2 Mo.	3 Mo.	1 Mo.	2 Mo.	3 Mo.	1 Mo.	2 Mo.	3 Mo.
1	0	26.5	19.1	4.7	4.3	14.1	7.6		0.79	11.8		0.48	0.50
1+W *		33.9	17.7	5.8	6.4	12.0	6.8		0.69	10.2		0.40	0.89
2	0.5	26.9	21.6	4.8	4.4	10.3	8.8		1.6	11.4		0.64	0.26
2+W		41.5	17.6	6.2	5.6	7.9	8.8		0.94	9.2		0.68	0.68
3	1.0	20.1	17.3	3.9	2.6	11.2	6.9		0.54	8.8		0.84	0.86
3+W		24.9	17.9	6.4	7.3	11.3	8.3		0.55	7.8		0.56	1.17
4	2.0	22.8	15.4	4.5	5.0	10.2	7.9		0.23	13.0		0.39	0.45
4+W		28.4	18.1	6.2	7.2	12.3	9.2		0.94	9.0		0.68	1.36
5	3.0	19.0	16.2	5.7	3.3	11.5	9.0		0.08	6.2		0.32	0.56
5+W		17.6	17.6	6.4	6.7	10.4	9.1		0.11	6.8		0.49	0.69
6	4.0	2.8	7.3	5.5	3.1	9.0	9.0		0.06	0.04		0.23	0.34
6+W		8.4	12.5	7.1	5.1	12.9	10.9		0.12	0.10		0.03	0.56
7	5.0	6.8	8.5	5.7	4.0	7.0	8.2			0.04		0.01	0.31
7+W		5.5	5.7	4.2	5.2	8.1	6.3		0.01	0.06		0.04	0.54
8	10.0	1.3	0.6	1.9	2.6	0.6	3.9						0.08
8+W		0.2	0.9	2.5	0.6	1.1	2.9						0.17
9	15.0		0.2	1.5	1.5	0.2	1.0						0.06
9+W		0.4	0.6	1.9		0.5	0.8						0.13
10	20.0			0.6	0.6		1.4						
10+W				0.3	0.6	0.2							
11	25.0				0.6								
11+W		0.1											0.02
12	50.0												
12+W													

* "W" indicates irrigation series receiving one inch of water per week in addition to rainfall.

Table III. Climatic Record During Experimental Period. Temperature Recorded in Degree-Hours Above 0°F. Rainfall Recorded in Inches.

Date Week Ending	Degree-Hours Per Week Above 0°F.	Cumulative Degree-Hours to Date	Rainfall Inches Per Week	Cumulative Rainfall to Date
June 9	12565	—	0	—
16	12712	25277	0	0
23	13082	38359	0.46	0.46
30	13753	52112	0.91	1.37
July 7	12582	64694	0.26	1.63
14	12605	77299	0.71	2.34
21	13853	91152	0	2.34
28	14183	105335	0.02	2.36
Aug. 4	13228	118563	3.21	5.57
11	13066	131629	2.83	8.40
18	13290	144919	0.58	8.98
25	12332	157251	1.06	10.04
Sept. 1	12659	169910	0.47	10.51
8	12477	182387	1.04	11.55
15	12172	194559	0	11.55
22	12182	206741	0	11.55
29	10704	217445	1.08	12.63
Oct. 6	10901	228346	0.86	13.49
13	9947	238293	1.61	15.10

Treatment Date: Treats. 1-7 (6/6/52). Treats. 8-12 (6/9/52).

Planting Dates: 7/11/52, 8/12/52, 9/11/52.

HERBICIDAL COMPARISONS BETWEEN SODIUM ARSENITE AND SEVERAL EXPERIMENTAL ARSENICAL COMPOUNDS[1]

Robert E. Frans and Richard J. Aldrich[2]

The phytotoxicity of sodium arsenite is a well established fact. It is one of the most effective of the contact herbicides. Since arsenic may be compounded in many different chemical combinations it was thought desirable to test some of these compounds for phytotoxicity.

This paper presents results of two years' studies with several experimental arsenical compounds. The various materials were first compared with sodium arsenite in field tests. Monoethanolamine arsenite was then selected for a more thorough field comparison with sodium arsenite. The relative soil toxicity of monoethanolamine arsenite and sodium arsenite was studied in the laboratory.

Field Comparison of Experiment Arsenicals

Methods

Seven compounds were compared with sodium arsenite in 1951 on annual broadleaf and grass weed seedlings. The materials were applied in 10 gallons of solution per acre at rates of 1, 2 and 4 pounds of arsenic per acre. In 1952, 9 compounds were compared with sodium arsenite on a uniform stand of rape and millet. These materials were applied in 20 gallons of solution per acre at rates of 2, 4 and 8 pounds of arsenic per acre. Plots in both years were 5 by 10 feet in size and were replicated three times in a randomized block design. Visual estimates of the per cent kill were made of each plot between three and five days after application. These percentage figures were transformed to degrees to allow a more precise analysis of variance (1).

Results

The 1951 data as given in Table 1, show that three of the experimental compounds were as effective as sodium arsenite. With one exception all the compounds tested in 1952 were at least as effective as sodium arsenite. There was no significant difference between the 2 and 4 pound rate in 1951 although both were significantly better than the 1 pound rate. In 1952 differences between rates were highly significant with the effectiveness increasing in direct proportion to the concentration of arsenic.

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

[2]Research Assistant in Farm Crops, NJAES and Agronomist, Division of Weed Investigations, BPIS&AE, USDA, respectively. Acknowledgment is made to the American Smelting and Refining Company for their support of this project.

Table 1. Effectiveness of arsenical compounds applied to test plants in the field.

Chemical	Per cent kill. Av. 3 rates	Transformed to degrees[1]
1951 - Applied on annual broadleaf and grass weed seedlings		
Sodium arsenite (comparative standard)	77	64.2
Diethanolamine arsenite	76	62.5
Sodium metasilicate arsenite	75	60.2
Triethanolamine arsenite	74	60.1
Isopropylamine arsenite	58	50.0
Monoethanolamine arsenite	58	49.3
Ammonium ethanolamine arsenite	56	48.8
Disodium methyl arsonate	55	48.2
L.S.D. .05		6.5
.01		8.4
1952 - Applied on uniform stand of rape and millet		
Sodium arsenite in Varsol (emulsion)	59	51.0
Oil soluble As in Varsol	59	50.6
Arsenic acid	52	46.3
Sodium arsenite - K Cl	51	45.2
Tetramethylammonium arsenite	49	44.3
Sodium arsenite (comparative standard)	42	40.3
Tri-isopropanolamine arsenite	41	39.6
Allylamine arsenite	40	39.0
3,3-Iminobispropanolamine arsenite	33	35.2
Methyl arsonic acid - sulfuric acid - sodium sulfate	22	27.7
L.S.D. .05		5.3
.01		6.8

[1]Percentages transformed to degrees according to Fisher's formual: $P = \sin^2\phi$ (3).

Field Comparison of Monoethanolamine Arsenite and Sodium Arsenite

Date from the preceding experiments indicated that compounds known as arsenite showed little variation in results obtained. Monoethanolamine arsenite, being the most economically feasible, was selected as being representative of this group of compounds to be studied in more detail in comparison with sodium arsenite.

Methods

In the fall of 1952 monoethanolamine arsenite and sodium arsenite were applied in four formulations at rates of 2, 4 and 8 pounds of arsenic per acre. Applications were made on a uniform stand of fall planted rape and millet. Solutions were applied in a volume of 40 gallons per acre to plots 5 by 10 feet in size replicated three times in a randomized block design. Visual estimates of per cent kill were made on each plot 9 days after application. These estimates were transformed to degrees for statistical analysis.

Results

As an overall average of all rates and formulations there was no significant difference in kill between the monoethanolamine arsenite and sodium arsenite. The data in Table 2 show that application in water with a wetting agent and 2,4-D gave the best control followed in order by application in water with a wetting agent, application as an emulsion in oil, and application in water. Differences were highly significant. The emulsions in oil were expected to give much better results but the emulsions proved to be unstable at the time of application and distribution over the plots was poor. Differences between rates were again highly significant with the effectiveness being in direct proportion to the concentration of the arsenic.

Toxicity of Monoethanolamine Arsenite and Sodium Arsenite in Soil

Methods

Five concentrations of each compound were applied to air dry soil in pint ice cream containers. The concentrations used were 0, 10, 20, 40, 80 and 160 parts of arsenic per million parts of air dry soil. The required amount of arsenic was dissolved in sufficient water to bring the soil to field capacity. The cartons were then allowed to stand overnight and the next day 20 oat seeds were planted in each carton. Three days later the cartons were again brought to field capacity and on the sixth day the shoot length of each seedling was measured. A completely randomized design was used with four replications of each treatment.

Results

Table 3 shows that highly significant differences exist among the levels of arsenic. Inhibition to the growth of cats was in direct proportion to the concentration of arsenic used. The mean difference between monoethanolamine arsenite and sodium arsenite, as an average of all concentrations, was not statistically significant. Monoethanolamine arsenite at 40 ppm gave significantly more inhibition than sodium arsenite at the same concentration. Further tests of this type are needed to determine their relative rate of breakdown or disappearance from the soil.

Summary

1. A comparison of sixteen experimental arsenical compounds with sodium arsenite under field and laboratory conditions showed that twelve of these compounds were as effective as sodium arsenite.

2. The arsenic content of the spray solution and the method by which the spray solution is fortified seems to be more important than the arsenic compound used in determining the effectiveness of arsenical herbicides.

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THE EFFECTS OF 2,4-D APPLIED TO FIELD-GROWN COTTON AT VARIOUS STAGES OF GROWTH

A. David Baskin /1

The problem created by the use on cotton of insecticides contaminated with herbicidal compounds has been of extreme practical importance during the past several years. These materials have been demonstrated at the Beltsville, Maryland Station, by laboratory and by field tests to contain up to 48,000 p.p.m. of a formative compound similar to 2,4-D and/or related compounds in their phytotoxic activity.

Little information has been published to afford a definitive knowledge of the response of field-grown cotton to concentrations of 2,4-D herbicides commonly found as contaminants. It was considered advisable to determine the probable effects of different concentrations of 2,4-D when applied to cotton at various stages of growth. The investigations herein reported present an evaluation of the effect of 2,4-D on formative responses and yield of field-grown Coker 100 Wilt cotton. These tests were made at the Virginia Tidewater Field Station, Holland, Va., during the 1952 season.

REVIEW OF LITERATURE

The few papers found to deal with the problem of agricultural chemicals contaminated with herbicidal compounds present excellent observations of the response of cotton to 2,4-D but present no quantative data for yields.

Staten (3) reported that degrees of effects of 2,4-D on cotton depends on the amount of contamination. Injury was manifested as delayed maturity, and with very light exposure the effects on yields were negligible. He found that 1 p.p.m. caused injury with recovery, whereas 10 p.p.m. prevented fruit set while growth in height of the cotton plant was normal.

Brown et al (1) found essentially the same responses in their studies and ascribed the effects of 2,4-D on yield to a temporary cessation of growth. When this occurs an increasing boll weevil population reduces the chances for production of cotton from late set bolls. Yield losses were greater on cotton contacted by drifting dusts or sprays of 2,4-D late in the season when plants were in bloom than when they were young.

It is important to note that the problem of contaminated insecticides has encouraged the development of biological testing procedures to evaluate formative influence of insecticide-herbicide mixtures (2,4).

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EXPERIMENTAL

Method: Concentrations from 5 to 500 p.p.m., inclusive, of 2,4-D acid (using a proprietary preparation of sodium 2,4-D monohydrate, 82% acid) were applied as a spray to randomized triplicated plots of drilled-in Coker 100 Wilt Cotton at two stages of growth.

Untreated plots served as checks and these were randomized along with all treated plots. One block of field-grown Coker 100 Wilt cotton was treated at the time of first 2 true leaves on 6-1 (hereafter referred to as L); a second block was treated at this time, (6-1), and again when flowers appeared on 7-21 (hereafter referred to as LF); a third block was treated only at the time of first flowers on 7-21 (hereafter referred to as F). All sprays were applied so that they would run off by using a 3-gallon hand-operated sprayer equipped with a No. 8001 Teejet Tip. The earlier treatment necessitated the application of 350 ml. of spray solution for 20 feet of row length of the young cotton plants. The later treatment required the application of 1000 ml. of spray for a wetting that would result in a run off.

Each plot was 10 feet long and consisted of 2 rows of treated plants flanked on each side by buffer rows in common with the adjacent plots. The rows were 42 inches apart and therefore each plot contained 70 sq. ft.

Observations of formative effects were made at 24-hour intervals for 72 hours following treatment. On 8-21, observations were again made for formative effects at a time intermediate between the last treatment and harvest. Counts of flowers were made on 7-21 and 8-21 and numbers of squares and bolls set were determined on 8-21. The cotton was hand-picked by experienced field help on 10-6.

A roller type laboratory gin was used for the separation of seed from lint. Yield data as presented reflects the effects of treatment on total yield, and on lint and seed yields separately. Wherever feasible the data were subjected to analysis of variance. For the yield data the interaction of the product of concentration and time of application were also analyzed.

RESULTS

Formative Responses of Coker 100 Wilt Cotton: The reactions of cotton to treatment with 2,4-D were directly proportional to concentration and were also found to increase in severity with any one concentration when applied to more mature plants. Plants treated at LF showed, after 72 hours, the most severe response which might be ascribed to an additive effect of the repeated treatment. Cotton plants treated only at F were not as severely deformed as those treated with the same concentration at LF; but, the initial responses evidenced by concentrations ranging from 50 to 500 p.p.m. 2,4-D acid at L were remarkably less severe by 8-21. The responses are summarized in Table 1. Each value in the table is an average of 3 readings converted to the nearest whole number.

Table 1. Formative responses /1 of Coker 100 Wilt cotton to various concentrations of 2,4-D applied at time of first 2 true leaves and at start of flowering.

Conc. 2,4-D acid	Average response on designated dates /2 during the growing season							
	L			LF			F	
	6-4	7-24	8-21	6-4	7-24	8-21	7-24	8-21
Untreated Check	1	1	1	1	1	1	1	1
5	1	2	1	1	3	2	3	2
10	2	2	2	2	3	3	3	2
25	2	2	2	2	4	3	3	3
50	3	3	2	3	4	4	3	3
100	4	4	2	4	4	5	4	4
200	5	5	2	4	5	5	4	4
500	5	5	4	5	5	5	4	5

/1 Response rating:

1. No apparent effect.
2. Occasional leaves distorted principally evident as prominent venation and slightly reduced area. Petioles slightly twisted. Epinasty up to 20° greater than normal angle of petioles to stem.
3. Frenching of leaves common; leaves moderately reduced in area. Epinasty 21-49° greater than normal angles of petioles to stem. Slight stem curvature apparent.
4. Frenching abundant and prominent; some rat-tailing of terminal leaves. Epinasty ranging from 50-74° greater than normal angles of petioles to stem. Total aspect of plant shows severe injury.
5. Leaves severely deformed, rat-tailing abundant. Epinasty 75° greater than normal angles of petioles to stem. Plants dwarfed, severely deformed or killed.

/2 6-4 - 72 hour reading for treatment (L) made 6-1.

7-24 - 72 hour reading for treatment (LF) made 7-21.

8-21 - A date intermediate between last treatment and harvest.

The height of cotton plants reflects the general formative effects observed. These data are summarized in Table 2. Each value is an average of at least 10 plants except for the two highest concentrations in which cases only the surviving plants could be measured.

Table 2. Height of plants treated with various concentrations of 2,4-D and of the untreated adjacent buffer plants measured 7-24-52.

Conc. 2,4-D acid	Average height of at least 10 plants or less where fewer survived.					
	L		LF		F	
	Treated	Buffer	Treated	Buffer	Treated	Buffer
p.p.m.	inches		inches		inches	
Untreated Check	30	30	31	31	31	31
5	30	30	25	32	28	28
10	27	32	25	34	30	30
25	21	32	24	33	26	32
50	15	34	17	31	26	30
100	12	32	14	32	30	34
200	10	31	12	31	36	30
500	10	34	8	31	24	31

It is apparent that the treated plants decreased in height as the concentrations of 2,4-D increased. The buffer plants showed no formative response at any time and their heights appear to fall within the limits of normal variation as indicated by the non-significance for differences between their means. These data were obtained for the 72-hour interval after treatment on 7-21 of the appropriate plots (LF and F) at start of flowering.

Squares, Flowers, and Bolls Set: Counts of squares and flowers at critical intervals during the growing season would be indicative of effects of treatment on maturity as would the numbers of bolls set. In turn these data would be useful in evaluating probable effects of treatment on yields.

Flowers were counted just prior to the treatment made at flowering time (7-21) and again on 8-21. On this latter date the numbers of squares and bolls present in each plot were also determined. The data summarized in Table 3 are averages of the three replications.

Table 3. Counts of squares, flowers, and numbers of bolls set of Coker 100 Wilt cotton on critical dates during the growing season.

Conc. 2,4-D acid (p.p.m.)	Squares 8-21			Flowers 7-21			Flowers 8-21			Bolls 8-21		
	L	LF	F	L	LF	F	L	LF	F	L	LF	F
Untreated Check	50.3	45.7	41.7	35.7	37.0	35.3	18.0	14.7	14.7	151.0	138.3	145.7
5	35.3	0	60.3	1.3	0	35.3	9.7	0	0	142.3	60.3	120.7
10	127.3	0	0	0	0	26.0	9.3	0	0	136.7	42.7	49.0
25	120.7	0	0	0	0	31.3	6.7	0	0	106.3	17.3	60.0
50	73.0	0	0	0	0	29.3	7.7	0	0	28.0	0	47.0
100	100.7	0	0	0.3	0	31.7	18.0	0	0	43.3	0	24.3
200	39.0	0	0	0	0	31.0	4.3	0	0	12.7	0	31.0
500	9.7	0	0	0	0	32.7	2.3	0	0	0	0	14.0
L.S.D.												
5%	20.1					/1	6.5				28.1	
1%	80.9					N.S.	8.8				37.7	

/1 N.S. = Not significant

It is apparent that the L and LF applications delayed maturity, the LF more so than the L. Essentially no flowers were in evidence in any of these plots on 7-21 although squares occurred abundantly. Squares still occurred in the L block on 8-21 and bolls were present, thereby indicating a delayed flowering. The LF series was severely affected by the repeat treatment as shown by the absence of squares and flowers on 8-21. Squares and flowers in LF- and F-treated plants showed severe burning on 7-24 following the treatment made at start of flowering. No significant differences could be found for numbers of flowers in the F series on 7-21 as would be expected since these plants were not previously treated. No flowers or squares were present on these plants on 8-21 but numbers of bolls set appear to have been directly proportional to the concentration of 2,4-D, decreasing as the concentration increased.

It is evident, therefore, that numbers of flowers in the F series just prior to treatment were abundant. Treatments with 2,4-D at this time affected boll set in direct proportion to concentration. Flowering in the LF series was delayed beyond that apparent for the L series. Hence the second application for the LF series reduced boll set more severely than similar treatment at any other time of plant growth; this might be because of the additive effect of the two treatments, which reduced boll set severely up to and including 25 p.p.m., and virtually eliminated boll formation at higher concentrations.

Discussion: In these tests, young plants in the two-leaf stage were sprayed with 350 ml. of solution containing 5 to 500 p.p.m. 2,4-D acid or 1.75 to 175.0 mg. actual 2,4-D acid. Concentrations of 5 p.p.m. (1.75 mg. acid) to 25 p.p.m. (8.75 mg. acid) show no substantial change in response with time. This is understandable in light of the response ratings used because a "2" response would include trace to more complete reactions. Dosages of 50 p.p.m. (17.5 mg. acid) to 500 p.p.m. (175.0 mg. acid) show a decrease in severity of response, which in case of the highest concentration is considerably less than that observed for 50, 100, and 200 p.p.m. as applied.

Thus plants treated in the L stage probably exhibit more positive effects in numbers of flowers, squares, and bolls set, as these influence final yields. In the case of plants treated in the LF and F stages the influence on yields are more clearly discernible in formative responses. Plants receiving a 5 p.p.m. 2,4-D acid spray at the LF stage would be contacted with 6.75 mg. of 2,4-D acid (350 ml. containing 1.75 mg. plus 1000 ml. containing 5 mg. 2,4-D acid). Plants sprayed with 500 p.p.m. 2,4-D acid would be contacted with 6.75 mg. of the acid (350 ml. containing 175.0 mg. plus 1000 ml. containing 500 mg.). In this way, and in the same order, plants treated at the F stage only would receive 5 and 500 mg. of 2,4-D acid.

Thus differences in actual amounts of 2,4-D as applied might account for some of the differences in formative responses as observed. Nevertheless, time of application appears to be even more critical than these relatively small differences in dosages. Sprays of 2,4-D applied to cotton plants on which squares and flowers are forming injure these parts in direct proportion to concentration. As these factors are closely related to boll set, the numbers of bolls formed would be essentially greatest in plants treated in the L stage only, less in plants sprayed in the F stage only, and least in plants receiving 2 treatments (LF). This is apparently what occurred, as indicated by the data for boll set. Here no significant differences for any given concentration of 2,4-D are apparent for plants treated in the L and F stages except, possibly for 500 p.p.m., in which case any value greater than zero might be regarded as significant. It is immediately apparent that boll set for LF-treated plants is significantly different from either the L or F series for any given concentration.

Yields: An analysis of variance was made for lint, seed, and total yields as they responded to the concentrations of 2,4-D, time of application, and the interaction of concentration and time of application. The LF time of application with 100 through 500 p.p.m. 2,4-D acid inhibited growth or proved lethal to cotton. Hence, the analysis of these data was limited to yields resulting from application of 2,4-D not higher than 50 p.p.m. These data are presented in Table 4.

Table 4. Yields of lint and seed, and total yields obtained from Coker 100 Wilt cotton after treatment with various concentrations of 2,4-D at 3 times of application, viz. L, LF, and F.

Concentration 2,4-D	Average weights in lbs./acre (gm./70 sq. ft. X 1.3707) converted to the nearest whole number.											
	Lint Yield				Seed Yield				Total Yield			
	L	LF	F	Av.	L	LF	F	Av.	L	LF	F	Av.
p.p.m.	lbs./acre				lbs./acre				lbs./acre			
Untreated check	769	692	650	704	1332	1148	1086	1189	2101	1840	1736	1892
5	463	108	226	266	798	143	316	419	1261	251	542	685
10	310	74	169	184	567	101	184	284	877	175	353	468
25	283	25	165	158	398	32	172	201	681	57	337	358
50	126	13	110	83	249	16	108	124	375	29	218	207
Mean for time of application	390	182	264		669	288	373		1059	470	637	
/1												
100	89	0	80		166	0	54		255	0	134	
200	11	0	42		22	0	31		33	0	73	
500	2	0	15		9	0	9		11	0	24	

/1 Yields for treatments with 100 through 500 p.p.m. 2,4-D acid not included in the analysis.

Concentration			
L.S.D. 5%	92	145	236
1%	125	197	321
Time of Application			
L.S.D. 5%	129	53	93
1%	195	81	141
Concentration X Time of Application			
L.S.D. 5%	159	Not significant	Not significant
1%	217		

Yields of lint or seed and the combined weights expressed as total yield obviously responded to the major factors of concentration of 2,4-D and time of application. Thus, in all cases, yields decreased as concentration increased and were significantly different at the 1% level from the untreated checks. Seed yields are important only insofar as they indicate amounts of oil obtainable but conclusions bearing on effects of treatment on the oil, itself, must await completion of appropriate analysis. Fundamentally, the most important yield is that of the lint, and this discussion will be accordingly limited.

It is evident that 5 p.p.m. of 2,4-D acid severely reduced lint yield (from 704 to 266 lbs./A. for the check and 5 p.p.m., respectively); and yields were further reduced as concentrations were increased. Reduction in yields from 10 through 50 p.p.m. of 2,4-D acid were not significant. It is also evident that yields from 5, 10, and 25 p.p.m. treatments produced no significant differences for the lint harvested. All concentrations of from 5 through 50 p.p.m. 2,4-D acid were different from the untreated check at the 1% level. It was also found that analysis of effects of time of application corroborated what was apparent from field observations and perusal of the weight data, i.e., plants treated at time of first true leaves (L stage) were not as severely affected as those treated at time of flowering (LF and F stages). Statistically these differences are significant at the 1% level. From a biological viewpoint, however, it is important that those plants (LF) receiving 2 treatments were even more severely affected than those receiving only 1 application at flowering time; and that yields of F-treated plants were lower than those of L (1 application at time of first 2 true leaves). As previously discussed this difference might be due to the actual amounts of 2,4-D acid applied at these 2 stages of growth. It will be noted that the yield of 5 p.p.m. at the F stage is approximately 50% that at the L stage but this could be essentially because of the 2.9 times greater amount of 2,4-D applied at F than at L. At 50 p.p.m., however, the F yield was almost 90% that of the L yield while the amounts of 2,4-D applied at both stages were proportionately the same. It is, therefore, apparent that concentrations of 2,4-D are highly effective in reducing yields, but that time of application is also important, particularly in the case of the higher concentrations, where yields are considerably less different and, in fact, may be higher for F than for L despite the greater amount of actual 2,4-D applied at F. Examination of the mean yields for time of application show the L to be significantly different from the LF and F at the 5% and 1% levels, respectively.

No significant differences, as may be seen in Table 4, were found for the untreated check or 50 p.p.m. relative to the interaction of concentration and time of application. It will also be noted that no significant difference exists between the LF and F times of application for concentrations of from 5 through 50 p.p.m. 2,4-D but that there is significance between the yields at L and LF or F at least at the 5% level.

The importance of the significance found for the product of concentration and time of application lies in the indication that the differences measured in terms of yield might well be influenced by other responses of cotton to treatment. Thus, the need to further examine the cotton for effects on fiber length, wall thickness, etc., is indicated. These data will be reported elsewhere as soon as they are available.

Summary

Field-grown Coker 100 Wilt cotton was sprayed with various concentrations of 2,4-D at two stages of growth. Very little boll weevil damage was evidenced at time of harvest. It was found that plants sprayed only at the time of first 2 true leaves (L) showed less severe response relative to numbers of flowers and squares, boll set, and yield than did plants sprayed twice (LF) or only at time of flowering (F). Formative responses appeared to be in direct proportion to concentration for any time of application. For plants treated in the L stage the severity of response decreased in time. Plants treated at LF and F showed more pronounced formative effects which were not mitigated in time. Yields responded to the major effects of concentration and time of application. Lint yields were apparently affected by the interaction of concentration and time of application. Thus the gross effect on lint yield is possibly characterized by differences in fiber length and wall thickness of the cotton fiber. This response to treatment when determined will be reported elsewhere.

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The Relation of Structural Configuration to the Herbicidal Properties and Phytotoxicity of Several Carbamates

W. C. Shaw and C. R. Swanson[1/]

Abstract[2/]

The purpose of this paper is to show the relation between structural configuration and herbicidal properties in the carbamate family of compounds. Preliminary studies with alkyl carbamates, N-phenyl and substituted N-phenyl carbamates indicate a high degree of correlation between molecular configuration and herbicidal activity. In addition, a high degree of selectivity and specificity has been exhibited by the various carbamates studied.

A possible mechanism involved in the killing action of the carbamates is the inhibition of chlorophyll production. A possible explanation of the mechanism may be that chromosome aberrations occur involving genes which control the production of chlorophyll in plants.

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

FIELD PLOT TECHNIQUE AND STATISTICAL ANALYSIS FOR WEED CONTROL EXPERIMENTS

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In the course of development of any field of research, methods of procedure must be developed which are most productive of reliable results. In field experiments with weed control methods there has been a large body of information from other cultural investigations to use as a guide. There are, however, a number of specific problems which have come up recently that warrant special mention at this time. The object of this paper is to point out some of the problems involved in field work with weed control and to suggest methods of solving them.

Size and Shape of Plots

No work has been reported to date on the optimum size and shape of plots for weed control experiments. Most investigators have used plots similar to those used in fertilizer experiments with the crops involved and have not bothered to determine whether or not the shape and plot size was optimum. Other workers have determined plot size and shape by equipment restrictions and have not always been satisfied with the results. It is apparent that considerations of border effect and plant competition will be different in weed work than in fertilizer work. Optimum plot sizes may also be different. Uniformity of weed population and uniformity of chemical application must be carefully considered. Shape of blocks and size of blocks become very important when weed population is considered.

No answers can be given to the questions of how large a plot to use, what shape it should be and how large a block is desirable, however, it seems that smaller plots could be used. It is recommended that each worker take it on himself to investigate some phase of this problem so that by combining results of various individuals, better experiments will be performed.

Number of Observations to be made

The number of observations made in an experiment usually falls into two classes, (1) The number of replications of the treatments, and (2) The number of observations made on each plot.

The number of replications is determined by the variability of the weed population in the experimental area, the variability of the crop plants and the degree of precision desired. With some estimates available of the variability to be expected, the number of replications necessary for varying degrees of precision can be determined from published tables. It is worth considering the fact that because of the influence of factors associated with location and climate, results vary considerably from year to year and a high degree of precision in one year at one location is not always necessary. It is better

in the end to sample more locations and climates than to concentrate carefully on one set of conditions. The net returns, from money spent in terms of recommendations for usage, will be greater with fewer replications at one location and more locations than with a highly replicated precise experiment at one location.

The number of observations made on each plot is determined largely by the variability within the plot and the desired precision of the mean. It is difficult to determine before-hand how much within plot variability to expect. However, there is no need to make the plot observations more precise than the means for the whole experiment. Optimum number of weed counts per plot and number of samples for chemical analyses or for yield measurements need more investigation.

Experimental Designs

Of the many designs available, the randomized block is most frequently used. There is good reason for this but there are several items to be considered in favor of other designs. Cultural factors are frequently very important to the response from chemicals and thus weed control experiments frequently include such factors as irrigation, tillage, cultivation, or even variety. Often crop responses to these other factors are either large or of little interest directly, while the interaction of the factors is of prime interest. In such cases a split-plot design with the cultural factor as the major plot is a logical set-up. Because cultural factors sometimes require large plots, using a split-plot design will actually reduce the size of the experiment compared to randomized blocks.

Incomplete block designs of various sorts are very useful when weed population is uneven. By using smaller blocks better comparisons can be made between chemicals. More use could be made of these designs in the majority of experiments.

A word should be inserted here for factorial experiments. Weed research has passed the point of merely spraying on chemicals to see if they control weeds. The problem now is to determine under what conditions chemicals are good and where they won't work and why. To do this properly requires the inclusion of several factors in the same experiment. This serves several purposes. It increases the effective replications for main effects without increasing total replications in the experiment. The response of the chemicals to several sets of conditions can be investigated and the consistency of these responses may be determined. Thus future action concerning these chemicals will be placed on a better basis and recommendations can be arrived at sooner. It would seem that profitable use could be made of complex experiments with careful designs as the stage of research advanced for any crop or chemical. It is also usually profitable to use a factorial experiment in screening chemicals, since cultural conditions or environment often markedly influence response to the treatments.

In summary it seems that investigators might profit by use of some of the more complex designs in weed work. This would be especially true in cases where the number of treatments is large and the number of replications desired at any one location is small.

Analysis of Data

A large proportion of data such as yield figures and other measurements presents no problems for analysis. These data can be handled by usual analysis of variance procedures. Other data, however, may require special handling. Weed counts, if large, can be analyzed in the usual way but in experiments where the counts are small numbers the data should probably be transformed to fit the requirements for analysis of variance better. If stand counts or yields are expressed as percentages and values near zero and 100 per cent occur, a transformation will be needed before analysis. Weed control is often expressed as rating figures. In most cases ratings should be transformed before analysis.

The types of transformations to use in the above cases have been described in several publications and it is only the purpose here to point out that the need for a transformation should be investigated before the data are analyzed.

General Remarks

Often it is desirable to combine demonstration weed control plots and experimental set-ups to provide better publicity and research at less expense. This is all right provided the researcher remembers that a good demonstration is not always a good experiment and vice versa. Perhaps a solution would be the planting of one replication especially for demonstration use and using the rest for research results.

People engaged in laboratory work may feel that the preceding remarks were not for them, but it should be evident that they will be able to profit by some of the suggestions made. In spite of popular opinion variation can be experienced in laboratory work and unless provision is made for it, difficulties may result.

No test is too small or too large to replicate properly. Anyone who has seen the wide differences in results from different parts of the same field will agree that single plots can be very misleading and costly. It is as important to have carefully designed experiments at the beginning of a project as well as at the end. Everyone is aware of the help that statistical procedures can give in research work; why not use them to the ultimate in weed research as well as in other work?

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METHODS FOR DETERMINING RELATIVE VOLATILITY OF ESTERS OF 2,4-D AND OTHER GROWTH REGULANTS BASED ON RESPONSE OF TOMATO PLANTS

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Renewed interest in volatility of hormone-like compounds has occurred since government restrictions were placed on the sale of certain esters used for herbicidal purposes. After crop plants neighboring on fields sprayed with volatile herbicides were injured, attempts were made to find low volatile esters which could be used with greater safety. This was done by making long chain esters containing five or more carbon atoms. Since many of these are now being made, the problem is to find satisfactory test methods for determining the relative volatility as compared with known compounds and standard formulations.

The volatility of hormone-like substances was reported as early as 1939 by Zimmerman, Hitchcock, and Wilcoxon (6, 9) and again in 1942 in the first publication on 2,4-dichlorophenoxyacetic acid (2,4-D) and other substituted phenoxy compounds (7).

About 1949 Marth and Mitchell (3), Mullison and Hummer (4), Tafuro et al. (5), and Allen (1) reported on volatility of esters and other derivatives of 2,4-D. King and Kramer (2) later reported on the volatility of polyethylene and polyethylene glycol esters of 2,4-D and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). Methods of detecting contamination of volatile material were recently described in an article by Zimmerman et al. (8).

The present report shows how methods can be placed on a quantitative basis for amounts of the esters used and the degree of responses induced on tomato plants. Several different methods are compared and their values discussed.

Materials and Methods

Tomato plants 2.5 to 3 inches in height were found to be the most sensitive for testing volatile substances. At this size the plants were 25 to 28 days old from seed.

Both pure chemicals and commercial formulations were tested. Unless otherwise stated, all of the formulations contained the equivalent of 4 lb. of acid per gallon. Tables 5 and 6 include a list of some of the formulations tested.

During the course of the investigations several techniques were used and compared. The principal containers were bell jars, vinylite bags, and paper bags. The paper bag was selected for the standard application technique. The method involved enclosing a single plant at the bottom of a fully opened 20 lb. paper bag together with a 7 cm. diameter filter paper moistened with a known amount of the formulation. The filter paper was placed at the bottom of the bag, not touching the side of the bag, the pot, or any part of the plant. The upright bag was sealed at the top by folding over two layers of paper and

fastening with paper clips. After bags were sealed, they were placed at the desired temperature and left for time periods of 1 to 24 hours. The formulations were applied to the filter paper by means of pipettes or platinum bacteriological loops. In most of the tests a 0.01 ml. loop was used.

Two or more plants were used for each treatment and treatments were replicated. The evaluation of results was based on responses such as epinasty of leaves, curvature of stems, proliferation, modification of leaves, and inhibition of growth. The initial responses (curvatures) were evaluated within 24 hours after the treatment and the others 7 to 10 days later. Leaf modification and proliferation of stems were each estimated on the basis of a magnitude of response scale ranging from 5 (minimum) to 40 (maximum). Only slight proliferation occurred on plants which exhibited pronounced modification. Increasingly higher doses of the chemical caused an increase in the magnitude of proliferation but no modification due to the lack of growth. An isopropyl ester formulation of 2,4-D was used as a high volatile substance and a propylene glycol butyl ether ester formulation of 2,4-D as a low volatile substance.

Results

Effect of concentrations. The magnitude of the response increased with the concentration of the formulations and the volatility of the chemicals. Table 1 shows the difference between a high and a low volatile ester. It also shows that the difference is greater at high than at low concentrations. For example, the isopropyl ester at the highest concentration induced stem proliferation, but the low volatile propylene butyl ether ester did not. Also the responses increased with length of exposure to the substances. For example, the high volatile ester at 0.10 per cent did not cause a response on plants with a 4-hour exposure but caused modification of leaves with the 24-hour exposure.

Table 1. Effect of concentration and duration of exposure on relative magnitude of responses of plants 10 days after treatment with 0.01 ml. of 2,4-D.

Concn., %	Responses to isopropyl ester					Responses to propylene glycol butyl ether ester	
	4-Hour exposure*		24-Hour exposure			24-Hour exposure*	
	Av. height increase, cm.	Modification	Av. height increase, cm.	Modification	Proliferation	Av. height increase, cm.	Modification
0.00	13	0	8	0	0	9	0
0.01	12	0	10	0	0	8	5
0.10	13	0	10	5	0	10	10
1.00	13	5	9	25	0	9	10
10.00	14	25	9	40	0	10	20
48.00	12	35	4	0	35	10	40

* No proliferation induced by this treatment.

The effect of the amount of formulation used. There was an increase in response with an increase in the amount of the formulation used for the expo-

sure. Table 2 shows the differences between high and low volatile ester formulations when different amounts were used. For example, when 0.1 ml. was used, the high volatile isopropyl ester induced pronounced proliferation and no modification, but the low volatile ester induced slight proliferation and pronounced modification. Little or no differences could be detected between a 4-hour and a 24-hour exposure to a high volatile ester when the amount used was 0.1 ml. or higher. At the 0.01 ml. rate no proliferation was induced with the high volatile ester when the exposure was for 4 hours, but pronounced proliferation occurred when the exposure was for 24 hours.

Table 2. Effect of amount of 2,4-D esters on the response of plants 10 days after treatment.

Amount, ml.	Response to isopropyl ester								Response to propylene glycol butyl ether ester			
	4-Hour exposure				24-Hour exposure				24-Hour exposure			
	Av. height increase, cm.	Modification	Proliferation	Av. stem bending, deg.	Av. height increase, cm.	Modification	Proliferation	Av. stem bending, deg.	Av. height increase, cm.	Modification	Proliferation	Av. stem bending, deg.
0.000	11	0	0	0	9	0	0	0	10	0	0	0
0.001	11	30	0	0	8	20	10	10	10	15	0	0
0.010	10	40	0	0	5	0	25	65	11	25	0	0
0.100	5	0	35	45	2	0	40	83	10	40	10	18
1.000	3	0	25	28	2	0	40	90	7	15	30	30

Effect of temperature. When the plants were treated over a range of temperatures (75° to 116° F.), the magnitude of the response increased with the temperature. Table 3 shows the effect of temperature on the response of plants to a low and a high volatile ester. For example, 0.001 ml. of the isopropyl ester caused proliferation at 116° F. but did not at 75° F.

Table 3. Effect of temperature on responses of plants 10 days after treatment with ester formulations of 2,4-D.

Ester formulation of 2,4-D	Length of exposure, hours	Amount, ml.	Responses after exposure at different temperatures, ° F.								
			75°			102°			116°		
			Av. height increase, cm.	Modification	Proliferation	Av. height increase, cm.	Modification	Proliferation	Av. height increase, cm.	Modification	Proliferation
Isopropyl	2	0.000	11	0	0	10	0	0	13	0	0
		0.001	11	20	0	10	30	0	4	0	25
		0.010	10	30	0	11	35	0	6	10	25
Propylene glycol butyl ether	4	0.000	7	0	0	6	0	0	8	0	0
		0.001	8	0	0	5	20	0	8	20	0
		0.010	8	0	0	7	30	0	9	40	0

Effect of duration of exposure. Increasing the length of exposure caused an increase in the magnitude of response on the test plants with either a high or a low volatile ester (Table 4). However, the high volatile ester caused more pronounced responses at any period of exposure than the low volatile ester. This relationship held even though the amount of the low volatile ester was ten times as great as that of the high volatile ester.

Table 4. Effect of duration of exposure to 2,4-D esters based on the responses of tomato plants 10 days after treatment.

Length of exposure, hours	Response to 0.01 ml. isopropyl ester				Response to 0.1 ml. of propylene glycol butyl ether ester			
	Av. height increase, cm.	Modification	Proliferation	Av. stem bending, degrees	Av. height increase, cm.	Modification	Proliferation	Av. stem bending, degrees
1	13	25	0	0	12	5	0	0
2	12	35	0	0	12	20	0	0
4	9	20	5	5	9	30	0	0
6	8	20	15	13	11	35	0	0
8	9	10	10	20	12	40	0	0
16	3	0	35	50	9	25	20	10
24	4	0	40	50	7	15	30	25

Comparison of formulations. Table 5 shows the comparison of various formulations of 2,4-D and 2,4,5-T. In all cases the alkanolamine salts proved to be non-volatile from a biological standpoint. 2,4,5-T does not cause modification of leaves. Therefore, if the formulations of 2,4,5-T caused modification of leaves, it was assumed to be contaminated with 2,4-D. Such contamination was detected in two commercial formulations of 2,4,5-T used and listed in Table 5. None of the non-contaminated low volatile esters of 2,4,5-T formulations caused a response on test plants regardless of the amount used. This is in contrast with the low volatile esters of 2,4-D, all of which caused a response. The high volatile esters of both 2,4-D and 2,4,5-T caused pronounced responses. Therefore, these results show that the high volatile ester formulations may be distinguished from the low on the basis of the marked differences in the magnitude of responses.

Table 5. Response of plants to formulations of 2,4-D and 2,4,5-T.

Formulation	Amount applied, ml.	24-Hour response: Av. stem bending, degrees		Responses after 9 to 10 days: Av. height increase, cm.		Modification		Proliferation	
		Test 1	Test 2	Test 1	Test 2	Test 1	Test 2	Test 1	Test 2
2,4,5-T									
Alkanolamine	0.01	0	0	8	5	0	0	0	0
	0.10	0	0	8	6	0	0	0	0
Butoxyethyl	0.01	0	0	10	8	0	5	0	0
	0.10	0	0	9	7	20	20	0	0
Ethoxyethoxy propanol	0.01	0	0	7	7	0	0	0	0
	0.10	0	0	9	6	5	0	0	0
Isooctyl	0.01	0	0	9	6	0	0	0	0
	0.10	0	0	8	8	0	0	0	0
Propylene glycol butyl ether	0.01	0	0	9	7	20	20	0	0
	0.10	0	10	10	6	30	15	0	5
Isopropyl*	0.01	--	23	--	6	--	0	--	0
	0.10	--	40	--	3	--	0	--	40
2,4-D									
Alkanolamine	0.01	0	0	8	8	0	0	0	0
	0.10	0	0	9	7	0	0	0	0
Butoxyethyl	0.01	0	0	9	6	15	10	0	0
	0.10	8	0	8	7	25	20	0	0
Ethoxyethoxy propanol	0.01	0	5	9	7	30	15	0	0
	0.10	8	5	10	9	35	20	0	0
Isooctyl	0.01	8	5	9	7	25	10	0	0
	0.10	10	10	10	10	30	20	0	0
Propylene glycol butyl ether	0.01	8	15	10	9	30	25	0	0
	0.10	20	40	10	9	35	20	10	10
Isopropyl	0.01	28	40	5	5	0	5	40	20
	0.10	70	65	2	2	0	0	40	40

* Contained the equivalent of 5 lb. of acid per gallon in acetone.

Relative volatility of nine commercial formulations of 2,4-D. Table 6 shows results obtained with formulations of 2,4-D which ranged from non-volatile to high volatile substances. Of the two esters found to be of high volatility, the pentasol ester was slightly less volatile than the isopropyl. Only slight differences were noted between the six formulations found to be of low volatility.

Table 6. Initial and 9-day responses induced on tomato plants by exposure for 24 hours to different 2,4-D formulations.

2,4-D formulation, 4 lb. acid per gallon	Amount applied, ml.	24-Hour responses			9-Day responses			
		Av. stem bending, deg.	Epinasty	Total response, ranks*	Av. height increase, cm.	Modification	Proliferation	Total response, ranks*
Alkanolamine	0.01	0	0	5.5	7	0	0	2
	0.10	0	0	5.5	5	0	0	2
	1.00	0	0	5.5	6	0	0	2
Isooctyl	0.01	0	0	5.5	8	15	0	5
	0.10	10	0	12	7	25	0	9
	1.00	20	10	17	6	20	5	15
Ethoxyethoxy propanol	0.01	0	0	5.5	6	15	0	5
	0.10	10	0	12	4	25	5	17
	1.00	13	10	15.5	4	10	10	19.5
Butoxypropyl	0.01	0	0	5.5	6	20	0	7.5
	0.10	10	0	12	7	35	0	12
	1.00	13	10	15.5	5	15	5	13
Butoxyethyl	0.01	0	0	5.5	5	20	0	7.5
	0.10	25	10	18	5	20	5	15
	1.00	25	15	19	6	20	10	18
Tetrahydro-furfuryl	0.01	0	0	5.5	7	15	0	5
	0.10	0	0	5.5	8	30	0	10.5
	1.00	30	5	14	4	10	10	19.5
Propylene glycol butyl ether	0.01	0	0	5.5	6	30	0	10.5
	0.10	60	20	23	4	5	15	22
	1.00	45	20	22	4	5	25	25
Pentasol	0.01	25	20	21	8	20	5	15
	0.10	15	20	20	5	10	15	21
	1.00	40	25	24.5	5	10	20	23
Isopropyl	0.01	40	25	24.5	6	5	20	24
	0.10	70	40	27	2	0	40	26
	1.00	65	40	26	1	0	40	27

* Highest rank value represents greatest response.

Discussion

Attention is called to the fact that tomato plants 2.5 to 3 inches in height were substantially more sensitive than larger plants. To obtain the same degree of response with the larger plants, higher doses of the chemicals had to be used. At a given dosage level with the smaller plants it was

possible to detect relatively small differences between volatile esters. By varying the dosage levels it was possible to obtain quantitative differences in volatility based on magnitude of the responses of test plants.

After testing several types of containers and methods of application, the 20 lb. paper bag and the 7 cm. filter paper were selected as most satisfactory. To guard against contamination, the bags were used only once. No contamination occurred in any of the tests where the paper bag, filter paper technique was used. However, contamination with 2,4-D was detected in some of the formulations of 2,4,5-T. Such contamination was further proved by direct application of the solutions to leaves of the test plants.

Summary

A simple rapid biological method for determining the relative volatility of different formulations of 2,4-D and 2,4,5-T is described. The technique consisted of enclosing in a 20 lb. paper bag a tomato plant 2.5 to 3 inches tall together with a piece of filter paper containing 0.01 to 0.1 ml. deposit of the test chemical. The period of exposure was 24 hours or less at 70° to 80° F.

Leaf epinasty and stem curvature were used as the criteria for evaluating the initial responses within 24 hours after treatment. Leaf modification, stem proliferation, and growth inhibition were used as a basis for evaluating the final responses at the end of 7 to 10 days. Leaf modification represented the minimum response, and stem proliferation and growth inhibition maximum responses. Under some conditions killing occurred, but this was preceded by pronounced proliferation and inhibition of growth. Initial responses were of value in detecting large differences between formulations, but small differences were evaluated on the basis of leaf modification 7 to 10 days after treatment.

Final responses showed that there were only slight differences in the volatility of six commercial formulations of 2,4-D esters of low volatility. Two highly volatile esters of 2,4-D differed slightly, but they were readily distinguished from those of low volatility. All ester formulations of 2,4,5-T induced less pronounced responses than the ester formulations of 2,4-D. Leaf modification was used as a criterion for determining 2,4-D contamination.

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A BIOLOGICAL METHOD FOR THE DETERMINATION OF EXTENT OF VOLATILITY OF ESTERS OF 2,4-D AND/OR 2,4,5-T

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The problem of volatility of esters of 2,4-dichlorophenoxyacetic acid (2,4-D) and/or 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) is current because there is a confused concept of volatility as it applies to the subject formulations; and because there is no standard method available to measure those factors peculiar to ester volatility that afford a scale of probable biological effects for commercial formulations. This paper sets forth what is believed to be an appropriate concept and an adequate definition as it applies to the subject esters and, further, proposes a method for the bio-assay of these formulations.

CONCEPT AND DEFINITION

The understanding of "volatility" is all too generally restricted to the physico-chemical sense of the word. As a primary premise it is here proposed that this sense be supplemented with a biological one.

A volatile substance is commonly regarded as one which easily wastes away by evaporation, one which readily vaporizes as volatile oils or liquids. Ether, alcohol, acetone, dimethylamine and trimethylamine placed in broad evaporating dishes and allowed to vaporize in the presence of cotton plants in the field produce no formative effects in cotton. A volatile 2,4-D or 2,4,5-T ester in a similar situation caused drastic injury to the same test object. Thus, in the first instance, the materials used are highly volatile but not formative. In the second case, the ester is far less volatile but highly formative. The ester is considered highly volatile, therefore, not because of its rate of evaporation (which is relatively low) but because of its formative effects. Thus a true concept of volatility as it applies to plant response is not contingent upon the rate of evaporation of the formulation, but rather on whether or not formative concentrations of the ester vapor are produced. Accordingly, it would be advantageous and is even necessary to include in the usual definition of "volatile" the term, "formative concentration," which, ipso facto, implies a biological effect. Hence a volatile 2,4-D and/or 2,4,5-T product should be considered as one which upon vaporization produces a formative concentration of a physiologically active compound recognized in affected plants by such responses as epinasty, leaf malformation, stem curvature, severe distortion, or other manner of plant response directly attributable to the action of the chemical. This understanding of volatility would be in accordance with the "Phytotoxic volatility" previously described by Allen (1).

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REPORTED METHODS

Several methods of determining volatility of herbicides are known which are essentially variations on the procedure reported by Mitchell and Marth (2). These tests depend on the vaporization of an ester from a suitable dish or a filter paper placed in a closed system with the test plant. In still air, vaporization will proceed at a rate governed by the gradients established between the source of the vapor and the air in the enveloping container. A closed system method neglects the important consideration of air turbulence which contributes vitally to the problem of ester volatility in practice. If, for example, weeds in a waste area were treated with a volatile ester and no current of air occurred to drive the vapor to crop plants and cause injury, the volatility of the ester would be important only in abstract. Furthermore, dilution of formative concentrations of ester vapor might occur, because of the diffusion gradient (assuming still air), and desirable plants at a distance from the source of the vapor would possibly never be affected. It is known, however, that cotton plants at considerable distance from a source of ester have been injured. Hence, it follows that wind is capable of driving formative concentrations of ester vapor for a distance and air turbulence should therefore be a primary factor in any assay of ester volatility.

Earlier preliminary methods that were used, involved bubbling of air stream through the ester and known non-volatile 2,4-D controls. All preparations proved to be highly formative. It was evident that a mist of 2,4-D droplets was produced by the air ebullition and these carried in the air stream afforded contact rather than vapor herbicidal action.

The forced-air method reported in this paper recognizes (a) the importance of turbulence in disseminating ester vapor and attempts to establish a standard for turbulence, and (b) eliminates air ebullition of any formulation. Hence, it is believed that biological effects of volatile esters of 2,4-D and/or 2,4,5-T are now more comprehensively characterized than by other known assay methods.

PROPOSED BIOLOGICAL METHOD

Rutgers tomato plants grown to 4-or5-leaf stage in dispensable containers are exposed to vapors of 2,4-dichlorophenoxyacetic acid and/or 2,4,5-trichlorophenoxyacetic acid ester formulations in a forced air system to determine the extent of their volatility. Epinasty and more advanced formative responses of the test plants are the measures by which volatility is evaluated.

Material and Method: Pipette 10 ml. of the undiluted product to be tested into a 200 x 25 mm. Pyrex test tube fitted with a 2-hole No. 5 neoprene stopper. Into one hole place a right angle glass tube with 1 arm extending 50 mm. into the test tube: The outside arm of this tube is attached to the compressed air line with rubber tubing. Into the second hole of the stopper place a glass tube extending 5 mm. into the test tube and 50 mm. above the stopper. The test tube, 2-hole stopper, and glass tubing coming in contact with the ester vapor should not be used again for herbicidal tests.

A wire ring around the test tube with a long stem pushed into the soil in the plant container serves to support the test tube alongside the plant. Clean, 1 qt. oil cans with the tops cut away and several holes punched through the bottom are suitable disposable containers for growing the test plants.

A large paper sack (1/6-1/4 barrel size) is placed over the plant including the test tube. This size bag covers each unit of the system and must be replaced by a new bag for each exposure interval.

Several products can be tested simultaneously by splitting the main air line with a Y-tube and arranging T-tubes for air take-off to each of the test tubes. Adjustment of screw clamps (in place of screw clamps - glass tubing with an appropriate capillary bore and of a length essential to provide a given rate of air flow, may be used) placed across the air line leading to the test tube immediately above the T-tube will provide an equal flow of air into each test tube. At the end of each of the 2 air line arms, bubble the air through 100 ml. water contained in 250 ml. Erlenmeyer flasks. An equal rate of bubbling in these 2 flasks will assure essentially equal rates of air flow through both arms. Further, this arrangement circumvents variations in the air diaphragm-valve gauge because excess of air is expelled through the water and a desired volume is circulated through the test tube onto the plant. An air flow displacing approximately 750 ml. of water per minute at the terminal flask and by screw clamp adjustment, approximately 150 ml. water per minute when emerging from the test tube, has been found adequate.

In each exposure 10 ml. of a saturated aqueous sodium 2,4-D solution serves as a check. This solution must be included as a standard preparation.

Exposure intervals of 2, 4 and 16 hours at room temperatures (70-75°F) have afforded reproducible responses by Rutgers tomato plants to a variety of ester formulations. First observations are made at the time of removal of the plants from under the paper bag and at intervals of 24, 48 and 72 hours after the exposure.

Evaluation of volatility is made in terms of plant response.

Reaction Class	Description of response /1
1	No apparent response
2	Epinasty 1°-20° /2 compared to normal; no curling
3	" 21°-40° compared to normal + slight curling
4	" 41°-60° compared to normal + moderate curling
5	" 61°-80° compared to normal + moderately severe curling
6	" 81° - greater than 90°; severe formative effects apparent (twisting of main stem, distortion of petioles and leaflets).

/1 The plant must be regarded on the whole. Epinasty readings are made on the youngest leaves and those just preceding.

/2 Angles are measured with a protractor.

Any given ester is tested for each of the three exposure intervals at least three successive times, a fresh 10 ml. aliquot of the undiluted product being used for every test. The product of the number of times (N) a reaction class (C) is obtained for each exposure interval (i) divided by the number of replications (r) constitutes the average response (R). Thus:

$$R_i = \frac{NC}{r}$$

A deviation of not more than one reaction class for successive tests at a given exposure interval would be tolerable in view of the fact that a high reading at one response might well overlap a low reading of the next higher response. In this case

$$R_i = \frac{N(C_1) + N(C_2)}{r}$$

Responses falling in class 1-2 are low volatile, and 3-6 are considered highly volatile for purpose of enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act.

Experimental work has shown that at 70-75°F low volatile preparations have been found to be the sodium salt of 2,4-D and the iso-octyl, butoxyethanol, butoxyethyl, polypropylene glycol, and tetrahydrofurfuryl esters of 2,4-D and/or 2,4,5-T. Volatile esters have been found to be the methyl, ethyl, propyl, butyl, amyl and pentyl series. We have found that each proprietary low volatile formulation should be tested for its activity, because difference in purity of compounds of these preparations are manifested. The amines of 2,4-D and/or 2,4,5-T have not been tested at this time for volatility by this method.

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The Relative Vapor Activity of Several Dinitro Compounds on Cotton Seedlings

P. J. Linder, W. C. Shaw, and P. C. Marth[1]

Abstract[2]

Recent experiments with 6 formulations of water soluble salts of dinitro ortho secondary butyl phenol indicate that all have measurable vapor activity on cotton plants. These studies were made in an attempt to determine some of the factors that caused the varying degrees of injury to young cotton plants which followed their use as pre-emergence herbicides during 1952.

Experiments were designed to study the relative vapor activity of 6 water soluble dinitro formulations. The experimental design was a randomized block with four replications. Each experiment was repeated five times. The tests were conducted with plants enclosed in gastight cellophane cases approximately $3\frac{1}{2}$ x $3\frac{1}{2}$ x 16 inches in size and exposed to the vapors of the dinitro compounds. Seedling cotton plants, 3 inches tall, of the Deltapine variety were used as test plants. Filter paper (No. 1 Whatman-9 cm. diameter) was sprayed with each dinitro formulation at the rate of 8 pounds DNOSBP equivalent in 40 gallons of water per acre. After the water had evaporated from the filter paper, it was inserted into the cellophane case containing the cotton seedlings growing in soil in a 3 inch clay pot. In order to avoid contact with the seedlings the treated paper was fastened to the inside of the case 10 inches above the tops of the cotton seedlings. The open end of the cellophane case was then sealed with a hot iron and the cotton seedlings were exposed to the vapor for a period of 48 hours at a temperature ranging from 73° to 90°F. At this time the plants were given a relative vapor activity rating. This rating was based on the relative injurious effects due to vapors in the enclosed bags compared with similarly enclosed untreated plants. The plants were then removed from the bags and placed in a greenhouse for 5 days at which time they were again examined for degree of injury and percent killed.

Under the conditions of these experiments the vapors from all 6 dinitro formulations were active on young cotton seedlings and caused varying amounts of injury. The vapors of formulations containing the ammonium salt of DNOSBP were most injurious. The vapors from the triethanolamine salt formulation were intermediate in activity, and the alkanolamine salt formulations least injurious.

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

A ROOT ELONGATION TEST FOR HERBICIDE SCREENING

James W. Brown[1]

It should be emphasized at the outset that, unfortunately, there is no single screening test which can furnish information regarding all the herbicidal potentialities of unknown compounds. Neither is there a single species which can serve as a "universal" test plant. A summary of herbicide screening has been made by Norman, Minarik, and Weintraub (2) in 1950.

The use of root measurements of red clover for determining the presence of 2,4-dichlorophenoxyacetic acid (2,4-D) in soil is described in a paper by Nutman, Thornton, and Quastel (3) where the work is mentioned as having been initiated in November, 1941, at Rothamsted. Since that time Swanson (5) in 1946 described a bio-assay which was used during some of the war years for screening. In this test corn was germinated in distilled water in Petri dishes for 48 hours at which time root lengths of 15-25 mm. were obtained. These seeds were then transferred to other Petri dishes containing aqueous solutions of chemicals to be tested. After another 48 hours root measurements were made and, after subtracting the initial root lengths, the percent of inhibition of root elongation was obtained for the latter period of growth. Ready and Grant (4) in 1947 described a somewhat similar test but used cucumber seeds without pre-germination. Mitchell and Brown (1) in 1947 used inhibition of root elongation of mustard seed in testing various stages of germination for sensitivity to 2,4-D.

In order to adapt the use of inhibition of root elongation to a screening test currently used, and to be described here, certain modifications of these prior tests were necessary. It was considered desirable to include several species and as a result seeds of 13 different species consisting of 7 broadleaves and 6 cereals are used routinely in conducting our root tests. By increasing the number of species it was necessary to limit the number of seeds of a given species to be used.

A modified Ragdoll technique of germinating seeds has been employed to germinate the test species. Seed rolls are prepared using Whatman #1 filter paper in 3-inch strips either 9 or 18 inches long (depending on seed size) with a ½-inch strip of #400 "Scotch" Brand Pressure-sensitive Tape (which has adhesive on both sides) placed along one edge of the filter paper. On top of this strip of tape a ½-inch strip of filter paper is placed which is about 2 inches shorter and which has ¼-inch holes on ½- or 1-inch centers. Fifteen seeds of a species are spotted on the exposed portions of the tape, the filter paper rolled with the seeds inside, and the roll held closed by the extra length of pressure tape. This pressure tape has the property of retaining its adhesiveness for the duration of the test under conditions of high humidity. Generally, when the seed rolls are opened out flat the seeds still adhere to the tape. The rolls are up-ended in 4-inch high paper drinking cups.

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The test solutions are poured over the seed rolls and the cups placed in metal trays 19 x 22 x 6 inches having perforated false bottoms and containing a ½-inch layer of water. The trays are covered with glass and serve as humidity chambers. They are kept at a temperature of 78 or 84° F. for 72 or 96 hours (depending upon the species), after which period the seed rolls are opened and the root lengths measured to the nearest centimeter. Since the roots respond to gravity, they are much straighter than when grown on a horizontal surface and consequently are easier to measure. Of the fifteen seeds planted on each roll, measurements are taken of the ten longest roots. The average root length of the group of ten seeds is used for computing the percent of inhibition of root elongation on an untreated control basis:

$$\left(\frac{C - T}{C} \times 100\right) = \%\ \text{Inhibition}$$

In cases where the root elongation is obviously affected for some reason other than the presence of a test compound, for example, profuse fungal or bacterial contamination or if the control root lengths are less than an average of 5 cm., the test is rerun. It is estimated that more than 95% of the rolls have 10 roots of acceptable lengths.

Aliquots of 50 mgs. of chemical are weighed and brought to 25 ml. volume in 100% acetone. Only 2.5 ml. of this stock solution is needed for the root test which is run at 3 concentrations, namely, 0.1, 1, and 10 ppm in tap water containing 0.5% acetone. The remainder of the 2,000 ppm stock solution is used in other screening tests in our program. A standard solution of 2,4-D is tested routinely on each species each time at the 1 ppm level. Each test also contains an untreated control consisting of 0.5% acetone in tap water. The inclusion of 1% Tween 20 in these test solutions was considered but was discarded when it was found that solutions containing Tween went through the paper cups. It was thought more desirable in this case to retain the paper cups with the elimination of a dishwashing problem attended by the possibilities of chemical contamination. The cups and filter papers are used only once and then discarded.

With this test 18 compounds are currently assayed each week at three dosage levels. This work load requires 780 seed rolls and is the limiting factor in increasing production. Desirable features of the test are that not much chemical is needed to test many species at three concentrations, the information is obtained in 3 to 4 days, greenhouse space is not required, about 24 square feet of shelf space is sufficient for our scale of operation, there is no dishwashing problem, and the time required to set up a test is small when it is considered that solution and seed roll preparation can be accomplished ahead of time.

At present, the results of these root tests are being kept on needle-sort punch cards. Where it is anticipated that there will be a considerable number of chemical compounds to be tested, machine punch cards eventually would be preferable. However, it may prove advisable to start with a needle sorting system until sufficient compounds have been tested to furnish experience with the types of questions to be asked of the records with the advantage that the set-up on machine cards could be coded accordingly.

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N-1 NAPHTHYL PHTHALAMIC ACID AND CRAG HERBICIDE 1 ON CUCUMBERS, MUSKMELONS, WATERMELONS, AND SQUASH

By R. D. Sweet and S. K. Ries

The cucurbit or vine crops are difficult to maintain free of weeds particularly during the harvest period due to their growth characteristics. Warren (3), Meador and Hemphill (1), and Sweet and Ries (2) have reported success with N-1 Naphthyl phthalamic acid[1/] (PA) for weed control in vine crops.

The purpose of the tests reported here was to determine: (1) The performance of three PA formulations as to weed control and vine crop yields at various locations in New York State, (2) The effects of time and rate of application, and (3) The effect of chemicals on culinary quality of the crops.

General Methods

Three formulations were used: N-1 Naphthyl phthalamic acid (formulation 1), N-1 Naphthyl phthalimide (formulation 2) and a 50-50 mixture of acid and imide (formulation 3). Chemicals were applied at the rate of two and four pounds in 30 to 45 gallons of water. Sprays were applied on a two-foot strip directly over the crop row at 30 pounds pressure with a small plot sprayer. Row spacing varied from four to eight feet. The row middles were cultivated in a normal, commercial manner, also crop fertilization and insect and disease control were handled with standard procedures.

WATERMELONS (*Citrullis vulgaris*)

Due to a limited acreage of watermelons in New York, only one test was conducted with this crop. The Honey Cream variety was direct-seeded on a Dunkirk fine sandy loam soil June 6, 1952. Past history of the plot area was not uniform and resulted in a rather high degree of variability in crop yields. The crop was irrigated three times to supplement natural rainfall. It received regular applications of Zerlate and Parathion for disease and insect control.

Two sprays were applied, immediately after emergence and pre-vining. A split-plot factorial design with four replications was devised which permitted single and combination treatments. On July 5, hereafter referred to as "early" some of the plots were treated with two and four pounds of formulation 1. Spraying was done immediately after the entire area had been cultivated and all plots hoed, <u>including</u> the checks. The pre-vining or "late" treatment included Crag 1 as well as formulation 1 of PA and was applied in the same manner as the "early" treatment. All plots <u>except</u> the checks were weeded prior to treating. A summary of the yields obtained is presented in Table 1.

From the table it is apparent that Crag 1 significantly reduced yields. Weed competition probably accounts for the relatively low yield of the no chemical plot, treatment 4. The data indicate a trend towards lower yields whenever the total quantity of PA applied was more than four pounds.

1/ Recently named "Alanap" by Naugatuck Chemical Co.

Table 1.

WATERMELON YIELDS FROM POST-EMERGENCE TREATMENTS OF N-1 NAPHTHYL PHTHALAMIC ACID AND CRAG 1

Number	Treatment Material Early	Treatment Material Late	Mean Yield In Pounds Per Plot
1)	Check	2 lbs. PA 1	70.2
2)	"	4 lbs. PA 1	99.8
3)	"	4 lbs. Crag 1	44.5
4)	"	Check	51.2
5)	2 lbs. PA 1	2 lbs. PA 1	76.2
6)	" "	4 lbs. PA 1	52.5
7)	" "	4 lbs. Crag 1	35.0
8)	" "	Check	79.8
9)	4 lbs. PA 1	2 lbs. PA 1	58.0
10)	" "	4 lbs. PA 1	49.7
11)	" "	4 lbs. Crag 1	36.2
12)	" "	Check	61.8

In Table 2 are presented the analysis of variance data. Two of the significant interactions are caused largely by the presence of Crag 1 in the second treatment. However, in the comparison involving rates of PA, it is apparent another factor, probably total amount applied, is causing the differential response.

Weed control was of a commercial nature in all treated plots regardless of chemical or rate. Those receiving four pounds or more of PA were almost free of weeds, whereas those with less PA would have required at least one hand hoeing.

Table 2.

ANALYSIS OF VARIANCE FOR WATERMELON YIELDS
OF PLOTS TREATED WITH COMBINATION POST-EMERGENCE TREATMENTS
OF N-1 NAPHTHYL PHTHALAMIC ACID AND CRAG 1

Source	D. F.	M. F.
First Treatment	2	
Check vs PA	1	1127
2 lbs. vs 4 lbs. PA	1	712
Error a	6	435
Second Treatment	3	
Check vs Chemical	1	348
Crag 1 vs PA	1	6805**
2 lbs. vs 4 lbs. PA	1	5
First Treatment X Second Treatment	6	
Check vs PA x Check vs Chemical	1	3154**
" x Crag 1 vs PA	1	514
" x 2 lbs. vs 4 lbs. PA	1	2760**
2 lbs. vs 4 lbs. PA x Check vs Chem.	1	196
" x Crag 1 vs PA	1	184
" x 2 lbs vs 4 lbs PA	1	240
Error b	27	338

** F value significant at the 1% level
Coefficient of variability = 30.8%

CUCUMBERS (*Cucumis sativus*)

Both pickling and slicing types of cucumbers are produced in New York. Newly introduced varieties have mosaic resistance, therefore three varieties were included: York State m. r. pickling, Niagara m. r. slicer, and Marketer, a standard slicer. The experimental area was a silt loam soil of better than average fertility. A split-plot factorial design with three replications was used. The pre-emergence chemicals were applied June 13, six days after planting. The soil was dry. Plants emerged unevenly from June 16 to 18. On July 23, those plots which were to receive only a pre-vining treatment were treated immediately following hand hoeing and cultivating. The plots which received the pre-emergence application were cultivated but not hand hoed. In this test no plots received both a pre- and post-emergence application.

Yield records as presented in Table 3 are the average of both the pre- and post-emergence plots. An excellent crop was obtained, particularly from the mosaic resistant varieties. About three tons per acre were harvested

Table 3.

CUCUMBER YIELDS AND WEED CONTROL FROM PRE- AND POST-EMERGENCE TREATMENTS OF N-1 NAPHTHYL PHTHALAMIC ACID AND CRAG 1

Treatment	Crop Yields[1]			Weed Control[2]		
	York State (number)[3]	Niagara (lbs.)	Marketer (lbs.)	Treat-ment	Chem Ave.	Rate Ave.
1) 2 lbs. PA 1	152	28.3	20.8	5.3	6.4	
2) 4 lbs. "	143	31.2	17.8	7.4		
3) 2 lbs. PA 2	153	31.3	23.3	2.8	3.5	
4) 4 lbs. "	160	38.0	15.5	4.2		
5) 2 lbs. PA 5	145	32.5	19.3	4.5	5.6	
6) 4 lbs. "	164	28.5	20.8	6.6		
7a) Check Pre-E	153	32.3	14.3	2.7		
7b) 4 lbs Crag 1 Post-E	139	31.3	14.3	- -		2 lb-4.2 4 lb-6.1
L. S. D. at 5%	N. S.	N. S.	N. S.	2.2	1.5	1.2
L. S. D. at 1%				2.9	2.1	1.6
Coef. of Var.	18%	23%	35%		48%	

1. Average of both the pre- and post-emergence plots
2. Weed control ratings based on pre-emergence plots only. No later weeds developed due to dry weather. 1= no weed control, 9= perfect control.
3. Numbers are believed to give a better estimate of yield than weight with pickling varieties.

from them in the first six harvests, and many more remained on the vines. No chemical significantly reduced yields. Due to extremely dry weather no new weeds germinated following the July 23 treatments. Weed control results are presented therefore for only the pre-emergence plots.

It is shown in Table 3 that commercial weed control was obtained with either four pounds of formulation 1 or of formulation 5. Formulation 2 did not give satisfactory control.

Samples were processed for study as to culinary quality, but the results are not yet available.

WINTER SQUASH

On a plot immediately adjacent to the cucumber test an identical experiment was conducted with three varieties of winter squash: Buttermut (Cucurbita moschata), Blue Hubbard (Cucurbita maxima), and Table Queen (Cucurbita pepo). Date of planting was June 20, and the pre-emergence treatments were applied one week later.

Weed control and yield results are presented in Table 4. Squash yields were very good, with Blue Hubbard producing about 16 tons. Table Queen was extremely variable having a coefficient of variability of 40 per cent. No chemical or rate significantly reduced yields.

Weed control was good but not excellent with the four pound rates of formulations 1 and 5. Results with formulation 2 were poor.

Table 4.
SQUASH YIELDS AND WEED CONTROL FROM PRE- AND POST-EMERGENCE TREATMENTS OF N-1 NAPHTHYL PHTHALAMIC ACID AND CRAG 1

Treatment	Yield in Pounds			Weed Control[1/]		
	Buttermut	Table Queen	Hubbard	Treat-ment	Chem. Ave.	Chem. Rate
1) 2 lbs. PA 1	58.0	31.0	121.5	5.0	5.4	
2) 4 lbs. "	56.0	28.1	157.0	5.8		
3) 2 lbs. PA 2	70.6	33.3	146.8	3.3	3.9	
4) 4 lbs. "	50.2	35.3	180.6	4.6		
5) 2 lbs. PA 5	55.7	30.8	163.5	5.4	5.9	
6) 4 lbs. "	63.2	20.8	160.2	6.3		
7) Check	60.0	31.8	154.2	2.6		2 lb = 4.6 4 lb = 5.6
L. S. D. at 5%	N. S.	N. S.	N. S.	1.4	1.0	0.8
L. S. D. at 1%				1.9	1.3	1.1
Coef. of var.	15%	40%	19%		31%	

MUSKMELONS (*Cucumis melo*)

Since commercially the most interest in vine crops is with muskmelons plots were located in six producing regions of the state. These were incorporated into parts of farmers fields and received standard practices for that farm. All were cultivated, but hand work was not done until after records on weed control were obtained.

All chemicals were applied post-emergence. In some instances the fields were free of weeds at that time, and in others weeds were three to four inches tall. There were three replications of the same chemicals and rates as used in the other vine crop tests.

Certain generalizations can be drawn from this series of tests.

First, no formulation or rate of PA caused injury, whereas Crag 1 was toxic at all locations.

Second, neither PA nor Crag 1 controlled weeds that were already well established.

Third, the majority of weeds causing trouble at harvest time germinated within a few weeks of planting. Controlling these weeds meant for clean fields at harvest. This may have been due to the very dry growing season of 1952.

Samples were obtained from two locations and replicated culinary tests for flavor and sweetness were conducted. In addition, refractive indices for percent of sugar were obtained. No difference due to treatment could be noted. There was a good correlation between refractive index and rating by the taster, but no correlation between this index and treatment.

SUMMARY

The vine crops: cucumbers, muskmelons, watermelons, and winter squash were successfully weeded by application of four pounds of N-1 Naphthyl phthalamic acid applied either pre- or post-emergence. At no location, in any of the nine tests conducted in 1952, was the chemical injurious to the crop. Weed control was only fair with two pounds of the chemical or with four pounds of the 50-50 N-1 Naphthyl phthalimide plus acid mixture. The "imide" alone gave poor weed control.

Annual weeds, both broadleaves and grasses, were controlled provided the chemical was applied before they had emerged. Only in a few instances were emerged weeds stunted or killed. Such species as purslane (*Portulaca oleracea*), red root (*Amaranthus retroflexus*), lambs quarter (*Chenopodium album*) and crab grass (*Digitaria sp.*) were readily controlled when treated before emergence.

Crag 1 was injurious to muskmelons and watermelons when applied after emergence, but did not reduce yields of cucumbers. It was not applied to squash.

PA did not affect the culinary quality of muskmelons. Taste tests on the other vine crops are not yet completed.

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WEED CONTROL IN CANTALOUPES WITH PA IN 1952[1/]

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Weeds during the first two months of the growing season are usually a serious problem for cantaloupe growers in Delaware. Cantaloupes are seeded the latter part of April or early May while the soil is still cold. Under these conditions, cantaloupe plants emerge slowly and consequently cannot compete with faster growing weeds. Tedious hand hoeing is then necessary. Warren (2) and Sweet and Ries (1) reported that N-1 naphthyl phthalamic acid (PA) was quite promising as a selective herbicide for cucurbits. The following experiment was set up in 1952 to test PA under Delaware conditions.

Experimental Procedure

Seed of the Jumbo Hale's Best variety was planted on May 8, 1952 at the Georgetown Substation on Norfolk loamy sand. Treatments as listed in Table 2 were replicated four times in a randomized block arrangement. The PA used was a 90 per cent wettable powder (formulation 1-6Q8) of N-1 naphthyl phthalamic acid supplied by the Naugatuck Chemical Division of U. S. Rubber Company. Rates of application per acre as listed in Table 2 are those of the wettable powder in 50 gallons of water. Pre-emergence applications were made on May 13, five days after seeding, while post-emergence treatments were made on June 3, 26 days after seeding when the melon plants were about on and one-half inches tall. Single-row plots, 40 feet long and six feet wide were used. Plots in Treatment 2 were cultivated and hoed when necessary according to commercial practice. All other plots were cultivated whenever necessary but not close to the rows, i.e., within six inches of the row. On June 13 weed counts were made on a one by three foot area over the row on each plot. This area was arbitrarily taken six feet from the end of each plot. Weeds were pulled, counted, clinging soil shaken from the roots, and weighed. On this same date the cantaloupe plants in a six-foot section of row were counted. On June 20, before the vines started to spread, all plots were thoroughly hoed and thinned to a uniform stand. For the remainder of the season all plots were cultivated similarly. Daily rainfall and mean temperatures for the two weeks following seeding are presented in Table 1. It can be seen that there was light rainfall the day before and four days after pre-emergence applications were made, probably enough for good weed germination.

Table 1. Daily Rainfall and Mean Temperatures, May 8 to 22, 1952, Georgetown, Delaware

	May														
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Daily Rainfall, inches	0	0	T	.06	.35	0	0	0	0	.60	.08	.04	.42	0	0
Daily Mean Temperature, °F	50	64	66	72	58	53	59	69	66	59	59	52	58	67	67

1/ Published as Miscellaneous Paper No. 156 with the approval of the Director of the Delaware Agricultural Experiment Station. Contribution (No. 39) of the Department of Horticulture, Nov. 1952.

Results and Discussion

Marketable yields, stand, and weed counts are presented in Table 2. Total and early yields, those during the first ten days of the harvest season, were not significantly affected, on a statistical basis, by any of the PA treatments. Neither was there any evidence of crop injury from any of the PA treatments except, possibly, for a slight temporary retardation of growth following the PA applications. Early yields are lower where PA was used, although not significantly so. The average weight of marketable melons in any treatment was not significantly different from that of the hoed-check treatment. However, melons averaged the least, 2.1 pounds, on the plots receiving the most PA, 4 pounds pre- and 4 pounds post-emergence. Those on the hoed-check plots averaged 2.4 pounds. Plant stand was not significantly affected by any treatment.

The weed population - consisting chiefly of crab grass, lamb's quarters, pigweed, ragweed, and carpet weed - was much reduced by all rates used. The two-pound pre-emergence application gave control reasonably sufficient for commercial use. On June 13 - 36 days after seeding and 31 days after the PA was applied - the average number of weeds per three square feet on plots receiving this treatment was ten while the comparable figure for the unhoed plots was 143. Furthermore, the few weeds on the treated plots were much smaller in comparison with those on the untreated plots.

Summary and Conclusions

PA (N-1 naphthyl phthalamic acid) proved a very effective selective herbicide for controlling certain broadleaved weeds and crab grass in cantaloupes in 1952. Two pounds of a 90 per cent wettable powder of PA in 50 gallons of water per acre, when applied five days after seeding, was sufficient to control weeds during the first six weeks of the growing season, which is the critical period under Delaware conditions. This treatment had no adverse effect on the stand of cantaloupe plants, nor on their growth except possibly a slight temporary retardation. Total marketable yields and size of melons were not significantly affected by the 2-pound rate of PA. There was an indication, however, that early yield, during the first 10 days of the harvest season, was somewhat reduced by this treatment.

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Table 2. The Effect of Pre- and Post-Emergence Application of PA on Cantaloupe Yield and Stand, and on Weed Counts in 1952 at Georgetown, Delaware.

Treatment	Marketable Melons from 4 Plots		Av. Wt. Mkt. Fruit, lb.	Stand June 13, Plants per 6 Ft. Row	Weeds per 3 Sq. Ft., June 13		
	Total	Early[1]			Broad-leaved, No.	Grasses No.	Total Wt. Grams
1. Check, not hoed	65	23	2.7	6	30	113	171
2. Check, hoed	80	44	2.4	5	0	1	1
3. PA, 2 lbs. pre-emergence	77	33	2.6	5	1	9	5
4. PA, 4 lbs. pre-emergence	70	36	2.3	6	2	13	13
5. PA, 2 lbs. pre-emergence + 2 lbs. post-emergence	63	30	2.6	5	3	12	6
6. PA, 4 lbs. pre-emergence + 4 lbs. post-emergence	66	30	2.1	4	2	5	4
L.S.D., 5% Point	N.S.	N.S.	0.4	N.S.	21	28	34

[1] Yield during first 10 days of season.

Chemical Weeding of Beets

Charles J. Noll and Martin L. Odland*

Salt (Na Cl) has been used most commonly as an herbicide for the weeding of beets. The salt is applied in a post-emergence application at the rate of 400 pounds per acre applied in 200 gallons of water after 4 to 5 true leaves have formed on the seedling plants. A number of serious weeds in onion fields, such as purslane, lambs quarters, and annual grasses have not been controlled by this treatment.

At the meeting of the Research Coordination Committee of the Northeastern Weed Control Conference for 1952 it was suggested that further work be done using CMU and Endothal in pre-emergence treatments. These two herbicides and TCA were used in this experiment as a comparison with the conventional salt treatment.

Procedure

Three pre-emergence chemicals were used in this experiment: TCA at 10 pounds per acre, CMU at ½ pound per acre and Endothal at 6 pounds per acre. These three chemicals were used in all possible combinations at this rate and at ½ of this rate making a total of eleven pre-emergence treatment plots. The twelth treatment was salt put on by the post-emergence method at the rate of 400 pounds per acre applied in 200 gallons of water. These treatments were arranged at random in each of ten replicated blocks measuring 20 feet by 18 feet. Each chemical treatment consisted of a single row 20 feet long and 18 inches wide. The herbicides were applied with a small sprayer over the row for a width of eight inches.

The land was prepared the 23rd of April and the beets seeded the 24th of April. The pre-emergence herbicides were applied the 26th of April and the salt in the post-emergence application on the 4th of June.

Results and Discussion

The results of the experiment are presented in Table 1. Weed control was estimated on the basis of 1 to 10, 1 being perfect weed control and 10 no weed control. Significantly

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poorer weed control was obtained from the uncombined TCA and CMU treatment than from the salt treatment. Endothal resulted in no significant difference from that of the salt treatment. In combination at half the rate no treatment was better than the salt treatment and TCA and CMU in combination was significantly poorer. In combination at full strength three combinations were significantly better than the salt treatment in regards to weed control. These were in order of control: Endothal, CMU and TCA, Endothal and CMU, and Endothal and TCA.

Records of beet yields show no significant difference in number of marketable beets per plot. Weight of marketable beets per plot varied significantly but none of the plots varied significantly from the salt treatment. TCA and CMU used alone significantly reduced the yield as compared to the better yielding plots due probably to lack of weed control. The best yields were obtained where Endothal was used alone or as one of the herbicides in the combination.

Conclusion

Of the three chemicals tested and at the rate used Endothal gave the best weed control. The amount of weed control was greatly increased when Endothal was combined with CMU and TCA or both. Number of marketable beets per plot was unaffected by the treatments. Yields were generally better where Endothal was one of the pre-emergence herbicides although differences were small.

Table 1. The effect of pre-emergence herbicides alone and in combination on weeds and number and weight of marketable beets in 1952.

Herbicide and Time of Application	Rate lbs. per acre	*Weed Control	Marketable Beets per plot Number	Marketable Beets per plot Wt. lbs.
Pre-emergence				
TCA	10	8.2	37.1	3.18
CMU	$\frac{1}{2}$	7.8	33.5	3.06
Endothal	6	4.3	42.0	4.33
TCA & CMU	$5 + \frac{1}{4}$	8.0	42.9	4.10
TCA & Endothal	$5 + 3$	5.0	42.4	4.52
CMU & Endothal	$\frac{1}{4} + 3$	6.4	39.8	4.20
TCA & CMU & Endothal	$5 + \frac{1}{4} + 3$	5.3	36.0	4.18
TCA & CMU	$10 + \frac{1}{2}$	6.1	32.2	3.27
TCA & Endothal	$10 + 6$	3.3	39.0	4.37
CMU & Endothal	$\frac{1}{2} + 6$	2.7	32.9	4.31
TCA & CMU & Endothal	$10 + \frac{1}{2} + 6$	2.4	37.6	4.51
Post-emergence				
Salt	400	5.2	38.4	3.86
Least significant difference at .05 level		1.8	N.S.D.	.98
Least significant difference at .01 level		2.3	N.S.D.	1.30

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

Experimental and Field Use of 3-Chloro-IPC On Vegetable Crops in Tidewater Virginia.*

by

L. L. Danielson 1/ and Virginia A. France 2/

Introduction

Increasing labor costs and, in many locations, the gradual diminution of supply of hand labor available to the fresh market vegetable crop grower has resulted in a large shift from vegetable to field crops such as corn, soybeans and small grain which require very little hand labor. Any new methods which will lower production costs will have a direct bearing in determining whether these acres now in field crops will be returned to vegetable production. It is hoped that chemical weeding of vegetable crops will aid in the return of vegetable crops to these areas.

One of the most promising of the new herbicidal chemicals used in our trials on vegetable crops in Tidewater Virginia is 3-Chloro-IPC (Isopropyl N 3-chloro phenyl carbamate). This work on 3-Chloro-IPC has extended over a period of three years involving greenhouse trials, field trials, and close supervision of introduction into commercial useage. Time and space do not permit the presentation of all of the data accumulated during this period but representative data will be presented along with general conclusions from all phases of the work.

Experimental Procedure and Results

Initial field experiments were concerned with control of weeds in spinach. Trials were designed to determine which weeds could be controlled, the minimum dosage rate which would accomplish this, and tolerance of deep and shallow planted spinach to this minimum rate. Table 1 below presents results of a representative series of treatments studying these effects.

* Acknowledgement is made to the Columbia-Southern Chemical Corporation for assistance in this work provided by a grant-in-aid and to the American Chemical Paint Company for supplying generous quantities of the material for grower trials.

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Table 1. Effect of Various Amounts of 3-Chloro-IPC on Weed Control and Growth of Old Dominion Blight Resistant Spinach. Chemical Applied Immediately After Planting in 100 Gals. Water Per Acre. Planting Date 10-13-50.

	Lbs. 3-Chloro-IPC Per Acre			
Shallow Planted Spinach (approx. ¼ inch)	0	2	4	6
Av. No. Plants Per Plot	168	147	135	80
L.S.D. (5%) 34.4 (1%) 48.2				
Av. % Killed	-	12.5	19.7	52.4
Av. Fr. Wt. Per Plant (Grams)	20.5	13.4	37.2	14.3
L.S.D. (5%) 3.3 (1%) 5.4				
Chickweed Av. No. Plants Per Sq. Yd.	76	0	0	0
Av. % Killed	-	100	100	100
Henbit Weed Av. No. Plants Per Sq. Yd.	177	178	184	106
Av. % Killed	-	0	0	40.1
Deep Planted Spinach (approx. 1½ inches)				
Av. No. Plants Per Plot	162	139	99	45
L.S.D. (5%) 31.5 (1%) 44.1				
Av. % Killed	-	14.0	38.9	72.1
Av. Fr. Wt. Per Plant (Grams)	1.8	1.9	3.2	5.9
L.S.D. (5%) 2.3 (1%) 3.2				
Chickweed Av. No. Plants Per Sq. Yd.	79	0	0	0
Av. % Killed	-	100	100	100
Henbit Weed Av. No. Plants Per Sq. Yd.	203	193	165	105
Av. % Killed	-	4.9	18.7	48.3

These results show that the rate of two pounds per acre gave complete control of chickweed but very little or no control of henbit weed. Significant reductions in spinach stand occurred at this two pound rate but such reductions in stand before thinning in commercial acreages would not ordinarily be serious since a heavy seeding rate is normally used to insure a good stand. Corroborative evidence was obtained in further trials of this character showing that practical control of chickweed could be obtained at this rate without serious injury to the spinach if planted during warm weather.

Success of these field trials on spinach indicated further use of this minimum weeding rate on other leaf crops and results of trials on kale and collards showed that these crops were also tolerant of weedkilling dosage

rates of 3-Chloro-IPC but that they were not as tolerant as spinach. These observations suggested a trial in which the length of the period of initial growth retardation caused by the chemical would be determined in a general way. Table II below presents data on such a trial conducted in the field.

Table II. Time Required For Spinach, Kale and Collards to Recover From the Initial Growth Retardation Produced by 3-Chloro-IPC Applied Immediately After Planting in 100 Gals. of Water Per Acre. Planting Date 5-31-51.

	Lbs. 3-Chloro-IPC Per Acre			
	0	1	2	3
Kale (Vates Blue Scotch)				
Av. Wt. Per Plant (Grams)				
48 Days	10.1	9.7	8.6	7.7
% Killed	-	11.9	22.0	48.7
Collards (Vates Cross)				
Av. Wt. Per Plant (Grams)				
48 Days	17.9	17.3	19.1	17.7
% Killed	-	9.7	9.7	28.1
Spinach (Old Dominion Blight Resistant)				
Av. Wt. Per Plant (Grams)				
39 Days	3.7	4.7	7.10	6.5
% Killed	-	0	0	0
Weeds % Killed				
Galensoga	-	33.4	18.8	27.8
Purslane	-	91.0	98.0	99.1
Crab Grass	-	73.3	93.3	89.8

These results show that spinach was only slightly retarded, whereas kale and collards required a considerably longer period for recovery under these conditions. The record on weed control in this experiment was excellent for purslane and crab grass with only slight control of galensoga at the two pound per acre rate of the chemical.

It was desired to determine the relative tolerance of a number of crops to the minimum weed killing rate of two pounds of 3-Chloro-IPC per acre applied immediately after planting. Since controlled conditions were needed, an experiment was arranged in two-gallon glazed pots in the greenhouse, using a sandy loam soil characteristic of this area. Tables III and IV below present a very brief summary of some of the data from this experiment.

Table III. Effect of Two Pounds Per Acre of 3-Chloro-IPC Applied Immediately After Planting of a Number of Vegetable Leaf Crops. Determination of Length of Growth Retardation Period. Planting Date 1-17-52.

Crop	* No. Days From Planting to Recovery	% Killed By Treatment
Spinach (Old Dominion Blight Resist.)	No wt. diff.	0
Kale (Vates Blue Scotch)	32	2.6
Collards (Cabbage Collards)	18	0.6
Broccoli (Italian Green Sprouting)	39	9.5
Cabbage (Round Dutch)	33	3.4
Mustard Greens (Giant Curled)	Killed	100
Turnip Greens (Large White Globe)	No wt. diff.	0
Hanover Salad Greens	31	5.4

* As determined by weekly weights which showed when treated and untreated plants no longer differed significantly in weight.

Table IV. Effect of Two Pounds Per Acre of 3-Chloro-IPC Applied Immediately After Planting of a Number of Vegetable Seed, Fruit, and Root Crops. Determination of Length of Growth Retardation Period. Planting Date 3-19-52.

Crop	* No. Days From Planting To Recovery	% Killed By Treatment
Potatoes (Sebago)	No diff.	10.0
Soybeans (Tokyo)	16	0
Lima Beans (Fordhook 242)	16	2.5
Snap Beans (Top Crop)	23	10.0
Sweet Corn (Aristogold)	29	3.5
Tomatoes (Rutgers)	31	5.0
Beets (Detroit Dark Red)	31	0
Peppers (California Wonders)	35	0

* As determined by plant height measurements and subsequent determination of fresh weight per plant of treated and untreated plants did not show significant differences.

Results of these greenhouse trials on vegetable leaf crops given in Table III showed that spinach and turnip greens were very tolerant of the standard two pound per acre application of 3-Chloro-IPC. All other crops were tolerant to a lesser degree with the exception of mustard greens which were killed. All of these leaf crops were considered to have a practical tolerance with the exception of mustard greens.

Results given in Table IV showed that all of these crops were tolerant to some degree. Whether this tolerance is practical must be determined by field trials carrying these crops to maturity.

These preliminary trials concerned with minimum weed killing rate and crop tolerance have been followed by field trials concerned with determining whether practical application of these methods may be made. In Table V, which follows, a summary of results from a number of field trials testing the method for practicality are presented.

Table V. Summary of Field Trial Results on the Practical Use of Two Pounds of 3-Chloro-IPC Per Acre Applied in 50 Gallons of Water Immediately After Planting Various Vegetable Crops.

Crop	Planting Date	Yield - Lbs. Per Plot *	
		Control	Treated
Broccoli (Decicco)	8-14-52	35.6	38.9
Cabbage (Round Dutch)	8-14-52	37.6	40.5
Collards (Cabbage Collards)	8-17-51	109.0	109.1
Collards (Vates Cross)	8-14-52	40.9	43.5
Hanover Salad	8-14-52	21.8	24.9
Kale (Vates Blue Scotch)	8-17-51	68.1	68.6
Spinach (Old Dominion Bl. Resist.)	10-27-51	39.8	37.9
Turnip Greens (Large White Globe)	8-14-52	21.1	19.9
Strawberries (Blakemore) 5 applications	3-13-51	87.8	79.7

Weed Control - Commercially acceptable in all cases.

* Differences between control and treated not significant in any case except spinach where yield was reduced due to cool weather following application of chemical.

These data show that practical field use of the material may be possible on a commercial basis. Grower observation of trials during this three year period led to large scale grower trials of the use of two pounds of 3-Chloro-IPC per acre on vegetable leaf crops in the Tidewater area of Virginia during the 1952 season. This large scale use resulted from a severe labor shortage as only small trials were recommended. Growers in many cases treated all of their acreage of some leaf crops assuming all responsibility. Very close contact was maintained with all growers using the material to insure correct useage. Over 2,000 acres of these crops were treated in this area in 1952. In no case was a crop lost due to treatment. Two small areas failed to get commercially acceptable weed control and this appeared to be due to the extremely dry weather which prevailed during which the chemical was dissipated before the weed seed germinated.

Experimental trials are continuing and commercial field areas which are treated are being observed for any irregularities in results.

Discussion & Conclusions

Minimum Weed Killing Rate of Application: May 1st to October 15th - two pounds per acre applied in 50 to 100 gallons of water. October 15th to May 1st.- one pound per acre in 25 to 50 gals. of water. The higher water rate in each case is suggested for dry soil conditions.

Weeds Controlled: Summer Weeds - crab grass (Digitaria sp.), bull grass (Eleusine Indica) and purslane (Portulaca oleracea). Winter Weeds - chickweed (Stellaria media), and annual blue grass (Poa sp.). Results on chickweed have been described in an earlier paper by Danielson (2).

Timing Application of Spray: Apply spray immediately after planting in all cases. This agrees very well with the results of Noll and Odlund on spinach (4).

Tolerant Leaf Crops: Spinach, kale, collards, broccoli, turnip greens, Hanover salad, and cabbage and beets for greens are tolerant.

Tolerant Vegetable Seed, Fruit and Root Crops: Snap beans, lima beans, soybeans, tomato seedings, pepper seedings, beet seedings, sweet corn, Irish potatoes, and strawberries are tolerant. Field trials run to maturity must be conducted on these crops to further substantiate the preliminary results obtained.

Crops Not Tolerant: Mustard greens and radishes not tolerant.

Depth of Planting: Usual field practice should be followed.

Effect on Crop Growth: All crops listed as being tolerant of the two pound per acre rate of application are usually somewhat retarded in the early stages of growth. This period varies in length from one crop to another but results on leaf crops indicate that recovery occurs early enough to prevent yield losses. Yield effects on other crops must be determined.

Effect of Temperature on Results: Continuous thermographic records have been made during the course of these trials and temperatures have been placed on a cumulative basis by calculating the number of degree hours above 40°F. in three weeks following planting and treatment as reported in an earlier paper by Danielson and France(3). Compilation of results from all trials conducted have indicated that 12,000 or more degree-hours above 40°F. must be accumulated during this three week period following application of two pounds of 3-Chloro-IPC per acre on newly planted spinach if injury is to be avoided. Severe stand reductions and growth retardation have been experienced at 8,000 degree-hour levels. Reducing the rate to one pound per acre during that portion of the year when degree-hours accumulated during the three week period are less than 12,000 has proved

satisfactory in reducing injury to the spinach.

This close correlation of temperature level and injury has been evaluated previously by Ries (5) in greenhouse and field tests and agree very well with the results presented here. The recently published work of Anderson et al (1) offers laboratory evidence of the effect of temperature variations on the rate of volatilization of 3-Chloro-IPC and offers an explanation of these field findings.

The method of correlating temperature with results on the basis of degree-hours will be refined as additional information is developed. In trials being run at the present time a further climatic factor is being measured, namely, sunlight. This is being done with a "sunlight integrator" which gives a cumulative daily foot candle hour determination. It is hoped that these records of temperature, sunlight, and rainfall will aid measurably in evaluating field results.

Effect of Rainfall and Soil Moisture: Rainfall following treatment in field trials does not seem to reduce effectiveness unless surface erosion occurs.

Best results with the chemical are usually obtained when the soil is moist enough for quick seed germination at time of treatment.

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POST EMERGENCE APPLICATION OF FIVE HERBICIDES ON TEN VEGETABLE CROPS[1/]

By R. D. Sweet and S. K. Ries

One area of need for chemical weed control that has received little attention from research workers is the home vegetable garden. A wide variety of crops are involved, relatively few gardeners have suitable equipment, and, with many, exact timing is not possible. All of these factors make the task of finding suitable chemicals more difficult. On the other hand, the gardener is likely to accept somewhat more crop damage than is the commercial operator.

The purpose of the tests was to determine if any of the already available herbicides could be used safely as post-emergence sprays on a variety of vegetables. The ideal would be one chemical for the majority of important home garden crops. Therefore, crop response rather than weed control was used as the principal criterion of performance.

Methods

The following crops were studied: leaf lettuce, snap and lima beans, carrots, beets, cucumbers, cabbage, potatoes, tomatoes and sweet corn. Chemicals applied were: Crag 1, 2,4-Dichlorophenoxyethylsulphate, at two and four pounds; 6036, Bis(Dichloro) phenoxyethyl oxalate, at two and four pounds; Sesin, 2,4-Dichlorophenoxyethyl benzoate at four pounds; Chloro IPC, Isopropyl N 3-chloro phenyl carbamate, at four pounds; and CMU, 3-(p-chlorophenyl)-1,1-Dimethylurea, at 3/8 pound. All materials were sprayed directly over the crop rows as post-emergence treatments immediately following hand howing and cultivating. Seeding and transplanting were done over the period of June 7 to 10. Treatments were applied July 12, three days after several days of rain totaling four inches. The chemicals were applied in 33 gallons of water at 30 p. s. i. by means of a small-plot sprayer. Prior to experimental treatment potatoes and sweet corn received pre-emergence chemical treatments (three pounds DN and 3/4 pound 2,4-D respectively) and carrots were sprayed with Stoddard solvent in addition to cultivation. The other crops were hoed and cultivated as needed prior to treatment. Following post-emergence chemical application no further hand weeding was done until just prior to harvest, at which time all large weeds were removed to prevent seeding.

Each crop was planted in a rectangular block and the blocks grouped in an area of Dunkirk sandy loam soil approximately 125 feet square. Individual plots were 4 x 14 feet with three replications. The number of crop rows per plot were as follows: Tomatoes, cucumbers and cabbage, one row; sweet corn, potatoes, lima and snap beans, two rows; lettuce, carrots and beets, three rows. Recommended insect and disease control practices were followed. Irrigation was applied as needed.

1/ Part of this work was made possible by a grant from the Carbide and Carbons Chemicals Co. NY, NY

Results

Crop yields are presented in Table 1. In only one crop, leaf lettuce, did chemicals average below the check. This is probably due to injury and to the lack of weed competition in the check plots. Since lettuce is a quick growing crop and since it was weeded just prior to treating, insufficient time elapsed until harvest (14 days) for new weeds to be a factor. CMU was significantly more toxic than any other chemical. No leaf symptoms were observed in any plot.

Snap beans yielded at the rate of about two tons to the acre on the check and the Crag 1 plots. At the four pound rate 6036 was more toxic than Crag 1 or Sesin. CMU and Chloro IPC caused significant yield reductions. The four pound rate of 6036 resulted in leaves with a darker than normal green, whereas the CMU treated plants showed marginal leaf burn.

Lima bean response to chemicals was practically identical to that of snap beans.

Carrot foliage was not visibly affected by any of the chemicals. No treated plots yielded differently from the check.

Although beet yields show a fairly large numerical difference between the four pound rates of Sesin and 6036 as compared to the check or the other treatments, this difference is neither statistically nor practically significant. For an unexplainable reason one small area which contained two of the three replications of 6036 and Sesin, but only one replication of some of the others, produced noticeably poorer beet foliage, and yields.

Cucumbers were especially susceptible to Chloro IPC as measured by yield. Foliage symptoms, however, were not striking. Although some chlorosis and burning of the leaf margins was noted, there was not much stunting. CMU also cut yields. It, on the other hand, caused severe stunting and chlorosis.

Potatoes yielded at the rate of about 500 bushels per acre in the check plot, and no treatment except Chloro IPC significantly reduced yields. In this treatment the crop leaves showed marginal burn and the plants were definitely stunted. CMU plots showed some burn on lower leaves. The remaining plots did not show any noticeable plant symptoms.

Yields of cabbage were not affected by any chemical. The check plots averaged 13 tons per acre. No foliage symptoms were apparent.

Chloro IPC and CMU were the most toxic treatments on sweet corn. Plot variability was high and consequently large differences are required for significance.

Tomatoes have long been considered a crop that is especially susceptible to herbicide injury. Generally speaking, however, this crop was more tolerant of the herbicides being tested than sweet corn, leaf lettuce, and snap and lima beans. The poor yields in the Chloro IPC and CMU plots were typical of results with potatoes and sweet corn. Leaf symptoms typical of hormone distortion, however, were present in the Crag 1, Sesin, and 6036 plots.

MEAN YIELDS IN POUNDS PER PLOT OF VEGETABLES RECEIVING POST EMERGENCE HERBICIDES

Table 1

Treatment	Lbs. per acre	LETTUCE Salad Bowl	SNAP BEANS Black Valentine	LIMA BEANS Fordhook 242	CARROTS Nantes	BEETS Det. Dk. Red	CUCUMBERS Niagara	TOMATOES Valiant	POTATOES Chenango	CABBAGE Danish Ballhead	SWEET CORN Golden Cross Bantam
Crag 1	2	17.7	5.4	8.0	40.3	96.0	49.7	14.7	37.0	31.7	17.3
"	4	15.0	5.9	8.6	55.6	92.3	38.7	19.0	32.7	35.7	19.3
6036	2	16.0	4.8	7.0	46.7	91.3	38.3	22.0	32.7	31.0	19.6
"	4	15.0	1.7	1.9	50.0	66.7	41.0	26.0	37.3	40.0	18.3
Sesin	4	15.7	4.9	8.4	42.0	68.7	46.3	20.3	41.0	37.0	24.7
Chloro IPC	4	16.0	3.3	3.9	56.3	96.0	3.0	13.0	25.7*	34.3	9.0
CMU	3/8	11.0*	2.2	2.0	44.0	82.0	20.3	15.7	29.3	36.3	16.7
Check		20.3[1]	5.0	8.3	41.7	87.7	39.3	18.0	33.3	34.0	25.0
L. S. D. at 5%			1.9	2.6	N.S.	N.S.	10.2	5.5		N.S.	8.7
L. S. D. at 1%			2.6	3.5			14.1	7.6			N.S.
Coefficient of Variability		20%	25.6%	24.0%	21.7%	16.4%	16.8%	16.9%	15.0%	18.6%	26.4%

*F value significantly lower than that of other treatments at the 5% level.

1 Check significantly higher than mean of treatments.

Summary

Post-emergence applications of herbicides were made to ten important garden crops, namely: leaf lettuce, beets, cabbage, carrots, cucumbers, sweet corn, tomatoes, potatoes, snap and lima beans. CMU was safe at 3/8 pound on only beets, cabbage, and carrots. It is interesting to note that Chloro IPC at four pounds was also safe on only these three crops. Sesin was remarkably less toxic to beans than 6036. On other crops there were no significant differences at the one percent level in crop responses to Sesin and 6036. Crop response to Crag 1 was similar to the response to Sesin, except that in sweet corn Sesin appears to be somewhat less toxic.

Based on crop tolerance, it appears from this one-year study that Sesin and Crag 1 have good promise for post-emergence use by the home vegetable gardener.

Cabbage, carrots and beets exhibited considerable tolerance to all chemicals tested.

Weeding Set Onions With Chloro IPC

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Four treatments were applied to plots of Ebenezer onions and together with the appropriate control plots these were replicated three times in randomized blocks. The plots consisted of six 15-foot rows, each fifteen inches apart. The soil was a Hadley very fine sandy loam and was considered to be of moderate fertility. The soil was prepared and fertilized rather heavily on April 16 and the onion sets planted on April 18.

Chloro IPC was applied to the plots on April 21 at the rates of 2, 4, 6 and 8 pounds per acre. The Chloro IPC was diluted with water and was sprayed on the plots at the rate of 100 gallons per acre. The spray was applied with a Brown Open-Hed No. 4 hand pressure sprayer fitted with a No. 8004 Spraying Systems T-Jet fan-type nozzle and the rate of application was regulated so that the plots were covered twice to assure as uniform application as possible.

The weed population was abundant and consisted of the following sorts: lamb's quarters, chickweed, wiregrass, pigweed, purslane and galinsoga. Data dealing with weed counts, size of weeds and height of the onions were recorded on June 9.

The plots were all cultivated four times by June 20. Cultivation has been considered advantageous even where no weeds were present (10,12). On this date the weeds on all plots were removed in the rows of onions. The plots were cultivated and hand weeded three more times before July 15 when the onions were harvested.

Results and Discussion

The results of these experiments are presented in Table I. From these data it is quite evident that Chloro IPC is very effective in reducing the weed pollination as compared to no treatment. Where 2 pounds of Chloro IPC per acre were used 21 weeds per yard of row were found as compared to 94.6 weeds per yard of row in the check plots and this difference was highly significant. Where six and eight pounds of Chloro IPC were used the weed population was reduced to about 5 weeds per yard of row. It is to be noted too that the weeds present on the treated plots were so small by June 20 as to be of little or no consequence as compared to those present in the check plots. This fact can be readily substantiated by referring to Figure I. One observation that should be noted is that the weeds present on the plots treated with two pounds of Chloro IPC were wire grass and pigweed while pigweed was the only weed present on those plots treated at higher rates.

Height of the onions was not adversely affected except where six pounds of the material was used and this difference is significant at the .05 level. Eight pounds of Chloro IPC did not have any effect on the height. No suggestion is offered to account for the shorter growth of onions in the six pound treatment.

Table I. Effect of Chloro IPC on the weed control and yield of Japanese set onions. Planted April 18, Treated April 21, Results recorded on June 20, 1952

Treatment	Lbs. per acre	Weeds per yard of row	Weed size 1-9*	Hgt. of Onions Ins.	Yield Lbs.
Chloro IPC	2	21.6	7.3	16.3	31.0
" "	4	10.6	8.3	17.0	37.3
" "	6	5.6	9.0	15.6	33.3
" "	8	5.3	9.0	17.3	37.0
Check		94.6	1.0	17.3	30.3
L.S.D. at .05		8.4	1.2	1.8	8.7
L.S.D. at .01		12.1	1.7	2.7	12.7

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

While the check plots yielded less than any of the treated plots this difference was not significant. Neither were any real differences displayed between the plots of any other two treatments. After harvest the onions from the treated plots did not appear to be adversely affected in any way.

Summary

Chloro IPC at the rate of six to eight pounds per acre applied as a pre emergence spray to set onions proved to be an excellent herbicide in these tests. The treatment suppressed the growth of weeds very satisfactorily for nine weeks. Yields of onions from the treated plots were not adversely affected, neither were they enhanced.

A PROGRESS REPORT ON THE USE OF STEM SPRAYS FOR ONION WEED CONTROL ON MUCK SOILS

Donald Y. Perkins

Most weed control work that has been done with onions has been concerned with pre-emergence and early post-emergence applications. Little work has been done with applications later in the season, when onions are big and when directed sprays can be used to advantage. Joe Antognini (1) has shown that oils and other chemicals can be used successfully as stem sprays for the control of weeds in onions from the middle of the season up until it is no longer feasible to go through them. Because of the extreme importance of controlling the weeds during the time between the last cultivation and harvesting (especially in view of the production of weed seed at this time), the following experiment was set up in an attempt to find chemicals with enough residual effect to control weeds during the entire period.

Materials and Methods

Twenty-one chemicals were selected and tested in the field in a simple randomized block experiment with 4 replications of each treatment. The field selected was one that was known from past experience to be very weedy; its weed population consisting of purslane and crab grass. Plots were 5 rows wide by 10 feet long. All sprays were made at the rate of 100 gallons per acre (of the chemical in solution). The chemicals used and their rates of application are listed in table 1. The spraying was done with a small hand CO_2 sprayer equipped with an 8001 nozzle and at 20 pounds per square inch pressure, in such a way that all the soil surface was covered, but only the necks of the onion plants. The onions at this time were just beginning to bulb. The field had been hand-weeded on July 1, and the spraying done on July 4, so that all weeds present at the time of spraying were very small. Weed counts were made on July 15 and on August 1, at which time all plots were hand-weeded. A rating of the best treatments was made at harvest time, which was August 25. All weed counts are the totals of 3 strips on the 3 center rows, the strips being 3 feet long and 4 inches wide.

Table 1. The Effect of 21 Chemicals When Applied as Stem Sprays to Onions on the Weed Counts and Onion Yields.

Treatment	Rate of Application	Weed Counts: July 15	Weed Counts: Aug. 1	Yield (lbs.)
C.M.U.	1 lb./acre in 100 gals. H_2O	9	165	143.3
Chloro I.P.C.	8 lbs/acre " " " "	44	149	146.8
Chloro I.P.C.	16 lbs./acre " " " "	22	145	132.7
Dow General	85 lbs./acre " " " "	33	423	139.7
N.I.X	15 lbs./acre " " " "	17	371	140.2
Na-Pentachlorophenate	2½ lbs. /acre " " " "	41	518	143.8
Na-Pentachlorophenate	4 lbs./acre " " " "	42	527	139.7
Dow Selective	3 pts./acre " " " "+sticker	58	411	132.6
KOCN	8 lbs./acre " " " "	14	572	148.5
KOCN	8 lbs./acre " " " "+sticker	12	447	131.8
Agronyl A	30 gals./acre	18	534	130.5
Endothal	10 lbs./acre in 100 gals. H_2O	8	7	119.5
Sulfasan	10 lbs./acre " " " "	56	548	145.6
Mono-sodium- cyanamid	100 lbs./acre " " " "	11	294	117.1
Phthalamic acid #1	2 lbs./acre " " " "	74	161	143.1
Phthalamic acid #1	4 lbs./acre " " " "	47	139	145.7
Phthalamic acid #2	2 lbs./acre " " " "	98	484	151.1
Phthalamic acid #2	4 lbs./acre " " " "	65	415	135.8
Phthalamic acid #5	2 lbs./acre " " " "	68	290	138.7
Phthalamic acid #5	4 lbs./acre " " " "	35	229	131.4
Craig Herbicide #1	4 lbs./acre " " " "	82	52	138.7
F and B Weed Killer (Sodium arsenite 34%)	10 gals./acre " " " "	2	10	125.1
Intermediate grade Cyanamid Dust	200 lbs./acre as a dust	91	459	138.0
Sesin	10 lbs./acre in 100 gals. H_2O	68	104	152.1
Agronyl A	100 gals. between rows and cultivated up to plants	22	313	142.0
Esso 45	50 gals./acre	25	322	123.7
Esso 180	50 gals./acre	12	444	130.3
Esso Medium Heat	50 gals./acre	21	432	129.5
Esso Medium Heat	100 gals./acre between row and cultivated up to plants	42	495	153.9
Agronyl A	50 gals./acre after first spraying with wax	6	438	106.2
Agronyl A	50 gals./acre	11	476	126.2
Check	50 gals./acre	65	625	132.4

Results

In table 1 we have listed the total weed counts and the total yields (all 4 replications of a treatment combined) for the experiment. Between July 4 and July 15 there was no rain and there had been little for the month previous to the experiment, so that the muck was very dry. The weed population at the time of the first weed count, therefore, was quite small. However, some differences do appear at this time, and those treatments that gave best weed control are as follows: F and B Weed Killer; Agronyl A, having first sprayed with wax; endothal, C.M.U.; Mono-Na-Cyanamid; Agronyl A, 50 gallons per acre; KOCN plus a sticker; Esso 180; KOCN without sticker; N.I.X.; Agronyl A, 30 gallons per acre; Esso Medium Heat; Agronyl A, 100 gallons between rows and cultivated up to plants; Esso 45; and Dow General.

Between July 15 and August 1, there was 1.6 inch of rain and the weed population was greatly increased. The weed counts taken at this second date may be taken as a measure of the residual effect of the chemicals used. The best weed control at this date was obtained with the following chemicals: Endothal, F and B Weed Killer, Craig Herbicide #1, Sesin, phthalamic acid #1 (4-pound rate), Chloro I.P.C. at both the 16- and 8-pound rates, phthalamic acid #1 at the 2-pound rate, C.M.U., phthalamic acid #5 at the 4-pound and 2-pound rates, Mono-Na-Cyanamid, Agronyl A (100 gallons between rows and cultivated up to plants), Esso 45, N.I.X., Dow Selective, phthalamic acid #2 at the 4-pound rate, Dow General, and Esso Medium Heat.

At harvest time, August 25, a visual rating was made and the best plots at that time were found to be F and B Weed Killer, Endothal, Craig Herbicide #1, Sesin, Chloro I.P.C., at both the 8- and 16-pound rates, and phthalamic acid #1 and #5, at the 4-pound rate. The first 4 treatments named had completely controlled the weeds at this time, while the plots of the last three showed few weeds and would have been classed as very clean.

Only the treatment of Agronyl A in which wax had first been used as a stem spray significantly decreased yields as compared to the check. Endothal and Mono-sodium-cyanamid reduced yields to some degree but not enough for statistical significance. Of the 8 treatments that looked good at harvest time, only Endothal and F and B Weed Killer resulted in lower yields than the check (although not significantly) while the yields of the others were as good or better than the check.

Conclusions

The results of this experiment indicate that very powerful chemical sprays can be used on onions in their later stages of growth with little harmful effect, if the spray is properly directed so that only the necks of the onions are hit. Chemicals of a high residual nature may be found so that a spray at the time of the last cultivation will control the weeds until harvest time. The chemicals that appeared most promising in this experiment were: Chloro I.P.C., Craig Herbicide #1, Sesin, F and B Weed Killer, Endothal, phthalamic acid #1 and #5, and C.M.U. Much still remains to be known about these, however; such as, for instance, their effect on the storage quality of the onions, or the length of their residual effect in the soil, or their activity under different moisture and temperature conditions. Further work is being continued along these lines.

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Chemical Weeding of Onions

Charles J. Noll and Martin L. Odland*

Onion weed control can be very expensive under certain conditions if the only solution to the problem is hand weeding. In the report of the Research Coordinating Committee of the Northeastern Weed Control Conference for 1952 it was generally agreed that potassium cynate could be used in both a pre-emergence and post-emergence application and it was suggested that further work on this problem include Endothal and cyanamid in a pre-emergence application and potassium cynate and Crag Herbicide No. 1 in a post-emergence application.

An experiment was set up to compare potassium cynate at 16 pounds per acre and Endothal at 6 pounds per acre applied in a pre-emergence application in comparison with an untreated check plot. In addition 1/3 of the pre-emergence treatments were further treated in the post-emergence application with potassium cynate at 8 lbs. per acre and 1/3 with Crag Herbicide No. 1 at 3 lbs. per acre.

Procedure

The land was prepared April 23 and seeded April 24. The pre-emergence applications were made April 26 and the post-emergence applications were made: Potassium cynate 22 May at the flag stage and Crag Herbicide #1 on 27 May after the flag stage.

Individual plots were 20 feet long and 18 inches wide. Treatments were arranged at random together with the non-treatment control in each of 20 replicated blocks. The herbicides were applied with a small sprayer over the row for a width of eight inches, potassium cynate at the rate of 100 gal. per acre and all other herbicides at 35 gallons per acre. Weeds between the rows were controlled through normal cultivation.

Weather was extremely dry throughout the growing season and onion yields were poor.

Results and Discussion

The results are presented in Table 1. Records are presented of weed control and stand and weight of onions. In the pre-emergence applications Endothal significantly reduced the onion stand but gave good weed control and

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yield was significantly increased in comparison with the untreated plot. In the pre-emergence application of potassium cynate weeds were not controlled and stand and yield of onions varied little from that of the untreated plot.

Crag Herbicide #1 in the post-emergence application significantly reduced the weed population in the pre-emergence potassium cynate plot but weed control was poor. Stand of onions was also reduced and yield was no better than the yield of the untreated plot.

Potassium cynate in the post-emergence application significantly reduced the weed population but weed control was good. Stand of onion plants was significantly reduced by this treatment. The best yield of all the plots was the plot treated with potassium cynate followed by potassium cynate although it was not significantly better than Endothal alone in a pre-emergence application.

Conclusion

Endothal offers possibilities for herbicidal weeding of onions when applied prior to emergence of the onions. At the rate used, 6 pounds per acre, the stand of onions can be expected to be reduced.

Potassium cynate in a post-emergence application gave good weed control but with a reduction of stand of onions.

If Endothal is to be used in a pre-emergence application followed by potassium cynate in a post-emergence application the rates used in this experiment, 6 lb. and 8 lb., should be reduced to minimize the damage to the young onion plants.

Table 1. The effect of pre-emergence and post-emergence herbicides on weeds, and stand and yield of onions in 1952

Pre-emergence Application		Post-emergence Application		* Weed Control	Onions per Plot	
Herbicide	Lbs. per acre	Herbicide	Lbs. per acre		Stand	Weight Grams
Potassium cynate	16	Nothing	--	8.50	87.0	360
" "	16	Potassium cynate	8	2.80	73.5	548
" "	16	Crag Herb. #1	3	6.85	71.7	384
Endothal	6	Nothing	--	2.55	61.2	469
"	6	Potassium cynate	8	1.10	50.7	366
"	6	Crag Herb. #1	3	2.15	45.4	329
Nothing	--		--	8.75	74.1	345
Least significant difference at .05 level				.88	11.4	121
Least significant difference at .01 level				1.17	15.1	160

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

EFFECT OF TIME AND METHOD OF APPLICATION OF STODDARD SOLVENT ON CELERY[1/]

By S. K. Ries and R. D. Sweet

Carew (1) and Grigsby (3), among others, have recommended Stoddard Solvent as an herbicide on celery seed beds, but to date it has not been recommended for application to celery transplants. However, some commercial celery growers have sprayed celery transplants successfully.

Emond and Moffat (2) believed that unsuccessful attempts were due to the time of treatment after transplanting. They demonstrated that celery grown on muck soil was only resistant to Stoddard Solvent if applied during the first three weeks after transplanting. This was true regardless of the size of transplant or the time of transplanting. Emond and Moffat's data also indicated that where two applications were made there was a decrease in yield of celery.

The purpose of this study was to verify the work by Emond and Moffat, to test further the effect of superimposed applications of Stoddard Solvent, to try different methods of application, and to determine whether differences in aromaticity of Stoddard Solvent affected plant response.

Materials and Methods

A split-plot factorial design with three replications was used. The smallest division was into a check and seven combinations of time of treatment: early, mid, late, mid on early, late on early, late on mid, and late on mid on early. The next division was for the two methods used: spray applied with one nozzle directly over the row, and spray applied with two nozzles directed so that the overlap occurred at the base of the plant or on the outer edges of the leaves and petioles of older plants. The largest division was for the percentage aromatics in the Stoddard Solvent, Varsol 1, 19%, and Varsol 2, 29%.

The variety Utah 15 was transplanted July 2 on a Dunkirk fine sandy loam. The chemicals were applied July 16, August 6, and August 18 at a rate of 75 gallons per acre with a small-plot sprayer. The celery was harvested October 1. Table 1 gives a summary of treatment dates and weather occurring at time of treatment. Temperatures became progressively lower with each of the later treatments but sunshine was good and no rain fell immediately after spraying. Thirty-six out of a total of forty plants per plot were harvested. The total weight from each plot and the number of plants with damaged "hearts" were recorded and rated. (See Table 2)

Table 1. Weather Record at Date of Treatment

Time	Date	No. of days after transplanting	Temperature Max.	Mean	Min.	Hours of Sunshine	Precipitation
Early	July 16	14	83	73	64	10.7	0
Mid	August 6	35	78	69	58	10.0	0
Late	August 18	47	72	61	50	12.1	0

1/ Much of this work was made possible by a grant from the Standard Oil Development Company, Linden, N. J.

Table 2. Injury Rating Scale for Heart Damage to Celery; Thirty-six Plants Harvested Per Plot

Number	Percentage	Rating
0	0	1
1-3	2-8	2
4-6	11-17	3
7-9	19-25	4
10-12	27-33	5
13-15	35-41	6
16-18	44-50	7
19-21	52-58	8
22-24	59-67	9

Results

A summary table of the analysis of variance for celery yields and injury ratings is presented in Table 3. From this it can be seen that the principal sources of variance were due to the method of application, the late time of treatment and the interaction of method times the late time of treatment.

Differences due to the main effect of method are presented in Table 4. From these data it may be concluded that spraying Stoddard Solvent directly over the plant caused a considerable decrease in yield and a greater occurrence of plants with damaged hearts as compared to directional spraying.

In Table 4 also are presented the means of all plots receiving a late treatment, as compared to those of all plots which did not receive a late treatment. From these results it may be conculded that when a plot received a late application of Stoddard Solvent, both the yield decreased and the number of damaged plants increased.

Figures 1 and 2 graphically demonstrate the interaction of method and time of application. By directing the spray so that it overlapped at the base of the plant, the injury to celery was decreased measurably when the plants were treated with Stoddard Solvent forty-seven days after transplanting.

These results indicate that it may be possible to weed transplanted celery with Stoddard Solvent by means of directional sprays. However, the time of treatment is very important, as was previously shown by Emond and Moffat (2). It is still not known whether the time of treatment is important

Table 3 Analysis of Variance for Yields and Damaged "Hearts" From Post-Emergence Sprays of Stoddard Solvent on Celery

Source	DF	Yields M. S.	Ratings[1/] M. S.
Percentage Aromatics	1	846.0	---
Replications	2	11.8	---
Error a	2	202.5	2.1
Method	1	2677.0**	256.7**
Percentage Aromatics x Method	1	17.0	---
Error b	4	44.8	0.7
Early	1	25.0	5.5**
Mid	1	2.0	0.5
Mid x Early	1	8.0	---
Late	1	2062.0**	341.2**
Late x Early	1	1.0	0.8
Late x Mid	1	13.0	---
Late x Mid x Early	1	68.0	---
Percentage Aromatics x Time	7	26.0	0.7
Method x Early	1	14.3	---
" x Mid	1	49.6	---
" x Mid x Early	1	147.5	1.8
" x Late	1	1881.5**	201.3**
" x Late x Early	1	11.3	0.8
" x Late x Mid	1	110.5	1.8
" x Late x Mid x Early	1	12.8	0.3
Percentage Aro. x Methodx Time	7	31.0	0.46
Error c (56 - 1 for M. P.)	55	37.9	0.54
Coefficients of variability		14.7%	21.8%

** F value significant at 1% level
1/ See Table 2 for key to ratings

Table 4 The Effect of Method and Time of Application On Celery Yield and Heart Damage

Treatment	Yield in Lbs.	Injury Rating 1/
1. Spray directly over row	36.6	5.0
2. Spray directed at base	47.1	1.7
F value for difference at 1% level	sign.	sign.
1. Plots with late treatment	37.2	5.2
2. Plots without late treatment	46.5	1.5
F value for difference at 1% level	sign.	sign.

1/ See Table 2 for key to ratings

because of some changing environmental factor such as temperature, or some physiological or morphological change with maturity of the celery plant. The latter seems to offer the best explanation since method of application had a pronounced effect. As the plant matures, it offers greater leaf and petiole surface for application of the Stoddard Solvent. In addition, as the celery plant grows it provides opportunity for increased accumulation of the oil in the growing point by creeping down the petioles. This may be at least partially responsible for the increased damage to the "hearts" at the time of late sprays.

Summary

Stoddard Solvent having 19 and 29 percent aromatics was sprayed on celery approximately two, five and seven weeks (plus all combinations) after transplanting. Each application was made either directly over the row or directed at the base of the plants. Both time and method of application greatly influenced the number of plants showing heart damage. Percentage aromatics had no apparent effect. Directing the spray at the base permitted application to plants of all ages studied without a decrease in yield. Regardless of the number of applications plants received, any combination of sprays involving the latest time of application resulted in injury except when the spray was directed at the plant base.

Directional sprays may offer an opportunity for widespread commercial application of Stoddard Solvent to celery.

Figure 1.

The Influence of Method of Application on the Occurence of Plants With Damaged "Hearts" When Sprayed at Different Times

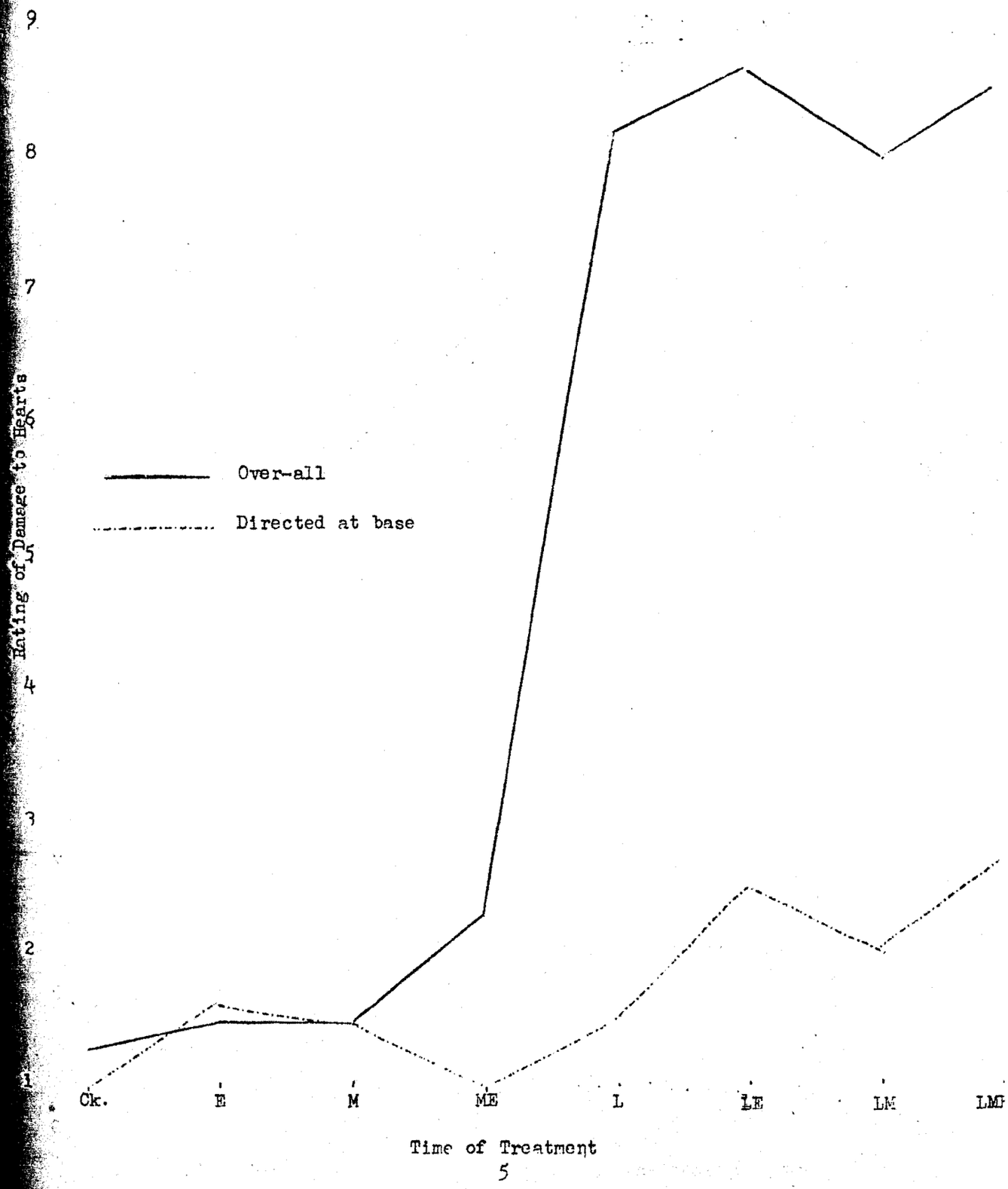
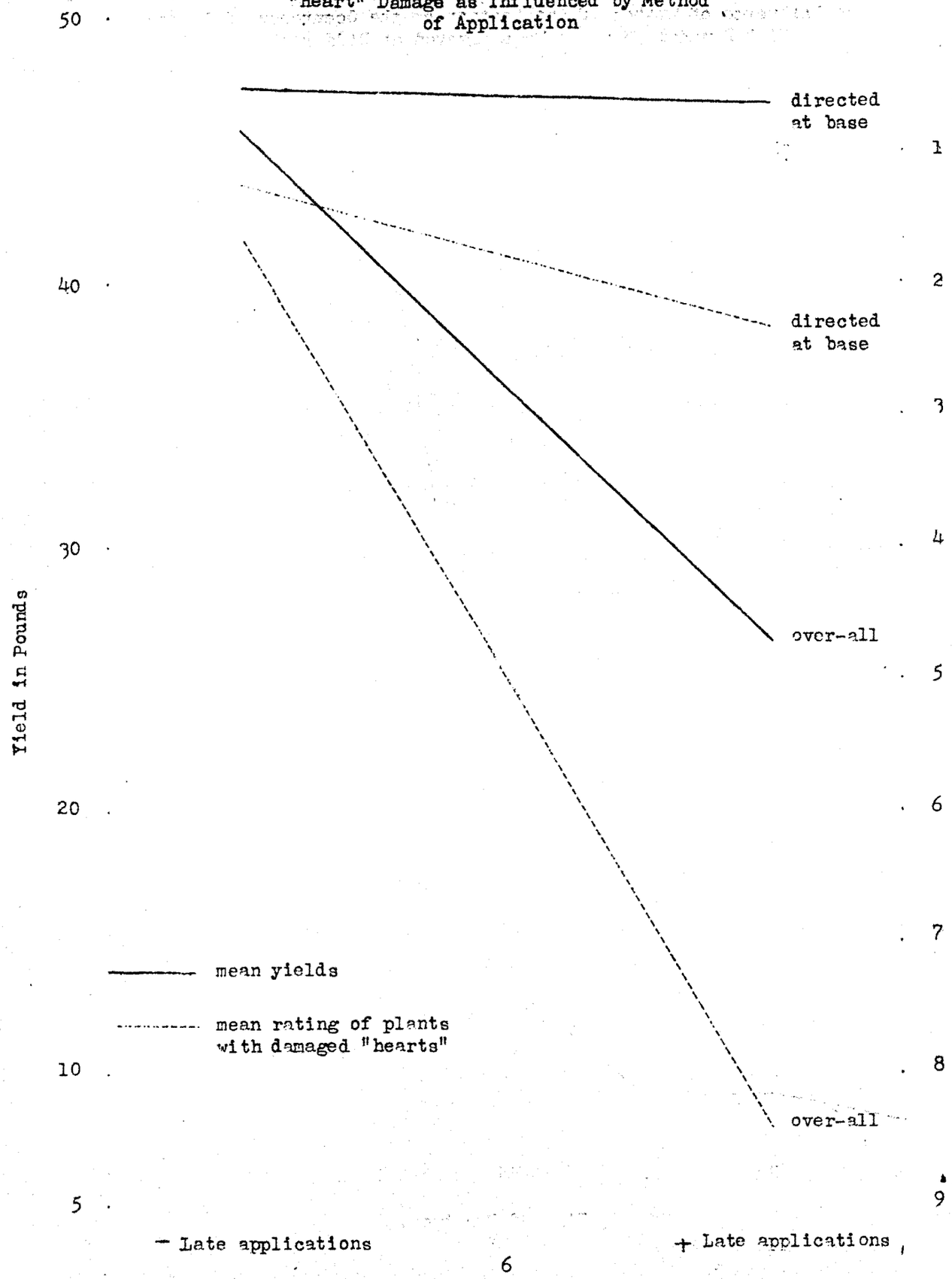


Figure 2 The Effect of Time of Application on Yield and "Heart" Damage as Influenced by Method of Application



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POST-EMERGENCE APPLICATION OF CERTAIN ESTERS OF 2,4-DICHLOROPHENOXYETHANOL ON TOMATOES[1]

By S. K. Ries and R. D. Sweet

In most of the Northeast tomatoes are transplanted to the field. Before and shortly after transplanting, weeds are easily controlled by cultivation. However, if an effective herbicide could be applied after the first cultivation, to make subsequent weed control unnecessary, it would be a valuable asset to the farmers program.

The purpose of this investigation was threefold: (1) To determine the response of tomatoes to three esters of 2,4-Dichlorophenoxyethanol (2) to test the effect of mixing two common fungicides with the above herbicides, and (3) to study the effect of time of application.

To the authors' knowledge, there has been no published work on the post-emergence field application of Crag 1, Sesin and 6036 to tomatoes.

Materials and Methods

The herbicides under test were: Crag 1, 2,4-Dichlorophenoxyethyl sulfate; Sesin, 2,4-Dichlorophenoxyethyl benzoate; and 6036, Bis (dichloro) phenoxyethyl oxalate. The fungicides used were Dithane and Zerlate.

A split-plot factorial design with two replications was used. The smallest division was a check and two rates of the three chemicals. The next division was time of application: early, late, and early on late. The largeest division was for fungicide, Dithane or Zerlate, mixed with the chemical.

The variety Red Jacket was transplanted June 6, on a silt loam soil. The plants were spaced at thirty inch intervals in rows five feet apart. There were five plants in a plot, and one guard plant was removed just before yields were taken. In addition, there were guard plants on all the edges and between major plots. The chemicals were mixed with the fungicide and applied in 109 gallons of water per acre by means of a small plot sprayer under thirty pounds pressure. The early treatment was applied July 11. Two days previously four and one-fourth inches of rain had fallen. The plants were in heavy blossom, but had not "tipped over." The late treatment was applied July 29, when about twenty fruit were set on each plant, and the plants had "tipped over." The first picking was made August 25.

Results

A summary of the analysis of variance for tomato yields is presented in Table 1. It can be seen that the major sources of variance are due to the differences between (1) Time of treatment (2) No treatment and some treatment (3) Chemicals, and (4) The interaction of early <u>on</u> late vs early <u>or</u> late times no treatment vs some treatment.

1/ Part of this work was made possible by a grant from the Carbide and Carbons Chemical Co. Ny, NY

Table 1 Analysis of Variance for Tomato Yields, in Pounds

Source	DF	M. S.
Fungicide	1	8.8
Reps	1	95.8
Error a	1	100.2
Early vs Late	1	567.2
Early and Late vs Early or Late	1	680.3*
Fungicide x Time	2	60.45
Error b	4	85.85
No Treatment vs Some Treatment	1	642.0**
Rate	1	142.0
Chem	2	613.0**
Chem x Rate	2	25.5
Treatment x Fungicide	6	6.0
Early vs Late x Check vs Some	1	23.0
" x Rate	1	137.0
" x Chem	2	87.0
" x Chem x Rate	2	2.0
Early and Late vs Early or Late x Check vs Some	1	297.0**
" x Rate	1	50.0
" x Chem	2	38.0
" x Chem x Rate	2	8.0
Treatment x Time x Fungicide	12	11.8
Error c	36	36.4

*F value significant at the 5% level
**F value significant at the 1% level
C. V. = 13.3%

Table 2 indicates the difference in yield of tomatoes when they received one application of chemical either early or late, and when they received two applications of chemical both early and late. This decrease from two treatments was true with all three chemicals. There was also a tendency for the single early application to be more toxic than the single late application.

Table 2 Difference in Yield Between Tomatoes Receiving Either An Early or a Late Herbicide Treatment and Those Receiving Both an Early and a Late Treatment

Either Early or Late	46.48
Both Early and Late	40.00

F value for difference significant at 5% level.

When the check was compared to the mean of all treatments it yielded significantly more at the one percent level as was indicated by the F test in Table 1. However, as is shown in Table 3, when the check was compared to individual treatments by means of an L. S. D., several treatments compared favorably. The most notable treatments were two pounds of 6036, two pounds of Sesin and four pounds of Sesin.

Table 3 Yield of Tomatoes from Post-Emergence Applications (All Combinations) Of Esters of 2,4 Dichlorophenoxyethanol

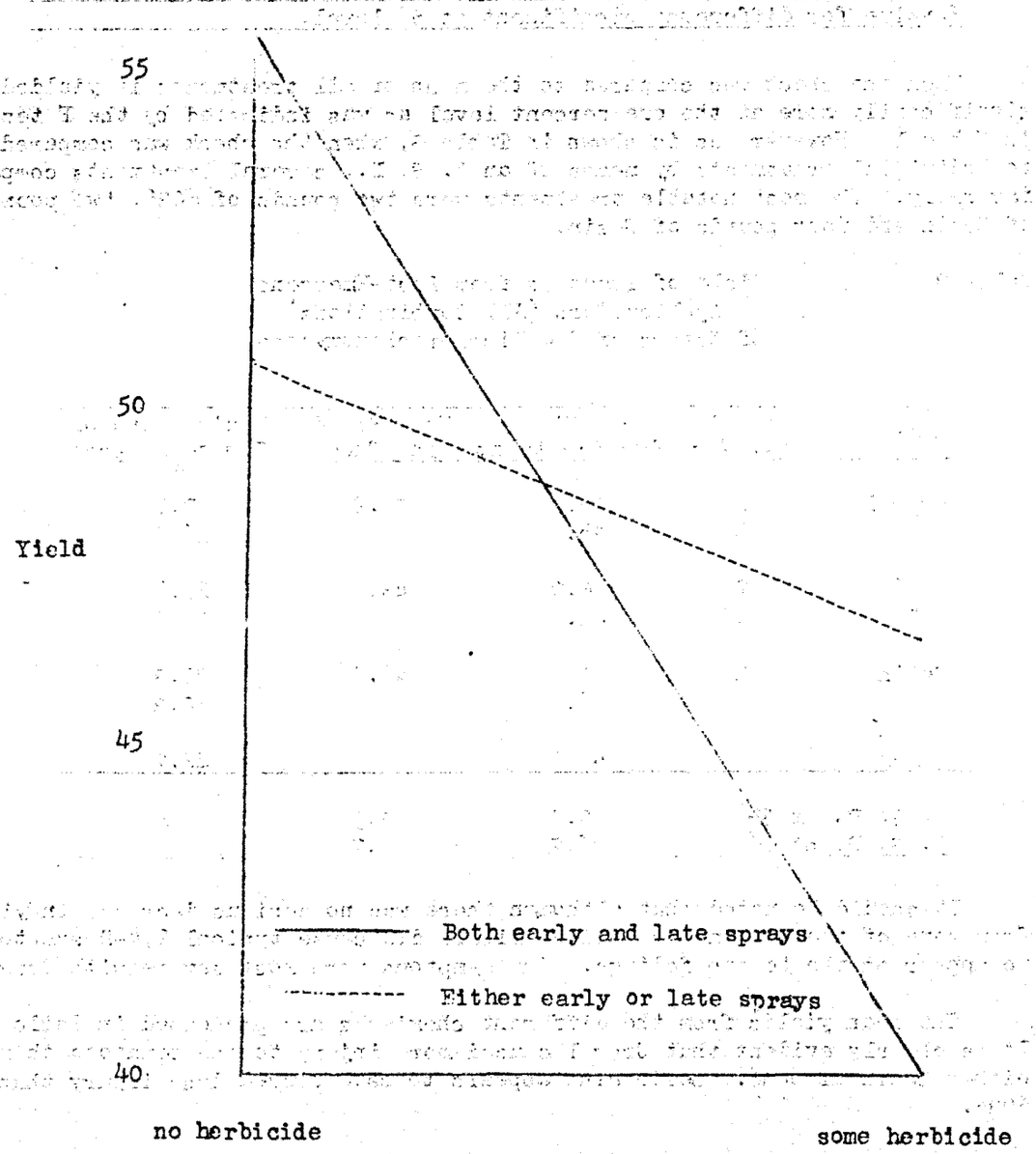
Chemical	Rate in Lbs./Acre	Mean Yield for Treatment	Mean Yield for Chem	Equiv. Tons of Tomatoes/Acre
Crag 1	2	39.2	38.9	17.1
"	4	38.7		16.9
6036	2	46.9	45.2	20.4
"	4	43.5		18.9
Sesin	2	51.2	48.9	22.3
"	4	46.7		20.3
Check		52.2		22.7
L. S. D. at 5%		5.0	3.5	
L. S. D. at 1%		6.7	4.7	

It should be noted that although there was no serious decrease in yield from some of the treatments, all chemicals did cause typical 2,4-D symptoms to appear on the tomato foliage. The symptoms were most severe with Crag 1.

The mean yields from the different chemicals are presented in Table 3. It is clearly evident that Crag 1 caused more injury to the tomatoes than either Sesin or 6036. Sesin also appears to have caused less injury than 6036.

The effect of time of treatment either with or without an herbicide is presented in Figure 1. From this graph it can be seen that the yield of the plots receiving both early and late sprays when compared with the yields of their own check was much lower than the yield of the single treatment plots compared with their own checks.

Figure 1 The Effect of Time of Treatment on Yield With and Without Herbicide



Discussion

It should be noted that there are two important factors that must be considered before any conclusions can be drawn from this experiment. First, the design of the experiment was weak in that there were no treatments where the chemicals were sprayed on the tomatoes without being mixed with a fungicide, therefore, it is possible that the fungicide decreased the activity of the chemicals. In another experiment, however, where no fungicide was included, all three of these chemicals were sprayed on the Valiant variety of tomatoes with similar results. Secondly, between July eleventh, the day of the early application, and August third, five days after the late application, rainfall totaled only 1.19 inches. It may be that there was not enough moisture to determine if the esters of 2,4-Dichlorophenoxyethanol used will leach down to the roots of the tomatoes and cause serious injury.

Summary

The yields obtained in this experiment indicated that Crag 1 was much more toxic to tomatoes than either Sesin or 6036. The two and four pound rate of Sesin and the two pound rate of 6036, in particular when applied only once either early or late, compared favorably with the check.

Treating tomatoes twice with any of the chemicals caused more injury than a single application.

EFFECTS OF CRAG HERBICIDE NO. 1. ON FIELD TOMATOES IN NEW JERSEY

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ABSTRACT

A field of tomato plants, variety Rutgers, was sprayed with Crag Herbicide No.1* (90% sodium 2,4-dichlorophenoxyethylsulfate) at the rate of 3½ pounds per 100 gallons water per acre at Mullica Hill, Gloucester County, N.J. June 30, 1952.

Within about two weeks effects of abnormal growth were seen in leaves, stems and fruits, seedless fruit being found on treated plots. The symptoms resembled tomato responses to mild doses of 2,4-dichlorophenoxyacetic acid.

* Carbide and Carbon Chem. Co., N.Y.,N.Y.

ASPARAGUS FIELDS TREATED WITH CRAG HERBICIDE NO. 1 IN NEW JERSEY, 1951, 1952

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ABSTRACT

Early in July at the end of the asparagus cutting season in 1951 and 1952, 4-6 acres of commercial asparagus land in Cumberland County, N.J., were sprayed with Crag Herbicide No. 1 at the rate of 3 pounds 10 ounces to 3.75 pounds per 100 gallons water per acre. The material was applied to freshly and finely disced ground before any asparagus had emerged. Commercial weed control of lambsquarters (*Chenopodium album*), pigweed (*Amaranthus retroflexus*) and other annuals was obtained throughout the autumn in 1951 and, in the 1952 trial, to the end of August.

In 1952 eight acres of commercial asparagus in Gloucester County, N. J., were similarly treated with Crag Herbicide No. 1 at the rate of 3½ pounds per 100 gallons water per acre. Annual Morning Glory (*Ipomea* spp.) was effectively controlled through August.

During the asparagus cutting season of 1952 two applications of Crag Herbicide No. 1 were made, the first May 13, the second, June 14, at the rate of 3.75 pounds per 100 gallons per acre to freshly cultivated commercial beds in Cumberland County. Similar treatment was given one acre of commercial beds in Gloucester County at another location, May 28. Commercial weed control was obtained for periods of two to four weeks. The asparagus from treated and untreated areas for three to seven days after treatment was commercially packed in tin and glass and is being tested for taste effects.

WEEDING ASPARAGUS SEEDLINGS CHEMICALLY, 1950-1952

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ABSTRACT

Field tests have been conducted with various chemicals in the summers of 1950, '51 and '52 for pre-emergence and post-emergence weeding of asparagus seedlings.

Carrot weeding oil of the Stoddard Solvent type* has appeared promising as a selective weed killer in such plantings to the stage when seedlings have become about three inches high. At the rate of roughly 80 gallons per acre of treated surface oil sprayed in a narrow band on top of the row of seedlings under various climatic conditions has generally resulted in only little or no damage to the asparagus fronds. Larger fronds are safely sprayed by directing the material at the stems near the ground, taking care not to apply oil to the leaflets. Oil was a good pre-emergence weed killer.

As pre-emergence treatments granular calcium cyanamide** at the rate of 800 pounds per acre of treated surface and solutions of potassium cyanate*** (five to ten pounds per acre, 60 gallons water with or without a wetting agent) were effective. Post-emergence treatments with cyanamide and cyanate were promising in selectivity when applied in warm, relatively dry weather and followed by dew or rain after a lapse of a number of hours but seemed too injurious to the small seedlings for safety when applied in humid weather.

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* Amsco Mineral Spirits, American Mineral Spirits Company, Chicago, Ill.
* Varsol No. 1, Standard Oil Development Company, Linden, N. J.
** Aero Cyanamid, Granular, American Cyanamid Company, N. Y., N. Y.
*** Aero Cyanate, American Cyanamid Company, N. Y., N. Y.

Pre-emergence Weeding of Asparagus Seedlings

Charles J. Noll and Martin L. Odland*

Asparagus seeds are slow to germinate and the seedling plants remain small through out the early part of the growing season, consequently weeds which usually germinate and grow rapidly, may be the limiting factor in the growing of asparagus roots. Many commercial fields of seedling asparagus have been plowed under because control of weeds through cultivation was impossible.

Commercial acreages of seedling asparagus have been successfully weeded with herbicides. Little experimental work has been published that verifies that the best herbicides were used in those commercial applications. Comparisons between treatments in regard to weed control and the effect of the chemical on the small asparagus plants was not made. The usual comparison was between a treated area of the field as contrasted to an untreated area of the field.

The purpose of this experiment was to determine if any of the chemical herbicides now available would effectively control weeds without reducing the asparagus stand or injure the asparagus seedling.

Procedure

Seventeen treatments, consisting of eight chemicals at two rates, one chemical at one rate and an untreated check, were used in the experiment. These treatments were arranged at random together with the non-treatment control in each of six replicated blocks that measured 20 feet by 27 feet. Each plot consisted of a single row 20 feet long by 18 inches wide. The herbicides were applied with a small sprayer over the seeded asparagus for a width of 8 inches.

The land was prepared May 1 and planted May 2. All chemicals were applied May 16 approximately one week prior to the emergence of the asparagus seedling. Weeds between the rows were controlled through cultivation. In late August after weed records had been taken all plots were thoroughly hand weeded. Roots were dug, counted and weighed in late September after growth had ceased.

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Results and Discussion

A summary of results is presented in Table 1. Weed control was estimated on the basis of 1 to 10, 1 being perfect weed control and 10 no weed control. All herbicidal treatment plots had significant weed control when compared to the untreated plot. At the rates used the best weed control was obtained with Premerge and Dowicide G.

The stand of asparagus seedlings was greatly reduced in the untreated plot due to the weed competition. Few chemical treatments had a stand significantly poorer than the check. The best stand was obtained with CMU at 1 pound per acre and Dowicide G at 12 pounds per acre.

Total weight of the roots was also very poor in the untreated check due to the weed completion. No chemical treatment plot had less weight of roots when compared to the check although many of the chemical treatments weren't significantly better. The heaviest weight of roots was obtained with Dowicide G used at the rate of 12 pounds per acre.

Conclusion

Under the conditions of this experiment and at the rates used Dowicide G at 12 pounds per acre was the best treatment considering weed control, stand of asparagus and weight of harvested asparagus roots.

Other chemicals that offer promise in the weeding of asparagus seedlings are Premerge and CMU

Table 1. The effect of pre-emergence herbicides on weeds, stand of asparagus and weight of asparagus roots in 1952

Herbicide	Rate per acre	*Weed Control	Asparagus per Plot Stand	Asparagus per Plot Weight Grams
Shell Oil 130	6 gal.	4.63	54.2	233
" " "	9 gal.	5.25	54.2	165
Dowicide G	12 lb.	1.25	63.5	684
" "	18 lb.	1.38	58.2	601
24D (Amine salt)	1 lb.	6.25	28.0	109
" " "	1½ lb.	4.50	26.0	107
DIAC (Amine salt 24D)	1 lb.	4.63	26.7	112
" " " "	1½ lb.	3.63	23.5	117
CMU	2/3 lb.	4.13	46.5	314
"	1 lb.	2.63	69.3	534
Endothal	3 lb.	3.25	42.2	192
"	4½ lb.	2.13	33.2	226
MCP 60%	1 lb.	4.00	30.5	147
" "	1½ lb.	2.63	22.2	176
Promerge	3 lb.	1.25	49.3	348
"	4½ lb.	1.00	48.5	544
Stoddard Solvent	100 gal.	4.50	41.8	141
Nothing	---	9.50	33.7	89
Least significant difference at .05 level		1.03	10.0	114
Least significant difference at .01 level		1.36	13.2	151

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

Pre-Emergence Treatments for Weed Control in Asparagus - 1952[1]

Desmond D. Dolan

Object

This experiment was designed to measure the relative degree of weed control by 15 different chemicals sprayed on the surface of the soil at a time shortly after disking in the spring application of fertilizer, before the emergence of the asparagus spears and sufficiently early in the season so that most of the young weeds were still at the germination or sprouting stage.

Procedure

The asparagus bed was 8 years old and located on Bridgehampton very fine sandy loam. It was fertilized with 1000 pounds of 5-10-10 per acre and disked on April 14. It was again thoroughly disked on April 17 and the treatments were applied on April 21. This was the time when most weed seeds were germinating.

The total of 16 treatments, including 15 chemical treatments and the check, were replicated four times in randomized blocks. Each plot consisted of two rows 43.5 feet long, measured 43.5 x 10 feet, and had an area of .01 acre.

Each chemical was made up as a spray according to the directions of the manufacturer and all materials were applied at the rate of 200 gallons per plot. A 1-foot alley was left between plots and care was taken to walk in the alleys as much as possible and avoid disturbance of the surface soil.

On May 21, or 30 days after application of the chemicals, counts of both broad-leaved weeds and grass weeds were made on five one-square-foot areas of each plot.

A separate analysis of variance was made for broad-leaved counts and grass counts.

Results and Observations

The 15 chemical treatments used, the companies supplying the chemicals, the rates of application per acre, and the average number of broad-leaved weeds per 5 square feet are shown in Table 1.

[1] Contribution No. 818 of the Rhode Island Agricultural Experiment Station

Table 1. Average number of broad-leaved weeds per 5 sq. ft. 30 days after treatment with 15 chemicals.

	Chemical	Supplier[1]	Amt./A.	Broad-leaved/sq.ft.
1.	Premerge	Dow	2.5 gal.	3.7
2.	Dowicide G	Dow	20.0 lb.	3.0
3.	Santobrite	Monsanto	20.0 lb.	3.1
4.	Sodium TCA 90%	Dow	50.0 lb.	98.7
5.	" " "	Dow	75.0 lb.	82.6
6.	C. M. U.	Dupont	1.5 lb.	5.5
7.	"	Dupont	3.0 lb.	10.8
8.	Endothal	Niagara Chemical	3.0 gal.	102.2
9.	N. P. A.	U. S. Rubber	5.0 lb.	61.4
10.	"	U. S. Rubber	10.0 lb.	36.0
11.	Crag Herbicide 1	Carbide & Carbon	3.0 lb.	22.3
12.	Chl. IPC 40%	Columbia Southern	2.0 gal.	9.2
13.	Weed Free	Chapman	2.0 gal.	12.9
14.	Oktone	Goodrich	1 qt./15 gal. oil	13.7
15.	Polyborchlorate	P. C. Borax	5 lb. in 2 gal.	4.3
16.	Check			312.7
			L. S. D. .05 =	56.4
			.01 =	72.9

Analysis of variance of the broad-leaved counts indicated that differences due to treatments were highly significant. Comparisons of the 16 treatment means with the check mean indicated that all treatments gave a significant degree of weed control. The following materials gave excellent weed control and there was no significant difference between them: - Premerge, Dowicide G, Santobrite, Polyborchlorate, Chlorophenyl dimethyl urea (C.M.U.), Chloro isopropyl phenyl carbamate (Chloro I.P.C.), Oktone, Crag Herbicide 1 and N-1 naphthyl phthalamic acid (N.P.A.) at the 10 lb. per acre rate. All of the afore-mentioned materials, except N.P.A., gave better control of broad-leaved weeds than either Sodium trichloroacetate (T.C.A.) or Endothal.

As the kodachrome slides show, the plots were still relatively free of weeds on June 13 when the pictures were taken. The degree of weed control seems to be determined more by thoroughness of kill at the time of application than by residual effects of the chemicals. The pictures indicate that Endothal did not kill wild radish (Raphanus raphanistrum) as did Premerge, Dowicide G, Santobrite, C.M.U., N.P.A., and Crag Herbicide 1. It may also be noticed that horse-weed (Erigeron canadensis) is quite resistant to Chloro I.P.C.

[1] Acknowledgement is given to the companies listed in Table 1 for contributing the materials used.

Analysis of variance of the grass counts indicated that difference due to treatments was not significant.

As regards ease of handling, C.M.U., Premerge, and Crag Herbicide 1 are excellent. Of these three, C.M.U. requires the smallest amount of material per acre and has the greatest weedicidal property relative to rate of application per acre. Crag Herbicide 1 gave excellent results in 1952. The efficiency of Crag Herbicide 1 seems to be greatly increased by early spring application and by avoiding disturbance of the soil after application.

Dowicide G and Santobrite have the disadvantage that dust or fumes of those materials escape very readily from the containers and cause violent sneezing and coughing in an enclosed room.

Conclusions

Several chemicals may be very effectively used for pre-emergence weed control in asparagus. These chemicals differ in amount required per acre and in ease of handling.

For greatest efficiency, pre-emergence treatments should be applied very early in the spring when the weed seeds are germinating and the surface soil should be disturbed as little as possible during or following application.

When properly applied, pre-emergence treatments will provide relative freedom from weeds for a period of 6 to 8 weeks after treatment. The degree of weed control seems to be determined more by thoroughness of kill at time of application rather than by residual effects of the chemicals.

Two species of weeds were found to display resistance to a particular chemical. This brings to mind the question as to whether classification is as important as counting in taking data from weed-control experiments.

Lima Bean Weed Control

Charles J. Noll, Martin L. Odland, and Robert F. Fletcher*

Introduction

The acreage of lima beans grown for processing in Pennsylvania has been steadily increasing for the last ten years. Most of the acreage has been located on general farms where labor is limited. Difficulty in securing weed control in the row has been a major factor limiting production. Even greater increases in the lima bean acreage would no doubt result if improved methods of row weeding were developed.

Screening experiments were initiated in 1948 in an attempt to find an herbicide that would reduce row weeding costs. Each year new herbicides were tested and the most promising of these were included in the following year's experiment. Most of these chemical herbicides were applied in a pre-emergence application.

In 1952 experiments designed to further test the most promising of the materials studied were set up. Two experiments were conducted at State College and in addition a demonstration on weed control was made on the farm of a commercial grower loacated in Lycoming County.

Procedure

In the first experiment (see Table 1) thirteen of the most promising chemicals were tested at two rates. Eleven of the chemicals were used in a pre-emergence application and two in a post-emergence application together with an untreated check plot. The treatments were arranged at random in each of ten replicated blocks that measured 20 feet by 81 feet. Each chemical treatment was a single row plot 20 feet long and three feet wide. The herbicides were applied with a small sprayer over the row for a width of 8 inches.

The land was prepared 8 June and planted 9 June. The pre-emergence applications were made 7 days after planting and the post-emergence applications 22 days after planting. Germination was so irregular that 22 days after planting some bean plants had trifoliate leaves while other bean plants were just emerging from the ground. The variety grown was Fordhook 242.

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The second experiment compared the two most promising chemicals, Premerge and Dowicide G, at one rate each and an untreated check. This experiment was like the first as to plot size, time of planting, time of pre-emergence application and variety but the number of replications was increased to 20 (see Table 2).

The commercial application was similar to the second experiment as to chemical herbicide used, Premerge and Dowicide G (see Table 3). The treatments were randomized. Each chemical treatment plot was 8 rows wide and approximately 1600 feet long. Five plots were treated with Premerge and four with Dowicide G. Five plots received no treatment. The herbicides were applied with a potato sprayer at the rate of 55 gallon per acre in a band application of 15 inches directly over the row.

One half the field was planted 2 June and one half seeded 4 June. All chemicals were applied 4 June. Variety grown was Thorogreen bush lima bean. Principal weeds were red root pigweed, lambs quarters, nut grass and a small amount of smart weed.

Results and Discussion

Dry weather at planting time and following planting resulted in a very small weed population. In the first experiment there was a significant difference at the .05 level in stand. Weed control and yield were uneffected by the treatment (seed Table 1). In the second experiment both chemicals used gave significant weed control at the .05 level but the stand and yield of lima beans was uneffected by the treatments (see Table 2).

Records of yields, weight of plants, and weight of weeds were taken at harvest time in the demonstration plots in Lycoming County from 25 feet of row from each treatment. Weeds were a serious problem. No stand count of lima beans was made as there was no indication of injury to the crop from the chemicals used. Both chemicals greatly increased the yield. Plots treated with Premerge averaged more than ten times the yield of the untreated plots (see Table 3).

The areas of the field not treated with the chemicals were not harvested because of the small yield.

Conclusion

Under dry conditions such as prevailed at State College in 1952 when weeds are not present in large numbers yields of lima beans are not increased by the use of chemical herbicides. Chemical herbicides used in the experiments

under these conditions did not seriously effect the stand of lima beans or effect the lima bean yield.

Where weeds are a serious problem as was found in Lycoming County in 1952 pre-emergence applications of Premerge can be used to help control the weeds. With good weed control yields are correspondingly increased.

Table 1. The effect of 13 different herbicides at two rates on weeds and stand and yield of lima beans at State College in 1952.

Herbicide	Rate per acre	Herbicide Application Days after planting	*Weed Control	Beans per plot Stand	Beans per plot Yield lbs.
Nothing	---	---	3.7	58.3	10.4
Premerge	8 lb.	7	2.1	62.2	11.5
"	12 lb.	"	2.6	56.3	10.2
Dowicide G	16 lb.	"	2.4	56.3	10.4
"	24 lb.	"	2.9	60.6	10.4
LFN-L-299	2 lb.	"	2.7	57.6	9.7
"	3 lb.	"	2.9	57.0	11.4
Shell 130	6 gal.	8	3.2	57.9	10.6
"	9 gal.	"	2.3	61.5	11.5
24D (Amine)	1 lb.	"	3.5	56.1	10.8
"	1½ lb.	"	2.3	53.8	10.2
DIAC	1 lb.	"	3.1	55.8	10.7
"	1½ lb.	"	2.9	54.7	10.5
40% Cloro IPC	1 gal.	"	2.6	60.4	11.1
"	1½ gal.	"	3.3	54.6	11.3
CMU	1 lb.	"	3.2	62.3	11.2
"	1½ lb.	"	2.7	59.5	10.7
MCP 60%	1½ lb.	"	2.4	54.5	10.2
"	2¼ lb.	"	2.8	53.1	10.7
PA #5	8 lb.	"	2.9	53.4	11.7
"	12 lb.	"	3.0	55.0	10.0
Endothal	5 lb.	"	2.6	62.4	10.4
"	7½ lb.	"	2.7	57.0	9.9
NIX	8 lb.	22	3.1	59.4	10.0
"	12 lb.	"	3.3	56.8	10.3
Crag #1	3 lb.	"	2.8	62.7	11.3
"	5½ lb.	"	2.5	53.4	9.9
Least significant difference at .05 level			N.S.D.	6.55	N.S.D.

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

Remarks: Growing season extremely dry

Table 2. The effect of two promising herbicides on weeds and stand and yield of lima beans at State College in 1952

Herbicide	Rate per acre	*Weed Control	Beans per plot Stand	Beans per plot Yield lbs.
Nothing	--	4.30	55.7	9.38
Premerge	8 lbs.	2.90	58.2	9.71
Dowicide G	16 lbs.	3.05	55.8	9.97
Least significant differance at 0.5 level		1.13	N.S.D.	N.S.D.

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

Table 3. The effect of two pre-emergence herbicides on weeds, yield and weight of plants of lima bean plots in Lycoming County in 1952.

Herbicide	Rate per acre	Average weight per 25 foot of row in pounds: Weeds	Bean plants	Pods
Nothing	--	31.2	2.1	1.1
Premerge	8 lbs.	7.7	13.3	17.5
Dowicide G	20 lbs.	28.8	8.6	6.0

No stastical analysis

PRELIMINARY INVESTIGATIONS WITH DINITRO AND MCP SPRAYS FOR WEED CONTROL IN LEGUME SEEDED PEAS

By
M. W. Miller[1]

Weeds are often a serious problem for the pea grower. They not only reduce pea yields but also increase harvesting and vining costs. Both the grower and the processor benefit from weed-free fields.

Among the weeds that infest the pea fields of the northeast, mustard (Brassica spp.) is probably the most common. Although a relatively easy weed to control, it is a strong competitor for soil nutrients and moisture. Mustard growth as heavy as 5.5 tons per acre in peas was reported by Dearborn in 1949 (1). A significant crop yield reduction was associated with this condition.

Several chemicals have been used to control weeds in peas, both as pre-emergence and as post-emergence applications. Vittum and Patterson found granular cyanamide satisfactory for pea weed control (7) Dinitro sprays (Dow Selective and Sinox W) have been used successfully (2). In 1948 the author observed successful use of high volume (75 gallons per acre) Dinitro sprays for pea weed control on a large acre basis (5). In recent studies dealing with reduced gallonage applications of Dow Selective, low volume sprays have shown promise (4, 5). In 1952 Fertig reported that Sinox PE, or Dow Premerge, applied in 30 to 35 gallons of water per acre resulted in less burning of small grains than Dow Selective or Sinox W in 33 to 66 gallons and better control of weeds, including mustard, lamb's-quarters, pigweed, smartweed, and volunteer buckwheat (3). Patterson found that MCP at low rates holds promise of excellent mustard control without reducing pea yields (6).

The purpose of this experiment was (1) to compare the effect of various rates and volumes of Dow Selective and Premerge sprays applied to legume seeded peas on pea yield, weed control, and injury to peas, clover, and alfalfa; and (2) to determine the effect of MCP on peas, weeds, and legume seedlings.

Materials and Methods

Perfection Freezer peas were planted April 29, 1952, on Ontario loam soil fertilized with a 10-10-10 analysis fertilizer at the rate of 500 pounds per acre. The plots were 12'10" wide and 100'0" long and consisted of two drill widths of an Ontario 7-11 grain drill. Chinese mustard (Brassica Juncea) was sown uniformly in all plots at the rate of 10 pounds per acre. Red clover was sown in half of each plot (one drill width) and alfalfa in the other. These legumes were sown at the rate of 12 pounds per acre. These seedings were made simultaneously with pea planting by using a seeding attachment on the drill. To accomplish this in one operation, the legume seed and the mustard were thoroughly blended and sown as a mixture at the rate of 22 pounds per acre, the clover-mustard mixture on one half of the plot and the alfalfa-mustard mixture on the other. Each plot was replicated three times. All sprays were applied June 3 with a tractor-mounted sprayer. Spraying Systems Nozzles 8004 were used for the 50 gallon per acre rate of application, 8002 for the 25 gallon rate, and 8001 for the 12 gallon rate. Pressure was maintained at 30

1 Horticulturist; Horticultural Research; Birds Eye Division General Foods Corp.

p.s.i. The peas were about six inches tall when sprayed and the weather was partly cloudy with a slight wind. Midday temperatures averaged 75°F and relative humidity varied from 52 to 70 per cent.

Weed (mustard, ragweed, and lamb's-quarters) and legume populations were obtained by counting the respective plants in one square yard area of each plot. Weed counts were made at pea harvest and legume (clover and alfalfa) counts were made in mid-August. Data concerning weight of pea vines and weeds in the various treatments were obtained by weighing the pea vines and weeds from one square yard in each replicate. These data were then calculated to tons per acre. Pea injury caused by sprays was evaluated three days after application and at harvest. These ratings were relative and based on the following scale:

Rating 1 to 9

1	No visible injury
2 & 3	Degrees of slight injury
4 & 5	Degrees of moderate injury
6 & 7	Degrees of severe injury
8	Very severely injured
9	Dead

The treatments were as follows:

1. Check - no treatment.
2. Dow Selective at 3 quarts in 50 gallons of water per acre.
3. Dow Selective at 3 quarts in 25 gallons of water per acre.
4. Dow Selective at 3 quarts in 12 gallons of water per acre.
5. Dow Selective at 1½ quarts in 12 gallons of water per acre.
6. Premerge at 1 quart in 50 gallons of water per acre.
7. Premerge at 1 quart in 25 gallons of water per acre.
8. Premerge at 1 quart in 12 gallons of water per acre.
9. Premerge at ½ quart in 12 gallons of water per acre.
10. MCP at ½ pound acid equivalent in 50 gallons of water per acre.
11. MCP at ½ pound acid equivalent in 12 gallons of water per acre.
12. MCP at ¼ pound acid equivalent in 50 gallons of water per acre.
13. MCP at ¼ pound acid equivalent in 12 gallons of water per acre.

Results

Dow Selective sprays gave 76 to 92 per cent weed control, depending upon the rate and volume applied. The weight of weeds per acre as shown in Table 1 tended to increase as spray volume decreased and spray concentration increased, and further increased when the rate of application was reduced. The best weed control as indicated by the least weight of weeds per unit area appeared to be from 3 quarts in 50 gallons per acre. Pea stand was unaffected by any of these sprays. As indicated in Table 2, pea yield tended to decrease with increased spray concentration and decreased volume. The greatest yield increase over the check was obtained in the 3 quarts in 50 gallons per acre treatment. There was no significant difference between treatments in pea quality as indicated by tenderometer value. Pea injury increased as the spray concentration increased and the volume decreased. Three days after spray application pea injury varied from moderate to severe depending upon

TABLE 1. THE EFFECT OF VARIOUS WEED CONTROL SPRAYS ON PEA VINES, WEED GROWTH, AND PEA INJURY

Code	Treatment*	Weight in T/A: Pea Vines	Weight in T/A: Weeds	Weight in T/A: Total	% Weeds By Weight	Total Weeds/ Sq.Ft.	PerCent Weed Control	Pea Injury Rating: At 3 Days	Pea Injury Rating: At Harvest
1.	Check	5.90	2.68	8.58	31	22.8	-	1.0	1.0
2.	Dow Sel. 3/50	7.30	.18	7.48	2	1.9	92	4.3	1.0
3.	Dow Sel. 3/25	8.13	.23	8.36	3	2.7	88	5.7	1.3
4.	Dow Sel. 3/12	6.20	.26	6.46	4	1.8	92	7.0	2.3
5.	Dow Sel. 1½/12	8.07	.45	8.52	5	5.5	76	6.2	1.0
6.	Premerge 1/50	7.23	.07	7.30	1	.8	97	2.3	1.0
7.	Premerge 1/25	8.36	.01	8.37	< 1	<.1	99	2.3	1.0
8.	Premerge 1/12	9.81	-	9.81	-	-	100	2.0	1.0
9.	Premerge ½/12	5.90	.31	6.21	5	2.4	90	1.8	1.0
10.	MCP ½/50	5.74	-	5.74	-	-	100	7.0	3.6
11.	MCP ½/12	4.76	-	4.76	-	-	100	8.0	6.3
12.	MCP ¼/50	5.93	-	5.93	-	-	100	6.0	3.0
13.	MCP ¼/12	6.03	-	6.03	-	-	100	7.0	3.7
L.S.D. 19:1		1.91	.50	1.86	19	4.7	21	.5	1.4
L.S.D. 99:1		2.60	.67	2.53	25	6.4	28	.6	1.9

TABLE 2. THE EFFECT OF VARIOUS WEED CONTROL SPRAYS ON LEGUME STANDS AND PEA PERFORMANCE

Code	Treatment*	Legume Stands Per Sq. Ft.: Alfalfa	Legume Stands Per Sq. Ft.: Clover	Pea Performance: Plant Height Inches	Pea Performance: Tender-ometer Value	Pea Performance: Yield T/A	Pea Performance: Per Cent Yield Increase
1.	Check	22.0	26.9	23.4	99	.61	-
2.	Dow Sel. 3/50	23.6	25.0	23.8	95	1.73	184
3.	Dow Sel. 3/25	22.2	18.1	22.4	96	1.62	166
4.	Dow Sel. 3/12	20.0	16.5	20.2	92	1.34	120
5.	Dow Sel. 1½/12	20.0	18.6	23.4	97	1.50	146
6.	Premerge 1/50	22.7	23.4	23.9	99	1.65	170
7.	Premerge 1/25	28.7	25.0	21.9	101	1.58	160
8.	Premerge 1/12	22.1	23.4	25.4	96	1.73	184
9.	Premerge ½/12	20.8	24.8	19.7	100	1.71	180
10.	MCP ½/50	15.8	24.6	19.9	95	1.36	120
11.	MCP ½/12	12.9	29.7	16.9	83	.61	-
12.	MCP ¼/50	21.4	24.3	19.7	99	1.25	105
13.	MCP ¼/12	18.7	25.6	19.7	94	1.28	113
L.S.D. 19:1		N.S.	5.4		7	.24	39
L.S.D. 99:1		N.S.	7.3		10	.33	55

* Dow Selective contains 1 pound of active DN per gallon.
Premerge contains 3 pounds of active DN per gallon.
Both Dow Selective and Premerge rates are quarts of active ingredient in gallons of water per acre. (Example: 3/50 is 3 quarts in 50 gallons of water).
MCP rates are actual pounds per acre (acid equivalent).

treatment. At harvest, however, there was no visible pea injury from the 3 quarts in 50 gallons of water per acre, very slight injury at 3 quarts in 25 gallons per acre, but noticeable injury at 3 quarts in 12 gallons per acre. Both alfalfa and clover showed injury from Dow Selective sprays when applied at volumes less than 50 gallons per acre. Alfalfa was more tolerant of these sprays than clover, as indicated by the fact that alfalfa stands were not significantly altered by treatment. Clover stands, however, were significantly reduced over the check when spray volumes of 25 and 12 gallons per acre were used.

The Premerge sprays gave 90 to 100 per cent weed control, depending upon spray rate and volume applied. As shown in Table 1, spray volume has no significant effect on weed weight per unit area. When the rate of application was reduced to ½ quart in 12 gallons of water per acre, both the weight and number of weeds per unit area increased over that of any 1 quart per acre application, regardless of volume applied. Based on field observation, however, the most acceptable weed control occurred when Premerge was applied at one quart in 12 gallons per acre. None of the Premerge treatments adversely affected maturity as indicated by the tenderometer value. There was no significant difference in yield due to treatment, as shown in Table 2. The greatest yield increase over the check, however, occurred in the treatment having the highest spray concentration and the lowest volume. There was only very slight pea injury 3 days after spray application and no visible injury to the peas from any of the Premerge treatments at harvest. Clover and alfalfa showed no visible injury and were not significantly reduced in population by any of the sprays.

The MCP treatments all provided 100 per cent weed control (Table 1), but were much slower in their action than the Dinitro sprays. Although none of the plants were killed, there was considerable damage to the peas. Pea yields were generally lower than those obtained in the Dinitro treatments as indicated in Table 2, although the treatment showing the most injury from the Dow Selective spray and the one showing the least injury from the MCP spray produced about equal yields. The greatest yield reduction and the most pea injury occurred when MCP was applied at the rate of ½ pound in 12 gallons of water per acre. This treatment also significantly affected maturity as indicated by the reduced tenderometer value. Pea growth was definitely retarded and yield substantially reduced. There was no significant difference in tenderometer value or yield between the other MCP spray treatments. Clover, although temporarily distorted by these sprays, recovered and showed no significant reduction in plant stand. Alfalfa was more severely affected by all treatments although the ¼ pound rate applied in 50 gallons of water per acre showed no reduction in stand.

Discussion

In a comparison between the two Dinitro sprays, Dow Selective and Premerge, Premerge appeared to give somewhat better weed control at all comparable concentrations and volumes than Dow Selective. Volume of Premerge sprays had no appreciable effect on weed control and excellent control occurred when 3/4 pound or 1 quart of Premerge was applied in volumes as low as 12 gallons per acre. As noted in Table 3, these data were not statistically significant, but the trends noted in the weed counts substantiated field observations. Regardless of chemical or volume, adequate weed control was obtained when Dinitro was applied at 3/4 pound per acre.

TABLE 3. WEED CONTROL COMPARISONS FOR DOW SELECTIVE AND PREMERGE SPRAYS

Treatment							
Lbs./A. Dinitro	Volume in Which Applied	Weeds Per Sq. Ft.1/			Per Cent Weed Control		
		Dow Sel.	Premerge	Diff.	Dow Sel.	Premerge	Diff.
3/4	50	1.9	.8	-1.1	92	97	+ 5
3/4	25	2.7	<.1	-2.6	88	99	+11
3/4	12	1.8	-	-1.8	92	100	+ 8
3/8	12	5.5	2.4	-3.1	76	90	+14
L.S.D. 19:1		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

1/ Check = 22.8 Weeds per sq. ft.

When Dow Selective was applied in treatments of decreasing volume, there was a trend toward reduced yield, whereas with Premerge sprays the trend was toward increased yield with reduced volume. There was no significant difference in yield between treatments having Dow Selective applied in volumes of 25 and 50 gallons per acre and Premerge in volumes of 50, 25, or 12 gallons per acre. Peas sprayed with Dow Selective at 12 gallons per acre volume were significantly less productive than peas sprayed with Premerge at corresponding rates and volumes.

Tenderometer values were not significantly affected by changes in spray volume or rate of application as shown in Table 4. The tenderometer values of the Premerge treatments were not significantly different from those of the check, whereas the tenderometer values of the Dow Selective treatments appeared lower than the check. This suggested a possible delay in maturity due to injury, particularly for the 3/4 pound rate when applied at 12 gallons per acre. These small differences would have no practical significance.

TABLE 4. PEA YIELD AND TENDEROMETER COMPARISONS FOR DOW SELECTIVE AND PREMERGE SPRAYS

Treatment							
Lbs./A. Dinitro	Volume in Which Applied	Yield in Tons/Acre 1/			Tenderometer Value 2/		
		Dow Sel.	Premerge	Diff.	Dow Sel.	Premerge	Diff.
3/4	50	1.73	1.65	-.08	95	99	+4
3/4	25	1.62	1.58	-.04	96	101	+5
3/4	12	1.34	1.73	+.39	92	96	+4
3/8	12	1.50	1.71	+.21	97	100	-3
L.S.D. 19:1		.15	N.S.	.11	N.S.	N.S.	3
L.S.D. 99:1		.22	N.S.	.15	N.S.	N.S.	4

1/ Check = .61
2/ Check = 99

Pea injury increased with reduced volume applications of Dow Selective whereas there was no significant difference between the injury ratings of the Premerge treatments regardless of volume or rate. Injury ratings taken 3 days after spray application were significantly higher for the 12 and 25 gallon applications of Dow Selective than for comparable Premerge applications. At harvest, there was still evidence of injury from Dow Selective at 3/4 pounds (3 quarts) in 12 and 25 gallons of water per acre. There was no visible injury from Premerge applications at any rate or volume at this time.

TABLE 5. PEA INJURY COMPARISONS FOR DOW SELECTIVE AND PREMERGE SPRAYS

Treatment		Pea Injury Rating					
		Dow Selective		Premerge		Difference	
Lbs./A. Dinitro	Volume in Which Applied	At 3 Days	At Harvest	At 3 Days	At Harvest	At 3 Days	At Harvest
3/4	50	4.3	1.0	2.3	1.0	2.0	-
3/4	25	5.7	1.3	2.3	1.0	3.4	.3
3/4	12	7.0	2.3	2.0	1.0	5.0	1.3
3/8	12	6.2	1.0	1.8	1.0	4.4	-
L.S.D. 19:1		.7	.7	N.S.	N.S.	.3	.2
L.S.D. 99:1		.8	1.0			.4	.3

Legumes seeded with the peas showed less injury from Premerge sprays than from Dow Selective sprays as volume was reduced. Alfalfa appeared to tolerate reduced volume of Dow Selective better than clover, as indicated by the plant stands in Table 6. There was no significant difference in either clover or alfalfa stands due to reduced volumes of Premerge sprays.

TABLE 6. PLANT STAND OF ALFALFA AND CLOVER AS INFLUENCED BY DOW SELECTIVE AND PREMERGE SPRAYS

Treatment		Clover/Sq. Ft. 1/			Alfalfa/Sq. Ft. 2/		
Lbs./A. Dinitro	Volume in Which Applied	Dow Sel.	Premerge	Diff.	Dow Sel.	Premerge	Diff.
3/4	50	25.0	23.4	1.6	23.6	20.0	3.6
3/4	25	18.1	25.0	6.9	22.2	22.7	.5
3/4	12	16.5	23.4	6.9	20.0	28.7	8.7
3/8	12	18.6	24.8	6.2	20.0	22.1	2.1
L.S.D. 19:1		2.8	N.S.	2.1	N.S.	N.S.	N.S.
L.S.D. 99:1		4.2	N.S.	3.0	N.S.	N.S.	N.S.

1/ Check = 26.9
2/ Check = 22.0

MCP, although an excellent weed killer, caused varying degrees of injury to the peas, clover, and alfalfa. In all cases yield was reduced when compared to that of the better Dinitro spray treatments. Yield was drastically reduced and pea maturity was retarded when MCP was applied at ½ pound per acre in 12 gallons of water. The same rate per acre applied in 50 gallons of water per acre did not significantly affect maturity and caused much less yield reduction. These differences in yield and maturity were not nearly as pronounced when ¼ pound per acre rate was used, although sufficient injury was caused to reduce pea yields when compared to the better Dinitro treatments. MCP reduced alfalfa stands but did not appear to adversely effect clover stands.

TABLE 7. EFFECT OF RATE AND VOLUME OF MCP APPLICATIONS ON PEA YIELD AND TENDEROMETER VALUE

Treatment	Pea Yield in Tons/A.		Tenderometer Value	
Lbs./Acre	50 Gal./A.	12 Gal./A.	50 Gal./A.	12 Gal./A.
½	1.36	.61	95	83
¼	1.25	1.28	99	94

TABLE 8. EFFECT OF RATE AND VOLUME OF MCP APPLICATION ON PEA INJURY

Treatment Lbs./Acre	Pea Injury Ratings			
	50 Gal./A.		12 Gal./A.	
	At 3 Days	At Harvest	At 3 Days	At Harvest
½	7.0	3.6	8.0	6.3
¼	6.0	3.0	7.0	3.7

TABLE 9. EFFECT OF RATE AND VOLUME OF MCP APPLICATION ON WEED CONTROL AND CLOVER AND ALFALFA STANDS

Treatment	% Weed Control		Clover Stands/Sq.Ft.		Alfalfa Stands/Sq.Ft.	
Lbs./Acre	50 Gal./A	12 Gal./A	50 Gal./A	12 Gal./A	50 Gal./A	12 Gal./A
½	100	100	24.6	29.7	15.8	12.9
¼	100	100	24.3	25.6	21.4	18.7

Conclusions

Based on one year's data with Premerge and MCP, and four years' experience with Dow Selective and Sinox W, the following conclusions were drawn:

1. Premerge was equally effective or better than Dow Selective for weed control in legume seeded peas.

2. Under the conditions of this experiment, volume of Premerge sprays did not significantly affect weed control. Acceptable weed control occurred at volumes as low as 12 gallons per acre. Peas and legumes (clover and alfalfa) were not injured. The advantages of lower volumes are obvious. A good recommendation would seem to be 20 to 30 gallons per acre.

3. Reduced volumes of Dow Selective sprays caused varying amounts of pea and legume injury and tended to reduce pea yields. Clover stands were also reduced but alfalfa was more tolerant and showed no apparent injury nor significant stand reduction. Premerge sprays did not significantly reduce the plant stand of clover or alfalfa at any volume or rate and caused no apparent injury.

4. MCP, although very effective in weed control, caused damage to both peas and alfalfa. Pea yields were reduced and in some cases maturity retarded. At a reduced rate of application, MCP may prove promising.

5. Injury to peas tended to result in delayed maturity.

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CHICKWEED CONTROL IN STRAWBERRIES BY THE USE OF DN'S AND IPC[1]

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Chickweed (Stellaria media) is usually the most troublesome winter weed in Delaware strawberry plantings. Several chemicals have been proposed for its control. One is commercially known as DN or Dinitro (dinitro-ortho-secondary-amyl-phenol or dinitro-ortho-secondary-butyl-phenol) applied in an oil-water emulsion as proposed by Danielson (2). Another is IPC (isopropyl N-phenylcarbamate) as proposed by Carlson and Moulton (1). Preliminary experiments conducted by the authors on growers' farms in 1949 and 1950 indicated that chickweed could be controlled in strawberry fields by timely applications of a water-soluble DN (ammonium dinitro-secondary-butyl-phenate) with little injury to crop plants. The object of the experiment reported herein was to compare these three chemicals with one another as to crop injury and control of winter weeds, principally chickweed.

Materials and Methods

Plants of the Tennessee Beauty variety were set for this experiment on March 8, 1951 at the Georgetown Substation. Plots were 4 by 15 feet and consisted of single rows of ten plants. Treatments were randomized in four blocks. Weeds were controlled in these plots by cultivation and hoeing during the summer of 1951, the last hoeing was done on August 24. A description of the chemicals used and their method of application is given in Table 1. All were applied as sprays at 50 to 75 pounds pressure. Monarch No. 59 fan-type nozzles were used.

Results and Discussion

The effect of the treatments on weed population and size is given in Table 2. First of all, it can be seen that although the weed population on the check plots, which were not hoed after August 24, was not high, weeds were of considerable size as indicated by their weight. All chemicals very significantly reduced the population and size of both chickweed and other broadleaved weeds, principally henbit (Lamium amplexicaule) and German knot-grass (Scleranthus annuus). IPC was particularly effective for chickweed control, even though it was slow in action. In all cases the chickweed was small and not matted down when the chemicals were applied. 2,4-D was added to Dow Selective in one treatment to aid in control of broadleaved weeds. Under the conditions of this experiment, the 2,4-D supplement seemed unnecessary.

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Table 1. Description of Treatments

Treatment	Active Ingredient and Concentration	Rate of Application per Acre	Date of Application
Check	-	-	-
Dow Selective	Ammonium dinitro-sec-butyl-phenate, 1 lb. per gal.	1 gal. in 100 gals. water	10/17/51
Dow Selective	Ammonium dinitro-sec-butyl-phenate, 1 lb. per gal.	1 gal. in 100 gals. water	1/18/52 & 3/10/52
Dow Selective and 2,4-D (Weedar 64)	Ammonium dinitro-sec-butyl-phenate, 1 lb. per gal. + Alkanolamine Salt of 2,4-D, 4 lbs. per gal.	1 gal.) 1½ pts.) in 100 gals. water	1/18/52
Dow General	Dinitro-ortho-sec-butyl-phenol, 5.12 lbs. per gal.	1 qt. in 15 gals. fuel oil and 85 gals. water	1/18/52
IPC	Isopropyl N-phenyl carbamate, 50% wettable powder	14 lbs. in 100 gals. water	10/17/51

Table 2. Average Weed Population and Weight per Three Squart Feet on April 8, 1952.

Treatment	Number of Weeds		Total Wt. of Weeds in Gms.
	Chickweed	Other Broad-leaved Weeds	
Check	7	10	72
Dow Selective in October	1	1	3
Dow Selective in Jan. and March	0.5	2	3
Dow Selective + 2,4-D in January	1	1.5	4
Dow General + Fuel Oil in January	1	1.5	3
IPC in October	0.2	5.5	7
L.S.D. at 5%	2.5	3	43

The effect of the treatments on strawberry plant mortality and yields is presented in Table 3. Plant mortality records were taken May 1, when plants failing to make new growth could be detected readily. The most desirable treatment with regard to both yields and plant mortality was Dow Selective applied in January and again in March. The yield from this treatment, 31 quarts with 65 per cent marketable was not significantly different from that of the check plots, 30 quarts with 67 per cent marketable. Plots treated with Dow Selective + 2,4-D and plots treated with Dow General + fuel oil yielded 17 per cent less than the check plots. Although this difference was not quite significant statistically, it is the opinion of the authors that some plant injury from the 2,4-D supplement and the Dow General in oil might be indicated, the latter causing six per cent plant mortality.

IPC and Dow Selective applied in October were particularly injurious to strawberry plants, causing 24 and 16 per cent plant mortality, respectively. This was reflected by significantly reduced yields with a much lower grade due to small berry size. The reason for this high plant mortality was probably due to the fact that when these two treatments were made, the strawberry plants were still quite tender and had not yet been exposed to temperatures below 36°F. Daily maximum temperatures around the October 10 date of application ranged mostly from 65 to 85°F., those around the January 18 date from 55 to 65°F., and those around the March 10 date from 45 to 55°F. The foliage burning following application of Dow Selective in October was quite severe, but only slight burning followed application of the same material made in January and March, undoubtedly because the foliage then had been hardened by freezing temperatures. Plant injury following application of IPC developed very slowly and included some epinasty.

Table 3. Percentage of Plant Mortality and Yields of Strawberries from Four Plots.

Treatment	Per Cent Strawberry Plants Dead 5/1/52	Total Yield, Quarts	Per Cent Yield, Marketable
Check	0	30	67
Dow Selective in October	16	11	34
Dow Selective in Jan. and March	0.2	31	65
Dow Selective + 2,4-D in Jan.	0	25	62
Dow General + Fuel Oil in Jan.	6	25	60
IPC in October	24	11	55
L.S.D. at 5%	-	8	0

Summary and Conclusions

A water-soluble dinitro, ammonium dinitro-secondary-butyl-phenate, in a single test, applied at the rate of one pound per 100 gallons of water per acre in January, after strawberry plants had been hardened by freezing temperatures,

and again in March, before new growth appeared, was found to be the most desirable treatment so far as control of chickweed and several other broad-leaved weeds, crop-plant injury, and yields were concerned. This treatment was definitely better under conditions of this experiment, when the weed population was not large, than the application of either the same material or IPC in October. The application of a Dinitro in an oil-water emulsion in January gave excellent weed control but caused six per cent strawberry plant mortality.

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USE OF A CROP PROTECTANT WITH CERTAIN HERBICIDES ON STRAWBERRY PLANTS[1]

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Some herbicides applied to crops grown in southern Delaware have not given as lasting effects as in other areas. Possibly, the light sandy soils (loamy sand of the Norfolk and Sassafras series) allow a more rapid loss of the applied herbicides than do other soil types. These results have led to the testing of herbicides of greater stability and of greater plant toxicity. Such chemicals ordinarily are not sufficiently selective for use in the control of germinating summer weeds in strawberries. This paper reports on the results of tests with a plant protectant and with herbicides of known or suspected toxicity to strawberry.

Procedure and Results

Greenhouse Tests

Sixty strawberry plants of the King variety were washed free of soil, weighed and planted in individual six-inch pots on February 4, 1952. On March 13, eleven treatments were applied to single plants, allowing five replicates of practically identical weights per treatment. When the experiment was terminated April 24, the plants were dug and leaf-crown weights were recorded.

The herbicides applied were CMU (3-p-chlorophenyl-1, 1-dimethylurea) and Chloro IPC (isopropyl N-(3 chlorophenyl) carbamate). CMU had proven very toxic to strawberries and to weeds in work at Delaware and elsewhere (1). The concentration applied in this test was one pound per acre. Chloro IPC also has been reported as toxic on strawberry at high concentrations (2). The concentration used in this experiment was one pound per acre, a concentration that would not be particularly damaging to strawberry according to the report by Bailey (1).

The plant protectant tested was a one per cent aqueous suspension of Norite A activated charcoal plus spreader. Activated charcoal has been effective in reducing toxicity of heavy 2,4-D applications (2). The protectant was sprayed onto the test plants with a one-quart Sure Shot sprayer at 100-150 pounds pressure. The plants were allowed to dry before the herbicides were applied with the same apparatus.

The concentrations of materials applied, mortality rates and final plant weights are shown in Table 1.

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Table 1. Effects of Various Herbicides, Applied March 13 to Strawberry Plants With and Without a Plant Protectant, on Plant Injury and Growth. Greenhouse Test 1952.

Herbicide	Protectant	Plant Injury March 30	Plant Mortality April 20	Final Wt. Average per Plant Without Roots
CMU, 1 lb.	Charcoal	Slight	0	9.5
CMU, 1 lb.	None	Severe	100%	-
IPC, 1 lb.	Charcoal	None	0	20.7
IPC, 1 lb.	None	Slight	0	12.1
None	None	None	0	19.0

Data in the table indicate that some protection against the phytotoxicity of the herbicides was afforded strawberry plants by the charcoal suspension. Although the final weight of the charcoal-protected plants sprayed with CMU was low, the young, unsprayed leaves appeared normal. The charcoal gave good protection against Chloro IPC. Evidently even the one-pound rate of Chloro IPC can cause some damage to unprotected plants.

Field Tests

Tennessee Beauty plants were set on Norfolk loamy sand on March 18. Each ten-plant treatment row was replicated four times. On April 4 the protectant and herbicidal sprays were applied separately with knapsack sprayers using Monarch No. 59 nozzles and 50-60 pounds pressure. The protectant dried before the herbicides were applied. A one per cent aqueous suspension of Norite A activated charcoal plus spreader was the protectant employed. The herbicides under test were CMU, one-half pound per acre, after a protectant spray; CMU, one pound per acre, with and without a protectant spray; and Chloro IPC, at one or three pounds, following a protectant spray of charcoal plus spreader.

Ten to fourteen days after the spray application, an interesting pattern of weed control was appearing. No weeds grew in the spacing between plants of the sprayed rows, but in the immediate area of each plant, a tuft of weeds was thriving. Evidently, the charcoal spray, applied to the soil as well as the plants, had protected the soil against herbicidal activity.

By the first of May, the rows sprayed with one pound of CMU without plant protectant were showing 50 per cent mortality and the plants of this treatment which were still alive showed considerable stunting. There was no mortality of plants sprayed with CMU following a charcoal plus spreader spray. In some cases the older leaves were severely damaged but all growth developed subsequent to spraying appeared normal. No plant damage was apparent on rows sprayed with Chloro IPC.

On June 1 the growth of weeds surrounding each strawberry plant necessitated control measures. The same materials were applied again, except that this time, the spray of Nuchar activated charcoal plus sticker

was applied before hoeing with the expectation that the hoeing would break up the charcoal film deposited on the soil under each plant. A similar application was made July 23. Observations made during the remainder of the growing season indicated that the mechanically broken film of activated charcoal had little residual effect against the efficacy of CMU applied to the soil.

The initial application of CMU had killed all unprotected strawberry plants by midsummer. In comparison the charcoal-protected plants showed only 22½ per cent mother-plant mortality from the three applications which had been made by the end of the growing season. However, each spray caused severe necrosis of mature leaves and a severe retardation of runner-plant development.

Discussion

The possibility of artificially protecting crop plants against herbicides of greater toxicity and residual capabilities for killing germinating weeds may well increase the list of materials having herbicidal value. The rate of application for certain herbicides, too, might be safely moved upward to permit better control of weeds. The ideal protectant would be effective on the established planting but ineffective on soil. However, the mechanical breaking of the soil film of the protectant, such as accomplished in this experiment by hoeing after application of charcoal, would not be of great disadvantage if the herbicide applied has long residual action. Such combinations of materials would prove of inestimable value in newly established perennial plantings, where weed control by either mechanical or herbicidal methods is expensive or hazardious.

Summary

The data of this experiment, suggest the possibility of protecting crop plants against the toxic action of more effective weed killers. Activated charcoal, although not the perfect protectant, was at least partially effective against toxic concentrations of CMU. The possibility of using combinations of crop-plant protectants and herbicides with long residual power against germinating weeds is suggested.

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THE USE OF CERTAIN HERBICIDES IN BLUEBERRY CULTURE[1]

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Most commercial fields of blueberries, although the plant is relatively shallow-rooted, are cultivated and hoed as a means of avoiding weed competition. Many growers cause varying degrees of root injury with mechanical weed control operations. It was the purpose of this experiment to determine if certain herbicides applied as ground sprays could reduce or preclude cultivations.

The materials under test were the oil-water emulsion type of dinitro (dinitro-ortho-secondary-amyl (or butyl)-phenol) and CMU (3-p-chlorophenyl-1, 1-dimethylurea) both of which were compared with a hoed and an unhoed check. The dinitro was applied at a concentration of approximately one pound per acre in 100 gallons of water. Two separate concentrations, one and two pounds per acre, of CMU were applied. Monarch No. 59 nozzles were used in applying the early season sprays with a knapsack sprayer at a pressure of 35-50 pounds. The last two dinitro sprays were applied at 50-60 pounds pressure with a mechanical sprayer using the above nozzles.

The plants used were of the Cabot variety, 5-years old growing on Portsmouth sandy loam. Treatment plots were four plants long, and each treatment plot was replicated at random five times down the row 102 plants long. No border plants were left between treatment plots. All plots were cleaned free of weeds in early April, before treatments were started.

To determine the effect of treatments on plant vigor, diameter measurements were made on selected and marked shoots before and at the end of the growing season. The effects of the treatments on soil moisture available to the blueberry plants were determined by the Bouyoucos (1) system with one block per treatment replicate buried six inches deep.

The detailed information regarding treatments, number of applications, and growth are presented in Table 1.

The plots most nearly free of competing weeds throughout the growing season were the CMU plots. Only one weed species, horse nettle (Solanum carolinense), seemed immune to the concentrations applied. The CMU concentrations appeared effective for all other weeds on this soil for about three months. After this period, the number of horse nettle weeds and the appearance of various grasses, primarily crab grass, made necessary a light hoeing and re-application of materials. Throughout the season, the blueberry plants exhibited no injury that could be attributed to CMU toxicity.

Applications of the dinitro spray were made whenever the weeds and grasses reached a maximum height of two inches. These plots were never hoed

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after the treatments were started. One obvious disadvantage of the dinitro spray was the killing of new shoots originating from the crown of the blueberry plants. Ordinarily, when these plants are pruned, some of these annual shoots serve as renewal stems for the blueberry bush.

Table 1. Materials, Dates of Treatment, and Diameter Growth of Marked Blueberry Stems Grown Under Different Weed Control Methods, 1952.

Treatment Concentration	Date Treatments Applied	Av. Increase in Diameter, Cm.
CMU - 1 lb. per acre	4/17, 7/26	0.83
CMU - 2 lb. per acre	4/17, 7/26	0.74
Dinitro - 1 lb. per acre	4/17, 6/3, 7/11*, 7/21, 8/26	0.61
Hoed Check	5/19, 6/5, 7/15, 8/20, 9/5	0.65
Unhoed Check	-	0.51
L.S.D. 5%		0.14

*A water-soluble dinitro applied this date failed to hold weeds and the emulsion form was applied ten days later.

Five shallow hoeings, following the initial one before treatments started, were necessary to control weeds on the hoed plots. Grasses and weeds grew to about two inches in height between hoeings.

The growth records presented in Table 1 show that no herbicidal control method seriously retarded growth. The high growth obtained on the CMU plots can hardly be explained by a reduction in competing growth, but no other explanation is available. What general effect the prevention of new shoot growth, such as experienced from the dinitro sprays, might have on total stem diameter, is unknown, but that factor also might help explain the relatively low rank of the dinitro treatment.

As would be expected, the weedy plots of the unhoed checks showed less moisture available to the blueberry plants than the plots where weeds were controlled. The greatest differences were in data recorded July 25 when the CMU plots averaged 74 per cent available moisture; the hoed, 69 per cent; the dinitro plots, 68.0 per cent, and the unhoed checks, 45.0 per cent moisture.

Although the results of this one-year test indicate that the use of herbicides may effectively reduce the number of cultivations needed in commercial blueberry fields for adequate control of weeds, more data are needed concerning the long-time effect of herbicides on soil properties. CMU and dinitro appeared to have had no toxic effect on blueberry grown on the soil type employed in this test, but as the Research Coordinating Committee (3) suggests, more information is needed regarding the toxic level of CMU particularly for these crop plants. No doubt the continued and thorough use of herbicides in large plantings would lead to a reduction in the number of sprays necessary to control weeds. Such has been the experience of citrus growers employing "till-less culture" (2). A reduction in the number of

dinitro sprays would aid the maintenance of the renewal system in the blueberry.

Summarized, the results of a one-year test of the effectiveness of herbicides versus hoeing for weed control in blueberries have shown CMU at one and two pounds per acre to have no apparent toxicity for blueberries, and required only two sprays during the growing season to control weeds adequately. Obvious disadvantages of monthly sprays with a dinitro contact weed killer are the prevention of renewal shoot growth of blueberry, and the number of sprays necessary for adequate weed control.

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3. Report of the Research Coordinating Committee. Supplement Proc. 6th Annual Northeastern Weed Control Conference, page 26. 1952.

CONTROL OF WINTER ANNUAL WEEDS IN APPLE ROOTSTOCK WITH 3-CIPC

By R. F. Carlson[1]

The demand for dwarf fruit trees has increased many fold the past few years creating the need for an increase and expansion of dwarf rootstock. With the establishment of new rootstock plantings a weed problem has developed requiring research with chemicals for their control. The winter annual weeds, such as common chick weed (Stellaria media), common mallow (Malva rotundifolia) and biennial blue grass (Poa annua) are difficult to control by manual and cultural practices. This is especially true with the dwarfing rootstock which is propagated by mound layering. These and other weeds are most difficult to remove in the spring without injuring the rootstock, because they are vigorously growing at the time the new shoot-growth is produced from the stool-crown.

Two conditions prevail in the propagation of dwarf rootstocks which must be considered in timing the herbicidal sprays. The newly established stoolblock is left intact the first two years, whereas, in the productive stoolblock the soil-mound is pushed aside and the rooted tops removed at ground-level, usually in November. Therefore, the new stoolblock should be sprayed in October the first two years and the productive one in November after the rooted tops have been removed.

Materials and Methods

Eighteen rows 300 feet long of a first year stoolblock planting of Malling I, VII, IX and XVI growing on a Hillsdale clay loam were sprayed October 18, 1951 with 6, 12 and 18 pounds per acre of isopropyl N-(3-chlorophenyl) carbamate (3-CIPC). An older stoolblock was similarly treated November 13 after the rooted shoots had been removed and the stool-crowns covered with an inch of soil. Some weeds were well established and others were just emerging at the time the sprays were applied in young plantings. No weeds were present when sprays were applied in the producing planting, since they were removed at the time the mound was pushed aside for the removal of the rooted cuttings.

The sprays were applied with a knapsack sprayer at a volume of 60 gallons per acre to the row from each side in the young plantings so that only the lower 4 to 6 inches of the stems of the rootstock came in direct contact with the spray. In the producing planting the spray was applied directly to the soil over the row from which the rooted shoots previously had been removed. A relatively warm day was selected for the application of the 3-CIPC with temperatures ranging from 60° to 70° F.

Weed counts were taken the following spring, May 18, and shoot-growth (current seasons growth) measurements were made in October and November the same year. All top growth and rooted cuttings removed were carefully examined for possible injury.

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Results

New planting: - An average of 79.3, 88.6 and 96.5 per cent weed control was obtained from 6, 12 and 18 pounds of 3-CIPC per acre respectively (Table 1). The weed counts were made in the spring following the fall applications. Measurements of the current seasons shoot-growth indicate that the chemical had no injurious effect on the rootstock at any of the concentrations used. Six pounds per acre of 3-CIPC gave satisfactory weed control and three times that amount produced no visable toxic symptoms on the stock applied in a semi-dormant to dormant stage of growth.

Table 1. Per cent weed control obtained from application of 3-CIPC at 6, 12 and 18 pounds per acre to Malling rootstocks. Applications were made in the fall, weed counts recorded in the spring, and shoot-growth in the fall.

Pounds per acre 3-CIPC	Weed Control (Per cent of check)	Average Shoot-growth of stock (inches)	
		Check	Treated
	New Planting		
6	79.3	18.6	21.1
12	88.6	20.2	17.8
18	96.5	19.1	19.9
	Producing Planting		
6	82.4	16.8	16.2
12	85.1	17.4	18.0
18	93.4	17.0	16.9

Producing planting: - Satisfactory weed control was obtained in this planting with 3-CIPC. Weed counts made in May showed 82.4, 85.1 and 93.4 per cent control of the winter annual weeds present (Table 1). No injury was apparent to the rootstock from any of these applications at relatively high rates per acre of the chemical. The rooted cuttings harvested in early November appeared normal in vigor and number of roots formed as compared to cuttings from untreated rows.

Discussion and Conclusion

The use of 3-CIPC at 6 pounds per acre applied when the rootstock is dormant appears to be satisfactory for control of many of the winter annual weeds. Although fall applications gave satisfactory weed control in the test reported here, early spring applications when the weeds are becoming active and the rootstock dormant may also be practical.

Based on weed control obtained under a condition of rather cool soil and air temperatures in the fall, the 3-CIPC appeared to persist in activity over a more

extensive period than when applied at higher temperatures during the summer. This conforms to an earlier report by Stevens and Carlson (1).

The top-growth in a new planting of rootstock is usually removed two years after planting, and consequently, two seasons occur to combat weeds before the stock is mounded. During this interval of stoolblock establishment, 3-CIPC could be used to advantage to reduce labor cost by approximately 80 per cent. A similar reduction in labor cost could be anticipated by properly timed applications of 3-CIPC in the productive stoolblock.

No difference in tolerance to 3-CIPC of the various types of the Malling rootstock could be detected.

Literature Cited

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WEEDING SWEET CORN WITH DINITRO HERBICIDES, 1948-1952

M.F. Trevett, R.D. Littlefield, and H.J. Murphy[1]

This paper presents four years' results on the effect of pre-emergence applications of dinitro herbicides[2] on the yield of sweet corn, corn seedling emergence, and weed control.

The tests were made on sandy loam and loam soils. Conventional seed bed preparation was practiced with a final fitting made ordinarily 3 to 4 days before planting.

Treatments were replicated from 5 to 10 times. Plots were harvested when the corn was at the soft dough stage of maturity.

In 1948 herbicides were applied with a garden type knapsack sprayer and a single nozzle spray wand. From 1949 to 1952 applications were made with a boom of plot width, enabling uniform distribution of a measured amount of spray with a single pass. Spray volume was either 60 or 70 gallons per acre.

Lamb's Quarters (*Chenopodium album*) and Pigweed (*Amaranthus retroflexus*) made up 60 to 70% of the broad-leaf weed population in all blocks in all years. Other broad-leaf weeds present in varying amounts included Spurry (*Spergula* spp.), Common Ragweed (*Ambrosia* spp.), Shepherd's Purse (*Capsella* spp.), Mustards (*Brassica* spp.), Horsetail (*Equisetum* spp.), Smartweed (*Polygonum* spp.). The principal grass was Barnyard Grass (*Echinochloa Crus-galli*).

Table 1 contains the following data: Variety and tillage practice, date of chemical treatment and corn emergence, rainfall subsequent to chemical treatment, and yields in pounds of snapped ears per acre. Statistical significance is given for the 5% level.

Table 2 gives the effect of dinitros on weed control for the years 1949, 1950, and 1952.

1/ Associate Agronomist, formerly technical assistant, and Assistant Agronomist, respectively, Department of Agronomy, University of Maine, Orono.

2/ The dinitros were supplied by the Dow Chemical Company and Standard Agricultural Chemicals, Inc.

Table 3 shows the effect of a dinitro on the rate of emergence of a late planting Early Topcross sweet corn in 1950.

Discussion:

Data in Table 1 indicate that under the rainfall conditions prevailing neither the ammonium nor the alkanolamine salts of dinitro-o-sec-butyl phenol had a significantly depressing effect on either stand or yield of sweet corn. Where the weed population was sufficiently great, cultivated dinitro plots produced significantly higher yields than plots that were cultivated but not chemically treated. Frequently, tip burn was observed on newly emerged seedlings in chemically treated plots. This rather minor injury had no lasting effect on seedling development.

Under certain environmental conditions dinitro herbicides apparently may briefly retard crop emergence. Contained in Table 3 is the rate of emergence of Early Topcross corn, planted July 26, 1950 and treated with 6 pounds per acre of DNOSBP from the alkanolamine salts August 2, 1950. On the second of August the tips of the earliest emerging plants were barely breaking through the soil. For the period August 3nd to August 5th percent emergence in check plots was significantly higher than in dinitro plots. However, by August 7th, and thence forward, differences in percent emergence between check and dinitro plots were not statistically significant.

Data in Table 2 indicate better control of broad-leafed weeds than of annual grasses. Deferring application of dinitros until as late as possible before emergence apparently increases the effectiveness of the treatment (Table 2, 1950, Block A).

Conclusions:

The ammonium and alkanolamine salts of dinitro-o-sec-butyl phenol, under conditions of moderate rainfall following application on sandy loam soils or heavier, apparently can be used safely for pre-emergence weed control in sweet corn.

Deferring treatment to within 48-72 hours of corn emergence apparently will result in better weed control than if dinitros are applied at planting.

TABLE 1. YIELDS AND STAND OF SWEET CORN IN PRE-EMERGENCE DINITRO BLOCKS, 1948-1952

Year and Block	Variety and Treatment	Yield: Pounds Snapped Ears Per Acre	Stand of Corn Plants Check = 100	a. Date DN applied b. Date Corn 10% Emerged	Rainfall Following Chemical Treatment Date	Inches of rain
1948	Hybrid C					
	Cultivated only	--	100	a. 6/17	6/18	.06
				b. Up 6/20	6/19	.38
	1.3# DNOSBP[1]/Acre, cultivated	--	89		6/20	.28
			N.S. @ 5%		6/21	
1949 A.	Hybrid C					
	Cultivated only	3194	--	a. 6/16	6/17	
				b. Up 6/20	6/18	.39
	1.3# DNOSBP[1]/Acre, cultivated	7529			6/19	.10
	LSD 5% - -	1737			6/20	.45
					6/21	1.25
B.	Cultivated only	3216	--	a. 6/20	6/20	.45
				b. Up 6/23	6/21	1.25
	2.0# DNOSBP[1]/Acre, cultivated	5939	--		6/22	
	LSD 5% - -	1686			6/23	.19
C.	Cultivated only	--	100	a. 6/27	6/26	
				b. 6/28	6/27	.04
	1# DNOSBP[1]/Acre, cultivated	--	103		6/28	
			N.S.		6/29	
1950 A.	Early Topcross					
	Cultivated and hand hoed	10,200	100	a. See treatment col.	6/16	
					6/17	.50
	3# DNOSBP[2]/Acre, applied 6/20 cultivated	9260	95	b. 6/23	6/18	
					6/19	
					6/20	
	3# DNOSBP[2]/Acre, applied 6/16 cultivated	8860	106		6/21	.04
					6/23	
	LSD 5% - -	1180	N.S.		6/24	
					6/25	.63

TABLE 1. YIELDS AND STAND OF SWEET CORN IN PRE-EMERGENCE DINITRO BLOCKS, 1948-1952 (Cont.)

Year and Block	Variety and Treatment	Yield: Pounds Snapped Ears Per Acre	Stand of Corn Plants Check = 100	a. Date DN applied b. Date Corn 10% Emerged	Rainfall Following Chemical Treatment: Date	Rainfall Following Chemical Treatment: Inches of rain
1950 B.	Cultivated only	--	100	a. 6/29	6/30	
				b. 7/8	7/1	.01
	6# DNOSBP[2]/Acre, cultivated	--	106		7/2	.03
					7/3	.38
			N.S.		7/4	.04
					7/5	.43
					7/6	.01
					7/7	
C.	Cultivated only	--	100	a. 7/11	7/11	.33
				b. 7/15	7/12	.09
	3# DNOSBP[2]/Acre, cultivated	--	100		7/13	
					7/14	.05
	6# DNOSBP[2]/Acre, cultivated	--	98		7/15	
			N.S.			
D.	Cultivated only	--	100	a. 8/2	8/2	
				b. 8/3	8/3	
	6# DNOSBP[2]/Acre, cultivated	--	100		8/4	
					8/5	.38
	9# DNOSBP[2]/Acre, cultivated	--	97			
			N.S.			
E.	Maine Topcross					
	Cultivated and hand hoed	9096	100	a. 6/15	6/15	
				b. 6/20	6/16	
	3# DNOSBP[2]/Acre, cultivated	7872	115		6/17	.50
		N.S.	N.S.		6/18	
					6/19	
					6/20	

TABLE 1. YIELDS AND STAND OF SWEET CORN IN PRE-EMERGENCE DINITRO BLOCKS, 1948-1952 (Cont.)

Year and Block	Variety and Treatment	Yield: Pounds Snapped Ears Per Acre	Stand of Corn Plants Check = 100	a. Date DN applied b. Date Corn 10% Emerged	Rainfall Following Chemical Treatment: Date	Rainfall Following Chemical Treatment: Inches of rain
1951	Maine Topcross					
A.	Cultivated only	9360	100	a. 6/12 b. 6/15	6/13 6/14	
	3# DNOSBP[3]/Acre, cultivated	9980	100		6/15 6/16	.29 .32
	6# DNOSBP[3]/Acre, cultivated	9640	108			
		N.S.	N.S.			
1952	Dirigo					
A.	Cultivated only	10,140	100	a. 6/21 b. 6/24	6/21 6/22	
	3# DNOSBP[2]/Acre, cultivated	11,980	98		6/23 6/24	
	6# DNOSBP[2]/Acre, cultivated	13,260	103		6/25	.03
		N.S.	N.S.			
B.	Experimental Hybrid					
	Cultivated only	3107	100	a. 6/13 b. 6/17	6/13 6/14	
	Cultivated and hand hoed	8033	73		6/15 6/16	
	6# DNOSBP[2]/Acre, cultivated	7530	77		6/17	.19
	LSD 5% - -	2415	N.S. (But a trend)			

1/ Ammonium dinitro ortho secondary butyl phenol (Standard Agricultural Chemicals, Inc.).

2/ Alkanolamine salts (of the ethanol and isopropanol series) of dinitro-o-sec-butyl phenol (Dow Chemical Co.).

3/ Triethanolamine and isopropanolamine salts of dinitro ortho secondary butyl phenol (Standard Agricultural Chemicals, Inc.).

TABLE 2. EFFECT OF DINITROS ON WEED CONTROL IN SWEET CORN

Year and Block	Treatment[1]	No. Weeds[2]/Sq.Ft. Broad-leaf	No. Weeds[2]/Sq.Ft. Annual Grasses	Height of Weeds Broad-leaf	Height of Weeds Annual Grasses
1949 A.	Cultivated only	13.2	1.9		
	1.3# DNOSBP[3]/Acre	4.1	2.3		
B.	Cultivated only	12.8	3.4		
	2.0# DNOSBP[3]/Acre	8.0	4.0		
1950 A.	Cultivated and hand hoed	2.0	1.3		
	3# DNOSBP[4]/Acre, applied June 20	0.9	7.0		
	3# DNOSBP[4]/Acre, applied June 16	2.2	20.3		
C.	Cultivated only	33.9	41.5		
	3# DNOSBP[4]/Acre	7.5	2.3		
	6# DNOSBP[4]/Acre	2.6	1.0		
D.	Cultivated only	64.4	1.4		
	6# DNOSBP[4]/Acre	7.6	0.7		
	9# DNOSBP[4]/Acre	2.3	1.4		
				August 7	
E.	Cultivated and hand hoed	2.1	1.7	1.1	1.6
	3# DNOSBP[4]/Acre	1.5	13.7	4.2	10.8
	Cultivated only	17.6	23.3	5.5	13.6
1952 A.	Cultivated only	2.7	2.7		
	3# DNOSBP[4]/Acre	0.54	—		
	6# DNOSBP[4]/Acre	0.48	1.2		
				August 14	
B.	Cultivated only	6.9	1.2	25	15
	Cultivated and hand hoed	0.9	0.3	7	6
	6# DNOSBP[4]/Acre	0.2	0.6	15	12

1/ All chemical treatments were cultivated.

2/ Weed counts made 4 to 6 weeks after treatment.

3/ Ammonium dinitro ortho secondary butyl phenol (Standard Agricultural Chemicals, Inc.).

4/ Alkanolamine salts (of the ethanol and isopropanol series) of dinitro-o-sec-butyl phenol (Dow Chemical Co.).

TABLE 3. EFFECT OF DINITROS ON RATE OF EMERGENCE OF EARLY TOPCROSS SWEET CORN, 1950

Date	Rainfall Inches	% Emergence of Corn Plants on Date Specified 1/		
		Check	6# DNOSBP 2/ /Acre, applied Aug. 2	
July 31	.31	—	—	
Aug. 1	.14	—	—	
Aug. 2	—	Tips of earliest emerging plants barely breaking through soil		
Aug. 3	—	7.1	1.4	LSD 10% - 2.2
Aug. 4	.38	21.8	6.0	LSD 5% - 2.7
Aug. 5	.48	36.9	19.1	LSD 5% - 1.48
Aug. 6	—	—	—	
Aug. 7	—	76.6	72.7	N.S.
Aug. 8	—	—	—	
Aug. 9	—	85.0	85.5	N.S.

1/ Corn planted July 26, 1950.

2/ Alkanolamine salts (of the ethanol and isopropanol series) of dinitro-o-sec-butyl phenol (Dow Chemical Co.).

Herbicidal Sprays in Strawberries

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Tests were conducted with chemical weed control of broadleaf annuals and grass in strawberries at Blacksburg, Virginia. Plantings made in 1951 and in 1952 were treated during their first summer after planting.

1951 Experiment

Several herbicides were compared alone and in mixtures. Included were 2,4-D amine; 2,4,5-T; Crag Herbicide No. 1; IPC; and Chloro IPC. The various treatments are listed in Table I.

The plants were set April 7, 1951 on clay loam of moderate texture and pH 5.2. Treatment plots of approximately 1/200 acre consisted of 14 plants each of Blakemore and Premier set 2 feet apart in rows 4 feet apart. Each treatment was replicated 4 times. Herbicides were applied with a hand sprayer in dilutions to 50 gallons per acre. Check plots received no herbicides and were given normal cultivation. Middles, 28 inches wide between rows, were cultivated the same as check plots. The sprayed row area was about 20 inches wide. Just prior to each herbicidal spray application the sprayed row area was hand weeded and cultivated. The weeds were gathered, sorted, counted and weighed fresh. Runners had started when the first spray was applied on May 24. A count was made on October 1 of the number of rooted runner plants as an indication of the injurious effect of the herbicides. Yields in quarts per plot were recorded June 1 to 17, 1952.

Results are given in Table I. Dry weather appeared to affect the growth of mother plants, development of runner plants and growth of weeds and grass. Premier failed to make satisfactory growth or yield.

Broadleaf annuals consisted mainly of plantain, ragweed, lamb's quarter, pigweed, wild carrot, spurge, smartweed, and wood sorrel. Grass was predominantly crab with a small amount of foxtail and orchard grass.

Since untreated plots were clean cultivated, no record of weeds or grass was available.

1952 Experiment

In 1952 a somewhat similar planting of Blakemore and Fairland varieties were set on April 7. Treatments and resulting weed control appear in T ble II. It has been observed that some cultivation is necessary to prevent hardening and packing of this clay loam soil with resulting difficulty of runner rooting and water run-off. Thus two levels of cultivation were included with the treatments. Preceding the first spray on June 6, all plots received 2 cultivations. The entire plot was sprayed at 50 gallons per acre with a special herbicide sprayer.

*J. R. Havis, formerly of this Station, assisted with the 1951 tests.

Table I. 1951 Records - Plants set April 7, 1951

Treatments per Acre.	Means per plot: No. Rooted Runner Plants Blakemore	Premier	No. of Annuals Weeds	Grass	Gms. wt. of Annuals Weeds	Grass	1952 yield in qts. Blakemore	Premier
A. 2 applications [1]								
1. 2,4-D 1 lb.	63.00	9.25	11.25	104.25	70.50	619.00	1.54	1.18
2. 2,4,5-T 3/4 lb.	8.25	2.50	26.75	104.25	230.00	521.25	.56	.58
3. 2,4-D 3/4 lb. + CH-1, 3 lbs.	48.00	6.25	3.00	98.25	20.50	307.75	1.65	1.01
4. 2,4-D 3/4 lb.	60.75	11.00	12.50	96.50	56.00	539.50	1.25	1.02
B. 3 application [1]								
5. 2,4-D ½ lb. + CH-1, 4 lbs.	48.50	5.25	0	23.50	0	68.50	1.21	.66
6. CH-1, 4 lbs.	66.00	12.00	0	10.50	0	120.25	1.00	.73
7. 2,4-D 1/3 lb. + CH-1, 3 lbs. + IPC, 5 lbs.	39.75	2.25	0	18.75	0	98.25	.86	.50
8. 2,4-D 3/4 lb. + Chloro IPC 3 lbs.	17.00	.50	1.50	20.75	2.25	100.00	.43	.35
C. 4 applications [2]								
9. CH-1, 3 lbs.	79.75	10.25	0	10.00	0	200.00	1.74	1.10
10. No herbicide	168.75	45.00	—	—	—	—	4.71	1.86
L.S.D. at 5% level	35.66	11.34	14.86	130.40	130.40	235.97	1.44	.78
Rank. [3]	9>2,7,8 10>1,2,3,4 5,6,7,8,9 1,4,6,9>2,8	10>1,2,3 4,5,6 7,8,9 6>8	2>1,3, 4,5,6 7,8,9	1,2,3,4 >5,6 7,8,9	2>1,3 4,5,6 7,8,9	1,2,4> 3,4,5,6 7,8,9 3 5 1 3	10>1,2 3,4,5,6 7,8,9	10>2,3,4 5,6,7,8 1 8

1/ At approximately 6 week intervals
2/ " " 4 " "
3/ The sign ">" indicates "significantly greater than"

Table II.- 1952 Records - Strawberry Plants Set April 7, 1952

Treatments[1] per Acre	Means per plot: No. of weeds Grass	Annuals
A. No Cultivation:		
1. No herbicide	43.50	265.75
2. 2,4-D, 1 lb.	18.00	71.75
3. CH-1, 2 lb.	11.50	62.75
4. CH-1, 3 lb.	15.00	41.00
5. Chloro IPC, 3 lb.	23.00	121.25
B. Cultivated before each spray:		
6. No herbicide	32.25	203.25
7. 2,4-D, 1 lb.	13.25	42.00
8. CH-1, 2 lb.	17.25	42.00
9. CH-1, 3 lb.	10.75	33.25
10. Chloro IPC, 3 lb.	21.00	63.25
L.S.D. at 5% level	12.35	54.87
L.S.D. at 1% level	16.67	74.10
Rank[2]	1 > 2,3,4,5 6 7,9 6 8	1 2,3,4,5 5 3,4 6 7,8,9,10

1/ 3 herbicides sprays at 5-week intervals

2/ The sign " " indicates "significantly greater than" at 5% level
The sign " " Indicates "significantly greater than" at 1% level

Summary

In general check plots produced more rooted runner plants than sprayed plots, indicating injury by the herbicides. Injury in 1952 was much less than in 1951, probably because of difference in soil moisture. Crag Herbicide 1 appeared generally to be the best of the herbicides under test. None of the treatments, however, seemed to be entirely satisfactory for weed control in these plots. Sprays of 2,4,5-T at 3/4-lb. per acre were very injurious to the strawberry plants and failed to control weeds satisfactorily.

CMU, ENDOTHAL AND TCA ON RED BEETS

By S. K. Ries and R. D. Sweet

Workers from several areas (1, 2, 3, 4) have investigated chemicals for weeding red beets. TCA, sodium salt of trichloroacetic acid, has proven effective as a material where annual grasses are the principal problem. Endothal, 3,6-endoxohexahydrophthalate, a newer material has also been reported as satisfactory. Neither of these materials has been consistently good, however, in areas such as New York where lambs quarter (Chenopodium album) and red root, (Amaranthus retroflexus) are predominant weeds. CMU, 3p-chloro phenyl-1,1 dimethyl urea, has given consistently better control of lambs quarter and red root than either TCA or Endothal, but in instances has caused considerable crop injury except at low rates.

The purpose of this study was to obtain information on how rates, timing, gallonage, and soil types influence crop response and weed control with CMU, TCA and Endothal.

Methods

Soils used were a Dunkirk sandy loam and a Dunkirk silty clay loam, averaging about 1.3 and 1.9 percent organic matter respectively. They averaged 8 to 10 and 15 to 20 percent clay respectively.

In the timing studies, chemicals were applied three times on the sandy loam: at planting, at come-up, and post-emergence when the beets had about four leaves. On the silty clay loam soil only the first two times were used. Rates of herbicides ranged from one eighth to three fourths pound of CMU; two to eight pounds of Endothal; and from four to twelve pounds of TCA. Intermediate rates of all three chemicals were included.

Results

The responses of beets and weeds to CMU, TCA and Endothal on soils of widely different textures are shown in Table 1. The stand of beets and the foliage ratings indicate clearly that more than one-fourth pound of CMU is injurious. From the standpoint of total yield, the individual plants that remained at the higher rates grew much larger. This resulted in comparable total weight except at the three fourths pound rate. Growers producing beets under contract with a premium for smaller sizes would be seriously penalized if CMU were used at more than one fourth pound unless the seeding rate is increased. Neither TCA nor Endothal injured beets at any of the rates used.

Weed control ratings were obtained for both annual grasses and broadleaved species. The former were primarily crabgrass (Digitaria spp.) and some barnyard grass (Echinochloa spp.). The broadleaved weeds were primarily purslane (Portulaca oleraceae), red root (Amaranthus retroflexus), and lambs quarter (Chenopodium album). In Table 1 it is apparent that on the sandy loam soil where crabgrass predominated TCA gave significantly better control of annual grasses than did CMU. Endothal was intermediate. At the other location, where there was a higher percentage of barnyard grass, Endothal was inferior to both TCA and CMU. Also the quantity of TCA needed for commercial grass control was higher. Only the 12 pound rate resulted in a rating of seven or higher. CMU at rates of three-eighths pound or higher gave commercial grass control.

Table 1. Response of Red Beets and Weeds to Treatments of CMU, TCA, and Endothal On a Sandy Loam and a Silty Clay Loam Soil

Treatment	Rate in pounds per acre	Sandy Loam			Silty Clay Loam			
		Ratings[1]			Beets		Weed Ratings[1]	
		Beet foliage	Weed Control B. L.	Grasses	Yield in lbs.	per plot	Broad-leaved	Grasses
CMU	1/8	8.7	7.1	2.4	26.1	168	5.4	2.6
"	1/4	7.8	8.4	2.7	28.8	166	8.1	3.6
"	3/8	6.5	8.7	4.5	22.6	151	8.9	6.9
"	1/2	5.1	7.6	4.6	21.4	114	9.0	8.6
"	3/4	2.9	8.6	3.6	17.8	51	9.0	8.4
Endothal[2] (liquid)	2	9.0	6.2	3.2	26.7	170	2.9	4.1
"	4	8.6	5.1	3.1	27.5	203	5.0	5.4
"	6	8.0	7.5	4.7	23.0	192	4.0	3.5
"	8	8.3	6.2	6.2	27.6	193	6.5	3.9
Endothal[2] (powder)	4	8.5	6.4	3.7	26.1	182	4.6	3.6
TCA	4	9.0	3.5	5.3	23.2	196	1.2	4.9
"	8	7.4	4.7	7.3	22.6	180	1.8	3.5
"	12	8.5	3.1	7.8	26.0	173	3.2	7.6
Weeded check		9.0	7.8	7.7	25.9	202	8.4	8.8
Unweeded check		8.8	4.4	2.6	23.2	157	2.5	1.5
L. S. D. at 5%		1.6	2.8	2.0	4.6	35	1.9	2.0
L. S. D. at 1%		2.2	3.7	2.6	6.1	46	2.6	2.7

1. Beet foliage rating of 9 = excellent; 7 = commercially acceptable; 1 = complete kill
   Weed control ratings of 9 = excellent; 7 = commercially acceptable; 1 = no control
2. Endothal liquid is product available in 1952; powder is chemical from 1951 supply

Broadleaved weeds were readily controlled by CMU at rates of one-fourth pound. Even the one-eighth pound rate on the sandy soil gave commercial control. Endothal was somewhat better than TCA at controlling Broadleaves. Neither chemical consistently controlled the species present.

There was no difference in crop response or weed control between the powder (1951) and liquid (1952) Endothal formulations.

The results from applying chemicals at different times are presented in Table 2. The four-leaf stage was included at only one location. It is interesting to note that crop response was identical at the first two times of treating. The average of all three chemicals indicate a degree of injury when applied in the four-leaf stage. However, this is due to damage from CMU. Ratings for TCA and Endothal show no difference in crop response regardless of time of treating. Weed control on sandy loam tended to become poorer as time of treating was delayed. On the silt loam, however, the reverse is true. This differential response, however, is not likely to be directly associated with soil type because conditions were favorable for immediate weed germination on the sandy loam soil, whereas the weeds emerged slowly on the silt loam plots.

Table 2 Effect of Time of Application on the Combined Performance of CMU, TCA, and Endothal on a Sandy Loam and a Silty Clay Loam Soil

	Time of Treatment			
	At planting	At come-up	4 True Leaves	L.S.D. at 1%
Sandy Loam				
Beet growth[1]	8.1	7.9	7.3	0.48
Grass control[1]	5.3	5.0	3.3	0.63
Broadleaves control[1]	6.7	6.6	5.9	0.44
Silty Clay Loam				
Beet yield (lbs.)	24.4	24.8	--	N. S.
Beet stand	163.1	170.1	--	N. S.
Grass control[1]	4.8	5.5	--	0.58
Broadleaves control[1]	5.0	5.7	--	0.45

1. Beet growth rating: 9= Excellent; 7 = commercial; 1= killed
Weed control rating: 9= Excellent 7 = commercial; 1= no control

Effect of Gallonage on Performance of CMU

It was apparent that more damage to beets from CMU was occurring in 1952 than was observed in 1951 in plots located on the same general soil types. The authors (4) reported no differential response of beets to CMU regardless of time of application, depth of planting, or moisture. One aspect, however, differed between the 1951 and 1952 experiments. In earlier experiments

chemicals were applied in about 35 gallons of water per acre, and in the latter in 90 gallons of water. Although gallonage has a relatively slight effect in these ranges with most herbicides, it was thought this might be an aspect worthy of study with CMU. CMU is relatively insoluble in water. Only about 225 ppm of CMU is soluble at ordinary room temperatures. If it were the soluble CMU that injures beets, them higher gallonages would be supplying more soluble CMU and hence would be causing more crop damage.

To test the above hypothesis a factorial design using a split-plot technique with two replications was used. One-half of the total number of plots received three-eighths inch of water from overhead irrigation immediately after treatments were applied. One-third of the plots received three-fourths pound CMU, the remaining thirds received one-half and one-fourth pound respectively. For each rate of CMU the plot area was split into three parts and the gallonages of water employed were 26.6, 53.2, and 106.4. These water volumes could be expected to provide 0.05, 0.10, and 0.20 pounds of CMU in solution as a constant for each of the three basic dry rates of one-fourth, one-half, and three-fourths pound. Soil type was a sandy loam. Sprays were applied when about ten percent of the beet seedlings had already emerged. The maximum day temperature was slightly above 90° F. and conditions for growth of beets and weeds were excellent.

The results of the gallonage test are presented in Table 3.

Table 3 The Effect of Water Gallonage of CMU Sprays On Beet Yields, in Pounds Per Plot

Pounds of CMU Dry	Pounds of CMU In Solution	Gallons of Water	Plots Irrigated	Plots Not Irrigated
1/4	.05	26.6	9.5	9.9
	.10	53.2	8.4	8.5
	.20	106.4	9.6	11.4
1/2	.05	26.6	7.5	11.8
	.10	53.2	6.7	9.8
	.20	106.4	8.7	9.8
3/4	.05	26.6	8.1	11.4
	.10	53.2	6.3	9.7
	.20	106.4	8.0	10.9

F value for gallons significant at 5% level.

Although the F value for gallonage is significant, it is at once apparent that the data do not fit the hypothesis that the quantity of CMU in solution governs damage to beets. In five of the six comparisons (Table 3) the intermediate gallonage reduced yields below those of either the lower or higher water quantities. The authors are unable to explain these results.

Organic Matter and CMU

Since research with CMU in Wisconsin (2) as well as unpublished tests in New York and elsewhere indicate that larger quantities of CMU are tolerated by crops when grown in organic soils, it was desirable to experiment further with the role of organic matter. In preceding paragraphs it was shown that clay content of soil has relatively little effect on crop response to CMU.

Greenhouse tests were conducted to determine the effect of CMU on beets and spinach grown on three different soils. Two of the soils were those used in the preceding field experiments. A third soil was a silt loam having an intermediate clay content and 4.1 percent organic matter. These field soils were placed in flats and arranged in a randomized block design with split plots for beets and spinach.

The results are shown in Table 4. The data indicate that as the percentage of organic matter increases, the reduction in stand of beets and spinach due to CMU is lessened. Although it seems that organic matter is a vital factor influencing the response of beets to CMU, it is too soon to draw definite conclusions from these limited data. One factor that may be important is micro-organism activity. It is likely that this activity is correlated with organic matter.

Table 4. Data Illustrating the Influence of Soil Organic Matter on Stand of Beets and Spinach When Treated with CMU Under Greenhouse Conditions

	Soil Characteristics					
	Sandy Loam		Silty Clay Loam		Silt Loam	
Percent organic matter	1.27		1.88		4.07	
pH	6.75		5.50		6.10	
Percent clay	8-10		15-20		10-12	
Soluble salts K X 10^5	22		52		21	
	Percent Stand[1]					
Pounds of CMU Per Acre	Beets	Spinach	Beets	Spinach	Beets	Spinach
none	100	100	100	100	100	100
3/8	64	68	42	71	126	109
3/4	9	67	27	37	69	106
1½	1	20	0	13	29	84

1 Stand is expressed as percent of check

This line of investigation is being continued. It provides a hypothesis that may explain differences in performance of CMU at various locations and in different years. If the hypothesis is eventually proved to be correct, it will permit better recommendations for quantities of CMU and for seeding rates of beets.

Summary

Red beets were tolerant of two to six pounds of Endothal and four to twelve pounds of TCA applied either pre- or post-emergence. CMU was toxic to beets at rates above three-eighths pound. Post-emergence applications were more toxic than those made pre-emergence.

Red beet response to CMU varied. Field tests indicated that location was an important factor. Preliminary greenhouse tests point toward soil organic matter as a vital factor correlated with crop response. Generally speaking, with higher organic matter, less damage resulted.

Clay content, pH of soils, and gallonage of water used in applying CMU had no consistent effects on beet stands or yields.

Crabgrass (Digitaria spp.) control was best with TCA and poorest with CMU. Barnyard grass (Echinochloa spp.) was best with CMU and poorest with Endothal. Broadleaved species, purslane (Portulaca oleraceae), lambs quarter (Chenopodium album) and red root (Amaranthus retroflexus) were controlled best by CMU and poorest by TCA.

There was no difference in beet response or weed control between the powder (1951) and liquid (1952) formulations of Endothal.

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PLANTING AND EMERGENCE APPLICATIONS OF A WATER SOLUBLE DINITRO AND CMU TO FIELD CORN

Ernest R. Marshall[1]

One of the most desirable methods of chemical weed control in corn would be the application of an herbicide simultaneous with the planting operation. If this single application could be effective in controlling weeds and grass in the corn row without injury to the corn until the corn had reached a stage where weeds would not be a problem it would indeed be an ideal herbicide.

A series of research projects were undertaken in 1951 designed to search for an herbicide which would be more effective as a pre-emergence herbicide for use on corn than those now being used. Results of the 1951 tests were presented by Marshall (1952.) Another series of screening tests were conducted during 1952. Materials tested in 1952 were Sesin, Compound 6036, 2,4-D acid, 2,4-D acetanilide, MCP acid, MCP acetanilide, Crag Herbicide 1, CMU, Sinox PE, ACP 299, butoxyethanol ester of MCP, sodium salt of MCP, diethanolamine salt of MCP and triethanolamine salt of 2,4-D.

In this series of tests Sinox PE and CMU (3 para chloro phenyl 1, 1 dimethylurea) were superior to any of the other treatments. These treatments were applied at two dates. One series was applied on June 3rd, the day the corn was planted, and the second series on June 10th the day the corn emerged. Weed and grass counts and ratings were taken on July 14th and again on August 15th. The treatments were applied with a small plot sprayer similar to the one described by Ries and Terry (1952) using 30 gallons of spray per acre. The planting application was made on a field of corn planted on sandy loam on the farm of Jack Frederickson at Geneva, New York; and the emergence application was made on a field of corn planted on stony loam on the farm of Charles Rooke, Alloway, New York. The individual plots were 20 feet long and 9 feet wide. Planting applications were replicated four times and emergence applications were replicated three times.

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Table 1. WEED CONTROL RESULTS FOLLOWING PLANTING APPLICATION OF SINOX PE AND CMU ON JUNE 3RD.

Treatment	Amt/A.	Counts/60 sq.ft. July 14		Weed control* ratings August 15th
		Weeds	Grass	
Sinox PE	3 lb	28	16	5.2
Sinox PE	6 lb	5	9	7.8
Sinox PE	9 lb	2	2	8.8
CMU	½ lb	36	12	6.5
CMU	1 lb	26	6	7.0
CMU	2 lb	9	2	7.8
Check		77	36	3.2
L.S.D. .05		23	12	1.6
L.S.D. .01		31	16	2.1

*Ratings 0-10 0 - no control 10 - no weeds in plot

Both 6 lbs. and 9 lbs. of Sinox PE and 2 lbs. of CMU gave excellent weed and grass control. The 2 lb. rate of CMU showed some early chlorosis or yellowing of the corn plants when they were 5-8 inches in height. This yellowing disappeared but the corn in these plots was retarded for several months. Some of the brace roots of the corn growing in the 9 lb. Sinox PE and the 2 lb. CMU plots showed injury. The brace roots of some of the corn plants in these plots would stop growing at the soil surface and not enter the soil.

Emergence treatments were applied as the corn was just emerging, some of it was up 1-2 inches, while some had not yet emerged. The weed and grass problem was much more severe at this location. The primary grass was quackgrass. Results are shown in Table 2.

Table 2. WEED CONTROL RESULTS AFTER EMERGENCE APPLICATIONS OF SINOX PE AND CMU ON JUNE 10TH.

Treatment	Amt/A.	Counts/4 sq.ft. July 14		Weed control* ratings August 15th
		Weeds	Grass	
Sinox PE	3 lb	2	39	4.0
Sinox PE	6 lb	1	34	5.3
Sinox PE	9 lb	1	20	8.7
CMU	½ lb	18	66	1.7
CMU	1 lb	7	36	5.7
CMU	2 lb	1	27	8.7
Check		76	88	.7
L.S.D. .05		25	24	2.3
L.S.D. .01		34	33	3.1

*Ratings 0-10 0 - no control 10 - no weeds in plots

Both materials gave excellent weed control and the higher rates gave good control of annual grasses and suppression of quackgrass. Visual observations showed at the 6 lb. and 9 lb. rate of Sinox PE and the 2 lb. rate of CMU gave sufficient quackgrass suppression so that the quackgrass was not a problem in these plots the remainder of the season. The 2 lb. CMU showed some early injury on corn similar to that occuring in the planting test.

Table 3 shows the data for the two tests combined. Weed infestation was much more severe in the emergence test than in the planting test so counts were taken on 60 square feet of plot in the planting test while in the emergence test only 4 square feet were counted. The results are for seven replicates.

Table 3. COMBINED WEED CONTROL RESULTS OF PLANTING AND EMERGENCE APPLICATIONS OF SINOX PE AND CMU TO CORN

Treatment	Amt/A.	Counts - July 14		Ratings*
		Weeds	Grass	August 15
Sinox PE	3 lb	17	25	4.8
Sinox PE	6 lb	3	17	6.7
Sinox PE	9 lb	2	10	8.7
CMU	½ lb	28	35	4.4
CMU	1 lb	18	19	6.4
CMU	2 lb	5	13	8.1
Check		76	58	2.1
L.S.D. .05		16	14	2.2
L.S.D. .01		21	18	3.0
*Ratings 0-10	0 - no control		10 - no weeds in plot	

In addition to the above two tests another test was conducted at each location and data similar to that given above was taken. Results of these tests are given in Tables 4, 5, and 6. The planting tests has six replicates and the emergence test had seven replicates.

Table 4. WEED CONTROL RESULTS AFTER PLANTING APPLICATION OF SINOX PE AND CMU ON JUNE 3RD

Treatment	Amt/A.	Counts/60 sq.ft. July 14		Weed ratings* Aug. 15
		Weeds	Grass	
Sinox PE	3 lb	26	16	5.0
Sinox PE	6 lb	5	11	7.5
Sinox PE	9 lb	1	4	8.8
CMU	1 lb	21	10	7.7
Check		74	41	2.1
L.S.D. .05		18	11	1.7
L.S.D. .01		25	15	2.3
*Ratings 0-10	0 - no control		10 - no weeds or grass	

Table 5. WEED CONTROL RESULTS AFTER EMERGENCE APPLICATION OF SINOX PE AND CMU ON JUNE 10TH.

Treatment	Amt/A.	Counts/4 sq.ft. July 14 Weeds	Grass	Weed ratings* Aug. 15
Sinox PE	3 lb	3	57	4.6
Sinox PE	9 lb	1	37	7.1
CMU	1 lb	7	49	6.0
Check		77	87	.3
L.S.D. .05		18	13	2.0
.01		24	18	2.8

*Ratings 0-10 0 - no control 10 - no weeds or grass

By combining the two planting and emergence tests we have the data given in Table 6. This includes a total of 13 replicates.

Table 6. COMBINED WEED CONTROL RESULTS AFTER PLANTING AND EMERGENCE APPLICATIONS OF SINOX PE AND CMU

Treatment	Amt/A	Counts-July 14 Weeds	Grass	Ratings* Aug. 15
Sinox PE	3 lb	14	38	4.8
Sinox PE	9 lb	1	22	7.9
CMU	1 lb	13	31	6.8
Check		76	66	1.3
L.S.D. .05		12	9	1.4
.01		16	12	1.8

*Ratings 0-10 0 - no control 10 - no grass or weeds

Discussion and Summary

The data show that adequate weed control was obtained by spraying either Sinox PE or CMU over the corn row at the time the corn was planted. Somewhat better weed control was obtained when the materials were applied at come up. This was especially true with Sinox PE.

There was definite suppression of quackgrass growth when the higher rates of Sinox PE or CMU were used.

The rate of Sinox PE necessary to give good weed control was somewhere between 3 lbs. and 6 lbs. per acre on an overall basis. The rate of CMU on the soil types tested necessary to give good annual weed control was 1 lb. per acre or slightly over. In no case was injury to the young corn seedlings noticed in the Sinox PE plot. Plots receiving 2 lbs. of CMU showed injury whether it was applied at planting or emergence. Late in the season it was noticed that corn brace roots on some plants would not enter the soil in the 9 lb. Sinox PE and the 2 lb. CMU plots.

On the basis of these results it appears that a planting application of Sinox PE or CMU on corn would enable a farmer to keep weeds or annual grasses from becoming a problem. This would be particularly true if a strip over the row only were sprayed and the cultivator then set so that no dirt would be thrown into the row.

Sinox PE has the advantage that it is a water soluble material and can be handled very easily in existing low pressure low volume weed sprayers. In addition it gives no injury to the corn seedlings when used at rates up to 9 lbs. per acre.

CMU has the advantage of being more residual in effect. One of the disadvantages of CMU is that the material is a wettable powder. Existing pumps on low pressure low volume sprayers are generally inadequate to handle wettable powders. Agitation in the tank is usually inadequate and the mechanism in the pump and the nozzle tips lose efficiency due to wear from the wettable powder suspension. Another factor to be considered is that the rate of CMU is more critical. Injury to the young corn seedlings was experienced with the 2 lb. rate of CMU whereas no early injury was noticed with any rate of Sinox PE.

Conclusions

1) Sinox PE at 3, 6 and 9 lbs. and CMU at 1 to 2 lbs. can be used successfully for planting or emergence weed control on field corn.
2) The higher rates should be used if the material is to be applied at planting.
3) The higher rates showed definite suppression of quackgrass.
4) There should be large scale tests conducted comparing Sinox PE and CMU under field conditions for weed and grass control in corn.
5) The dosage rates which gives corn injury are more critical with CMU than with Sinox PE.
6) Sinox PE is more practical to use than CMU in existing low pressure low volume weed sprayers.

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Pre-emergence Weed Control in Silage Corn With Calcium Cyanamide, 2,4-D, and CMU[1,2]

C. R. Skogley and D. A. Schallock[3]

Various chemicals have been used for many years in an attempt to control weeds in field corn (1,2,3,4). Although some of these chemicals have appeared to be quite satisfactory the optimum in weed control has not been reached. Continual search for a new and better chemical or for better utilization of those already in use should bear this out.

A program of chemical weed control in field corn was started at the Rhode Island Agricultural Experiment Station in 1947. Calcium cyanamide was the only chemical used the first year and in 1948 2,4-D was included in the trials. The results from 1947 through 1949 have been reported (5,6). Based on the success and recommendations of this preliminary work, additional experiments have been conducted.

During 1951 a weed control experiment using Calcium cyanamide in silage corn was conducted with time and rate of application as variables. In 1952 a test was set up to compare the effectiveness of Calcium cyanamide, 2,4-D and CMU as herbicides for controlling weeds in corn.

The 1951 and 1952 trials will be discussed in this report.

Materials and Methods

Both the 1951 and 1952 tests were conducted at the Agronomy experimental plots at Kingston on soils classed as Bridgehampton silt loam.

The experiment in 1951 consisted of pre-emergence and emergence treatments with three rates of granular calcium cyanamide employed: 400, 500, and 600 pounds per acre. A randomized block design with four replications was used with plot size of 1/45 acre. The corn was planted on May 22 using 1000 pounds of a 4-12-12 fertilizer per acre. The pre-emergence applications were applied on the same day. The cyanamide was applied by hand. The soil surface was dry at the time of application but 1½ inches of rain fell within the next 48 hours.

1/ Contribution No. 815 of the Rhode Island Agricultural Experiment Station, Kingston, R. I.

2/ This work was made possible in part by the grant and materials given by the American Cyanamid Company and the materials given by the E. I. DuPont de Nemours & Co.

3/ Assistant Agronomist and Assistant Research Professor of Agronomy, respectively.

The emergence treatments were applied on May 28, six days after planting. The soil surface was wet and the corn was just beginning to emerge.

Weed notes were taken when the weeds in the check plots were about two inches high. No cultivation was employed until after the notes were complete.

In 1952 the weed control test was set up on a demonstrational basis, using 15 plots of 2/15 acre each. Three chemicals were used and each material was applied to 3 plots, each selected at random. Six check plots were maintained so that normal corn culture could be readily compared with chemically weeded corn.

The chemicals and the rates at which they were used are as follows: Granular calcium cyanamide at 500 pounds per acre, applied with an 8-foot cyanamide broadcaster; CMU (3-p-chlorophenyl-1-1,1-dimethylurea) at 1½ pounds per acre in 100 gallons of water, applied with a 10 row commercial potato sprayer at 400 pounds pressure; and 2,4-D amine (Dimethylamine 2,4-dichlorophenoxyacetate, 41.2% acid equiv.) at 2 pounds per acre in 5 gallons of water applied with a 2-row sprayer operated at 30 pounds pressure.

These were considered to be the optimum rates and were based on results from preliminary trials at the Rhode Island Station as well as suggestions from elsewhere.

The corn was planted on May 23 using 1,000 pounds per acre of an 8-12-12 ratio fertilizer. The 2,4-D and CMU were applied five days after planting and the cyanamide was applied on the sixth day. The soil surface was wet during and for several days following the treatments. Field notes on corn injury and weed populations were taken when the weeds in the check plots were about 2 inches high.

Results
1951

Table 1 lists by treatments the silage corn yields, weed scores, and predominant weeds present. The best weed control and the highest yield was obtained on the plots treated at emergence with 600 pounds of calcium cyanamide per acre. However, the difference between weed control and yield as based on rates was not as striking as the differences attributed to time of application. Almost 100 percent control of crabgrass, pigweed, and spurrey was obtained with all three rates when the calcium cyanamide was applied just as the corn was beginning to emerge. No weed control was observed even at the 600 pound rate when the calcium cyanamide was applied the same day the corn was planted. At the pre-emergence-400 pound treatment the weeds were apparently stimulated as a result of the application. At the 500 and 600 pound rates, applied at planting, the yields were significantly higher than on the plots where no calcium cyanamide was applied although the weed population was similar in kinds and numbers.

Table 1. Yield, weed score, and predominant weeds present, by treatment, on silage corn plots in the 1951 calcium cyanamide experiment.

Treatment	Tons/Acre Green	Tons/Acre D.M.	Weed Score*	Predominant Weeds**
400 lbs./A at planting	17.6	4.80	5.5	Crabgrass, pigweed, spurrey
500 lbs./A " "	19.2	5.25	4.5	" " "
600 lbs./A " "	19.3	5.88	4.5	" " "
400 lbs./A at emergence	19.6	5.95	1.5	Quackgrass, crabgrass
500 lbs./A " "	20.1	5.38	2.0	Crabgrass, quackgrass
600 lbs./A " "	20.9	6.42	1.0	Quackgrass, crabgrass
Check	13.8	4.21	4.5	Crabgrass, pigweed, spurrey
LSD at 5%		.89		

* 0 = No weeds, 10 = solid weed cover
** Largest population listed first

No chemical injury to the corn was noted on any plot at any time throughout the test.

One cultivation was sufficient for weed control on the plots treated six days after planting while three cultivations did not satisfactorily control the weeds on the plots treated at planting or on the check plots.

The overall growing season was favorable for corn during 1951 with sufficient rainfall throughout and a long growing season.

1952

The silage corn yields, weed scores, and predominant weeds present are listed by treatment in table 2. No significant yield increase was obtained from the use of a herbicide. Very good weed control was observed where any of the three chemicals was used. Based on weed population estimates, the best control was obtained where calcium cyanamide was used. The next best control was obtained with 2,4-D and CMU was rated third. Two to three times more weeds were present on the untreated plots however than on any of the chemically treated areas.

Table 2. Yield, weed score, and predominant weeds present, by treatment, on silage corn plots treated just prior to emergence with calcium cyanamide, CMU and 2,4-D amine, during 1952.

Treatment	Tons/Acre Green	Tons/Acre D.M.	Weed Score*	Predominant Weeds**
2,4-D amine, 2 lbs./A	19.3	4.61	2.3	Smartweed, pigweed, ragweed
CaCN, 500 lbs./A	19.2	4.38	1.3	Nutgrass
CMU, 1½ lbs./A	18.7	4.25	3.3	Smartweed, chickweed, ragweed
Check 1	18.3	4.16	8.3	Pigweed, purslane, ragweed, chickweed
Check 2	17.6	4.02	8.0	" " " "
LSD at 5%		.95		

* 0 = No weeds, 10 = solid weed cover
** Largest population listed first

Two subsequent cultivations were sufficient for complete weed control on the plots chemically weeded. Three cultivations plus hand-hoeing on the check plots failed to match the control obtained where the chemicals were used.

The 1952 growing season at Kingston was one of the hottest and driest on record. Soil and climatic conditions were normal, however, during the early part of the growing season.

No chemical injury was noted on the corn at any time as a result of the treatments.

Discussion

1951

There are several reason why delayed application of calcium cyanamide may give better weed control in corn than an application immediately following planting. By delaying the application the weed seeds turned up in fitting and planting the field may have ample time to germinate. After the soil surface has been disturbed, several days may be required before maximum weed seed germination occurs. By delaying the application, soil temperature and perhaps moisture may be more favorable for both seed germination and for the breakdown of calcium cyanamide to a toxic state. As the chemical was applied just before the corn emerged, and perhaps because of the nature of the corn seedling, no injury resulted to the corn.

The yield increase on the treated plots may be attributed to additional nitrogen supplied by the calcium cyanamide and to a decrease in weed competition for moisture and nutrients. The average yield for the plots treated at planting was lower than the yield for the plots treated at emergence. The prime factor here perhaps was the lack of weed control on the plots treated at planting.

1952

The excellent results obtained during 1952 with the weed control chemicals tend to bear out results from previous tests. Good weed control in silage corn can be obtained if the herbicide is in toxic concentrations in the soil when the weed seeds are germinating or have germinated. The prime factor affecting the timing may be the soil moisture and temperature conditions governing the weed seed germination after the land is fitted or the corn is planted.

That there were no significant yield increases resulting from weed control or the additional nitrogen from the calcium cyanamide can perhaps be attributed to two factors: 1. Control of weeds in the check plots by cultivation and 2. the extra nitrogen was not made available to the crop because of the very dry season. The nitrogen applied in the fertilizer in 1952 was twice as high as that used in 1951 and was evidently adequate for the season.

Summary and Conclusions
1951

1. Replicated plots of silage corn were treated with 400, 500, and 600 pound rates of granular calcium cyanamide in 1951. The variable included both rate and time of application. Applications were made at planting and six days after planting.

2. All treatments, except the 400 pound rate applied at planting, gave significant yield increases over the check.

3. Excellent weed control was obtained at all rates when the calcium cyanamide was applied just before the corn emerged. No control was obtained when the material was applied at planting.

4. It is possible that the weed seeds brought to the surface by seedbed preparation and planting are in maximum germination several days after the corn is planted and are more susceptible to chemical injury at that time.

5. The silage corn yield increase may be attributed to weed control and additional nitrogen from the calcium cyanamide.

1952

1. In 1952 replicated plots of silage corn were treated with one rate each of calcium cyanamide, 2,4-D and CMU. The rate and timing of all applications was based on optimum results from previous trials.

2. No significant yield increase was obtained as a result of using any of the three herbicides in 1952. Good control of all weeds except perennial grasses was observed where each chemical was used.

3. Under normal Rhode Island conditions at least one or two cultivations may be eliminated by using a herbicide such as calcium cyanamide, 2,4-D or CMU.

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THREE YEARS RESULTS WITH THE USE OF MCP AND 2,4-D FOR WEED CONTROL IN SEEDED GRAINS

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Chemical weed control in seeded grains is becoming a more standard practice in the northeast each year. One of the greatest potentials of chemical weed control usage in this area lies in the control of weeds in small grains underseeded to mixed legumes. Seeded grain weed control by chemicals presents certain specific problems. A desirable herbicide for use in grains underseeded to legumes should show selectivity not only for the grain nurse crop but also for the legume underseeding. The material should lend itself to low gallonage application and should be safe for use over a period of several days during the growth of the crop. In addition in the northeast, the material should show a degree of specificity towards wild mustard control, this being the principal weed pest of seeded grains in this area.

The development of such a weed killer presents a real challenge. 2,4-D has been used to some extent because it has certain of the requirements. It is selective on grains, it can be used in low gallonage application and its period of usefulness extends over a period of time. The principal disadvantage is that legumes in general are very sensitive to 2,4-D injury. Even with this shortcoming 2,4-D has been used in the past where weed infestation was so serious that legume injury was secondary in importance to weed control. 2,4-D has been used with some degree of success by commercial and other experienced weed control operators.

The dinitros have also been used where weeds in seeded grains were a serious problem. The dinitros, however, require relatively large amounts of water for application, time of application and environmental conditions are more critical and because of this under some conditions legume and grain injury may be severe.

In order to find a material which might have fewer shortcomings than 2,4-D or the dinitros a research program was originated by Tafuro, Flagg and VanGeluwe (1951.) This program was extended by VanGeluwe and Marshall (1952.) As a result of these and other studies MCP 60 a formulation containing the diethanolamine salt of 2 methyl 4 chloro phenoxyacetic acid formulated from 2 methyl 4chlorophenoxyacetic acid (MCP) containing approximately 60% MCP has been sold commercially in the northeast for use in seeded grain weed control. This study has been carried through another season and these 1952 results will be reported in this paper. This paper also includes a summary of the data for the three years during which this study has been in progress.

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PROCEDURE

A replicated test comparing seven (7) treatments and a check was conducted on the G.R.Alexander farm in Cortland, New York. The treatments were applied to a field of oats underseeded with alfalfa, ladino and red clover on June 14, 1952 using a jeep sprayer. Materials were applied in 8 gallons of water per acre at 40 pounds pressure. Mustard was just coming into full bloom and the alfalfa and clover in the seeding was 2-3" in height. The oats were 12-14" high. The weather was clear with a temperature near 70°F. when the materials were applied. The plots were 22' wide, 90' long with a check strip between each strip of treatments to prevent drift across plots. There were four (4) replicates. On the following day, June 15th, counts were made of the mustard, clover, and alfalfa stand in each plot. Four one square foot areas were counted in each plot and these same areas were permanently marked for later counts. Mustard infestation was very high, running as high as 50 plants per square foot. Visual observations were made on June 20th and the permanently marked areas were recounted on July 24, 1952.

RESULTS

The results of the 1952 test are presented in Table 1. The percentages given are the per cent changes from the original counts made June 15th.

Table 1. CHANGE IN MUSTARD, CLOVER AND ALFALFA STANDS AFTER HERBICIDE SPRAYS APPLIED WHEN ALFALFA AND CLOVER WAS 2-3 INCHES HIGH.

Material	Amt/Acre	Per cent change in stand six weeks after treatment		
		Mustard	Clover	Alfalfa
Amine MCP (100%)	.35#	-100	+36	-36
Amine MCP (60%)	.35#	-97	+103	-35
Na MCP	.35#	-99	+88	-57
LV MCP (60%)	.35#	-93	+96	-46
LV MCP (100%)	.35#	-94	+128	-48
Amine 2,4-D	.35#	-100	+34	-60
ACP 299	2.8#	-74	+83	-48
Check (Untreated)		-83	+15	-49

The amine MCP formulations were diethanolamine salt formulations. The low volatile MCP formulations were butoxyethanol ester formulations. Amine 2,4-D was a triethanolamine salt formulation. Treatments of Amine MCP (100%) and LV MCP (100%) were formulated from a pure 100% MCP acid. The amine MCP (60%), Na MCP, and LV MCP (60%) were formulated from MCP acid which contained approximately 60% MCP acid, the remainder of the mixture containing other isomers such as 2 methyl 6chlorophenoxyacetic acid.

Mustard control was good with all treatments except check and ACP299. When counting the mustard remaining in the marked areas on the day the counts were made, any mustard plants showing green were counted as living although in all the treatments except check and ACP299 there was 100% prevention of seeding. Mustard infestation was so heavy that mustard counts in the check decreased by 83% due to competition and other factors. With original mustard counts running as high as 50 plants per square foot an 83 per cent reduction would still leave nine mature mustard plants per square foot, a serious infestation. ACP299 although it failed to control mustard completely, retarded mustard growth and thus allowed more clover plants to survive this treatment than survived in the check plots.

The stand of clover increased in all plots, although there were marked differences in the effect of the various treatments on clover survival. 2,4-D and amine MCP (100%) reduced clover survival below check indicating injury to the small clover seedlings. Amine MCP 60 and LV MCP (100%) showed the least injury to clover and the stand of clover in these plots was markedly better than in the check plot. This being due in part to the elimination of mustard competition.

The sodium salt of MCP and the LV MCP 60 gave results intermediate between the above two groups. ACP299 gave similar results but the increased growth of clover is probably a result of stunting of the mustard in these plots, the clover plants thus surviving better.

These results are in agreement with earlier results reported by VanGeluwe and Marshall (1952.) They found that amine MCP 60 formulation was safer to use on clover than MCP formulations made from MCP acids containing higher percentages of 2 methyl 4 chlorophenoxyacetic acid.

The stand of alfalfa decreased in all plots, the greatest decrease being in the 2,4-D plot and the least in the amine MCP plots. The sodium salt of MCP plot showed a greater decrease than did the check. The other treatments did not vary significantly from the check although both the amine MCP plots gave less reduction of alfalfa stand than the unsprayed check. It is evident that alfalfa suffered more from environmental factors and competition than did the clovers.

SUMMARY OF RESULTS 1950-1952

The results of three years work (1950-52 are shown in Tables 2, 3 and 4.

The 1950 data are presented in somewhat different form than are the 1951 and 1952 data. Part of the results shown under the 1950 data were taken from unpublished data of Tafuro, Flagg and VanGeluwe (1950.)

The 1951 data were taken from VanGeluwe and Marshall (1951.)

Table 2. EFFECTIVENESS OF MCP AND 2,4-D IN CONTROLLING MUSTARD 1950 - 1952

Material	1950 Decrease in no. plants per plot .5# acid equiv	1951 %Stand reduction after treatment w/ .12#acid equiv	1952 %Stand reduction after treatment .35#acid equiv.
amine 2,4-D	-187	-76	-100
amine MCP(60)	-192	-83	-97
amine MCP*		-80	-100
check		-67	-83

*The amine MCP used in 1951 was formulated from MCP acid containing approximately 85% MCP acid and that used in 1952 from 100% MCP acid.

Mustard control in all three years was as good with MCP as with 2,4-D.

Table 3. EFFECT OF 2,4-D AND MCP SPRAYS ON CLOVER UNDERSEEDED IN OATS 1950-52

Material	Stand count Aug 31,1950 .5#/acre	Per cent change 1 mo.after spraying 1951 (.12#)	1952 (.35#)
amine 2,4-D	82	+3	+34
amine MCP 60	111	+51	+103
amine MCP*		-8	+36
check	112	+17	+15

*The amine MCP used in 1951 was formulated from MCP acid containing approximately 85% MCP acid and that used in 1952 from 100% MCP acid.

The data in Table 3 show that amine MCP 60 was superior to 2,4-D or MCP in all comparisons. In 1951 the 2,4-D and the MCP reduced clover stand below that of the check. The MCP 60 plot however, showed a much greater stand of clover than did the check plot. By comparing data in Table 2 with data in Table 3 it can be seen that MCP 60 gave as good mustard control as either MCP and 2,4-D and at the same time was much less injurious to the clover seedlings. This was also true in 1952.

Table 4. EFFECT OF 2,4-D AND MCP SPRAYS ON ALFALFA UNDERSEEDED IN OATS 1950-52

Material	Stand count Aug 31,1950 .5#/A.	Per cent change 1 mo.after spraying	
		1951 (.12#/A)	1952 (.35#/A)
amine 2,4-D	104	-28	-60
amine MCP 60	114	-24	-35
amine MCP*		-39	-36
check	156	-31	-49

*The amine MCP used in 1951 was formulated from MCP acid containing approximately 85% MCP acid and that used in 1952 from 100% MCP acid.

The data in Table 4 shows that the effect of 2,4-D, MCP 60 or MCP sprays on alfalfa seedlings varied from year to year. In 1950 both 2,4-D and MCP 60 gave a reduction in the stand of alfalfa. In 1951 this reduction was not apparent. In 1952 the 2,4-D again showed a reduction in alfalfa stand. The amine MCP 60 reduced alfalfa stand less than amine 2,4-D in both 1951 and 1952. It appears that factors such as the formulation used, the nurse crop and weed canopy, temperature, rainfall, amount of herbicide, and amount of liquid carrier applied per acre tend to determine the amount of damage occuring to the alfalfa.

Discussion and Summary

Three years results with the use of 2,4-D, MCP 60 and MCP for the control of mustard and other weeds have brought out marked differences.

Two out of three years MCP apparently gave better mustard control than 2,4-D. Observations of these plots and large fields sprayed with the commercial formulation of MCP 60 have shown that MCP 60 gives good control of other annual weeds such as ragweed, smartweed, lambsquarters, etc. In all three years rates of 2,4-D, MCP 60 or MCP above 1/8 lb. acid equivalent per acre gave excellent mustard control and resulted in 100% suppression of mustard seed formation.

The greatest difference between the materials occurs in their effect on the clover seeding. The survival of clover seedlings depends to a large degree on the amount of competition offered by mustard and other weeds. In fields where mustard infestation is severe as in the case of the 1951 and 1952 plots there was a much greater stand of clover in the MCP 60 plots following treatment than in the check. Treatments with both 2,4-D and MCP resulted in more severe injury to the clover than treatment with MCP 60. It is possible that

the presence of other isomers such as 2 methyl 6 chlorophenoxyacetic acid in the MCP 60 may be affecting the selectivity of the material. Other factors such as wetting agents, emulsifiers used, etc. undoubtedly will affect the action of the material on clover. The three years data show that where mustard or other weeds are a problem treatment with MCP 60 at rates which will give weed control when the seeding is 2-3 inches high will result in an increase in clover seedling survival. It is apparent that red and ladino clover are less sensitive to injury from MCP 60 than from 2,4-D or MCP formulations containing higher amounts of 2 methy 4 chlorophenoxyacetic acid.

Alfalfa showed a decrease in stand over check during one year when MCP 60 was used, but two years when mustard infestation was severe it resulted in a better stand of alfalfa than occurred in the check. The tolerance of seedling alfalfa to sprays of 2,4-D, MCP 60 or MCP differs from that of clover and factors such as weed and grain canopy, formulation, temperature, rainfall and amount of spray applied per acre are more important in determining the effect on the alfalfa seedlings than is the case with clover.

Conclusions

1) Where weeds, particularly mustard, are a problem in grains underseeded to mixed legumes including red and ladino clover and alfalfa weed control will result in a greater survival of clover and alfalfa than in untreated areas.

2) MCP 60 shows more selectivity in clover seedlings 2-3 inches in height than does 2,4-D or MCP.

3) MCP 60 gives less injury to red and ladino clover than does MCP formulations containing higher percentages of MCP.

4) Rates of MCP 60 and 2,4-D over 1/8 lb. acid equivalent give adequate mustard control and have resulted in 100% suppression of mustard seeding.

5) Commercial use of MCP 60 for weed control in seeded grains indicates that this material is safe to use at rates of from 1/8 to 1/3 pound acid equivalent per acre in low volumes of water (5-8 gallons), when weeds, particularly mustard, are a problem.

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PRELIMINARY OBSERVATIONS ON YELLOW ROCKET CONTROL IN ESTABLISHED CLOVER AND ALFALFA FIELDS.

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One of the most troublesome weed problems on New York Dairy farms is the control of yellow rocket (Barbarea vulgaris). Established stands of legumes often run as high as 50 per cent of this weed the first harvest year, and, in many cases, even the second.

Where the first cutting is removed as grass silage, seed formation can be prevented. However, where it is taken as field cured hay, the yield of useful forage is low and the quality markedly reduced. Also, when handled as field cured hay and fed on the farm, most of the yellow rocket seed is returned to other fields in the manure and bedding.

Yellow rocket and other broad-leaved weeds can be controlled by the new herbicides now available; however, during the growing season legumes are normally more susceptible than any of the weeds.

Reports in the literature show legumes to be more tolerant to MCP than 2,4-D. Also, the dinitro materials can be used on legumes without a reduction in stand. This paper is a report on some farm demonstrations set up in Madison County during the spring of 1952 using MCP, and dinitro formulations. The results were so striking that a preliminary report seemed desirable at this time. The procedure followed in these demonstrations may have promise in developing a weed control program in legume stands.

Material and Method

Two fields (designated as A and B) were selected on the farm of Sterling Tayntor at Morrisville, New York.

Field A was an alfalfa-grass mixture seeded in the spring of 1950. The seeding rate was 12 pounds of alfalfa and 8 pounds of timothy. The hay harvested in 1951 contained 25-30 per cent yellow rocket. From the results presented in this paper, it is clear that most of those plants plus those that germinated during the 1951 growing season were present at the time the treatments were applied.

Field B was seeded to the Cornell General Purpose Mixture in the spring of 1951 with oats as the companion crop. The seeding mixture contained 6 pounds of alfalfa, 6 pounds of red clover, 3 pounds of alsike and 6 pounds of timothy.

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The oats and seeding was sprayed with 1/8 pound of MCP to control annual weeds (primarily mustard and yellow rocket). However, observations made in the fall of 1951 showed a good stand of seedling yellow rocket plants which germinated after the MCP treatment.

Since yellow rocket resumes growth in the spring before legumes, it was hoped that a very early treatment would give control without any permanent injury to the legume.

Treatments were applied on April 9 using a tractor mounted sprayer. The following chemicals and rates per acre were used on both fields:

1. 1 quart Sinox P. E.
2. 2 quarts Sinox P. E.
3. 3 " Sinox P. E.
4. 4 " Sinox P. E.
5. ½ pound MCP "60" (ACP)
6. 1 quart Sinox General plus 10 gallons No. 2 fuel oil.
7. 3 pints Maleic hydrazide plus 16 ounces Triton B 1956.

All treatments except Sinox General were applied in 40 gallons of water per acre. The General was applied in 80 gallons.

The temperature at the time of treatment was 60 degrees. The following day (April 10) was clear (temperature 65). .12 inches of rain fell on April 10 after 8:00 P.M.

The materials were applied in 18-foot strips with an 18-foot check strip between treatments. Each strip was just less than 1/4 acre.

The predominant weed species in the two areas were:

Yellow rocket (Barbarea vulgaris)

Cinquefoil (Potentilla spp.) Mostly in Field A.

Dandelion (Taraxacum officinale).

Night-flowering Catchfly (Silene noctiflora)

Narrow-leaved plantain (Plantago lanceolata)

Canada Thistle (Cirsium arvense)

Bedstraw (Galium Mollugo)

Ox-eye daisy (Chrysanthemum Leucanthemum)

Peppergrass (Lepidium spp.)

The number of yellow rocket plants at the time of spraying varied 1 - 8 per square foot.

Results

Yield data and stand counts were taken between June 13 and 17 in F[illegible] when the clover and alfalfa was about 1/10 and 1/4 full bloom. Information on Field A was taken between June 17 and July 4 when the alfalfa was about [illegible] bloom. Ten 3 x 3 foot square quadrats were harvested from each of the [illegible] MCP and Sinox P. E. (4 quart) plots in Field B and from the MCP and check in Field A.

The total weight of green material, the weight of legume and grass, weight of all weeds, the weight of yellow rocket alone, the number of yel[illegible] plants and their average height was recorded for each quadrat harvested. [illegible] information is presented in Tables I and II below.

TABLE I. FIELD A, ALFALFA MCP TREATMENT.

- 1 -	- 2 -	- 3 -	- 4 -	- 5 -	- 6 -	[illegible]
Square No.	Total Wt.	Legume Wt. inc. Grass	All Weeds weight	Rocket Wt.	Rocket No.	Rocket [illegible] inches
1	3.1	2.8	.3	--	2	[illegible]
2	3.0	2.6	.4	--	3	12
3	3.6	2.9	.7	--	8	6
4	4.5	3.5	1.0	--		
5	5.1	42.	.9	--		
6	4.9	42.	.7	--		
7	4.5	2.9	1.6	--		
8	4.1	3.1	1.0	--	5	12
9	3.9	3.4	.5	--		
10	4.6	3.9	.7	--		
Averages	4.13	3.35	.78	.01	1.8	
Totals	41.3	33.5	7.8	.1*	18.0	
Field A, Alfalfa Check						
1	4.0	3.9	1.1	.3	51	15
2	3.6	2.7	.9	.3	50	15
3	4.4	3.1	1.3	.2	36	15
4	4.4	3.0	1.4	.2	41	14
5	4.1	2.5	1.6	.1	26	15
6	4.1	2.6	1.5	.05	18	15
7	5.1	4.2	.9	.1	29	15
8	4.4	3.9	.5		3	10
9	3.8	2.7	1.1	.3	25	14
10	4.2	3.1	1.1	.1	18	15

TABLE I. FIELD A, ALFALFA MCP TREATMENT (continued)

- 1 -	- 2 -	- 3 -	- 4 -	- 5 -	- 6 -	- 7 -
Square No.	Total Wt.	Legume Wt. incl. Grass	All Weeds weight	Rocket Wt.	Rocket No.	Rocket Wt. inches
Averages	4.21	3.07	1.14	.165	29.7	
Total	42.1	30.7	11.4	1.65	297	

TABLE II. FIELD B, RED CLOVER, MCP TREATMENT.

- 1 -	- 2 -	- 3 -	- 4 -	- 5 -	- 6 -	- 7 -
Square No.	Total Wt.	Legume Wt. incl. Grass	All Weeds weight	Rocket Wt.	Rocket No.	Rocket Wt. inches
1	4.9	4.5	.4		2	
2	4.3	3.9	.4		2	
3	3.4	3.0	.4		2	
4	5.1	4.4	.7		1	
5	5.0	4.7	.3		1	
6	4.9	4.7	.2		2	
7	5.2	4.7	.5			
8	4.7	4.5	.2		3	
9	6.0	5.6	.4			
10	4.9	4.6	.3		1	
Averages	4.84	4.46	.38	.005*	1.6	
Totals				.05*	16	
Field B, Red Clover Check						
1	4.4	3.7	.7	.4	50	24
2	5.5	4.5	1.0	.4	15	30
3	6.4	4.2	2.2	1.3	34	30
4	5.7	5.2	.5	.3	21	24
5	4.9	4.2	.7	.2	17	24
6	6.3	4.2	2.1	.4	30	24
7	5.0	4.0	1.0	.6	37	24
8	5.4	3.5	1.9	1.3	64	24
9	5.2	4.2	1.0	.3	19	19
10	6.2	4.5	1.7	.7	21	24
Averages	5.50	4.22	1.28	.59	31.3	
Totals	55.0	42.2		5.9	313	

TABLE II. FIELD B, RED CLOVER, MCP TREATMENT (continued)

Field B - Red Clover Sinox P. E. (4 quarts)

- 1 -	- 2 -	- 3 -	- 4 -	- 5 -	- 6 -	- 7 -
Square No.	Total Wt.	Legume Wt. incl. Grass	All Weeds weight	Rocket Wt.	Rocket No.	Rocket Wt. inches
1	7.1	6.1	1.0	.2	13	19
2	5.4	4.3	1.1	.3	26	20
3	4.2	3.9	.3	.1	15	19
4	5.4	4.5	.9	.0	1	15
5	6.0	5.4	.6		3	12
6	6.5	5.4	1.1	.2	13	24
7	7.0	5.2	1.8	.6	28	26
8	5.0	4.2	.8	.4	21	19
9	4.3	3.6	.7	.1	5	22
10	3.8	3.2	.6	.05*	10	12
Averages	5.47	4.58	.89	.195	13.5	
Totals	54.7	45.8	8.9	1.95	135	

*Estimated. Scales used sensitive to only 1/10 pound.

Sinox P. E.

Sinox P. E. at the rates used did not give good weed control. All rates gave some control, which increased with increasing concentration but even the 4 quart rate was not considered satisfactory.

The 1, 2 and 3 quart rates controlled top growth of the very small seedling weeds and resulted in some leaf burning of larger rosettes. However, the effect was very temporary. The 4-quart rate controlled yellow rocket plants up to 3 inches in diameter but anything larger than this was only partially burned back and recovered rapidly.

Yield data (Table II) show the the 4-quart treatment reduced the total weight of weeds over the check by approximately 30 per cent. However, on April 23, thirteen days after treatment the larger rocket plants in even the 4-quart treatment had seed stalks up to 6 inches long with flower buds appearing.

Dow General

There was complete top kill of all rocket plants up to 8 inches in diameter. However, as with the high rate of Sinox P. E., all plants over 3 inches in diameter made regrowth and were normal at harvest time. Rapid recovery was particularly noticeable with yellow rocket and cinquefoil. By May 15, the rocket and cinquefoil plants in the treated area were as vigorous as those in the check.

Maleic Hydrazide

Although treated plants appeared normal, there was a very noticeable delay in seed stalk development and flowering. Without close observation, the treatment looked very promising as inhibiting seed production. Further observation, however, showed only a temporary delay of 10 - 14 days in flowering at which time the treatment was little different from the check.

MCP

As shown by yield data and stand counts (Table I and II), MCP resulted in almost complete control of weed growth. The total weight of all weeds in the 10, 3 x 3 foot square quadrats of red clover was 3.8 pounds compared to 12.8 pounds for the check. For yellow rocket alone, the weights were .05 pound in the treated vs. 5.9 pounds in the check. Calculated on an acre basis, this is 24 pounds for the treated compared to 2800 pounds for the check.

In the alfalfa area (Field A), the total weight of all weeds in the treated was 7.8 pounds, compared to 11.4 for the check. The difference in control of all weeds here compared to Field B was the high percentage of cinquefoil in the alfalfa. Considering yellow rocket alone, the weights were 0.1 pound for the treated compared to 1.65 pounds for the check. The effectiveness of the treatment for yellow rocket control is even more pronounced when the total number of yellow rocket plants is noted. The total plants in the 10 treated quadrats was 18 compared to 297 in the check.

Based on stand counts from the red clover and alfalfa fields, MCP gave 95 per cent control of yellow rocket. The average number of yellow rocket plants per square foot in the treated plots was 0.20 for Field A and 0.17 for Field B, respectively. The adjacent checks showed 3.3 and 3.4 plants per square foot, respectively.

Summary and Conclusions

The use of dinitro materials (Sinox P. E. and Sinox General) as applied in these demonstrations did not give satisfactory weed control. Although stand counts showed 57 per cent control of yellow rocket in the 4 quart rate of Sinox P. E., there was still an average of 1.5 plants per square foot at harvest time. Also, since yellow rocket represented only one-fourth the total weight of weeds per plot (Table II), it is clear that other weeds were as predominate as yellow rocket in these trials. The results shown here agree favorably with preliminary data from both fall and spring treatment of legumes by the Agronomy Department of Cornell University.

The most significant trend in these demonstrations is the promise shown by MCP as an early spring treatment for legume weed control. Calculated on a ton basis, the yield per acre of weed-free forage was not reduced on either Fields A or B. Actually, there was some increase in yield. The MCP treatment on Field B reduced the amount of air dry weeds (25 per cent moisture) by 1400 pounds per acre.

PRE-SEEDING WEED CONTROL IN ALFALFA WITH CALCIUM CYANAMIDE[1/] [2/]

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The success of legume and legume-grass seedings depends considerably on weed control in the seeding year. The approach to the solution of this problem has previously been along the lines of cultural practice. The success of pre-emergence applications of herbicides for weed control in row crops has encouraged experimentation with pre-planting applications of calcium cyanamide on alfalfa (1) (2).

There was a two-fold purpose for this study; (1) to determine the number of days that would be a satisfactory interval between the time of cyanamide treatment and the seeding of the legume; and (2) to determine if the qualitative test for cyanamide nitrogen is reliable enough to use as a basis for arriving at a safe time of seeding under different conditions.

Materials and Methods

The study was performed on the experiment station plots on soil classified as silt loam. Moisture and temperature records were available from the branch weather station at Kingston.

Plots 5' x 18' were fitted for seeding and allowed to remain 3 days before treatment to permit the weed seeds to begin to take on moisture. Following this period, calcium cyanamide at the rate of 500 pounds per acre was broadcast on all but the check plots. Four treated plots and one check plot were then seeded to Narragansett alfalfa at the rate of 15 pounds of viable seed per acre. These seedings as treatments were repeated daily for seven more days.

The plots were raked lightly, seeded by hand, raked again and rolled. Every effort was made to keep the soil surface as undisturbed as possible, consistent with good seedbed preparation.

Each day the plots were seeded, soil samples were taken on these newly seeded plots. The samples were taken to a maximum depth of one inch and the composite samples obtained were tested immediately to determine the amount of cyanamide nitrogen present in the soil.

Procedure for qualitative test for cyanamide nitrogen[4/]

One teaspoonful of soil was placed in a 50 ml. beaker and 25 ml. of 10% acetate acid was added. The material was stirred thoroughly for two minutes then filtered through a Whatman #2 filter paper. Five ml. of the filtrate was placed in a test

1/ Contribution No. 814 of the R. I. Agr. Exp. Sta., Kingston, R.I.
2/ This work was made possible in part by a grant from the American Cyanamid Company.
3/ Assistant Research Professor of Agronomy, Assistant Agronomist, and Assistant Professor of Agricultural Chemistry, respectively.
4/ This procedure, supplied by The American Cyanamid Company, was modified to suit local equipment and conditions. The additional levels used for cyanamide nitrogen were compared against known standards.

tube and diluted to 10 ml. with water. One ml. of 6N ammonium hydroxide was added, followed by 5 drops of the 10% solution of ammoniacal silver nitrate. (Dissolve 10 g. silver nitrate in 50 ml. water and while stirring, carefully add sufficient concentrated ammonium hydroxide until the precipitate which first forms has just dissolved. Make up to 100 ml. with water and keep in a brown bottle.)

A yellow, cloudy precipitate of silver cyanamide formed immediately if the soil contained as much as 100 pounds of cyanamide per acre. The test would detect as little as 50 pounds per acre by a slight, yellow, colloidal precipitate. If no precipitate formed, 6N ammonium hydroxide was added two drops at a time, shaking the test tube after each addition, until the pH of the solution was at neutrality. If no precipitate formed, the test showed the absence of cyanamide..

This test was suggested to show when a soil, which had been treated with calcium cyanamide, no longer contained toxic concentrations of cyanamide. When the test gave negative results, it indicated that the major portion of the cyanamide had decomposed and it should be safe to plant.

Plant counts were made on all replicates of all treatment and control plots one month after seeding. Weed notes were made two months after seeding.

Results and Discussion

The rate of 500 pounds per acre of calcium cyanamide was chosen because this rate gave the most complete weed control of common weeds in earlier field corn trials (3).

The seedbed preparation and seeding technique did not differ materially from farmer practice, and late summer seeding is consistent with recommendations for seeding alfalfa.

The first phase of the study was made in early September of 1951 during a relatively dry period. Although the soil was moist when fitted, the surface dried out rapidly and no rain fell during the test period. There was fog in the early morning and the humidity remained high, however. The cyanamide granules lay visible on the surface for several weeks after the completion of the test.

The laboratory test of the samples taken on the plots seeded the third day showed the most decisive break -- from above 300 pounds per acre to the 100-300 pounds per acre level of cyanamide. The plant counts increased significantly (an increase of almost 50%) on the third day treatment. During the remainder of the test, the laboratory results fluctuated considerably, with one or two replicates consistently remaining high while the remaining replicates decreased to the negative value.

The plant counts, meanwhile, remained fairly constant except for the seventh day treatment where the plant count increased from 135 plants per square yard to 177 plants per square yard. The plant count of the control plot was 229 plants per square yard, about normal for the first seven days. On the eighth day treatment plots and check plot the plant count dropped to an average of 127 and 102 plants per square yard, respectively. By this time it was very difficult to roll the seedbed for compaction without "boiling" the soil containing the seed and cyanamide ahead of the roller. It is believed that this displacement caused the varied and low results of both laboratory test and plant count.

Table 1. The Effect on Seedling Emergence of Various Intervals Between the Application of Calcium Cyanamide and the Time of Seeding Alfalfa, Correlated With the Qualitative Test for Cyanamide Nitrogen.

Interval Treat-ments	1951 Results			1952 Results		
	Cyanamide Test	Plants per sq. yd.		Cyanamide Test	Plants per sq. yd.	
		Treated	Check		Treated	Check
	++	140		+++	24	
	-		167	+++	51	
A	+++	58		+++	18	
(1 day)	+++	52		+++	18	
	+++	71		-	-	177
		80.25 Av.			27.8 Av.	
	+++	124		+++	66	
B	-		204	++	84	
(2 day)	+++	116		+++	81	
	+++	41		+++	49	
	+++	45		-	-	165
		81.5 Av.			70.0 Av.	
	+++	116		+++	54	
C	++	118		++	84	
(3 day)	-		231	+++	57	
	+	118		+++	51	
	++	117		-	-	189
		117.3 Av.			61.5 Av.	
	+++	149		++	96	
D	-		173	++	96	
(4 day)	+++	87		+++	69	
	+	131		+	96	
	+	129		-	-	171
		124 Av.			89.2 Av.	
	++	145		+++	42	
E	++	127		+	81	
(5 day)	-		219	++	60	
	+	112		++	45	
	+++	78		-	-	207
		115.5 Av.			57.0 Av.	

Table 1. (continued)

Interval Treat-ments	1951 Results			1952 Results		
	Cyanamide Test	Plants per sq. yd.		Cyanamide Test	Plants per sq. yd.	
		Treated	Check		Treated	Check
	+	109		++	84	
F	-	148		+	78	
(6 day)	++	153		+	105	
	-		238	++	93	
	-	133		-	-	183
		135.75 Av.			90.0 Av.	
	+++	164		+	120	
G	+	198		++	102	
(7 day)	+	128		++	60	
	-		229	+	123	
	++	218		-	-	156
		177 Av.			101.2 Av.	
	+++	189		-	126	
H	-	111		+	162	
(8 day)	-	130		+	135	
	+	81		-	117	
	-	-	102	-	-	174
		127.75 Av.			135.0 Av.	

+++ >300 pounds Cyanamide per acre
++ 100-300 pounds Cyanamide per acre
+ 50-100 pounds Cyanamide per acre
- < 50 pounds Cyanamide per acre

The three week period previous to the 1952 test was wet and the ground was very moist at the beginning of the experiment. The alfalfa seeded during the first four days emerged within three days on the check plots. Precipitation in the amount of 0.06 inches fell on the seventh and eighth days of the test period. Humidity otherwise was normal for the season.

The plant count increased from 27 plants per square yard to 70 between the first and second days seeding. The break in the cyanamide test results, however, came after the third day and again between the seventh and eighth day of the test period. The plant counts increased to an average of 135 per square yard on the treated plots seeded the eighth day but did not attain the plant count of 177 plants per square yard found on the control plot for that day.

The two seasons' data taken from experiments performed on two areas of the same soil type and under different soil moisture levels, indicated that a waiting period of up to eight days after cyanamide application is not sufficient to eliminate the possibility of injuring the germinating alfalfa seedings.

This situation, if generally true, creates a problem in actual practice. During the seasons when legume seedings are made, it is not often practical to wait eleven and more days after the land is fitted before we begin seeding. Four test-demonstration plots made on farms in the state supported that contention. One of the farms experienced dry weather during a 14 day waiting period and the earlier seedings enjoyed a more favorable germinating period, nullifying the weed control effect. Several inches of rain on the fourth day of the test on another farm compacted the soil requiring re-fitting the seedbed. This brought new weed seeds to the surface to grow vigorously with the advantage of the extra nitrogen. The other two farmer trials with 10 day waiting periods were successful in obtaining a good stand, controlling broad leaf weeds, and increasing vigor and yield in the seeding year.

The qualitative test for cyanamide nitrogen may be used as a guide to deciding on a safe seeding date following the weed control treatment. From the results of the tests under the soil and moisture conditions indicated, it must be expected that some injury to germinating seedlings will occur for several days after the laboratory test gives a negative result. For the small area involved, a large number of carefully taken soil samples were composited, so it is unlikely that improvements in the validity of the soil test could be made in that direction.

The 500 pound per acre rate of calcium cyanamide gave excellent control of chickweed (Stellaria media) and spurrey (Spergula arvensis) on all of the treated plots. The check plots after two months had a stand of 50% weeds, about evenly divided between the chickweed and spurrey species. If a 350 to 400 pound rate would give satisfactory control of both spring and fall weeds common in new seedings, a cyanamide rate reduction could shorten the duration of toxic concentrations of cyanamide in the soil. This would allow for a more suitable seeding practice and perhaps the laboratory test could then be an acceptable guide for seeding within a five to seven day interval following the application of calcium cyanamide. Additional research is needed to prove or disprove this point.

Summary and Conclusions

The application of 500 pounds per acre of calcium cyanamide gave excellent control of broad leaf weeds in alfalfa seedings but the interval range between the time of application and the seeding of the alfalfa was not sufficient to eliminate injury to the germinating seedlings.

The qualitative test for cyanamide nitrogen is a satisfactory guide to arriving at a safe seeding date, but on an individual test basis could not be used with the present indicator levels as an absolute basis for seeding without causing some injury.

The 400 pound rate of cyanamide application may reduce the waiting period before seeding, decrease the amount of injury to the germinating seedlings, and make the practice acceptable to the farmer. Additional research is needed on this point.

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Chickweed Control in Grass-Legume Seedings by Preplanting Applications of Calcium Cyanamid[1]

Jonas Vengris, Wm. G. Colby, Mack Drake[2]

Chickweed control in alfalfa and grass-legume seedings is important in Massachusetts as well as in other northeastern states. Recent research data indicate some possibilities of controlling this weed with late fall or early spring herbicidal applications when the cultural plant such as alfalfa is dormant. Even if these control measures are effective at this time, serious damage to the new seeding may have already occurred because of the smothering effect of a heavy matted growth of chickweed. Some loss and injury to cultural plants is inevitable (2). It seems that the logical goal should be to control this weed before it develops a matted growth and has opportunity to suppress cultural plants and infest the soil by continuously producing new seeds. Under normal conditions chickweed seeds as well as legume seeds (alfalfa) germinate quickly, and so the possibilities of pre-emergence herbicidal applications are very limited. Hence, the use of preplanting applications of suitable herbicides appears to be more promising. Our 1952 preliminary data obtained from tests with calcium cyanamid as a preplanting herbicide are quite promising.

Methods and Results

During the 1952 growing season two field experiments were conducted with the preplanting application of calcium cyanamid in alfalfa and grass-legume seedings.

The soil on the experimental area was a fine sandy loam with fair drainage and a pH of 6.3. The land was badly infested with chickweed (*Stellaria media*) and annual weedy grasses. A randomized block, split plot factorial design with three replicates, was used. Plots were 10 ft. by 20 ft. in size.

Spring Seeding Trials. One-half of the experimental area was prepared for seeding April 23; the remaining half was left for fall seeding trials. Six days after seedbed preparation, granular cyanamid was broadcast at the rate of 400, 600 and 800 lb. per acre. The check plot received sodium nitrate at the rate of 500 lb. per acre. After treatment, one-half of each plot was raked lightly to the depth of 3 to 4 cm.; the other half was left undisturbed. Two seeding mixtures were used: one straight alfalfa (Ranger) and the other a mixture of hay grasses and legumes. One seeding was made 7 days after treatment and another 14 days after. The seeds were broadcast on the

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3. Acknowledgment is gratefully made to the American Cyanamid Company for the material used in this experiment.

surface and rolled in with a corrugated hand roller. No rain followed the treatment until shortly before the second seeding, when 1.74 inches of rain fell. In spite of the dry weather, however, the soil was moist at all times. On May 10, seedling counts were made. Four areas of one sq. ft. each were chosen at random in each plot for this purpose. For either seeding date, no injury was apparent on the plots which were raked in after treatment. Where the cyanamid was left undisturbed on the surface, alfalfa seeded 7 days after treatment showed injury at all three rates of cyanamid applications, and the hay mixture showed injury at the 600-lb. and 800-lb. rate. The seedings made 14 days after soil treatment showed no injury.

The weed population was made up largely of chickweed (Stellaria media), crab-grass (Digitaria sanguinalis), old-witch-grass (Panicum capillare), carpetweed (Mollugo verticillata), lamb's quarters (Chenopodium spp.), pigweed(Amaranthus retroflexus), low cudweed (Gnaphalium uliginosum).

Good control of weeds, particularly chickweed, was secured from all treatments.

TABLE I

Effectiveness of Preplanting Applications of Calcium Cyanamid in Controlling Weeds in Spring Seedings of Alfalfa and Grass-legume Mixtures.

No.	Treatments	Botanical composition on Air-dry Weight Basis			
		Chick Weed	Other Weeds	Total Weeds	Cult. Plants
		%	%	%	%
	ALFALFA				
1.	Check, 80 lb/A Nas $NaNO_3$	30	40	70	30
2.	400 lb/A $CaCN_2$ seeded 7 d.aft.appl.	3	21	24	76
3.	600 lb/A " "	2	32	34	66
4.	800 lb/A " "	2	28	30	70
5.	400 lb/A " " 14 days "	5	22	27	73
6.	600 lb/A " " " "	4	28	32	68
7.	800 lb/A " " " "	2	22	24	76
	GRASS-LEGUME MIXTURE				
8.	Check, 80 lb/A Nas $NaNO_3$	25	43	68	32
9.	400 lb/A $CaCN_2$, seeded 7 d. aft. appl.	2	22	24	76
10.	600 " " "	2	24	26	74
11.	800 " " "	3	25	28	72
12.	400 " " 14 days "	12	20	32	68
13.	600 " " " "	4	21	25	75
14.	800 " " " "	0	23	23	77

In general, the check plots consisted of 30 percent cultural plants and 70 percent weeds. With the treated plots the percentages were approximately reversed with 70 percent cultural plants and 30 percent weeds.

It was observed that more complete control of weeds was obtained initially from the 600-lb. and 800-lb. rates of cyanamid than from the 400-lb. rate. However, as the growing season progressed the additional nitrogen released from these high applications rates tended to stimulate the growth of weedy annual grasses (*Panicum capillare*, *Digitaria sanguinalis*) so that by the time the botanical analyses were made, differences in weed control effectiveness between different treatments had disappeared.

Fall Seeding Trials The experimental procedure that was followed in the spring seeding trials was repeated in the fall seeding experiment. The seedbed was prepared August 4, and cyanamid was applied August 8. Seedings were again made at 7-day and 14-day intervals after treatment. No cyanamid injury to either grasses or legumes was observed from any of the treatments. This can probably be explained by the high summer temperatures and the occurrence of two heavy rains on August 10 and again on August 12 just prior to the first seeding.

In general, the results from the fall seeding trials (Tables II and III) follow the same pattern for the spring seeding trials (Table I).

TABLE II

Effectiveness of Preplanting Applications of Calcium Cyanamid in Controlling Weeds in Fall Seedings of Alfalfa and Grass-Legume Mixtures; Seedings made 7 days after treatment.

No.	Treatments	Botanical composition on Air-dry Weight Basis			
		Chick Weed	Other Weeds	Total Weeds	Cult. Plants
	ALFALFA	%	%	%	%
1.	Check, 80 lb/A Nas $NaNO_3$	27	33	60	40
2.	400 lb/A $CaCN_2$ seeded 7 d. aft. applic.	1	43	44	56
3.	600 " " "	7	27	34	66
4.	800 " " "	1	32	33	67
	GRASS-LEGUME MIXTURE				
5.	Check, 80 lb/A Nas $NaNO_3$	20	36	56	44
6.	400 lb/A $CaCN_2$ seeded 7 d. aft. appl.	1	19	20	80
7.	600 " " "	4	17	21	79
8.	800 " " "	2	23	25	75

TABLE III

Effectiveness of Preplanting Applications of Calcium Cyanamid in Controlling Weeds in Fall Seedings of Alfalfa and Grass-Legume Mixtures; seedings made 14 days after treatment.

No.	Treatment	Ground Area Covered			
		Chick Weed	Other Weeds	Total Weeds	Cult. Plants
		%	%	%	%
	ALFALFA				
1.	Check, 80 lb/A Nas $NaNO_3$	40	11	51	25

Table III continued

No.	Treatment	Ground Area Covered: Chick Weed	Other Weeds	Total Weeds	Cult. Plants
	Alfalfa continued:	%	%	%	%
2.	400 lb/A $CaCN_2$ seeded 14 d. aft. appl.	5	12	17	58
3.	600 " "	9	15	24	53
4.	800 " "	6	12	18	54
	GRASS-LEGUME MIXTURES				
5.	Check, 80 lb/A Nas $NaNO_3$	44	13	57	32
6.	400 lb/A $CaCN_2$ seeded 14 d. aft. appl.	1	5	6	83
7.	600 lb/A " "	2	6	8	83
8.	800 lb/A " "	2	6	8	82

Discussion and Conclusions

The use of calcium cyanamid as a preplanting herbicide preparatory to seeding grasses and legumes appears to be quite promising. Cyanamid was equally successful with early spring and fall seedings. Control of chickweed, a very serious weed in new seedings, was exceptionally good. Under the conditions of these experiments, a 400-lb. per acre application of calcium cyanamid gave as satisfactory results as the 600-lb. or 800-lb. rates.

Good soil moisture relationships are necessary to promote the breakdown or hydrolysis of calcium cyanamid in the soil. It is the presence of some of these hydrolysis products persisting for a short time that produce herbicidal effects (1). If cultural plants are seeded before these toxic substances have disappeared, plant injury will result. These experiments show that lightly raking of calcium cyanamid into the soil following application helps the chemical to mix with the moist soil. This procedure facilitates the breakdown of the toxic substances and reduces the danger of injury to subsequently seeded cultural plants.

The following conclusions and observations seem to be justified:

1. A seedbed should be prepared 4 to 7 days before the application of calcium cyanamid. Weed seeds start to germinate and so become susceptible to the toxic effects of cyanamid decomposition products. The timing of the application to coincide with the germination of weed seeds is an important factor in effective control.
2. Rates of calcium cyanamid as low as 400 lbs. per acre appear to be effective in controlling chickweed.
3. Lightly mixing calcium cyanamide with the top 3 to 4 cm. of soil immediately following application facilitates the breakdown of this material and reduces the danger of injury to the new seeding.
4. If soil moisture relationships are good, spring seedings can be made 7 days after treatment and fall seedings, because of higher temperatures, in 4 to 7 days. However, it must be strongly emphasized that soil conditions, particularly moisture relationships, must be favorable for the breakdown of calcium cyanamid in the soil. If these

If these conditions are not favorable, the period between treating and seeding may be longer. Recently developed soil tests (3) may be helpful in determining "safe" seeding dates.

5. In order not to stimulate the growth of new weeds, the soil should be disturbed as little as possible at seeding time. Broadcasting the seed on the surface followed by rolling with a corrugated roller appears to be satisfactory.

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END

Chemical Chickweed Control and Its Influence on Yields of Alfalfa-Grass Mixtures

Frederick W. Berggren[1/] and Robert A. Peters[2/]

INTRODUCTION

Common chickweed (Stellaria media (L.) Cyrillo has become a very prominent weed in many hay fields in the eastern United States and is causing considerable concern among farmers. Successful chemical control of chickweed in alfalfa has been reported by Hoague and Stabler (1) and Raleigh (2).

The following series of experiments were designed to determine the effectiveness under Connecticut conditions of several chemical treatments applied at several dates. Of particular concern was the effect of treatment on the forage stands present.

A study of some of the growth habits of chickweed was also made to provide a better basis for planning control measures.

MATERIALS AND METHODS

Treatments were applied in early winter on December 1, 1951, and in early spring on March 17, 1952, to an established dormant stand of

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alfalfa-grass, seven years old, infested with chickweed. Treatments on a new seeding made the previous fall were applied on April 4, 1952, while the alfalfa was still dormant.

The chemicals used were 2, 4, and 8 pounds active ingredient per acre of isopropyl N-(3, chlorophenyl) carbamate; 1, 2, and 4 pounds active ingredient per acre of ammonium dinitro ortho secondary butylphenate; 7.5, 15, and 30 pounds active ingredient per acre of potassium cyanate; and 10, 20, and 40 pounds actual material per acre of Atlacide. All materials were applied in 40 gallons of water solution except DNOSBP which was in 80 gallons per acre.

In addition to field notes, yield data were obtained from hand separated samples kept under refrigeration until separated.

Supplemental to the above dormant treatments, applications were made of DNOSBP, alkanolamine salt, and of CIPC at rates of 1 and 2 pounds active ingredient per acre on September 11, 1952, on actively growing forage stands.

RESULTS

Early Winter Applications on Established Alfalfa

By January 1, complete control of chickweed had been attained from all chemicals except CIPC which did not completely kill chickweed until February. Control from DNOSBP was good despite the fact that the temperature was at the freezing mark at the time of treatment. However, by April 22, reinfestation from new chickweed seedlings had occurred on all plots except on the CIPC plots. At harvest time, June 2, some new seedlings were present on the CIPC plots as well. It was apparent that single fall applications will not suffice to control chickweed until harvest time.

Yield data presented in Table 1 show that there was a highly significant reduction of chickweed from all treatments except at the 40 pound rate of Atlacide. Since alfalfa was significantly reduced by this latter treatment, competition for chickweed was reduced; thus the greater amount of spring seedling growth. There was a significant increase in the amount of alfalfa harvested from plots receiving 8 pounds of CIPC, however, this rate reduced grass stands. The increase in alfalfa on these plots may have been due to a reduction in grass competition. Timothy and orchard grass were the species principally affected by CIPC. Kentucky bluegrass was the only grass species present on these plots at the time of harvest.

Table 1

Yields of the Constituents of an Established Alfalfa Mixture
(Treated December 1, Harvested June 2)

Treatment	Lbs. Per Acre	Dry Matter (Pounds Per Acre)		
		Chickweed	Alfalfa	Grass
CIPC	2	22	2044	386
	4	10	2276	715
	8	2	2987	86
DNOSBP	1	36	1557	1535
	2	24	1219	993
	4	12	2428	1295
Potassium Cyanate	7.5	38	1857	1389
	15	60	2320	1159
	30	12	1183	1135
Atlacide	10	36	1854	624
	20	43	1339	840
	40	163	1063	626
Control		182	2111	1017
L.S.D. Control vs. Treated	5%	67	844	571
	1%	91	N.S.	770

Early Spring Applications on Established Alfalfa

By May 19, CIPC at all rates had completely controlled chickweed without injury to alfalfa. There was some injury to grasses. Atlacide had killed most of the chickweed but had injured alfalfa. DNOSBP and potassium cyanate had stunted chickweed, but considerable recovery occurred. Neither chemical affected the alfalfa or grass.

Yield data in Table 2 show that all rates of CIPC completely eliminated chickweed. All rates of Atlacide and 2 and 4 pounds of DNOSBP significantly reduced chickweed. Potassium cyanate was not effective in controlling this weed. Atlacide was injurious to alfalfa and grass causing a highly significant reduction at the 40 pound rate. At the 8 pound rate of CIPC there was a significant increase in alfalfa, but the grass was significantly reduced.

Table 2

Yields of the Constituents of an Established Alfalfa Mixture
(Treated March 17, Harvested June 3)

Treatment	Lbs. Per Acre	Dry Matter (Pounds Per Acre)		
		Chickweed	Alfalfa	Grass
CIPC	2	0.0	1677	621
	4	0.0	1806	333
	8	0.0	2358	175
DNOSBP	1	125	2190	1094
	2	46	2181	921
	4	17	1651	1353
Potassium Cyanate	7.5	163	2082	535
	15	137	1859	849
	30	175	1588	713
Atlacide	10	79	1343	674
	20	24	1348	720
	40	5	686	369
Control		230	1680	979
L.S.D. Control vs. Treated	5%	108	700	569
	1%	146	945	767

Applications on an Alfalfa Mixture Seeded the Previous Fall

At the time of treatment on April 4, the plots were covered with a one to two inch mat of chickweed. When yield data were taken on May 30, the check plots had over a ton per acre of chickweed.

Atlacide and CIPC were the most effective chemicals. Considerable chickweed had been killed by Atlacide on May 3, but the CIPC was slower in killing. DNOSBP and potassium cyanate initially stunted the chickweed but by May 3 the plants were recovering.

As shown from the yield data in Table 3, all rates of CIPC, Atlacide, and 2 and 4 pounds of DNOSBP caused a highly significant reduction of chickweed. A significant reduction was obtained from one pound of DNOSBP and all rates of potassium cyanate. Alfalfa was not affected by any treatment. The 2 and 4 pound rates of CIPC significantly reduced grasses.

Table 3

Yields of the Constituents of a Fall Seeded Alfalfa Mixture
(Treated April 4, Harvested May 30)

Treatment	Lbs. Per Acre	Dry Matter (Pounds Per Acre)		
		Chickweed	Alfalfa	Grass
CIPC	2	1053	144	182
	4	122	252	324
	8	12	290	408
DNOSBP	1	1526	273	717
	2	1360	312	489
	4	1082	130	621
Potassium Cyanate	7.5	1468	211	535
	15	1502	288	705
	30	1562	223	691
Atlacide	10	1197	329	681
	20	477	261	597
	40	65	197	677
Control		2190	266	609
L.S.D. Control vs. Treated	5%	581	N.S.	271
	1%	784	N.S.	367

Since the applications were made some time after the area became infested with chickweed, any reduction in alfalfa yield attributable to the chickweed was not adequately measured.

Early Fall Treatment

On an established stand in which the forage species extended above the chickweed, both CIPC and DNOSBP had killed the chickweed by the end of October. The DNOSBP, however, had reduced the amount of alfalfa top growth.

In another area, applications were made on a 2 inch mat of chickweed which completely covered a seeding made one and one-half months prior to treatment. The CIPC killed the chickweed without apparent damage to the forage. The DNOSBP initially killed considerable chickweed, but by the end of October the treated areas were again heavily infested by regrowth of the chickweed.

Chickweed Growth Studies

Chickweed plants were observed in the blooming and seed producing stages from September through June at Storrs, Connecticut, in 1952. Seed germinated in the field from April until November wherever the surface soil was moist. On July 18, a count of chickweed seed present on the plants and scattered on the soil surface indicated that over 24,000 seeds per square foot were produced.

Experiments to determine the effect of temperature and age of seed upon germination were carried out in the laboratory. Three sets of seed were used. One set was harvested on the day the test started, another three weeks before and the third twelve weeks before. Seeds were germinated on filter paper in petri-dishes. Four replications of each set

were held for two weeks at 7° C., 15° C., and 25° C. The percent germination is shown in Table 4.

Table 4

Germination of Chickweed as Affected by Age and Temperature

Temperature	Age of Seed: 1 Day	3 Weeks	12 Weeks	Average All Temperatures
	Percent Germination			
7° C	0.0	35.0	21.3	18.8
15° C	12.5	66.3	50.0	42.9
25° C	0.0	7.5	8.8	5.4

15° C. appeared to be better for germination than 7° C. or 25° C. Three week old seed germinated better than either fresh seed or the older 12 week seed.

SUMMARY

Adequate control of chickweed was obtained from 2 pounds of CIPC applied in December and March on established alfalfa but 8 pounds were required to give good control when applied in April on a matted stand. However, 1 pound of CIPC gave good control of matted chickweed when applied in September. Although CIPC did not injure alfalfa it was injurious to timothy and orchard grass. Four pounds of DNOSBP gave control varying from good, when applied in September, December and March on sparse chickweed, to poor when applied in April or September on a matted growth. Although DNOSBP was not as effective as CIPC, it did not injure grasses. When applied on actively growing alfalfa in September, DNOSBP at 1 and 2 pounds reduced the amount of top growth.

Potassium cyanate killed established chickweed in December but only stunted it when applied in March and April. Alfalfa stands were reduced following December treatment of 30 pounds of this material.

Good control of chickweed was achieved following March and April applications of 40 pounds of Atlacide. When applied in December and March, 40 pounds seriously reduced alfalfa stands while 10 and 20 pounds reduced the stands to a lesser extent.

While over-all effectiveness of the chemicals used was greatest from fall applications, seedling reinfestation on all plots except those treated with CIPC largely counteracted the action of the herbicides by harvest time the next season.

The prolific growth of chickweed was shown to be in part due to the magnitude of seed production and of the ability of the seed to germinate over a wide range of conditions.

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A FIELD STUDY OF RATES AND DATES OF APPLYING CERTAIN CHEMICALS FOR CONTROL OF CHICKWEED IN ALFALFA 1/

Lindsay F. Morris, Jr., and Albin O. Kuhn 2/

INTRODUCTION

Alfalfa is an important crop in the agriculture of the Northeastern region. The ever increasing livestock numbers in this region call for greater use of plants that can give high production per acre. Alfalfa, when properly grown, alone or in combination with grass, gives high yields. In Maryland as alfalfa acreage has increased, weed problems have become more serious. The majority of the alfalfa stands are established in the state by late summer seeding. Many farmers in the state have complained that chickweed, Stellaria media (L.), has been reducing the stands obtained in the seedling year. Previous work in Maryland has shown that heavy stands of chickweed can almost eliminate alfalfa during the first season after establishment. Previous work at the Maryland Agricultural Experiment Station has also shown that the dinitros can be used to effectively reduce chickweed competition. The work here reported is a study of some other chemicals that might also be effective. 3/ This report covers work conducted during the fall, winter, and spring of 1951-52.

Although initially the project was planned to study the control of chickweed in alfalfa, it became apparent that other species are competing in alfalfa establishment. At the location where this study was conducted, winter cress, Barbarea vulgaris R. Br., and volunteer barley, Hordeum vulgare (L.), were both prevalent. Stands of these plants were heavy and appeared to be competing with the alfalfa. A survey of other fields in the state showed that volunteer small grain and winter cress were found in abundance in most fields.

New studies have been initiated at the Maryland Agricultural Experiment Station to evaluate chemicals for control of all of these weeds that have appeared to be a problem in satisfactory establishment of alfalfa.

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

3/ Grateful acknowledgement is given to Dr. Warren G. Shaw, Division of Weed Investigations, BPISAE, USDA, Beltsville, Md. for suggestions with regard to chemicals and rates for this study.

OBJECTIVES

The broad objectives of this study were to determine the effectiveness of various chemicals in controlling common chickweed in seedling alfalfa stands and to evaluate damage to the seedling alfalfa. The plots were designed to give, primarily, precision on the comparisons of various chemicals and rates and, secondarily, to give some indication of the importance of date of treatment on maintenance of stands and yield.

MATERIALS AND METHODS

Location. The study was conducted on a well drained Chester soil in Baltimore County on the farm of Mr. John Zouck, near Glyndon, Maryland. The alfalfa was seeded by drilling in August of 1951 on a seedbed especially prepared for this crop. The seeding was a mixture of 24 pounds per acre of Buffalo alfalfa and 6 pounds per acre of commercial timothy. A soil sample taken at the time of first treatment had a pH of 6.9. Fertilization practices appeared adequate for good growth of alfalfa.

Treatments. Fifteen different treatments were made, using five chemical compounds each at three rates. An untreated check was included for comparison. The chemicals and rates were as follows: Ammonium salt of 4,6-dinitro-ortho-secondary-butyl-phenol (ammonium salt of DNOSBP) at 1, 2, and 4 pounds of active ingredient per acre; amine salt of 4,6-dinitro-ortho-secondary-butyl-phenol (alkanolamine salt of DNOSBP) at 1, 2, and 4 pounds of active ingredient per acre; isopropyl N-(3-chlorophenyl)carbamate (CIPC) at 4, 8, and 16 pounds of active ingredient per acre; isopropyl N-phenylcarbamate (IPC) at 4, 8, and 16 pounds of active ingredient per acre; and calcium salt of trichloroacetic acid (calcium salt of TCA) at 8, 16, and 32 pounds of acid equivalent per acre.

Each chemical at each rate was applied as a post-emergence spray on four separate dates as follows: October 27, 1951, before frost had made the alfalfa plants dormant; January 11, 1952, after the alfalfa seedlings were dormant; March 11, 1952, just before alfalfa began new growth; and April 3, 1952, when the alfalfa was just beginning new growth.

Plot Layout. A split plot design was used with chemicals and rates as the sub-plot treatments. Each plot was 7'x20'. Approximately a 6'-wide strip in the center of each plot was sprayed.

Procedure and Equipment. The sprayer was calibrated to apply 18 gallons of liquid per acre with a pressure of 35 pounds per square inch. The first cutting of alfalfa was made on May 30, 1952. A strip 34"x14.3' was cut from the center of each plot to obtain yield comparisons. The harvested material was stored in a refrigerator until hand separations could be made. The material was separated into the following components: Alfalfa, winter cress, barley, timothy, and miscellaneous. The components of these separations were dried. The second and third harvests were completed on July 19 and August 28, 1952, respectively. These harvests were comparatively free of weeds and no hand separations were made.

EXPERIMENTAL RESULTS

Average Alfalfa Yields For All Dates Of Treatment. The average dry matter yields of alfalfa in tons per acre for the various treatments are shown in Table 1.

Table 1. Alfalfa yields in 1952. Average of 4 dates and 3 replications of treatment of stand seeded in August 1951. 1/

Treatment No.	Treatments applied 10/27/51, 1/11/52, 3/10/52, & 4/3/52	Rate in Lbs. per Acre 2/	Dry matter yields in tons P/A 3/
7	CIPC	4	2.24
6	Alkanolamine salt of DNOSBP	4	2.11
10	IPC	4	2.11
3	Ammonium salt of DNOSBP	4	2.07
8	CIPC	8	2.04
4	Alkanolamine salt of DNOSBP	1	2.03
1	Ammonium salt of DNOSBP	1	2.00
11	IPC	8	1.99
5	Alkanolamine salt of DNOSBP	2	1.92
2	Ammonium salt of DNOSBP	2	1.92
12	IPC	16	1.91
16	Untreated check	0	1.84
13	Calcium salt of TCA	8	1.80
15	Calcium salt of TCA	32	1.79
14	Calcium salt of TCA	16	1.74
9	CIPC	16	1.62
L.S.D. .05			.16
L.S.D. .01			.21

1/ Studies made on John Zouck farm near Glyndon, Baltimore County, Maryland by Maryland Agricultural Experiment Station.

2/ All rates of the dinitros expressed as DNOSBP equivalent, the carbamates as active ingredient and TCA as acid equivalent.

3/ Yields are from a seeding of timothy and alfalfa with all grass and weeds removed.

Analysis of variance of the alfalfa yields showed a highly significant F value for treatments. The F value for dates was not significant. Alfalfa yields are used as an index of the effectiveness of these chemicals in the

control of chickweed, and as a measure of injurious effect the chemicals may have had on the alfalfa.

In this table any single combination of a chemical and rate was considered as an individual treatment. It will be noted that several treatments gave significantly higher yields than the untreated check. From a practical point of view the differences were not large. This is explained by the fact that while a good stand of chickweed was present over the entire experimental area, the chickweed plants made sufficient growth to be seriously competetive with the alfalfa only in limited areas within each plot.

Field observations of these areas showed that the dinitro treatments markedly reduced chickweed competition, but that the chickweed in these plots made new growth by the time of the first harvest. In the plots treated with CIPC and IPC the chickweed was killed completely and no new chickweed growth appeared by the time of the first harvest. Approximately one month's delay was noted from the time of treatment until noticeable reduction in the vigor of the chickweed could be observed on plots treated with both CIPC and IPC. The Calcium TCA treatments had little effect on the growth of chickweed. Some of the heaviest stands of chickweed were found in the Calcium TCA treated plots by time of the first harvest.

Heavy stands of winter cress were found throughout the experimental area. The CIPC treatments delayed the growth of this weed in the spring, but did not reduce its stand.

Alfalfa Yields As Affected By Date of Treatment. The data for alfalfa yields for the three cuttings in 1952 for treatments applied at each of four dates are shown in Table 2.

No significant differences were found for date of treatment. This appeared to be largely due to the way in which the experiment was designed, giving low precision on the date comparison. Table 2 is presented because there are some interesting indications concerning date of treatment. These data indicate that at the 8 and 16-pound rates of CIPC and the 4,8, and 16-pound rates of IPC the alfalfa was injured by treatments applied on October 27, 1951. This injury was apparent from examination of the plots during the winter, and from alfalfa stand counts made in April 1952.

Table 2. Alfalfa yields in 1952 for each of 4 dates of treatment of stand seeded in August 1951. 1/

Treatment No.	Chemical	Rate Lbs/A 2/	Dates of Treatments 10/27/51	1/11/52	3/10/52	4/3/52
			Dry matter yields of alfalfa in tons per acre			
1	Ammonium salt of DNOSBP	1	1.94	2.10	1.93	2.00
2	Ammonium salt of DNOSBP	2	1.84	1.37	1.87	2.07
3	Ammonium salt of DNOSBP	4	1.84	2.28	2.24	1.91
4	Alkanolamine salt of DNOSBP	1	2.19	2.05	2.10	1.78
5	Alkanolamine salt of DNOSBP	2	1.91	1.86	2.17	1.73
6	Alkanolamine salt of DNOSBP	4	2.21	1.97	2.35	1.90
7	CIPC	4	2.23	2.11	2.41	2.18
8	CIPC	8	1.83	2.11	2.20	1.96
9	CIPC	16	1.41	1.89	1.57	1.61
10	IPC	4	1.23	2.27	2.43	2.30
11	IPC	8	1.13	2.15	2.37	2.23
12	IPC	16	1.01	2.32	2.26	1.98
13	Calcium salt of TCA	8	1.78	1.50	2.12	1.76
14	Calcium salt of TCA	16	1.45	1.80	1.95	1.75
15	Calcium salt of TCA	32	1.43	1.60	2.29	1.84
16	Untreated check	0	1.65	1.79	2.01	1.90
	Average of each date		1.69	1.95	2.14	1.93
	L.S.D. .05		N.S.	N.S.	N.S.	N.S.
	L.S.D. .01		N.S.	N.S.	N.S.	N.S.

1/ Studies made on John Zouck farm near Glyndon, Baltimore County, Maryland by Maryland Agricultural Experiment Station.

2/ All rates of the dinitros expressed as DNOSBP equivalent, the carbamates as active ingredient and TCA as acid equivalent.

Separation Of Plant Material From First Cutting Of Alfalfa. The results of the separation of plant material harvested in the first cutting on May 30, 1952 are presented in Table 3.

These data show that the CIPC and IPC treatments eliminated both the timothy and barley from the plots. Also, it is noted that the dinitro compounds had no effect on the timothy and barley present.

Table 3. Results of separations made of the first cutting of alfalfa seeded in August 1951. 1/

Treatment No.	Chemical 2/	Rate Lbs/A 3/	Yields of Dry Matter				
			Alfalfa	Timothy	Winter Cress	Barley	Misc.
			T/A	T/A	T/A	T/A	T/A
1	Ammonium salt of DNOSBP	1	.49	.43	.29	.51	.07
2	Ammonium salt of DNOSBP	2	.44	.41	.30	.45	.09
3	Ammonium salt of DNOSBP	4	.45	.54	.28	.37	.09
4	Alkanolamine salt of DNOSBP	1	.46	.35	.43	.56	.11
5	Alkanolamine salt of DNOSBP	2	.43	.45	.48	.45	.07
6	Alkanolamine salt of DNOSBP	4	.49	.56	.33	.33	.08
7	CIPC	4	.61	.00	.47	.01	.05
8	CIPC	8	.54	.00	.25	.00	.02
9	CIPC	16	.26	.00	.10	.00	.00
10	IPC	4	.61	.00	.54	.00	.01
11	IPC	8	.50	.00	.54	.00	.09
12	IPC	16	.49	.00	.48	.02	.03
13	Calcium salt of TCA	8	.34	.20	.52	.10	.20
14	Calcium salt of TCA	16	.37	.22	.64	.22	.18
15	Calcium salt of TCA	32	.40	.19	.61	.06	.19
16	Untreated check	0	.40	.41	.33	.51	.12

1/ Studies made on John Zouck farm near Glyndon, Baltimore County, Maryland by Maryland Agricultural Experiment Station.

2/ Treatments applied 10/27/51, 1/11/52, 3/10/52, and 4/3/52.

3/ All rates of the dinitros expressed as DNOSBP equivalent, the carbamates as active ingredient and TCA as acid equivalent.

DISCUSSION

Previous studies at the Maryland Agricultural Experiment Station and elsewhere have shown that the dinitro compounds can be used to effectively reduce the competition from chickweed in stands of alfalfa. The results of this study indicate that these dinitro compounds are valuable in grass-alfalfa mixtures in that they can be used in the range of 1 to 4 pounds of DNOSBP equivalent throughout the fall and winter period with no important adverse effect on either the alfalfa or the grass.

The results of this study indicate that CIPC may be very effective for use in pure stands of alfalfa, particularly for treatment in mid-winter.

Observations of the effect of the CIPC on chickweed in alfalfa, from the treatments applied, indicate that the range of rates used in this study were higher than are needed for effective chickweed control. It is felt that a study of rates of 1, 2, and 4 pounds per acre may be more logical in the future.

SUMMARY

A mixture of timothy and alfalfa was seeded in August 1951. Five chemicals, each at three rates, were applied on October 27, 1951, and January 11, March 10, and April 3, 1952, to study their effectiveness in the control of chickweed.

1. The ammonia and alkanolamine salts of DNOSBP, applied at the rates of 1, 2, and 4 pounds per acre on all dates, proved effective in reducing competition from chickweed. These treatments did not completely kill the chickweed, and did not injure the timothy or alfalfa.

2. CIPC, applied at the rates of 4, 8, and 16 pounds per acre, proved effective on all dates in killing the chickweed, and preventing regrowth of this weed. This herbicide also killed all timothy growing in association with the alfalfa, and all volunteer barley occurring in the plots. CIPC at all rates and dates of treatment retarded the growth of the alfalfa in early spring.

3. IPC, applied at the rates of 4, 8, and 16 pounds per acre gave results similar to that obtained with CIPC except that it proved more injurious to the alfalfa from treatments applied October 27, 1951.

4. Calcium salt of TCA, applied at the rates of 8, 16, and 32 pounds per acre, gave no control of chickweed.

CHICKWEED CONTROL IN ALFALFA

Richard J. Aldrich and John E. Baylor[1]

Chickweed (Stellaria media) is the most serious weed pest of summer seeded alfalfa in New Jersey. It germinates at about the time summer seedings are made and makes very rapid growth during the time the young alfalfa seedlings are becoming established. Under New Jersey conditions it frequently blooms and produces seed throughout the winter and early spring which makes effective control by cultural means extremely difficult. It starts rapid growth early in the spring and by virtue of its dense growth provides high moisture conditions conducive to disease attacks on the young alfalfa plants.

The use of chemicals for controlling chickweed has been under investigation at the New Jersey Agricultural Experiment Station for the past three growing seasons. The early tests suggested chemicals and rates per acre most satisfactory for chickweed control. 1951 and 1952 tests were conducted to measure the effect of volume of water in which chemicals were applied and date of application on chickweed control and alfalfa growth.

Experimental

1950-51

Methods: During 1950-51 chemicals and rates per acre shown in tables 1 and 2 were applied to chickweed in seedling and established alfalfa respectively. For both seedling and established alfalfa one set of plots was treated with the chemicals listed in October and a second set was treated in January. In all tests the plots were 6 by 25 feet in size in a randomized block experimental design with three replications. Applications were made in 100 gallons of water per acre. The two tests on established alfalfa were located in central New Jersey and in southern New Jersey. One of the three tests in summer seeded alfalfa was located in central New Jersey and the remaining two tests were located in southern New Jersey.

Results: In the summer seeded alfalfa it was quite apparent that DNOSBP was the only chemical of the four tested that appeared to hold promise for chickweed control. Although there was measurable control of chickweed with the other chemicals applied on October 18, alfalfa stands were seriously reduced by Endothal, potassium cyanate, and sodium isopropylxanthate as is indicated in table 1. Chickweed was not effectively controlled by any rate of the latter three chemicals applied on January 18. It was observed that exposed chickweed foliage was effectively "burned-off" by $1\frac{1}{4}$ pounds of DNOSBP ammonium salt

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[1]Agronomist, Division of Weed Investigations, BPIS&AE, USDA, and Assistant Extension Specialist in Farm Crops, New Jersey Agricultural Experiment Station, respectively.

Table 1. Alfalfa stands and second cutting yields on plots treated with chemicals for chickweed control, seedling alfalfa, southern New Jersey, 1951.

Treatment per Acre			Treated October 18	Treated January 18	
			Alfalfa plants/ sq. ft.	Alfalfa plants/ sq. ft.	Lbs. dry matter per acre
1.	DNOSBP[1]	.45 lbs.	29.8	25.7	2828
2.	"	.9 "	29.0	27.4	2805
3.	"	1.8 "	31.3	28.9	2991
4.	Endothal[2]	1.0 lb.	5.3		
5.	"	2.5 lbs.	2.3		
6.	"	5.0 "	0.3		
7.	Potassium cyanate	8.0 "	22.9		
8.	" "	16.0 "	16.2		
9.	NIX[3]	10.0 "	17.9		
10.	NIX	20.0 "	9.0		
11.	Check		28.8	24.7	2677

[1]Dow Selective

[2]Sodium 3,6-endoxohexahydrophthatate

[3]Sodium isopropyl xanthate

Table 2. The effect of five chemicals applied for chickweed control on yields of established alfalfa, southern New Jersey, 1951.

Chemical	Pounds per Acre	Pounds Dry Matter/Acre	
		Treated October 18	Treated January 18
DNOSBP	1-1/4	2667	3370
"	2-1/2	2783	3621
"	5	2878	3590
Endothal[1]	1	2453	3188
"	2-1/2	2049	2979
"	5	2286	3251
Potassium cyanate	8	3045	3452
" "	16	3836	3346
Sodium isopropyl-xanthate (NIX)	10	2955	3476
" " " "	20	2857	3309
Chloro-IPC[2]	3	3328	3933
"	6	3505	3471
"	12	3423	3225
Check		2754	3468

[1]Disodium 3,6-endoxohexahydropthalate

[2]Isopropyl N-(3-chlorophenyl)carbamate

on both dates. However, chickweed made a considerable amount of regrowth by harvest time on plots treated during October of the previous fall, whereas there was much less regrowth on plots treated in January. Unfortunately, complete yield data were not obtained from any of the 1950-51 tests in summer seeded alfalfa. It is possibly significant that there is an indication of an increase in the second cutting yields, as seen in table 1, since in tests conducted during 1951-52 it was found that by far the greatest increase was produced in the first cutting.

Of the five chemicals tested in established alfalfa DNOSBP and Chloro IPC appeared to hold the most promise for chickweed control. Chickweed was completely controlled with 6 and 12 pounds of Chloro IPC applied on October 18 and with all three rates of Chloro IPC applied on January 18. There was considerable regrowth of chickweed in plots treated with all rates of DNOSBP on October 18, whereas there was only a limited amount of regrowth on plots treated January 18. First cutting yields from the test in established alfalfa in central New Jersey are shown in table 2. It is interesting to note the effect of Chloro IPC on alfalfa yields for the two dates. Chickweed was effectively controlled with all rates on both dates. There was no evidence of injury to alfalfa from any rate applied in October and yields were consistenly higher than check. Alfalfa was severely stunted on plots treated with 12 pounds per acre in January and yields were apparently reduced. Although there are no large differences in yield between DNOSBP treated and untreated plots it should be pointed out that yields for treated plots represent essentially pure alfalfa whereas yields for check plots represent the weight of alfalfa and chickweed combined.

1951-52

Results from 1950-51 tests suggested three primary problems which were investigated in the 1951-52 tests including: (1) proper date of application, (2) volume of water necessary for maximum chickweed control, and (3) the relative effectiveness of repeated applications vs. single applications of DNOSBP.

Methods: Tests in seedling alfalfa were established at three locations in central and southern New Jersey and a test in one year old alfalfa was conducted in southern New Jersey. The treatments shown in table 3 were made in a field of seedling alfalfa in southern New Jersey. A randomized block experimental design was used with three replications in which plots were 6 by 25 feet in size.

The treatments shown in table 6 were applied to seedling alfalfa in the second test in southern New Jersey. The plots were 6 by 50 feet in size and were not replicated.

Chloro IPC and the ammonium salt of DNOSBP were tested in a summer-seeded mixture of red clover, ladino, alsike clover and bromegrass. Two and one-half pounds of Chloro IPC per acre were applied in 100 gallons of water to separate plots on September 29, November 6 and December 24. Three-fourths, 1 and 1½ pounds of the ammonium salt of DNOSBP were applied in 100 gallons of water per acre to separate plots on September 29, November 6, December 24, September 29 and November 6, September 29 and December 24, and November 6 and December 24. Plots were 6 by 25 feet in size in a randomized block experimental design with three replications.

The treatments listed in table 7 were made in established alfalfa in a test in southern New Jersey. The plots were 6 by 50 feet in size and were not replicated.

Results: Per cent chickweed control obtained with 1 pound of the ammonium salt of DNOSBP in the test in seedling alfalfa in central New Jersey is shown in table 3. Chickweed was effectively controlled with the treatment on October 12 and in

Table 3. Chickweed control obtained with one pound of the ammonium salt of DNOSBP, central New Jersey, 1952.

Date Treated	Gallons of Water per Acre				Ave. All Volumes	Check
	10	20	40	100		
	%	%	%	%	%	%
October	87.7	83.3	91.7	97.3	90.7	0.0
December	56.7	69.0	81.0	74.3	70.2	0.0
February	45.7	76.0	72.7	68.3	65.8	5.3
October & December	99.3	100.0	100.0	100.0	99.8	1.7
October & February	100.0	100.0	100.0	100.0	100.0	0.0
December & February	97.7	100.0	96.0	100.0	98.5	5.3
Av. all Dates	81.2	88.0	90.2	90.0		2.0

		Gallons	Dates	Gallons x Dates
L.S.D.	.05	2.5	3.0	6.0
	.01	3.3	4.0	7.9

all treatments in which two applications of DNOSBP were made. It would not appear that the volume of water in which the DNOSBP was applied was too critical, although control obtained with 20, 40 and 100 gallons was significantly better than that obtained with 10 gallons of water per acre. Chickweed was not effectively controlled with single applications of DNOSBP on December 27 and February 7 regardless of the volume of water in which the DNOSBP was applied.

Effective chickweed control obtained with the DNOSBP is reflected in significantly higher alfalfa yields in table 4. The chickweed was removed by hand from the hay samples; yields are therefore in pounds of alfalfa at approximately 2 per cent moisture. From the yields it is apparent that injury from chickweed competition was most depressing on first cutting yields, although there was some carry over of effect in the second cutting. As seen in table 5 injury associated with chickweed competition would appear to be closely related to alfalfa stands. The average number of alfalfa plants on plots where chickweed was effectively controlled was 790,000 plants per acre, whereas the average number of alfalfa plants for comparable untreated plots was 476,000 plants per acre. This represents approximately a 40 per cent reduction in stand where chickweed was not controlled.

In the non-replicated test in seedling alfalfa in southern New Jersey all treatments made in October were followed by serious heaving of the alfalfa seedlings. As can be seen in table 6 this injury resulted in reductions in second cutting yields. It is interesting to note that first cutting yields were consistently above checks for all treatments including the October date; it would appear that the deleterious effects of a reduction in alfalfa stand were more than offset by the beneficial effects of chickweed control. Chickweed was removed by hand from the hay in this test also. Chickweed was effectively controlled with Chloro IPC on all three dates and with DNOSBP on October 25 and in all combinations. Effective control is reflected in increases in pounds of dry matter, the largest increase resulting from the Chloro IPC treatment on December 27.

Unfortunately, yields were not obtained in the test in summer-seeded ladino, alsike, red clover and bromegrass at the Station. Weed control observations were in general agreement with data from other tests in the state. Chickweed was effectively controlled with 2½ pounds of Chloro IPC on all dates. Chickweed control with two applications of 3/4 of a pound of DNOSBP per acre appeared to be superior to control obtained with the highest rate as a single application on any date.

Yields from the test in one year alfalfa in southern New Jersey are shown in table 7. Chickweed was not removed from the hay in this test; yields are in pounds of total dry matter at approximately 2 per cent moisture. Yields were consistently, although not greatly, higher on treated plots than they were on check plots. It was observed that chickweed was not a serious problem in this field during the test.

Table 4. Yields of seedling alfalfa as effected by one pound of the ammonium salt of DNOSBP applied for chickweed control, southern New Jersey, 1952.

Date Treated	Pounds of Dry Alfalfa per Acre					
	Gallons of water used					
	10	20	40	100	Check	
October 12						
1st cutting	2566	3278	3335	2631	1283	
2nd cutting	2289	2520	2394	2478	1920	
Total	4855	5798	5729	5109	3203	
Av. of all gallons						4939
December 27						
1st cutting	2220	2631	2373	1965	1701	
2nd cutting	2089	2270	1758	1987	2046	
Total	4309	4901	4131	3952	3747	
Av. of all gallons						4208
February 7						
1st cutting	1753	2207	2018	2146	1808	
2nd cutting	1701	2318	2058	1915	2038	
Total	3454	4525	4076	4061	3846	
Av. of all gallons						3992
October & December						
1st cutting	2629	3307	3551	2971	1776	
2nd cutting	2436	2457	2373	2226	1625	
Total	5165	5764	5924	5197	3401	
Av. of all gallons						5090
October & February						
1st cutting	3349	3091	3045	2844	1777	
2nd cutting	2520	2289	2226	2373	2142	
Total	5869	5380	5271	5217	3919	
Av. of all gallons						5131
December & February						
1st cutting	3033	2991	2978	2582	1986	
2nd cutting	2205	2268	2240	2352	2079	
Total	5238	5359	5218	4934	4065	
Av. of all gallons						4963
Av. of all dates	4815	5288	5058	4745	3697	
L.S.D. between dates	.05	308 lbs.				
	.01	400 lbs.				
L.S.D. between gallons	.05	281 lbs.				
	.01	366 lbs.				

Table 5. The effect of one pound of ammonium salt of DNOSBP, applied for chickweed control in alfalfa, on alfalfa stands.

Date Treated	Gallons of water per acre				Av. all gallons	Check
	10	20	40	100		
	Plants per acre in thousands					
October	933.4	846.7	806.7	746.7	833.4	560.0
December	666.7	693.4	620.0	520.0	625.0	660.0
February	413.4	620.0	580.0	820.0	608.3	760.0
October & December	700.0	786.7	893.4	1040.0	855.0	346.7
October & February	740.0	746.7	720.0	686.7	723.4	433.3
December & February	720.0	660.0	760.0	846.7	746.7	566.7
Av. all dates	695.6	725.6	730.0	776.7	732.0	554.4
L.S.D. .05 for gallons = 146.3						

Table 6. Yields of seedling alfalfa as effected by chemical treatment for chickweed control. Southern New Jersey, 1952.[1]

	Pounds Dry Alfalfa per Acre		
	First cutting	Second cutting	Total
1 lb. DNOSBP			
October 25	3059	695	3754
December 27	3306	1175	4480
February 7	2396	1565	3961
October-December	3458	782	4240
October-February	3725	979	4704
December-February	3309	1565	4874
3 lbs. Chloro IPC			
October 25	2986	717	3703
December 27	3816	1434	5250
February 7	2949	1435	4383
Average all Treated	3223	1150	4372
Check	2362	1282	3644

[1] Yields are the average of plots in which the chemicals were applied in 10, 40 and 100 gallons of water per acre. There were no apparent differences between volumes of water.

Table 7. Yields of established alfalfa as effected by chemical treatments for chickweed control, southern New Jersey, 1952.[1]

Treatment	Pounds Dry Matter per Acre		
	First cutting	Second cutting	Total
1 lb. DNOSBP			
October 25	2487	1324	3811
December 27	2801	1211	4012
February 7	2523	1369	3892
October & December	2676	1200	3876
October & February	2758	1412	4170
December & February	2466	1226	3692
3 lbs. Chloro IPC			
October 25	2274	1256	3530
December 27	2742	1267	4009
February 7	2651	1576	4247
Average all Treated	2598	1316	3914
Check	2162	1308	3470

[1]Yields are the average of plots in which the chemicals were applied in 10, 40, and 100 gallons of water per acre. There were no apparent differences between volumes of water.

Discussion and Summary

Results to date indicate that heavy chickweed populations significantly reduce yields of established and seedling alfalfa. The reduction in yields is most pronounced in the first cutting and have been most significant in first year alfalfa. To measure adequately the effects of chickweed on yield, it will be necessary to continue collecting yield data throughout the life of an alfalfa stand in which chickweed was initially controlled.

Chickweed was effectively controlled with the lowest rate of Chloro IPC used on all dates and in all volumes of water. Results in 1950-51 indicated that 6 pounds of Chloro IPC per acre was near the maximum which could be tolerated by alfalfa and 12 pounds applied in January resulted in severe inhibition. On the basis of our results to date, it would not appear that the lowest effective rate has been established for Chloro IPC.

The volume of water in which DNOSBP is applied would not appear to be critical although control obtained in 10 gallons of water per acre was slightly less than in 20, 40 and 100 gallons of water. After the chickweed became matted it was not effectively controlled by single applications in even the highest volume of water per acre.

Logically, it would seem advisable to eliminate chickweed as early as possible so that it will offer a minimum of competition to the establishment of the alfalfa. Although excellent results have been obtained with some applications made prior to frost in the fall, where heaving conditions prevailed serious reductions in alfalfa stands have resulted by these early treatments. Although chickweed was effectively controlled with 1 pound of DNSOBP applied in October in the fall of 1951, a similar application in 1950 was followed by considerable chickweed regrowth. The fall of 1951 was not typical as far as chickweed development conditions are concerned. Dry weather during September delayed chickweed germination so that October applications were made on relatively much smaller chickweed plants than was the case in 1950. Since it is desirable to eliminate chickweed as early in the fall as is feasible and yet it does not appear that a single application of dinitro at this time will do the job, repeat applications have considerable merit. On the basis of results with repeat treatments in 1951-52 it appears that it may be possible to use slightly less material at each application than is necessary if a single application only is relied on.

CONTROL OF CHICKWEED IN ALFALFA[1]

-- W. H. Mitchell and C. E. Phillips[2]

The presence of chickweed (Stellaria media) in fall seeded alfalfa has been a matter of great concern on many dairy farms in Delaware. Attempts at chemical control have produced variable results ranging from nearly complete control to a surface burning followed by near normal development of the weed. Raleigh (1) has shown that February, March, or April treatments with Sinox PE quickly killed the top 1 to 3 inches of the mat of chickweed but the under portion continued to grow. The present study was an attempt to develop a more effective chickweed control program.

Materials and Methods

All treatments were made on an August-seeded stand of alfalfa. Stable manure had been used in the preparation of the seedbed. A vigorous stand of chickweed was established in the alfalfa by September 20. Sinox W was applied at 1/2, 1, and 2 gallons per acre in 25, 50, and 100 gallons of water respectively. As indicated by Table I, the treatments are made in October, November, February, and March. A garden type tractor was equipped to deliver the spray material through 4 fan type nozzles on a 6 foot boom. The plots were 6' x 30' in a randomized block design with 3 replications. The spray was delivered at approximately 40 pounds pressure with some fluctuation as the rate of application was varied. Additional treatments consisting of 1 1/2 gallons of Sinox W, 1/2 gallon of Sinox PE, 22 pounds of sodium cyanate, 22 pounds of potassium cyanate, and a mixture of 3 pounds of E.H. #1 and 1 1/2 gallons of Sinox W per acre were applied in November. A frame 36 by 36 inches, divided into 36 compartments similar to that described by Muzik, T. J. et al (2) was used to obtain stand data. If chickweed were present in all 36 compartments as the readings were taken, the treatment was given a rating of 36. If there were no chickweed plants present, or complete control, the treatment was given a rating of 0. One reading was taken at the center of each plot area. All stand counts were made in April.

Results

Sinox W at 1/2 gallon per acre in 25 gallons of water was not as effective as the one-gallon rate in 50 gallons of water when applied in October or November. At the time of the October application, the alfalfa plants had not been frosted but were green and vigorous, standing about 3 inches high. The chickweed

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2. Assistant Research Professor and Head, respectively, Department of Agronomy, Delaware Agricultural Experiment Station.

was 2 inches high at this time. There appeared to be some burning of the alfalfa at the 1 gallon rate although this was not a significant injury as shown by the stand counts taken in April. There was no increase in control by using the 2 gallon as opposed to the 1 gallon rates. There was less apparent injury to the alfalfa from the November spraying than from those made in October.

Table I. The Effect of Time and Rate of Application of Sinox W in Controlling Chickweed in Alfalfa.

Treatment Per Acre	Date of Application	Diluent Gallons H_2O per Acre	Temp. at Time of Treatment F°	Chickweed *	Alfalfa **
1/2 gal. Sinox W	10/25	25	72	25	34
1 gal. Sinox W	10/25	50	72	7	32
1/2 gal. Sinox W	11/10	25	50	28	34
1 gal. Sinox W	11/10	50	50	3	34
2 gal. Sinox W	11/10	100	50	9	35
1 gal. Sinox W	2/6	50	45	36	36
2 gal. Sinox W	2/6	100	45	33	35
1 gal. Sinox W	3/20	50	Aprox. 45	36	36
2 gal. Sinox W	3/20	100	Aprox. 45	36	36
Check				36	36
L.S.D. .05				7.6	N.S.
.01				10.5	

* 36 = No control
0 = Complete control

** 36 = No damage
0 = Complete loss of stand

Just previous to the November treatment there were 6 days during which the temperature dropped to 26° - 30° F. at night. The "hardening off" of the alfalfa as a result of this cooler weather may explain the slight decrease in injury in November as compared to October.

The February and March treatments did not give significant control of the chickweed. The chickweed was killed on the surface but continued to make growth from the protected area under the slightly matted surface. Chickweed did not make appreciable growth during the winter months and at the time of the February and March treatments it was about 3 inches high and not strongly matted.

Of the several materials studied for use in controlling chickweed, the di-nitro compounds were most effective. Table II shows the severe injury to the alfalfa caused by all other treatments. In addition to causing good control of chickweed all treatments gave excellent control of henbit (Lamium amplexicaule).

Table II. A Comparison of Various Chemicals for the Control of Chickweed in Alfalfa.

Treatment Per Acre	Date of Application	Diluent Gallons H_2O per Acre	Temp. at Time of Treatment F°	Chickweed *	Alfalfa **
1 1/2 gal. Sinox W	10/10	75	50	5	36
1/2 gal. Sinox PE	10/10	75	50	5	35
22 lbs. Sodium Cyanate	10/10	75	50	22	24
22 lbs. Potassium Cyanate	10/10	75	50	27	26
1 1/2 gal. Sinox W + 3 lbs. E.H. #1	10/10	75	50	1	22
Check				36	35
L.S.D. .05				7.00	5.77
.01				9.95	8.21

* 36 = No control
0 = Complete control

** 36 = No damage
0 = Complete loss of stand

Summary

Sinox W at 1/2 gallon per acre in 25 gallons of water when applied either in October or November caused a significant reduction in the stand of chickweed but did not prevent regrowth.

The use of Sinox W at 1 gallon per acre applied with 50 gallons of water gave excellent control of chickweed in both the October and November treatments. The October application caused more leaf burn of the alfalfa than did the November treatments. This did not cause a significant reduction in the alfalfa stand.

February and March applications caused some surface burning at the 1 and 2 gallon per acre rates but in all cases were less effective than the fall applications.

Sinox PE and Sinox W produced a nearly complete control of chickweed when sprayed in November at 1/2 and 1 1/2 gallons per acre respectively. At the rates used potassium cyanate, sodium cyanate, and E.H. No. 1 gave good control of chickweed but caused serious injury to the alfalfa.

Literature Cited

1. Raleigh, S.M. Control of Chickweed in Alfalfa. Northeastern Weed Control Conference Proceedings, 6: 257-258, 1950.

2. Muzik, T.J. et al. A Method for Statistical Evaluation of New Herbicides, Agron. Jour. 44: 91-92, 1952.

Acknowledgement

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PASTURE RENOVATION WITH THE AID OF CHEMICALS

M. A. Sprague[1]

The use of chemicals to reduce the need for extensive tillage in preparing a seedbed is a new principle of pasture renovation which shows considerable promise. It involves the replacement of a great deal of tractor power, unconventional and heavy equipment and numerous passages over the field with chemical energy applied in one trip over the field followed by few tillage operations with conventional implements. The principles of good seedbed preparation remain the same, viz., destroying the presently established unwanted plants; providing a firm smooth seedbed, shallow coverage and seed-soil contact, and in addition leaving an evenly distributed trash mulch on the surface to deter erosion.

The new method promises to have some advantages over the conventional method of numerous diskings, some of which are important. A more complete kill of the old grass sod can be accomplished which insures less vegetative regrowth and more than likely will mean a seeding of adapted species will last longer. Large stones, stumps and similar obstructions are less of an obstacle than where tillage is relied upon entirely. Steeper more inaccessable slopes are available where extensive tillage is difficult or hazardous. Competition to developing seedlings from the established sod is reduced to a minimum and some plant pests can be eliminated which tillage will not destroy. Light tillage implements can be used more effectively on a dead sod than on a live one with a lower power requirement to accomplish the surface cultivation required. This means that, where field conditions permit, wider, lighter implements such as the 8-10 foot spring-tooth harrow can be used in place of the narrow (6 foot), heavy cut-away disks or tool-bar implements. This results in quicker passage over the field and accomplishing more acres per day. Smaller clumps of sod are turned which fall apart and crumble easily forming a more uniform seedbed. Band seeding in the dead sod without previous tillage is a promising possibility as a method of "getting the job done" with the least possible immediate outlay of money.

This principle which has been effective in pasture renovation may well find a place in other phases of agriculture. It would appear that certain crop species can be eliminated with temporary sterilants with a minimum of tillage when passing from one to another stage in a rotation. Before we can arrive at this, however, we must have a sterilant effective in killing all species; one which is rapidly lost from the soil; one preferably not poisonous or corrosive to equipment; and a chemical or a combination of chemicals which can be used in either warm or cool seasons.

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Acknowledgment is due Rodney A. Briggs, Extension Associate in Farm Crops, for observations derrived from five 3 to 7 acre pastures renovated with chemicals in 1952.

The method which has been applied successfully on bluegrass pastures in central and northern New Jersey consists of the following steps: (1) Prepare the field for renovation - Choose an area during the spring of the year presently being neglected and which has pasture potential. Test the soil and meet the lime needs as soon as possible. Graze continuously and heavily throughout the spring and early summer. Clip once if necessary in June to prevent any accumulation of top growth around urine spots.

(2) Spray the pasture sod July 15 to 20 with 25 pounds active acid sodium trichloroacetate in 10 or 20 gallons of water mixed with 1/4% of wetting agent and 1/2 pound 2,4-D per acre.

(3) Apply fertilizer prior to the last week of August in accordance with recommendations based on soil tests.

(4) Cultivate, once up and down the slope and once across the slope with a conventional tandem disk harrow, spring-tooth harrow or similar tillage implement during the last week of August (30 to 35 days after spraying). Pull a smoothing harrow behind the implement the last time over the field.

(5) Sow a recommended pasture mixture containing an adapted grass and legume. Use plenty of seed, approximately 10 per cent more than generally recommended on a plowed seedbed, band seed or apply broadcast and roll with a cultipacker roller. Where recommended use up to 1 bushel of oats as a companion crop.

(6) Fence the seeded area against grazing during the fall. Delay grazing the following spring until the new seeding is well established. This generally means start pasturing the first week of May when the grasses reach 8-10 inches high.

Spring seeding following fall preparation of the seedbed has been equally successful. In the event of a spring seeding fertilizers should be applied just prior to one cultivation which should be in the spring of the year. Seeding should be as early as possible after the weather begins to warm up.

A 2 year study in Mercer County gave the results indicated in the attached table and graph. Of particular interest is the excellent establishment of the seeded species on the chemically treated sods with little or no tillage and the comparatively very small percentage of Kentucky bluegrass 2 years after seeding on the areas previously chemically treated. The areas renovated solely with tillage (conventional manner) showed by hand separations 24 per cent of the forage produced was Kentucky bluegrass, whereas only a trace was found in any of the plots treated with the temporary sterilant.

Table 1. Per cent composition of native and seeded species one and two years after chemical renovation and reseeding to orchardgrass and ladino clover in August, 1950.

Pasture Plants	Per Cent Composition by Dry Weight					
	Not Disked		Disked Twice		Disked 7 Times	
	TCA Sprayed	Not Sprayed	TCA Sprayed	Not Sprayed	TCA Sprayed	Not Sprayed
July, 1951						
Orchardgrass Ladino Clover	100.0	13.6	100.0	45.7	100.0	89.1
Kentucky bluegrass	Trace	48.2	Trace	30.2	Trace	10.9
Others	Trace	38.2	Trace	24.1	Trace	Trace
September, 1952						
Orchardgrass Ladino Clover	95.2	37.0	93.6	51.2	98.8	72.8
Kentucky bluegrass	Trace	49.6	Trace	45.0	0.1	24.2
Others	4.8	6.6	6.4	3.7	1.1	3.0

Limitations and Precautions

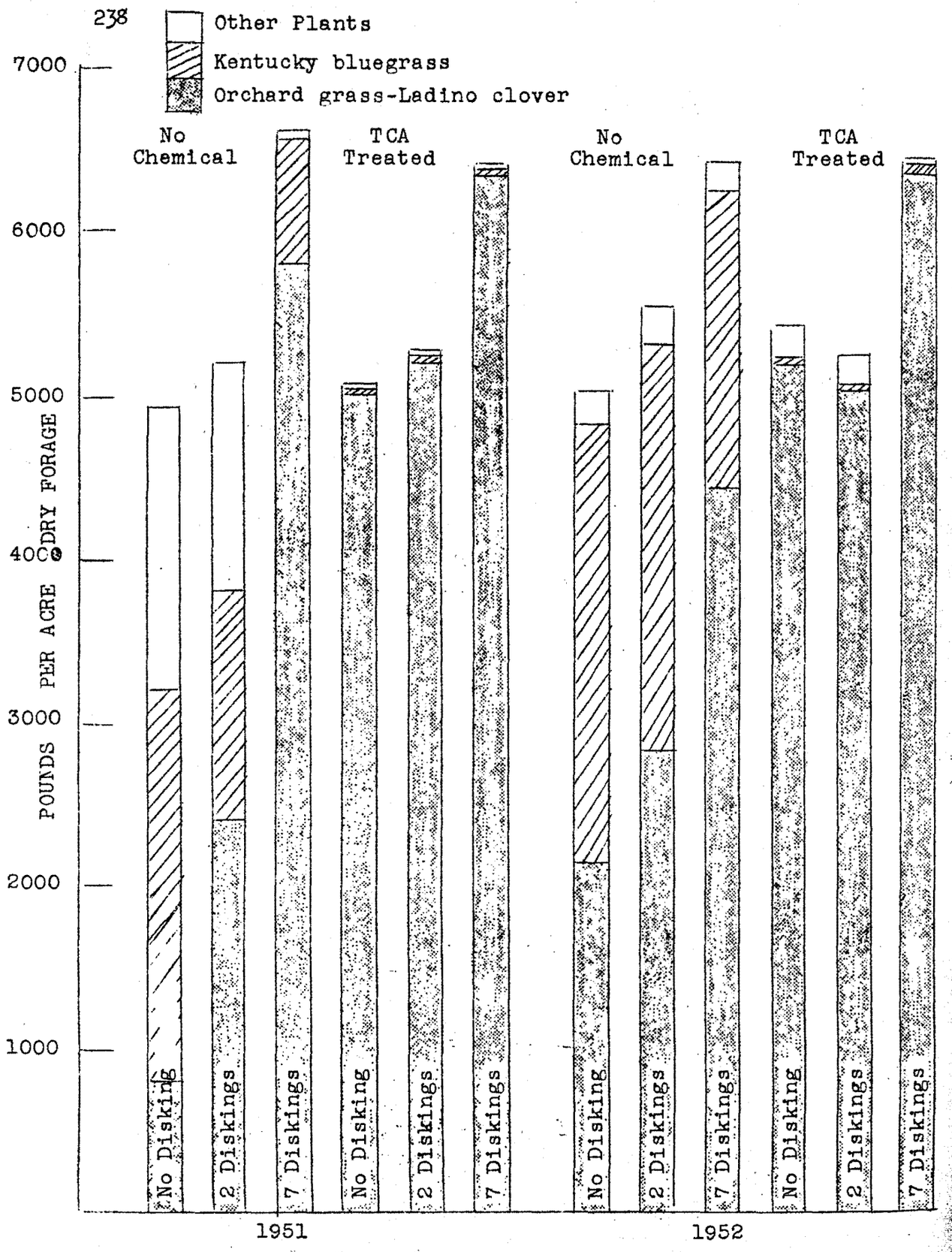
Some precautions are worthy of consideration:

(1) The pasture must be uniformly close-grazed before applying the chemical in order to insure a complete kill with 25 pounds of active acid per acre. On pastures where top growth has accumulated up to 50 pounds are required which adds considerably to the expense of the operation.

(2) Best kill is obtained when TCA is applied in mid-summer rather than in the cooler months of spring and fall. Kentucky bluegrass is most active, vegetatively, during cool moist weather and regrowth is rapidly apparent, particularly following fertilization. Winter applications have been extremely ineffective whereas mid-July and August treatments have been successful.

(3) In New Jersey at least 30 days should be allowed between the time of spraying and time of seeding. This time interval can probably be altered where the rainfall is high and the soil type is characterized by good drainage. In New Jersey one inch of rainfall has been sufficient to leach the material from the silt loam soils used in our trials. One trial during 1952 in Pennsylvania indicated the chemical was still in the soil in toxic concentrations at the time of seeding wheat one month after spraying a sod on a clay soil.*

*J. B. Washko. Personal communication.



Yield of seeded and native species during the first and second years following renovation with and without chemicals and with different amounts of tillage. The native Kentucky bluegrass sod was sprayed with 25# TCA per acre on Aug. 13 and seeded to orchardgrass-ladino clover on Sept. 8. 1950

Rainfall during the interim between chemical application and seeding was considerably less than 1 inch.

(4) Although good seedings have been made on dead sods not cultivated, normally at least one or two tillage operations are required to prepare the seedbed for successful establishment of the new seeding. This covers the seed with soil insuring seed-soil contact vital to germination and emergence and insures complete kill of plants which may have escaped the chemical. In addition, on steep slopes a limited amount of cultivation may prevent excessive runoff and loss of chemical before it can get into the soil to do its work.

(5) Lime and fertilizers must be used to meet the mineral requirements of the crop on these long neglected fields in order to insure rapid establishment and efficient high production.

THE EFFECT OF HERBICIDES UPON POTATOES USED FOR CHIPPING

BY Tom Eastwood, Wise Potato Chip Company and

J. S. Cobb, The Pennsylvania State College

Two experiments were conducted, one with the Rural Russet variety at Camp Potato, Penna., and the other with the Katahdin variety at State College, Penna. The several herbicidal materials, Table I, were applied as a delayed pre-emergence treatment in the Rural Russet experiment, and as a pre-emergence treatment in the Katahdin experiment. All materials, except the $CaCN_2$ which was applied dry, were applied in water at the rate of about 50 gallons per acre.

The Rural Russet potatoes were planted on 1 June 1951, and they were harvested on 21 September 1951. Herbicidal treatments were applied on 18 June 1951.

The Katahdin potatoes were planted on 8 June 1951, and they were harvested on 15 October 1951. Herbicidal treatments were applied on 22 June 1951.

No yield data were secured in the Rural Russet experiment, but yield data and weed counts were obtained in the Katahdin experiment (1).

The Rural Russet potatoes were separated into two lots at harvest. One lot was given chip processing tests at once. The other lot was stored at 54° F. for 6 weeks before being given chipping tests.

Only one lot of the Katahdin tubers were available, which were stored for about 3-1/2 months at about 40° F. before chipping tests were run.

All the potatoes of both varieties were put into curing storage at 70° F. for 6 weeks during the processing tests. Weekly tests were recorded during this period. All test lots comprised a weight of 20 to 25 pounds of tubers at the beginning of the curing period.

Specific gravity measurements of the tubers were determined with the National Potato Chip Institute Potato Hydrometer. Relative reducing sugar content of the tubers was estimated by the standard picric acid method and was expressed in terms of a relative scale of 1 to 5. The chip color was recorded by a scale of 1 to 5 also. Taste tests were ascertained on unsalted chips with a similar scale of 1 to 5, except the first lot of Rural Russet potatoes were taste graded with a scale of 1 to 4.

TABLE I.
SPECIFIC GRAVITY OF RURAL RUSSET POTATOES FROM PLANTS WHICH HAD RECEIVED DELAYED PRE-EMERGENCE HERBICIDAL TREATMENTS[a]

Herbicides		Mean Specific Gravity When Held at Curing Storage at 70°F. 6 Wks.		
Materials	Am't/acre	No Cool Storage	6 Wks. Cool Storage 54°F.	Average
Cyanamid	1200 lbs.	1.0886	1.0887	1.0887
Cyanamid	800 lbs.	1.0884	1.0892	1.0888
CMU	1 lb.	1.0903	1.0903	1.0903
CMU	2 lbs.	1.0879	1.0867	1.0873
Crag Herbicide No. 1	5 lbs.	1.0910	1.0883	1.0897
Crag Herbicide No. 2	5 lbs.	1.0911	1.0913	1.0912
NaTCA	25 lbs.	1.0896	1.0903	1.0900
Premerge[b]	2 gals.	1.0870	1.0893	1.0882
Sinox General (plus 1 pt. oil)	2 qts.	1.0903	1.0912	1.0908
Untreated		1.0924	1.0935	1.0930
LSD (5%)		0.0013	0.0014	0.0025
(1%)		0.0018	0.0019	0.0031
Min. Acceptable Limit		1.0809	1.0808	1.0798

Notes: a. Cyanamid $CaCN_2$
CMU 3-p-chlorophenyl-1-1-dimethylurea
CH-1 sodium 2,4,-dichlorophenoxy ethyl sulfate
CH-2 dichloral urea, 73% WP
Sinox General dinitro-o-sec.-butyl phenol, 50%; and dinitro-o-sec.-amyl phenol, 10%; (equivalent 5.1 lbs. per gal.)
NaTCA sodium trichloroacetate, 90%
Premerge alkanolamine salt (ethanol and isopropanol series) of dinitro-o-sec.-butyl phenol, 53% (equivalent 3 lbs. DNOSBP per gal.)

b. Twice the usual quantity of this herbicide was used for these particular experiments.

Experience soon dictated the change to the 1 to 5 scale. Tuber condition was noted in the scale of 1 to 5, while curing storage losses were in percentage values. (Limited cold storage losses data indicated no effect of the herbicides upon keeping quality.) In all cases where in the grading scale range of 1 to 5 was used, the maximum acceptable value was denoted by the value of 1.

TABLE II
COLOR OF CHIPS PROCESSED FROM RURAL RUSSET POTATOES FROM PLANTS WHICH HAD RECEIVED DELAYED PRE-EMERGENCE HERBICIDAL TREATMENTS

Herbicides		Mean Chip Color When Held at Curing Storage at 70°F. 6 Wks.		
Materials	Am't/acre	No Cool Storage	6 Wks. Cool Storage 54°F.	Average
Cyanamid	1200 lbs.	2.42	2.50	2.46
Cyanamid	800 lbs.	2.42	2.17	2.30
CMU	1 lb.	2.42	2.50	2.46
CMU	2 lbs.	2.28	2.17	2.23
Crag Herbicide No. 1	5 lbs.	1.71	2.00	1.86
Crag Herbicide No. 2	5 lbs.	2.00	2.17	2.09
NaTCA	25 lbs.	2.00	1.83	1.92
Premerge	2 gals.	2.14	2.33	2.24
Sinox General (plus 1 pt. oil)	2 qts.	1.85	2.00	1.93
Untreated		2.00	2.17	2.09
LSD (5%)		0.46	0.49	0.43
(1%)		0.61	0.66	0.53
Max. acceptable limit		2.40	2.43	2.38

TABLE III
TASTE OF CHIPS PROCESSED FROM RURAL RUSSET POTATOES FROM PLANTS WHICH HAD RECEIVED DELAYED PRE-EMERGENCE HERBICIDAL TREATMENTS

Herbicides		Mean Chip Taste When Held at Curing Storage at 70°F. 6 Wks.	
Materials	Am't/acre	No Cool Storage	6 Wks. Cool Storage 54°F.
Cyanamid	1200 lbs.	2.66	2.63
Cyanamid	800 lbs.	2.66	3.13
CMU	1 lb.	1.66	3.75
CMU	2 lbs.	2.00	4.13
Crag Herbicide No. 1	5 lbs.	1.66	3.38
Crag Herbicide No. 2	5 lbs.	2.77	3.63
NaTCA	25 lbs.	3.00	3.25
Premerge	2 gals.	2.66	2.88
Sinox General (plus 1 pt. oil)	2 qts.	1.66	2.75
Untreated		1.33	1.75
LSD (5%)		0.60	1.29
(1%)		0.79	1.71
Max. acceptable limit		2.53	3.13

TABLE IV

RELATIVE REDUCING SUGAR CONTENT OF RURAL RUSSET POTATOES FROM PLANTS WHICH HAD RECEIVED DELAYED PRE-EMERGENCE HERBICIDAL TREATMENTS

Herbicides		Mean Relative Reducing Sugar Content when held at Curing Storage at 70°F. for 6 Weeks		
Materials	Am't/acre	No Cool Storage	6 Wks. Cool Storage 54°F.	Average
Cyanamid	1200 lbs.	1.28	1.00	1.14
Cyanamid	800 lbs.	1.28	1.00	1.14
CMU	1 lb.	1.28	1.17	1.23
CMU	2 lbs.	1.42	1.00	1.21
Crag Herbicide No. 1	5 lbs.	1.00	1.00	1.00
Crag Herbicide No. 2	5 lbs.	1.14	1.00	1.07
NaTCA	25 lbs.	1.57	1.00	1.29
Premerge	2 gals.	1.28	1.17	1.23
Sinox General (plus 1 pt. oil)	2 qts.	1.42	1.00	1.21
Untreated		1.28	1.00	1.14
LSD (5%)		0.49	0.22	0.32
(1%)		0.64	0.29	0.39
Max. acceptable limit		2.43	2.19	2.28

TABLE V

TUBER CONDITION AND % CURING STORAGE LOSSES OF RURAL RUSSET POTATOES FROM PLANTS WHICH RECEIVED DELAYED PRE-EMERGENCE HERBICIDAL TREATMENTS

Herbicides		Mean Tuber Condition and % Storage Losses When Held at Curing Storage at 70°F. for 6 Weeks					
Materials	Am't/acre	No Cool Storage		6 Wks. Cool 54°F.		Average	
		Tuber Cond.	% Loss	Tuber Cond.	% Loss	Tuber Cond.	% Loss
Cyanamid	1200 lbs.	1.00	10	1.00	6	1.00	8
Cyanamid	800 lbs.	1.00	11	1.00	8	1.00	10
CMU	1 lb.	1.00	8	1.29	6	1.15	7
CMU	2 lbs.	1.00	10	1.14	6	1.07	8
Crag Herbicide No. 1	5 lbs.	1.00	9	1.00	7	1.00	8
Crag Herbicide No. 2	5 lbs.	1.00	13	1.29	9	1.15	11
NaTCA	25 lbs.	1.00	5	1.00	6	1.00	6
Premerge	2 gals.	1.00	8	1.00	8	1.00	8
Sinox General (plus 1 pt. oil)	2 qts.	1.00	6	1.14	6	1.07	6
Untreated		1.00	6	1.29	9	1.15	8
LSD (5%)		-	-	0.42	-	0.21	4
(1%)		-	-	0.56	-	0.27	5
Max. acceptable limit		2.00	-	2.37	-	2.18	16

TABLE VI.
MEAN VALUES FOR TUBER AND CHIP PROCESSING DATA OF KATAHDIN POTATOES FROM PLANTS WHICH HAD RECEIVED PRE -EMERGENCE HERBICIDAL TREATMENTS

Herbicides		Mean Data For 6 Wks. Curing Storage 70°F					
Materials	Am't/acre	Specific Gravity	Rel.Red. Sugar	Chip Color	Chip Taste	Tuber Cond.	% Loss
Cyanamid	1200 lbs.	1.0774	1.71	2.71	3.31	1.38	11
Cyanamid	800 lbs.	1.0811	1.57	2.71	2.88	1.13	7
CMU	1 lb.	1.0764	2.57	3.29	3.25	1.00	7
CMU	2 lbs.	1.0771	2.00	3.00	3.69	1.13	9
Crag Herbicide No. 1	5 lbs.	1.0814	1.57	2.29	2.88	1.00	7
Crag Herbicide No. 2	5 lbs.	1.0809	1.86	2.86	3.00	1.00	8
NaTCA	25 lbs.	1.0760	2.00	3.43	4.50	1.00	9
Premerge	2 gals.	1.0807	1.86	2.86	3.88	1.00	7
Sinox General (plus 1 pt. oil)	2 qts.	1.0799	1.57	2.86	3.81	1.00	7
Untreated		1.0837	1.57	2.43	2.56	1.00	7
LSD (5%)		0.0019	0.65	0.59	0.28	0.23	-
(1%)		0.0025	0.86	0.78	0.37	0.31	-
Acceptable limit		1.0803 (Min.)	2.57 (Max.)	2.52 (Max.)	2.26 (Max.)	2.20 (Max.)	-

SUMMARY AND CONCLUSIONS

The specific gravity of the potato tubers was reduced in all cases by the use of the herbicidal materials in the field as a pre-emergence application with both varieties. These reductions were significant in every instance. The dry matter content of the tubers of the Rural Russet variety was not decreased below acceptable limits, but it was in several cases for the Katahdin variety.

Herbicidal effects upon the color of the processed chips were somewhat variable. Only one material produced consistent off-color on both varieties. This was the CMU at the rate of 1 pound per acre. For reasons unknown the 2 pound rate of this compound did not cause significant color changes in the potato chips.

Definite off-flavors in the chips were caused by the application of pre-emergence herbicides upon the potato field. All materials, except one, caused off-flavors in both varieties. Sinox General caused no flavor change in the Rural Russet chips, but it did in the Katahdin chips.

No definite alterations in the relative reducing sugar content of the tubers were observed as a result of use of the herbicidal materials. CMU at the acre rate of 1 pound caused increased reducing sugar content in the tubers of the Rural Russet variety.

In general the herbicides exercised no particular influence upon the keeping quality of the tubers under curing storage conditions. However, the 1200 pound per acre application of Cyanamid did cause an apparent increase in storage loss in the Katahdin potatoes.

The observations reported here should stimulate work in the study of the effect of the various herbicides used both commercially and experimentally on potatoes upon the eating quality of the tubers, and in particular upon the eating quality of the processed potatoes such as potato chips. In other words the internal quality of the treated potatoes is of important concern as well as the efficacy of the herbicide as a weed control agent and its effect upon the yield of marketable tubers.

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POTASSIUM CYANATE DUST FOR THE CONTROL OF CRABGRASS[1]

Lee W. Bannerman, Ralph E. Engel and Richard J. Aldrich[2]

Introduction

The objective of this investigation was to study the effectiveness of potassium cyanate dusts for crabgrass control. In tests conducted at Rutgers University during the summer of 1951 it was found that a 10 per cent potassium cyanate dust was more effective than the more concentrated 25 per cent potassium cyanate dust; also that the addition of a wetting agent to 25 per cent potassium cyanate dusts significantly increased the degree of crabgrass control. These results suggested that dilute formulations of potassium cyanate dusts containing a wetting agent would be an effective material for control of crabgrass. The work done this summer and presented here includes studies of dilute formulations of potassium cyanate dusts and the incorporation of wetting agents with these dusts.

Materials and Methods

This paper includes the results of three separate crabgrass tests conducted at Rutgers University during the summer of 1952. The tests were conducted during the month of August and the first week in September. The growing conditions were favorable with warm temperatures and a high soil moisture content. All tests were located on a predominantly Kentucky bluegrass turf in the vicinity of the Rutgers Golf Course. Application of the dust was by means of a small insecticide duster and the time of treatment was early in the morning to take advantage of the usually wet turf and low wind velocities. All treatments were repeated three times at approximately one week intervals. The experimental design was a randomized block with three replications. Plots were 5 by 15 feet, and 4 by 15 feet were treated leaving a one foot strip in each plot as a check to enable evaluation of the degree of crabgrass control. Five individual estimates of per cent crabgrass control were used to evaluate the treatments. These ratings were made on the basis of 0 for no control and 100 for complete control. Turf injury ratings were not made since none of the dust treatments this summer resulted in any noticeable damage to the

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turf grasses. The 5 per cent dusts in all three tests were prepared by diluting an American Cyanamid formulation of 25 per cent dust with attaclay. The various wetting agents were added to the 5 per cent potassium cyanate dusts in ratios to provide the appropriate rates per acre.

In Test 1 (table 1) the 5 per cent potassium cyanate dust was tested at 8 and 16 pounds per acre with and without the wetting agent Nekal BX and 5 and 10 pounds per acre. The wetting agent Nekal BX was also applied alone at 5 and 10 pounds per acre.

In Test 2 (table 2) the 5 per cent potassium cyanate dust was tested at 8 and 16 pounds per acre with the wetting agent N-185 at 5 and 10 pounds per acre. The 8 pounds of potassium cyanate and 10 ounces of phenyl mercury acetate sprays were applied in 40 gallons of water per acre.

In Test 3 (table 3) the 5 per cent potassium cyanate dust was tested at 16 pounds per acre with and without the wetting agents A-400, N-185 and Nekal BX at 5 pounds per acre. Milorganite containing 3 per cent potassium cyanate and American Cyanamid formulations of 5 per cent and 25 per cent dust were included in this test.

Discussion

As seen in Table 1 the 16 pound treatment plus 5 pounds of Nekal BX resulted in significantly better control than the 16 pound treatment without a wetting agent. At the eight pound level the trend was toward better control with the addition of a wetting agent, however, the difference was not significant. The two treatments which included Nekal BX alone at five and ten pounds per acre were not significantly different than the plots which received no treatment.

The results in Table 2 show that 16 pounds of potassium cyanate dust plus five pounds of N-185 gave the best crabgrass control, however, this treatment was not significantly better than the 16 pounds of potassium cyanate dust alone. The 8 pound potassium cyanate dust treatments gave as good control of crabgrass as did 8 pounds of potassium cyanate applied as a solution. In contrast to the dust treatments in this test the 8 pounds of potassium cyanate applied as a solution resulted in noticeable discoloration of the turf. Phenyl mercury acetate in this test gave no crabgrass control.

The 16 pounds of potassium cyanate dust plus 5 pounds of Nekal BX, as shown in table 3, gave the best crabgrass control and was significantly better than 16 pounds of 25 per cent potassium cyanate dust and also the 16 pounds of potassium cyanate milorganite treatment. With the 5 per cent dusts in this test the addition of a wetting agent did not affect crabgrass control.

Table 1. Crabgrass control obtained with 5 per cent potassium cyanate dusts applied with and without two rates of wetting agent.

Pounds of potassium cyanate per acre	Pounds of Nekal BX per acre	Average estimated per cent control	Transformed[1] to degrees
16	5	83.3	197.9
16	10	75.7	182.9
16	None	64.0	159.5
8	10	46.0	127.3
8	5	36.0	108.7
8	None	34.6	102.2
None	5	2.0	20.0
None	10	1.0	10.0
Check	None	1.0	10.0
L.S.D. .05			36.8
.01			44.6

[1]Transformed to degrees according to Fisher's formula: $P = \sin^2\phi$ (1).

Table 2. A comparison of crabgrass control obtained with 5 per cent potassium cyanate dusts and recommended sprays of potassium cyanate and phenyl mercury acetate.

Chemical treatment and rate per acre	Average estimated per cent control	Transformed[1] to degrees
5 per cent potassium cyante dust		
16 pounds - 5 pounds N-185	91.0	217.8
16 " - 10 pounds N-185	79.6	196.6
8 " - 10 pounds N-185	67.3	166.3
8 " - 5 pounds N-185	67.3	166.3
Potassium cyanate spray[2] 8 pounds - wetting agent	67.3	166.3
Phenyl mercury acetate spray 10 oz. - no wetting agent[2]	0.0	0.0
Check	4.0	27.5
L.S.D. .05		36.3

[1]Transformed to degrees according to Fisher's formula: $P = \sin^2\phi$ (1)

[2]Chemical applied in 40 gallons of water per acre.

Table 3. Crabgrass control obtained with various potassium cyanate dusts applied with and without wetting agents.

Pounds of potassium cyanate per acre	Concentration of dust	Wetting agent and pounds per acre	Average estimated per cent control	Transformed to degrees[1]
16	5%	Nekal BX 5	90.5	216.4
16	5%	None	87.1	212.6
16	5%	A-400 5	87.1	208.8
16	5%	N-185 5	85.8	205.3
16	5%	None	85.3	203.0
16 A.C.C.[2]	5%	None	81.9	195.8
16	5%	None	79.9	190.2
16 A.C.C.	25%	None	77.5	185.1
16 Milcyanate[3]	3%	None	74.9	181.8
Check			0.0	0.0
L.S.D. .05				27.8

[1]Transformed to degrees according to Fisher's formula:
$P = \sin^2\phi$ (1)

[2]Chemical formulated by American Cyanamid Company.

[3]Chemical formulated by Sewerage Commission, Milwaukee, Wis.

Summary

The 5 per cent potassium cyanate dust applied at the rate of 16 pounds per acre resulted in generally satisfactory crabgrass control in all tests conducted. These 5 per cent dusts applied to turf for crabgrass control resulted in slight injury to the turf grasses. The incorporation of wetting agents increased the effectiveness of the 5 per cent dust in some tests; however, the increased effectiveness was not evident in all tests. It appears that with proper formulation, potassium cyanate dust will effectively control crabgrass in bluegrass turf.

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Studies With Endothal For Clover Control in Turf

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In 1950 Nutter, Cornman and Fertig (1) observed that plots treated for crabgrass control with disodium 3,6-endoxahexahydrophthalate, commonly called Endothal, were entirely free of white clover (Trifolium repens). Further experimentation during 1950 and 1951 (2) clearly showed that Endothal was a specific control for white clover.

An effective method of controlling clover especially in sport's turf has been sought for many years. Since Endothal has given such promising results, two liquid formulations were tested at the Rhode Island Agricultural Experiment Station during the summer of 1952 to determine its effectiveness under local conditions.

Method and Materials

The experimental area was located on lawn turf composed of Chewing's fescue, Kentucky bluegrass and Colonial bentgrass mowed to a height of 1½ inches. Although the infestation of clover varied throughout the area, there was a sufficient amount in each plot to determine the effect of the treatments.

Individual plots were 5 feet by 10 feet. The treatments were in duplicate and randomized within each of 2 blocks.

The treatments consisted of formulation F-4069, containing 2/3 pound of Endothal and 3 1/3 pounds of ammonium sulfate per gallon, applied at rates of ¼, ½ and 1 pound of actual Endothal per acre and formulation F-3003, containing 2 pounds of Endothal per gallon, applied at ½, 1 and 2 pounds of actual Endothal per acre. Each treatment was applied in water at rates of 25, 50 and 100 gallons per acre. One application only was made-July 21, 1952.

A Co_2 pressure-type sprayer equipped with a Tee-jet fan type nozzle was used to apply the materials. It was necessary to make two changes, one in size of the orifice and the other was in the time allotted to apply the treatments at the various rates of water used.

Plant notes taken were based on the percent of area covered by clover before the treatments were applied, two weeks after, and three months after application. Discoloration notes were taken one and two weeks after treatment.

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[2]Assistant Agronomist and Agronomist, respectively.

Results

The results in table 1 show that F-4069 was not highly effective in eliminating clover at the rates used. There was a reduction in clover immediately following the treatments but on many plots some recovery of clover occurred. This may be noted in table 1 by comparing the clover present three months after treatment with that present two weeks after treatment.

There was no apparent correlation between the amounts of water used as carriers for the three rates of F-4069 and the degree of control or amount of discoloration of the desirable grasses. At the ¼ and ½ pound rates medium discoloration resulted but the grasses had regained normal color by the second week following the treatments. Discoloration was greatest at the one pound rate but no permanent injury was noted.

Formulation F-3003 was highly effective against clover at the two pound rate. These results are presented in table 2. Two pounds applied in 100 gallons of water per acre gave slightly better control than the same amount applied in 25 and 50 gallons of water. Control at light rates, except at the one pound rate applied in 50 and 100 gallons, was mediocre.

In general, control was better when the treatments were applied in 50 and 100 gallons of water but there was slightly more discoloration with the 100 gallon rate of water. However, the rate of F-3003 had more influence on discoloration than did the amount of water. Discoloration ranged from slight at the ½ pound rate to temporary injury at the 2 pound rate.

Table 1. Control of clover in turf grasses with a liquid formulation (F-4069) of Endothal.

Material	Pounds of Endothal per acre	Gallons of water per acre	% Clover before trt.	% Clover 2 wks. After trt.	% Clover 3 mos. after trt.	% Control	Discoloration* 1 wk. after trt.	Discoloration* 2 wks. after trt.
F-4069	¼	25	7	2	2	71	2	1
" "	"	50	8	4	7	13	2	1
" "	"	100	10	5	5	50	1	0
" "	½	25	6	1	3	50	1	1
" "	"	50	10	3	4	60	2	1
" "	"	100	8	2	2	75	2	1
" "	1	25	13	3	8	38	3	2
" "	"	50	18	2	4	78	4	3
" "	"	100	6	2	3	50	3	3
Check	-	-	12	12	15	0	0	0

*Discoloration index - 0=none, 1=slight, 2=medium, 3=severe, 4=temporary injury.

Table 2. Control of clover in turf grasses with a liquid formulation (F-3003) of Endothal.

Material	Pounds of Endothal per acre	Gallons of Water per acre	% Clover before trt.	% Clover 2 wks. after trt.	% Clover 3 mos. after trt.	% Control	Discoloration* 1 wk. after trt.	Discoloration* 2 wks. after trt.
F-3003	½	25	9	3	8	11	1	0
" "	"	50	7	1	3	57	1	1
" "	"	100	10	3	5	50	2	1
" "	1	25	18	2	7	61	3	3
" "	"	50	14	1	2	86	2	2
" "	"	100	5	trace	1	80	3	2
" "	2	25	17	trace	1	94	4	3
" "	"	50	10	trace	1	94	2	2
" "	"	100	12	trace	-1	98	4	4
Check	-	-	12	12	15	0	0	0

*Discoloration index - 0=none, 1=slight, 2=medium, 3=severe, 4=temporary injury.

A comparison between the 1 pound treatments of F-4069 and the 1 pound treatments of F-3003 showed that the F-3003 formulation gave better control and that herbicidal activity was not increased by the addition of ammonium sulfate in the F-4069 material.

Summary and Conclusions

Two formulations of Endothal, F-4069 containing ammonium sulfate, and F-3003, were tested for the control of white clover in lawn turf at the Rhode Island Agricultural Experiment Station during the 1952 season. Formulation F-4069 was applied at rates of ¼, ½ and 1 pound of actual Endothal per acre, and F-3003 at rates of ½, 1 and 2 pounds per acre. Each treatment was applied in 25, 50, 100 gallons of water per acre. One application was made on July 21, 1952.

Formulation F-3003 applied at the rate of 2 pounds per acre was the most effective treatment but caused severe discoloration of a temporary nature.

The different amounts of water, 25, 50 and 100 gallons, used as carriers for the treatments did not appear to influence the degree of control or the amount of discoloration. The addition of ammonium sulfate did not increase the herbicidal activity of formulation F-4069.

Acknowledgements

The authors wish to express their appreciation to the Niagara Chemical Division of the Food Machinery and Chemical Corporation for supplying the test materials used in this study.

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CHEMICALS FOR THE CONTROL OF CRABGRASS IN PUTTING-GREEN TURF[1/]

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It has been repeatedly observed at the Rhode Island Agricultural Experiment Station that the early control of crabgrass aided in maintaining a desirable stand of grass during the most difficult part of the growing season. The material found most satisfactory as a pre-emergence treatment as well as a successful control for immature crabgrass has been phenyl mercuric acetate (1) (2). Two comparatively new chemicals, dichloral urea and n-1 naphthyl phthalamic acid, have been reported (3) as effective controls for crabgrass when applied before or at the time of seed germination.

During the summer of 1952 a pre-emergence and post-emergence experiment was conducted at the Rhode Island Agricultural Experiment Station to compare the herbicidal properties of dichloral urea and n-1 naphthyl phthalamic acid with PMAS and Scutl for the control of crabgrass on putting-green turf.

Methods and Materials

A. Pre-emergence experiment:

The experimental areas were located on a planting of Piper velvet bentgrass and Toronto creeping bentgrass made in 1946 and maintained under putting-green conditions. Infestations of crabgrass have been serious on the velvet bent plots for several years but on the Toronto plot previous infestations of crabgrass have been light.

The plot plan used was the same for both areas. It consisted of 5 rows of plots each containing 10 plots 5 x 5 feet. There were eight treatments and two checks randomized within each row of plots.

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

1. E.H. 2 (73% dichloral urea) 2 and 4 pounds of actual ingredient per acre.
2. 5-6Q8 (90% N-1 naphthyl phthalamic acid) 1 and 2 pounds of actual ingredient per acre.
3. Scutl (0.75% phenyl mercuric acetate) Scott's spreader settings number 5 and 6. At these settings approximately 1.7 and 2.5 pounds of Scutl were applied per 1,000 square feet, respectively.
4. PMAS (10% phenyl mercuric acetate) 3/4 and 1 1/4 ounces per 1,000 square feet.

1/Contribution No. 817 of the R. I. Agr. Exp. Sta., Kingston, R. I.
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E. H. 2, 5-6Q8, and PMAS were mixed with water at the rate of 2½ gallons of water per 1,000 square feet and applied with a 15 gallon power sprayer. Scutl, which is phenyl mercuric acetate impregnated in vermiculite, was applied with a Scott's spreader.

The first application was made on June 4, 1952 before any crabgrass was visible and was followed by six more applications of each chemical at 10-day intervals. Shortly after the first application was made, seedling crabgrass plants were observed. Discoloration notes were taken 7 days following each application. Crabgrass notes were taken after the fourth and seventh treatments and recorded as estimates of the percent of area covered by crabgrass. The percent crabgrass figures given in table 1 and 2 are averages determined from the 5 replicates of each treatment. The percent control figures for each treatment are based on the difference between the amount of crabgrass on the treated plots and that on the checks.

B. Post-emergence experiment:

The experimental area consisted of a planting of Seaside creeping bent made in 1947. It was adjacent to the velvet bent plots and was also maintained under putting-green conditions. The plot plan was similar to that described for the pre-emergence experiment except that there were 9 treatments instead of 8.

It was originally planned to test all materials used in the pre-emergence study on established crabgrass, however, results obtained with E. H. 2 and 5-6Q8 did not seem to justify further investigation. Two phenyl mercurials were included in the post-emergence study.

In the pre-emergence experiment on velvet bent Scutl caused objectionable discoloration and some injury. In an attempt to overcome this disadvantage the following methods were used in applying Scutl: (1) at setting number 5, applications were made on dry grass, on wet grass, and on dry grass and then washed in with water, and (2) applications at setting number 6 were made on dry grass, and on dry grass and then washed in with water.

The liquid phenyl mercury, PMAS, was applied at rates of 1 and 1¼ ounces in 5 and 10 gallons of water per 1,000 square feet with a 15 gallon power sprayer. The object was to determine what effect different rates of PMAS with different amounts of water as a carrier had on crabgrass control and on turf discoloration.

At the time the first treatments were applied on July 2, crabgrass was in the early crab-stage of growth. Six applications were made at 7-day intervals. Crabgrass notes taken included only the percent of area covered by crabgrass before the first treatments were applied and at the finish of the experiment. The percent crabgrass figures and the discoloration rates in table 3 are the averages of the five replicates of each treatment. Percent control was determined by comparing the amount of crabgrass present at the start of the experiment with that remaining after the experiment was terminated.

Results

A. Pre-emergence experiment:

The results in table 1 show that the phenyl mercurials, PMAS and Scutl, were the most effective treatments for the control of crabgrass in velvet bent turf.

PMAS at both the 3/4 and 1 1/4 ounce rates gave consistently good control of crabgrass throughout the experiment, although the control at the 1 1/4 ounce rate was slightly better than at the 3/4 ounce rate. Discoloration of velvet bent was slight after each of the first three treatments at both rates, but little or no discoloration was observed from later treatments.

Scutl at both rates also gave consistently effective control of crabgrass but was more prone to discolor and injure the velvet bent than was the liquid mercury formulation. The first two treatments of Scutl at both rates were applied on wet grass in the early evening. The discoloration was so severe on plots treated at the heavy rate that subsequent applications were made on dry grass. Although there was a noticeable reduction in discoloration it was apparent that velvet bent was susceptible to discoloration by the Scutl treatments due probably to the dense growth which held most of the vermiculite particles in contact with the leaf blades.

The heavy rate (4 lbs. per acre) of E. H. 2 (dichloral urea) apparently eliminated many crabgrass plants in the seedling stage but had little effect on those plants that survived the initial treatments. This is shown in table 1 by the large increase in area covered by crabgrass following the fourth treatment. After the third application of E. H. 2 at the heavy rate, isolated discolored areas were observed. These discolored areas persisted and the grass showed no signs of recovery one month after the treatments were terminated. At the light rate of 2 pounds per acre, E. H. 2 was relatively ineffective on seedling crabgrass. The grass was not injured at the light rate but some discoloration was noted.

There was no evidence of crabgrass control even in the seedling stage on plots treated at both rates with 5-6Q8 (n-1 naphthyl phthalamic acid). The velvet bent turned a yellowish green color after the second treatment and did not grow as fast as the checks. The chemical appeared to act as a growth inhibitor on the velvet bent but not on crabgrass, as indicated by the greater amount of crabgrass on the treated plots when compared to that on the check. After the treatments were terminated, the grasses appeared to recover satisfactorily.

The results obtained on Toronto creeping bent are presented in table 2. Although the amount of crabgrass on the treated plots and checks was exceedingly light the results followed the same general pattern as those obtained on velvet bent. The mercurials were again the most effective treatments. Toronto creeping bent was not as susceptible to injury and discoloration from the Scutl treatments as was the Piper velvet bent. Scutl did not injure and caused only medium discoloration on Toronto.

The light rate of E. H. 2 and both rates of 5-6Q8 did not reduce the crabgrass population. At the heavy rate, E. H. 2 caused a reduction in crabgrass, but it again injured the desirable grass.

Table 1. Control of crabgrass by applying chemicals on velvet bentgrass putting-green turf before crabgrass was visible and repeating the treatments at ten day intervals.

Material	Rate	% Crab after 4 trts.	% Control	% Crab after 7 trts.	% Control	*Discoloration 7 days after 1st trt.	2nd trt.	3rd trt.	4th trt.	5th trt.	6th trt.	7th trt.
Dichloral urea	2 lbs/A	8	33	30	12	0	1	1	1	1	0	0
Dichloral urea	4 lbs/A	2	83	20	41	0	1	4	4	4	4	4
PMAS	3/4 oz/M	1	92	2	94	1	1	1	0	0	0	0
PMAS	1 1/4 oz/M	Trace	99	Trace	99	1	1	1	0	0	0	0
N-1 phthalamic acid	1 lb/A	11	8	50	0	0	0	1	1	1	0	0
N-1 phthalamic acid	2 lbs/A	12	0	59	0	0	0	1	1	1	0	0
Scutl	1.7 lb/M**	1	92	1	97	1	2	2	2	2	2	2
Scutl	2.5 lb/M***	Trace	99	1	97	1	3	3	2	2	2	2
Check	-	12	-	34	-	0	0	0	0	0	0	0

*Discoloration index - 0 = none, 1 = slight, 2 = medium, 3 = severe, 4 = injury
**Applied with Scott's spreader at setting number 5
***Applied with Scott's spreader at setting number 6

Table II. Control of crabgrass by applying chemicals on Toronto creeping bentgrass putting-green turf before crabgrass was visible and repeating the treatments at ten day intervals.

Material	Rate	% Crab after 4 trts.	% Control	% Crab after 7 trts.	% Control	*Discoloration 7 days after 1st trt.	2nd trt.	3rd trt.	4th trt.	5th trt.	6th trt.	7th trt.
Dichloral urea	2 lbs/A	1	50	4	0	0	1	1	1	0	0	0
Dichloral urea	4 lbs/A	-1	90	1	75	0	1	2	3	3	3	3
PMAS	1 oz/M	Trace	96	Trace	98	0	1	0	0	0	0	0
PMAS	1 1/4 oz/M	Trace	96	Trace	98	1	1	1	1	1	1	0
N-1 phthalamic acid	1 lb/A	3	0	10	0	0	0	0	0	0	0	0
N-1 phthalamic acid	2 lbs/A	1	50	10	0	0	0	0	1	1	0	0
Scutl	1.7 lbs/M**	Trace	96	Trace	98	0	1	1	0	2	2	1
Scutl	2.5 lbs/M***	Trace	96	Trace	98	0	2	2	1	1	1	2
Check	-	2	-	4	-	0	0	0	0	0	0	0

*Discoloration index - 0 = none, 1 = slight, 2 = medium, 3 = severe
**Applied with Scott's spreader at setting number 5
***Applied with Scott's spreader at setting number 6

B. Results of post-emergence experiment:

All PMAS and Scutl treatments, gave excellent control of crabgrass on the Seaside bent area. Many of the plots were entirely free of all crabgrass plants.

The ounce rate of PMAS was equally as effective as the 1 1/4 ounce rate. The amounts of water, 5 and 10 gallons per 1,000 square feet, did not appear to influence the degree of control or discoloration. Scutl eliminated crabgrass at both rates but caused medium discoloration when applied at setting number 5 on wet grass and at setting number 6 on dry grass. Applications made at the heavy rate on dry grass and then washed in did not discolor until after the last treatment was applied. Scutl applied at setting number 5 on dry grass, and on dry grass and then washed in, did not cause any visible discoloration.

Summary

Pre-emergence and post-emergence experiments were conducted during the summer of 1952 at the Rhode Island Agricultural Experiment Station with chemicals for the control of crabgrass in putting-green turf. Chemicals used in the pre-emergence experiments on Piper velvet bent and Toronto creeping bent included PMAS (a 10 percent formulation of phenyl mercuric acetate), Scutl (phenyl mercuric acetate impregnated in vermiculite), E. H. 2 (dichloral urea) and 5-6Q8 (n-1 naphthyl phthalamic acid). PMAS and Scutl were used in the post-emergence experiment on Seaside creeping bent.

A. Pre-emergence experiment:

The phenyl mercurials, PMAS and Scutl, were the most effective treatments in this study. The 1¼ ounce rate of PMAS was only slightly superior to the 3/4 ounce rate, however, both treatments gave excellent control. Scutl used at Scott's spreader settings number 5 and 6 controlled crabgrass satisfactorily but caused objectionable discoloration when applied on velvet bent and medium discoloration on Toronto creeping bent.

E. H. 2 (dichloral urea) at the rate of 2 and 4 pounds of actual ingredient per acre and 5-6Q8 (n-1 naphthyl phthalamic acid) at 1 and 2 pounds of actual ingredient per acre did not control crabgrass satisfactorily. E. H. 2 at the heavy rate injured both velvet bent and Toronto creeping bent. At both rates 5-6Q8 inhibited growth of the desirable grasses but did not cause any permanent injury.

B. Post-emergence experiment:

All PMAS and Scutl treatments effectively eradicated crabgrass. Control at the 1 ounce rate of PMAS was equally as effective as the 1¼ ounce rate. There was no difference in crabgrass control or turf discoloration when the material was applied in 5 or in 10 gallons of water per 1,000 square feet. Scutl applied at setting number 5 on dry grass, and on dry grass and then washed in, did not discolor the Seaside creeping bent. However, Scutl applied at setting number 5 on wet grass, and at setting number 6 on dry grass, and on dry grass and then washed in, caused medium discoloration.

Table III. Control of immature crabgrass by treating Seaside creeping bentgrass putting-green turf with two phenyl mercuric acetate preparations.

Material	Rate per 1000 sq. ft.	Method of Application	% Crab before trt.	% Crab after 6 trts.	% Control	*Discoloration 7 days after 1st trt.	2nd trt.	3rd trt.	4th trt.	5th trt.	6th trt.
PMAS	1 oz.	5 gal. H_2O	4	Trace	98	0	0	0	1	0	0
PMAS	1¼ oz.	5 gal. H_2O	8	Trace	99	0	0	0	0	0	0
PMAS	1 oz.	10 gal. H_2O	11	Trace	99	0	0	0	0	0	0
PMAS	1¼ oz.	10 gal. H_2O	11	Trace	99	0	0	0	0	0	1
Scutl	1.7 lbs.**	Applied on dry grass	12	Trace	99	0	0	0	0	0	0
Scutl	1.7 lbs.	Applied on wet grass	7	Trace	99	0	0	0	0	2	3
Scutl	1.7 lbs.	Applied on dry grass and washed in	8	Trace	99	0	0	0	0	0	0
Scutl	2.5 lbs.***	Applied on dry grass	7	Trace	99	0	0	0	0	1	2
Scutl	2.5 lbs.	Applied on dry grass and washed in	9	Trace	99	0	0	0	0	0	2
Check			13	22	0	0	0	0	0	0	0

*Discoloration index - 0 = none, 1 = slight, 2 = medium, 3 = severe
**Applied with Scott's spreader at setting number 5
***Applied with Scott's spreader at setting number 6

Conclusions

As a pre-emergence treatment, repeated applications at intervals of 10 days with 3/4 ounces of PMAS (10%) per 1,000 square feet appeared to be a satisfactory method of crabgrass control on putting-green turf.

As a post-emergence treatment for the control of immature crabgrass in putting-green turf, repeated treatments with 1 ounce of PMAS (10%) per 1,000 square feet applied at 7 day intervals provided satisfactory control.

Scutl appeared promising as a method of controlling crabgrass on putting-green turf either as a pre-emergence or post-emergence treatment. Further testing is necessary to determine rates and methods of application best suited for the various types of putting green grasses.

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A SUMMARY OF FOUR YEARS RESULTS ON CRABGRASS CONTROL IN ONTARIO

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Investigations in the control of crabgrass (Digitaria spp.) in lawns have been carried on at the Ontario Agricultural College since 1949. An abstract was submitted to the N.C.W.C.C. by Bibbey covering the 1949 results. A report was submitted by Waywell and Bibbey on the results obtained during the 1950 season to the N.E.W.C.C. This report is a consolidation of these results with those obtained during the past two seasons.

In 1949 PMA at the rate of 3 oz. of product (1.2% mercury equivalent) per 3 gallons per square rod gave good control of crabgrass when two or three applications were made at 7 to 10 day intervals. Potassium cyanate at 1.6 oz. per gallon (1.0%) per square rod gave almost 100% control of crabgrass with one treatment but the lawn grass (Kentucky Blue grass) was burned severely, although it recovered in 7 to 10 days. The addition of a wetting agent (Vatsol K) did not alter the results at the rates used. The summer was dry until August and the turf was in poor condition. These trials suggested the possibility of effective crabgrass control by using several treatments at lower concentrations.

The results in 1950 with the liquid formulation of PMA confirmed the 1949 findings. Three treatments with PMA plus 2,4-D made the lawn grass yellowish for several weeks. The dry formulation of PMA in vermiculite applied at the double rate was not as effective as the PMA liquid applications. Two treatments using 2 gallons of 0.2% potassium cyanate (.64 oz. KOCN) gave good control of crabgrass with only a minor burn to the lawn grass. At the concentration used a sticker (Spraylastic) failed to influence the results. At 0.8% potassium cyanate (2.6 oz. KOCN) applications made with a sprinkling can were equal to those where the solution was applied as a spray. Maleic hydrazide was not effective for crabgrass control at the pre-heading stage when applied at the rate of 1 and 2 lbs. per acre in one or three applications. Growing conditions through the 1950 season were very good with precipitation through July and August well above average.

The 1951 tests for crabgrass control were limited to a series of single plot tests. At the time of treatment, on the 22nd of August, the crabgrass was well advanced and some of the plants were setting seed. The crabgrass plants were uniformly distributed over the area and made up approximately 50% of the total plant cover. The remainder of the plant cover was Kentucky Blue grass with a small quantity of White Dutch

Clover. Growing conditions were good at the start of the test but a dry period lasting through late August and the first week of September had an adverse effect on grass growth. The second treatment was postponed until after a good rain. Growing conditions were good through the remainder of September. The materials used and the results obtained are shown in Table I.

Table I. Crabgrass treatments on a Kentucky Blue grass lawn at Guelph, Ont., 1951.

Material	Method	Rate	# of treat-ments	Plot size	% Control 15 Sept	Remarks
KOCN (25% dust)	dust	½ lb.	2	15'x10'	95	Other grasses green and healthy.
KOCN (91%)	watering can	5t/2 gal. (.7 oz./ 2 gal.)	2	10'x10'	50	
		10t/2 gal. (1.4 oz./ 2 gal.)	2	10'x10'	95+	
		15t/2 gal. (2.1 oz./ 2 gal.)	2	10'x10'	100	Severe burn of other grasses.
PMA (.74% in vermiculite)	spreader	double	2	½ sq. rod	40	Other grasses pale. Slow in action.

KOCN = potassium cyanate
t = teaspoons

Under the conditions of the test the potassium cyanate dust effectively controlled crabgrass. Two treatments were required with an interval of 10 days between treatments. Satisfactory control was obtained when a solution containing 10 teaspoons (1.4 oz.) of 91% potassium cyanate in 2 gallons of water was applied with a watering can. At this rate no burn was apparent one week after treatment. The dry application of PMA was again not satisfactory.

Investigations on the control of crabgrass were continued during the 1952 season. Plots were laid out and first treatments were applied during the third week of July. Second and third applications were made at approximately 10 day intervals. Three replicates were used for all treatments except Milcyanate. At the time of treatment the largest crabgrass plants were approximately 2 inches in size. Throughout the period of the test the moisture supply was poor and the growth of the turf grasses was retarded. The chemicals used, the method of application, and the results obtained are given in Table II.

Examination of these data show that all treatments reduced the crabgrass infestation. The watering can method of applying potassium cyanate at 10 and 15 teaspoons (1.4 and 2.1 oz.) of 91% material in 2 gallons of water per 100 sq. ft. was the most effective method. At the 15 teaspoon (2.1 oz.) rate, browning of the turf grasses was excessive. When one-third the quantity of liquid was applied the result was still satisfactory. In the spray applications 0.8% with a spreader and sticking agent was only slightly more effective than the 0.8% treatment without the sticker. The liquid application of PMA was as effective as the dry application. Both methods of application were less effective than the best potassium cyanate treatments. Chlordane applied 10 days after a potassium cyanate treatment and Chlordane applied alone were not successful treatments. Three treatments using Milcyanate were required to obtain effective control. The two rates could not be compared as a heavy rain following the 7½ lb. rate reduced the effectiveness of the third application.

Summary

1. Potassium cyanate applied as a water solution has given consistently good results over the four year period.

2. Both a watering can and garden sprayer have been satisfactory in applying the potassium cyanate solutions.

3. The addition of a sticking agent has not materially increased the effectiveness of the cyanate treatments.

4. A rate of 0.64 oz. to 1.4 oz. per square rod has given good control of crabgrass when applied as a spray at a low volume and when applied at a higher volume with a watering can.

5. Liquid applications of PMA have been more successful than dry applications in most years.

Table II. Crabgrass treatments on a Kentucky Blue grass lawn at Guelph, Ontario, 1952.

Material	Method	Rate	# of treat-ments	28 Aug. Severity*	20 Sept % crab-grass	Remarks
KOCN (5% dust)	dust	1½ lbs	2	0	11	
KOCN (91%)	spray	0.2% (0.16 oz)	2	0	25	½ gal/300 sq'
		0.4% (0.32 oz)	2	0	6	" " " "
		0.8% (0.64 oz)	2	0	2	" " " "
		0.8% (0.64 oz)	2	0	1	" " " "
KOCN (91%)	watering can	5t/2 gal (0.7 oz)	2	0	3	2 gal/100 sq'
		10t/2 gal (1.4 oz)	2	1	0	" " " "
		15t/2 gal (2.1 oz)	2	2	0	" " " "
		10t/2/3 gal (1.4 oz)	2	0	2	2 gal/300 "
KOCN (Mil-cyanate)	spreader	5 lb/500 sq'ft	1	-	19	equal to 400 lbs/A
			2	-	9	
			3	-	2	
		7½ lb/500 sq ft	1	-	15	equal to 600 lbs/A
			2	-	7	
			3	-	1	
PMA	spray	1½ oz/gal	3	1	3	slow in action
PMA (.74 vermicu-lite)	spreader	double	3	1	3	much slower than liquid
KOCN & Chlor-dane	spray	10 lb/A	2	0	7	plots treated with KOCN at 10t/2 gal /100 sq' 10 days before Chlordane treatment
Chlor-dane	spray	10 lb/A	2	0	17	
			1	0	20	
Check	-	-	-	0	31	

* Severity:- 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe
% crabgrass = % crabgrass ground cover. t = teaspoons
gal = Imperial gallon

PRE-EMERGENCE AND POST-EMERGENCE WEED CONTROL WITH GLADIOLI CORMELS[1]

by

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Three separate experiments of preliminary nature were conducted during the growing season of 1950 at the Ornamentals Laboratory, Farmingdale, Long Island, New York. They included, (1) pre-emergence experiment, (2) pre-emergence plus post-emergence experiment, and (3) pre-emergence plus post-emergence experiment with various combinations of these two application procedures.

Cormels of the Fulton variety were screened to a uniform size. The sizes used for each experiment are listed below. All cormels in each replicate of each experiment were weighed and counted to permit germination and plant stand calculations.

All the liquid herbicidal materials were applied in the volume of 100 gallons of water per acre.

When the pre-emergence sprays were applied the entire treated area, 6 inches on each side of the row, was treated. With the post-emergence applications this same cross-sectional area of row was treated, but the spray stream was so directed to wet only the lower 1 to 2 inches of the stems of the gladioli plants.

All treatments within the three separate experiments were replicated four times in a partial randomization scheme in the field.

The cormels were planted in a Sassafras loam soil on 9 May 1950. Initial emergence of the plants commenced on 3 June 1950. Flower production started on 25 August 1950, and it was completed on 9 October 1950. The crop was dug during 16 to 18 October 1950. Curing of the corms and cormels at 80 to 90°F for 10 days started on 18 October 1950. Cleaning, grading, and weighing of the crop was done from 29 October to 5 November 1950. The corms and cormels were held at 70°F during this period.

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EXPERIMENT 1 - PRE-EMERGENCE WEED CONTROL

Five kinds of chemical herbicides were tested along with a salt hay mulch. A Stoddard solvent type (oil) was supplied by the Standard Oil Development Company as Esso Weed Killer No. 35. Three different formulations of pentachlorophenol (PCP) were used. They were supplied by the Monsanto Chemical Company as Santophen 20, containing 83% technical pentachlorophenol; by the Shell Oil Company as Shell 130, containing 9.4% technical pentachlorophenol, 88.4% aromatic petroleum derivatives, and 2.2% inert materials; and by the American Chemical Paint Company as Pentadine Concentrate No. 10, containing 38.6% pentachlorophenol, 36.7% pine oil, and 24.7% solvent material. Sodium pentachlorophenate (NaPCP) was supplied by the Monsanto Chemical Company as Santobrite, containing 83% technical grade sodium salt. Calcium cyanamid ($CaCN_2$) was supplied by the American Cyanamid Company as the pellet grade. Maleic hydrazide (MH) was supplied by the United States Rubber Company as MH-30, containing a 30% solution formulation of this chemical.

Cormels which passed through a 3/8 inch screen (square) and which were retained upon a 1/4 inch screen (square) were selected. Each replicate comprised a weight of 50 grams containing 268 to 316 cormels.

Each replicate plot was 10 ft^2 in area.

Early pre-emergence treatments were put on 17 May 1950. Delayed pre-emergence applications were made on 3 June 1950. The post-emergence material (mulch) was applied on 29 June 1950 when the plants were 4 to 6 inches tall, and after the area had been hand weeded.

The oil was applied at the rate of 75 gallons per acre. Pentachlorophenol put on at 5 pounds per acre rate in 25 gallons of oil per acre, and at 5 pounds per acre in a oil-water emulsion at 25 and 75 gallons per acre respectively. Sodium pentachlorophenate was used at the rate of 20 pounds per acre plus 2 1/2 pounds of lye as a solvent aid and wetting agent. Calcium cyanamid was spread at the rate of 150 pounds per acre with 150 pounds of fine dry sand. Maleic hydrazide was sprayed on at the rate of 2 pounds per acre. Salt hay was deposited in sufficient thickness to make a layer about 2 inches deep when packed.

Table 1 presents the data secured upon the effects of the several herbicidal treatments upon the growth of the gladioli plants. It must be mentioned that two different formulations were used for the PCP in oil and for the PCP in the oil-water emulsion mixtures. In each case two replicates received one mixture, while the other two replicates received the second mixture of the same active ingredients. Since the phytotoxicity data and the weed counts indicated no essential differences between the two respective formulations in each case the data are reported as based upon four replicates of the active ingredients.

Table 2 presents the various weed counts made throughout the season. The total (sum of 4 counts) weed growth for a 91 day period after application is given for the salt hay mulch plots.

EXPERIMENT 2 - PRE-EMERGENCE PLUS POST-EMERGENCE WEED CONTROL

Three herbicidal compounds were utilized in this experiment; namely, NaPCP as listed above, a technical grade of pottassium cyanate (KOCN) supplied as Aero Cyanate by the American Cyanamid Company, and MH as listed above.

Cormels which passed through a 3/4 inch screen (square) and which were retained upon a 1/2 inch screen (square) were selected. Each replicate comprised a weight of 240 grams containing 205 to 218 cormels.

Table 1

Effect of Several Herbicidal Treatments (Pre-Emergence) Upon the Growth of the Gladioli Plant

Treatments	Average Yields of Four Replicates					
	Total No. of Flowers	% Plant Stand 3 July 50	8 Aug. 50	17 Oct. 50	Corm Wts. gms.	Cormel Wts. gms.[a]
Check	3.3	32	39	51	698	118
Oil	2.5	40	49	65	857	158
Oil + PCP	3.5	37	43	57	811	143
Oil + PCP + H_2O	4.0	40	46	58	881	160
NaPCP	4.3	38	41	54	907	144
$CaCN_2$ - early + late	2.0	35	44	51	678	124
$CaCN_2$ - early	2.5	41	36	54	768	143
$CaCN_2$ - late	2.8	30	42	49	619	121
MH	3.3	31	39	52	759	128
Mulch	0.0	32	38	47	720	97
LSD (5%)	2.7	9	8	3	149	39
LSD (1%)	-	12	11	5	202	53

Notes: a. Only those cormels retained upon a 1/4 inch screen (square) were recorded.

Each replicate plot was 15 ft^2 in area.

The herbicidal application times were 27 May 1950 for the delayed pre-emergence treatment, 2 July 1950 for post-emergence No. 1 28 July 1950 for post-emergence No. 2, and 25 August 1950 for post-emergence No. 3.

The NaPCP was used at the rate of 10 pounds per acre. KOCN was put on at the rate of 10 pounds per acre. The MH was applied at the rate of 1 pound per acre.

Table 3 presents the data secured upon the effects of the several herbicidal treatments upon the growth of the gladioli plants.

Table 4 lists the various weed counts made throughout the season.

EXPERIMENT 3 - PRE-EMERGENCE PLUS POST-EMERGENCE PLUS COMBINATIONS WEED CONTROL

Three herbicidal compounds were examined. They included 2,4 dichlorophenoxyacetic acid (2,4-D) as the triethanolamine salt containing the 2,4-D acid equivalent of 4 pounds per gallon supplied as GLF "66", phenyl mercuric acetate (PMA) supplied as a 10% solution as Tat C-Lect by the O. E. Linck Company, and a mixture of 2,4-D and PMA supplied as Tat GW by the O. E. Linck Company, comprising 2.54% 2,4-D acid equivalent and 7.50% phenyl mercuric acetate.

Weed Counts in Gladioli Herbicide Experiment With Pre-Emergence Applications

Treatments	Average Counts of Four Replicates					
	Initial [b]	18 Days	36 days		91 days	
	BL	BL	BL	GR	BL	GR
Check	37	116	201	27	120	39
Oil	34	46				
Oil + PCP	17	1	20	12		
Oil + PCP + H_2O	17	0	18	8		
NaPCP	31	0	12	9		
$CaCN_2$ - early + late	42	81				
$CaCN_2$ - early	32	102				
$CaCN_2$ - late	38	85				
MH	48	57				
Mulch [a]					36	9
LSD (5%)	-	24	29	10	27	15
LSD (1%)	-	33	42	15	50	28

Notes: a. Salt hay mulch was a post-emergence application.
b. Counts made 2 days after applications.
(1) Days indicate number of days following applications. Total weed counts taken each time for every replicate for the entire 10 $ft.^2$ area. Plots hand weeded at counting time.
(2) BL - denotes broad-leaf type weeds, mostly mustard and ragweed.
(3) GR - denotes grass type weeds, mostly crab grass.

Cormels which passed through a 1/2 inch screen (square) and which were retained upon a 3/8 inch screen (square) were selected. Each replicate comprised a weight of 200 grams containing 327 to 404 cormels.

Each replicate plot was 20 ft^2 in area.

Each material was applied at three different times, and at all various combinations of these different periods of applications, making a total of 7 different applications for each material. The pre-emergence applications were applied on 3 June 1950. Post-emergence No. 1 treatments were made on 8 July 1950. On 19 August 1950 the post-emergence No. 2 treatments for the Tat GW and the PMA were put on, while the 2,4-D treatment was put down on 21 August 1950. (A medium rainfall occurred between these two dates.)

The 2,4-D was applied each time at the rate of 16 pounds per acre. (Through an unfortunate calculation error 16 pounds were used instead of the planned 4 pounds.) PMA was used at the rate of 5 pounds per acre. The commercial mixture of 2,4-D and PMA (Tat GW) was utilized at the recommended rate of 2 fluid ounces per gallon or 6.25 quarts per 100 gallons. This application supplied the 2,4-D and the PMA at the respective rates of 0.35 and 1.05 pounds per acre.

Table 5 presents the data secured upon the effects of the several herbicidal treatments upon the flower production of the gladioli seedlings.

Table 3

Effect of Several Herbicidal Treatments (Pre-Emergence Plus Post Emergence) Upon the Growth of the Gladioli Plant

Treatments	Average Yields of Four Replicates					
	Total No. of Flowers	% Plant Stand 2 July 50	8 Aug. 50	17 Oct. 50	Corm Wts. gms.	Cormel Wts. gms.[a]
Check	122	58	59	78	1561	146
NaPCP	131	58	67	83	1636	157
KOCN	132	58	63	83	1516	140
MH	154	66	66	85	1571	140
LSD (5%)	19	7	10	10	292	34
LSD (1%)	27	10	15	14	419	49

Notes: a. Only those cormels retained upon a 1/4 inch screen (square) were recorded.

Table 6 shows the germination data for the cormels as well as the percent plant stand achieved throughout the growing season. Table 7 lists the final plant stand in terms of specific treatment effect, material effect, and application effect.

Table 8 gives the yield data for corm production. Table 9 presents the yield of cormels which were retained upon a 1/4 inch screen (square).

Tables 10, 11, and 12 tabulate the various weed counts made throughout the growing season. Table 10 lists the weed control data for a period of 18 and 46 days following the pre-emergence applications of the herbicidal materials. Table 11 presents the results of the post-emergence No. 1 effectiveness for weed control. The entire season weed control for a total accountable period of 117 days was recorded and is listed in Table 12.

Natural conditions from late August to late September reduced weed populations regardless of materials and applications. Counts were made 38 and 40 days after the post-emergence No. 2 applications. The growth of both broad-leaf and grass type weeds was too insufficient, even in the check plots, to warrent discussion and analyses of the data.

SUMMARY AND CONCLUSIONS

EXPERIMENT 1 - PRE-EMERGENCE WEED CONTROL

None of the materials tested as pre-emergence herbicidal agents caused any phytoxic effect upon the gladiolus plants at the concentrations used.

$CaCN_2$ in the pellet form used at the rate of 150 pounds per acre was an ineffective pre-emergence herbicide.

Maleic hydrazide at 2 pounds per acre was not suitable as a herbicide when used as a pre-emergence application.

Table 4

Weed Counts in Gladioli Herbicide Experiment
With Pre-Emergence and Post-Emergence
Applications

Average Counts of Four Replicates

Herbicides	Pre-Emergence		Post-Emergence						Totals - 105 Days-	
		26		17		28		34		
	Initial	Days	No. 1-Days		No.2-Days		No.3-Days			
	BL	BL	BL	GR	BL	GR	BL	GR	BL	GR
Check	158	495	113	83	44	21	11	5	663	109
NaPCP	142	41	40	71	9	8	5	2	95	81
KOCN	148	266	64	46	40	25	6	6	376	77
MH	144	353	95	54	55	29	7	3	509	86
LSD (5%)	-	80	57	30	33	14	-	-	94	41
LSD (1%)	-	116	81	43	47	20	-	-	136	58

Notes: (1) Days indicate number of days following applications. Total weed were taken each time for every replicate for the entire 15 ft.^{2}. Plots hand weeded at counting time.

(2) BL - denotes broad-leaf type of weeds, mostly mustart and ragweed.

(3) GR - denotes grass type weeds, mostly crab grass.

Oil at 75 gallons per acre as a pre-emergence application was effective against broad-leaf weeds for at least 18 days. PCP at 5 pounds per acre in either oil (25 gallons per acre) or in a oil (25 gallons per acre) - water (75 gallons per acre) emulsion produced good weed control against broad-leaf type weeds following the pre-emergence treatment for at least 36 days. NaPCP at 20 pounds per acre produced similar results. Both these materials, PCP and NaPCP, even gave fair control over the grass type weeds.

Salt hay mulch was suitable as a means of post-emergence weed control when applied to make a packed layer of about 2 inch depth.

EXPERIMENT 2 - PRE-EMERGENCE PLUS POST-EMERGENCE WEED CONTROL

A total of four applications of herbicides during the growing season of a crop of gladioli cormels caused no adverse effects upon the growth of the plants. These materials included NaPCP at 10 pounds per acre rate. KOCN at 10 pounds per acre rate, and MH at 1 pound per acre rate.

Table 5

Effect of Herbicidal Treatments Upon the Flower Production of Gladioli Seedlings

Average Yields of Four Replicates

Applications	Materials 2,4-D	2,4-D + PMA Treatment Means	PMA	Application Means
Pre-Emergence	48.8	107.0	102.0	85.9
Pre-Emergence Post-Emergence No. 1	3.3	74.8	44.8	40.9
Pre-Emergence Post-Emergence No. 1 Post-Emergence No. 2	2.3	57.5	56.3	38.7
Pre-Emergence Post-Emergence No. 2	41.0	109.3	99.3	83.2
Post-Emergence No. 1 Post-Emergence No. 2	34.0	58.0	51.3	47.8
Post-Emergence No. 1	48.0	97.0	71.8	72.3
Post-Emergence No. 2	108.0	110.3	109.5	109.2
Materials Means	40.1	87.7	76.4	
Check				99.5

LSD	Treatments	Materials	Applications
(5%)	37.9	11.4	17.4
(1%)	50.4	15.1	23.1

Notes: Some of the 2,4-D treated plots had some abnormal flowers. The following lists the average for each treatment:

Pre-Emergence	---none distorted
Pre-Emergence plus Post-Emergence No. 1	---very few distorted
Pre-Emergence plus Post-Emergence No. 1 and No. 2	---very few distorted
Pre-Emergence plus Post-Emergence No. 2	---11% distorted
Post-Emergence No. and No. 2	---71% distorted
Post-Emergence No. 1	---26% stunted
Post-Emergence No. 2	---48% distorted

Table 6

Effect of Herbicidal Treatments Upon the Germination of Cormels and the Growth of Gladioli Seedlings

Treatments Herbicides	Applications	Average Yields of Four Replicates % Plant Stand 4 July 50	8 Aug. 50	18 Oct. 50
2,4-D	Pre-Emergence	25	64	63
2,4-D PMA	Pre-Emergence	56	67	77
PMA	Pre-Emergence	52	62	75
2,4-D	Pre-Emergence Post-Emergence No. 1	26	40	22
2,4-D PMA	Pre-Emergence Post-Emergence No. 1	43	57	71
PMA	Pre-Emergence Post-Emergence No. 1	47	59	73
2,4-D	Pre-Emergence Post-Emergence No. 1 Post-Emergence No. 2	21	47	24
2,4-D PMA	Pre-Emergence Post-Emergence No. 1 Post-Emergence No. 2	43	60	69
PMA	Pre-Emergence Post-Emergence No. 1 Post-Emergence No. 2	52	55	65
2,4-D	Pre-Emergence Post-Emergence No. 2	26	56	62
2,4-D PMA	Pre-Emergence Post-Emergence No. 2	46	57	76
PMA	Pre-Emergence Post-Emergence No. 2	52	58	74
2,4-D	Post-Emergence No. 1 Post-Emergence No. 2	50	52	32
2,4-D PMA	Post-Emergence No. 1 Post-Emergence No. 2	39	54	70
PMA	Post-Emergence No. 1 Post-Emergence No. 2	41	58	59
2,4-D	Post-Emergence No. 1	47	49	37
2,4-D PMA	Post-Emergence No. 1	48	60	78
PMA	Post-Emergence No. 1	45	59	74
2,4-D	Post-Emergence No. 2	39	59	69
2,4-D PMA	Post-Emergence No. 2	44	57	74
PMA	Post-Emergence No. 2	44	61	70
Check		37	59	75
LSD (5%)	All plots	7	7	10
	Herbicide plots only	10		
(1%)	All plots	9	12	14
	Herbicide plots only	14		

Notes: 4 July 50 - Plant counts made after pre-emergence applications on 3 June 50. Thus, these counts are a measure of only the

Table 6 con't.

effect of the pre-emergence treatments upon cormel germination. Those 10 plots not marked pre-emergence at this time were in actuality check plots during this particular period.

8 Aug. 50 - Plant counts made after pre-emergence application on 3 June 50 and post-emergence No. 1 application on 8 July 50. Thus, these counts are a measure of the effect of the pre-emergence alone, post-emergence No. 1 alone, and the combination of the two treatments. Those 4 plots not marked either pre-emergence or post-emergence No. 1 at this time were in actuality check plots during this particular period.

18 Oct. 50 - Plant counts made after all three application, pre-emergence on 3 June 50, post-emergence No. 1 on 8 July 50, and post-emergence No. 2 on 19 and 21 Aug. 50. All counts for all plots are a measure of the specific series of treatments listed in the above Table for the entire season.

Table 7

Effect of Herbicidal Treatments Upon the Final %
Stand of the Gladioli Seedlings

Applications	Average of Four Replicates Materials			
	2,4-D	2,4-D + PMA	PMA	Application Means
	Treatment Means			
Pre-Emergence	63	77	75	71.5
Pre-Emergence Post-Emergence No. 1	22	71	73	55.4
Pre-Emergence Post-Emergence No. 1 Post-Emergence No. 2	24	69	65	52.7
Pre-Emergence Post-Emergence No. 2	62	76	74	70.8
Post-Emergence No. 1 Post-Emergence No. 2	32	70	59	53.8
Post-Emergence No. 1	37	78	74	62.8
Post-Emergence No. 2	69	74	70	70.9
Materials Means	44.1	73.5	70.1	
Check				75

LSD	Treatments	Materials	Applications
(5%)	10	4	6
(1%)	14	5	8

Maleic hydrazide seemed to be instrumental in increasing flower production.

Control of broad-leaf type of weeds was satisfactory with the NaPCP. KOCN did not perform well, while the MH material was ineffective from a practical viewpoint.

Table 8

Effect of Herbicidal Treatments Upon the Corm Yield of Gladioli Seedlings

Applications	Average of Four Replicates in Grams Materials 2,4-D	2,4-D + PMA Treatment Means	PMA	Application Means
Pre-Emergence	1743	2309	2552	2201
Pre-Emergence Post-Emergence No. 1	437	2156	2301	1632
Pre-Emergence Post-Emergence No. 1 Post-Emergence No. 2	461	2053	1977	1497
Pre-Emergence Post-Emergence No. 2	1793	2230	2492	2172
Post-Emergence No. 1 Post-Emergence No. 2	807	2311	1974	1698
Post-Emergence No. 1 Post-Emergence No. 2	1023 2018	2599 2233	2221 2166	1948 2139
Materials Means	1183	2270	2241	
Check				2376

LSD	Treatments	Materials	Applications
(5%)	371	140	214
(1%)	493	187	285

Table 9

Effect of Herbicidal Treatments Upon the Cormel Yield of Gladioli Seedlings

Applications	Average of Four Replicates in Grams Materials 2,4-D	2,4-D + PMA Treatment Means	PMA	Application Means
Pre-Emergence	172	320	341	278
Pre-Emergence Post-Emergence No. 1	29	290	375	231
Pre-Emergence Post-Emergence No. 1 Post-Emergence No. 2	35	294	343	224
Pre-Emergence Post-Emergence No. 2	218	311	325	285
Post-Emergence No. 1 Post-Emergence No. 2	74	347	296	239
Post-Emergence No. 1	94	254	305	218
Post-Emergence No. 2	228	331	300	286
Material Means	123	307	326	
Check				333

LSD	Treatments	Materials	Applications
(5%)	76	29	44
(1%)	101	38	58

Note: Only those cormels retained upon a 1/4 inch screen (square) were recorded.

Table 10

Weed Counts in Gladioli Herbicide Experiment
(Pre-Emergence Plus Post-Emergence Plus Combinations)
Following Pre-Emergence Applications

Herbicides	Average Counts of Four Replicates			
	Initial	18 Days	46 Days	
	BL	BL	BL	GR
2,4-D	59	0	4	14
	74	0	-	-
	49	0	-	-
	57	0	11	28
2,4-D plus PMA	52	100	162	36
	65	60	-	-
	56	45	-	-
	53	60	113	26
PMA	68	0	39	36
	55	0	-	-
	56	0	-	-
	53	0	54	23
Check	60	600	702	33
LSD (5%)	-	49	69	25
(1%)	-	65	95	-

Notes: BL - Broad-leaf type weeds, mostly mustard and ragweed.
GR - Grass type weeds, mostly crab grass.

EXPERIMENT 3 - PRE-EMERGENCE PLUS POST-EMERGENCE PLUS COMBINATIONS WEED CONTROL

The 2,4-D at 16 pounds per acre was the most toxic material. This toxicity was measured in terms of losses in flower yield, flower quality, cormel germination, percentage plant stand, corm yield, and cormel yield. PMA was somewhat less toxic against flower yield, while it was practically non-harmful otherwise when used at the rate of 5 pounds per acre. The commercial mixture (Tat GW) of 2,4-D at 0.35 pounds and PMA at 1.05 pounds per acre was the least toxic material, showing only slight injury to flower yield, and essentially no effect upon the other measurements.

A strong degree of interaction in respect to phytotoxicity was noted between the materials and the applications. However, the post-emergence No. 1 application, which was applied about the time flower buds were forming, appeared to be the most damaging application. This damage was intensified when this application was combined with other applications.

Table 11

Weed Counts in Gladioli Herbicide Experiment
(Pre-Emergence Plus Post-Emergence Plus Combinations)
Following Post-Emergence No. 1 Applications

Herbicide	Applications	Average Counts of Four Replicates 27 Days BL	27 Days GR	48 Days BL	48 Days GR	82 Days BL	82 Days GR
2,4-D	Pre-Emergence Post-Emergence No. 1	1	16	6	18	12	19
2,4-D	Pre-Emergence Post-Emergence No. 1	2	17	-	-	-	-
2,4-D	Post-Emergence No. 1	12	10	-	-	-	-
2,4-D	Post-Emergence No. 1	5	8	9	15	16	18
2,4-D PMA	Pre-Emergence Post-Emergence No. 1	17	15	43	35	57	37
2,4-D PMA	Pre-Emergence Post-Emergence No. 1	26	18	-	-	-	-
2,4-D PMA	Post-Emergence No. 1	67	11	-	-	-	-
2,4-D PMA	Post-Emergence No. 1	68	22	105	37	112	42
PMA	Pre-Emergence Post-Emergence No. 1	11	5	34	14	43	15
PMA	Pre-Emergence Post-Emergence No. 1	17	7	-	-	-	-
PMA	Post-Emergence No. 1	34	7	-	-	-	-
PMA	Post-Emergence No. 1	35	5	56	23	64	26
Check		156	41	227	65	236	70
LSD (5%)		18	13	33	25	33	26
(1%)		24	17	46	34	46	36

Notes: BL - Broad-leaf type weeds, mostly mustard and ragweed.
GR - Grass type weeds, mostly crab grass

Table 12

Total Weed Counts in Gladioli Herbicide Experiment for Entire Season in Plots Receiving Pre-Emergence, Post-Emergence No. 1, and Post-Emergence No. 2 Applications

Herbicide	Rate Each Application lbs per acre	Average Counts of Four Replicates 117 Days BL	117 Days GR
2,4-D	16	7	17
2,4-D PMA	0.35 1.05	81	25
PMA	5.0	31	10
Check		836	70
LSD (5%)		84	24
(1%)		121	34

Table 12
con't.

Notes: BL - Broad-leaf type weeds, mostly mustard and ragweed.
GR - Grass type weeds, mostly crab grass.

All three materials gave suitable control of the broad-leaf type of weeds. Control of the grass type of weeds was less satisfactory and more erratic, but in general it was commercially feasible. Decreasing order of effectiveness against the former type of weeds was 2,4-D, PMA, and the commercial mixture (Tat GW) of 2,4-D and PMA, while against the latter type it was PMA, 2,4-D, and the commercial mixture.

All the applications appeared to control the broad-leaf type of weeds. However, the pre-emergence application failed to stop the grass type of weeds.

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An Anatomical Study of the Abscission Zone of Rosa dilecta Rehr., variety Better Times as Affected by the Defoliant Disodium 3,6-endoxohexahydrophthalate

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Introduction

The use of ethylene gas for defoliation of hydrangea is well known, but the action of the ethylene and of defoliant sprays is not precisely known. The present study was undertaken to describe the anatomy of Rosa dilecta Rehr. variety Better Times in relation to abscission and to follow the anatomical change resulting from the application of one chemical disodium 3,6-endoxohexahydrophthalate (Endothal), which has proved useful in the defoliation of many types of nursery stock in late summer and early autumn under field conditions.

Materials and Methods

Material examined in the study of leaflet defoliation was taken from vigorous, growing plants that had been benched in the greenhouse. Plants started from cuttings were used as subjects for leaf defoliation and for observing defoliation under more normal conditions than that set up for the study of the leaflet.

The plants required a higher concentration of defoliant than the rose leaves that were removed from plants and placed in closed containers (Pridham, 11). Optimum defoliation was obtained by spraying plants with a concentration of 2% and leaves with ½% of ME-3001 (an Endothal formulation). In both cases they were sprayed until the foliage dripped.

The potted plants so sprayed were placed directly on the greenhouse bench and given no other treatment. Sterile pint milk bottles which contained a small amount of moist sand were used as containers for the leaves. After inserting the leaves in the bottle the bottle cap was set in place and closed with a paraffin seal. Cultures were stored in the dark at 85°F.

Samples consisting of a portion of the stem and the petiole were taken from the potted plants at 24 hour intervals over a five day period. Petiole and petiolule samples were taken from the leaves in the milk bottles at 2 hour intervals for the first 24 hours and then daily for the next four days. From those two series it was possible to determine when the first signs of defoliation appeared.

Both fresh and paraffin-embedded material were studied. Fresh sections were cut free hand and stained with the following: IKI, anilin blue, and ruthenium red (Johansen, 7).

Paraffin-embedded material was fixed with chloroform, 100% alcohol, acetic acid in a ratio of 3:2:1 and dehydrated by the tertiary butyl alcohol method as outlined by Johansen (7). The safranin-fast green staining schedule of Banks (1), with slight modifications, was used.

External appearance of abscission zone of petiolule and petiole before treatment

At the junction of axil or of the petiole and petiolule a relatively deep depression marks an underlying zone. Only on close examination is a slight constriction noted around the base of the petiolule. As abscission becomes more evident a translucent, definite abscission zone appears.

The broad base of the petiole is slightly swollen at the point of attachment, resulting in a relatively deep depression at the transition of stem to petiole (in this paper known as notch). This becomes more apparent as the leaf reaches maturity.

While the color of the notch may predict impending abscission, it does not determine the precise location of the zone. In young leaves the petiole base is yellow green in contrast to the dark green of the stem. As normal abscission approaches the petiole turns a pale yellow and eventually the entire leaf becomes yellow. Petioles treated with Endothal undergo this same color change, but the blades do not. They remain green even after defoliation has taken place.

General anatomy of abscission zone of petiolule and petiole

Since the anatomy of the abscission zones of the petiolule and petiole are similar in most respects, separate descriptions of their general anatomy will not be made.

The abscission zone as seen in longitudinal section is widest in the area of the axil, ordinarily from 3 to 14 cells wide, as compared to 6 to 10 cells wide in the vicinity of the vascular bundles and notch. This zone is marked by smaller cells but they are not thinner-walled than adjacent ones bordering the zone. The zone passes down from the axil in a slanting direction to the vascular bundles then curves upward to the notch. The epidermal cells in the axil are no different from the adjoining epidermal cells, but those bordering on the notch are closely compressed with their long axes parallel to the abscission zone.

Immediately below the epidermis in the petiolule and surrounding the axil are angular collenchyma lying in a compact wedge with the apex adjoining the inner parenchymatous tissue and the base abutting on the epidermal layer.

On the notch side of the abscission zone the first three to four rows of loosely arranged polyhedral cells in the petiolule (four to six rows in the petiole) constitute the outer parenchyma. The inner parenchyma cells are elongated in the plane of the abscission zone and become progressively larger to the innermost layer. Few or no intercellular spaces are present between these inner parenchyma cells, but in the area between the inner and outer parenchyma large intercellular spaces are present. The innermost layer of parenchyma cells is vestigial endodermis. The cells are smaller, thinner-walled and not elongated as are the adjacent inner parenchyma cells.

Evidence that the abscission zone is a region of weakness is the decrease, or in some cases the complete lack, of pericyclic fibers. In transverse section the few pericyclic fibers are in isolated strands proximal to the notch. Parenchyma is interposed. Vascular bundles are reduced in diameter; the phloem and cambial cells show no change from those above and below the zone. The length of the spirally thickened protoxylem cells is shorter, and in many cases, the end walls lie in the zone.

In both treated and untreated leaves and leaflets that were nearing complete separation, it was noted that from 2 to 3 tiers of cells of the zone proximal to the petiole and petiolule base became exceedingly active. Some cells appeared with dense cytoplasm and large nuclei but no cell division was initiated at the time of defoliation. Separation was initiated and finally consummated in this layer regardless of cellular activity or the lack of it. Previous to nuclear activity this layer of cells exhibited no distinguishing differences from adjacent cell layers in the abscission zone.

External modifications of petiolule and petiole after treatment

The first change that appeared after treatment was the yellowing of the mature petiole bases 24 hours after application of the defoliant. In 48 to 72 hours when defoliation was imminent, this yellowing had extended well above the petiole base. During this time separation was initiated in the outer margin of the stipule in the area of the axil. In the final stages of separation the petiole remained attached to the stem by tissues in the area of the vascular bundles. The slightest disturbance such as air movement, or jarring brought about complete separation of the petiole from the stem.

Similar external modifications were observed when petiolules were treated; however, the defoliation process was markedly speeded up. Some leaflets defoliated in 24 hours.

Anatomical modifications of petiolule and petiole after treatment.

Petiolule. No evidence of anatomical modification could be detected prior to the 14th hour after the start of the experiment, but the modifications that followed were extremely rapid.

1. Modifications during the first 24 hour period at 85°F.

The first modification consisted of marked swelling accompanied by gelatinization of the cell walls. This alteration of cell walls occurred generally between the first and second rows of inner parenchyma, occasionally between the inner and outer parenchyma in the region proximal to the notch and proximal to the petiolule base. This is followed in 16 hours by the appearance of intercellular spaces and rounding up of the freed cell surfaces.

The first manifestation of complete cell separation is in the collenchyma of the axil after a period of 18 hours. This is indicated by the appearance of a translucent, indefinite layer (the separation layer) extending from the collenchyma immediately beneath the epidermis to the elongated inner paren-

chyma. The wedge of collenchyma cells undergoes similar cytological changes to those of the parenchymatous cells noted above except that the swelling is more marked often reaching as much as two to three times the normal size.

Microchemical tests with ruthenium red revealed that the compound middle lamellae of the collenchyma and parenchyma cells of the abscission zone contain pectic material and that in 14 hours after the start of the treatment the compound middle lamellae stain a darker color, signifying that a change has taken place, possibly a change of insoluble pectic materials to soluble forms., or a change of phase from gel to sol.

Tests with IKI for starch accumulations in the abscission zone showed that starch was evenly distributed but as defoliation neared it became conspicuously absent. This may indicate that the starch is either used up in respiration or removed by translocation or changed to sugar, etc.

In the first 22 hours, complete separation of the collenchyma of the separation layer had taken place. Very quickly other cells of the collenchyma wedge separate until nearly all have become involved. In approximately all cases cells separate first along their compound middle lamellae, with no involvement of the secondary walls; however, some cellular dissolution does take place, particularly in the collenchyma of the axil. The epidermal cells take no part in the separation at this time. It is only after the tension becomes too great that the epidermis ruptures.

As completion of separation is brought about in the collenchyma, the translucent layer now appears in the inner parenchyma surrounding the vascular bundles, acting as a forerunner of impending separation of the compound middle lamellae of these cells. Dissolution of the cells is markedly reduced in these tissues.

The translucent layer then crosses the vascular bundles, where the phloem cells are separated along their compound middle lamellae and the protoxylem appears to be mechanically ruptured. Apparently the last tissues involved are the outer parenchyma and epidermis in the area of the notch.

In longitudinal section the marginal outline of the leaf scar is concave. The surface is of an extremely rough nature due to the irregular breakage pattern exhibited by the cells of the separation layer and the broken spiral thickenings of protoxylem projecting above this layer. Some of the cells of the separation layer remain attached to the defoliated petiolule.

Under the humid conditions and high temperature 85°F which existed in the sealed bottles the development of callus cells was noted on the newly exposed surfaces of treated material within two days after treatment. Anilin blue indicated their presence as early as 34 hours. These spherical, thin-walled cells protrude from gaps in the epidermis.

Petiole. The anatomical modifications in the petiole are fundamentally no different from those described for the petiolule.

Observations on Normal Abscission

This experiment was performed with Rosa dilecta Rehr. variety Better Times, grown in the greenhouses in winter. Petioles and petiolules were taken when abscission appeared imminent. Externally the leaf had reached the pale yellow stage. As abscission progressed to the point where actual breakage was visible, external observation showed that abscission had been initiated in the collenchyma of the stipule wings. This was confirmed by the examination of the internal tissues.

Collenchyma separation was well advanced before the epidermis was ruptured. The collenchyma wedge, unlike that of treated material, showed no indication of being completely involved in the process of abscission. Those cells actually involved were the tiers constituting the separation layer.

The remainder of the process of normal abscission followed that of induced abscission or defoliation.

Discussion of induced and normal abscission

Color changes are important indicators of abscission for in both normal and induced abscission, at the first showing of petiolule and petiole yellowing, the defoliation process is well advanced internally. This yellowing indicates the approximate time starch begins to disappear from the abscission zone. In the course of normal or induced abscission when yellowing occurs and starch disappears the cells of the abscission are separated by large intercellular spaces. Rounding of the cell surfaces becomes evident. Yellowing has been correlated with starch removal by Livingston (8) in Valencia orange leaves that are yellowed and in which the abscission process has been initiated. Under such conditions there is a general absence of starch except in the separation layer, whereas in earlier growth stages starch had been evenly distributed in the abscission zone.

In the experiment conducted with petiolules, the external appearance of callus cells at approximately two days proved to be an indication of impending defoliation in ME-3001 treated material. The presence of callus cells on the wound surfaces would indicate that the process of defoliation is between living cells and that no injury has resulted to the leaf scar. When a high concentration of Endothal is applied, death of the organ prevents defoliation. The callus cells on wound surfaces are quite normal under the conditions of high humidity. Hodgson (6) has observed with Citrus that cells separating in the abscission zone under high moisture conditions may become meristematic, resulting in groups of callus cells on the wound surface. Since dissolution of the compound middle lamella and separation of the cells proceed independent of callus, the two plant responses are separate and callus does not appear to be a primary factor.

Two methods of cell separation were apparent in treated material (1) by chemical dissolution of the compound middle lamellae and (2) by chemical dissolution of the compound middle lamellae followed by dissolution of the entire cell wall. The chemical dissolution of the compound middle lamellae was first described by Correns (3) as being characterized by swelling, gela-

tinization and rounding up of cells on the freed surfaces. Hodgson (6) believes that the steps noted above are in two stages: 1) swelling and gelatinization and 2) separation and rounding up of cells; thus indicating that there may be more than one reaction involved. This method of cell separation was found in normally abscissing petiolules and petioles and in parenchymatous cells of the separation layer in the treated.

Method 2, chemical dissolution of the compound middle lamellae followed by dissolution of the entire cell wall, was very apparent in the collenchyma of the axil of Rosa dilecta Rehr. variety Better Times. Swelling, gelatinization and the appearance of intercellular spaces were observed prior to the dissolution of the compound middle lamellae which in turn was followed by complete dissolution of the cell walls. At first only the cells of the separation layer were involved; eventually adjacent collenchyma cells and some parenchyma were included. Dutt (4), in his work with Gossypium flowers, found that the greatest degree of alteration takes place in cells near the boll side of the abscission zone. Here cells are completely dissolved. Brown and Addicott (2) support this evidence in part in their findings with Phaseolus vulgaris after treatment with ethylene saturated water. Their evidence indicates that cellular dissolution was found in the majority of cases. Only occasionally did cells separate along their middle lamellae.

The findings of this study show that separation takes place with or without the presence of a well developed separation layer. If the layer is well developed, no cell division occurs prior to defoliation. These findings concur with those of Brown and Addicott (2) on Phaseolus vulgaris and with Gawadi and Avery (5) in their work with poinsettia, cotton and pepper.

The majority of anatomical investigators, working with abscission and defoliation, have reported that the last phase of the abscission process was found to occur in the xylem by mechanical rupture. Findings in this study do not concur fully with the findings of these anatomical investigators.

Dutt (4) reported organ suspension in abscission of Gossypium flowers whereby some of the vascular system remained intact for a short time before complete abscission took place. Further corroborating evidence is given by McCown (9, 10) who mentions that the weight of apple fruits usually caused completion of abscission in the cortical and epidermal tissues. Abscission was initiated in the pith of the apple peduncle, followed successively by separation in the xylem, cambium, phloem and tissues under discussion.

Ratsek (12), in his work on normal abscission of peduncles of Rosa dilecta, states ". . . . it (abscission) progresses through the pith and later outwardly to the epidermis, xylem tissue was not involved and tore unevenly on abscission." This statement confirms in part the observations of the authors. The point of exception lies in the rupture of the xylem. Evidence is not given to prove whether the xylem remained after all other tissues had separated or broke before separation in the cortex and epidermis was complete.

Summary

1. The oldest leaves were the first to defoliate when plants were treated with Endothal.

2. Some leaflets were defoliated within 24 hours following application of Endothal. Generally three to five days were required for both leaf and leaflet defoliation.

3. Yellowing of the petiolule or petiole indicates the approximate time starch begins to disappear from the abscission zone.

4. The presence of callus cells on the wound surfaces indicates that the process of defoliation is between living cells.

5. The first manifestation of complete cell separation is in the collenchyma of the axil. Culmination of the process is reached by the rupturing of the protoxylem and the separation of the outer parenchyma and epidermis in the area of the notch.

6. Two methods of cell separation were apparent: 1) Separation by chemical dissolution of the compound middle lamellae only. This method of cell separation was found in normally abscissing petiolules and petioles and in parenchymatous cells of the separation layer in the treated. 2) Separation by complete dissolution of the cell walls. This method was found in the collenchyma cells of the axil and in some parenchyma adjacent to these cells.

7. In normal abscission the collenchyma wedge, unlike that of treated material, showed no indication of being completely involved in the process of abscission.

8. Separation took place with or without the presence of a well developed separation layer in treated material. The separation layer is present in normally abscissing leaves.

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Temperatures at Which Defoliated Twigs of *Forsythia intermedia spectabilis* Show Cold Injury

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In previous tests during a mild winter it was found that when plants were defoliated in September and then planted in the field, no greater mortality occurred overwinter in chemically defoliated plants than in hand defoliated controls. Serious mortality did result when shrubs were dug in early September and were permitted to lose from 15 to 20% of their weight before heeling the plants in for later planting.

The present tests were undertaken to determine the relative hardiness in October of plants defoliated during August or earlier. *Forsythia intermedia spectabilis* were used. The growth regulators maleic hydrazide and alpha naphthaleneacetic acid were sprayed on the plants July 14 at the conclusion of the first flush of growth. The immediate objective was to induce bud dormancy so that refoliation would not immediately follow hand or chemical defoliation. Untreated control plants were also used.

3,6-endoxohexahydrophthalate formulated as endothal is available as Niagarathal D.F. Liquid (6.3%) from the Niagara Chemical Division of the Food Machinery and Chemical Corporation, Middleport, N. Y., and was used in the following tests. Five twigs large enough to have 10 leaves of normal mature size were selected on each plant and on three separate dates, July 22, July 29 and August 4. Ninety per cent or more defoliation resulted within a week. Twigs were also defoliated by hand July 22 but not on July 29 nor on August 4. Refoliation was allowed to take place and the new leaves collected September 29. Dry weights were obtained and the data used to indicate the effectiveness of the dormancy inducing agents applied prior to defoliation.

Two tests were made to establish the relative resistence of twigs to low temperature. The first test was begun August 18 and included only leaf bearing twigs. The purpose was to measure the effect of the dormancy inducing chemicals. The second test concerned both foliated twigs and the 15 chemically defoliated twigs on each of the two plants in the several treatments. The twigs were gathered October 3 for testing.

Cold treatment was applied as follows. Twigs were collected and any leaves remaining on the twigs were removed. The twigs were grouped and wrapped in cold (40°F) wet newspaper or paper toweling. The appropriate samples were grouped and stored in polyethylene freezer locker bags at 40°F. After a convenient period of three days or more the appropriate bag of samples was transferred to a second refrigerator and the temperature dropped about 1°F per day to selected temperatures and after 2 days the process reversed. The samples were finally held at 70°F. They were examined for mould and for other indications of dead or injured tissue. After three weeks the twigs were inserted as cuttings in quartz sand in a propagating bench for final observation on growth.

The test temperatures for August sampling were 28°, 23° and 18°F. The temperatures used in October to determine loss of hardiness due to defoliation were 22°, 17° and 12°F.

Table 1. Per cent mortality following exposure of non-defoliated twigs tested 8/18 to specific low temperatures

°F Low temperature treatment	control	parts per million: maleic hydrazide 1000	maleic hydrazide 5000	alpha naphthaleneacetic acid 62	125	250	500	Mean
28	0	25	25	50	0	0	0	14
23	50	25	25	75	0	0	25	30
18	100	100	100	100	100	100	100	100
Mean	50	50	50	75	33	33	42	48

L.S.D. - chemical treatment of parent plant, 26% at 5% level, 39% at 1% level.
L.S.D. - temperature to which twig exposed, 18% at 5% level, 26% at 1% level.

Treatment of the parent plant with growth regulator 7/14 did not result in more than marginal significance at the 5% level. Difference occurred in only one treatment (NAA 63 ppm) in which stimulation of growth was also noted, Table 3.

The temperature to which twigs were exposed appeared to be the significant factor in survival rather than growth regulator treatment. The temperature at which serious injury took place lay between 23° and 18°F. At 23°F two samples showed no injury, i.e., NAA 125 and 250 ppm.

Table 2. Mortality per cent in defoliated twigs as indicated November 20 by inspection three weeks after subjecting twigs to temperatures of 22°, 17° or 12°F on October 20.

Growth regulator spray (ppm) applied to parent plant 7/14 prior to defoliation 7/22, 7/29 or 8/6 by Niagarathal D.F. Liquid.

0°F Low temperature treatment	control	parts per million: maleic hydrazide 1000	maleic hydrazide 5000	alpha naphthaleneacetic acid 62	125	250	500	Mean
22	6.6	22.2	6.2	23.5	6.2	31.8	0.0	13.8
17	0.0	64.4	33.3	0.0	0.0	13.5	53.0	23.4
12	0.0	100.0	37.0	66.6	45.0	80.0	69.0	56.8
Mean	2.2	62.2	25.5	30.0	17.1	41.8	40.6	31.3

L.S.D.- chemical treatment of parent plants, 36% at 5% level, 51% at 1% level.
L.S.D.- temperature to which twigs exposed, 24% at 5% level, 33% at 1% level.

Treatment of the parent plant with growth regulator prior to defoliation resulted in significantly higher mortality in three of the six treatments when compared to untreated controls.

The average mortality among twigs receiving growth regulator and defoliant indicates significantly greater mortality in twigs subjected to 12°F than in those subjected to 17° or 22°F.

In comparing mortality in twigs defoliated by hand with those defoliated chemically no loss was found in either hand or in chemically defoliated twigs at 17° or at 12°F. When twigs were first treated with growth regulator sprays, the mortality was 6% following hand defoliation and for chemically defoliated twigs it was 13% and 15% when test temperatures were 17° and 12°F as based on results after 3 weeks from the time twigs were removed from cold temperature chambers.

Table 3. Refoliation 9/29 on twigs defoliated chemically on plants previously sprayed on 7/14 with growth regulators. Refoliation expressed as dry weight of new growth from 10 twigs.

Growth regulator (ppm) sprayed on parent plant on 7/14 prior to defoliation.

Date defoliated	control	maleic hydrazide 1000	maleic hydrazide 5000	alpha naphthaleneacetic acid 62	alpha naphthaleneacetic acid 125	alpha naphthaleneacetic acid 250	alpha naphthaleneacetic acid 500	Mean
7/22	2.75	1.25	0.45	27.84	15.32	14.25	1.65	9.07
7/29	0.83	0.43	0.15	3.14	3.55	2.65	1.70	1.78
8/ 6	0.50	0.00	0.72	1.69	0.00	0.00	0.00	0.42
Mean	1.36	0.56	0.44	10.89	6.29	5.63	1.12	3.76

L.S.D. - treatment prior to defoliation, 15 at 5% level and 24 at 1% level.

L.S.D. - date of defoliation, 8.8 at 5% level and 12 at 1% level.

While the data presented do not show statistical significance, several quite consistent trends are evident. First the amount of refoliation is less as the defoliation takes place later in the season. Second, the maleic hydrazide data conform to the above trend and with one exception show less refoliation than occurs in control plants. Third, the data from the alpha naphthaleneacetic acid treatment follow trend one as noted above, and also show a gradation in response correlated with the amount of chemical applied. The response ranges from stimulation of growth to retardation.

Table 4. Refoliation on 9/29 on twigs defoliated chemically on 7/22 compared with refoliation on twigs defoliated by hand on 7/22. Refoliation expressed as dry weight of new foliage on 10 twigs.

Growth regulator sprays (ppm) applied to parent plant prior, 7/14, to defoliation, 7/22.

Defoliation method	No.	maleic hydrazide 1000	maleic hydrazide 5000	alpha naphthaleneacetic acid 62	alpha naphthaleneacetic acid 125	alpha naphthaleneacetic acid 250	alpha naphthaleneacetic acid 500	Mean
Hand	5.40	3.80	0.00	20.57	1.63	2.48	5.47	5.61
4069	2.75	1.25	0.45	27.84	15.32	14.25	1.65	9.07
Mean	4.07	2.53	0.23	24.20	8.47	8.37	3.56	7.35

L.S.D. - chemical treatments, 24 at 5% level, 37 at 1% level.

L.S.D. - method of defoliation, 86 at 5% level, 422 at 1% level.

While no statistically significant data are given, repression of bud break is consistently shown in plants treated with maleic hydrazide. Stimulation of growth is noted following treatment with small amounts of alpha naphthaleneacetic acid.

Summary

Resistence of twigs to injury from low temperature is greater in October than in July. Twigs defoliated in July were not injured by 12°F in October. All twigs subjected to 18°F in July were killed but in October untreated control twigs were uninjured following test temperatures of 17° and 12°F.

The method of defoliation, i.e. by hand or by Niagarathal D.F. Liquid, did not result in differences in mortality in the present tests.

Dormancy inducing treatments with the growth regulators maleic hydrazide and alpha naphthaleneacetic acid did not interfere with the defoliant action of the Niagarathal D.F. spray but did result in considerable mortality when twigs were submitted to test temperatures of 17° and 12°F in October.

Dormancy inducing treatment by growth regulators sprayed on foliage prior to defoliation did not always retard bud break but did show trends correlated with the amount of growth regulator applied.

Control of Winter Annual Weeds in Rows of Woody Nursery Stock by Directional Spraying with Contact Herbicides in Late Fall

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During the past several years directional sprays have been applied when temperatures were about 40°F. The sprays have been confined to the narrow soil on either side of the rows of nursery stock, usually Taxus cuspidata varieties, so that only the soil normally hoed or hand weeded received herbicide treatment. The weeds predominating were annual chickweed, Stellaria media, annual bluegrass, Poa annua, yellow rocket, Barbarea vulgaris, and groundsel, Senecio vulgaris. Herbicides were applied to well established weeds of 1 inch or more in size. First tests were made in late winter or early spring before growth started. In 1951 treatments were confined to December and January. Directional spraying is used to reduce the amount of herbicide coming in contact with nursery stock. No attempt was made to shield the base of the stem or the low branches and buds. Stems were often covered with herbicide to a height of 4 to 8 inches. Treatments were made by hand, using knapsack spray equipment. One gallon of spray mix was used per 100 feet of row. Rows were 36 inches apart.

Herbicides tested include potassium cyanate, sodium pentachlorophenate, Stoddard Solvent, 3,6-endoxohexahydrophthalate formulations, isopropyl xanthate, I.P.C. and chloro I.P.C., dinitro formulations of the pre-emergence group and C.M.U. The most consistent results have come from the dinitro formulations and from chloro I.P.C. The nature of the results are indicated in the lantern slides which indicate better than 90% control of weeds within the area receiving the herbicide and without obvious injury to the Taxus plants.

Tests were run during the summer of 1952 in late July following the cessation of first growth and the formation of bark on young stems. Both Taxus and such deciduous shrubs as roses, forsythia, philadelphus, Japanese barberry and Hills of Snow hydrangea were treated without the loss of more than an occasional leaf.

To study the effect of herbicides on dormant buds of nursery stock, twigs of Forsythia and of Ligustrum were cut in October and sectioned to 3-4 nodes grouped in units of 10 and 8 such units sprayed. After spraying, 4 units were allow to dry rapidly at 85°F and the remaining 4 dried slowly in a cool 50°F temperature. Each unit of twigs was then placed in a quart bottle containing moist sand. The bottles were closed and stored for a month at the original temperatures, 85°F and 50°F. Estimate of injury was made after cutting the bark and bud or buds. Any evidence of injury was recorded as injury. The twigs were then placed in a propagating bench. Bud break and foliation of upper nodes of Forsythia is normal. Ligustrum is still dormant. The summary of the estimate of injury is given in Table 1.

Table 1. Estimate of injury to bark or buds in *Forsythia intermedia spectabilis* and *Ligustrum ovalifolium* following direct coverage of herbicidal sprays of recommended concentration and of double strength or higher. Volume of spray approximated 1 gallon per 100 feet of row.

		Estimated injury %, Average of 4 units					
		Forsythia		Privet (dead twig)		Privet (buds dead or injured	
Herbicide	Concentration	85°F	50°F	85°F	50°F	85°F	50°F
Control	Water only	3.3	0	0	0	0	0
Sinox W	1:100	0	0	0	0	0	0
	1: 50	0	0	0	0	0	0
	1: 25	0	0	0	0	0	0
	1: 12½	0	0	0	0	0	0
Sinox pre-emergence	1: 50	7.5	0	100	0	100	0
	1: 25	7.5	0	100	0	100	12.5
	1: 12½	55.0	15	100	0	100	12.5
Dow pre-emergence	1: 50	5.0	0	47.5	0	100	10
	1: 25	5.0	0	92.5	0	100	0
	1: 12½	92.5	7.5	100	0	100	7.5
Chloro I.P.C.	1: 50	0	0	0	0	0	0
	1: 25	10	0	2.5	0	2.5	0
	1: 12½	2.5	0	2.5	0	2.5	0
3,6-endohexa-hydrophthalate (ME-3003)	1: 50	0	0	5.0	0	5.0	0
	1: 25	5.0	20	0	0	0	2.5
	1: 12½	10.0	47.5	15.0	0	15.0	0

Injury was most common following rapid drying of dinitro sprays of double strength or greater. In Ligustrum such treatment was lethal. Under cool slow drying conditions followed by cool storage (50°F) but without the washing effect of rains, ice or snow, very little injury was found except in Forsythia when liberal amounts of 3,6-endohexahydrophthalate from six to sixty times as concentrated as used for defoliation purposes resulted in serious injury.

Used at 1:25 pre-emergence formulations of dinitros and of chloro . . I.P.C. are effective herbicides for winter weed control without likelihood of serious injury to dormant nursery stock. To date field observation would indicate that these two chemicals have not remained in the soil in sufficient amounts to adversely modify growth. This is in agreement with the findings of Crafts[1] and of Zobell[2].

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2. Zobell, C. E. Action of Micro-organisms on Hydrocarbons. Bact. Rev. 10: 1-49. 1946.

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REPORT ON INVESTIGATIONS IN HAWTHORN CONTROL

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In several counties in western Ontario hawthorn (Crataegus spp.) has completely covered thousands of acres of otherwise suitable agricultural land. A much larger area is partially infested and will be rendered useless unless this shrub is brought under control. Cultural methods are useful under some conditions. When the trees are small, deep plowing followed by normal cultural practices has been satisfactory. Tractors and bulldozers have been used to pull or 'uproot' well established trees but this method is expensive, re-growth is often a problem, and in some areas it is difficult to get men to do the work. Cultivation is not desirable on alluvial flats along certain rivers as they are flooded for a short period each spring. Investigations have been conducted each year at Guelph since 1946 to determine the practicability of chemical control measures.

A report was made by Gammon (1) in 1949 and by Gammon and Bibbey (2) in 1950 on the effect of stage of development on the control of hawthorn with three types of 2,4-D applied as foliage sprays. The amine salt, sodium salt, and isopropyl ester of 2,4-D were applied at 1000, 2000 and 4000 ppm in water as "over-all" sprays to trees of a similar size. The same quantity of solution was applied to each tree with a low pressure spraying device. Treatments were made in triplicate and were applied at the following stages of development:- (1) buds starting to open, (2) buds half open, (3) leaves half size, (4) leaves fully developed, (5) flowers in bud, and (6) full bloom. No complete kill was obtained with any treatment applied at the first two stages of development. Variable results were obtained at the third and fourth stages, particularly with the sodium salt at the lighter rate. Satisfactory kills of both tops and roots were obtained at the flower bud and full bloom stages with all treatments.

Basal bark treatments

In 1950, basal bark treatments were applied in mid-May, in early July, and during the third week in August. Twelve inches above ground level of each trunk was sprayed till "run-off" with each mixture. The treatments used were:- (1) 2,4-D butyl ester, (2) 2,4-D/2,4,5-T butyl esters, and (3) 2,4,5-T isopropyl ester. The concentrations and carriers used for each chemical were 3, 5 and 7 percent in water and in oil (Varsol). Approximately 160 ml. was applied on each tree.

The results obtained in this series were similar for the three dates of treatment. The results of the May treatments are shown in Table I.

Table I. Results of basal bark treatments of hawthorn, Guelph, 1950

Treatment	%	Water				Oil			
		17 Sept. '50		12 Sept. '50		17 Sept. '50		12 Sept. '50	
		% affected	Deg.	% affected	Deg.	% affected	Deg.	% affected	Deg.
2,4,5-T ester	7	0	0	100	2	100	2	0	0
	7	0	3	100	2	100	4	100	4
	7	0	2	100	2	100	4	100	4
	5	0	1	100	4	0	0	10	2
	5	0	2	0	0	0	3	40	2
	5	0	1	100	4	60	3	60	3
	3	0	0	0	0	100	4	100	4
	3	0	1	0	0	0	3	80	3
	3	0	1	100	4	0	3	0	0
Check	-	0	0	0	0	0	0	0	0
2,4-D/ 2,4,5-T esters	7	0	2	100	4	100	4	100	4
	7	50	3	50	3	100	1	100	4
	7	100	4	100	4	70	4	100	4
	5	50	2	50	2	100	4	100	4
	5	10	3	50	2	80	3	100	4
	5	0	1	-	-	95	4	100	4
	3	25	3	40	2	90	3	100	4
	3	25	2	0	2	95	4	100	4
	3	0	1	0	0	90	4	100	4
Check	-	0	0	0	0	0	0	0	0
2,4-D butyl ester	7	100	4	100	4	100	4	100	4
	7	80	2	100	3	30	4	100	4
	7	100	4	100	4	100	4	100	4
	5	0	0	50	4	100	4	100	4
	5	5	3	50	2	100	4	100	4
	5	95	3	90	3	100	4	100	4
	3	0	2	0	0	50	3	100	4
	3	0	1	90	1	100	4	100	4
	3	5	2	75	3	80	4	100	4
Check	-	0	0	0	0	0	0	0	0

% = percent active ingredient
Deg. = degree, 0 = none, 1 = slight, 2 = moderate, 3 = severe, 4 = dead
2,4,5-T ester = 2,4,5-T isopropyl ester
2,4-D/2,4,5-T = 50/50 butyl ester

Oil was more effective than water as a carrier at all rates. All trees in the 2,4-D butyl ester and 2,4-D/2,4,5-T butyl ester treatments were dead the year following treatment at all rates of applications. The 2,4,5-T isopropyl ester treatments were not as successful.

The 1951 basal bark tests were all applied in May. The treatments consisted of (1) 2,4-D butyl ester in both oil (Varsol) and fuel oil, (2) 2,4-D/2,4,5-T butyl esters in fuel oil, (3) 2,4,5-T propylene glycol ester in fuel oil, (4) Varsol, (5) fuel oil, and (6) untreated checks. The rates used were 2,4,6 and 8 percent of acid for each chemical. Each group of five trees was sprayed to "run-off" with 800 ml. of mixture or oil. Four months after treatment all trees treated with 2,4-D butyl ester at 4, 6 and 8 percent in both oils were dead. Four of the five trees treated with 2,4-D butyl ester in fuel oil were dead. Only one tree was dead in the group treated with 2,4-D butyl ester in Varsol. When the data for the three chemicals in fuel oil was compared, two of the twenty treated with 2,4-D butyl ester, five of the twenty treated with 2,4-D/2,4,5-T butyl esters and seven of twenty treated with 2,4,5-T propylene glycol ester were still alive at the end of the first year. Sixteen months after treatment all trees treated with 2,4-D butyl ester and 2,4,5-T propylene glycol ester were dead. Three of the twenty treated with 2,4-D/2,4,5-T esters at the lower rates were alive. All of the trees treated with Varsol or fuel oil alone were alive at the end of the second year. The untreated checks were normal.

In April 1952 a program was started in which a series of basal bark treatments is repeated at intervals of approximately thirty days through one complete year. Treatments consist of (1) fuel oil alone, (2) 2,4-D butyl ester at 2 and 4 percent, (3) 2,4-D/2,4,5-T butyl esters at 2 percent, and (4) 2,4,5-T propylene glycol esters at 2 percent in fuel oil. Fifty trees have been treated and tagged for each date.

Preliminary results of a check of the May treatments this fall are given in Table II. On the trees here listed as dead there were no buds, and no green cambium layer could be found on any of the branches. Final readings will not be made until next summer.

Table II. Preliminary results of basal bark treatments at Haysville, 1952.

Chemical	% acid	dead	alive
2,4-D butyl ester	4	18	32
	2	15	35
2,4-D/2,4,5-T butyl ester	2	7	43
2,4,5-T propylene glycol ester	2	7	43
Fuel oil	0	0	50

Stump treatments

Stump treatments in 1950 were applied in mid-May and mid-August within a few hours of cutting. The chemicals used were:- (1) 2,4-D butyl ester, (2) 2,4-D/2,4,5-T butyl esters, and (3) 2,4,5-T isopropyl esters. The rates used were 1, 4, and 7 percent for each chemical in water and in oil (Varsol). Notes were taken on the amount of regrowth and vigour of the regrowth in comparison with the untreated checks. Each stump was sprayed till "run-off" with approximately 150 ml. of mixture. Some of the data obtained is shown in Table III.

With few exceptions all treatments reduced the amount of regrowth from the stumps. Results of the August treatments appear to be better than those of the May treatments. Oil (Varsol) was more efficient than water as a carrier for all treatments at both dates. There was a slight amount of regrowth from the lower rates of 2,4-D butyl ester and from the 2,4-D/ 2,4,5-T butyl esters when applied in oil.

The 1951 stump treatments consisted of:- (1) 2,4-D butyl ester in water, Varsol, and fuel oil, (2) 2,4-D/2,4,5-T butyl esters in water and fuel oil, and (3) 2,4,5-T propylene glycol esters. The rates used were 2, 4, 6, and 8 percent of acid for each chemical. Sixteen months after treatment 11 of the 140 stumps treated had some regrowth. Of these 8 were in the treatments where water was used as the carrier. There was no significant difference in effect between the chemicals or between fuel oil and Varsol. All the untreated checks were hidden by normal regrowth about two feet in height.

A second group of stumps was treated with 2% 2,4-D butyl ester in fuel oil and in three oils of different aromatic content. These oils varied from 23% to 50% aromatics. Twenty stumps were treated with each mixture. Ten were treated with fuel oil alone, ten with Varsol, and six were untreated checks. In this test approximately half as much material (80 ml.) was used on each stump.

All stumps treated with fuel oil alone re-sprouted. Half (10) of those treated with 2,4-D butyl ester in fuel oil re-sprouted. There was no significant difference between the oils of different aromatic content. All untreated checks grew normally.

Summary

1. The species of hawthorn growing in the area used (Crataegus punctata Jacq.) was controlled by "over-all" foliage sprays of the amine salt, sodium salt, and isopropyl ester of 2,4-D at rates of from 1000 to 4000 ppm applied when the leaves were fully expanded and the flowers were in bud or in bloom.

Table III. Results of hawthorn stump treatments at Guelph, 1950

Treatment	%	May treatments								August treatments							
		Water				Oil				Water				Oil			
		Sept 51		Sept 52		Sept 51		Sept 52		Sept 51		Sept 52		Sept 51		Sept 52	
		R	V	R	V	R	V	R	V	R	V	R	V	R	V	R	V
2,4,5-T ester	7	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	7	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	7	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	20	3	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	1	100	3	100	3	0	-	0	-	0	-	0	-	0	-	0	-
	1	80	3	80	3	0	-	0	-	0	-	0	-	0	-	0	-
	1	0	-	0	-	0	-	0	-	5	2	10	2	0	-	0	-
Check	-	100	4	100	4	100	4	100	4	100	4	100	4	100	4	100	4
2,4-D/ 2,4,5-T esters	7	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	7	10	4	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	7	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	100	4	100	4	0	-	0	-	0	-	0	-	0	-	0	-
	4	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	1	100	4	5	4	0	-	0	-	0	-	0	-	0	-	0	-
	1	50	3	20	4	0	-	0	-	0	-	10	2	0	-	0	-
	1	100	4	0	-	25	4	20	4*	0	-	0	-	0	-	0	-
Check	-	100	4	100	4	100	4	100	4	100	4	100	4	100	4	100	4
2,4-D butyl ester	7	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	7	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	7	5	1	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	4	0	-	0	-	25	4	30	4*	0	-	0	-	0	-	0	-
	1	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
	1	60	4	70	4	0	-	0	-	0	-	0	-	0	-	0	-
	1	30	3	30	4	10	4	50	4*	5	1	20	3	0	-	0	-
Check	-	100	4	100	4	100	4	100	4	100	4	100	4	100	4	100	4

* root
% = percent active ingredient
R = regrowth expressed in percent of checks
V = vigour, 1 = very little, 2 = little, 3 = moderate, 4 = healthy
2,4,5-T ester = 2,4,5-T isopropyl ester

2. For basal bark treatments oil was superior to water as a carrier.

3. Results were similar for basal bark treatments made in early May, early July, and mid August.

4. A mixture containing as low as 2% acid of 2,4-D butyl ester in oil applied as a spray to the lower foot of trunk until "run-off" has given satisfactory control of the hawthorn species treated.

5. Over a period of three years 2,4-D butyl ester has been equal to or superior to 2,4,5-T esters or mixtures of 2,4-D and 2,4,5-T butyl esters in almost all basal bark treatments.

6. Regrowth from freshly cut stumps has been prevented for over two years by spraying them till "run-off" with 2,4-D butyl ester, 2,4-D/2,4,5-T butyl esters, or 2,4,5-T esters in fuel oil at rates as low as 2% acid.

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Translocation of 2,4,5-T in Cuban Marabu

by J. R. Hay and K. V. Thimann

Field trials by numerous workers have shown that 2,4-D and 2,4,5-T in many cases do not kill the underground parts of woody plants. The ability of certain shrubs and trees to survive and produce new shoots seriously limits the value of these compounds. The most probable reason for the survival of roots is that the material does not move into them in toxic amounts although physiological concentrations must occur there whenever resprouting is delayed. For this reason we have initiated a study of the downward translocation of 2,4,5-T into the roots of Marabu. The following report, while strictly preliminary, allows a few conclusions to be drawn.

Marabu (*Dichrostachys nutans*), the most important of the woody weeds in Cuba, has a vast network of horizontal roots which are concentrated mostly within the top six inches of soil. When cut back, vigorous suckers or ratoons arise which, if left alone, will attain a height of 6-8 feet within a season, suppressing all the local vegetation and forming solid stands up to 20 feet high extending for miles. The particular stand upon which these experiments were conducted was a cut-over area which had produced suckers 4-5 feet high and approximately 1/2-3/4 of an inch in diameter at the base (cf. Thimann, 1951). It was located at the Atkins Garden in Soledad, near Cienfuegos, Cuba.[1]

In order to study the movement of the herbicide it was extracted from samples of tissue from treated plants. These extracts were subsequently subjected to a bioassay for auxins (the Pea test) to determine the content of the herbicide in the different samples. The technique of these extractions has been worked out in the laboratory on seedlings growing under constant conditions and treated in a reproducible way. It will be published elsewhere. It will suffice to mention here that the method does not depend upon growth inhibition and therefore gives results which are not influenced by inhibiting substances present in the tissue. This extraction method has some advantages over the use of growth regulators containing C^{14}, since it has been shown that C^{14} may be given off as $C^{14}O_2$. This free $C^{14}O_2$ may then be reincorporated within the plant so that really what one traces is the C^{14} in other compounds and not necessarily the intact 2,4-D. (Fang et al., 1951).

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[1] We wish to acknowledge the support of the Elizabeth Thompson Science Foundation in defraying part of the expenses concerned with this work, and to thank Dr. I. Duncan Clement, Economic Botanist in Charge, The Atkins Garden and Research Laboratory, for his generous help and cooperation. The 2,4,5-T was generously supplied by the American Chemical Paint Company.

Generally the herbicide 2,4,5-T (Weedone 2,4,5-T butoxyethanol ester) was applied according to the present recommendations for the control of woody plants. Three to four gram samples were taken from various parts of the plant to be extracted. In most cases the bark was separated from the wood and both extracted separately.

In the first experiments the herbicide was applied near the base at rates of 8, 16 and 32 lbs. per 100 gals. in diesel oil. Samples of the bark and wood were then taken from the horizontal roots for testing. Six such trials showed that no 2,4,5-T could be recovered from either the wood or the bark of the roots, either at 2 days or up to 13 days after treatment.

This apparent lack of downward movement into the roots might be due to the lack of downward movement in the stem. Solutions of 2,4,5-T in disel fuel were, therefore, applied to a band about 6 inches wide located on the stem 2-3 feet above the ground. The response to such treatment was striking in that all those parts above the treated area were killed within a few days, whereas the leaves and stems below the treated area appeared to be unaffected. This visual observation in itself suggested strongly that the 2,4,5-T was not moving down. Table I contains data which agree with those of the previous trials in that downward movement was not detected. The fact that 2,4,5-T was recovered in good yield above the treated area where characteristic responses were evident gave support to the reliability of the method.

Four mid-stem treatments in which bark and wood from above the treated area were analyzed separately all showed that the wood contained the greatest amount of herbicide although initially it was the bark that had been treated. Movement upward then takes place in the wood. In this respect the results agree with all earlier findings with synthetic auxins in herbaceous plants, where upward movement is related to the transpiration stream and limited to the wood (see Ferri,1945). With this information it is possible to account for the spectacular top kills produced by bark treatments. The material apparently penetrates through the bark into the wood, whence it is carried upward in the transpiration stream. Also, part of the reason for the recognized superiority of oils as carriers for bark treatments is probably the fact that the suberized corky layer of bark succeeds in keeping the greater part of aqueous solutions out. Oils, on the other hand, due to their different solubility characteristics, are able to penetrate through the bark. In any event, in these trials it was found that 2,4,5-T is not moved downward in the bark and when in the wood of intact plants the movement is upward.

This general conclusion was tested in another way. A number of the outermost leaves on the branches of a few stems were dipped in an aqueous solution of 2,4,5-T at a concentration of 4 lbs. per 100 gallons. Again downward movement into the stem below the treated area could not be detected--either by visual observation

of effects or in the extracts. The results of the latter determinations are shown in Table II. Also, it will be noted in Table II that after 2 days 2400 γ per gram fresh weight was recovered from the leaves whereas at the end of 7 days only a little over 10% of this amount was accounted for. Since the material did not leave the treated area it is reasonable to assume that the 2,4,5-T was destroyed in the leaves.

In order to minimize the hindrance to translocation offered by the stem, attention was now transferred to the treatment of stumps. There are two ways in which 2,4,5-T can be applied to stumps, namely to the bark and to the cut surface. In trials in which the material was applied to the bark, no 2,4,5-T was found in the root sections. This agrees with the above results of the application to intact plants. However, when the herbicide was applied to the cut surface it could at least be recovered from stem tissue below, as is shown by the data in Table III. The stumps for these treatments were 25 cm. high and 3 cm. samples were taken at 6-9 cm. and 16-19 cm. below the cut surface. In 10 plants receiving cut-surface treatments significant amounts were recovered below the point of application. In addition, however, in every case more material was recovered from the wood than from the bark, as is indicated in Table III. Therefore, under these conditions downward movement does occur but the 2,4,5-T moves in the wood rather than in the bark.

It is apparent from all the above data that under conditions of field application the basal part of the stem is a serious limitation on transport of 2,4,5-T into roots. In the last trials of this series, therefore, the 2,4,5-T was applied to the cut surfaces of short stumps, 5 cm. high. Sections for analysis were taken from the roots at a total distance of 5 to 7 inches from the cut surface. As shown in Table IV, 2,4,5-T was found in these root sections well below the point of application. Although downward movement from cut surfaces was detected 7 inches below the cut surface, as in Tables III and IV, the full extent of this movement was not determined because time was not available.

Discussion

First, it is clear that when 2,4,5-T is applied to the base, only upward movement takes place and this occurs in the wood. Second, large quantities of the applied herbicide are destroyed in leaves within a few days. Third, downward movement from cut surfaces of stumps has been demonstrated and this apparently takes place more in the wood than in the bark. Last, some movement into the roots does occur when the material is applied to cut surfaces of very short stumps.

Basal treatments in practice require volumes great enough to produce considerable run off. Since downward movement within the plant from bark treatments is negligible, it seems that these treatments are effective simply because the oil mixtures run down and soak into the bark in the area from which the new buds arise. Hence, plants which form buds only in the base, and not in root tissue, can be killed.

Although our experiments are preliminary, it is clear that the only treatment causing detectable movement of 2,4,5-T into the roots was application to the cut surface of very short stumps. It is suggested that this procedure be tested on other types of woody plants which sprout from the roots.

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Table I. Recovery of 2,4,5-T when about 32 mg. were applied to a midsection of a stem of Marabu. Samples taken 1 inch above and below treated area.

TIME days after application	SAMPLE		2,4,5-T, γ/gram fresh weight
1	Below	bark	0
		wood	0
	Above	bark	Trace
		wood	13
3	Below	bark	0
		wood	0
	Above	bark	3
		wood	12
7	Below		0
	Above		8

Table II. Recovery of 2,4,5-T when applied at 4 lbs./100 gals. to foliage of Marabu

TIME days after application	SAMPLE	2,4,5-T, γ/gram fresh weight
2	Treated leaves	2400
	Stem in treated area	5
	Stem below treated area	0
7	Treated leaves	320
	Stem in treated area	0
	Stem below treated area	0

Table III. Recovery of 2,4,5-T from stems when about 80 mg. were applied to cut surfaces of long (25 cm.) stumps of Marabu

TIME days after application	Distance of sample below cut surface	SAMPLE	2,4,5-T γ/sample
2	6-9 cm.	Bark	14
		Wood	23
7	16-19 cm.	Bark	0
		Wood	40
11	16-19 cm.	Wood	12

Table IV. Recovery of 2,4,5-T 5 days after about 80 mg. were applied to cut surfaces of short and long stumps of Marabu

Length of stump	Sample from	Distance below cut surface	2,4,5-T γ/gram fresh weight
25 cm.	Stem	16-19 cm.	6
		16-19 cm.	8
5 cm.	Root	11-14 cm.	3
5 cm.	Root	15-18 cm.	10

EFFECT OF PLACEMENT OF DORMANT BASAL SPRAY ON TOP-KILLING AND SPROUTING OF SCRUB OAK

W. C. Bramble, D. P. Worley, and W. R. Byrnes

Basal application of brush control sprays containing 2,4,5-T has been reported as a successful control method by a number of investigators (4). In fact, it has become an accepted technique in control of woody brush (3), and is particularly useful when brush control is done selectively during the winter season in coniferous plantations (1).

One weakness of the dormant basal spray technique, however, has been the irregular basal sprouting of certain resistant woody plants after the tops have been killed back by the initial spray application. In such cases, a certain number of plants fail to sprout while others sprout the following growing season. It has been suggested by Coulter (2) that the key to root-kill is the degree to which spray material reaches the "root crown", and in his tests, basal stem treatment without runoff to the crown permitted sprouting of trees killed back by 2,4,5-T.

The following tests were conducted with scrub oak (Quercus ilicifolia Wang.). This widely-occurring shrub or small tree attains a height of 26 feet, has a well-known ability to sprout vigorously after fire and cutting, and has been observed to sprout erratically after being killed back by chemical sprays. The tests were designed to find out if sprouting could be correlated with the degree to which spray material reached the root collar area, which lies at or slightly below the litter and humus soil layers of the soil surface.

METHODS

In all tests the spray material used was Weedone 2,4,5-T in a concentration of 4 per cent by volume in kerosene (12 pounds of acid per 100 gallons). The following applications were made using ten plants in each test:

(1) The spray material was applied with a brush to completely cover the lower 12 inches of stem above the ground line without allowing the chemical to run down to the root collar or into the ground.

(2) The spray material was applied with a brush so as to completely cover only the root collar, which had been exposed by digging away the litter and surface soil.

(3) The spray material was applied with a brush to completely cover both the lower 12 inches of stem as in (1) above and to the root collar as in (2) above.

(4) The spray material was applied with a knapsack sprayer to cover the ground surface in a 2-foot circle around the plant, care being taken not to spray the plant stem.

(5) The spray material was applied with a knapsack sprayer to completely cover the lower 12 inches of the stem, and as in usual application procedures, an excess was sprayed on so as to run down the stem towards the root collar. This was repeated on two groups of plants, one group contained small to medium plants that ranged from 1/16 to 3/4 inches in basal diameter, while the other group contained large plants that ranged from 1-1/4 inches to 2-3/4 inches in basal diameter.

All applications were made in March, 1952, in central Pennsylvania.

RESULTS

The effects of the various spray applications were clear-cut (Table 1) and can be summarized as follows:

(1) 2,4,5-T applied to the base of the stem, only, caused a 100 per cent top kill and all plants sprouted at their bases.
(2) 2,4,5-T applied to the root collar, only, caused a 100 per cent top kill and none of the plants sprouted.
(3) 2,4,5-T applied to both stem and root collar caused both a 100 per cent top kill and none sprouted.
(4) 2,4,5-T applied to the ground, only, did not affect the plants.
(5) 2,4,5-T applied in excess to the base of stems caused a 100 per cent top kill; but 40 per cent of the plants sprouted.

Table 1. Summary of placement tests with 2,4,5-T, Weedone 2,4,5-T (3 lbs. of acid equiv. per gal.) used as a 4 per cent by volume soln. in kerosene.

Applied in March 1952; results taken in November 1952, after one growing season.

Point of application	No. plants	Ml. of spray applied		Per cent of original plants with complete top kill	Per cent of original plants sprouting at base
		Per plant	Per inch of circum.		
(1) Base of stem, only	10	5.9	0.86	100	100
(2) Root collar, only	10	23.7	1.87	100	None
(3) Base of stem & root collar	10	23.7	4.47	100	None
(4) On ground under plant	10	230.0	32.09	None	——
(5) Excess on base of stem	10 (small)	70.0	10.07	100	40
Excess on base of stem	10 (large)	100.0	9.96	100	40

SUMMARY

A dormant spray of 2,4,5-T, at a concentration of 12 lb. acid equiv. per 100 gal. of kerosene, was applied to scrub oak in March 1952. Spray was applied in separate tests to the following points: (1) the base of the stem, (2) the root collar, (3) the base of stem and root collar, and to the ground beneath the plant. Results have indicated that a complete top kill could be obtained by applying spray in low volume to either the base of stem or root collar; but that basal sprouting was prevented only when spray was applied to the root collar. Spray applications to the base of the stem in excess (10 ml. per inch of circum.) so that runoff to the root collar occurred gave only partial control of sprouting. Spray applications to the ground around the plant had no apparent effects.

It is apparent, therefore, that getting the spray to the root collar is the key to suppression of sprouting in scrub oak. Use of high volumes, which have been found more effective than low volumes (2,5), apparently are valuable only in that they aid in carrying the active ingredient to the root collar more effectively. Much higher volumes of spray per plant than commonly used at present, at lower concentration of 2,4,5-T, and applied to the base of the plant to get the spray past obstacles such as leaf litter, soil, or irregular contours in the root collar should give improved control. Although it appears to be more economical at present to accept a certain amount of basal sprouts and attempt to reach the point of sprout origin with a second spray given at least one year later, increase in volume of spray to reduce per cent of plants sprouting vs. cost is being investigated.

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THE IMPORTANCE OF WEEDS IN ALLERGIC MALADIES

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The title of my discussion contains two terms equally difficult to define, the terms "weeds" and "allergic maladies." Both are vague, indefinite, elastic, subject to wide variations in interpretation. An agreement upon the concept of these two expressions is essential to any remarks that may be made upon them. When does a plant become a weed, what is a weed? My audience, the members and guests of the Northeastern Weed Control Conference, are able to answer this question much better than I. One's point of view would have something to do with reaching a decision. The overgrown vegetations of the tropics, rank and commonplace, become rare and pleasing exotic plants elsewhere; the golden rod, an annoyance to the farmer, may appear as a colorful attractive flower to the urban dweller. It would seem that a plant becomes a weed when its nuisance value outweighs its esthetic or economic worth to man, when its lustiness and vigor, despite its beauty of form or flower, permit it to crowd out more delicate and more desirable plants, or when its noxious qualities make it a threat to the well-being of man and animal. On the basis of there being specific hazards to his own health, the allergic individual is inclined to group as weeds many additional plants, attractive and harmless to the majority of the population, but decidedly disturbing to him.

The person suffering from an allergic malady is a peculiar individual, due largely to the fact that his disease is caused usually by commonplace substances in his physical environment, rather than by bacterial invasion of his body by infection. Although he comes into contact with these substances to a degree no greater than do other members of the general population, his symptoms are prompt, severe, incapacitating, and place in the role of a major offender with great etiologic importance such an ordinary and usually harmless agent as the ever present weed. This tendency to react with marked discomfort to his surroundings is an hereditary feature. It is a family trait transmissible from a member of one generation to that of another. Apparently it is governed according to the laws of dominance that Gregory Mendel found operative in his study of the transmission of traits of the sweet pea. It is important to remember that the feature which is inherited is the capacity of the allergic individual's tissue cells to become extremely irritated or sensitized in a specific manner. The well developed clinical allergic complaint itself is not inherited, its form being influenced greatly by the exposures and contacts in the individuals environment. Hay fever, rhinitis, bronchial asthma, bronchitis, and dermatitis (urticaria and eczema) are examples of allergic maladies caused by this cell sensitization. The tendency to an allergic condition may be manifested in a parent as hay fever, in the child as an entirely different ailment such as bronchial asthma.

Every one of us is equipped by nature with a clearing mechanism for protecting himself from the irritation of foreign substances passing into his system by absorption through the respiratory and gastrointestinal tracts and the skin. These foreign substances naturally and normally present are in the air we breath as are pollens, dusts, animal danders; in the food we eat;

in plant resins with which the intact skin comes into contact. Upons being absorbed into the body such substances are attacked by tissue cells especially equipped for the purpose of neutralizing and disposing of any invading foreign material. This process is completed without harm to the normal individual or his tissue cells, and without apparently detrimental after effects such as the development of allergic symptoms. In 10% of the population, however, this special protective mechanism or phagocytosis does not end with this normal activity of disposing of foreign matter. The mechanism often through hereditary influences extends beyond this, becoming exaggerated and overcompensating. Enormous increases in the number of the defensive tissue cells or a great enhancement of their protective activities, or both, is stimulated by their contacts with the foreign substances. Such cells are equipped to produce a prompt and vigorous attack upon the reinvading foreign substance. This activity is responsible for the release of toxic materials which cause the severe, often incapacitating allergic symptoms. Individuals whose tissue cells are thus sensitized to intense activity upon exposure and re-exposure to foreign substances are termed allergic. The allergic symptoms from which they suffer may assume a variety of forms such as those of hay fever, bronchial asthma, or of allergy of the gastrointestinal tract or skin, depending upon the body area in which occurs the greatest degree of sensitized cell activity. Urban dwellers and rural workers, child and adult, the black and white races, the American Indian, are all affected. The foreign materials, the causative agents, are many and varied, but are usually airborne as pollens or dusts or ingestible substances such as foods and drugs.

Of major importance in our discussion are airborne plant pollens drawn into the respiraroy tract in the inhaled air. Fortunately, not all types of pollens are producers of allergic symptoms. Countless varieties are innocuous. The heavy, sticky type of pollen which tends to be immobile unless transported by the bodies and wings of visiting insects and bees is rarely the cause of hay fever. The colorful attractive, often scented blossoms such as of the daisy or of goldenrod, designed to lure these carrying agents, are harmless unless cut and brought indoors where they dry, allowing their pollens to permeate the closely confined atmosphere of the house. The airborne pollens of the plants with inconspicuous, less noticeable blossoms are the usual cause of hay fever. Produced in tremendous excess, bouyant and widespread, these pollens are responsible for the distress of thousands of cases of hay fever and bronchial asthma.

Fortunately for the allergic sufferer, not all types of airborne pollen are hay fever and asthma producers. Over the past four decades it has been the goal, seemingly impossible, of allergist and of botanist to discover in all the wealth of vegetation the particular offenders, and to identify the plants whose pollens produce allergic symptoms. In this the investigators were aided by two tremendously important facts; the first, that the skin cells of the allergic patient share the sensitization found in other types of tissue cells; and the second, well known to you, that there has been established by nature a reliable, dependable schedule of pollination characteristic of each plant, a schedule influenced but slightly by climatic or weather variations.

The great diagnostic aid which enables us not only to identify the patient with hay fever, but also to determine the specific, exact pollen causes important in his case, is the skin test. Upon exposing the cells of the skin by puncture or scarification procedures to minute carefully estimated amounts of extracts of the various suspected pollens, characteristic changes will occure, but only

at those sites tested with these pollens to which the patient's cells are sensitive. Within a few minutes itching, flushing, and swelling of the skin will occur, with the development at the test site of a wheal or small hive, which persists for 15 to 20 minutes, then disappears. This test is very specific and delicate. It enables the investigator not only to identify the particular offending pollens, but also to determine the degree of sensitiveness present in the individual to each specifically offending pollen, a matter of great variability from patient to patient, and from pollen to pollen.

Well known to the patient suffering from a pollen allergy is the period within which his symptoms occur. The seasonal limits of onset and offset of his discomforts are relatively constant from year to year, provided he continues to be in the same environment. By comparing his period of suffering with the pollination period of various plants producing airborne pollen, the investigator is enabled to narrow the list of possible causes in each patient's problem. The individual who states that his hay fever occurs from mid-August to October is immediately suspected of being a victim of ragweed pollen, since its pollination period coincides with the patient's time of discomfort.

Additional useful information regarding ragweed allergy may be obtained by comparing the patient's daily fluctuations in the degree of severity of his symptoms with the daily census of his specifically disturbing pollen as influenced by variations in weather conditions. A daily count of the pollen trapped upon an adhesive coated slide, exposed for constant periods, will provide the information upon the rate of pollen production. In this state, extensive surveys have been conducted by the New York State Department of Health, which has established pollen collection stations in many strategic areas of the state, furnishing valuable information as to pollen production in the several sections. Thanks to the characteristic appearance microscopically of the various types of pollen, a classification can be made of those most prevalent. Ragweed pollen has been made the object of especial study. The Department of Health has thus been able to determine areas relatively free of this weed, and has prepared a valuable list of these for ragweed sufferers.

The lists of weeds and plants which cause hay fever is known to us through the highly successful efforts and zealous co-operation of the botanist. Field studies and pollen surveys, the collection of pollen from suspected plants, and its subsequent testing by the allergist upon pollen victims has yielded an evergrowing mass of information. Throughout the years important data has been collected in all areas of the United States, the Central and South American Republic, England, and other European countries. One of the most valuable reference volumes upon the hay producing plants of the United States is that of Wodehouse. (1)

In the Northeastern area of the United States the dates of pollination of the important hay fever and asthma producing plants permit a sharp division of the pollen victims into three groups. In the first are those whose symptoms occur between mid-March and June 1st. No weed is a culprit although many tree pollen victims in this group are ready to stigmatize as weeds the real sources of their discomfort, which are the ash, beech, birch, elm, oak, hickory, and poplar. The pollen of the alder and of the swamp sedges occasionally produces symptoms. In the second group, the symptoms persist from mid-May to mid-July. English plantain, Plantago lanceolata, is a weed of much importance here, with Sorrel, Rumex acetosella, of lesser importance. Of greater moment than these weeds, however, is the family of grasses -- timothy, orchard, cat, rye, redtop,

june, bermuda, sweet vernal, velvet. Roses, since insect pollinated, are innocuous unless cut and kept indoors. The term "Rose Cold" is, therefore, an incorrect designation for the summer type of hay fever. In the third group of patients the symptoms occur from mid-August to frost, and it is here that the weed asserts its importance. The ragweeds, giant and dwarf, Ambrosia trifida and elatior, are the chiefs of them all, having the dubious reputation of being the cause of more suffering than all other pollens combined. Not only does the discomfort they produce involve a greater number of victims, but the suffering is more intense in degree and occurs at a time of the year, at the threshold of autumn, when secondary, complicating bronchial and sinus diseases are encouraged to appear. It has been estimated that 1/3 of all untreated ragweed hay fever sufferers eventually develop bronchial asthma, a much more serious and disabling disease. Of lesser importance are Cocklebur (Xanthium); Lambs' quarters (Chenopodium); Pigweed (Amaranthus); Mugwort (Artemisia); American Hemp, Wild Rice (Zizanea); Great Reed (Phragmites); Marsh Elder (Iva). As stated, Golden Rod does not deserve the evil reputation it has. Its pollen, since insect borne, will cause no symptoms unless the blossoms are brought indoors. The list of weeds which produce allergic discomfort is even greater in other areas of the United States. In the Plains states, Southwestern states, and the Pacific states, the most troublesome are the chenopods, thistle (Salsola), and burning bush (Kochia); and the wormwoods or sages (Artemisias).

Since the distressing allergic symptoms result from actual physical contact of pollen and patient, the surest way to obtain relief for the patient is for him to escape to an area where the pollen producing plants, particularly disturbing to him, do not grow. Bermuda, Nova Scotia, the tropics, our own Southwest and areas in the Rocky Mountains, offer complete freedom from hay fever to rag weed sufferers. Less completely free localities are the southern tip of Florida, California, areas in the heavy wooded sections of the upper Michigan peninsula, of Maine, and of Canada and some parts of the White Mountains. The pollen surveys of the New York State Department of Health has established the relative freedom from pollen of numerous Adirondack localities. (2)

Such escapes from pollen, however, are impractical or impossible for the majority of sufferers, who cannot be absent from their work or their families for the long intervals required. For them relief can be expected by attacking the hay fever producing weeds themselves by eradication, a slow, painful, and not very successful process, by manual removal or by cutting at the strategic mement when pollination is imminent. Far superior are the chemical methods. The New York City Department of Health, according to Dr. Samuel Frant,(3) has since 1946 conducted an extensive plan for the extermination of ragweed by employing a spray of the hormone 2,4-D, dichlorophenoxyacetic acid. This procedure has succeeded in reducing greatly the growth of ragweed within the city limits. In proper dilutions it is said to be selective in action in that it does not kill desirable grasses, but it is known, of course, to be lethal for vegetables and flowers.(4) Persistence in spraying the ragweed areas each year seems essential to prevent a return of the ragweed. Following the example of New York City, other municipalities have adopted this plan of extermination. Until all states in the ragweed zone collaborate in a determined and extensive plan, however, the hay fever victim may be somewhat benefited, but will continue to suffer, since the pollen produced by weeds many miles away can be easily transported to him by air currents.

The patient can conduct his own plan of weed pollen control in his immediate environment by the installation in his bedroom or home, and in his place of

business, of efficient conditioning units. Such units should filter but not chill the air, since respiratory membranes irritated and congested by pollens seem especially prone to "colds," acute repiratory infections, or sinusitis when suddenly subjected to excessively chilled air. It must be realized, too, that to be most effective, conditioned areas should have as their source of outside air only the conditioning apparatus, and that all doors or windows should be kept closed; as little traffic as possible should be permitted into the area, since disturbing quantities of pollen may be imported upon the hair and clothing of those entering.

These measures of escape and avoidance are not altogether successful. Efforts must be made to so condition the pollen sufferer that he may continue to work and live in the pollen-containing atmostphere. This is not the time or place to discuss the therapy of hay fever--but it is pertinent to say that such treatment is based upon an attempt to increase the tolerance of the sensitized cells so that they do not react with such vigor or intensity upon exposure to the disturbing pollen. Minute, gradually increasing amounts of an aqueous extract of the specific pollen excitant are given hypodermically at weekly intervals during the period beginning, three months before the expected season and extending through it; or, in selected cases, larger doses administered once monthly throughout the year, though once weekly during the season, are effective. The use of antihistaminic drugs, or ephedrine, or soothing eye drops, or avoidance of dusts, gases, and chemical fumes, contribute to the relief of the patient.

Although, as stated, everyone is exposed to overwhelming amounts of weed pollens in the atmosphere, only 10% develop pollen allergy. A very different situation exists with another great group of allergenic substances which produce not respiratory distress, but inflammation of the skin. The dermatitis which is caused by the oleoresin of the poison ivy vine, Rhus radicans, is an outstanding example of this form of allergy. Burning, itching, redness and vesiculation of the skin with oozing, weeping lesions, occur at the site of contact. If there has been excessive exposure, the lesions spread by continuity and often through the blood and possible through the lymphatic systems as well to other, often distant, areas of the body. The victim may become serverely ill, with damage to his intestinal and kidney tissues. As well known to you, poison ivy dermatitis has been long recognized as an occupational hazard by those who work in heavy vegetation. A century ago, the building of the Union Pacific Railroad was repeatedly interrupted by epidemics of ivy poisoning until the workers, gangs or recent immigrants from Europe, were taught buy the Indians how to immunize themselves by eating daily small portions of the ivy leaf. Such a form of treatment, however, is as rugged as the times in which it was advocated, since poison ivy lesions of the mouth, tongue, and other parts of the alimentary canal can readily result.

Contact dermatitis, of which ivy poisoning is a prime example, will develop in almost any individual provided the contact is sufficiently great. Investigations have shown that the application of the concentrated oleoresin to the skin of man or animal will cause typical blisters in approximately every instance. It has been shown too, that the application of the toxic agent of the primrose or primula will cause a dermatitis in 100% of the cases studied. (5)

Many attacks of ivy poisoning occur which are mystifying in that the victim is convinced he has not been in contact with the vine. Such attacks are often due to the vaporizing of the toxic agent present in unrecognized poison ivy vines adhering to the bark of firewood or present in brush fires. Dogs, cats,

horses, cattle, tennis and golf balls, clothing, previously contaminated with poison ivy, may all be the unidentified, intermediary agents which transimit the oleoresin which is the cause of the mysterious attacks.

In addition to being produced by poison ivy and primula, contact dermatitis of an almost identical nature may be caused by poison oak (Rhus diversiloba); poison sumac or poison dogwood (Rhus venenata); ground ivy or English Ivy (Hedera helix); and Virginia Creeper or Woodbine (Ampelopsis quinquefolia). Ragweed through its oleoresins of pollen and leaf may cause severe intractable dermatitis in farmers and in outdoor workers.

The oleoresins of timothy and of other grasses, of Golden Rod, and of Cocklebur, may produce dermatitis. The list of weeds producing such allergic lesions is long, including, among others, the Crowfoot family (Ranunculaceae) of which Columbine, Delphinium, Clematis, and Aconite are members; Hemp (Cannabis indice); and Yarrow (Achillae millefolium). This noxious quality is not a characteristic which is confined to the vulgar weed. Cultivated plants also have retained this highly unpleasant damaging effect upon the skin caused by contact with their leaves. Important in this connection are chrysanthemum, tulip, hyacinth, narcissus, jonquil, and daffodil. Contact dermatitis has been caused by the exposure of the skin of gardeners and green grocers to such vegetable as tomato, bean, asparagus, spinach, celery and lettuce. The oleoresins of many other plants as well as of many shrubs and trees have been reported as allergenic factors. (6)

Best known of all these causes since most extensively studied is the poison ivy. The active sensitizing agent can be readily extracted from the leaves.(7)(8) With applications of this extract, the skin of a hitherto normal human or animal can be rendered highly sensitive to it. A satisfactory degree of immunity can be established in individuals allergic to it by administering carefully adjusted weekly doses of the extract given hypodermically. After such prophylactic treatment, which may extend even several months, the anticipated rash may occur, but it is usually confined to the area of the skin directly exposed to the poison ivy. Generalized eruptions with intense itching and oozing do not appear. Injections of poison ivy extracts given to abort an attack already well developed are often highly dangerous, since they may intensify the symptoms. This principle of developing tolerance to a poisonous oleoresin has been applied in the treatment of other forms of plant dermatitis, such as that of poison oak, poison sumac, primula, and ragweed.

The newly developed steroid hormones, ACTH and Cortisone, have been reported as highly effective in controlling severe attacks of plant dermatitis, but are agents requiring caution in their use. The itching may often be controlled by antihistaminic drugs and lotions. Frequently an attack may be prevented by applications of a mild alkaline solution such as the lather of brown laundry soap, applied to the skin immediately after contact with the toxic agent has occurred. The use of medications containing oils, ointments, alcohol, gasoline, or other fat solvents, should be avoided as they tend to intensify and spread the lesions by dissolving the toxic oleoresin and rendering it more absorbable.

Manual eradication of the poison ivy vine is a procedure hazardous for most individuals, and often unsuccessful since incompletely accomplished. Chemical spraying with 2-4 D, as used for ragweed, is effective but not as satisfactory for poison ivy as ammonium sulfamate. The novice has learned to

his sorrow that the latter must be used with caution since it is not selective in its action, but will kill growth, including highly prized plants and shrubs.

In conclusion may I repeat that a most important step in the handling of any allergic problem is the attempt to remove the cause. This step can often be readily accomplished by the allergist if the exciting substance be an animal dander, a dust, or a food. It is impossible for him to accomplish if the exciting substance be derived from widespread plant sources as in the case of an airborne pollen or a corrosive oleoresin. Such causes can effectively be reduced only at their point of origin and only through the aid and effort of those immediately concerned with weed control. Such co-operation is gratefully welcomed by all physicians confronted with the problem of alleviating allergic maladies.

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NEW DEVELOPMENTS IN SPRAYERS FOR CHEMICAL WEED CONTROL

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It is a pleasure to appear here today as a member of the Speakers Bureau of the National Sprayer & Duster Association.

The membership of this Association is made up of the principal manufacturers of sprayers and dusters. The purposes of the Association, which are similar to those of most other trade associations are, (1) to further improve the quality and performance of the products, (2) to extend the use of its members products, and (3) to carry on a broad educational program on the proper selection, use, and care of sprayers and dusters.

The subject assigned to me today is new developments in sprayers for chemical weed control. These developments have largely paralleled the developments in weed control chemicals and methods of control. Although it seldom shares the limelight, the equipment for applying the chemicals accurately and economically is an essential ingredient of a successful weed control program.

The $42.5 million output of the sprayer and duster industry in 1951, representing a tenfold increase in ten years, reflects to a considerable extent the increasing demand for equipment for applying weed control chemicals. In some counties where weeds are a major agricultural problem, as many as 95 per cent of the farmers now own and use power sprayers as a principal weapon in their fight against weeds. More farmers each year come to agree with the slogan of the Roberts County, South Dakota, Weed Control Board which reads, "It costs more to keep weeds than to control them."

A Half Century of Weed Spraying

It may appear to those not familiar with the history of this type of equipment that farm sprayers were first developed in the period of 1945-50. The record shows, however, that several companies now manufacturing sprayers were organized for that express purpose prior to 1890, and sprayers and dusters have had a long and successful record on many farms--especially those where fruit, vegetables, and livestock are commercially produced.

A search of the literature disclosed that sprayers were used for applying weed control chemicals fifty years ago; however, changes taking place since 1945, admittedly, have practically revolutionized, not only weed spraying but, the entire spraying program in agriculture.

In 1912 pioneer weed control specialist, Professor H. L. Bolley, of North Dakota Agricultural Experiment Station, prepared a bulletin, "How to Spray Sulphate of Iron," which was based on ten years research. This bulletin gave these recommendations, "- - to do the best work, apply at least 52 gallons (containing 100 pounds of sulphate of iron) to the acre--the solution must be applied with a powerful spraying machine, producing a real mist free from drops. The best pressure is 80 to 100 pounds, measured at the nozzle, not at the pump."

Here in the Northeast, Dr. H. E. Horton, an agronomist, worked closely with what is now the Agricultural Engineering Department at Cornell University in testing and appraising the performance of sprayers used for the application of sulphate of iron in the period 1909-11. Then in the employ of the American Steel and Wire Company, he cooperated with the state agricultural colleges and farmers, primarily in the Great Plains area, in promoting this practice.

Interest in chemical weed control declined in the next decade because of the somewhat erratic performance of the limited group of chemicals then available, the necessary high rates of application, and certain limitations of the application equipment.

By the time a new group of weed control chemicals had been developed, that is, in the twenty-year period prior to the introduction of 2,4-D, there had been a good many advances made in spraying equipment, primarily for fruit tree work. Most of these chemicals in this period were commonly applied at the rate of 80-160 gpa and at pressures in the range of 75 to 150 psi.

The equipment adapted for this use consisted of many types, ranging from one thousand gallons capacity tanks mounted on track-laying chassis and equipped with 40-foot booms capable of covering 120 acres per day to small units converted from orchard sprayers and equipped with small rotary pumps similar to those used for forest fire control often powered by the fan belt of the transporting truck.

Although these chemicals were used extensively in the commercial truck growing areas, their use over the country as a whole was primarily for spot control of noxious weeds, which were required by law to be controlled.

The whole program of weed control was, of course, drastically changed following the introduction of 2,4-D. The basis for this change was the experimental work which showed that this chemical could be successfully applied at such extremely low rates as 2 gallons per acre instead of 80 to 160 gallons per acre--the common spraying rate at that time.

Chemical manufacturers, anxious to expand this new market, and farmers, short of help, were quick to see the potentialities of this new method.

Manufacturers of sprayers and dusters, whose production had been greatly restricted during the war, were unable to completely meet this sudden and unprecedented demand for equipment for weed control because of the large backlog of orders for regular equipment which their dealers were demanding and because of the limited supplies of raw material available.

With typical American ingenuity, new manufacturers, operating many small shops in rural areas with their war contracts cancelled were attracted to this field and quickly "tooled up" for sprayer production. The plans for this equipment, which had been prepared in feverish haste by chemical manufacturers, state colleges, and others, were based primarily on a design which required a minimum of scarce material and would meet the requirements for applying 2,4-D and not for what would do the best spraying job for the farmer or allow for his future needs. This sprayer assembly usually consisted of a low-gallonage, low-pressure, rotary-type pump to be powered by the tractor power take-off or belt pulley, a pressure relief valve and pressure gage, a three-section boom equipped with the all important low-gallonage nozzles, the necessary shut-off valves, line strainers and connecting hose. Hydraulic agitation was furnished by by-pass from the pump. Having enough headaches by this time, the manufacturer passed on to the farmer the problem of locating a suitable spray container, and so the typical 55 gallon steel drum found a new use as a spray tank. Plans for constructing the brackets for attaching the tank or tanks and the boom to the tractor were also furnished by the manufacturer. In spite of the fact that much of this equipment was make-shift and troublesome, the goal of an easier method of controlling weeds challenged the farmers ingenuity and led them to solve problem after problem. The economics of chemical weed control now was right. The farmers could see this long before they learned the chemical names of the weed killers they were using.

Farmers were soon to find that this weed sprayer

was a limited use machine and could not handle some other jobs which they were to find around their farm. Nevertheless, these sprayers, where they operated successfully, in one year's operation often brought sufficient increased profits through weed control to pay many times the original cost of the machine and the chemical used.

These early sprayers, therefore, served to introduce the new practice of chemical weed control on thousands of farms throughout the country and to pave the way for the more ready acceptance and use of other pest control chemicals which followed in rapid order.

This new concept in field spraying which called for a new precision in manufacture and field operation of sprayers and which reduced by as much as 90 per cent or more the amount of water to be handled as a diluent based on previous spraying standards has been a major development of our time. This principle was soon to be successfully used in other fields to bring under control for the first time on a large scale such pests as grasshoppers, corn borers, greenbugs, and undesirable brush.

Sprayers of this general type today reflect many changes and improvements incorporated by the sprayer engineers based upon suggestions from farmers, dealers, Federal and State weed control specialists, chemical manufacturers, and others.

Nozzle clogging has been greatly reduced by the use of finer screens in some cases and by changing the nozzle size from 5 gallons per acre to 10 or 15 gallons per acre or more in others. New chemical formulations have also helped substantially. The introduction of replaceable nozzle tips or discs has resulted in a savings to the farmers and further contributed to the flexibility of use of this equipment.

Tubular spray booms have been strengthened by use of the new eyelet-type nozzle connection. Then, as materials became more plentiful, some manufacturers adopted the combination-type boom which uses a strong structural member to support a separate feed line of synthetic hose or brass tubing.

Certain types of pumps, unsuited to this type of spraying, have been discarded by the sprayer manufacturers. Other types have been improved by using sealed bearings to eliminate leakage and better types of materials in the moving parts. The limitations of certain types of pumps also became better known by farmers. Gear pumps, for example, cannot be used satisfactorily with wettable powders, whitewash, or other

abrasive spray materials. To overcome limitations of this type, some sprayer manufacturers have recently adapted the piston-type pump for tractor power-take-off operation. Others have adapted the diaphram-type pump to the same type of use.

The use of synthetic rubber, resistant to oils and chemicals, has greatly reduced problems of hose and gaskets.

Owners of some of the early sprayers failed to spray their weeds at the proper time because the mounting brackets for attaching booms and tanks to the tractor were difficult to mount and detatch. This problem is considerably simplified with most of the new commercially designed units. The problem may also be solved in a positive way by the use of the new trailer tank units on which the boom can be mounted. This is quickly made ready for use then, merely by attaching the pump to the power take-off shaft and the hitch to the tractor drawbar. A self-contained, air-cooled engine is provided on some units as a further convenience and for stationary spray work.

The new manifold-type control valve, currently produced by several companies, contributes to ease in controlling the flow to the several segments of the boom or the handgun.

The rate of application can now be controlled with a much greater degree of accuracy by using the new tractor speedometer.

Single nozzle-type booms which provide a coverage of 10 to 50 feet or more are now being used for special spray jobs. Although it is believed that wind velocity and direction may affect the uniformity of distribution, this type of unit may prove useful where extreme accuracy is not required, such as for roadside and right-of-way spraying, and possible other uses.

Multiple Purpose Sprayers

As materials became more readily available, there was an increasing demand for a more versatile type sprayer which could be used, not only for weed spraying but, for a wide variety of other uses then rapidly developing. The new multiple-purpose farm power sprayer was the result. Many of the basic features, tested for many years in the orchard and vegetable crop sprayers, were incorporated into this design. The pump, the heart of the unit, is the positive piston reciprocating-type piston or plunger pump consisting of one or two cylinders with a capacity of 5 to 8 g.p.m. and developing

pressures of from 250 to 400 or even up to 800 p.s.i. Mechanical agitation is a basic feature to assure satisfactory use with the widest possible range of chemicals and formulations. Tank capacities range from about 50 to 250 gallons. Most of these models are wheel mounted, although many are available mounted on skids. Power is derived either from the power-take-off shaft or a self-contained engine. A field boom and a hand gun with a length of hose are usually standard equipment. Sometimes the small skid models are mounted on a platform on the rear of the tractor.

These units are still greatly outnumbered by the tractor-mounted, tractor-powered units, but since they are soundly engineered to meet a wide variety of farm spraying problems, they are certain to become increasingly popular as farmers gain additional spraying experience.

Another type of sprayer used to some extent for weed control, particularly in corn after the last cultivation, is the high clearance sprayer.

The power wheelbarrow-type sprayer, frequently used for turf weed control on golf courses, is still another useful type of sprayer.

Hand Equipment

Hand equipment is playing an increasingly important part in the farm chemical weed control program. This is especially true on farms where large fields of noxious weeds have been reduced to small patches and can more easily be controlled by the smaller equipment. Dormant brush control is another growing field of use. Many farmers today mount the compressed air or knapsack sprayer, filled with weed control chemical, on their tractor where it is handy for instant use as they pass patches of weeds needing spraying on their way to and from field work.

The compressed air sprayer is now made in various sizes from 1½ to 5 gallon capacity. Some models are available with rechargeable CO_2 cylinders which eliminate hand pumping. Sprayer carts are available for transport of the larger size compressed air sprayers thus lightening the job of hand operation. The knapsack sprayers, with a capacity of 4 to 6 gallons, are now available with side lever operation or telescoping type pumps. Most of these hand units are now produced with oil- and chemical-resistant hose and gaskets. Adjustable nozzles are available to cover a wide range of weed spraying operations. When equipped with a multiple nozzle hand spray boom, these hand sprayers make short work of spraying fence

corners or weed patches left in fields following the last cultivation.

Conclusion

The manufacturers of sprayers are proud to play a vital role in a development as important to agriculture as weed control. I can assure you of their interest in continuing to produce the type of equipment best suited to the job and to that end will welcome your suggestions.

- end -

THE CHEMICAL CONTROL OF NORTHERN NUT GRASS, CYPERUS ESCULENTUS L.

Joseph R. Orsenigo and Ora Smith 1/

During the past decade northern nut grass, Cyperus esculentus, has become increasingly important as a weed pest in the production of some economic crops in New York State. Inquiries concerning this weed have been received from potato growers on Long Island and nurserymen and cash crop producers in the counties bordering Lake Ontario. The areas of nut grass infestation are not often contiguous, nor is this weed of equal importance everywhere encountered. It grows on well-drained cash crop soils as well as on poorly-drained soils. It has been noted most frequently as a weed pest in planting of potatoes, dry beans, field corn, oats and nursery stocks.

The initial problem seemed to require two objectives: the finding of a treatment which would effectively control nut grass in small, densely infested areas to prevent spread of the weed, and the finding of an economical means of controlling nut grass that could be used in conjunction with some crops.

Storage, greenhouse and field experiments were conducted relative to the nut grass plant and its control measures.

This paper is a brief, generalized summarization of some of the results obtained during three years' work on the chemical control of nut grass, Cyperus esculentus. Publication of the complete data from this study is intended in the near future.

It is felt that a fundamental difference exists between the two nut grass species most commonly encountered in the United States, Cyperus rotundus and Cyperus esculentus. This difference is possibly due to a discrete inherent difference between the two species or perhaps to environmental conditions where these species are indigenous and most widespread. Literature reports on the effectiveness of 2,4-dichlorophenoxyacetic acid at low rates of application, i.e., two to five pounds per acre, in the control of C. rotundus are too numerous to cite. Such low rates of 2,4-D application do not seem to control C. esculentus in either the season of treatment or in the season following treatment. However, northern nut grass plants show approximately the same responses as are manifested in the southern species, namely, injury to aerial parts as noted by chlorosis and zones of necrosis in the leaf blade in the general region where the leaves join the basal corm.

According to farmers following various practices, cultural measures in themselves do not afford economic control of northern nut grass. Such practices have included scheduled fallowing and regular cultivation or harrowing operations. Most important in the farmer's feeling regarding cultural practices is the place of cash crops in the farm income and the

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ever-present dislike of fallow and reduced productive acreage. Plantings of row crops, regularly cultivated, achieve control of nut grass between the crop rows. But, in the row itself, there is little control and nut grass becomes an active competitor with the crop plant. Rotations such as are followed in dairy-cash crop farming in New York State do not appear to be effective in control. As an example, a field used principally for the culture of potatoes and cash crops in a dairy rotation system was severely infested with nut grass prior to 1942. At that time the operator seeded the field to permanent pasture. During the eight year period until 1950, the field afforded good grazing on a mixed pasture sod. A small part of the field was plowed and fitted in the spring of 1950. Within one month nut grass shoots were evident in the fitted area, and nut grass soon became the predominant plant. By September of that year, nut grass density was of the order of 10 to 15 shoots per square foot. Throughout the summer of 1950 it was difficult to find nut grass plants in the pasture and adjacent to the fitted area. All plants encountered in the sod were small and chlorotic. These few nut grass plants, however, had produced a few small tubers. A cursory search of the pasture would not have indicated the importance of the nut grass infestation.

Greenhouse screening experiment.

Several chemical treatments were applied to nut grass plants grown in greenhouse flats when the nut grass plants were less than four inches in height. The first of these experiments confirmed prior, unreported data which indicated that the sodium salt of trichloroacetic acid (TCA) was an effective control measure at rates of application of about 100 pounds per acre. Ammonium thiocyanate applied at 50 and 100 pounds per acre also appeared promising in greenhouse trials, but this chemical failed to control nut grass in subsequent field tests. Maleic hydrazide at 30 and 60 pounds per acre was ineffective in control as were low rates of Varsol 2 (five and ten gallons per acre) and half-and-half mixtures of amine salts of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid at two and five pounds per acre. At the termination of the experiment the soil was screened. No significant difference in new tuber production was found between any of the chemical treatments. New tubers were stored for several months at 40°F. at which time sub-samples were placed under sprouting conditions. There was no significant difference in sprouting between tubers produced under the various treatments.

Tuber storage experiment.

In previous years, nut grass tubers were kept viable by placing them in moist, white quartz sand in cold storage rooms maintained at 40°F.

In this experiment, mature nut grass tubers were produced by growing plants in the greenhouse. Tubers were collected and stored in moist white quartz sand at 40°F. for a period of two months. Tubers were then separated into specific gravity classes by the use of salt solutions (sodium chloride). Tubers in the specific gravity class, 1.100 to 1.190, were used in this experiment. The average moisture content of these tubers was 52 per cent. From this source, tubers were selected in lots of ten each. Each lot was wrapped in a small square of cheesecloth and secured with a rubber band. The pre-packaged tubers were then placed

under the various experimental conditions described below. Five-gallon, screw-top flint buckets (glass "pickle" jars) were used as storage containers. Two liters of appropriate solutions of sulfuric acid were added to each bucket to provide constant humidity. Tuber packages were randomly chosen and suspended over the "constant humidity solutions". Three humidity conditions were supplied: low, medium and high. Relative humidity conditions would be approximately 21, 50 and 98 per cent, respectively. One bucket of each of the relative humidity classes was placed under each of the following temperature conditions: 32°F., 50°F. and room temperature (70-85°F.). At three week intervals sprouting tests were conducted by removing one package of tubers from each jar. The ten tubers from each sample were placed on moist filter paper in small Petri plates and placed in darkened chambers where the temperature was in the range 70° to 85°F. Observations were made on tuber condition upon removal from storage. The number of tubers sprouting and the number of sprouts per tuber were counted at three and seven days after the samples had been placed under sprouting conditions. At the time of the first sampling date it was apparent that most tubers placed at room temperature had sprouted regardless of the humidity conditions. Growth of these shoots soon ceased, apparently due to lack of moisture. Sprouting data will be discussed for observations taken after a sprouting period of seven days. After six weeks of storage, sprouting was negligible in tuber lots removed from the two lower humidity classes regardless of the storage temperature. After seven months of storage, more than half the tubers removed from the high humidity class sprouted regardless of the storage temperature. These data are presented in Table 1.

Tuber chains.

In the field, in New York State, relatively few tuber chains have been found. In the greenhouse it is more usual to find tuber chains produced. But, they are produced in numbers substantially less than those produced by *C. rotundus*. It is believed that more tuber chains would be produced by *C. esculentus* in the field if the growing season were longer. As reported by Smith and Fick (3) apical tubers were first to sprout in every case when tuber chains were placed under sprouting conditions.

Depth of sprouting.

Cylindrical soil columns, nine inches in diameter by seventeen and one-half inches tall, were made by placing soil penetration tubes inside three-gallon glazed crocks. Twenty nut grass tubers were planted at each of four depths; four, eight, twelve and sixteen inches by tamping greenhouse potting soil into the cylinders to depths sufficient to provide the amounts of soil cover indicated above. The soil cover was tamped into place in shallow layers after the tubers were placed. Three replications were set-up in this manner in the 70°-80°F. greenhouse where they received normal daylight for the spring months in Ithaca. Watering followed customary greenhouse practice. The soil columns were not set into the soil so the conditions could not be considered comparable with those in the field. Each of the soil columns was probably warmed to a greater degree at the deeper levels than would be encountered in the field. Also, soil compaction within the cylinders probably was not as great as would be encountered in the field. By 14 days after planting, shoots began to emerge from cylinders where nut grass tubers had been planted at the

TABLE 1. Number of *Cyperus esculentus* tubers sprouting (of ten tuber samples) in seven days time after removal from the storage conditions indicated.

Storage temperature	RT (70-85°F.)			50°F.			32°F.		
Humidity class	low	med.	high	low	med.	high	low	med.	high
Length of storage									
0 weeks	9	9	10	10	8	10	6	7	9
3 weeks	0	0	5	0	0	10	10	10	6
6 weeks	0	0	6	0	0	10	0	6	10
9 weeks	0	1	5	0	0	10	0	0	10
12 weeks	0	0	9	0	0	6	0	0	10
15 weeks	0	2	5	0	0	9	0	0	9
18 weeks	0	0	6	0	0	10	0	0	8
24 weeks	0	0	6	0	0	8	0	0	10
27 weeks	0	0	8	0	0	7	0	0	8
30 weeks	0	0	8	0	0	7	0	0	6
33 weeks	-	-	7	-	-	9	-	-	1
36 weeks	-	-	6	-	-	8	-	-	5
Average tuber moisture content at initiation	52 per cent								
Average moisture content after six months of storage, in per cent	3.6	4.6	48.6	3.5	5.8	54.9	4.9	6.7	51.9

least depth. In six additional days, shoots began to emerge from tubers planted at the eight inch depth. Thirty-three days after planting, shoots began to emerge from tubers planted at the twelve inch depth. Among the cylinders where tubers had been planted at the 16 inch depth, shoots emerged in but one replication. One shoot emerged in 42 days and one shoot in 46 days. Partial data are presented in Table 2.

TABLE 2. Nut grass shoot counts taken at 45 days after planting tubers at several depths. Average of three replications of 20 tubers each.

Depth of planting		Average number of shoots
4 inches		25.67
8 inches		20.33
12 inches		5.67
16 inches		0.33
	LSD 0.05	4.31
	LSD 0.01	6.52

Field experiments, materials and methods.

A large number of herbicidal materials were evaluated in the screening work. These were applied alone in both high and low rates as well as in combination with other herbicidal chemicals. In several instances the effect of various surface active agents was tested. Adequate statistical designs were chosen. The plot size most frequently used was one-five hundredth of an acre. Materials were applied with a small, carbon dioxide powered plot sprayer. Several unreported trials indicated that applications of most herbicidal materials were not effective when applied to nut grass plants at advanced stages of development. Therefore, all experiments were initiated when the average height of the nut grass plants was less than four inches. In order to avoid complications resulting from the uneven emergence of nut grass due to tuber production at different levels beneath the ground surface, plots were dragged with a spring-toothed harrow when the nut grass plants were about three inches tall. Chemicals were then applied when nut grass plants were less than four inches tall.

The method of treatment evaluation in the field work was as follows. A visual evaluation scale of one to five was set up. A value of one was used to indicate no nut grass control as compared to check plots, while a value of five was used to signify 100 per cent nut grass control. A value of three was used to indicate 50 per cent control while values of two and four were used to signify appropriate degrees of intermediate control. Plot ratings were usually made at monthly intervals following chemical treatment. Where necessary in post-emergence treatments, nut grass stand ratings were made at the inception of the experiment to permit the use of covariance analysis. Depending on farmer cooperation, nut grass control plots were left undisturbed over winter. Visual evaluations were made once in the spring of the year following treatment.

Field experiments, general results.

Some of the general information obtained in the field experiments follows. No attempt will be made to present materials and rates found ineffective in nut grass control; only the most effective treatments will be presented.

Contact-type and hormonal-type herbicidal materials were found to be equally effective or equally non-efficacious when applied to nut grass plants one and one-half, three or four inches in height. In screening experiments, TCA at 50, 75, or 100 pounds per acre was found to be significantly more effective than most other materials at the rates used. Nut grass control of eighty per cent or more was achieved in the year of treatment. Frequently, there was no difference in nut grass control between TCA at 50 and 100 pounds per acre. In the spring following the year of application, plots receiving the higher rate of TCA were found to have the smallest nut grass population as determined by visual evaluations.

There was no significant difference in control when any one rate of TCA was applied in aqueous solution or in Diesel Oil emulsions of 10 or 20 per cent (at 100 gallons per acre).

In later experiments, the addition of 2,4-D or a dinitro to TCA increased nut grass control over that obtained by either of the materials applied alone.

When treatments were made at advanced stages of nut grass development, 2,4-D at 15 pounds per acre applied in five or ten per cent emulsions (at 100 gallons per acre) of either Aromatic 180 or Bayol "D" was significantly more effective in nut grass control than 75 pounds per acre of TCA. Nut grass stand reductions of 80 per cent or more were noted in these 2,4-D plus oil emulsion plots in the year following treatment.

When applications were made prior to nut grass emergence, the most effective treatments were TCA at 50 and 15 pounds per acre and CMU at eight pounds per acre.

The most effective post-emergence treatments in controlling nut grass up until the present time are:

C M U - 20 pounds per acre and higher
General 7BD and General 7 - 15 gallons per acre (applied in 85 gallons of water per acre)
TCA - 75 pounds per acre
TCA - 25 or 50 pounds per acre plus 2,4-D at 15 pounds per acre or Dinitros at nine pounds per acre.
2,4-D - 15 pounds per acre in emulsions (at 100 gallons per acre) of:
Aromatic 180 at five gallons per acre, or
Bayol "D" at five gallons per acre, or
Diesel Oil at five gallons per acre.

TCA has been the most reliable material when applied at sufficiently early stages of growth.

Field experiments, TCA applied to oats and nut grass.

In 1950 chemically treated plots were located in an oat field which was hopelessly infested with nut grass. TCA, among other chemical treatments, was applied at rates up to 200 pounds per acre when the oats were in the boot stage. Nut grass was controlled by TCA at 100 and 200 pounds per acre, and the oat stand was not completely reduced. In the following year, an attempt was made to treat oats at one date of application with several rates of TCA. TCA was applied in water solution and in aqueous solution to which various surface active agents had been added. This experiment was not completed due to adverse weather conditions.

In 1952 three experiments were set up wherein TCA was applied at several rates to seeded oats infested with nut grass. Two identical experiments were conducted in two counties. These consisted of jeep-applied TCA treatments of 0, 25, 50, and 75 pounds per acre. Dreft was added to the aqueous spray solution to a concentration of 0.05 per cent. At time of treatment oats were at the early head stage while nut grass plants were about eight inches tall and producing tubers. As shown in Table 3, yield of grain at the two locations was quite different. The reason for this difference is not known at present. Germination tests on sub-samples of grain showed no differences in germinability between the various treatments. Seed germination data are presented in Table 4.

TABLE 3. Oat yields in bushels per acre from TCA treated oats. Variety - Clinton. Average of four replications in a Latin Square design.

TCA rate, pounds per acre	Oat yield, bushels per acre: Chenango County	Oat yield, bushels per acre: Oneida County
0	43	49
25	36	54
50	22	42
75	22	49
LSD 0.05	7	
LSD 0.01	11	

TABLE 4. Percentage germination in four days of oats grown in plots treated with TCA at several rates at the early head stage. Variety - Clinton. Average of four replications in a Latin Square design.

TCA rate, pounds per acre	Percent germination: Chenango County	Percent germination: Oneida County
0	96.1	96.0
25	95.8	96.7
50	96.5	94.4
75	96.7	95.7

In the third experiment in 1952, oats were treated at three different stages of growth; boot, early head, and milk. TCA was applied at 0, 25, 50, and 75 pounds per acre in two carriers. One carrier was an aqueous solution and the other an aqueous solution to which commercial Dreft had been added to give a concentration of 0.05 per cent. This factorial was set up in eight replications in a randomized block design.

There was no significant difference in oat yield between the two carriers used. Significant differences in oat yields were found for both rate and time of application of TCA. The linear and orthogonal comparisons are illustrated in Figure 1 while the data are presented in Table 5.

No analyses were made for yield of straw, nor were bushel-weight values taken. The legume seeding was practically eliminated in all TCA treated plots. Ratings of nut grass control made after combining show 80 to 90 per cent control for the highest rate of application. Nut grass control will be further evaluated by visual ratings in the spring of 1953.

Germination tests were conducted on the yield of grain from each plot. Germination percentages in seed from the plots treated with TCA at 75 pounds per acre were seven to ten per cent lower than germination percentages for seed obtained from check plots or plots treated with a lower rate of TCA. With the exception of the 75 pounds per acre TCA plots, germination percentages for the experiment were about 95 per cent.

TABLE 5. Oat yields in bushels per acre from TCA treated oats at three stages of development. Average of 16 plots. Variety - Clinton.

TCA rate, pounds per acre	Stage of oat development at time of application		
	Boot	Early head	Milk
0	23	35	32
25	27	27	33
50	23	21	31
75	20	16	30

Discussion.

The first aim of the nut grass control program, that of obtaining a usable measure for the control of nut grass in small heavily infested areas is attained through the use of TCA at 75 pounds per acre or the use of 2,4-D at 15 pounds per acre applied in a five per cent emulsion of an aromatic oil (at 100 gallons per acre).

The accomplishment of the second objective is more difficult. Apparently the principal means of nut grass propagation and spread is the tuber. Seed seems to be a minor source of infestation and maintenance. In the past several years in New York State, seed scapes have been produced in abundance. Yet, the seed yield from these scapes has not been great. Seeds have been very variable; many were "light" seeds without an

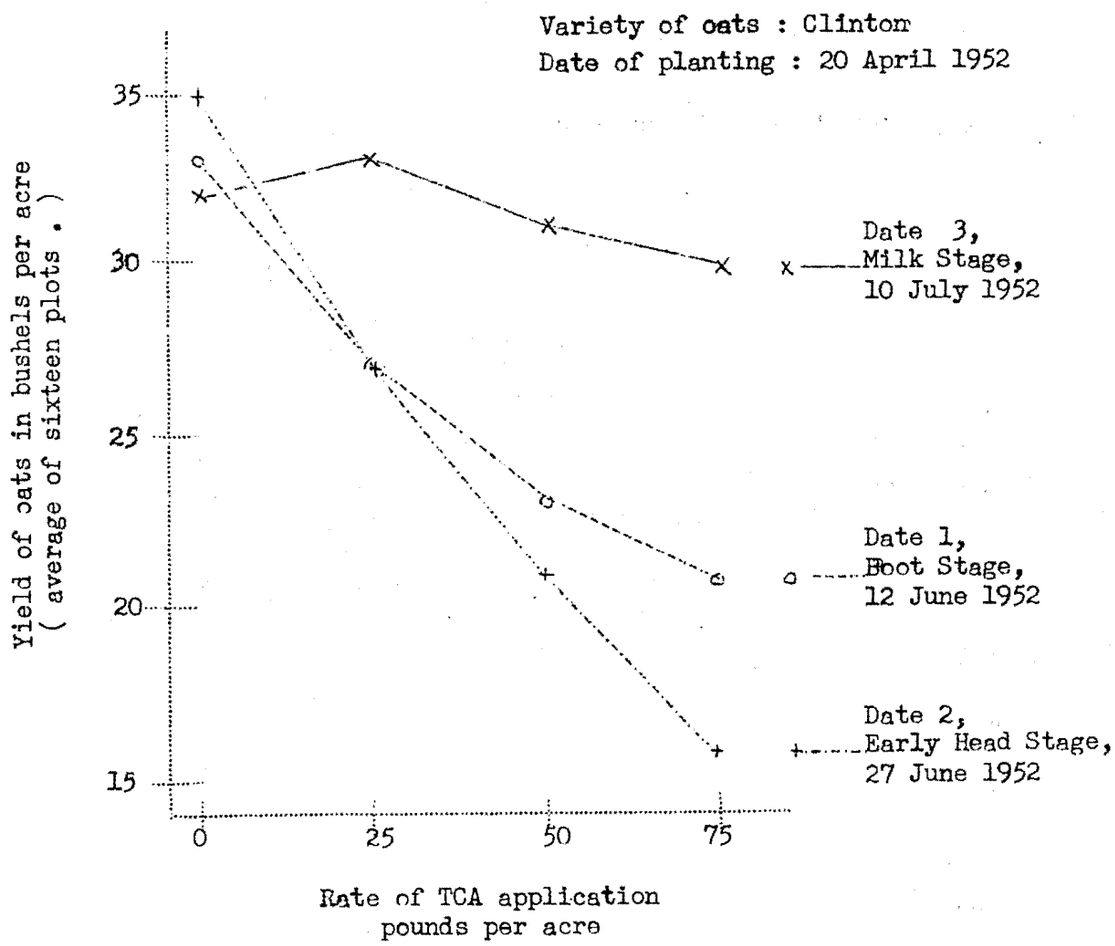

Figure 1. Interaction between rate and date of TCA application on yield of Clinton oats.

endosperm while others apparently had no embryo. Simple germination procedures have failed to produce any plants from seed. None of the procedures used by Justice (1) was employed.

If tubers are accepted as the principal source of propagation and spread, our problem is to control tuber production by nut grass plants. Probably, nut grass tubers do not live long in the soil. The majority of tubers produced in one year probably sprout during the following growing season or subsequently die. Undoubtedly, some tubers remain in a dormant condition. It is doubtful that tubers are produced at depths much greater than eight or ten inches (3).

It is obvious that the production of tubers will be low if nut grass top growth is controlled prior to tuber formation and maturation. Those chemicals reported as most effective in nut grass control were most effective when applied at early stages of plant development. Therefore, chemical treatments should be applied prior to tuber formation when the plants are small. It is suggested that treatments be applied before the nut grass plants are more than four inches in height or have more than four to six leaves. If the field to be treated is to be left fallow for the growing season, the control obtained from chemical treatment will be increased if the following cultural procedure is employed. When nut grass plants are three to four inches in height, the field should be dragged with a spring-tooth harrow or similar implement. This will effect some nut grass kill, but it will also permit the growing season to advance somewhat so that tubers situated more deeply will produce aerial shoots. When nut grass shoots re-grow to three or four inches in height, the chemical treatments should be applied. With this procedure, chemicals with residual activity can also become more effective.

There are several control measures available which utilize TCA. Pre-emergence treatments of low rates of TCA could be applied a short time prior to shoot emergence. Probably most control would be obtained if the field to be treated were plowed and fitted first. The treatments could then be applied several days prior to shoot emergence.

TCA could be utilized as previously suggested. The field to be treated is first plowed and fitted. When nut grass plants are several inches in height, the field is dragged. Then chemical treatments can be applied when nut grass plants again reach three to four inches in height. It is possible to utilize 2,4-D or other treatments reported as effective in such a procedure.

The relative tolerance of some cruciferous crops to TCA could be used in a nut grass control program. As reported by Sweet and Ries (4) cabbage and cauliflower have marked tolerance to TCA. This would suggest a program similar to those above, except that late crops of cabbage or cauliflower would be set 30 to 60 days after TCA treatment. The fourth alternative is to use TCA in nut grass infested oat fields. TCA sprays could then be applied at the proper time. All of the procedure above are expensive, all require discretion, and all have certain hazards.

There is a promising treatment for partial control of nut grass. Field corn has shown tolerance to CMU at one pound per acre in pre-emergence treatments (2). CMU applied prior to nut grass emergence is an effective retardation measure for periods up to six weeks in length. If CMU were pre-emergence applied to plantings of field corn a satisfactory period of nut grass control should result. Nut grass tuber production probably would also be reduced.

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Defoliation Response of *Ligustrum ovalifolium* to 3,6-endoxohexahydrophthalate Formulations

A. M. S. Pridham and Robert Hsu, Cornell University

Under field conditions existing in the fall of the year when nursery stock is dug for storage low temperatures of 40° to 60°F are common. The following studies were therefore undertaken to explore the possibilities of securing good defoliation under cool weather conditions. Constant temperatures were obtained in refrigerators. Twigs of uniform size and age were kept in closed containers at high humidity for specific periods of time. Defoliation was estimated by jarring the twigs in the closed containers (milk bottles) and recording the number of leaves that fell. Twigs were used that had 10 uniform normal leaves. Four twigs were used in separate containers for each treatment.

The following tables are summations of experiments to define the relative influence of temperature, amount of defoliant and age of foliage. Consideration is also given various wetting agents, to chemicals that modify pectic gels and to other defoliants than endothal formulations as they may modify defoliation at 40° and 50°F in *Ligustrum ovalifolium*.

Temperature and Dilution

Table 1. The per cent defoliation occurring after 24 hours when *Ligustrum ovalifolium* twigs were held at three constant temperatures after spraying with Niagarathal D.F. Liquid at 3 rates. Experimental units of 10 twigs of 10 leaves, 8/13.

Culture temperature	Dilution of Niagarathal D.F. Liquid 1:20	1:40	1:80	Mean
50°F	4.0	5.0	12.0	7.0
60°F	80.0	79.0	51.0	70.0
70°F	45.0	43.0	46.0	45.0
Mean	43.0	42.0	46.0	

Untreated controls - no defoliation

L.S.D. Mean dilution, 39% at 5% level, 91% at 1% level.

L.S.D. Mean temperature, 25.4% at 5% level, 42% at 1% level.

The marked reduction in defoliation at 50°F is obvious. The data fail to indicate that statistically significant differences associated with the amount of defoliant.

Table 2. The per cent defoliation occurring after 1, 2, and 3 days when twigs were held at 50°F following sprays with 3 dilutions of Niagarathal D.F. Liquid. Experimental units of 10 twigs of 10 leaves, 8/13.

Days after spraying	Dilution of Niagarathal D.F. Liquid 1:20	1:40	1:80	Mean
1	4.0	5.0	12.0	7.0
2	35.0	13.0	45.0	31.0
3	59.0	47.0	81.0	62.3
Mean	32.7	21.7	46.0	

Untreated controls - no defoliation

L.S.D. mean dilution, 18.9% at 5% level, 31.3% at 1% level.

L.S.D. mean day, 18.9% at 5% level, 31.3% at 1% level.

The amount of defoliant used does not follow a consistent trend as related to the defoliation obtained and the mean differences are not statistically significant. Defoliation increased significantly over the 3 day period.

In a second test over a period of 7 days, differences associated with temperature were again statistically significant but differences associated with dilution of defoliant were not. Defoliation at 40°F after 7 days was 15% mean value and no defoliation had taken place in the untreated control cultures.

Table 3. The per cent defoliation occurring after 3 and 5 days at 50°F following sprays with 4 dilutions of Niagarathal D.F. Liquid. Experimental units of 4 twigs of 10 leaves, 11/21

Days after spraying	Dilutions of Niagarathal D.F. Liquid 1:100	1:250	1:500	1:1000	Mean
3	57.0	55.0	7.5	1.7	30.3
5	100.0	100.0	52.0	40.0	73.0
Mean	78.5	77.5	29.7	20.3	

Untreated controls showed no defoliation.
L.S.D. mean dilution, 11.5% at 5% level, 21.5% at 1% level.
L.S.D. mean days, 8.4% at 5% level, 15.7% at 1% level

As indicated in Tables 1, 2 and 3, relatively small amounts of defoliant are efficient at 50°F. Table 4 indicates that dilutions greater than 1:250 become clearly and significantly less effective within the time limit of the experiment. The twigs collected Nov. 21 came from plants that had been subjected to frost, the leaves were normal green in color and new growth had ceased.

From this series of tests the observation is drawn that defoliation may occur more rapidly when larger amounts of defoliant are applied but that the final amount of defoliation is not influenced greatly at least within limits. The dilution of 1:80 appears to be a reasonable one to use for Ligustrum ovalifolium under late summer and early fall.

Age of Foliage

Table 4. The per cent defoliation one day after spraying leaves of various ages 50°F with several chemicals in combination with Niagarathal D.F. Liquid, 1:100. Experimental units of 4 twigs of 10 leaves, Ligustrum ovalifolium, 10/29.

			Chemical used in addition to Niagarathal D.F.Liquid					
Leaf type	Not treated	None	Methyl alcohol 1%	Ethyl alcohol 1%	$KMNO_4$ 100 ppm	Ascorbic Acid 100 ppm	H_2O_2 400 ppm	Mean
Young	0.0	27.5	50.0	45.0	42.5	50.0	17.5	33.2
Green	0.0	7.5	1.5	0.0	0.0	2.5	0.0	1.6
Green, old	0.0	2.5	2.5	0.0	0.0	17.5	7.5	4.3
Red, old ringed	7.5	15.0	30.0	60.0	32.5	62.5	32.5	34.2
Mean	2.5	13.1	21.0	26.3	18.7	33.5	14.4	

L.S.D. treatment chemicals, 20% at 5% level, 27% at 1% level.
L.S.D. leaf type, 14% at 5% level, 20% at 1% level.

The age of the foliage as indicated by young partly developed foliage as compared to foliage of mature size is associated with statistically significant differences in response to defoliants. Similar significant differences were found with red colored leaves on stems ringed by wire from wired tree labels used to carry a record of plant treatments and left for two seasons without loosening.

In previous tests it has generally been found true that older foliage that is losing its bright green color defoliates more readily than foliage of normal size but good color. Under greenhouse conditions of early spring young foliage of small size was found to defoliat readily. Since the majority of the foliage present on nursery stock in the field is of mature size and good color, the authors' attention has usually centered on leaves of mature size.

Defoliant Activators

The use (Table 4) of methyl alcohol and of ethyl alcohol or of ascorbic acid in conjunction with the defoliant at 50°F improves the effectiveness of the defoliant at or near the 5% level of significance. The greatest gain is with the ascorbic acid when significance approaches the 1% level.

The use of methyl and ethyl alcohol at 10% under outdoor conditions gave response after 2 days similar to that noted in Table 5. The tests were run October 17 outdoors. Individual twigs were selected for treatment. Niagarathal D.F. Liquid 1:100 resulted in 20% defoliation and the alcohols in 63% for methyl and 88% for ethyl. On October 22 entire plants were sprayed and six out of 13 species treated showed some improvement in the amount of defoliation but were species which usually respond to chemical defoliants. Ascorbic acid was not used in outdoor tests.

Table 5. The per cent defoliation 5 days after treating leaves at 40° and 80°F with combinations of defoliant and dormancy inducing growth regulators, 7/12-7/17. Using 4 twigs of 10 leaves per treatment.

	Defoliant and culture temperature					
	None		Ethylene		Niagarathal 1:20	
Growth regulator	40°F	80°F	40°F	80°F	40°F	80°F
None	0.0	0.0	0.0	100.0	30.0	95.0
Maleic hydrazide 1500 ppm	0.0	0.0	0.0	95.0	15.0	15.0
Naphthaleneacetic acid, 500 ppm	0.0	0.0	0.0	0.0	7.5	7.5

The data indicate that the growth regulators did not result in immediate defoliation and that the effectiveness of defoliants was reduced by naphthaleneacetic acid 500 ppm. The Niagarathal D.F. Liquid brings about some defoliation in cultures held at 40°F. Ethylene at approximately 20 ppm did not induce defoliation in cultures held at 40°F.

As indicated in an earlier paper in this series growth regulators applied as foliar sprays a week or more in advance of Niagarathal D.F. Liquid did not seriously interfere with defoliation.

Table 6. The per cent defoliation 7 days after treating leaves of *Ligustrum ovalifolium* at 40°F with combinations of wetting agents and Niagarathal D.F. Liquid, using samples of 5 twigs of 10 leaves per treatment.

Date	Activator	Niagarathal 1:40 control	Activator-defoliant combination
7/1	Nonic 10%	26.0	66.0
7/2	Butyl cellosolve 5%	35.0	60.0
7/2	Naccoline 1%	35.0	70.0

Untreated controls and wetting agent controls did not result in defoliation. Similar tests were run over a 3 day period at 40°F with 18% commercial formulations. Four appeared to be equally effective to the usual activator employed with Niagarathal D.F. Liquid.

Tests were conducted outdoors in September without consistent increase in defoliation over the commercial product already available.

Specific Defoliants

Table 7. The per cent defoliation occurring nine days after spraying foliage of Ligustrum ovalifolium with three defoliants and three temperatures. Experimental units of 4 twigs of 10 leaves per treatment. Sprayed till foliage drips, 9/15

Culture temperature	Defoliant and concentration: Shed-A-Leaf 1%	Shed-A-Leaf 3%	Shed-A-Leaf 5%	Pacific Coast Borax 1%	Pacific Coast Borax 2%	Pacific Coast Borax 3%	Niagarathal D.F. 1:80	Mean
40°F	0.0	0.0	0.0	0.0	0.0	0.0	28.0	4.0
50°F	17.0	15.0	25.0	15.0	7.0	25.0	93.0	28.0
60°F	85.0	83.0	85.0	87.0	97.0	100.0	100.0	91.0
Mean	37.0	33.0	33.0	42.0	35.0	33.0	73.0	

Untreated controls showed no defoliation.

L.S.D. defoliant treatments, 10% at 5% level, 15% at 1% level.
L.S.D. culture temperature, 7% at 5% level, 9% at 1% level.

The differences related to defoliant do not indicate improvement in response over Niagarathal D.F. Liquid at 40°F.

Tests were made outdoors in September with eight types of plants. Defoliation was rated on a scale of 0 through 5. The average was 2.1 for Shed-A-Leaf, 2.1 for Pacific Coast Borax Co. defoliant and 3.7 for Niagarathal D.F. Liquid. No defoliation occurred in untreated control plants.

The present results with the effects of defoliants at controlled low temperature treatments agree with those reported earlier - Pridham, A. M. S. Defoliation of Nursery Stock by Chemical Means, Proc. 6th NEWCC, 275-282. 1952.

Summary

1. Temperatures below 60°F reduce the effectiveness of all defoliants studied to date.

2. 3,6-endoxohexahydrophthalate formulations were somewhat effective at 40° and 50°F.

3. The amount of Niagarathal D.F. Liquid used at low temperatures should be in excess of 1:250 but need not be greater than 1:40.

4. The growth status of the leaf at the time defoliants are applied is important.

5. Ascorbic acid and methyl or ethyl alcohol give promise of effective defoliant activation at low temperatures.

6. Growth regulators used in conjuection with defoliants usually retard defoliant action except when the amount of growth regulator is too low to induce bud dormancy.

NORTHEASTERN WEED CONTROL CONFERENCE

MINUTES OF THE BUSINESS MEETING

January 8, 1953

Meeting called to order by President Minarik at 1:15 p.m.. He introduced persons seated at the head table.

The treasurer gave an informal report indicating the Conference was in a satisfactory financial condition. A complete report follows in the Supplement.

Raleigh was asked to report to the Conference on the activities of the Association of Regional Weed Control Conferences. Several meetings have been held, the most recent one being held in May, 1952. Plans were discussed for a proposed National Meeting and this meeting will be held in December 1953 at Kansas City, the same week as the meeting of the North Central Weed Control Conference. North Central Conference is prepared to assist in plans for the National Meeting and will also act as local arrangements committee. The Association officers also appointed R. D. Sweet as permanent Editor of "WEEDS".

Lovvorn was called on to make a few remarks concerning the recent meeting of the North Central Weed Control Conference held in conjunction with the meeting of the Eastern Canadian Weed Conference. He indicated that the meeting was very successful and that steps had been taken in preparing for the National Meeting. The next meeting of the North Central Weed Control Conference will be held during the week of December 10, 1953.

Discussion was held concerning the status of our Proceedings with regards to official publication of papers. It was pointed out that the Proceedings is appearing regularly in reference literature and everyone seems to consider papers here as officially published. It was suggested that authors note this and prepare their papers for the Proceedings in line with established publishing procedure of their company or institution.

The possibility of the Conference presenting awards for outstanding contributions to the field of weed control was discussed. Sentiment expressed seemed to favor such awards and Zimmerman made the motion that a committee be appointed to determine the details of making such awards so that the presentation of awards could begin with the 1954 meeting. Phillips seconded and motion carried.

Discussion was also held on the question of recognizing work of county agents and assistants in weed contorl. Van Geluwe moved that the awards committee also consider this point and present plans to the Executive Committee for action. Standen seconded the motion and it was carried.

Minarik then appointed an Auditing Committee of S. N. Fertig and R. D. Sweet.

The point was brought up that Sweet had expressed a desire to resign as Editor of "WEEDS". A possible alternate method of publishing "WEEDS" was discussed and then Zimmerman moved that the Conference recommend that Sweet be prevailed on to retain his position for another year and "WEEDS" continue to be published as at present. Yowell seconded and motion carried.

There being no further business the Nominating Committee, Dale Wolf (Chairman), R. A. Peters and W. C. Shaw was asked for its report. In the absence of Wolf, Shaw reported for the Committee the following slate of officers for 1953:

President - R. H. Beatty
Vice-Pres. - A. O. Kuhn
Sec.-Treas. - W. C. Jacob
Editorial Bd. of Weeds - H. L. Yowell

Odland moved and Hitchcock seconded motion that report be accepted. Carried.

Each office was considered individually and there being no further nominations, Phillips moved and Ahlgren seconded that the nominations be closed and the Secretary be instructed to cast a unanimous ballot for the slate of officers as presented. Motion carried.

After thanking everyone for his help during the year Minarik passed the chair to Beatty.

Beatty announced that he would make committee appointments on Friday.

There being no further business, Veatch moved and Sweet seconded that we adjourn. Motion carried and meeting adjourned at 2.00 p.m..

On Friday Beatty announced the following committee appointments:

Program - - - - - - - - - -	John VanGeluwe, G.L.F. Chairman S. N. Fertig, Agronomy E. M. Rahn, Horticulture J. A. DeFrance, Turf Arthur Wallach, Public Health John Baylor, Extension
Publications - - - - - -	R. J. Aldrich, Rutgers Univ.Ch.
Coordinating - - - - - -	T. E. Odland, Rhode Island, Ch.
Sustaining Membership - -	M. F. Trevette, Maine, Ch. C. Hovey L.Southwich
Public Relations - - - -	L. L. Danielson, Va., Ch. S. B. LeCompte J. B. Harry

Awards - - - - - - - - - - C. E. Minarik, Camp Detrick, Ch.
R. D. Sweet
G. H. Ahlgren
S. M. Raleigh
H. L. Yowell

Sub-Comm. for Co.
Agents Awards - - John Baylor, Rutgers Univ. Ch.
C. E. Phillips
S. N. Fertig

Walter C. Jacob, Secretary

NORTHEASTERN WEED CONTROL CONFERENCE

TREASURER'S REPORT

January 15, 1953

Receipts

Cash on hand - Feb. 11, 1952	$3,025.67	
Sales of Proceedings and reprints	622.50	
Sustaining Memberships	1,475.00	
Sales of 1953 Proceedings	845.00	
Registration at 1953 meeting	633.50	
Luncheon Tickets	487.50	
Total		$7,089.17

Expenses

General			
Postage and Communciations	$216.97		
Supplies	66.94		
Travel of Exec. Committee	300.97		
Stenographic help	200.00		
Check charge	.15		
Total		$ 785.03	
Publications			
1952 Supplement (partial)	$125.00		
Reprints	92.25		
1953 Proceedings	675.88		
1953 Supplement (partial)	263.75		
Mimeograph Supplies	76.00		
Newsletters	51.50		
Total		$1,284.38	
Meeting			
Programs	$ 85,00		
Badges	30.58		
Registration Clerks	50.00		
Typewriter rental	5.64		
Mixer	90.86		
Expenses paid by Secretary	144.46		
Luncheon	487.04		
Total		$ 893.58	
Total Expenses			$2,962.99
Cash on hand Jan. 15, 1953			4,126.18
			$7,089.17

Walter C. Jacob, Sec.-Treas.

January 16, 1953

We have examined the foregoing financial statement of the Northeastern Weed Control Conference and find it correct as submitted.

/s/ Stanford N. Fertig

NORTHEASTERN WEED CONTROL CONFERENCE

Secretary's Report of the Conference Meeting
Janury 7,8,9, 1953

The increased attendance this year indicates continuing expansion of interest in the field of weed control. A total of 432 persons registered for the meeting this year, about a 9% increase over 1952.

Some change was evidenced in make-up of the Conference this year from last. The number of Experiment Station and U.S.D.A. personnel was about the same but a 50% increase was noted in attendance from companies supplying chemicals or equipment. A 12% decrease was noted in attendance from users of weed control. Of the total attendance this year 24% came from Experiment Stations and the U. S. D. A., 42% from suppliers of chemicals and equipment, 31% from users of weed control, and 1½% each from Extension people and press. The people present came from 25 states, Washington, D. C., and Canada, with about 12% coming from outside the area included in the northeastern states. A record number of 134 commercial companies were represented at the meeting.

The sustaining membership list was again increased to a total of 40 companies. The fact that this many companies are willing to help support the Conference is an indication of a wide degree of acceptance of the need for the Conference.

The luncheon-business meeting was well attended as was the social mixer on the first evening.

Considerably more than 100 people attended the meeting of the Coordinating Committee on Friday. A rather large report was covered in the course of the day and the final report that appears in the Supplement expresses the opinions of the majority of the Conference. Extra reprints are available for distribution from the Secretary.

The next meeting will be held at the Hotel New Yorker on January 5,6,7,1954 as decided by the Executive Committee.

Walter C. Jacob

Walter C. Jacob, Secretary

REPORT OF THE RESEARCH COORDINATING COMMITTEE of the NORTHEASTERN WEED CONTROL CONFERENCE FOR 1953

The purpose of this report is to bring together the phases of weed research work where at present there is general agreement on methods, chemicals, concentrations and proper usage. It should also serve to point out problems that exist and need further research. In this connection, closer co-ordination between research personnel throughout the area might speed up the solution to many problems. It is evident from this report that the area of agreement is increasing while the area of disagreement is diminishing.

The information in this report should not precede recommendations by the various State Experiment Stations. The information included here should serve only as a guide to those making recommendations.

The number of states or reports in parentheses ( ) indicates the number of reports received and the agreement on the practice by research workers throughout the area covered by the conference.

S. N. Fertig

PERENNIAL WEEDS AND GRASSES IN CROP ROTATIONS

L. Southwick

QUACK GRASS

(Agropyron repens)

Agreement

1. Sodium TCA seems to be the most thoroughly tested and most effective material, cost-wise, for quack grass control in crop land on the basis of reports from ten states and Canada.

2. It requires less TCA if application follows soon after tillage. Without tillage - 75 to 100 pounds; with tillage 30 to 50 pounds.

3. If heavy rains follow TCA application, particularly on light sandy soils, excessive leaching will often result in poor control and a second application should be made. Often this application should be made without waiting to see if good control has been obtained.

4. Often better results are obtained from mid-summer (July-August) application than from earlier treatment.

5. Application directly on the soil is often better than spraying the grass foliage.

6. TCA application in the fall is safe for controlling quack grass in land to be planted the following spring to most annual crops, berries and bush fruits.

7. Some crops are more tolerant when planted soon after TCA treatment, such as members of cruciferae and leguminosae families.

8. Treating with dinitro contact sprays kills quack grass to the ground and recovery is slower than following cultivation.

9. Directional spraying with dinitro contact sprays to suppress grass in crops such as grapes, bush fruits and nursery stock is effective and economical.

Further Trials Indicated

1. More work is needed to determine the best way to use Sodium TCA in relation to quack grass control on crop land without losing a crop. Fall application is generally agreed on as practical and some crops can stand spring treatment, but more definite recommendations are needed for satisfactory grower acceptance. These recommendations should be made in relation to soil type and the rainfall.

2. More information is needed on the effectiveness of combination treatments, including the following: (1) TCA and dinitro, (2) TCA and CMU, (3) TCA and Maleic Hydrazide.

3. Premergence use of dintro at 6 to 9 pounds per acre and CMU at 2 pounds on corn suppressed quack sufficiently so that it was not a problem according to two reports. This deserves further investigation.

4. Maleic Hydrazide at 6 pounds per acre plus wetting agent applied to grass foliage at the start of active growth stopped growth for two months according to one report and this decreased its competitive capacity during the critical period for tree and bush crops.

5. For experimental trial - Maleic Hydrazide application in spring, followed by plowing under for corn.

6. For experimental trial - CMU at 4 to 8 pounds per acre. More information is needed on the retention of CMU in the soil and the tolerance of various crops planted at different times following CMU application

7. According to one report, Chloro IPC at 50 to 100 pounds is effective when applied in the fall.

8. Use of Stoddard Solvent as a contact spray was reported by one investigator to be fairly effective against quack grass in nurseries

9. More information is needed on equipment for applying directional contact sprays. Also the relative importance of diesel oil versus highly aromatic oils as carriers or solvents for DN need to be determined.

10. The elimination of quack grass from established asparagus beds is a very important problem needing further work.

NUT GRASS

(Cyperus esculentus L.)

Agreement

1. For spot treatment use of 75 pounds TCA per Acre when nut grass is up to four inches tall. Better results have been obtained with previous dragging or harrowing followed by spraying as soon as plants begin to develop again.

2. No chemical treatment is recommended for large scale commercial use.

Further Trials Indicated

1. Pre-emergence application of 50 pounds of Sodium TCA prior to nut grass emergence. Initial results in New York show promise.

2. Early post-emergence application of CMU at 20 pounds and General Chemical 7BD at 15 gallons applied before nut grass is four inches tall show promise according to New York report.

3. Late post-emergence treatments giving better than 80% control when applied on nut grass up to twelve inches in height include the following, according to the New York report:

   a. Sodium TCA, 75 pounds plus 2,4-D, 15 pounds
   b. 2,4-D, 15 pounds plus oil, 5 to 10 gallons
   c. CMU, 20 pounds

4. CMU at 20 to 50 pounds per acre (3 reports)

5. Dinitro use for pre-emergence weed control in corn seemed to give control in one test (West Virginia).

6. Use of MCP at 10-15 pounds plus oil, 5 to 10 gallons. Different formulations (amines and esters) suggested.

CANADA THISTLE

(Cirsium arvense)

Agreement

1. Use of 1/2 to 1 pound 2,4-D annually for two or more years will give commercial control and finally eradication. Canada suggests one-half pound in grain, followed by after harvest cultivation.

2. There is not sufficient evidence to say that MCP is more effective than 2,4-D, although occasional reports so indicate.

Problems Needing Further Work

1. Combinations of 2,4-D and MCP.

2. Pre-emergence applications of 16 to 30 pounds 2,4-D low volatile ester showed promise for eradication, (1 report).

WILD GARLIC

(Allium vineale)
(4 reports)

Agreement

1. 2,4-D seems to be as good as any chemical. More than one treatment required for effective control. Best results obtained by spraying in very early spring using one pound or more per acre.

Further Trials Indicated

1. MCP in one test, (Delaware) looked promising at 1/2 pound in late March.

HORSE NETTLE

(Solanum carolinense)
(2 reports)

Agreement

1. 2,4,5-T as a fall treatment is best. Application is made when the horse nettle blossoms are setting fruit with some fruits developing.

Further Trials Indicated

1. Allow horse nettle to reach full bloom, clip, and when regrowth is 4 to 6 inches tall, spray with 2,4-D - 2,4,5-T at 1.5 pounds per acre (1 report).

WINTER CRESS (Yellow rocket)

(Barbarea vulgaris)
(3 reports)

Agreement

1. This weed can be controlled with 1/2 pound 2,4-D where the

presence of susceptible legumes is not a factor. Fall or spring treatment usually effective.

Further Trials Indicated

1. Early spring application of MCP when legumes are dormant.

2. Late fall or early spring application of dinitro looks quite promising.

MILK WEED

(Asclepias syriaca)

Agreement

1. No reasonable chemical control measure has been found effective.

Further Trials Indicated

1. CMU at 40 pounds or more per acre. For spot treatment only.

2. Amonium Sulfamate at 3/4 pounds per gallon of water with a wetting spray application.

CHICORY

(Cichorium Intybus)
(1 report)

One report from Vermont indicates 3/4 pounds 2,4-D in the Spring, or 1/3 pound in the fall will give effective control.

SMALL GRAINS AND SMALL GRAINS UNDERSEEDED TO LEGUMES

John E. Baylor

Approximately 12 to 15 percent of the 3½ million acres of small grains in the Northeastern States were treated with chemicals for weed control in 1952. 2,4-D, MCP and the dinitros were the chemicals used. Since 1951 report thoroughly covers the status of 2,4-D for weed control in small grains, this report will not include that chemical.

The most important weeds of small grains are also thoroughly covered in the 1951 report and will not be repeated here.

Based on the reports received there is no general agreement regarding the us of MCP and the dinitros for weed control in small grains. And there appears to be a considerable range of rates, volumes and formulations among those states where these 2 materials are recommended.

1. Will MCP be recommended in 1953 in small grains not underseeded to legumes?

2 states - Yes	8 states - No
4 reports - Yes	10 reports - No

2. Will MCP be recommended in 1953 in small grains underseeded to legumes?

3 states - Yes	7 states - No
7 reports - Yes	7 reports - No

General Agreement of States Recommending MCP

1/5 to 2/5# MCP using low gallonage applied when grain is 6" - 10" tall and protective canopy of weeds. Not generally safe to use when alfalfa or birdsfoot trefoil is underseeded legume.

3. Will dinitro be recommended in 1953 in small grains not underseeded to legumes?

2 states - Yes	8 states - No
2 reports - Yes	11 reports - No

4. Will dinitro be recommended in 1953 in small grains underseeded to legumes?

4 states - Yes	6 states - No
6 reports - Yes	7 reports - No

General Agreement for States Recommending Dinitros

1 to 1½ qts. of Dow Premerge or Sinox P. E. in 25-50 gal. solution applied in spring when weeds are very small.

5. Special problems encountered in 1952:

   1) MCP more severe on certain legumes and weed selectivity somewhat more variable.
   2) Dry weather reduced effectiveness of control measure.

6. New research now underway in the northeast

   1) Susceptibility of legumes underseeded in small grains both as pure stands and in grass legume mixtures (Cornell Univ.)

   2) Screening of new compounds for grains underseeded (G.L.F.)

7. Problems needing further study

   1) Susceptibility of different legumes normally seeded in small grains.

2) Possibilities of safe fall treatment of winter grains to be underseeded the following spring.

3) Effects of temperature before treatment on results of treatment.

4) Formulations of MCP and dinitros giving most satisfactory results.

5) Control of following perennial weeds in small grains: Winter cress (yellow rocket) quackgrass, horsenettle, nutgrass, Canada thistle, wild onion, garlic, milkweed and bindweed.

Note: Canada Thistle and wild onion and garlic were the most frequently mentioned perennial weeds needing immediate attention.

SEEDLING AND ESTABLISHED LEGUMES AND PERMANENT PASTURES

R. A. Peters

Legumes in the seedling stage which have not been seeded in a small grain companion crop are to be included in this category, as well as established legumes.

Pastures include both the permanent type composed of Kentucky bluegrass or bentgrass with or without common white clover and semi-permanent types such as orchard grass-Ladino clover.

GENERAL AGREEMENT

I. Legumes

A. Alfalfa

1. Chickweed Control

Either DNOSBP or Chloro IPC can be used. DNOSBP, amine or ammonium salt, should be applied at a rate of 1 pound per acre in 20 to 50 gallons of water in late fall or winter. Chloro IPC should be applied at rates of 1 to 4 pounds per acre whenever alfalfa is dormant. Use only on pure legume stands. The latter chemical injures grasses.

Three states - four reports recommend DNOSBP. Two states - three reports recommend Chloro IPC. One state recommends either.

2. General Control of Weeds in New Seedings.

DNOSBP, amine, at 1 to 1.5 pounds per acre in 25 to 50 gallons of water per acre applied when alfalfa is 3 to 6 inches high.

Two states - three reports agree.

B. Clovers

1. Control of Weeds in New Seedings.

On red clover, MCP at rate of ¼ pound acid equivalent per acre applied when clover is 3-6 inches high and has 2 or more true leaves.

One state - two reports agree.

For red or Ladino clover use DNOSBP, amine at 1 to 1.5 pounds per acre in 30 gallons or more of water per acre applied when weeds are in 3-7 leaf stage.

One state - two reports agree.

II. PASTURES

A. Permanent Pastures.

1. Wild Garlic Control

2,4-D ester, 1 to 1.5 pounds acid equivalent per acre applied in the spring before growth is active. Application for more than one year will be necessary.

Three states agree.

2. Broadleaf Weeds Susceptible to 2,4-D.

2,4-D amine or ester, .5 to 1.5 pounds acid equivalent per acre.

Two states agree for use on grasses, one state recommends for grass-common white clover mixtures.

3. General

Adequate fertilization and clipping will control many species.

B. Semi-permanent Pastures.

Good grazing and clipping management will control most weeds in established stands.

PROBLEMS NEEDING MORE WORK

1. Susceptibility to 2,4-D, MCP and other herbicides of legumes at different stages of growth and amount of cover.

2. Pre-planting weed control (Cyanamid is promising).

3. Use of herbicides in the preparation of seed beds for forage on nontillable land.

4. Control of winter cress (yellow rocket) in hay fields.

5. Control of chickweed in clover seedings.

6. Control of weeds in birdsfoot trefoil.

7. Control of wild garlic and wild onion with maleic hydrazide.

8. Importance of weeds found in seedling and established forages in terms of reduction in yield, nutritive value and palatability of forage.

SURVEY OF WEEDS IMPORTANT IN FORAGE CROPS

Listing of weeds considered to be serious as received from nine states.

A. Weeds of hay fields consisting mainly of legumes.

Twenty-six species reported. Species reported by two or more states are given below with the number of states reporting in parentheses.

chickweed (5), curly dock (5), winter cress (4), horse nettle (4), Mustard sp. (3), Canada thistle (3), buckhorn (2), quackgrass (2), plantains (2), wild carrot (2).

B. Weeds of pastures.

Sixteen species reported.

wild garlic (5), wild onion (2), curly dock (5), thistles (4) horse nettle (4), chicory (2), buttercup (2).

FIELD CORN

Collins Veatch

(Summary of 13 reports from 11 states)

Pre-emergence

2,4-D

Use 1 - 1 1/2 lbs. acid equivalent of 2,4-D per acre
5 agree, others vary from 1/2 to 2 lbs.

Use amine or esters of 2,4-D. Low volatile esters preferred.
5 agree, 4 amine only, 3 L.V. ester only

Make application shortly before emergence of corn
6 agree, 2 soon after planting, 3 planting to emergence

Exceptions - - not recommended on sandy, cloddy or stony soils.
7 agree, 5 no comment

Other Chemicals

Calcium Cyanamid - Apply 300 - 600 lbs. per acre over row at planting time, to be followed by cultivation later. (4 reports)

Dinitros - Apply 3 to 6 lbs. per acre of parent acid of water soluble dinitro per acre (Sinox P. E. or Premerge)
4 reports recommend, 2 other reports mention

C.M.U. - Three reports mention but not ready to make recommendations.

Post-emergence

2,4-D

Use 1/4 to 1/2 lb. acid equivalent per acre
12 agree

Use amine or low volatile ester, using esters at lower rates.
7 agree, 5 recommend amine only

Make application any time from emergence until 15" high
7 agree, 2 recommend drop pipes when corn is over one foot in height.

Special Work

Study of nitrate content. Fifty-five varieties were treated with amine and low volatility ester at 3 rates. No changes in nitrate content were found following treatment. (N. Y.)

It was reported that applications of 6 lbs. of Premerge gave some supression of quack grass and controlled nut grass.

PROBLEMS NEEDING MORE WORK

1. Control of weedy or annual grasses (5 reports)
2. Better control of Jimson weed, smart weed and morning glory or bindweed.
3. Chemical to control quack grass in corn.
4. Pre-emergence control on light soils
5. Other chemicals for pre- and post-emergence applications to corn where it is grown in areas of susceptible crops.
6. Timing of chemical treatments and cultivations.
7. Cultivation needed where weeds have been chemically controlled.
8. More accurate data on effect of stage and condition of growth on the outcome.
9. Treatment of corn at lay-by to control late germinating weeds and grasses. Directional spray suggested.

SWEET CORN

Collins Veatch

(Summary of 9 reports from 8 states)

Pre-emergence

2,4-D not generally recommended.
5 reports agree. (3 of these suggest amine at 1-1 1/2 lb per acre)
3 reports recommend amine at rates of 3/4 to 1 1/2 lb. except on sandy, cloddy, or stony soil.

Alkanolamine salt of DNOSBP (Sinox P. E. or Premerge) at rates of 1 1/2 to 6 lbs. active agent in 50 gal. water per acre.
6 reports agree but vary in recommendations as to time of application from planting to 3" high and in band or full coverage.

Calcium Cyanamid (Aero Cyanamid)
Apply 300-600 lbs. per acre soon after planting. 3 reports

Sodium Pentachlorophenate - Apply 15 to 20 lbs. in 50 gal. of water soon after planting. 2 reports

Post-emergence

Application of 2,4-D amine
7 reports agree, 2 reports did not recommend.
Rate of application 1/4 to 1/2 lb. acid equivalent per acre
5 reports agree, 2 recommend 1/2 to 3/4 lb.
Application to be made before corn reaches height of 6".
3 reports agree
1 recommends 4" as maximum height
1 suggests application when weeds are 1" high.

One report recommends the application of Premerge at rates of 1 1/2 to 3 lbs. dinitro as amine salt using complete coverage up until corn is 3" in height and using a directed spray on older corn.

Special Work

A study was made of respiration rates and sugar analysis. No detrimental effects were found when 2,4-D or D. N. were used as recommended. (Ohio)

PROBLEMS NEEDING MORE WORK

- Effective pre-emergence herbicide
- Grass control on sandy soils where pre-emergence applications of 2,4-D are not safe.
- Control of specific weeds such as Horse Nettle
- Effect of herbicide on maturity and quality of corn.

5. More specific information on environmental factors and use of 2,4-D so that adequate recommendations can be included to tell growers when and when not to use 2,4-D in weeding sweet corn.
6. Effectiveness of MCP formulations (amines, esters, sodium salt), trichlorobenzoics, Crag Herbicide and Sodium Isopropyl Xanthate, for weed control in corn.

VEGETABLES

E. M. Rahn

Asparagus - Established Bed (11 reports from 8 states)

For Extensive Use

1. Crag Herbicide No. 1, 2-4 lbs. in 30-50 gals. per acre. Apply after clean cultivation, before, during, or after cutting, (3 states)
2. Granular Cyanamid, 200-400 lbs. per acre, before, during or after cutting season. (4 states, 5 reports)
3. 2,4-D, 2 lbs. per acre, pre-emergence, before and after cutting season, (2 states)
4. Dinitros, 6 lbs. in 30 to 50 gals. per acre, pre-emergence before and after cutting season. (2 states)
5. NaPCP, 25 lbs. in 30-50 gals. per acre, pre-emergence, before and after cutting season. (2 states)
6. Potassium Cyanate, 2% directional spray after cutting season. (2 states)
7. Cyanamid Dust, 75-100 lbs. per acre, during or after cutting season. (1 report)

For Trial

1. CMU, 1-3 lbs. in 50-100 gals. per acre, pre-emergence. (2 states)
2. Crag Herbicide No. 1, 2 lbs., plus Chloro-IPC, 2 lbs. in 50 gals peracre when needed. (1 state)
3. PA, 4-6 lbs. in 30-50 gals. per acre, pre-emergence. (1 report)
4. Stoddard Solvent, 75-100 gals. per acre, directional spray after cutting season. (1 state)

Problems Needing More Work

1. Effect of above chemicals on various soil types over a long period.
2. Use of TCA for grass control.
3. Control of perennial weeds.
4. Use of Trichlorobenzoic plus Chloro IPC.

Asparagus - Seedlings (3 reports from 3 states)

For Extensive Use

1. PCP, 6 lbs. in 60 gals. contact pre-emergence per acre, in oil-water emulsion. (1 state)

2. Dinitro, 1 lb. in 60 gals. per acre, contact pre-emergence in water or oil-water emulsion. (1 state)
3. Stoddard Solvent, 60-80 gals. per acre, when asparagus is under four inches high. (1 state)
4. NaPCP, 12 lbs. in 35 gals. per acre, pre-emergence. (1 state) Use on trial basis on light soil.

Snap Beans and Lima Beans (10 reports from 6 states)

For Extensive Use

1. Dinitros (water-soluble), 6-9 lbs. in 30-50 gals. per acre at planting or 3 lbs. per acre just before emergence. (6 states, 9 reports). Use low rate on light soils.
2. NaPCP, 25 lbs. in 30-50 gals per acre at planting. (1 state)
3. NIX, 8 lbs. in 80 gals. as directional spray, (80 gal. per covered acre), before trifoliate leaves unfold. (1 report)

Problems Needing More Work

1. Selective hormone type weed killers needed.
2. Use of PA.
3. Relation of volume to injury in emergent sprays of dinitros or NIX.
4. Control of nutgrass and wiregrass.

Beets (3 reports from 2 states)

For Extensive Use

1. If grasses are principal problem, TCA, 8-12 lbs. in 30 gals. per acre, pre-emergence. (1 state)

For Trial Use

1. Endothal, 6 lbs. in 30-50 gals. per acre, pre-emergence. Not so good for lambs quarters. (2 states, 3 reports).
2. CMU, 3/8 lb. in 30 gals. per acre, pre-emergence. Probably safer on mineral soils high in O.M. (1 state 2 reports)

Problems Needing More Work

1. How much CMU reduces stand at varying levels of O.M.
2. Use of Oktone.

Carrots (4 reports from 4 states)

For Extensive Use

1. Stoddard Solvent, 75-100 gals per acre, when true leaves appear. (4 states)

Parsnips, Parsley, Dill

Same as for carrots. (1 state)

Cole Crops

For Trial

1. Chloro IPC, 2 lbs. in 50 gals., either after seeding or transplanting. (1 state)
2. NIX, 8 lbs. in 80 gals. overall directional spray after plants are 4 inches high. (1 report)
3. Use of Oktone and Chloro IPC.

Tomatoes, Peppers, Eggplant, Okra

For Trial

1. NIX, 8 lbs. in 80 gals. overall, pre-emergence or directional spray. (1 report)

Problems Needing Further Work

1. A selective herbicide is needed to apply to tomato plants when they are half grown to prevent weeds coming in late in the season. Possibly Sesin.

Lettuce

For Trial

1. Chloro IPC, 2-3 lbs. in 100 gals, per acre, pre-emergence. (1 state)
2. IPC, 4 lbs. 3 weeks after planting in field. (1 state)

Onions (6 reports from 3 states)

For Extensive Use

1. Potassium Cyanate, 1-2 percent sprays, 50-100 gals. per acre, post emergence after Flag stage of seeded onions or after set onions are 6 inches tall. (3 states,4 reports)
2. Cyanamid Dust, 75 lbs. per acre, pre-emergence, on muck soils. (1 report)

For Trial

1. Endothal, 5-6 lbs. in 30 gals. per acre, pre-emergence, on muck soils. (1 report)
2. NIX, 8 lbs. in 80 gals. per acre, pre-and post-emergence. (1 report)

Problems Needing More Work

1. Use of Cyanamid Dust on mineral soils.

Peas (7 reports from 3 states)

For Extensive Use

1. Dinitros (water soluble), 3/4 -1 lb. in 25-75 gals. per acre, when peas are 3-8 inches tall and weeds are small. (3 states, 5 reports)
2. Cyanamid Dust, 75 lbs. per acre, when weeds are wet and are no larger than 4-leaf stage. (1 report)

Problems Needing More Work

1. Relation of climatic factors to effectiveness of dinitros.
2. Use of dinitros, CMU, and granular Cyanamid in pre-emergence applications.
3. Volume of liquid with the dinitro materials.
4. MCP at different rates using amines, esters and sodium salt.

Radish

For Trial

1. CMU, 1/2 lb. in 50 gals., at planting. (1 state)

Spinach (6 reports from 5 states)

For Trial

1. Chloro IPC, use 2 lbs. in warm weather, 1 lb. in cool weather, 30-50 gals. per acre, immediately after planting (2 states, 3 reports). Injury may result on very sandy soils or soils low in O.M. (1 report) When temperatures average below 60°F. crop injury results; under these conditions use IPC (2 reports). One state recommends extensive use.
2. IPC, 2-4 lbs. in 30-50 gals of water, pre-and post-emergence (2 states) One State recommends extensive use.
3. Granular Cyanamid, 400-800 lbs. per acre, pre-planting, for fall or winter seeded spinach. (1 state)

Problems Needing More Work

1. A selective herbicide to control lamb's quarters and henbit and which would cause less crop injury at low temperatures.
2. Relation of climate and soil characteristics to effectiveness of granular cyanamid.
3. Use of Oktone.

Vine Crops (5 reports from 3 states)

For Trial

1. PA, 2-6 lbs. in 30-50 gals. per acre, pre-or post-emergence but before weeds emerge. (3 states, 5 reports)

Problems Needing More Work

1. Are repeated post-emergence applications of PA safe?
2. Can PA be used in hotbeds and greenhouses during starting of plants?
3. Use of PA on various soil types and varieties of cucurbits.

POTATOES

C. E. Cunningham

Agreement

1. Pre-emergence application of dinitro compounds at 1 1/2 to 4 1/2 lbs. DN per acre, the amount being determined by the specific weed problem, applied with or without fuel or diesel oil depending on formulation, in 30-100 gallons of water per acre.

2. Chemical treatment may eliminate one to three early weedings and/or cultivations.

3. One or more hillings are necessary with certain varieties to prevent tuber exposure.

Problems Needing More Work

1. Continued testing of new materials for pre-emergence applications.

2. Effect of weather, stage of weed growth, and soil condition upon the herbicidal activity of materials used for pre-emergence application.

3. Post-emergence application of herbicides that show selectivity to control late germinating grasses.

4. Method of applying herbicides to control late germinating broadleaf weeds and grasses at time of last cultivation and/or hilling.

5. The value of cultivation other than for weed control.

6. Combinations of chemical weed control and cultivation.

7. The effect of herbicides upon potato quality.

STRAWBERRIES

Ernest R. Marshall

Eleven states and seven commercial firms interested in strawberry weed control were contacted in preparing this report.

I. The material used most generally and successfully in commercial plantings of strawberries for broadleaved, annual grass or winter annual weed control was Crag Herbicide 1 at 2-3 lbs. per acre before weeds emerge but after plants are established and as needed thereafter. (8 states agreed - 11 reports agreed)

The following precautions were suggested:

a) Crag Herbicide 1 does not control all weeds and must be applied when weed seeds are germinating for good results. (3 states)
b) Must have adequate soil moisture and temperature conditions (3 states)
c) On some soil types Crag Herbicide 1 gives poor results (3states
d) Runner reduction and root injury may occur if Crag Herbicide 1 is applied too soon after setting or when the runners are starting to root. (4 states)

II. 2,4-D at .25 to 1.0 lb. per acre for broadleaved weed control. (5 states agree)

The following precautions were suggested:

a) Avoid spraying during flower, fruit, runner or bud development periods. (5 states)
b) 2,4-D is not effective during drought conditions (1 state)
c) 2,4-D will reduce yield if applied at flowering.(2 states)
d) 2,4-D may cause abnormal leaves and petiole twisting.(1 state)

III. Various dinitros 1.0 to 1.5 lb. per acre with or without oil applied in fall after the strawberry plants are dormant and while the weeds are small. (4 states agree)

The following precautions were suggested:

a) Avoid application before growth stops in the fall or after growth begins in the spring. (3 states)
b) Avoid application on fields injured from fertillizer application. (1 state)

IV. IPC at 7-lbs. or Chloro IPC at 2 lbs. per acre particularly for the control of chickweed and grasses, apply after plants are dormant in the fall. (2 states agree)

The following precautions were suggested:

a) IPC or Chloro IPC is selective on weeds and does not control all weeds. (2 states)
b) Rates if Chloro IPC over 2 lbs. per acre gives chlorotic leaves and injury to foliage and runners. (2 states)

V. Geese - 3 to 4 young geese per acre (1 state)

VI. <u>Combinations suggested for trial:</u>

1) Chloro IPC 2 lbs. and Crag Herbicide 1 at 2 lbs. per acre.
2) IPC or Chloro IPC and dinitros.
3) 2,4-D and dinitro
4) Crag Herbicide 1 and dinitro.
5) Crag Herbicide 1 and 2,4-D
6) 6 lbs. Chloro IPC or IPC. 6 weeks after planting

In general Crag Herbicide 1 and 2,4-D were the weed killers generally used and recommended. Crag Herbicide 1 was recommended for use before broadleaved weed seedlings were up and 2,4-D after seedlings emerged. For winter weeds the dinitros were favored over IPC and Chloro IPC.

The principal criticism of Crag Herbicide 1 was lack of adequate weed control when applied after weed seedlings were up; under dry conditions or on certain soil types.

2,4-D, IPC and Chloro IPC were criticized because of foliage and runner injury.

Several states are working with various combinations of chemicals for strawberry weed control such as Crag, IPC (or Chloro IPC), Crag 2,4-D, Crag DN, 2,4-D DN or the use of geese in combination with the various chemicals.

VII. Problems Needing More Work

(If research on this problem was reported the state reporting such research is listed.)

1) Testing of new materials and combinations of materials such as IPC, Chloro IPC, Crag Herbicide, PA, CMU, and Sesin. (Michigan State College, Va. Truck Experiment Station, Delaware, New Jersey, Rhode Island.)

2) More accurate information on timing of sprays and effect on runner set and yield. (Mich. State, New York, Va. Truck Exp. Station, Rhode Island, New Jersey, Maine.)

3) Control of chickweed, henbit, annual bluegrass, and ryegrass. (Va. Truck Exp. Station, Delaware, New Jersey.)

4) Use of activated charcoal in conjuction with 2,4-D as a protection agent. (Mich. State College.)

5) Renovation of old berry beds with combinations of chemicals. (New Jersey)

6) Search for a more effective selective material. (Rhode Island)

7) Soil and plant residue.

8) Control of perennial weeds.

POMOLOGY AND BRAMBLES

Anthony Tafuro

1. Poison Ivy in Orchards (Apple, Peach, Cherry)

Suggested rates - 2,4,5-T (low volatile) one to two lbs. per 100 gallons of water or two to three pounds total 2,4-D - 2,4,5-T mixture (low volatile) in 100 gallons of water. A dormant application in the fall or winter with these same rates in 40 gal. of oil has been suggested also.

Time of application - Late July to mid-August when ivy has attained full leaf growth. Thorough coverage is important. Do not spray chemical solution on any part of fruit trees. In summer application, drift should be kep at minimum. Suggest to use hand sprayer or other type of low volume sprayer. Do not use orchard sprayer.

2. Grapes (Concord)

Rate - 2 pints DNOSBP and 10 gallons of oil in 100 gallons of water. Apply spray at rate of 200 gallons per acre (area sprayed). 50 gallons per acre of vineyard since application is made only under trellis.

Time of application - In spring when grass is not more than 6 inches high and a second or third application when grass recovers on mature vines. (see Cornell Ext. Bul 816).

3. Raspberry and Blackberry

A. Suggested rate - 1/2 to 1 1/2 pounds 2,4-D amine per acre.

Time of application - Early spring, before new canes emerge, or in summer when tips of new canes can be avoided. Should be directional spray to avoid succulent shoots, particularly for black raspberries.

B. Suggested rate - Crag Herbicide #1 - three to four pounds per acre.

Time of application - Within one week after cultivation in season when seedling weeds are expected, or when first tiny seedling weeds are visible.

PROBLEMS NEEDING MORE WORK

1. Test oil qualities and quantities to be used for grass control in grapes.
2. More work in controlling perennial grasses, emerged annual grasses in brambles.
3. Work on bramble tolerance to Dinitro-fortified oil emulsion when used routinely for more than one year.
4. Use of Oktone. Keep off stems.

BLUEBERRIES AND CRANBERRIES

No major changes in recommendations from last year and to avoid repetition refer to 1952 proceedings. Also refer to Maine Agr. Exp. Sta. Bulletin 499 for weed control in low-bush blueberries.

WEED CONTROL IN COMMERCIAL NURSERY AND ORNAMENTAL PLANTINGS

A. M. S. Pridham

The present summation is the first in this area of agriculture. Approximately one hundred questionnaires were sent out; 35 were returned from commercial nurserymen, park or arboretum managers and from research workers.

1. Commercial Use

A few nurserymen are using herbicides effectively in limited directional spraying. The treatments are primarily adjunct to standard cultural practices.

Solution of weed control in nurseries has progressed with the development of better machinery and planting practices, some of which are expensive. Cross checking at planting time for cross and diagonal cultivation is an example of an expensive practice. Hilling and fall hoeing are other practices based on awareness of the necessity to deal promptly with seedling weeds. The Howard Rotary hoe is finding favor in the numerous small blocks of nursery stock in which perennial weeds are a major problem.

For lining out stock in small plantings, the wheel hoe and sawdust mulches have several advocates. Seed bed treatment and other special situations are individual cases and no generalizations are offered.

Specific treatment for individual weeds and crops is appreciated particularly in gladiolus and evergreen seed beds but no generalizations are offered.

2. Troublesome Weeds

A list of 21 weeds suggested in the questionnaire received three additions and three of the original suggestions received no votes. The list thus stands as follows together with the number of votes in 23.

Annual Weeds	
Ambrosia artemisiifolia - ragweeds	7
Barbarea vulgaris, yellow rocket	4
Chenopodium album	6
Digitaria sanguinalis	12
Poa annua	4
Portulaca oleracea	16
Stellaria media	15
Perennial Weeds	
Agropyron repens, quack grass	12
Artemisia vulgaris, wormwood, chrysanthemum weed	8
Cerastium vulgatum, mouse-eared chickweed	12
Circium arvensis, Canada or California thistle	7

Perennial Weeds cont.

Convolvulus spp., bindweed	6
Cyperus exculentus, nothern nutgrass	6
Malus rotundifolia, mallow	1
Polygonum cuspidatum, Japanese bamboo	3
Rhus Toxicodendron, poson ivy	7
Roripa sylvestris, creeping yellow cress	1
Solanum carolinense, horse nettle	1
Typa, cattail	2

3. Annual Weeds

Early cultivation and hoeing while the weeds are seedling to 3 inch size is common practice. Directional spraying is noted as satisfactory for the following herbicides by two or more reporters.

Herbicide	Rate	Results	Specific Weeds Controlled	Crop
Aero Cyanate	Manufacturers	Variable	Portulaca Crabgrass	Gladiolus
Chloro IPC	"		Chickweeds Crabgrass	"
Crag 1	2-4 lb/acre 1-2lb/acre		Chickweeds Crabgrass	"
Dinitro				
Selective formulation	Manufacturers		Chickweed	Gladiolus
Pre-emergence "	"		Most seedling weeds	Fass Taxus
General formulation + oil	"		Most small weeds	
N.I.X.	8-12 lb/acre	Variable	Portulaca Annual chickweed	
Stoddard Solvent	To wet weed foliage		Most small weeds	Conifer seed beds
2,4-D (non-volatile)	1-3 lb/acre		Portulaca	Lawns Gladiolus

These herbicides used as directional sprays on seedling weeds have been reported generally satisfactory. They have also been used specifically for the weeds noted. Not enough data was given to indicate tolerance of specific crops during periods of active growth.

Herbicide	Rate	Crop	Specific Weeds controlled
C.M.U.	Not stated	Blueberries	Quackgrass
M.C.P.	2-4 lb..acre	-	Yellow rocket
Monochloroacetic acid	1-3%	-	Seedling grasses
Niagarathal V.	7½-10./acre	Roses	Seedling to 2"
Oktone	½ gal.:30 gal.oil	Taxus	Summer weeds
Sodium arsenite	8-15 lb./acre	-	Annaul chickweed Portulaca Crabgrass
Sodium chlorate	dilute (?)	-	Annual chickweed
Undecylinic acid	-	-	Seedling grasses

4. Perennial Weeds

Agropyron repens. For nurseries, cross cultivation with Howard rotary hoe or Farmall tractor to reduce hand hoeing. Heavy infestations might be treated with sodium trichloroacetate if nursery stock is not present. Repeated use of directional contact herbicides is a possibility.

Artemisia vulgaris, wormwood. No reports aside from the author's, notably that application of growth regulators to roots upturned by fall plowing has been successful. Foliar sprays that do not injure nursery stock have not yet been found entirely successful under field conditions.

Cerastium vulgatum, mouse-eared chickweed. Dinitro formulations appear to be satisfactory as used according to the manufacturer's directions. Fall application Chloro I.P.C., C.M.U. and 2,4-D also appear promising.

Circium arvensis, Canada thistle. The reports are too limited to suggest more than cultivation plus the contact directional spraying which will be done for summer and fall annual weed control.

Convolvulus spp., bindweed. Tests and experience too limited to recommend other than cultural practices in nursery.

Cyperus esculentus, northern nutgrass. Reports are too few for recommendations. Sodium trichloroacetate has been reported by several workers as responsible for chlorotic-like in nursery stock. Hence due care should be used in selecting this chemical for use on nutgrass in nurseries.

Polygonum cuspidatum, Japanese bamboo. Four reports noted this as a serious weed. It is serious for amateur gardeners and many requests are received each year for help. Aside from repeated application of contact herbicides, no suggestions were offered here.

Rhus Toxicodendron, poison ivy. Among nursery stock this pest might be controlled by cultivation. In hedge rows Ammate and 2,4,5-T are useful when due precaution is taken against crop injury. Both chemicals were reported to injure nursery stock.

SUMMARY

Cultivation and hoeing are still largely practiced in commercial nurseries. Specially devised equipment such as a two row rototiller, grape hoe, Howard rotary hoe, are reported to be useful. Cross cultivation is reported to minimize hand hoeing or use of soil scratchers. High costs of hand labor and some injury to crops plants is reported. Prompt control of small weeds is stressed as important. Chemical weed control is practiced in conifer seed beds with Stoddard Solvent, and in gladiolus plantings 2,4-D, Crag 1, dinitro formulations.

Directional spraying with contact herbicides appears to be a useful procedure. Crag 1, dinitro formulations and Stoddard Solvent are most widely used in research work and commercial practice. Fall and dormant season spraying is possible.

Sodium trichloroacetate should be used with caution. 2,4-D is not popular; chloro IPC is promising; other herbicides are useful in specific cases.

The most serious weed in northeastern nurseries is Artemisia vulgaris or chrysanthemum weed for which no chemical control is available.

PROBLEMS NEEDING MORE WORK

1. Continued search for an herbicide that will control Artemisia vulgaris when it becomes established in nursery plantings so that foliar or soil surface treatment can be made without injury to nursery crops.

2. To establish the tolerance of nursery crops in dormant or mature growth to directional spraying with herbicides now available for control of annual weeds.

3. To establish the tolerance of nursery crops including particularly roses, Taxus, peonies, and narcissi to herbicides suitable for the control of annual and perennial weeds during May through August.

4. To establish crop tolerance of nursery crops including Forsythia, grapes and gladiolus to herbicides effective in the control of annual weeds May through August.

5. To establish the efficiency and persistence of soil fumigants in preparation of nursery soils for seed bed and limited lining out areas where irrigation is commonly used.

6. To find practical chemical means of controlling Agropyron repens, Cyperus esculentus, Polygonum cuspidatum and Rhus toxicodendron in nursery and ornamental plantings.

WOODY PLANTS

W. A. Ashbaugh

Introduction

The writer employed the device of using a questionnaire as a different approach to the problem of Woody Plant Control because of these reasons:

1. The writer, as a user, is reasonable neutral with respect to the four general groups interested in this problem.

2. It was suspected that a wider divergence of opinion exists than former Coordinating Committee reports indicated.
3. Assistants, to analyze the data received, were available.
4. Since chemical control of woody plants has progressed past the pilot plant stage, better coordination between the research groups and the user groups, particularly with respect to problems which need attention, would be desirable.

Response to Questionnaire

	Research	Users	Contractors	Manuf.	Total
Number Distributed	65	69	24	45	203
Number Acknowledged	48	49	12	24	133
Number Completed	36	39	10	11	96
Percentage Response	55%	57%	42%	24%	47%
States Represented	16	17	7	7	26
Canada	1	0	0	0	

Probably the most important conclusion to be drawn is that the basic idea of chemical control is generally accepted. Now, it remains to discover some means of better coordinating the efforts of all the groups interested in this problem.

Because of the enormous volume of data contained in these questionnaires, a detailed analysis is being prepared for distribution at a later date. Both this report and the one following, indicate directions in which every investigator can work to advance the art of Woody Plant Control.

Summary

On a separate page, the reader will find a brief summary table showing some important statistics developed from the questionnairs. A more complete analysis of these data will be found in the following text.

Areas of General Agreement

(Based on 96 questionnaires returned)

Foliage Spraying - Eighty-five percent indicate that foliage spraying is still a standard practice. The remaining 15% varied from those searching for a more efficient method, to those who have standardized on basal or some other spraying method.

Fifty-two percent recommend maximum plant heights for greatest efficiency and economy, from 3' to 8'.

Sixty percent of reports indicate that standard foliage spray methods (4# acid D/T per 100 gal. water) are being followed.

Basal Spraying - Eighty-eight percent of the replies indicate results from moderate to highly successful.

SUMMARY

Reports Received From Woody Plant Questionnaire

	Standard Practice	Other Methods
Foliage Spraying	85%	15%

Maximum Ht. of Plants	3'-5'	6'-8'	9'-12'	13'-20'	20' up
Foliage Spraying	15%	37%	25%	15%	8%

	Successful	Moderate	Unsuccessful	Formulas: 16# T ahg oil	Formulas: Others
Basal	76%	12%	5%	50%	50%

General Agreement: Basal-small, smooth barked trees; Frill-large, thick barked trees

	Succ.	Inconclusive	Unsucc.	Spray Immed.	Spray Later	8-16# T* ahg** oil	20# T or D/T*** ahg oil	Formulas	Various other hormones	Ammate
Stump	78%	16%	6%	91%	9%	32%	19%		26%	23%

	Maximum Height 0'-2'	3'-4'	5'-8'	8'-11'
Roadside	19%	36%	36%	9%

Special Procedure	Cut & Stump Spray	Spray Late in season	Basal	Various Others
Roadside	38%	9%	14%	39%

Method of Prevention	Repeat Treatments	Oil Basal	Water Foliage	Various Others
Root Sprouting	62%	13%	11%	14%

Root Sprouting Species	Sumac	Locust	Sassafras	Poplar	Ash	Others
Root Sprouting	18%	15%	8%	8%	7%	44%

	No Spray	Basal or Stump	Favorable Wind	Ammate	Various Others
Safety	34%	29%	13%	7%	17%

Methods of Control	Basal	Foliage	Others
Resistant Species	48%	39%	13%

Resistant Species	Ash	Maple	Oak	Basswood	Hickory	Others
Resistant Species	23%	17%	17%	8%	8%	27%

* T = 2,4,5-T ahg = per 100 gallons *** D/T = 2,4-D + 2,4,5-T

Twenty-nine percent of the replies indicate that basal spraying is more efficient when applied to smooth barked trees, 6 inches or less in diameter.

Eighty-two percent of the replies indicate that hormone type sprays are used. Remainder are using a total of 12 different chemicals.

Basal sprays appear to be successful on the majority of woody plants. Only two replies indicated basal spraying was unsuccessful on specific plants.

Half of the replies indicate that 16# 2,4,5-T acid in an ester formulation per 100 gallons of oil is standard practice. Basal spraying would be more popular were it not for high costs.

Stump Spraying - Seventy-eight percent of the replies indicate that stump treatment results have been satisfactory.

Ninety-one percent of the replies indicate that stump spraying must be done immediately after cutting.

Thirty-two percent of the replies indicate that 8# to 16# of 2,4,5-T per 100 gallons of oil is recommended.

Fifty-three percent of the replies indicate that 2,4,5-T is used in some proportion in their stump treatment formula.

Frill Method - Except for research workers, little interest was shown in the Frill Method.

Sixty-six percent of the replies indicated that the Frill Method should only be used for rough barked trees over 6 inches in diameter, and then only in certain locations. 2,4-D and 2,4,5-T are used more extensively than Ammate or Arsenic.

Roadside Spraying - It is well known that the problem of controlling roadside brush is of vital importance to Highway Commissions, Communication and Electric Utilities. Nevertheless, there is practically nothing in the way of general agreement that can be detected in the replies we have received to our questionnaire. For example, out of 57 persons reporting, 15 different procedures and recommendations were given.

Fifty-five percent of the replies indicate the maximum height of vegetation to be sprayed along roadsides should not be more than 3' to 4'. (Some woody plants will grow from 4' to 8' in the growing season after cutting.)

Root-Sprouting Species - There appears to be general agreement that certain root sprouting species, which are usually considered susceptible to foliage spraying when young, become difficult to control when they have developed a strong root system which will enable root sprouting to occur.

Sixty-two percent of the replies indicate that repeated spraying will frequently control root sprouting.

Twenty-nine woody plants were reported as being root-sprouting species. The first four were Sumac - 18%, Locust - 15%, Poplar -8% and Sassafras 8%.

Resistant Species - Mr. H. C. Ferguson has further data on resistant plants.

Forty woody plants were reported as being in resistant class. Percentage of agreement on five most frequently reported was Ash -23%, Maples - 17%, Oaks - 17%, Basswood - 8%, and Hickory - 8%.

Forty-eight percent of the replies indicated that basal spraying was the most effective way to control resistant plants.

Translocation - This question was merely to determine the general opinion of the workers who are interested in woody plant control. It is recognized that the actual determination of whether translocation occurs will only be answered by careful scientific research.

Few reporters appear to consider translocation significant. Of the 42 replies received, 36% indicated that there was translocation in connection with foliage spraying, and 19% felt that basal or stump spraying showed evidence of translocation.

There is reasonably general agreement that there is no immunity development in an individual plant. Some reporters feel that there is evidence of a variation in resistance in some plant species which could be confused with immunity development.

Safety - Safety, particularly in the field application of chemicals for woody plant control, is a problem of extreme importance. It is probable that more extensive work on safety, other than the development of low volatile esters of 2,4-D and 2,4,5-T may be indicated.

Eighty-three replies were received indicating recommended procedure when spray drift may be dangerous. Thirty-four percent recommended "no spray", and 29% recommended basal or stump spray. There appears to be general agreement on such matter of fact items as favorable wind conditions, non-volatile chemicals, and the use of common sense.

New Chemicals and Equipment - There is certainly general agreement that better chemicals than those available today, are desirable. There appears to be a growing interest in the use of oil/water emulsions.

Equipment appears to be relatively stabilized at this time. There seems to be general agreement that for foliage spraying, power sprayers are desirable. Usually, when basal or stump spraying is being done, the general practice is to use knap-sack sprayers, although several of those reporting indicate that an interest in light mechanized spray equipment for basal or stump spraying is increasing.

An important remaining problem is chemical application on difficult terrain where power equipment cannot be used, and normal knapsack spraying would be too expensive. For areas such as this, six references to airplane and helicopter spraying indicate that when there is no drift hazard, this method is satisfactory. There were two references to pack mules or horses carrying very light mechanized spray equipment over difficult terrain. There is one report that the use of a hood over the spray gun permits more efficient control of drift. Tapping tools, which permit the injection of the chemicals in a manner similar to a hypodermic needle, are reported in three cases. It appears that the arsenic compounds are more efficient than either the ammate or hormone type compounds when using tapping equipment.

Trends Away From Present Practice - We have searched carefully for indications of trends away from present general practices. The replies indicate little that is significant.

The addition of oil (up to 10%) is receiving consideration by some investigators. Promising results have been reported.

There is some indication that ground saturation around the base of woody plants to control root sprouts is receiving serious consideration.

There is indication that there is a trend toward basal and stump spraying when resistant plants are a major problem.

Problems Requiring Further Study - In our request for problems requiring further study, we received 152 responses from the 96 replies to our questionnaire. In the list of problems which follows, an effort has been made to combine these questions into more or less natural groups.

As one very important contributor comments - "I don't know of any problems that don't require further study."

The members of the Northeastern Weed Control Conference can be roughly divided into two groups - those interested in the theoretical problems, and those interested in practical application. It is recommended that an effort be made to secure volunteers who will accept some of the suggested problems and report back to this Conference next year. The Coordinating Committee should decide the relative importance of the problems needing further work.

Foliage Spraying - 7 Problems

1. Enumeration of factors which control the type of equipment (power or hand) to be used on an area that is to be foliage sprayed.
2. Further work to indicate the relation between effectiveness of kill, and season when foliage is sprayed.
3. Study to indicate whether the use of 2,4,5-T alone can be justified from an economic or results basis.

Basal Spraying - 13 Problems

4. Continued search for improved methods, improved equipment, more efficient carrier, and lower costs.

5. Further study of oils with respect to effectiveness, optimum dosage and optimum volume.
6. Continued study to develop more effective basal treatments when dealing with highly resistant plants.

Stump Spraying - 5 Problems

7. Continued study of stump spraying techniques to obtain more consistent results.

Dormant Spraying - 8 Problems

8. Development of an effective blanket dormant spray to kill woody plants efficiently and economically.

Translocation - 11 Problems

9. Further work to determine if translocation has anything to do with the effectiveness of the various chemicals.

Chemicals - 23 Problems

10. Further study to produce chemicals which will give more consistent results.
11. Development of formulas which will have more consistent action on a wider range of woody plants.
12. Continued study to discover if some of the new compounds such as CMU etc., have any place in woody plant control.
13. Carriers or stickers to enhance the killing power of solutions.

Applications - 5 Problems

14. Further study to develop more efficient application techniques and equipment.

Chemical Control Chart - 4 Problems

15. Development of simplified chart showing the most effective means of control for individual species.

Safety - 10 Problems

16. Continued work to determine the effect of spray compounds on live stock.
17. Development of spray nozzles which will produce a more uniform size of spray droplet to reduce drift.

Weather and Season - 3 Problems

18. Further study to determine the influence of various climatic factors on effectiveness of spray techniques.

Ecology - 2 Problems

19. Continued study to determine if ecology can be applied in a practical manner in the control of woody plants.

Spray Personnel - 4 Problems

20. Development of methods to permit better organization and training of more efficient spraying crews.
21. Desirability of licensing personnel responsible for spraying.

Equipment - 8 Problems

22. Development of improved equipment for traversing difficult terrain.
23. Development of protective paint to combat corrosion when using ammate.
24. Study to determine value of oil resistant clothing.

Technical - 11 Problems

25. Field work with detailed analysis of results such as interactions of concentration, volume of spray, and percent and portion of leaf surface treated, together with effect of season and ratio of D to T.
26. Study of influence of size of root system in the control of root sprouting.
27. Study to determine effect of stump or full plant spraying on final percent kill.
28. Investigation to determine which components of oil have phytotoxic properties.

Economics - 11 Problems

29. Development of a method of cost accounting to compare the various methods of treatment.
30. Study of spray interval vs. cost.
31. Study to determine if it is economical to bull-doze a trail to simplify future spray applications.
32. Study to determine most desirable basis of woody plant spraying bids:
    a. Time and material
    b. Line mile
    c. Acres or lump sum

Spray Permission - 3 Problems

33. Methods to be used to convince various agencies and the general public on desirability of right-of-way spraying.

Related Program of Spraying - 1 Problem

34. Development of an educational program by the Northeastern Weed Control Conference to encourage the large users to adopt a related program.

Conclusions

Because of the large number of comments received from this questionnaire, only very general conclusions are being offered at this time.

1. The questionnaire method has been an excellent means of determining the problems of a large number of workers and users.
2. The areas of general agreement appear to be somewhat more restricted than formerly indicated.
3. Considering questionnaires received on a geopgraphical basis, no outstanding differences in experience can be detected.
4. Practically all phases of the general problem of chemical control of woody plants need further study.

SUSCEPTIBILITY OF WOODY PLANTS TO HERBICIDES

H. C. Ferguson

This report is an attempt to show the resistance of some common woody plants to some chemicals and their combinations and the time of year that they could be applied to attain a maximum or results. The plants shown have been restricted to some of the ones that are known to be difficult to control by means of chemical sprays while a number of plants regarded by many persons as easy to control have been purposely deleted.

The results are a summary of 82 questionnaires received from colleges, universities, state forests organizations, utility companies, tree and landscape contractors and other interested persons. When tabulating the final results, all answers, regardless of origin or occupation, were given the same evaluation.

A very interesting item that appeared with the return of these questionnaires is the difference of opinion that exists regarding the same species. Where a plant is reported as resistant or susceptible to a spray it is so reported because there was a majority of the questionnaires that indicated it to be that way. In instances where a clear majority could not be established, a "?" mark was inserted to indicate that the opinion was almost equally divided regarding that species. However, there was not one plant listed where the return questionnaires did not indicate that some questions from the standpoint of its resistance or susceptibility existed. This would indicate that there is a great need for further study of this matter and possibly the addition of the conifers in the next year's work.

Reaction of Woody Plants to Herbicides

Plant Species Common Name Scientific Name	Water Carrier-Foliage Appl'n 2,4-D - 2,4,5-T Comb'n*	2,4,5-T alone *	Ammate ***	Oil Carrier-Basal Appl'n 2,4-D- 2,4,5-T Comb'n**	2,4,5-T alone **
Ailanthus (Ailanthus glandulosa)	S	S	M	S	S
Arrow Wood (Viburnum acerifolium)	S	R	S		M
Ash (Fraxinus Spp.)	R	R	M	M?	M
Basswood (Tilia americana)	R	M	M	R?	M
Beech (Fagus grandifolia	M	M	S	S	M?
Birch (Betula Spp.)	S	S	S	S	S
Bramble (Rubus Spp.)	S	S	S	M	S
Buckeye (Aesculus Hippocastanum)	M	M	M	S	S?
Cucumber Tree (Magnolia acuminata)	S	S	S	S	S
Elm (Ulmus Spp.)	S	M	S	S	S
Green Briar (Smilax rotundifolia)	R	R	M?	R	R
Gum Black (Nyssa sylvatica)	M	S	S	M	M
Gum Red (Liquidambar styraciflua)	S	S	S		S?
Hawthorn (Crataegus Spp.)	M	M	M?	S	S?
Herculus Club (Aralia spinosa)	S	S	S		S
Haw (Viburnum prunifolium)	M	M	M	S	S?
Hickory (Carya Spp.)	M	S	M	M?	S
Honey Locust (Gleditsia triacanthos)	M	S	M	S	M
Ironwood (Ostrya virginiana)	S	R	S	S	M
Laurel (Kalmia latifolia)	R	R	M	S	M
Maple Sugar (Acer saccharum)	R	R	S	S	S
Maple Red (Acer rubrum)	R	M	M	S	S
Oak White (Quercus alba)	M	M	S	S	S
Oak Red (Quercus borealis maxima)	M	M	S	S	S
Locust (Robinia pseudo-acacia)	S	S	M	S	R
Paw Paw (Asimina triloba)	M	M	S		M
Persimmon (Diospyros virginiana)	R	R	M	M	M
Poplar (Poplus Spp.)	S	S	S	S	S
Poisom Ivy (Rhus Toxicodendron)	S	S	S	M?	S
Red Bud (Cercis canadensis)	M	M	S	S	M
Sassafras (Sassafras variifolium)	S	S	S	S	S
Spice Bush (Benzoin aestivale)	S	S	S		S
Sycamore (Platanus occidentalis)	S	S	S	S	M
Tulip Tree (Liriodendron tulipifera)	S	S	S	M?	S
Willow (Salix Spp.)	S	S	S	S	S
Witch Hazel (Hamamelis virginiana)	S	S	S	S	S

*Conc. 4# acid per 100 gal water
Best results June, July, Aug., Early Sept.
Ten feet max. height controlled by chem.

**Conc. 16-20# acid per 100 gal. oil
Best results through dormant season
No limit to max. height controlled

*** Conc. 75-100# per 100.gal. water
Best results May, June, July, Aug. Early Sept.
Ten feet max. height controlled by chem.

R - - Resistant
M - - Moderately resistant
S - - Susceptible
? - - Opinion divided

TURF

Ralph E. Engel

The following states offered recommendations on control of turf weeds: Delaware, Maine, Maryland, New Jersey, Rhode Island, and West Virginia.

Agreement

1. The chemical, 2,4-D, was recommended for control of broadleaved weeds by 5 of 6 states reporting. All five reports recommended amine formulations. Two recommended salts of 2,4-D, and two recommended esters under certain conditions. The rates of application ranged from 1/4 to 1½ pounds of actual 2,4-D per acre. Three of the five reports recommended both spring and fall treatment.

2. Three reports recommended phenyl mercury acetate for controlling crabgrass. Rates of application varied from 1⅛ to 2½ ounces of 10% active material /1000 square feet for lawn type turf. A range of 1-1½ ounces per 1000 square feet was recommended for putting green turf. Two to six treatments at 7-10 day intervals were considered necessary according to conditions.

   One report recommended dry application of phenyl mercury acetate.

3. Potassium cyanate was recommended at a rate of 8-16 pounds per acre by three reports. Two to three treatments were considered necessary. All reports suggested a minimum gallonage of water that ranged from 86-200 gallons/acre. All three reports recommended potassium cyanate for lawn or Kentucky bluegrass type of turf only.

   Good management was stressed by all six reports. High cut (four reports), adequate fertilization (four reports), selection of improved strains (two reports), proper use of lime in conjunction with fertilizer (two reports), and careful watering (one report) were recommended.

Urgent Problems Requiring Work

1. Methods of control of goosegrass, Poa, annua, and clover.
2. The effect of such environmental factors as temperature, soil moisture, and soil reaction on chemical treatments used for crabgrass control.
3. The effect of the use of herbicides on turf grasses.
4. Continued study on crabgrass control.
5. Efficient methods for applying herbicdes to turf areas.
6. Endothal for clover control.
7. Fall and spring application of MCP at varying concentrations.
8. Use of 2,4,5-T for weed control in turf.

PUBLIC HEALTH

A. H. Fletcher

Ragweed

Agreements

1. Approximately 5% of the persons living in the Northeast have pollen hayfever. It is estimated that 80% to 90% of these are sensitive to the ragweed pollen.

2. The effective control of ragweed depends primarily of the prevention of pollination.

3. The low pressure high volume aqueous foliage spray application of 500-1000 parts per million of acid equivalent of 2,4 of non volatile formulations such as the sodium or amine sa of 2,4-D during the growing season but before pollination have been shown to be effective, practical, and safe when applied as a drenching spray.

4. Spraying ragweed not only prevents pollen and seed productio but has a cumulative effect. Ragweed growth is discouraged through the stimulation of competing vegetation.

5. The control of ragweed plants in urban areas has proven effective and economically feasible when carried out as a centrally directed and administered spraying program using 2,4-D. High pressure spraying or fogging should not be used in such areas.

6. Two broad types of programs that provide the maximum of relie are:
   a. First, the control of the extensive and concentrated ragweed growth in urban areas where the largest number of people will benefit with the least per capita cost, and
   b. Second, the control of ragweed along highways, especially those subject to erosion and along ne highways without plant cover along banks, shoulde and right-of ways, because people have to travel along the highways in their daily activities.

Problems Needing More Work

1. Research, education and more local control programs are needed to successfully meet the over-all problems of contro

2. The cooperation of several specialists, including aerobiologists, botanists, public works engineers, sanitarians, agriculturists and public health administrators, is essen in solving the problems of control and in evaluating contr programs.

3. The development of practical measures for the control of ragweed to prevent pollination in connection with the growing of crops such as potatoes, corn, tomatoes, grain, etc.

4. Research to determine the concentration and dynamics of pollen in the atmosphere necessary to bring about allergic reactions.

5. Research into the ecology of the ragweed plant.

6. Botanical and meteorological factors influencing the distribution of pollen in the air from the ragweed growing areas.

7. Practical measuring devices to quantitatively sample pollenin air. This is necessary to determine where pollen is coming from and to measure the reduction in pollen concentrations in the air following the elimination or reduction of ragweed growing areas.

POISON IVY

Agreements

1. A substantial percent (as high as 20% to 25%) of the population in many suburban type communities, where poison ivy has been allowed to grow unchecked, are poisoned each season.

2. Poison ivy is found in wood lots, along fence rows, parks, playgrounds and other recreational areas, as well as on trees, poles and in orchards.

3. Poison ivy can be effectively controlled using ammonium sulfamate, 2,4,5-T combinations of 2,4-D - - 2,4,5-T ester formulations. Higher concentrations of the chemical are necessary to kill poison ivy growing in the shade than in the sun.

4. Borax has been successfully used at rates of 4 lbs. per 100 sq. ft.

Problems Needing More Work

1. Studies of penetration, absorption and translocation of herbicides in the poison ivy plant and the influence of time of application on the effectiveness of control.

2. Research is needed to determine uniform applications of lethal amounts of herbicide to control poison ivy.

3. The cooperation of several specialists, including botanists, public works engineers, sanitarians, agriculturists and public health administrators, is essential to developing good control programs.

HERBICIDAL POISONING OF LIVESTOCK

S. N. Fertig

During the past two years there have been numerous reports of injury or death of livestock from eating crop, weed and woody species treated with presently used herbicides. The following points are presented based on the investigation of several alleged cases of such poisoning and from communication with research workers in several states and foreign countries.

1) There are no known cases of actual herbicidal poisoning from field application of presently used herbicides marketed as non-poisonous. There is no sound toxicological evidence available for the presently publicized "nitrate" "phenol" and nitrite poisoning idea as a common cause of death. True, nitrate and nitrite poisoning has occurred in cattle, sheep and swine from eating plants grown on high nitrate soils or from other feed sources. None of these, however, have been definitely traced to or shown to be caused by herbicidal treatment.

2) All alleged cases of herbicidal poisoning of livestock and wildlife that have been definitely diagnosed have been caused by one of the following: (1) lead, (2) arsenic, (3) "hardware disease", (4) poisonous plants, (5) old age, (6) parasites, (7) drowning (8) poor marksmanship ("hot"lead), (9) contaminated feed or (10) injection or oral dosage of some medicine or drug.

   In all cases which have been carefully surveyed, even though the herbicide has been associated with the trouble, it has in no case been directly or indirectly related to the deaths reported.

3) Some livestock losses, have occurred in areas where herbicides were used, which to date have not been explained by careful post-mortem examination. The fact that no sickness or deaths occurred prior to the use of the herbicide has caused the finger of suspicion to be leveled against it. It must be remembered that many similar cases occurred before the presently used weed killers were known and in areas where no herbicide had ever been applied. Would it not be wise to follow the legal adage - "a man is innocent until he is proven guilty". At least, let him be sentenced by someone who knows the law.

   Two cases of apparently "almost certain herbicidal poisoning" in New York State during 1952 were definitely shown to have been caused by old paint buckets and lead pipe, which had been in the pasture area for 10 or more years. The interesting fact is that these pasture areas had been used each year and no trouble encountered until a few days after

the herbicide 2,4-D was applied. In no case should a hasty decision or diagnosis be made or accepted.

4) Another commonly reported cause of livestock losses has been from eating the leaves of such woody plants as choke cherry or wild cherry, or grazing sudan grass or other members of the Prunus or Sorghum Family believed to accumulate high levels of hydrocyanic acid. Here again, losses occurred prior to the use of modern herbicides and are still occurring in areas where herbicides have not been used. Also, there is good experimental evidence to show that there is no increase in hydrocyanic acid from treatment with 2,4-D and 2,4,5-T. At least for wild cherry which has been the most frequently accused.

In this connection, if wild cherry and choke cherry leaves cause poisoning, they are just as dangerous when green as when wilted and just as dangerous not sprayed as sprayed.

5) Poisonous weeds are a frequent cause of livestock sickness and death. They are a constant source of trouble in some sections of the country and in some pasture areas of the Northeast. At present, the exact effect of herbicides on poisonous weeds is not known. Some research workers feel that translocated spray materials may improve the palatability of these plants to a degree where animals would graze them. However, in actual grazing trials on desirable grasses and legumes, livestock have shown no preference for treated material.

With poisonous weeds as with other problems mentioned, many livestock have died from eating poisonous plants long before such weed killers as 2,4-D, 2,4,5-T and TCA were available. They will unfortunately continue to do so. As a precaution, however, it is suggested that livestock not be permitted in treated areas where poisonous plants are growing. Probably just as many losses could be prevented if this suggestion was followed for similar areas not treated with herbicides.

6) Most people are still unfamilar with the chemicals now being used as herbicides. Livestock losses occurring following the use of these materials gives them understandable cause for alarm. There is no justification, however, for the action of other well-meaning citizens who are no more familiar with the chemicals but who insist on writing scare stories and shouting from the roof tops that modern herbicides are in effect "mass murderers". If the materials are as dangerous as some people would like us to believe, there is no one connected with the field of herbicide development who would dare market or recommend them. Also, since they are now used in all 48 states, Canada and most foreign countries, someone sould have found a clear-cut case by this time.

It should be understood that research workers, industrial concerns and Federal and State agencies are just as interested in the users well-being as any other individual or group. This not only relates to the user himself, but to livestock, wild-life and indiscriminate control of woody and herbaceous vegetation. The commercial concerns have thoroughly checked the poisonous properties of their products. State and Federal laboratories are constantly analyzing agricultural chemicals for these same reasons. In addition, Experiment Station workers have conducted controlled laboratory and field studies to find any effects of these herbicides on livestock.

7 This summary should not convey the idea that such things as nitrate poisoning from herbicidal treated vegetation is impossible. However, the frequency of its occurrence has been grossly exaggerated if it has occurred at all. Experimental evidence has shown that such plants as lamb's-quarters (Chenopodium spp.) and pig weed (Amaranthus retroflexus) increase in potassium nitrate content following treatment with 2,4-D and 2,4,5-T formulations. Sugar beet tops have responded likewise. This increase has been great enough to cause death if grazing animals ingest sufficient quantites of this herbage. Lamb's quarters and pigweed under field conditions have reached 5-5½ per cent potassium nitrate on dry weight basis. According to the University of Wyoming workers, a 500-pound animal would need to eat 5 or more pounds of forage on a dry weight basis, containing 5 percent potassium nitrate, to be toxic. This would mean 20-25 pounds of fresh green material. Here again, the combination of the conditions necessary for nitrate poisoning to occur are rare and should it occur the symptoms are sufficiently clear that veterinarians should readily diagnose it.

8) The strange part of the whole story of herbicidal poisoning is the conditions under which they have occured. In all the cases I have studied and most of those reported the animals have been forced to hunt or "steal" the treated herbage. They have been grazing areas adjacent to those sprayed or at most could have obtained only a few mouthfuls from a fence row, hedge row, or roadside where weeds or brush had been sprayed. It is unbelievable that a herbicide this deadly could have reached the general public without detection. Contrast this with the large number of users who have annually sprayed pastures, small grains, and row crops; with the grazing experiments that have been conducted to try to produce the poisoning; with experiments of actually feeding the chemical to animals and with the extensive laboratory tests before the chemical reaches the market. None of these have shown any harmful effects at amounts animals could possibly get from sprayed vegetation.

If those interested in explaining how deadly these weed killers are only had some sound basis for their arguments, they would be justified in sounding the alarm. However, before assuming the role of an expert on such problems, it would be well to obtain a better understanding of the materials used as herbicides. Find out what they are, how they are used, and what other people have learned about their chemical and physical properties. Demanding payment or forcing the enactment of legislation to cover losses due to someone else's negligence may be justified but to make others pay for one's own negligence is nothing short of stealing.

True, there is a cause for the death of every cow, hog, rabbit, deer, bulldog or honeybee but they are not all due to weed-killers.

REPORT OF THE COMMITTEE ON TERMINOLOGY

R. H. Beatty, W. H. Lachman, A. G. Norman (Chairman)

The Committee is of the opinion that there are certain severe problems of terminology and nomenclature to be faced in the field of weed control and herbicide usage. It is notoriously difficult to secure unanimity of opinion in terminological matters or universal acceptance of terms and definitions, but it should not be impossible to secure a measure of agreement about those words and phrases that are in most common use. For bibliographic reasons conformity is necessary. The editors of publications reporting work on this subject each set their own standards of style and usage, but would be greatly aided by general recommendations by the weed control organizations. Consistency and clarity in terminology may also be highly desirable in relationships with the user and the public, who may well be somewhat tired of the pseudo-scientific diffuseness of advertising or sales agencies. Perhaps the most acute need currently is for a system of nomenclature of compounds that avoids the difficulties encountered in pronunciation and repetition of long or involved chemical names.

The Committee recommends that there be developed

(1) a system of classification of herbicidal or weed control chemicals based on salient characteristics;

(2) a system of nomenclature of proved herbicidal or weed control chemicals the names of which are long, cumbersome or difficult for the non-chemist to pronounce or spell;

(3) a procedure to be followed in describing and reporting data on chemicals being tested for weed control or herbicidal potentialities.

Expanding these recommendations for clarification, the case for (1) is that compounds now in use for vegetation control have diverse

properties and are employed for various purposes, some of which are inadequately defined, described or implied in existing terms. It is not to be expected that categories can be established so rigidly that a particular compound will fall only in one class. It is never satisfactory to attempt to redefine an old term more narrowly than its general usage, which means that certain new terms must be coined. For example, the type of action involved in effective pre-emergence applications is not currently covered by a single term.

The case for recommendation (2) is so obvious as to need little defense. We now are lost in a nomenclatural jungle, primarily because in many cases the proper chemical name is inconveniently lengthy. Trade names, abbreviations, alphabetical designations, trivial pseudo-chemical terms all are employed. This is not a problem peculiar to the field. The insecticide and fungicide people have machinery for coining and uniformly adopting euphonous names which all agree to use and which are not restricted to a particular manufacturer. The need, therefore, is for the establishment of a formal or informal group representing all interests to accomplish this objective. When compounds are produced by only one company their prerogative in selecting a trademarked name cannot be denied.

The case for recommendation (3) is that currently there is no consistency in describing and reporting data on compounds as yet unproven, even in our own publication. Some authors will use the chemical name only, others will abbreviate it, combine chemical symbols with alphabetical abbreviations, or employ a prematurely given trade name. Examples can be cited of the same compound under different abbreviations in a single issue of a journal. The danger here is that an ill-chosen abbreviation can become widely accepted if the compound is proved to be effective. The classic and horrible example is "2 comma 4 hyphen capital D" for a compound prepared to the extent of millions of pounds a year.

Because of a late start <u>the Committee</u> has not been able to do more this year than delineate the problems to be faced. It <u>further recommends</u> that it be reappointed and charged with the development of proposals relating to (1) and (3) above, and it co-operate and co-orinate its activities with respect to (2) with the appropriate committee of the Association of Regional Weed Control Conferences who will seek a solution on a national basis.

TECHNIQUES AND EQUIPMENT USED IN EVALUATING CHEMICALS FOR THEIR HERBICIDAL PROPERTIES

W. C. Shaw and C. R. Swanson[1/]

An Abstract[2/]

The discovery of the herbicidal properties of 2,4-D and related compounds has served to accelerate the search for new chemicals having herbicidal possibilities. Foliar screening techniques have been valuable in detecting the activity of a number of compounds but their specificity limits their use as a testing method for new herbicides. The methods described here were designed to measure the overall activity of the chemicals under test.

In the micro screening test, corn, wheat, cotton and soybeans are used as crop test plants and crabgrass, mustard, rough pigweed and annual ryegrass are employed as weeds. The test plants are planted in one quart oil cans and sprayed pre-emergence with 2 and 16 pounds per acre of chemical with an atomizer. To apply three replications, 184 mg of chemical are required.

The same test plants are used in the macro screening test. The crops are planted 1 1/4 inches deep in rows in 14 x 20 inch metal flats and the weed seeds are distributed evenly over the soil surface and covered with 1/4 inch of soil. The flats are sprayed immediately after planting at 2 and 16 pounds per acre in 40 gallons of solvent per acre at 30 psi and 2 mph. For three replications, 8.1 gms of chemical are required. The chemicals are applied with a screening table which includes an endless flexible steel conveyor belt 24 inches by 12 feet, a variable speed automatic transmission, a 3/4 h.p. electric motor, a spray boom adjustable for height and nozzle spacing, a speedometer, a pressure regulator, an air compressor, mercoid magnetic positive quick-acting shutoff valves, ball bearing rollers at the entrance and exit ends of the table, and a control panel. Aerosol cans, which may be discarded after use, are used to reduce contamination.

In both the micro and macro tests the plants are sub-irrigated in metal pans until uniformly moist. No overhead watering is employed.

The field screening test requires 250 grams of chemical to apply 2 and 16 pounds per acre pre-emergence across 34 crop and weed species. A 5 foot strip is sprayed perpendicular to two rows of each crop spaced 20 inches apart using an experimental plot sprayer.

In all three screening phases, the effects of each chemical are determined by giving each species a vigor rating and measuring the height reduction and per cent kill. Vigor ratings are made according to a numerical scale as follows: 0, no effect; 1,2,3, slight injury; 4,5,6, moderate injury; 7,8,9, severe injury; 10, all plants killed.

1/ Agronomist and Associate Plant Physiologist respectively, Division of Weed Investigations, BPISAE, U. S. Department of Agriculture, Beltsville, Maryland

2/ An abstract of a manuscript to be published in volume #2 of "Weeds", Journal of the Association of Regional Weed Control Conferences.

TWO TESTS FOR HERBICIDE SCREENING

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Due to the many and varied possible plant responses to chemicals being tested for growth-regulatory activity and to the relative sensitivity of different species to different compounds, it is virtually impossible to obtain the complete herbicidal answer from a single test involving a single species and a single criterion of response.

The term "screening" is taken here to mean the testing of chemical compounds for possible herbicidal or other agricultural use, but is confined to those procedures used prior to, but not including, field trials. A summary of herbicide screening has been made by Norman, Minarik, and Weintraub (2) in 1950.

ROOT ELONGATION TEST:

The use of root measurements of red clover for determining the presence of 2,4-dichlorophenoxyacetic acid (2,4-D) in soil is described in a paper by Nutman, Thornton, and Quastel (3) where the work is mentioned as having been initiated in November, 1941 at Rothamsted. Since that time, Swanson (5) in 1946 described a bio-assay which was used during some of the war years for screening. In this test corn was germinated in distilled water in Petri dishes for 48 hours, at which time root lengths of 15-25 mm. were obtained. These seeds were then transferred to other Petri dishes containing aqueous solutions of chemicals to be tested. After another 48 hours root measurements were made, and after subtracting the initial root lengths, the percent of inhibition of root elongation was obtained for the latter period of growth. Ready and Grant (4) in 1947 described a somewhat similar test but used cucumber seeds without pre-germination. Mitchell and Brown (1) in 1947 used inhibition of root elongation of mustard seed in testing various stages of germination for sensitivity to 2,4-D.

In order to adapt the use of inhibition of root elongation to a screening test currently used, and to be described here, certain modifications of these prior tests were necessary. It was considered desirable to include several species, and, as a result, seeds of 13 different species consisting of 7 broadleaves and 6 cereals are used routinely in conducting our root tests. By increasing the number of species it was necessary to limit the number of seeds of a given species to be used.

A modified ragdoll technique of germinating seeds has been employed to germinate the test species. Seed rolls are prepared using Whatman #1 filter paper in 3 inch strips, either 9 or 18 inches long (depending on seed size), with a ½-inch strip of #400 "Scotch" brand pressure-sensitive tape (which has adhesive on both sides) placed along one edge of the filter paper. On top of this

strip of tape a ½-inch strip of filter paper is placed which has ¼-inch holes on ½- or 1 inch centers. Fifteen seeds of a species are spotted on the exposed portions of the tape, ~~the exposed portions of the tape,~~ the filter paper rolled with the seeds inside, and the roll held closed by the extra length of pressure tape. This pressure tape has the property of retaining its adhesiveness for the duration of the test under conditions of high humidity. Generally, when the seed rolls are opened out flat, the seeds still adhere to the tape. The rolls are up-ended in 4 inch high paper drinking cups. The test solutions are poured over the seed rolls and the cups placed in metal trays 19 x 22 x 6 inches, having perforated bottoms and containing a ½-inch layer of water. The trays are covered with glass and serve as humidity chambers. They are kept at a temperature of 78 or 84° for 72 or 96 hours (depending upon the species), after which period the seed rolls are opened and the root lengths measured to the nearest centimeter. Since the roots respond to gravity, they are much straighter than when grown on a horizontal surface and consequently are easier to measure. Of the fifteen seeds planted on each roll, measurements are taken of the ten longest roots. The average root length of the group of ten seeds is used for computing the per cent of inhibition of root elongation on an untreated control basis:

$$\left(\frac{C - T}{C} \times 100 \right) = \% \text{ Inhibition}$$

In cases where the root elongation is obviously affected for some reason other than the presence of a test compound; for example, profuse fungal or bacterial contamination, or if the control root lengths are less than an average of 5 cm., the test is rerun. It is estimated that more than 95% of the untreated rolls have 10 roots of acceptable lengths.

Aliquots of 50 mgs. of chemical are weighted and brought to 25 ml. volume in 100% acetone. Only 2.5 ml. of this stock solution or 10 mgs. of chemical are needed for the root test which is run at 3 concentrations; namely, 0.1, 1, and 10 ppm in tap water containing 0.5% acetone. The remainder of the 2,000 ppm stock solution is used in other screening tests in our program. A standard solution of 2,4-D is tested routinely on each species each time at the 1 ppm level. Each test also contains an untreated control consisting of 0.5% acetone in tap water. The inclusion of 1% Tween 20 in these test solutions was considered but was discarded when it was found that solutions containing Tween penetrated the paper cups. It was thought more desirable in this case to retain the paper cups with the elimination of dishwashing problem attended by the possibilities of chemical contamination. The cups and filter papers are used only once and then discarded.

With this test 18 compounds are currently assayed each week at three dosage levels. This work load requires 780 seed rolls and is the limiting factor in increasing production. Desirable features of the test are that not much chemical is needed to test many species at three concentrations; the information is obtained in 3 to 4 days; greenhouse space is not required; about 24 square

feet of shelf space is sufficient for our scale of operation; there is no dishwashing problem, and the time required to set up a test is small when it is considered that solution and seed roll preparation can be accomplished ahead of time.

SPRAY TEST:

The same species which are used in the root test are also used in a spray presentation test but as week-old seedlings contained in 1/4 or 1/2 gallon glazed pots. The number of individual plants per pot varies depending upon the particular species. Four pots receive a given treatment and three pots are harvested in 7 to 10 days. The fouth pot is held for a 4 to 6 weeks observation. The number of replications is held to a minimum in order to conserve greenhouse space. Inhibition of fresh weight of top growth is the quantitative criterion.

The spraying is accomplished by placing 4 pots of each species ready for treatment on a low cart which conveniently fits inside of a lucite spraying chamber which is counterbalanced and suspended vertically. The room in which the spraying is done is equipped with a 30-inch ventilating fan capable of exhausting the air in the room 3 to 4 times a minute.

With the following technique, 16 to 20 pots representing 4 or 5 species may be sprayed at one time. The spray box is lowered over the cart containing the plants and the spray nozzle is inserted through a hole in the top of the box. The basal area of the chamber is 1/2 square yard and the spray is rotated so that this surface is evenly covered. The spray solutions consist of 10 ml. of acetone containing 1% Tween 20 and are applied with an air pressure of 10 pounds per square inch. After a set of plants is sprayed, the droplets are allowed to settle for a few seconds and the spray chamber is raised, the cart removed, the chamber lowered again and a garden hose equipped with a special nozzle, which produces a flat 360 $^{\circ}$ spray at right angles to the flow of water, is inserted into the box and the inside surfaces are thoroughly washed. Provision is made to include empty carts during this washing procedure in order to minimize contamination.

At present the results of these tests are being kept on needle-sort punch cards. Where it is anticipated that there will be a considerable number of chemical compounds to be tested, machine punch cards eventually would be preferable. However, it may prove advisable to start with a needle sorting system until sufficient compounds have been tested to furnish experience with the types of questions to be asked of the records with the advantage that the setup on machine cards could be coded accordingly.

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A PROGRESS REPORT ON THE VAPORIZATION OF DINITRO-o-sec-BUTYLPHENOL FROM PAPER AND SOIL*

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Following the 1952 occurrence of injury to cotton treated with formulations of DNOSBP* (dinitro-o-sec-butylphenol) used as a pre-emergence herbicide, experiments by several southern experiment stations and the Bureau of Plant Industry indicated that the DNOSBP could move about in the vapor phase. This is a preliminary report of a quantitative chemical study of this vapor phenomenon.

A laboratory apparatus was made to measure the amount of chemical lost from soil surfaces and was designed around the idea that the measurement should take place from an area where the distribution of the chemical on the soil was like that obtained in field practice. (See Figure 1) After the pots of soil had been sprayed with typical nozzles and at field delivery rates they were placed in the oven and the collection cap was gently imbedded in the soil about one-half inch. Thus, the treated surface under investigation was the undisturbed soil and in addition an area could be chosen where the spray pattern was uniform and unaffected by shadow effects of the pot edge.

The absorber tube was charged with 1 ml. of 1% NaOH and 10 ml. of water. Air was drawn through the apparatus at arate of 400 ml. per minute for four hours at 110°F. At the completion of the run the solution from the absorber was adjusted to a suitable volume (100 to 500 ml.) and the color was measured in a spectrophotometer using four cm. cells. The amount of DNOSBP was calculated from a curve prepared from standard solutions of DNOSBP (95.1% purity).

The soil area under the cap was 5.9 square inches, and contained 7.68 mg. of DNOSBP where the rate of application was 18 pounds of DNOSBP per acre. This rate was used since it gave increased sensitivity to the analysis during the four-hour aeration period.

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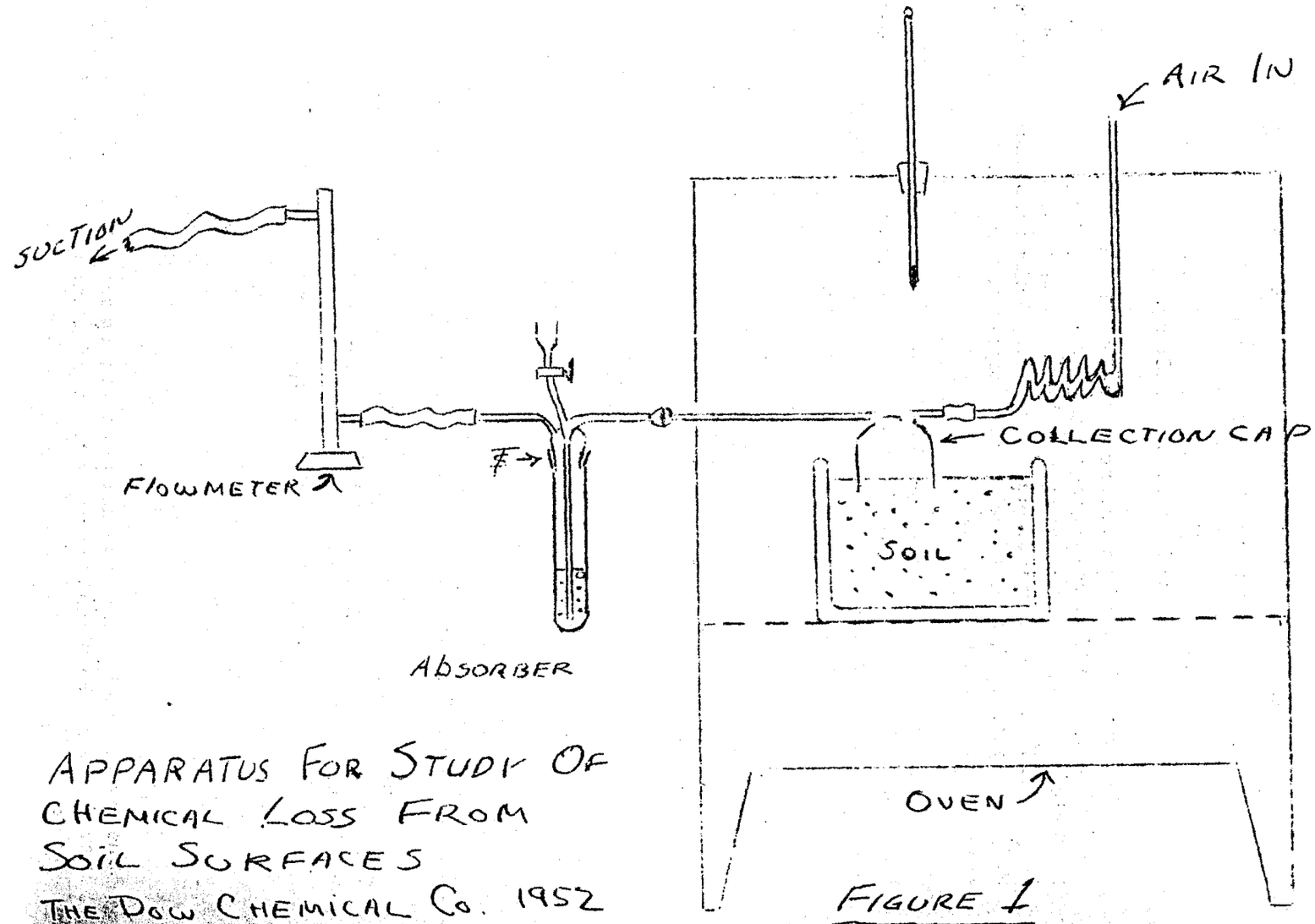
*One such formulation is Premerge containing three pounds of DNOSBP per gallon as the alkanolamine salt; a product of The Dow Chemical Company.



APPARATUS FOR STUDY OF CHEMICAL LOSS FROM SOIL SURFACES
THE DOW CHEMICAL CO. 1952

FIGURE 1

Results

I. Loss of DNOSBP from Soil

Conditions:

18 pounds DNOSBP per acre
Aeration temperature = 110°F
Ml. of air/minute = 400
Incoming air humidity = 50%
Hours air drawn over sample = 4
Soil type = silt loam
pH = 6.6
Where soil given as "wet" = sub-watered after placement of cap until surface wet

Table 1

Formulation Used	Condition of Soil	Micrograms DNOSBP Recovered (Average)
1952 Premerge	Air Dry	9.3
1952 Premerge + lime (*)	Air Dry	8.8
1952 Premerge + lime (*)	Wet	22.5
1952 Premerge	Wet	222.0
1951 Premerge	Wet	215.0 (**)
Dow Selective (***)	Wet	222.0 (**)
None (Blank)	Dry	1.0

(*) Lime, $Ca(OH)_2$, applied at rate of 50 pounds per acre in 40 gallons of water before Premerge application.
(**) Single determination.
(***) Ammonium salt of DNOSBP.

In one series of tests filter paper was cut to match the diameter of the cap placed over the soil, sprayed at the rate of 18 pounds of DN per acre, and aerated in sealed chamber using moist air.

II. Loss of DNOSBP from Filter Paper

Conditions:

18 pounds DNOSBP per acre
Aeration temperature = 110°F
Ml. of air/minute = 400
Incoming air humidity = 99%
Hours air drawn over sample = 4
Paper = Dry

Table 2

Formulation Used	Micrograms DNOSBP Recovered (Average)
1952 Premerge	32.0
1951 Premerge	23.0
Dow Selective	512.5

Discussion

These results show that after DNOSBP formulations are sprayed on the paper or soil a portion of the DNOSBP, under the temperature conditions indicated, can move in the vapor phase through the atmosphere. The reasons for this phenomenon are understood and can be accounted for by well-known physical-chemical laws.

The amount of DNOSBP vaporized due to its own vapor pressure at 110°F is so very small that it is hardly detectable. However, DNOSBP is subject to water vapor distillation. Water vapor is always escaping from soil surfaces upon which DNOSBP rests, and the phenol is carried along with the water vapor in proportion to the amount of water vaporized.

Although the DNOSBP in the Premerge formulation is present as the salt there are equilibria conditions that provide the free dinitrophenol for the water vapor distillation. The alkanolamine or the ammonium salt of DNOSBP is in equilibrium with the ions forming the salt and as the free phenol is decreased by removal the upset equilibrium causes more phenol to be released.

When the salt of the nitrophenol contacts the soil medium a far more complex situation exists. This is because there are other ions present which promote double decomposition of the salt by the formation of insoluble salts, the formation of less highly ionized substances, etc.

The different amounts of DNOSBP removed from dry soil and wet soil are well explained by the water vapor distillation phenomenon. In the case of the wet soil much more water vapor is evolved, consequently more DNOSBP is moved.

The influence of the soil medium on the amount of DNOSBP available in the free phenol form is shown by the constancy of the amount of DNOSBP lost whether the chemical was applied as the alkanolamine salt or the ammonium salt. This influence becomes even more apparent when the loss of DNOSBP from paper is considered. Here the salt of DNOSBP had a

profound effect. In the case of the ammonium salt there is a larger amount of free phenol available for water vapor distillation since the ammonium ion is more easily dissipated than the alkanolamine. This has the effect of making more free phenol available.

The results obtained where lime was added to the soil surface are extremely interesting inasmuch as the low loss of DNOSBP in the vapor phase coincides with lowered injury obtained in plant growth tests. This can probably be best explained on the basis that the high concentration of calcium ions in a very thin zone of the soil pushes the nitrophenol-salt equilibrium towards the calcium salt which is not water vapor distillable. Where the soil was in a completely dry condition the lime effect was not too noticeable, and was probably due to the lack of water vapor to move the free phenol where present.

Although DNOSBP can move in the vapor phase along with water it is probable that only a portion of it is lost into the atmosphere and it is possible that some of the DNOSBP condenses out on both soil particles and plant parts, especially when the latter are cooler than some of the surrounding soil.

Biological tests using emerging cotton seedlings have shown that under some conditions DNOSBP can move through the atmosphere in concentrations sufficient to injure the young plants. As indicated above, greenhouse tests where lime was used in conjunction with a Premerge application lessened the injury to emerging cotton.

Both greenhouse tests and field experience have shown that corn, beans, peanuts, and potatoes are much more tolerant of DNOSBP than cotton.

PROGRESS REPORT OF THE NATIONAL AGRICULTURAL CHEMICALS ASSOCIATION COMMITTEE TO STUDY TEST METHODS FOR DEFINING LOW VOLATILE ESTERS OF 2,4-D

W. R. Mullison[1], W. W. Allen[2], R. C. Scott[3]

It has been known for some time that certain plant growth regulators volatilize, and that their vapors affect plants. Zimmerman and Hitchcock (6) in 1939 referred to irradiated cinnamic acid as the first crystalline growth substance to be effective as a gas for inducing responses similar to those caused by ethylene gas. In later work Zimmerman and Hitchcock (7, 8) report that esters are more volatile than the corresponding acids or salts. This work was done mainly with compounds like naphthalene acetic acid, β-indole butyric acid, β-naphthoxy acetic acid, and other plant growth regulators known at that time.

The term volatile is a relative one and the criterion of how easily a material vaporizes or evaporates is determined by its vapor pressure. For comparison, the vapor pressures of several common materials at 80°F are as follows: ethyl ether - 572 mm., ethyl alcohol - 65 mm., water - 26 mm., mercury - 2.1×10^{-3} mm. Ordinarily, mercury is considered to be non-volatile; yet when constantly used in laboratories, precautions must be taken against its vaporization to prevent human poisoning. The isopropyl ester of 2,4-dichlorophenoxyacetic acid has a vapor pressure of about 1.0×10^{-3} mm. at 80°F. However, this material can cause damage to plants because of its extremely great activity even though its vapor pressure is very low. The isopropyl ester of 2,4-D compared with the common materials mentioned, would be considered to have a low order of volatility. In spite of this, however, it is considered by investigators in the herbicide field to be a very volatile ester of 2,4-D. Thus, the question arises as to how to define volatility of 2,4-D esters. Allen (1) suggested that the effect of the vapor of the material upon the plant be the criterion for defining this phenomena rather than the actual magnitude of the vapor pressure and further suggested that the term "phytotoxic volatility" be used when referring to the volatility of 2,4-D esters. Thus, any material whose vapors caused harmful effects on plants would be considered to have phytotoxic volatility. References henceforth in this paper to volatility will be made following this definition.

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Several investigators Allen (1), Marth and Mitchell (3), Mullison and Hummer (4), and Wolf, et al (5), have reported data that indicates that the volatility of 2,4-D esters varies and in general decreases as the length of the aliphatic carbon chain increases. Moreover, changes in chemical structure of the esterifying group may alter volatility. Therefore, since various 2,4-D esters have different levels of volatility, the use of the term "low volatile" as applied to certain esters of 2,4-D has arisen. Questions then arise concerning low volatile esters of 2,4-D. How should a low volatile ester of 2,4-D be defined to distinguish it from a volatile 2,4-D ester? What are the best methods for determining the volatility of these esters?

In an attempt to answer these questions, a subcommittee under the sponsorship of the 2,4-D Committee of the N.A.C.A. was set up. This subcommittee is made up of members from three companies engaged in the manufacture of 2,4-D esters and this paper is a progress report of their work on this problem.

In considering an approach to this problem, two main points are apparent. First, what method of measurement is to be used in measuring the phytotoxic volatility; and, second, what limits should be decided upon that will differentiate between volatile and low volatile esters of 2,4-D?

The major part of the subcommittee's work to date has been confined largely to try and find an adequate test method or methods which will measure the volatility of 2,4-D esters. To be acceptable, the test method or methods must give consistent results which can be readily duplicated by other laboratories.

The test methods considered were:

1. Physical Methods - An easy physical method would be very desirable as it would be quantitative and tend to avoid subjective bias by the operator. In any case, the magnitude of the vapor pressure would have to be correlated with the plant responses as suggested earlier.

However, since the static method of determining vapor pressure data for compounds of this type by obtaining boiling point determinations over a series of pressures below 760 mm. of mercury has not been too satisfactory up to the present, and since the dynamic method of measuring actual amounts of material carried off in a saturated gas stream has, in the past, not been satisfactory because analytical methods of a sinsitivity sufficient to measure very small amounts of 2,4-D were not available, the physical methods were discarded.

2. Biological Methods - In any type of biological test, several points should be kept in mind. The test should be sensitive; easy and rapid to perform; quantitative; usable throughout the year; require simple and readily available equipment; and lastly but of extreme importance, the test should be one which can readily be duplicated in other laboratories.

Biological test methods in the field and in the laboratory were considered. However, due to their seasonal nature and many uncontrollable variables, field tests did not appear practical. Therefore, laboratory methods were decided upon and the following two methods were used: (a) plant volatility test method, and (b) seed volatility test method.

The plant volatility test method is a modification of Zimmerman and Hitchcock's (6) method and is as follows:

Young tomato plants four to six inches high are used as test plants. Four-liter beakers are used as the container or a plastic bag 8" x 8" x 10". A 60 mm. Petri dish is used to contain the formulation or compound being tested. Five cc. of material is placed in the dish. Suggested exposure periods are four, eight, sixteen and twenty-four hours at 80°F. Twenty-four hours and two weeks after conclusion of the treatment the condition of the plants are noted.

A possible arbitrary grading scheme suggested in an attempt to obtain a somewhat quantitative system divides the responses into six groups as follows:

A. no effect

B. slight (epinasty and leaf modification with no stem swelling)

C. moderate (a few irregular stem swellings and leaf modification)

D. severe (general stem swellings, stems often bent and leaf modifications)

E. very severe (stems swollen from tip to base, usually markedly bent, stunting, sometimes cracked stems, and necrotic areas, little apical growth, often no leaf modification because of this lack of apical growth)

F. dead

All tests should be replicated and fresh samples used for every test.

The glassware used is washed with acetone and strong caustic and tested for contamination by exposing a young tomato plant before being reutilized in a regular test.

Table 1 gives the results of one experiment obtained by three laboratories using this test at 70-80°F. This table is not to be construed as being the expression of the committee as to the relative volatilities of the compounds tested. It is given here to indicate the need for a standardized test with reproducible results that can be easily duplicated in other laboratories.

The seed volatility test method is a modification of Mullison and Hummer's (4) method and is as follows:

Pint-sized Mason jars with Kerr-type lids are used. Ordinary window screening is used to make a small circular dish 2-3/16" in diameter and 1/2" deep. This is suspended by three wires on a small hook soldered into the top of the lid. Fifty seeds are placed on this screen. It may be possible to simplify this by using a cheesecloth bag. Preliminary results indicate no difference between either type container. If a larger jar such as a quart or half-gallon is used, more seeds may be easily treated. In this case, one hundred seeds are suggested. The materials being tested are placed in the bottom of a 50 mm. Pyrex Petri dish. Five milliliters of material are placed in the dish. A small wire frame with a loop attached into which the Petri dish sits facilitates moving it into and from the jar.

Exposure periods suggested are two and four weeks at 80°F after which the seeds are germinated. Jars and equipment should be dry to prevent mold contamination. Both a treated control and an untreated control are used. If root measurement data are taken a germination temperature of 70°F is suggested. In this case, at least three 100 mm. Petri dishes with ten seeds per dish are used. Ten cc. of distilled water is added and the seeds are germinated on #1 Whatman filter paper. Root measurements are taken about four to six days after the test is started. If per cent germination is taken, seeds are planted in coarse river sand 1/2" deep and placed in greenhouse for germination. Per cent germination is taken about ten days after seeds are planted.

Table 2 gives the results obtained by three laboratories using the root germination test. Again, these data are to be considered as being only the results of one test showing the variation that can occur in data obtained from different laboratories using a similar technique.

Summary

Both the plant test method and the seed test method have advantages and disadvantages. However, either or both tests appear to give the same relative ranking in respect to phytotoxic volatility of the compounds studied. The seed test seems to have the advantage of being able to control test conditions more easily and to get a better quantitative measurement although it is slower. This is a progress report, however, and the committee is continuing its effort to improve these methods as well as to develop new ones. The ultimate goal of the committee is:

1. To obtain the best and simplest method or methods which will will give consistent results.

2. To make it possible to establish methods for defining phytotoxic volatility of 2,4-D esters.

Table 1

The Results of A Cooperative Tomato Plant Volatility Test Done By Three Laboratories

2,4-D Esters	Hrs. Exp.	Lab. 1 Observations 24 Hr.	Lab. 1 Observations 8 Day	Lab. 2 Observations 24 Hr.	Lab. 2 Observations 14 Day	Lab. 3 Observations 24 Hr.	Lab. 3 Observations 14 Day
isopropyl	4	N*	S	M	D	SL	M
	8	N	S	SL	D	SL	M
	24	VS	D	D	D	SL	D
pentasol (mixed amyl)	4	N	M	M	D	SL	SL
	8	N	S	M	VS	SL	M
	24	S	D	VS	VS	SL	M
isooctyl	4	N	N	--	--	N	SL
	8	N	N	--	--	N	SL
	24	N	VS	--	--	N	M
butoxyethanol	4	N	SL	SL	SL	N	SL
	8	N	SL	S	S	N	SL
	24	N	VS	M	SL	N	M
polypropylene glycol butyl ether	4	N	N	M	S	N	SL
	8	N	N	SL	VS	SL	SL
	24	N	M	VS	D	SL	M
tetrahydro-furfuryl	4	N	SL	--	--	N	SL
	8	N	SL	--	--	N	SL
	24	N	M	--	--	N	M
control	4	--	--	N	N	N	N
	8	--	--	N	N	N	N
	24	N	N	N	N	N	SL

*N - no effect
SL - slight effect
M - moderate effect
S - severe effect
VS - very severe effect
D - dead

Table 2

The Results of A Cooperative Pea Seed Volatility Test Done By Three Laboratories

Exposure Period 14 Days at 75°F + 5°

2,4-D Esters	Lab. 1 6 Days Germination at 80°F Av. Root Length	Lab. 1 Root Growth as % of Control	Lab. 2 4 Days Germination at 70°F Av. Root Length	Lab. 2 Root Growth as % of Control	Lab. 3 11 Days Germination at 80°F Av. Root Length	Lab. 3 Root Growth as % of Control
isopropyl	5.8*	41	7.8	29	2.1	10
pentasol (mixed amyl)	5.0	35	8.6	32	3.1	14
isooctyl	10.5	75	24.5	90	8.5	39
butoxy ethanol	9.3	66	19.3	71	9.8	45
polypropylene glycol butyl ether	16.6	118	23.3	86	9.7	45
tetrahydrofurfuryl	14.5	103	26.1	96	10.9	50
control	14.1	100	27.1	100	21.8	100

*All root lengths are expressed in millimeters.
Part of the variation is due to the temperature being different during germination which is particularly important here since peas are a cold weather crop.
Note also the variation in the length of germination periods before root measurements were taken.
The third point is that the data from Lab. 3 is very poor with a great deal of variance in the treatments due to mold contamination, but it was included here because it was the only data available at this time on these particular formulations.

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