THE ROLE OF WEED SCIENCE IN URBAN AMERICA

Rachel Snyder[1]/

Recently in an interview in Look Magazine, Walter Cronkite was quoted as saying that when he receives speaking invitations from learned societies, he suspects it is a diabolical plot to show that he does not know things. I had that same feeling about this one. Cronkite went on to say "People expect so much from journalists. They don't realize that we are only journalists, that the only topic we really know is our time." While I was considering your invitation to come here, it dawned on me that something about knowing our times may have been in your motives. Possibly you suppose, and it may be true, that in my job I can take a little wider view of "our time" than you are able to do, to let me comment with relative objectivity on the "Role of Weed Science in Urban America." At any rate, I hope this is the case, because it won't take but a moment to expose my ignorance in chemistry, weed science, and the other scientific or technological disciplines most of you deal with daily.

Weed science is important in urban America as well as on the farms -- even though rural and agricultural needs have traditionally dominated our thoughts and policies in weed science. It is easy to see why the farm consumer has enjoyed more of your attention than the city dweller. The country is where most of the weeds are. Home gardeners have merely received the left-overs -- or "fall out" -- from the agricultural herbicide technology, but even so, we are grateful for what we have. In relative importance, the urban element is gaining in impact on your industry, for a variety of reasons besides the dandelions in the lawns. I plan to expand on this in a few minutes, but mention it now to support the notion that cities deserve a bigger share of your concern. There may be more weeds in the country, but there are more people in cities.

The city dweller's needs for weed control are far more complicated than the farmer's needs. To an urbanite, or suburbanite, a weed is a many-sided threat or unwanted thing. First, it threatens his esthetic pleasure -- he doesn't like the looks of dandelions, crabgrass and chickweed in his lawn, or the purslane coming through his gravel mulch, or the volunteer hackberries in his chain link fence. Second, it is threat to his investment -- either his pocketbook or his time, because he is under social and economic pressures to keep his place looking good. The neighbors complain if he lets weeds go, so he fights them to keep friends and maintain property values in his neighborhood. To protect his own investment he has to keep weed trees from ruining his house foundations, sewer lines and sidewalks, keep bindweed from overwhelming his roses, or trumpet creeper from unroofing his garage. Because he spends his days in an office and has only snatches of yard time on evenings and weekends, he seeks time-saving ways to cope with weeds. Obviously, the economic aspects of weed control to city dwellers can't be compared to their farm importance, but nevertheless they exist.

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Third, the weed is a threat to the urbanite's physical comfort. I'm thinking especially of allergic reactions to such weeds as poison ivy and ragweed, but there could be many more examples of nearby plants he might wish to eradicate because they menace human health where many people are clustered together. This infinity of individual weed problems in urban environments, and the needs for precision and safeguards in control methods because of confined space, make the picture seem nightmarishly complex.

Then add to this picture, the problems of ignorance on the part of the urbanite who buys and uses the weed-control product. It's not that he is stupid or uneducated. It's just that weed control isn't such a bread-and-butter issue to him as it is to the farmer. He has never thought he had to study carefully the weed controls he buys. Probably he doesn't even clearly understand the differences between herbicides, insecticides, fungicides, or any other pesticide. Much of what is written and spoken about them goes over his head. To make matters worse, in his weekend haste to go golfing or sailing, he won't read labels.

Educating this urban consumer looms as a serious problem. To get his attention and make him read, to overcome his haphazard methods, to impress him with the distinctions between different situations and products, and to dissuade him from false impressions he may already hold, -- these are some of the hurdles facing anyone selling him chemical weed controls.

Here we return to the observation of a moment ago, that Urban America is increasingly important to weed science as well as the other way around. In the cities, ideas and policies are forming that are affecting weed science. No one goes far into this subject now without meeting what is being called the environmental crisis. The centers for the reading, talking, organizing and protesting on environmental issues are in cities and suburbs. Here is where attitudes are formed. You cannot ignore this movement because it is gathering velocity each day. In it, as you know, is a strong current of nihilism that threatens to sweep everything in its path. It could cripple development and production of pesticides here and throughout the world with far-reaching consequences. The damage has already begun.

It is a strange and cruel twist, because these new environmentalists seemingly yearn for the same goals we all do -- a balanced natural world where man lives in harmony with all other forms of life. But inadequate information, misinformation, half truths, shaky interpretations, and other errors have convinced them of a lot that isn't so. Fine distinctions between pesticides, or even fairly wide distinctions are commonly ignored. One group thinks the world will blow apart anyway in five years if not sooner, so there is no use trying to be constructive, and it does not matter who gets hurt. I hope I am not overstating this development, but it is surprising how many have turned completely against all pesticides in a sort of philosophical reaction against technology or science.

Most of us in the gardening world think we have been environmentalists all our lives. Many of us recognize that it is time to change some of our ways so that we and other species may have a future on this planet. We fear that true concerns for the environment may be lost in this reactionary backlash. However that may be, you as weed scientists are involved in the

thick of this controversy, and that alone is enough reason for paying increased attention to Urban America.

Last fall I joined a local Citizen's Environmental Council -- an organization I hope and expect will help bring improvements in the environment of our area. I thought my knowledge of pesticides might be of help, so I offered to work with the Council's "pesticide task force." At the first meeting it became clear that a knowledge of pesticides was not what they wanted. I have not dared to go to any more meetings, even though I still think they need me. But from this, I got one insight; these persons reached their negative ideas about pesticides because as suburbanites they were sick and tired of trying to keep up with the neighbors' "status lawns." In fact, they seemed resentful of all gardeners as a class, and might like to get rid of gardeners along with the pesticides. They were critical of those who used weed, insect, and disease control chemicals because of the risks (real or imagined) to children, pets, birds, plants, air, food, water, and what-have-you.

Forgive me for indulging in personal experience to bear me out. You scientists call this an "empirical approach," and do not consider it very scientific. It is just to explain how I have come to realize that besides needing to communicate better with urban dwellers who use herbicides, you have to contend with another growing element in the urban population that is anti-all pesticides.

Before considering possible solutions, let us put ourselves in the urban gardener's place to see things as he does. Suppose we create a Mr. A. Urban Weedfighter. (A. for Average). He has a mainly bluegrass lawn of around 5,000 square feet, although probably he has never measured it. In it are dandelions and plantain, chickweed and veronica, and from May to November, crabgrass. Based on recent studies we can assume he is in the 33 to 50 age bracket, has an income over $10,000, some college education, and for a living engages in some commercial activity. He has a wife, two children, a dog. He has not read many books since he left school, but he does read the paper every day, a couple of magazines a month, and he watches television most evenings. He does the lawn work on Saturdays between errands, and his wife usually lays out the work program for him.

It is a warm sunny Saturday morning in April and all up and down the block the dandelions are starting their revelry, including in Mr. Weedfighter's yard. Mrs. W. has been at them with a butcher knife, but has left no dent so at breakfast she says something must be done. He promises, and after breakfast heads for the hardware store, where they sell dandelion killers. There he tells his needs to the clerk, a college sophomore who works there on Saturdays. They go to the herbicide shelf, look over a dozen kinds, several of which are labeled to kill dandelions, and Mr. W. buys the cheapest. The clerk asks about sprayers but Mr. W. remembers the hose-end he used last year, which will do, so he heads home. By this time it is 11 o'clock and a breeze is rising. He changes clothes, gets out the garden hose, finds his spray bottle, borrows an old spoon from the kitchen, and starts on the job. First he has to fill the spray jar, so he looks at the label directions, but after reading the first four lines of fine type which curl around the bottle and are printed in black on a vibrating red background,

he still does not know how much to put in. So he decides it doesn't matter anyhow, uncaps the bottle, pours some into the jar, adds water from the hose (running the jar over), puts on the sprayer top, connects the hose, turns up the pressure and starts after the dandelions.

I do not need to conclude this horror story down to its final details because all of you know how the plot unfolds. Many of this man's neighbors will also know of it. It is no wonder the militant environmentalists are down on Mr. Urban Weedkiller. Yet he is more to be pitied than despised. He has simply trusted too many people, and all along the line they have let him down. On the other hand, perhaps the hierarchy of herbicides has trusted him too much, too.

Nowhere in the newspapers and magazines he trusts, or on the radio or television, did anyone tell him clearly and emphatically to be careful with the weed killer he bought. The store keeper should have warned him, but he has 5,000 other items there to sell, a dozen other customers at the same time, and the clerk probably knows no more about it than the customer. Go back to the formulator who packaged the product. He could have chosen not even to market a highly volatile product. He could have made the directions more clear and readable, he could have attached some educational device to explain what is in the bottle and how to respect it. But the formulator is a businessman with payrolls, so he meets the label requirements, watches costs, packages and distributes his products at prices he thinks will compete with others and will still give a little profit.

What of the manufacturer? He also has payrolls to meet, so he manufactures what is in demand. And that scientist in the industry laboratory or at the university? He is far removed from Mr. Urban Weedkiller, and can hardly imagine such a person. This scientist probably knows of safer, more foolproof compounds for dandelion control than what was in that bottle. But his work is linked to the wider industry, and industry has had more on its mind than dandelions in city lawns, or the naive weekend workers who spray them and the rest of the landscape with 2, 4-D.

Some elements in this web will have to shift. The cross-currents of our times will demand them. More than likely, changes will be forced upon us, but if we could choose what would happen, we should first study what this urbanite really needs. Ideally, he needs products chemically engineered to be convenient, safe and effective for their purposes, when used under crowded urban conditions by untrained and hurried people. The materials should land and stay where intended, and should carry no smells or side-effect menaces to flora or fauna. They should contain some sort of safeguards against misuse, and be demonstrably safe in a tight urban environment. This sounds Utopian, but I understand some such herbicide compounds are already a reality on industrial levels. Technology could surely provide such products. Now to go a step farther, some way should be found to divert city consumers from obtaining any products not meeting these criteria. Ideally, they should not be on the store shelf and available to the urbanite, because he needs protection against mistakes, starting at the point of purchase.

Ideally, our urbanite also needs more consideration in the package, the applicator, and the instructions. He is left too much on his own. The pack-

age could contain aids to convenience and to accuracy for applying the herbicide. It could contain an educational approach in the message printed on it. This customer is capable of understanding what the product was intended for and what it was not, if he is simply told. He needs background "whys and why nots" to deepen his respect for the product he has purchased. It will help him understand why he is paying more for it. The best time to reach him with this message is not in some remote newspaper, magazine or television ad, although those might help -- but just before he opens the package. If the label is not big enough for the communication task, why not some attractive, durable little folder tied to the bottle or package so it can't be overlooked?

Is this dreaming? It all would cost money. Maybe it is economically impractical. Then there are the problems of getting things registered. However, I know of some moves already in this direction, and I hope they show feasibility both from a business standpoint and from that of simplifying things for the consumer. The herbicide industry and urban consumers need each other. What helps an urban consumer must help the industry. Safeguarded weed controls designed and packaged specifically for urban use would be one avenue for constructive action.

Other things also must be done. In the interests of truth and justice you cannot passively let go unanswered all the accusations being leveled against weed controls and other pesticides. A quote I recently read from one of your own colleagues said "science is no longer a good word." There may be truth in that lament, but don't accept it as final. Much of the current prejudice against science and technology is mixed up with a lot of other prejudices. In any case, your side of the story needs to be heard. The only way I know for you to tell it is with a broad public relations and educational effort on many levels. A good starting place is with the press itself. Many editors, editorial writers and reporters are obviously as ill-informed as this poor urban consumer we have described, if not more so. At least our imaginary Mr. W. knew the difference between DDT and 2,4-D, but not so with some writers and what's worse, their editors. This seems incredible, but you are as well aware of its truth as I. Last June 2, the very day I got your invitation to come here, the Kansas City Times carried an editorial about ecology. "When robins started dropping dead on lawns a few years ago," this editorial started, "it dramatized the fact that useful chemicals <u>applied to kill weeds</u> (italics are mine) could have some drastic side effects on other living things." Then the writer went on for six big well-intentioned paragraphs about the need for more <u>knowledge</u> on the ecological effects of spraying various pesticides. In a way it is laughable, but you can't laugh off the confusion it revealed in that influential place. It leaves you wondering where you could possibly start to straighten this man out, so you give up without trying. No longer can we let these instances go by. Whenever you find the press in such errors, at least try individually or as a group to set the record straight. In your educational efforts you must start far back. You need to explain terms, give definitions, teach a little basic chemistry, botany, biology, and physics, to lay a foundation for true understanding with the people in communications. Maybe some herbicide workshops for the press are in order. Although sensationalism tempts them, most journalists really try to understand and present things objectively. Too often they hear or know only one side.

Then, let your communications proceed to another level -- the public itself --

ecologists, environmentalists -- everyone else who will listen. Be thorough, be open, discuss all sides of issues, give backgrounds, cite studies and authorities. Point out fallacies, illogic, and confusions -- such as the classic one of judging a brush killer and the Vietnam war as if they were peas from the same pod.

Most of you have probably considered yourselves most of your lives as in work you thought was benefiting mankind. Now suddenly you may find yourselves attacked as money-mad wreckers of the "balance of nature" and polluters of the planet. To add to the irony, you find it hard to defend yourselves and your activities because you know so much that your critics don't know or want to know.

Only you can narrow that gap. You have already taken good steps along this path, with promising response. People who live in cities and suburbs are important to you -- there are so many of them. Not only challenges but opportunities await you there in weed science, and unless the doom seekers are right, this is where much of the future action will be.

CHEMICAL WEEDING OF DIRECT SEEDED CABBAGE

Charles J. Noll[1]

Cabbage (Brassica oleracea var capitata) seeded in the field was treated for weed control with a variety of herbicides applied as preplanting incorporation treatments, pre-emergence treatments and as post-emergence treatments. The most promising treatments were: as incorporation treatments 4-isopropyl-2,6-dinitro-N,N-dipropylaniline (EL 179) and 4-methylsulfonyl)-2,6-dinitro-N, N-dipropylaniline (nitralin) and as pre-emergence treatments 2,4-dichlorophenyl p-nitrophenyl ether (nitrofen), 2-chlorl-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor), and 2-chloro-N-isopropylacetanilide (propachlor). Nitrofen used as a post-emergence treatment was less effective than when used as pre-emergence treatment.

Materials and Methods

The weed trials were conducted at the Horticultural farm located 10 miles west of University Park. The soil, a Morrill loam, was plowed in the fall of 1969 and the seedbed prepared May 4, 1970. Pre-plant incorporation treatments were applied and the field seeded to the variety Golden Acre the same day. The pre-emergence treatments were applied May 5 and the post-emergence treatments applied May 18. An estimate of weed control was made July 20 using a one to nine rating scale. One is full weed growth and 9 is complete weed control. Weeds present in the field were lambsquarters (Chenopodium album L.), barnyardgrass (Echinochloa crusgalli (L.) Beauv.), and yellow foxtail (Setaria glauca (L.) Beauv.).

Single row plots were 28 feet long and 3 feet wide. Treatments were randomize in each of 8 blocks and all chemicals were applied in a 2 foot band over the row. Cultivation controlled the weeds between the rows. The cabbage was harvested August 20.

Results

The results are presented in Table 1. All herbicides in the trials significantly reduced the weed population as compared to the unweeded plot. The only herbicide that reduced the stand of plants was trifluralin. One harvest and lack of uniformity in maturity at time of harvest resulted in a reduced yield per plot. Indications are that a number of herbicides could be used to weed direct seeded cabbage.

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Table 1. Weed control, number of plants, and number and weight of heads of cabbage under chemical herbicide treatments.

Treatment	Active Rate lbs/A	Application Days from Planting	AVERAGE PER PLOT Weed Control 1-9	Stand of Plants	Harvest Record No. Heads	Wt. Heads lbs.
1 Nothing	---	---	2.0	48	6	6.4
2 Nothing	---	---	1.3	59	7	6.7
3 EL 179	1	Inc-0	7.8	60	13	19.7
4 "	2	"	7.3	50	14	17.3
5 BAS 3870H	1	"	6.3	44	9	11.3
6 "	2	"	7.8	47	13	20.9
7 Nitralin	1	"	7.1	45	13	20.1
8 Trifluralin	3/4	"	8.6	17	2	3.1
9 Trifluralin & Nitrofen	3/4 & 4	" -1 & Pre +1	9.0	6	1	1.6
10 Nitrofen e.c.	4	Pre +1	6.9	44	16	22.9
11 "	6	"	7.6	44	16	26.3
12 Alachlor	2	"	8.9	61	18	26.6
13 "	4	"	9.0	50	19	23.8
14 "	6	"	9.0	34	11	17.7
15 Propachlor	4	"	8.6	60	15	21.3
16 "	6	"	7.9	34	16	27.8
17 BAS 2903H	4	"	7.5	57	14	17.8
18 "	6	"	7.3	47	12	15.5
19 Nitrofen w.p.	3	"	7.4	51	16	24.0
20 "	4 1/2	"	8.0	52	17	25.1
21 Nitrofen e.c.	3	Post +14	7.6	63	13	18.6
22 "	4 1/2	"	7.8	52	15	19.7
Least Significant Difference 5%			0.9	11	4	6.4
" " " 1%			1.1	14	5	7.7

THE FALL APPLICATION OF FRUIT TREE HERBICIDES

F. N. Hewetson[1]

The application of herbicides in orchards has generally been confined to late winter or early spring, depending on the material being used and the objectives desired. Spring is always a very busy time in the orchard, so that any operation which could be done at some other time of the year would be an improvement in orchard management practice.

Materials and Methods:

With this objective in mind, an experiment was initiated to evaluate the application of the more commonly used orchard herbicides in the late fall after the fruit had been harvested.

Trees for this experiment, representing the five major fruits grown commercially in Pennsylvania, were planted in 1967. The Red Delicious apple, Bartlett pear, Elberta peach and Stanley prune were planted on May 12, and the Montmorency red tart cherry on November 9. The herbicides were applied on October 31, 1969, with a double nozzle hand gun connected to a small truck mounted power sprayer. The herbicides used in this experiment consisted of diuron, paraquat, simazine and terbacil, applied alone and/or in combination. There were three replications for each of the five fruits, making a total of 15 applications for each herbicide treatment.

At the time of application, the area around the trees was covered with grass and a miscellaneous assortment of weeds, including broad-leaved plantain (*Plantago major* L.), buckhorn (*Plantago lanceolate* L.), dandelion (*Taraxacum officinale* Weber) and sheep sorrel (*Rumex acetosella* L.).

Results and Discussion:

The effect of these treatments were evaluated in June, July and October, 1970. The results, as measured by weed control and foliage injury, are shown in Fig. 1 and Tables 1 and 2.

The best seasonal weed control, on the basis of the fifteen applications for each herbicide, as indicated in Fig. 1, was obtained with all treatments which included diuron, listed as nos. 4, 5, 7 and 8. The poorest weed control resulted from using terbacil alone in treatment 6. The treatments which included simazine (2 and 3) were intermediate. Although simazine gave good weed control at the beginning of the season, it lost its effectiveness as the season progressed, so that by October it was not much better than terbacil used alone.

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Fruit trees are long-lived plants. Therefore it is extremely important to make careful observations on the effect of herbicides on tree performance, especially foliage injury.

In this experiment, as indicated in Table 1, the various fruits showed striking differences with respect to leaf injury from the various herbicides. While the apple and peach were practically immune to foliage injury from the fall applications, the cherry and plum foliage were injured by almost all of the herbicides used in this experiment, with the exception of terbacil used alone on the plum. The pear trees showed foliage injury wherever terbacil was used.

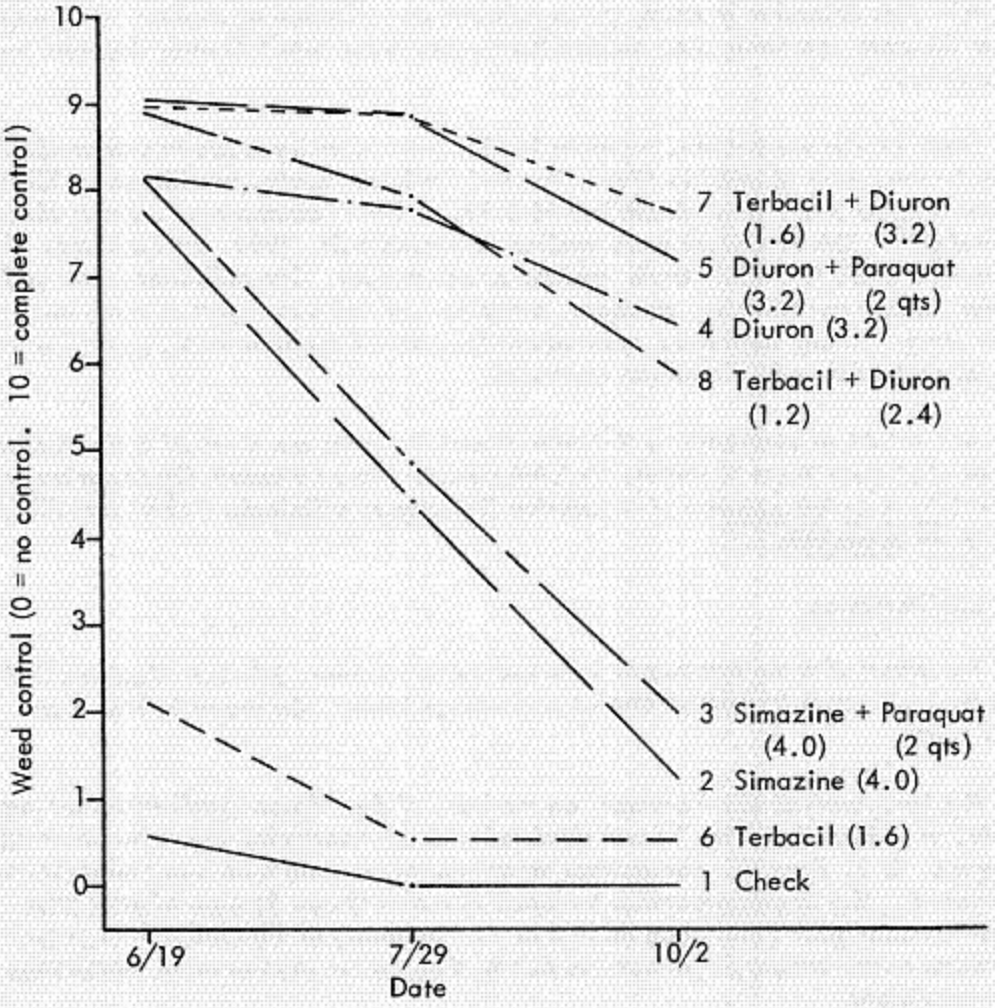

Fig. 1 Weed control during the season.

Table 1.

LEAF INJURY FROM FALL APPLICATIONS OF FRUIT TREE HERBICIDES

Treatments			Fruit				
No.	Materials	Rate (lbs AI/A)	Apple	Cherry	Peach	Pear	Plum
1	Check						
2	Simazine	4.0		x[a]			x
				x			x
				o			xx
3	Simazine	4.0		o		x	x
	+ Paraquat	(2 qts)		xx		o	x
				o		o	xx
4	Diuron	3.2	x?	x			o
			o	xxx			x
			o	o			x
5	Diuron	3.2		x			o
	+ Paraquat	(2 qts)		xxx			x
				o			x
6	Terbacil	1.6		x		x	
				x		x	
				x		o	
7	Terbacil	1.6		x		x	xx
	+ Diuron	3.2		xxx		o	x
				x		o	xx
8	Terbacil	1.2		xx	x	x	xx
	+ Diuron	2.4		xxx	o	o	o
				x	o	o	xxx

[a] x = slight leaf injury
xx = moderate leaf injury
xxx = severe leaf injury

Simazine injury was evident in the cherry and plum, but only slightly on one pear tree when it was used with paraquat. No injury was observed on the apple or peach tree foliage. Diuron, used alone or with paraquat, injured both the cherry and plum foliage, but caused no foliage injury to the apple, peach or pear trees. Terbacil alone injured the cherry and pear foliage, but not that of the apple, peach or plum trees. However, when used with diuron, terbacil caused much more severe injury to the cherry and plum foliage than when either material was used alone. In contrast, the terbacil plus diuron treatment caused no injury to the apple and only slight foliage injury to one peach tree.

Table 2.

FALL APPLICATIONS OF FRUIT TREE HERBICIDES

Treatments No.	Materials	Rate (lbs AI/A)	Weed Control[a]	Leaf Injury[b] Apple	Cherry	Peach	Pear	Plum
1	Check		0	0	0	0	0	0
2	Simazine	4.0	1.2	0	2	0	0	4
3	Simazine + Paraquat	4.0 (2 qts)	2.0	0	2	0	1	4
4	Diuron	3.2	6.4	0	4	0	0	2
5	Diuron + Paraquat	3.2 (2 qts)	7.2	0	4	0	0	2
6	Terbacil	1.6	0.5	0	3	0	2	0
7	Terbacil + Diuron	1.6 3.2	7.7	0	5	0	1	5
8	Terbacil + Diuron	1.2 2.4	5.9	0	6	1	1	5

[a] 0 = no weed control
10 = complete weed control

[b] Number in Table indicates extent and severity of leaf injury as in Table 1

Summary:

The effects of herbicides on weed control and leaf injury to fruit trees are summarized together in Table 2. This condensation of the results makes it possible to evaluate the overall effects of the various herbicides on weed control in the light of tree performance and susceptibility to injury. On the basis of this experiment, the application of certain herbicides in the fall appears to be safe and effective for the apple and peach, but somewhat hazardous for cherry, pear and plum trees.

FIELD TRIALS WITH HERBICIDE-MULCH COMBINATIONS

C.S. Oliver[1]

Several herbicides were mixed with unprocessed hardwood bark, sawdust, cocoa hulls, and peat moss to determine the value of herbicide-mulch combinations in reducing weed growth in landscape plantings. All herbicide-mulch combinations provided better weed control than when herbicides were applied to the soil surface and no mulch applied. 2, 6-dichlorobenzonitrile (dichlobenil) provided better weed control than 2-chloro-4, 6-bis (ethylamino)-s-triazine (simazine) and N, N-dimethyl-2,2-diphenylacetamide (diphenamid) when mixed with organic mulch materials. There was no difference observed among the various organic mulches used and their ability to control weed growth.

Introduction

In the manufacture of wood products from Pennsylvania's forest areas there is a large by-product residue in the form of bark, wood chips and sawdust. New restrictions limiting burning of wood residues has led to a disposal problem. In an effort to solve this problem a number of Pennsylvania sawmill operators, in conjunction with the Small Industries Research unit and the Department of Horticulture at The Pennsylvania State University, sought to determine possible uses for bark and other wood by-products.

In recent years most wood wastes have been used as mulches or soil conditioners. As a mulch, unprocessed hardwood bark offers many advantages. It not only provides an attractive soil cover but also reduces evaporation of moisture from the soil surface, reduces fluctuations in soil temperature, prevents crusting of the soil surface and reduces weed growth.

Several studies have indicated there is a synergistic effect which occurs when an organic mulch and herbicide are used in combination (1,2,3,4,5). These studies indicate herbicides when premixed with mulch materials before they are applied to landscape areas aid in extending the weed control over a longer period than one would expect when either mulch or herbicides are used alone. The purpose of this test was to determine the comparative value of unprocessed hardwood bark and other organic mulch materials in controlling weed growth when mixed with several different herbicides.

Materials and Methods

Replicated test plots were established to compare unprocessed hardwood bark with other organic mulch materials. These plots were located in existing landscape plantings on the campus of The Pennsylvania State University. Each plot measured approximately 27 square feet. Woody plant species growing in the test area were Washington Hawthorn (*Crataegus phaenopyrum*), Bristol Ruby Weigela (*Weigela* 'Bristol Ruby') and Linden Viburnum (*Viburnum dilatatum*).

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For the purpose of comparison, three common organic mulch materials were selected to compare with mixed unprocessed bark. These were: cocoa hulls, fresh sawdust, and spahgnum peat moss.

Herbicides were mixed with each mulch by tumbling together in a cement mixer. Approximately 3½ bushels (4½ cubic feet) of mulch was placed in the mixer at one time. As the mulch was agitated, herbicide was sprinkled into the mixer. Two gallons of water and the proper concentration of herbicide to provide the rate desired was used for this purpose. The treated mulch was then placed in large plastic bags and transported to the test sites where it was applied at a two-inch depth.

The three herbicides selected for testing with the various organic mulch materials were 2-chloro-4,6 bis (ethylamino)-s-triazine (simazine 80% WP) 2, 6-dichlorobenzonitrile (dichlobenil 50% WP) and N,N-dimethyl-2,2-diphenylacetamide (diphenamid 80% WP). The herbicide rates were 2 lb., 4 lb., and 4 lb. of actual ingredient per acre, respectively.

Results

No comparative differences were observed from the time of treatment on August 24, 1969 and throughout the fall months. Therefore, data collection began during the spring of 1970. Each month, beginning with April, the test plots were checked. No weeds were observed in the herbicide-mulch plots or in areas treated only with mulch until mid-May. The results observed during early July appear in Table 1.

Table 1. Comparative effect of several herbicide-mulch combinations in reducing weed growth in landscape plantings.

Mulch	Herbicide diphenamid	dichlobenil	simazine	No herbicide
Bark	4.0	1.0	3.5	4.0
Sawdust	4.0	1.0	3.0	5.0
Cocoa hulls	4.0	1.0	3.5	5.0
Peat	5.0	1.5	3.5	5.5
No Mulch	8.0	6.5	7.0	10.0

Weed Rating - 0 = no weeds
10 = 100% weed coverage

In addition to recording the weed coverage in each plot, the prevalence of each specific weed species was also recorded. In all treated and untreated plots the primary weed species growing in order of their prevalence were:

1. creeping woodsorrel (Oxalis corniculata)
2. common chickweed (Stellaria media)
3. black medic (Medicago lupulina)
4. lambsquarters (Chenopodium album)
5. bitter nightshade (Solanum dulcamara)
6. field bindweed (Convolvulus arvensis)

Canada thistle (Cirsium arvense) and common pokeweed (Phytolacca americana) were present in check plots not treated with a herbicide or mulch and in several of the mulch plots where herbicides were not applied. None of the herbicides used in the test plots show specific activity in Canada thistle control.

There was no visual difference in the appearance or quality of the organic mulch materials used in the test ten months after the original application. Although each mulch had settled considerably, they appeared in excellent condition

None of the plant materials growing in the test area showed visual symptoms of injury from either the organic mulch used alone or in combination with herbicides.

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WEED CONTROL IN GLADIOLI PLANTINGS

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Abstract

We planted three varieties of gladioli (Beverly Ann, Pink Friendship, and Spic and Span) on May 28, 1970 in a Freehold sandy loam, and applied all herbicides as sprays the same day. The herbicides that were incorporated were applied just prior to planting. The herbicide treatments were: alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide) at 6 lb/A; VCS-438 (2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione) at 2 and 4 lb/A; R-7465 (2-(a-naphthoxy)-N,N-diethylpropionamide) at 2 and 4 lb/A; RH-315 (N-(1,1-dimethylpropynyl)-3,5-dichlorobenzamide) at 4 lb/A; linuron (3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea) at 2 and 4 lb/A; nitralin (4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline) at 2 and 4 lb/A (incorporated); trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) at 2 and 4 lb/A (incorporated); RP-17623 (2-tertiobutyl-4-(2,4-dichloro-5-isopropyloxyphenyl)-5-oxo-1,3,4-oxadiazoline) at 2 and 4 lb/A; BAS-2903-H (2-chloro-N-(1-methyl-2-propynyl) acetanilide) at 4 and 8 lb/A; nitrofen (2,4-dichlorophenyl p-nitrophenyl ether) at 6 lb/A; alachlor at 4 lb/A plus linuron at 2 lb/A; DCPA (dimethyl tetrachloroterephthalate) at 8 lb/A plus sesone (2-(2,4-dichlorophenoxy) ethyl sodium sulfate) at 4 lb/A; and SAN-6602 (N'-(3-chloro-4-methoxyphenyl)-N,N-dimethylurea) at 4 lb/A plus SAN-6706 (4-chloro-5-(dimethylamino)-2-a,a,a-trifluoro-m-tolyl)-3(2H)-pyridazinone) at 2 lb/A. We made weed control evaluations on August 6, 1970 and then hand weeded all plots. The principal weed species present were: crabgrass (Digitaria sanguinalis (L.) Scop.), lambsquarters (Chenopodium album L.), pigweed (Amaranthus retroflexus L.), and carpetweed (Mollugo verticillata L.).

Superior weed control was obtained with alachlor plus linuron, SAN-6602 plus SAN-6706, trifluralin, nitralin, and RP-17623. Good weed control was obtained with alachlor, VCS-438, linuron, DCPA + sesone, and BAS-2903-H. Nitrofen, R-7465, and RH-315 resulted in unsatisfactory weed control. Other data collected included number of spikes, weight of flowers harvested, and corm weight. Only those treatments that were unsatisfactory in controlling weeds resulted in significant reductions in corm weight, weight of flowers, and number of spikes.

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TIMING OF CHEMICAL APPLICATION TO CONTROL BROMUS TECTORUM IN ESTABLISHED NURSERY PLANTINGS [1]

J. Lincoln Pearson [2]

Introduction

Bromus tectorum (downy brome, cheat grass, wild oats) is becoming a major weed problem in the nursery industry in southern and central New England. Originally it was considered an occasional invader but because its period of growth is fall, winter, and spring, it has escaped the regular mechanical cultivation period which is from June to August.

Nurserymen who use herbicides have followed recommendations for use during cool weather and when soil moisture is at a high level. Simazine must have good soil moisture to become active and Dichlobenil is volatile at temperatures above 45°F unless incorporated. Therefore early spring and late fall applications have been effective against many broad leaf weeds and some grasses (2). Downy brome germinates in late August and September and escapes the effect of the herbicides applied in early spring and late fall. An early fall application of herbicide would probably control the germination of downy brome but the use of Simazine and Dichlobenil in early fall would prevent germination of a fall cover crop (3).

It is now recognized that when downy brome is not controlled it spreads very rapidly to new areas.

Objective

The objective of this study was to determine at what time and at what rates Dichlobenil, Simazine and Diphenamid should be applied to control downy brome in Taxus.

Materials and Methods

The experimental area was a nursery in North Kingstown, R.I. Downy brome had become established as a small infestation in 1965 in a field containing Taxus and by 1968 it had spread to approximately a third of the 20 acre field

For each date of treatment one block 320 ft long and 10 ft wide was selected where downy brome grass had been severe the previous year. Within each block, plots were established 20 ft long by 10 ft wide to include 3 rows of Taxus, 30 plants/plot. Plots were replicated four times at random within each block, untreated plots were included as controls.

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The herbicide formulations used in this experiment and the time and rate of use were as follows:

Herbicide and Formulation	Block 1 Trial 1 4/11/69 Rate ai/A	Block 2 Trial 2 4/11/69 Rate ai/A	Block 2 Trial 2 10/2/69 Rate ai/A	Block 3 Trial 3 10/2/69 Rate ai/A	Block 4 Trial 4 11/17/69 Rate ai/A
Dichlobenil 4% G	6	6	6	6	6
Simazine 4% G	4	3*	3*	4	4
Diphenamid 5% G	6	6	6	6	6

* Simazine was used at the 3-pound rate because 8 pounds/acre in one year could cause damage to the Taxus.

In early April all weeds, including broad leaf weeds and the fall, winter, and spring growth of downy brome were cleared by hand from the experimental blocks. Herbicides were applied with a hand operated cyclone type distributor. April and October treatments were incorporated lightly with a tractor attached cultivator, to improve moisture contact with the herbicide and to prevent volatilization of the active ingredients.

Results and Discussions

All plots were observed frequently following treatments, but because of different times of herbicide application no data was recorded until the spring of 1970. Results of the trials were evaluated on May 23, 1970 which approximates the time that downy brome sets its seed and growth is so heavy that cultivation is difficult in untreated areas. Effectiveness of treatments was evaluated by estimating percent of the ground covered with downy brome. Results of the four trials were varied as is indicated by the following tables and discussion of Trials 1, 2, 3, and 4.

Trial #1 Single Spring Application

There was no indication that herbicides applied on April 11, 1969 had any effect on the germination of downy brome seed in the late summer of 1969. Plots were not mechanically cultivated and downy brome seedlings completely covered the surface.

When final data was taken May 23, 1970 (Table 1) the only observable difference between the control and treated plots was that the Dichlobenil and Simazine treatments appeared to reduce the height of growth of the downy brome. This verifies previous unpublished results from work which was carried out in 1968 in Rhode Island.

Table 1. Effect of Herbicide Application April 11, 1969 Upon Downy Brome on May 23, 1970.

Herbicide and Formulation	Pounds/A (active ingredients)	Percent Downy Brome Stand
Dichlobenil 4 G	6	100 1/
Simazine 4 G	4	100
Diphenamid 5 G	6	100
Control	0	100

1/ Means were not significant at any level as found by the Duncans Multiple Range Test.

Trial #2 Double Applications of Herbicides

The plots in Trial #2 received applications of Dichlobenil 4 G at 6 lbs ai/A, Simazine 4 G at 3 lbs ai/A, and Diphenamid at 6 lbs ai/A on April 11, 1969 and again at the same rate on October 2, 1969. Both applications were incorporated lightly. At the time of the second application of herbicides the stand of downy brome was heavy. Data taken May 23, 1970 (Table 2), indicated that Dichlobenil 4 G at a total of 12 lbs/A, and Simazine 4 G at 6 lbs/A in two applications was effective in controlling downy brome seedlings and also in preventing further germination.

The diphenamid at 12 lbs/A prevented further germination but did not prevent the growth of the seedlings germinated prior to the second application.

No cover crop was seeded as the residue remaining from the Dichlobenil and Simazine according to previous experiments (3) would have prevented its germi nation.

Final results of Trial #2 were observed on October 15, 1970 after control plots showed new germination of downy brome and growth of 2 to 3 inches. The plots given the double Simazine treatments in 1969 showed very little new germination of downy brome, the downy brome in the Dichlobenil double treated plots germinated, but there was evidence of growth suppression. The double treatment of Diphenamid had no effect either on germination or growth of downy brome at the above date.

The high rates of herbicides used in Trial #2 could not be used in newly transplanted fields because of possible damage to root systems, and they should not be repeated in successive years in any ornamental plantings because build up of residue would create a problem when the field was re-planted.

Table 2. Effect of Double Application of Herbicides on April 11, 1969 and October 2, 1969 Upon Downy Brome on May 23, 1970.

Herbicides and Formulation	Pounds/A (active ingredients)	Percent Downy Brome Stand
Dichlobenil 4 G	12	0 c 1/
Simazine 4 G	6	5 c
Diphenamid 5 G	12	40 b
Control	0	100 a

1/ Means followed by different letters are significant at the 5% level as found by Duncans Multiple Range Test.

Trial #3 Single Early Fall Application of Herbicides

Treatments in this trial were applied at the same time as the second application made in Trial #2. Results indicated that Simazine was more effective than either Dichlobenil or Diphenamid, but under the conditions of this trial, none of the treatments would be satisfactory in nursery management because the percent control was too low (Table 3).

Table 3. Effective of Single Application of Herbicides October 2, 1969 Upon Downy Brome on May 23, 1970.

Herbicide and Formulation	Pounds/A (active ingredients)	Percent Downy Brome Stand
Dichlobenil 4 G	6	70 c 1/
Simazine 4 G	4	40 d
Diphenamid 5 G	6	90 a b
Control	0	100 a

1/ Means followed by different letters are significant at the 5% level as found by Duncans Multiple Range Test.

Trial #4 Single Fall Application of Herbicides

Dichlobenil and Simazine showed no effect on downy brome 6 to 8 inches in height, but did control the less mature seedlings (Table 4). Trials carried out in Rhode Island in 1968 with Dichlobenil and Simazine, (unpublished) showed no effect on downy brome. These inconsistent results may have been related to substantial rainfall following the treatments of November 19, 1969.

Diphenamid treatments had no effect on downy brome in this trial.

Table 4. Effect of Herbicide Application on November 19, 1969 Upon Downy Brome on May 23, 1970.

Herbicide and Formulation	Pounds/A (active ingredients)	Percent Downy Brome Stand
Dichlobenil 4 G	6	60 b 1/
Simazine 4 G	4	75 c
Diphenamid 5 G	6	100 a
Control	0	100 a

1/ Means followed by different letters are significant at the 5% level as found by the Duncans Multiple Range Test.

Effect on Growth of Taxus

There was no evidence of injury to the foliage of Taxus from any of the treatments. Many of the plants were sold in April and May of 1970 and there was no injury observed to the root systems at time of digging.

Summary

The herbicides Dichlobenil, Simazine and Diphenamid were applied to established Taxus plantings at four different times and at different rates to determine if Bromus tectorum (downy brome) could be controlled.

Dichlobenil 4 G at 6 lbs ai/A, Simazine 4 G at 3 lbs ai/A and Diphenamid at 6 lbs ai/A applied on April 11, 1969 and repeated, at the same rates, October 2, 1969 gave the best control of downy brome in the fall of 1969 and the spring of 1970. Dichlobenil and Simazine were effective against both the newly germinating seedlings and the seedlings which were previously growing. Diphenamid had no effect on existing seedlings but prevented further germination.

Single application of the three herbicides did not give satisfactory

control of downy brome when applied in early April, early October, or in November.

The October and November treatments of Dichlobenil and Simazine gave some control but not enough to destroy existing plants of downy brome.

There was no evidence of damage to the Taxus.

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WEED CONTROL IN SWEET CORN

Richard A. Ashley[1/]

Abstract

Excellent full season control of crabgrass, witchgrass, pigweed and lambsquarters was obtained with alachlor 4 EC at 3 lbs./A, propachlor 65 W at 5 lbs./A and SD15418 80 WP at 4 lbs./A. Combinations of these materials with each other and with chlorobromuron, atrazine or butylate also gave excellent weed control at lower rates of applications.

Introduction

Experiments were conducted on the University of Connecticut Vegetable Research Farm in North Coventry, Connecticut to evaluate several herbicides and herbicide combinations with regard to weed control and crop injury in sweet corn.

Materials and Methods

Sweet corn (Zea mays var. rugosa) cv. Wonderful was planted June 11, 1970 in 36-inch rows on a Merrimac fine sandy loam soil. Treatments were arranged in a randomized block design with treated plots consisting of 3 rows 10 feet long. Treated area was 70 square feet with an untreated strip 2 feet wide between plots. Treatments were replicated 3 times.

Preplant incorporated applications of butylate at 4 and 6 lbs./A were made June 10, 1970 and immediately incorporated to a depth of 2 to 3 inches using a garden rototiller.

Preemergence applications of chlorobromuron 75W at 1.5 and 2 lbs./A, alachlor 4EC at 1.5 and 3 lbs./A, alachlor 10G at 1.5 and 3 lbs./A, SD15418 (2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methylpropionitrile) 15G at 2 and 4 lbs./A, SD15418 80WP at 2 and 4 lbs./A, SD15418 4WDL at 2 and 4 lbs./A, propachlor 65W at 4 and 5 lbs./A, and atrazine 80W at 1½ and 3 lbs./A were made on June 11, 1970. All rates are in ai/A.

In addition, the combinations listed in Table 1 were applied on June 10 and 11 as described above. Method and time of application was as for individual chemicals. All combinations of preemergence chemicals were applied as tank mixes. All spray applications were made at a rate of 40 gal./A.

The predominant weed species present in the experimental area were: Large crabgrass (Digitaria sanguinalis (L.), Scop.), witchgrass (Panicum capillare L.), lambsquarters (Chenopodium album L.), and redroot pigweed (Amaranthus retroflexus L.).

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Weed ratings were taken to determine the control of the above weed species using a 0 to 10 scale with 0 indicating no effect and 10 indicating complete kill. Similar ratings were taken for crop stand and vigor.

Yield data were taken on September 11, 1970 to determine the effect of the herbicide treatments, if any, on yield.

Results and Discussion

Excellent full season control of crabgrass, witchgrass, pigweed and lambsquarters was obtained with alachlor 4EC at 3 lbs./A, propachlor 65W at 5 lbs./A and SD15418 80WP at 4 lbs./A. In addition, combinations of chlorobromuron 75W + alachlor 4EC at 3/4 + 1½ lbs./A, chlorobromuron 75W + SD15418 80W at 1½ + 1 lb./A, chlorobromuron 75W + Propachlor 65W at 3/4 + 2, 3/4 + 4, or 1½ + 2 lbs./A; chlorobromuron 75W + butylate 6EC at 3/4 + 2, 3/4 + 4 or 1½ + 2 lbs./A; alachlor 4EC + S 15418 80W at ½ + 1 lb/A; alachlor 4EC + propachlor 65W at 3/4 + 2, 3/4 + 4 or 1½ + 2 lbs./A; alachlor 4EC + atrazine 80W at 3/4 + 3/4 or 1½ + 3/4 lbs./A; alachlor + butylate 3/4 + 2, 3/4 + 4 or 1½ + 2 lbs./A; SD15418 80W + propachlor 65W at 1 + 2, 1 + 4 and 2 + 2 lbs./A; SD15418 80W + butylate 6EC at 1 + 2, 1 + 4 and 2 + 2 lbs./A gave excellent control of the weed species present at reduced rates of application (Table 1).

Chlorobromuron gave excellent control of pigweed and lambsquarters throughout the season with an August 25, 1970 rating of 9.7 and 9.7 for the 1½ and 2 lbs./A rates respectively. Control of crabgrass was poor from the beginning and witchgrass came in these plots very heavily after mid-season. Ratings for crabgrass and witchgrass control on July 22, 1970 were 5.0 for chlorobromuron at 1½ lbs./A and 5.0 for chlorobromuron at 2 lbs./A. Corresponding figures for the August 25, 1970 ratings were 1.0 and 0 for the 1½ and 2 lbs./A rates respectively.

Chlorobromuron performed very well in combinations with alachlor, propachlor, butylate and SD15418. Three-quarters lb./A of chlorobromuron was sufficient to give full season control of the broadleaf species present when combined with alachlor at 1½ lb./A, propachlor at 2 or 4 lbs./A or butylate at 2 or 4 lbs./A. In combination with SD15418 at 1 lb./A, 1½ lb./A of chlorobromuron was required.

Alachlor 4EC at 1½ lbs./A gave good early control but poor full season control of crabgrass and lambsquarters. Control of crabgrass by alachlor 10G at the same rate was significantly better. The August 25, 1970 rating of annual grass control gave a rating of 6.3 for alachlor 4EC at 1½ lb./A with crabgrass as the incompletely uncontrolled grass as compared to a 9.3 rating for alachlor 10G at 1½ lb./A with crabgrass and witchgrass appearing in trace amounts. Alachlor 4EC at 3 lbs./A gave excellent full season control of all weed species.

Alachlor 4EC performed well in combinations with chlorobromuron, SD15418, propachlor, atrazine and butylate. In most cases the 1½ lb./A rate of alachlor

was best in combinations but as little as 3/4 lb./A provided excellent control in combinations with 2 or 4 lbs./A propachlor, atrazine at 3/4 lb./A or butylate at 2 or 4 lbs./A.

SD15418 at 4 lbs./A gave good full season weed control regardless of formulation. August 25, 1970 ratings for control of pigweed and lambsquarters showed an 8.7 rating for SD15418 80W at 4 lbs./A as compared to 8.0 for the 15G and 9.7 for the 4WDL. Corresponding figures for control of crabgrass and witchgrass were 9.3, 7.2 and 7.3 for the 80W, 15G, and 4WDL formulation respectively. Weed control was unacceptable at the 2 lb/A rate.

SD15418 80W performed well in combinations with propachlor and butylate at all rates tested. The combinations of SD15418 at 1 lb./A plus chlorobromuron 1½ lb./A and SD15418 at 1 lb./A plus alachlor at 1½ lbs./A gave full season control of the weed species present.

Propachlor 65W at 4 and 5 lbs./A gave excellent control of crabgrass and witchgrass but did not effectively control lambsquarters at the 4 lb./A. Propachlor combined effectively with chlorobromuron, alachlor, SD15418 and atrazine at all rates tested.

Butylate at 4 lbs./A gave a 50% reduction in crop stand and vigor. Crop injury was not noted at the 6 lb. rate nor when the 4 lb. rate was used in combination treatments. Combinations of butylate + chlorobromuron, butylate + alachlor and butylate + SD15418 were outstanding at all rates tested.

Alachlor 4 EC or 10G at 1½ and 3 lbs./A, SD15418 80W, 4WDL or 15G at 4 lbs./A, propachlor 65W at 4 and 5 lbs./A and butylate 6EC and 6 lbs./A gave significantly better control of crabgrass and witchgrass than the atrazine 80W chemical check at 1½ or 3 lbs./A. All combination treatments gave better control of the annual grasses present than atrazine 80W at 1½ lb./A.

SD15418 15G at 2 lbs./A and butylate 6EC at 4 lbs./A produced yields significantly below that of the weed-free check. Yields from the weed-free check were 6.3 lbs. as compared to 1.2 lb. from plots treated with SD15418 15G and 1.5 lbs. from plots treated with butylate 6EC at 4 lbs./A.

The combination of chlorobromuron at 1½ lbs. plus alachlor at 3.4 lb. produced the only yield significantly higher than the weed-free check at 10.7 lbs.

Table 1. Evaluation of several herbicides and herbicide combinations for weed control in sweet corn.

Treatment[1]	Rate Lb/A.	Weed Control Ratings[2] July 22, 1970 ABLW[4]	July 22, 1970 AGW[5]	Aug. 25, 1970 ABLW[4]	Aug. 25, 1970 AGW[5]	Weeds Incompletely Controlled	Yield Lb/plot
Chlorobromuron 75W	1½	9.5	5.0	9.7	1.0	Crabgrass, witchgrass	5.6
Chlorobromuron 75W	2	9.3	5.0	9.7	0	Crabgrass, witchgrass	5.5
Alachlor, 4EC	1½	8.2	9.0	6.3	7.0	Lambsquarters, crabgrass	7.2
Alachlor, 4EC	3	9.8	9.7	9.3	9.3		7.4
Alachlor, 10G	1½	9.5	9.7	9.3	8.0		6.6
Alachlor, 10G	3	8.8	9.7	7.3	9.7	Lambsquarters	6.2
SD15418 80W	2	7.8	8.0	7.3	0	Pigweed, crabgrass, witchgrass	5.3
SD15418 80W	4	9.3	10.0	8.7	9.3	Pigweed	7.1
SD15418 4WDL	2	8.3	8.0	8.4	2.7	Pigweed, crabgrass, witchgrass	5.3
SD15418 4WDL	4	9.2	9.0	9.7	7.3	Witchgrass	7.3
SD15418 15G	2	5.5	2.3	2.0	0	Pigweed, crabgrass, witchgrass	1.2
SD15418 15G	4	9.0	9.2	8.0	7.2	Pigweed, crabgrass, witchgrass	5.3
Propachlor 65W	4	7.0	9.8	4.3	9.0	Lambsquarters	5.1
Propachlor 65W	5	9.5	10.0	8.7	9.3	Lambsquarters	7.3
Butylate 6E	4	0	8.3	0	2.3	Lambsquarters, pigweed, crabgrass, witchgrass	1.5
Butylate 6E	6	7.0	9.0	7.7	7.7	Lambsquarters, pigweed, crabgrass, witchgrass	4.5

Table 1. (continued)

Treatment[1]	Rate Lb/A.	Weed Control Ratings[2] July 22, 1970 ABLW[4]	AGW[5]	Aug. 25, 1970 ABLW[4]	AGW[5]	Weeds Incompletely Controlled	Yield Lb/plot
Atrazine 80W	1½	10.0	2.7	9.8	0	Crabgrass, witchgrass	4.0
Atrazine 80W	3	10.0	8.7	10.0	4.7	Crabgrass, witchgrass	5.3
Chlorobromuron 75W + Alachlor 4EC	3/4+3/4	9.2	9.2	8.0	8.0	Pigweed, witchgrass	8.1
Chlorobromuron 75W + Alachlor 4EC	3/4+1½	9.8	9.5	9.7	8.7	Lambsquarters, witchgrass	8.1
Chlorobromuron 75W + Alachlor 4EC	1½+3/4	9.3	9.2	9.7	7.0	Crabgrass, witchgrass	10.7
Chlorobromuron 75W + SD15418 80W	3/4+1	9.0	7.7	7.3	4.3	Pigweed, witchgrass	4.9
Chlorobromuron 75W + SD15418 80W	3/4+2	9.7	9.2	9.7	7.0	Witchgrass	7.6
Chlorobromuron 75W + SD15418 80W	1½+1	10.0	9.3	9.0	7.8	Crabgrass	6.8
Chlorobromuron 75W + Propachlor 65W	3/4+2	9.7	9.8	8.7	9.2	Lambsquarters	7.7
Chlorobromuron 75W + Propachlor 65W	3/4+4	9.8	9.8	9.7	9.3		8.8
Chlorobromuron 75W + Propachlor 65W	1½+2	9.8	9.8	10.0	9.0		8.7
Chlorobromuron 75W + Atrazine	3/4+3/4	9.8	8.0	10.0	2.0	Crabgrass, witchgrass	5.8
Chlorobromuron 75W + Atrazine	3/4+1½	10.0	8.7	10.0	5.0	Witchgrass	8.6
Chlorobromuron 75W + Atrazine	1½+3/4	10.0	8.7	10.0	3.7	Witchgrass	7.8
Chlorobromuron 75W + Butylate 6E	3/4+2	9.5	9.5	9.3	8.7	Crabgrass, witchgrass	7.6
Chlorobromuron 75W + Butylate 6E	3/4+4	9.7	9.2	9.3	8.0	Crabgrass, witchgrass	6.2
Chlorobromuron 75W + Butylate 6E	1½+2	9.8	9.7	10.0	8.3	Crabgrass, witchgrass	7.9

Table 1. (continued)

Treatment[1]	Rate Lb/A.	Weed Control Ratings[2] July 22, 1970 ABLW[4]	July 22, 1970 AGW[5]	Aug. 25, 1970 ABLW[4]	Aug. 25, 1970 AGW[5]	Weeds Incompletely Controlled	Yield Lb/plot
Alachlor 4EC + SD15418 80W	3/4+1	8.7	9.2	7.0	5.3	Pigweed, crabgrass, witchgrass	5.2
Alachlor 4EC + SD15418 80W	3/4+2	8.0	8.5	7.7	5.3	Pigweed, crabgrass, witchgrass	5.8
Alachlor 4EC + SD15418 80W	1½+1	9.2	10.0	9.0	9.3		9.6
Alachlor 4EC + Propachlor 65W	3/4+2	9.3	9.8	9.0	9.3		7.2
Alachlor 4EC + Propachlor 65W	3/4+4	9.8	9.7	9.5	9.0		9.5
Alachlor 4EC + Propachlor 65W	1½+2	9.8	9.7	9.3	9.5		8.1
Alachlor 4EC + Atrazine 80W	3/4+3/4	9.7	9.7	9.3	8.3	Witchgrass, crabgrass	7.0
Alachlor 4EC + Atrazine 80W	3/4+1½	9.8	8.3	10.0	4.7	Witchgrass, crabgrass	6.4
Alachlor 4EC + Atrazine 80W	1½+3/4	10.0	9.8	10.1	9.7		8.4
Alachlor 4EC + Butylate 6EC	3/4+2	10.0	9.8	10.0	9.7		7.5
Alachlor 4EC + Butylate 6EC	3/4+4	10.0	9.8	10.0	9.0		8.2
Alachlor 4EC + Butylate 6EC	1½+2	9.8	9.8	9.8	9.3		8.0
SD15418 80W + Propachlor 65W	1+2	9.8	10.0	9.8	9.3		8.5
SD15418 80W + Propachlor 65W	1+4	10.0	10.0	8.8	9.7	Pigweed	5.3
SD15418 80W + Propachlor 65W	2+2	10.0	10.0	9.5	9.7		8.4
SD15418 80W + Atrazine 80W	1+3/4	10.0	8.5	10.0	4.0	Witchgrass	6.0
SD15418 80W + Atrazine 80W	1+1½	9.8	8.8	10.0	5.0	Crabgrass	5.5
SD15418 80W + Atrazine 80W	2+3/4	9.8	9.2	9.7	7.3	Crabgrass, witchgrass	8.8

Table 1. (continued)

	Rate	Weed Control Ratings[2] July 22, 1970		Aug. 25, 1970		Weeds Incompletely Controlled	Yield Lb/plot
	Lb/A.	ABLW[4]	AGW[5]	ABLW[4]	AGW[5]		
SD15418 80W + Butylate 6EC	1+2	10.0	9.2	9.8	7.7	Crabgrass, witchgrass	7.8
SD15418 80W + Butylate 6EC	1+4	9.7	9.8	9.3	9.0		7.9
SD15418 80W + Butylate 6EC	2+2	10.0	9.5	9.8	9.0		7.6
Propachlor 18G + Atrazine 6G	3+1	9.5	9.3	9.7	8.7	Crabgrass	5.4
Butylate 6EC + Atrazine 80W	4+1	10.0	9.3	10.0	8.3	Crabgrass	8.0
Hoed Check							6.3
LSD 1%		1.8	2.5	2.7	3.3		5.0
LSD 5%		1.3	1.9	2.1	2.5		3.7

1 Preplant incorporated treatments applied 6/10/70. Preemergence treatments applied 6/11/70.

2 Average of 3 replicates. 10 = complete kill, 0 = no effect.

3 Average of 3 replicates.

4 Annual broadleaf weeds.

5 Annual grassy weeds.

A PRELIMINARY REPORT ON FORMATION OF SEED AND GERMINATION OF FALL PANICUM (*PANICUM DICHOTOMIFLORUM* MICHX.) AND WITCHGRASS (*P. CAPILLARE* L.)[1/]

C. M. Rivera and R. A. Peters[2/]

Abstract

Fall panicum (*Panicum dichotomiflorum* Michx.) and witchgrass (*Panicum capillare* L.) seeds were collected in the fall of 1969 and 1970, and treatments were imposed with the aid of growth chambers in an effort to increase germination.

When 1969 seeds were four to five months old, leaching in running water, exposure to dry heat, and exposure to freezing temperatures did not increase germination percentages appreciably (less than 25% germinated). However, sulfuric acid or mechanical scarification, 0.2% KNO_3, 0.2% NH_4HPO_4, and soil leachates did promote germination percentages significantly (50-100%). These tests were conducted under 70-80° F, 16-hour day (the higher temperature being in effect during the daylight hours). A 24-hour day was used.

Germination tests of untreated 1969 seeds were performed solely under 70-80° F, 16-hour day, and in general germination remained below 10% for eleven months. Germination tests of untreated 1970 seed lots were performed under several alternating temperature regimes: 70-80° F, 10-hour day; 70-80° F, 16-hour day; 80-90° F, 10-hour day; 80-90° F, 16-hour day. Germination of two month-old 1970 witchgrass seeds exhibited a temperature and photoperiodic response under the prescribed conditions, particularly with KNO_3 as a moistening agent (80-90° F treatments: 16-hour day, KNO_3 - 86%; 16-hour day, H_2O - 58%; 10-hour day, KNO_3 - 28%; 10-hour day, H_2O - 0%; all 70-80° F treatments: 0%). Two month-old fall panicum seeds, though, failed to respond to identical treatment. Both species, however, did respond to scarification indicating that the seeds were not immature.

Dormancy is thought to be associated with the seed coat since scarification promoted germination. Determinations are being made to ascertain whether dormancy is due to water impermeability, hindered gaseous exchange, or some other factor.

1/ Intended source of publication: Weed Science, 1971-72.

2/ Graduate Assistant and Professor of Agronomy, respectively, Plant Science Department, University of Connecticut, Storrs, Connecticut.

Effect of Incorporation and Irrigation on Weed Control by Combinations of Butylate and Other Herbicides

Richard A. Ashley[1]

Abstract

Incorporation of atrazine, SD15418, and chlorobromuron when used in combinations with butylate, resulted in significant reduction in weed control. The butylate-alachlor combination gave excellent full season weed control when both herbicides were preplant incorporated or when the butylate was preplant incorporated and the alachlor was surface applied.

Introduction

Experiments were conducted on the University of Connecticut Vegetable Research Farm, North Coventry, Connecticut to determine the effect of incorporation on weed control by combinations of butylate with various non-volatile herbicides. The effect of irrigation on the performance of these combinations was also studied.

Materials and Methods

Sweet corn (*Zea Mays* var. *rugosa*) cv. Royal Crest was planted June 11, 1970 in 36-inch rows on a Merrimac fine sandy loam. Treatments were arranged in a split plot design with main treatments being irrigation and no irrigation. Irrigated plots received seven 1-inch irrigations. Plots intended as unirrigated received one 1-inch irrigation to insure a crop. Subtreatments were (1) butylate 3 lbs./A PPI + atrazine 1 lb./A PPI, (2) butylate 3 lbs./A PPI + atrazine 1 lb./A preemergence, (3) butylate 3 lbs./A PPI + alachlor 1.5 lb./A PPI, (4) butylate 3 lbs./A PPI + alachlor 1.5 lb./A preemergence, (5) butylate 3 lbs./A PPI + SD15418 [2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methylpropionitrile] 1 lb./A PPI, (6) butylate 3 lbs./A PPI + SD15418 1 lb./A preemergence, (7) butylate 3 lbs./A PPI + chlorobromuron 3/4 lb./A PPI, and (8) butylate 3 lbs./A PPI chlorobromuron 3/4 lb./A preemergence. Experimental plots consisted of 3 rows 10 feet long. Treated area was 70 square feet with a two-foot untreated area between plots.

Preplant incorporated treatments were applied June 11, 1970 using a power driven sprayer and incorporated immediately after application to a depth of about 2-3 inches using a garden rototiller. Where both chemicals in a combination were incorporated, they were applied as a tank mix. All materials were applied in approximately 40 gallons of water per acre.

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Predominant weed species in the experimental area were: large crabgrass (Digitaria sanguinalis (L.) Scop.), witchgrass (Panicum capillare L.), purslane (Portulaca oleracea L.), lambsquarters (Chenopodium album L.) and red root pigweed (Amaranthus retroflexus L.). Weed ratings were taken based on the above species to determine control of broadleaf weeds and annual grasses. A 0 to 10 scale was used with 0 indicating no effect and 10 representing complete kill. Similar ratings were taken for crop injury.

Yield data were taken on August 26, 1970 from the center row of each plot to determine the effect of treatments, if any, on yield.

Results and Discussion

Control of large crabgrass and witchgrass by combinations of butylate and SD15418 and butylate and chlorobromuron was significantly reduced by the incorporation of the SD15418 or chlorobromuron (Table 1). Control of the grasses by combinations of butylate and atrazine or butylate and alachlor was not affected by incorporation. In the August 25, 1970 rating, control of large crabgrass and witchgrass by the butylate + chlorobromuron combination was 3.5 where both chemicals were incorporated versus 8.0 where the chlorobromuron was surface applied. The butylate + SD15418 was rated at 4.5 where both herbicides were incorporated and 7.4 where the SD15418 was surface applied. Comparable figures for the butylate + atrazine and butylate + alachlor combinations were 5.7 and 7.2 and 9.1 and 9.9 respectively.

Control of broadleaf weeds by the butylate-atrazine combination was significantly reduced by the incorporation of atrazine (Table 2). The July 22, 1970 rating was 8.8 for broadleaf control in plots where both butylate and atrazine were preplant incorporated compared to 9.9 where the atrazine was surface applied. Pigweed was the incompletely controlled species.

The same rating showed control of broadleaf weeds by butylate + SD15418 and butylate + chlorobromuron to be reduced by incorporation of the SD15418 and chlorobromuron. Ratings for these combinations were 8.5 for incorporated and 9.5 for surface application and 6.3 incorporated and 9.2 surface for butylate + SD15418 and butylate-chlorobromuron respectively. These differences were evident in the August 25, 1970 rating. Both pigweed and lambsquarters were incompletely controlled.

The loss of weed control due to the incorporation of SD15418 in combination with butylate was primarily the result of irrigation. In plots where only the 6.07 inches of natural rainfall plus one 1-inch irrigation was applied, there was no loss of activity from incorporation of SD15418 (Table 3). The August 25, 1970 ratings of annual grass control were 6.0 where both butylate and SD15418 were incorporated and 5.7 where the butylate was incorporated and SD15418 surface applied. On plots where natural rainfall plus seven 1-inch irrigations were applied, ratings were 3.0 where both were incorporated and 9.2 where SD15418 was surface applied.

With chlorobromuron the loss of activity seemed to be the result of simple dilution since significant decreases in phytotoxicity accompanied incorporation regardless of irrigation level. Under natural rainfall conditions, the August 25, 1970 ratings of annual grass control were 2.0 where both butylate and chlorobromuron were incorporated and 7.7 where chlorobromuron was surface applied. Comparable ratings under irrigated conditions were 5.0 and 8.3 for incorporated and surface applications respectively.

Yield data reflects the decline in weed control resulting from incorporation of atrazine, SD15418 and chlorobromuron when used in combination with butylate (Table 4). Only the butylate-alachlor combination produced comparable yields for both incorporation and surface application of alachlor.

Table 1. Effect of incorporation on control of annual grasses by combinations of butylate and other herbicides.

Herbicide	Applied[2]	Weed Control Rating[1] 7/22/70	8/25/70	Weeds Incompletely Controlled
Butylate 3 lbs./A + atrazine 1 lb./A	PPI PPI	8.2	5.7	Crabgrass, witchgrass
Butylate 3 lbs./A + atrazine 1 lb./A	PPI Pre	9.3	7.2	Crabgrass, witchgrass
Butylate 3 lbs./A + alachlor 1.5 lb./A	PPI PPI	9.8	9.1	Crabgrass, witchgrass
Butylate 3 lbs./A + alachlor 1.5 lbs./A	PPI Pre	10.0	9.9	Witchgrass
Butylate 3 lbs./A + SD15418 1 lb./A	PPI PPI	8.0	4.5	Crabgrass, witchgrass
Butylate 3 lbs./A + SD15418 1 lb./A	PPI Pre	9.0	7.4	Witchgrass
Butylate 3 lbs./A + chlorobromuron 3/4 lb./A	PPI PPI	8.7	3.5	Crabgrass, witchgrass
Butylate 3 lbs./A + chlorobromuron 3/4 lb./A	PPI Pre	8.8	8.0	Crabgrass, witchgrass
LSD 1%		1.5	2.7	
LSD 5%		1.1	2.0	

1. Average of 3 replications at 2 irrigation levels.
   10 = complete kill, 0 = no effect

2. PPI treatments applied 6/11/70. Preemergence treatments applied 6/12/70.

Table 2. Effect of incorporation on control of broadleaf weeds by combinations of butylate and other herbicides.

Herbicide	Applied	Weed Control Rating[1] 7/22/70	Weed Control Rating[1] 8/25/70	Weeds Incompletely Controlled
Butylate 3 lbs./A + atrazine 1 lb./A	PPI PPI	8.8	9.5	Pigweed
Butylate 3 lbs./A + atrazine 1 lb./A	PPI Pre	9.9	10.0	Purslane
Butylate 3 lbs./A + alachlor 1.5 lb./A	PPI PPI	9.6	9.3	Lambsquarters
Butylate 3 lbs./A + alachlor 1.5 lbs./A	PPI Pre	9.9	9.9	Lambsquarters
Butylate 3 lbs./A + SD15418 1 lb./A	PPI PPI	8.5	6.8	Pigweed, lambsquarters
Butylate 3 lbs./A + SD15418 1 lb./A	PPI Pre	9.5	9.3	Pigweed, lambsquarters
Butylate 3 lbs./A + chlorobromuron 3/4 lb./A	PPI PPI	6.3	5.0	Pigweed, lambsquarters
Butylate 3 lbs./A + chlorobromuron 3/4 lb./A	PPI	9.2	9.4	Lambsquarters
LSD 1%		1.2	2.4	
LSD 5%		0.9	1.8	

1. Average of 3 replications at 2 irrigation levels. 10 = complete kill, 0 = no effect.

2. PPI treatments applied 6/11/70. Preemergence treatments applied 6/12/70.

Table 3. Effect of incorporation and irrigation on control of large crabgrass (*Digitaria sanguinalis* (L.) Scop.) and witchgrass (*Panicum capillare* L.) by butylate and other herbicides.

Herbicides	Applied[2]	Weed Control Rating 8/25/70[1]	
		Irrigated[3]	Not Irrigated[4]
Butylate 3 lbs./A	PPI	5.3	6.0
+ atrazine 1 lb./A	PPI		
Butylate 3 lbs./A	PPI	6.3	8.0
+ atrazine 1 lb./A	Pre		
Butylate 3 lbs./A	PPI	9.0	9.2
+ alachlor 1.5 lb./A	PPI		
Butylate 3 lbs./A	PPI	9.8	10.0
+ alachlor 1.5 lbs./A	Pre		
Butylate 3 lbs./A	PPI	3.0	6.0
+ SD15418 1 lb./A	PPI		
Butylate 3 lbs./A	PPI	9.2	5.7
+ SD15418 1 lb./A	Pre		
Butylate 3 lbs./A	PPI	5.0	2.0
+ chlorobromuron 3/4 lb./A	PPI		
Butylate 3 lbs./A	PPI	8.3	7.7
+ chlorobromuron 3/4 lb./A	Pre		
LSD 5% = 2.8			

1. Average of 3 replicates. 10 = complete kill. 0 = no effect.
2. PPI treatments applied 6/11/70. Preemergence treatments applied 6/12/70.
3. Received 6.07 inches natural rainfall plus seven 1-inch irrigations.
4. Received 6.07 inches natural rainfall plus one 1-inch irrigation.

Table 4. Effect of weed control by combinations of butylate and other herbicides on yield of sweet corn.

Herbicide	Applied[1]	Yield[2]
Butylate 3 lbs./A + atrazine 1 lb./A	PPI PPI	5.2 lb.
Butylate 3 lbs./A + atrazine 1 lb./A	PPI Pre	9.7
Butylate 3 lbs./A + alachlor 1.5 lb./A	PPI PPI	10.2
Butylate 3 lbs./A + alachlor 1.5 lbs./A	PPI	10.6
Butylate 3 lbs./A + SD15418 1 lb./A	PPI PPI	5.2
Butylate 3 lbs./A + SD15418 1 lb./A	PPI Pre	9.1
Butylate 3 lbs./A + chlorobromuron 3/4 lb./A	PPI PPI	4.9
Butylate 3 lbs./A + chlorobromuron 3/4 lb./A	PPI Pre	7.8
LSD 1%		3.8
LSD 5%		2.8

1. PPI treatments applied 6/11/70. Preemergence treatments applied 6/12/70.
2. Average of 3 replicates at 2 irrigation levels.

RESULTS OF FIELD TESTS WITH S-6115 ON CORN

R. A. Schwartzbeck, J. W. Pullen
K. P. Dubrovin, J. P. Brown [1/]

"Outfox"* (2-chloro-4-cyclopropylamino-6-isopropylamino-1,3,5-triazine) formerly S-6115 is a new herbicide discovered and developed by Gulf Research & Development Company for post-emergence weed control in corn. The compound has a proposed common name of "cyprazine" and has been tested under the code numbers S-6115 and S-9115.

Most broadleaf and grassy weeds common to corn fields are susceptible to "Outfox" with the exception of perennial species which usually are not killed but are stunted.

Replicated small plot field tests were conducted in 10 midwestern states in 1968. Excellent control of most problem species was obtained. The following year tests ranging in size from 1 to 12 acres were expanded to the 14 states in which over one million acres of corn were grown. Weed control and yield data collected from both farmer-applied and Gulf Research-applied tests showed satisfactory results in almost all instances.

Evaluation began in 1968 of the persistence of "Outfox" in soil. Samples were taken periodically during the growing year and again the following spring. Both chemical and bioassay determinations were made and with both methods "Outfox" was found to decline rapidly.

Experiments were continued in 1969 in 14 states representing 27 soil types in which pre- and post-emergent applications were made. Soybeans, oats and turnips were seeded at application time and at intervals of approximately 30, 60 and 90 days. Pooled results showed that oats and soybeans seeded 60 days after treatment and turnips seeded 90 days after treatment grew normally.

These results were reinforced by observing over 100 fields during the spring and summer of 1970 on which "Outfox" had been applied in May or June of 1969. On 5 of these fields there was an indication of carry-over and in these cases it was due to an application of higher rates than recommended.

"Outfox" has also shown promise as a pre-emergent material applied alone and in combination with other pre-emergent herbicides for corn. Preliminary data from "Outfox" applications to sorghum and sugar cane have also appeared promising.

* Trademark of Gulf Oil Corporation

[1/] Gulf Research & Development Company, 9009 West 67th Street, Merriam, Kansas.

SEED TREATMENT AND INCORPORATION AS FACTORS INFLUENCING ANNUAL GRASS CONTROL IN CORN - 1970

R. A. Peters and W. M. Dest[1/]

After many years usage of atrazine, annual grass weeds have become the principal weeds of many corn fields in the Northeast. The following investigation was directed at methods of using chemicals which have demonstrated marked activity on annual grasses.

Procedure

The experiment was on a Paxton fine sandy loam on the Agronomy Research Farm, Storrs, Conn. Corn was planted and herbicides were applied on June 17, 1970. The soil surface was dry but soil moisture was adequate. All pre-plant treatments were incorporated within 45 minutes of application. Applications were made with a self-propelled small plot sprayer at a rate of 40 gal/A. All EPTC butylate treatments were incorporated. On the EPTC plots seed treatment was the variable. An antidote of 1/2% dust of napthalic anhydride was applied at a rate of 12 grams of dust per 6 lb of corn seed in the seed hopper. Large crabgrass (Digitaria sanguinalis) was the predominant grass weed in the experimental area. There was a sparse stand of lambsquarter and rough pigweed. The other chemicals were both pre-plant incorporated and surface applied as a pre-emergence application.

A randomized block experimental design was used with three replications. Plot size was 16 x 20 feet. Weed control was rated on a scale of 1-9 with 1 as no effect and 9 as complete control.

Effect of napthalic anhydride seed treatment on corn injury

As anticipated, corn injury was marked when EPTC was used the day of planting. Injury was manifested by restricted expansion of leaves and curvature of the stalks. Some plants outgrew initial injury at the 3 lb/A rate. On August 21, 28% of the corn plants showed some injury, however, the silage yield of 11.3 T/A was as high as the standard atrazine-alachlor treatment (Table 1). At the 6 and 9 lb rate of EPTC, plant injury was severe and corn yields were significantly lower than with EPTC at 3 lb/A rate. The use of the napthalic anhydride treatment reduced the percentage of injury at all three rates of EPTC and resulted in significantly greater yields at the 6 and 9 lb/A rates compared to the same rates without seed treatment. At the 3 lb/A rate there was no gain in yield of corn from the antidote since

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there was no serious injury from EPTC alone.

Grass control was very good from all EPTC treatments.

Comparisons of incorporation vs pre-emergence applications

Incorporating both butylate and atrazine did not reduce the effectiveness as compared to pre-plant applications of butylate followed by a pre-emergence application of atrazine. This applied to both grass weeds and broadleaf weeds. Similarly, incorporation of atrazine and alachlor in combination was as effective as pre-emergence applications. Incorporation of BAS 2903-H, however, resulted in a distinct reduction of crabgrass control as rated on August 21, as compared to pre-emergence treatments. This difference in control, however, was not reflected in the corn silage yields.

Soil moisture was ample at planting but only 1/10 inch of rainfall occurred on the first 10 days after seeding. Any dilution effect from incorporation apparently was compensated by the mixing of the herbicides into the germination zone except with BAS 2903-H.

Crabgrass control did not persist as long with the atrazine 1 plus alachlor 1 lb/A treatments as with atrazine + butylate treatments or BAS 2903-H pre-emergence treatments.

Table I. Crabgrass control, corn injury and corn yields.

Chemical		lb/A ai	Crabgrass Control 7/20/70	Crabgrass Control 8/21/70	% Corn Plants Injured 8/21/70	Corn Yields T/A 30% DM
Atrazine	PPI[1]	1				
+ Butylate	PPI	3	8.7	7.0	13.0	11.5 abc
Atrazine	PRE[2]	1				
+ Butylate	PPI	3	8.3	8.3	0.0	12.8 a
Atrazine + Alachlor	PPI	1 + 1	7.7	6.3	3.0	11.7 abc
Atrazine + Alachlor	PRE	1 + 1	8.0	6.0	5.0	9.5 abcd
BAS 2903-H[3]	PPI	2	7.0	3.7	3.0	9.3 abcde
BAS 2903-H	PRE	2	8.7	7.3	0.0	11.9 ab
EPTC	PPI	3	8.7	8.0	28.0	11.3 abc
EPTC + NA[4]	PPI	3	9.0	8.0	15.0	12.1 ab
EPTC	PPI	6	9.0	8.7	52.0	8.0 def
EPTC + NA	PPI	6	9.0	9.0	27.0	10.6 abc
EPTC	PPI	9	9.0	9.0	88.0	4.3 f
EPTC + NA	PPI	9	9.0	8.7	32.0	8.3 bcde
Control			1.0	1.0	0.0	6.1 ef

1/ PPI - pre-plant incorporated

2/ PRE - pre-emergence

3/ 2-chloro-N- (1-methyl-2-propynil) acetanilide

4/ Napthalic anhydride seed treatment (rate)

STATUS REPORT ON NO-TILLAGE CORN PRODUCTION IN CONNECTICUT

R. A. Peters and W. M. Dest[1/]

(Abstract)

A cooperative effort was made in 1970 between the University of Connecticut and three area Extension Dairy Specialists to interest dairy farmers in growing silage corn commercially by no-tillage methods. The Specialists assisted the growers in obtaining no-tillage planting equipment, in making specific recommendations upon request on herbicide treatments, and in one area of the state by actually assisting in the planting operation. Approximately 1600 acres of no-tillage corn were planted with generally satisfactory results.

Herbicide treatments varied but most involved paraquat plus atrazine. Vegetation control was generally satisfactory, however, control of dandelions and quackgrass was erratic.

Lack of uniform stands was found at several locations. This is related to poor seed placement by the no-tillage corn planter and/or greater insect injury than found in conventional seed-beds.

In a long term experiment at Storrs, second year corn silage yields on no-tillage plots were the same as yields on plowed, conventional plots.

Surface application of a complete fertilizer applied after planting was effective. Corn roots were observed growing close to the soil surface where the fertilizer was concentrated. If applied prior to planting, however, the fertilizer on the soil surface was thrown aside by the fluted coulter of the no-tillage planter resulting in poor corn seedling growth. Banding of phosphorus fertilizer with the seed is suggested.

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FALL PANICUM CONTROL IN FIELD CORN WITH TRIAZINES[1]

D. E. Robinson and Jonas Vengris[2]

Introduction

In recent years fall panicum (Panicum dichotomiflorum Michx.) has become a prominent weed in corn in the Eastern United States (4). The need for controlling this weed has therefore become urgent.

Alachlor (2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide) and butylate (S-ethyl diisobutylthiocarbamate) are now extensively used for controlling fall panicum and other grassy weeds in corn. Some work, however, reveals that fall panicum can be controlled by simazine (2-chloro-4, 6-bis(ethylamino)-s-triazine) whereas atrazine (2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine) is less effective for this purpose (1, 2, 3, 4). Interest is now also directed towards witchgrass (Panicum capillare L.) which shows potential for becoming a serious weed in this area of the United States.

This experiment was designed to evaluate simazine and atrazine for the control of fall panicum and witchgrass in field corn. Butylate and alachlor treatments were included for comparison only.

Materials and Methods

This study was conducted at the University of Massachusetts, Amherst, on a fine sandy loam soil with only fair drainage. On June 1, 1 ton of limestone and 1000 lb/A of 10-10-10 fertilizer was incorporated into the seedbed during preparation, at which time the area was also uniformly infested with fall panicum and witchgrass seeds. On June 3, hybrid 335A Wisconsin field corn was planted. Three blocks, each consisting of 16 (12' x 25') plots were laid out and the treatments listed in Table 1 were randomly assigned to each block. All post-emergence treatments were applied with 1 gal/A Agway Booster oil. Fall panicum and witchgrass plants were at the 2-3 leaf stage (2-3 cm) when post-emergence treatments were applied.

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[1]Contribution of the Massachusetts Agricultural Experiment Station, College of Agriculture, University of Massachusetts, Amherst, Massachusetts. This study was supported in part by the Cooperative Extension Service, Smith-Lever funds.

[2]Graduate Research Assistant and Professor, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, Massachusetts.

There was heavy rainfall soon after the pre-emergence treatments were applied on June 4 and lighter intermittent showers followed on June 5 and 6.

Weed stands in the various plots were evaluated at different times during the course of the study and the average percentage weed control determined. Corn was harvested on September 22 and yields were determined from the center three rows of each plot (Table 1).

Table 1. Effect of herbicidal treatments on fall panicum control and dry matter yields of silage corn.

Treatments	Date of application	Percent control	Yields lb/plot
1. Check		0	42.4
2. Check, clean		100	57.1
3. Butylate 4 lb/A, pre-plant, incorporated	6/ 3/70	94	56.7
4. Alachlor 2 lb/A, pre-emergence	6/ 4/70	94	52.6
5. Atrazine 2 lb/A, pre-plant, incorporated	6/ 3/70	50	47.2
6. Atrazine 4 lb/A, pre-plant, incorporated	6/ 3/70	76	54.4
7. Atrazine 2 lb/A, pre-emergence	6/ 4/70	66	52.8
8. Atrazine 4 lb/A, pre-emergence	6/ 4/70	90	53.1
9. Atrazine 2 lb/A, post-emergence + oil	6/19/70	89	51.7
10. Atrazine 4 lb/A, post-emergence + oil	6/19/70	98	53.0
11. Simazine 2 lb/A, pre-plant, incorporated	6/ 3/70	96	51.9
12. Simazine 4 lb/A, pre-plant, incorporated	6/ 3/70	99	54.4
13. Simazine 2 lb/A, pre-emergence	6/ 4/70	97	56.4
14. Simazine 4 lb/A, pre-emergence	6/ 4/70	98	54.4
15. Simazine 2 lb/A, post-emergence + oil	6/19/70	83	50.6
16. Simazine 4 lb/A, post-emergence + oil	6/19/70	92	52.0
LSD at 5% level		9.1	6.6

Results and Discussion

Witchgrass did not compete strongly and represented only about 10% of the weed stand in the check plots. At the same time this weed was very effectively controlled by all the herbicide treatments used in the study.

Butylate and alachlor both gave excellent control of fall panicum. Pre-plant and pre-emergence applications of simazine at 2 and 4 lb/A were also effective in controlling this weed. Post-emergence treatments of simazine gave only fair results at 2 lb/A but was quite satisfactory at the 4 lb/A rate. The more soluble atrazine, probably due to greater leaching brought about by the heavy rainfall, gave poor control when applied pre-plant and at 2 lb/A pre-emergence. Pre-emergence treatments of atrazine at 4 lb/A however gave satisfactory control.

Corn yields were significantly lower on plots which received pre-plant applications of 2 lb/A atrazine than on hand-weeded checks. No significant yield differences occurred between these checks and other treated plots.

Summary and Conclusion

The effects of simazine and atrazine in the control of fall panicum and witchgrass in field corn were evaluated. All herbicides used in the study controlled witchgrass effectively. For fall panicum, simazine at 2 and 4 lb/A gave excellent control when incorporated prior to planting or applied pre-emergence. Post-emergence treatments of simazine were also good at 4 lb/A rate but were somewhat less effective at the lower rate. Post-emergence applications of atrazine at both rates and pre-emergence treatments at 4 lb/A were also satisfactory. However, atrazine did not give effective control when incorporated prior to planting and at 2 lb/A pre-emergence.

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EFFECT OF SIMAZINE ON THE TRANSPIRATION AND CO_2 UPTAKE OF THREE WEED SPECIES[1]

E. T. Pratt and T. R. Flanagan[2]

ABSTRACT

Transpiration rates of buckhorn plantain (Plantage lanceolata L.), sheep sorrel (Rumex acetosella L.), and common dandelion (Taraxacum officinale Weber) were measured by the weight loss of potted plants. A closed system was employed for measuring transpiration and CO_2 uptake simultaneously. The soil surface was covered with a wax mixture to prevent evaporation. Soil surface applications of 2-chloro-4,6-bis (ethylamino)-s-triazine (simazine) at the rate of 2.24 kg/ha were made 16 to 55 days previous to testing. All measured rates were expressed on a dry weight basis and regressed on percent soil moisture (range 50% to 15%).

Transpiration rates measured with either technique, showed significant increases following simazine treatment. CO_2 uptake as measured with the closed system were decreased after simazine application, but this trend was significant only for sorrel and plantain.

Both transpiration and CO_2 uptake rates as depicted by the linear regression model, generally declined as soil moisture was depleted. This trend for some of the treatments may be entirely due to the rapid drop of rates as soil moisture approached the permanent wilting percentage.

The simazine treatment resulted in significant reduction in leaf weight per unit area for all three species. This may partially explain the increased transpiration, as treated plants had a relatively larger surface area per gram dry top than control plants of the same species.

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[1] From a thesis by E. T. Pratt in partial fulfillment of the requirement for the M.S. degree at the University of Vermont; (M.S. to be submitted to Weed Science)

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SWEET CORN RESPONSE TO ALACHLOR AND OTHER HERBICIDES[1,2]

J. A. Ivany and R. D. Sweet[3]

ABSTRACT

Five years of field testing of alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide) showed it to be safe on four varieties of sweet corn (Zea mays var. rugosa). Applications made both pre-emergence and either early or late post-emergence gave no sweet corn injury. Combinations of alachlor with atrazine and Bladex were safe at the low rates used and had no effect on yield. Alachlor in combination with Primaze and chlorobromuron gave injury on the variety NK-199.

INTRODUCTION

Much research in recent years has centered around the use of combinations of herbicides to control weeds in sweet corn (Zea mays var. rugosa). This has been done to achieve broad spectrum weed control, and with reduced rates of application to minimize chance of herbicide carryover. Alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide), a recent introduction, has gained favor for use as a corn herbicide. It gives excellent grassy weed control; however, it is weak on certain broadleaf weeds notably lambsquarters (Chenopodium album) (1, 2, 3). Atrazine (2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine), is weak in control of annual grasses especially fall panicum (Panicum dichotomiflorum) (1). Combinations of these two herbicides should give broad spectrum weed control.

The studies reported here are a summary of experiments conducted over a five-year period to evaluate alachlor and the other herbicides given in Table 5 when applied separately or in combination for weed control and effect on yield of sweet corn.

EXPERIMENTAL

Experiments were conducted at the Cornell Vegetable Research Farm, Freeville, New York. The specific information as to dates of planting and treating, soil type, and dates of weed and crop rating and harvest is given in Table 1.

1/ Paper No. 626 of the Department of Vegetable Crops, Cornell University, Ithaca, New York.

2/ This research was partially supported by a grant-in-aid from the Monsanto Chemical Company.

3/ Research Assistant and Professor, respectively.

Table 1. Specific information regarding soils, treatments and harvests for the seven experiments being reported.

Exp.	Soil Type	Date Planted	Date and Timing of Treatment	Harvested (H) or Rated (R)
1966	Howard gravelly loam	6/13	6/13 pre	7/15 (R)
1967	Howard gravelly loam	6/15	6/16 pre 6/29 post	7/18 (R) 8/7 (R)
1968	Howard gravelly loam	6/11	6/21 weed emerg.	7/10 (R)
1969	Howard gravelly loam	6/30	6/30 pre 7/23 post	8/7 (R) 8/7 (R)
1970	I Eel silt loam	6/8	6/8 pre	Jub. 9/4 (H) NK-199 9/1 (H)
	II Eel silt loam	6/9	6/9 pre	9/22 (H)
	III Howard gravelly loam	6/10	6/10 pre	7/7 (R)

Table 2. Summary of sweet corn and seeded grass ratings[a] when exposed to various alachlor treatments, 1966-1969.

Year	Treatment	lb/A	Timing	Sweet corn Gold Cup	Sweet corn Deep Gold	Grasses Jap. Mill.	Grasses Y. Fox.
1966	alachlor	3	pre	7.5		9.0	
	alachlor	6	"	6.5		9.0	
1967	alachlor	2	pre	7.5	8.0	8.5	
	alachlor	3	"	7.0	8.5	8.5	
	alachlor	4	"	8.0	8.0	9.0	
	alachlor	2	early post	8.5	8.0	1.5	
	alachlor	4	"	8.5	8.5	6.5	
1968	atrazine	0.5	weed emerg.	9.0	9.0	8.0	9.0
	atraz.+alac.	0.5+3	"	8.5	9.0	9.0	9.0
	alachlor	3	"	8.0	7.5	9.0	9.0
1969	alachlor	4	pre	8.6	9.0	9.0	
	atrazine	1	"	8.5	9.0	3.5	
	atrazine	2	"	9.0	9.0	8.0	
	atraz.+alac+oil	1+2+1 gal.	late post	6.0	6.0	8.0	
	atraz.+alac+oil	2+4+1 gal.	"	4.5	6.5	9.0	
	control			9.0	9.0	9.0	9.0

[a] Rating: Crop: 9=perfect crop; 7=slight injury but acceptable; 1=complete kill of crop.
Weed: 9=perfect control; 7=acceptable control; 1=no control.

In all experiments, except 1970, 1 row each of Gold Cup and Deep Gold was seeded in each plot. Rows were either 30" or 36" apart. In 1970 Jubilee and NK-199 were the varieties seeded. In all experiments Japanese millet (Echinochloa crusgalli var. frumentacea) was drilled between the corn rows. In a few instances yellow foxtail (Setaria lutescens) was also seeded. In the latter instance, one row of each grass specie was seeded equidistant between the corn rows. When only Japanese millet was utilized, two rows were seeded.

Treatments were applied with a hand-held small plot sprayer using a CO_2 pressure source at a total spray volume of 35-40 gallons per acre. All rates of application given in this paper refer to the amount of active ingredient applied. All experiments were designed as randomized complete blocks with either two or three replications.

At the post-emergence stage in 1967 the corn had 3-4 leaves and was 7-9 inches tall. The seeded millet had 3-4 leaves and was 2-3 inches tall. In 1968 when the "at emergence" treatment was applied the corn was 2-3 inches tall, just past the spike stage, and the millet and foxtail had just emerged. In 1969, at the post-emergence stage the corn had 7-8 leaves and was 12 inches tall and the millet had 6-8 leaves and was 8 inches tall.

Over the years the post-emergence treatments varied with respect to time of application. In 1967 and 1969, the treatments were timed at two different developmental stages of the corn i.e., early post-emergence in 1967 and late post-emergence in 1969. In contrast, the timing in 1968 was at the spike stage of the seeded grassy weeds and the corn was just past the spike stage. These stages of application, pre-emergence to late post-emergence, gave a broad range of growth over which corn response to alachlor could be evaluated.

During 1970, experiments were conducted to compare the response of two additional sweet corn varieties, Jubilee and NK-199 to alachlor alone and in combination with other herbicides. A special test[4/] was conducted in 1970 to compare corn yields when atrazine, alachlor and Bladex (2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methylproprionitrile) and certain combinations of these were used. The stand of Jubilee was somewhat thick due to an error in planter adjustment, however, valid comparisons can be made.

Crop and weeds were evaluated 5 to 8 weeks after treating using a visual rating system. Crop response was rated from 1 to 9 with 9 a perfect crop; 7 slightly injured but acceptable crop; and 1 complete kill of crop. Weed control was also rated from 1 to 9 with 9 perfect control; 7 commercially acceptable control; and 1 no control. In the 1970 test yield was determined by recording the number and weight of marketable ears in 25 feet of row.

RESULTS AND DISCUSSION

Response of Gold Cup and Deep Gold sweet corn to alachlor is shown in Table 2 for the years 1966-1969. Both varieties responded well to alachlor with no injury symptoms when the herbicide was applied pre-emergence or post-

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4/ The yield test was part of a cooperative project with researchers at Rutgers and the Virginia Truck Experiment Station.

Table 3. Rating[a] of sweet corn and planted Japanese millet exposed to alachlor and other herbicides applied pre-emergence, alone and in combination.

Treatment	lb/A	Sweet Corn Jubilee	Sweet Corn NK-199	Jap. Millet
Atrazine	1	9.0	8.5	9.0
"	2	9.0	8.5	9.0
Alachlor	1.5	9.0	9.0	9.0
"	3	9.0	8.5	9.0
Atrazine+alachlor	1+1.5	9.0	8.5	9.0
" "	2+3	9.0	8.5	9.0
Primaze	1	9.0	7.5	8.0
"	2	9.0	7.5	9.0
Primaze+alachlor	1+1.5	8.5	6.5	9.0
" "	2+3	9.0	6.5	9.0
Simazine	1	9.0	8.5	7.5
"	2	9.0	7.0	9.0
Simazin+alachlor	1+1.5	9.0	6.5	9.0
" "	2+3	9.0	8.5	9.0
Chlorobromuron	1.5	7.5	7.0	9.0
"	2	7.0	6.0	9.0
Chlorobromuron+alachlor	1.5+1.5	7.5	6.5	9.0
" "	2+3	6.0	5.5	9.0
S-6115 (Outfox)	.75	9.0	8.0	7.5
"	1.5	9.0	8.0	9.0
control		9.0	8.5	2.2

a/ For an explanation of rating see Table 2.

emergence. In Table 2, it can be seen that the post-emergence treatments during 1967-1969 were at three different corn growth stages, as previously described. The results show that alachlor applied alone was safe on corn at all growth stages studied i.e., spike stage, early, and late post-emergence. Alachlor in combination with atrazine and oil[5] post-emergence gave corn injury. Kill of millet was excellent when alachlor was applied at weed emergence or in combination with atrazine and oil. The early post-emergence treatment of alachlor alone, however, resulted in poor kill of millet at the highest rate.

A summary of visual ratings of sweet corn and millet response to alachlor and several other herbicides and their combinations is given in Table 3. Alachlor and Primaze (mixture of atrazine and prometryne (2,4-bis(isopropylamino)-6-methylthio-s-triazine) in combination resulted in injury to the NK-199 variety. Also chlorobromuron (3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea) alone caused slight injury to corn and when combined with alachlor greater injury resulted especially on the NK-199 variety. Kill of millet was excellent with all treatments in this experiment.

5/ Sunoco 11-E was the oil used.

Table 4. Summary of sweet corn ear count and weight per plot and millet rating when treated with alachlor and other herbicides and herbicide combinations pre-emergence.

Treatment	lb/A	Jubilee No.	Jubilee Wt.	NK-199 No.	NK-199 Wt.	Millet Rating[a]
Atrazine	.75	56.0	31.4	25.0	14.8	8.6
"	1.5	59.0	30.4	23.0	12.6*	9.0
Alachlor	1.5	56.0	29.6	26.0	15.1	9.0
"	3	56.0	30.3	30.0	17.6	9.0
Bladex	1	54.0	26.3	29.0	14.9	5.6
"	2	51.0	24.5	28.0	15.6	8.6
Atrazine+alachlor	.75+1.5	56.0	27.9	29.0	14.8	9.0
" "	.75+3	62.0	33.9	30.0	17.5	9.0
Bladex+alachlor	1+1.5	62.0	33.9	28.0	17.4	9.0
" "	1+3	66.0	34.7	30.0	18.0*	9.0
control (hand weeded)		58.0	29.7	26.0	15.3	-
LSD .05[b]		14.0ns	7.8ns	5.0ns	2.7	-

a/ For explanation of rating see Table 2.
b/ Means followed by an asterick are significantly different from the control at the 0.05% level.

Table 5. Herbicides used in this study.

alachlor	2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide
atrazine	2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine
bladex	2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methyl-proprionitrile
chlorobronuron	3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea
primaze	mixture of 38% atrazine + 2% related compounds and 40% prometryne (2,4-bis(isopropylamino)-6-methylthio-s-triazine
simazine	2-chloro-4,6-bis(ethylamino)-s-triazine
S-6115	2-chloro-4-cyclopropylamino-6-isopropylamino-1,3,5-triazine

The results of the total number of marketable ears per plot and their weight in the yield test is given in Table 4. The two corn varieties showed good tolerance of most herbicide treatments. Only Bladex at 2 lbs/A caused a slight reduction in ear count and weight on the Jubilee variety. This was not noted on the NK-199 variety, however, with this variety a low ear count and weight was noted with atrazine. This may be a varietal response and merits further study. Kill of the seeded millet was excellent with all treatments except Bladex at 1 lb/A. At least 2 lbs/A of Bladex was needed for complete millet kill.

SUMMARY

In five years of field testing, alachlor was shown to be safe on four varieties of sweet corn; Gold Cup, Deep Gold, Jubilee and NK-199. Pre-emergence and early and late post-emergence applications were made with no corn injury. In combination with atrazine and oil, post-emergence corn injury was noted. Combinations of alachlor with atrazine and Bladex was practical at the low rates used and had no effect on yields.

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EFFECTS OF VEGETABLE-MINERAL OIL ADDITIVES ON POSTEMERGENCE ACTIVITY OF ATRAZINE[1]

L. A. Almodovar and R. D. Ilnicki[2]

Abstract

Phytobland petroleum oils have been used successfully as adjuvants to herbicides.

Experimental vegetable-mineral oil mixtures[3] at ½ gal/A concentration were investigated as adjuvants to 2-chloro-4-(ethylamino)-6-isopropylamino) s-triazine (atrazine) for postemergence application to corn (Zea mays L., var. Indiana 654). Fall panicum (Panicum dichotomiflorum Michx.) and large crabgrass (Digitaria sanguinalis (L.) Scop.) were ½ to 3" tall and had two to six leaves when sprayed. Herbicide suspensions were applied in 20 gallons of spray emulsion per acre. The experiments were conducted in a Holmdel loam soil at the Adelphia Research Center, Rutgers University, during 1970.

In Experiment 1, vegetable oils from rapeseed, sunflower, linseed, corn, cottonseed, safflower, soybean, and peanut were each combined with a mineral oil (11E oil) in mixtures containing one part vegetable oil to seven parts mineral oil plus emulsifier. Oil-water emulsions containing atrazine at 0.5, 1.0, or 2.0 lb a.i./A were broadcast sprayed to 4-week-old corn plots.

Experiment 2 included seven ratios of vegetable to mineral oil mixtures ranging from 0/8 to 8/8 as adjuvants to atrazine. Oils from rapeseed and cottonseed were included in the mixtures with 11E oil. Atrazine was applied at 0.75 and 1.5 lb a.i./A.

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[1]From a thesis by L. Almodovar in partial fulfillment of the requirement for the Ph.D. degree at Rutgers University.

[2]Assistant Agronomist, University of Puerto Rico and Research Assistant, Rutgers University; and Research Professor of Weed Science, respectively, Department of Soils and Crops, Rutgers University, New Brunswick, New Jersey.

[3]Adjuvants were supplied by Sun Oil Company, Philadelphia, Penna.

Weed Control

The peanut oil formulation (EPEA) was the least effective in controlling weeds. Other formulations and ratios were essentially equal in effectiveness.

Control of broadleaf weeds was excellent in both experiments except from the peanut oil formulation with atrazine at 0.5 lb/A.

Fall panicum and crabgrass were more resistant to treatment. Two months after spraying the control was only 30-40 percent.

Corn Yields

Experiment 1 -- Plots treated with EPEA, the least effective of the group, yielded 7-10 bu of corn/A less than the other adjuvant treatments. Plots treated with atrazine without adjuvant yielded 3-5 bu/A less than all the oil treatments except EPEA.

There were significant differences between the lower (0.5 lb) and the other rates of atrazine, but not between 1 and 2 lb/A. The difference between the lower and the higher rate was highly significant. The increase in yields with higher rates was approximately 5 bu/A.

Experiment 2 -- There were no significant differences between corn yields from atrazine treatments at 0.75 and 1.5 lb/A. Uncultivated checks yielded 14 bu/A less than the atrazine (0.75 lb) oil treatments.

There were no differences among the different oil ratios investigated.

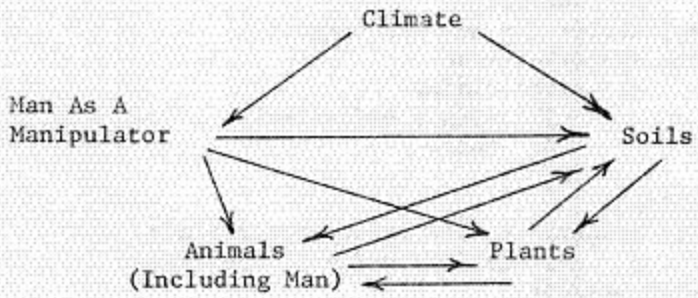
THE ECOSYSTEM APPROACH TO HERBICIDE EVALUATION

R. D. Shipman 1/

INTRODUCTION

Whenever man introduces pesticides into the environment, he may inadvertently apply these biological tools on areas or to organisms that are not a part of his principal target. Basic to any decision for applying a chemical that is foreign to the total environment is the undisputed fact that man is dealing with an integrated system, an interacting and interdependent complex. Weed scientists in particular, and man in general, must realize that the ecological system includes the circulation, transformation, and accumulation of introduced matter. In short, the success or failure of a pesticide application will depend upon the consequences of the changes that occur after application. Conversely, it is important to have a greater knowledge of the environmental target before applications are made.

To reinforce this concept as it is related to the new discipline of weed science, a simplified view of an ecosystem is presented below: 2/



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2/ Van Dyne, George M. 1969. The ecosystem concept in natural resource management. Academic Press, New York, New York.

In this system, man, of course, is the chief driving force. As a manipulator, he can introduce any and all kinds of physical and biological tools into this system, thereby altering its flow of energy for positive, negative, long-term, or short-term effects.

To illustrate how an ecosystem approach to herbicide evaluation can be achieved, an outline (checklist) of procedures will be presented first. Following the outline, an actual five-year study will then be evaluated using the main points given in the outline, thus relating the theoretical model to the results obtained from an actual study. The potential applier of a pesticide should familiarize himself not only with the following points, but also his client and the public-at-large should be cognizant of these procedures:

OUTLINE

I. Pre-application principles

A. The chemical and its structure
1. Common and chemical name
2. Empirical formula and molecular weight
3. Chemical and physical properties
a. Stability
b. Toxicity
4. Volatility (on and off target)
5. Use specifications
a. Label claims
1) Plants and animals
2) Rates

B. Macro-climate
1. Air temperature and frost-free periods
a. Seasonal and daily fluctuations
2. Wind velocity
3. Rainfall periodicity

C. Soil
1. Moisture retention and runoff
2. Type, structure and organic matter
3. Topography and slope
a. Nearness to streams

D. Vegetation type
1. Agricultural
2. Forest
3. Grassland
4. Urban

E. Objectives of application
1. Assessment of local opinion (benefits)
2. Legislative restrictions
3. Success of prior applications

II. Chemical application

A. Decision to apply
1. Based on pre-application principles (I,A,B,C,D,E) given above

III. Post-application principles

A. Assessment of results
1. Unbiased quantification of data
B. Residue and degradation analysis
C. Total environmental evaluation
1. Non-target
a. Man
b. Land, water, air, vegetation, wildlife and domestic animals
2. Food chains

RESULTS

Let us now see how the major requirements given in the above outlined procedure might be applied to an actual investigation:

I. Pre-application principles

A. The chemical and its structure

The herbicide used in this investigation was a 25 percent active pelleted formulation of fenuron (3-phenyl-1, 1-dimethylurea). Its empirical formula is $C_9H_{12}N_2O$ and it possesses a molecular weight of 164.202. Fenuron is stable towards oxidation and moisture under conventional conditions and its solubility is 3850 ppm. in distilled water at 25°C. The LD_{50} to rats is 6400 mg/kg. According to the manufacturer's label, it is non-corrosive, non-volatile, non-flammable, and is low in toxicity to man and animals under recommended conditions of use. It may cause irritation of eyes, nose, throat, and skin, and a caution is given to avoid breathing dust and contact with skin, eyes, and clothing. For application, the recommended rate is 50-75 pounds per acre if broadcast for control of certain undesirable woody plants. It is recommended also for control of woody plants in fence rows, drainage ditches, utility and railroad right-of-ways, and other non-cultivated areas. The seller makes no warranty of any kind, express or implied, concerning the use of fenuron. The buyer assumes all risk of use or handling whether in accordance with directions or not.

B. Macro-climate

The average annual precipitation in the vicinity of this study is 42 inches. The average number of days with snow cover per year is 85 and the mean annual snow depth is 46 inches. Approximately 140 days per year are frost-free; the maximum-minimum January daily air temperatures are 38° and 21°F respectively. The July maximum-minimum air temperatures are 81° and 57°F.

C. Soil

Soil types at the experimental site are well-drained, acidic, sandy loams derived from sandstones and shales. Organic material is extremely low in these soils. The topography in this area is gentle to rolling at an elevation of 1900 feet above sea level and with 3-10 percent slope gradients. Major mountain streams are within two miles of the chemically treated area.

D. Vegetation type

A mixed oak-hickory forest stand located near Black Moshannon on the Allegheny Plateau was chosen for investigation. White, scarlet, red, and chestnut oak of low-grade quality is the dominant tree vegetation type with occasional red maple, hickory, and sassafras. Witch hazel, shadbush, and dogwood are the dominant understory species represented. Approximately 70 percent of the overstory trees are low in quality, showing visible signs of disease and basal scars from past wildfires. The area is a prime hunting area for deer, grouse, and other wildlife.

E. Objectives of herbicide application

The purpose of this experiment was to investigate the ecological interactions of low-grade hardwood overstory and understory defoliation and the early height response of underplanted Japanese larch (Larix leptolepis, Sieb. and Zucc.) seedlings. The principal biological tool employed in order to manipulate this forest ecosystem was pelleted fenuron. With fenuron applied at varying rates, it was presumed that low quality hardwood stands of this type could be converted to faster growing timber and wildlife production, both resource products to be grown on the same unit area.

Prior to the time of herbicide application, the local forest owners were contacted and the benefits to be derived from this testing were discussed. The success of several prior tests in other areas was referred to as evidence of the positive values of using herbicides in this area.

II. Chemical application

A. Decision to apply

After consultation with the forest land owner and a careful review of the chemical to be used, the decision to carry out these trials was made. On the experimental site, natural reproduction of desirable timber species originating from seed was extremely sparse to non-existent. Thus, the prospects for stand conversion with fenuron, based upon a quantitative appraisal of the present stand characteristics, appeared to be excellent.

In May 1965, two-year-old Japanese larch seedlings were planted beneath the canopy of a low-grade mixed oak-hickory stand located near Philipsburg, Pennsylvania. Seedlings were underplanted with a planting bar at a 6 x 6 foot spacing. Nine duplicate one-tenth acre plots, including controls, were assigned at random on the experimental site. Each plot was designated as a treatment (method per rate) combination. Approximately one

month following planting, all plots were treated with pelleted fenuron. The herbicide was applied directly to the soil surface by hand at varying rates per acre for each treatment as follows: Grid (7.0, 13.7, 15.5, and 45.0 pounds), row (15.0 and 30.0 pounds) and broadcast (15.0 and 30.0 pounds). Two plots, untreated and planted, were designated as controls.

One year after treatment, a complete inventory of overstory competing hardwood trees and understory shrubs was made. Trees and shrubs were tallied individually for each treatment according to species, number, crown class, basal area, and percent of crown defoliation. In a like manner, the planted Japanese larch seedlings were inventoried by number surviving, height, grade and degree of deer browse.

III. Post-application principles

A. Assessment of results

The effects of fenuron application, six growing seasons after treatment, according to method, rate, seedling growth and level of overstory elimination are given in Table 1. The height response of Japanese larch seedlings showed significant differences among the various rates and methods of application. An analysis of the mean seedling heights indicated that all treatments were significantly superior to the untreated controls. Among the eight grid applications, there was no significant increase in height growth with increased rates of application, although a trend is indicated. Considering the average response of all treatments, a grid or row application of 15.0 pounds per acre appears to produce the greatest height growth. The five-year height growth on a plot treated with 16.0 pounds is shown in Figure 1.

Initially, a multiple regression and correlation analysis employing nineteen independent variables was made to eliminate those variables which did not contribute significantly to the change in average height growth. Utilizing the principle of persimonious regression, the five independent variables that singly and in combination produced the highest percent of explained variance (R^2) were developed (Table 2). The "best" single independent variable expression of growth, which explains 82 percent of the variation, was the number of dead overstory trees. This relationship, significant at the 1 percent probability level, can be expressed as follows:

$$\hat{Y} = 2.12144 + 0.11210\ (X)$$

where: $\hat{Y}$ = predicted mean height growth of Japanese larch
X = number of dead overstory trees

B. Residue analysis

Employing oat seedlings as plant indicators of herbicide toxicity, the amount of fenuron residues remaining in soils of the test site was estimated five months after the May 1965 application. The results of these tests showed that among the three variables investigated, soil depth, soil texture, and herbicide rate, the rate of application appeared to be

most significant in terms of parent residues remaining. As shown in Table 3, no residues were detected by this method at the 5 pounds per acre active rates, and only 7 percent of the parent chemical remained at the 10 pound per acre rate. Thus, one can conclude that insignificant residues were detected in a time span of five months after application.

Figure 1. A low-grade mixed hardwood forest converted to Japanese larch trees with pelleted fenuron herbicide. Trees, after six growing seasons, are 8-10 feet tall, an 80 percent increase in height growth over trees planted on untreated plots.

Table 1. Effects of Fenuron Herbicide by Rate Applied, Seedling Growth and Overstory Reduction
(1970 - Six growing seasons after treatment)

Method	Plot No.	Herbicide Rate (lbs./A)	Seedling: $\bar{x}$ height (feet)	Seedling: Survival (percent)	Seedling: Grade 1 (number)	Seedling: Deer Browse (number)	Overstory Trees: Dead (number)	Overstory Trees: Basal Area (Sq. feet)
Grid	2	37.5	9.4	89	58	21	53	8.521
Grid	6	15.0	6.8	78	37	33	45	7.583
Grid	7	9.0	5.9	73	31	34	28	8.312
Grid	8	12.5	8.1	90	55	30	49	7.329
Grid	9	5.0	5.2	89	21	59	22	6.898
Grid	15	15.0	7.1	86	41	36	39	7.918
Grid	18	16.0	8.6	74	45	25	57	7.591
Grid	19	52.5	8.6	73	46	20	56	7.542
Row	4	30.0	7.3	61	18	29	43	9.186
Row	10	30.0	8.0	86	52	30	45	8.353
Row	11	15.0	6.7	86	50	27	43	6.690
Row	17	15.0	8.3	77	45	28	52	7.706
Bdcst.	5	30.0	6.8	41	14	22	38	8.768
Bdcst.	16	30.0	7.8	31	19	12	69	7.640
Bdcst.	20	15.0	5.1	59	13	34	32	6.977
Bdcst.	1	15.0	5.1	42	13	25	39	7.977
Control	12	0.0	2.0	77	5	22	7	6.569
Control	14	0.0	3.0	72	15	46	11	5.909
	Means:	19.0	6.65	71.3	32.1	29.6	40.4	7.637

Table 2. Percent of Variation (R^2) Accounted for by Five Independent Variables Six Growing Seasons After Fenuron Treatment.

Dependent variable	R^2 for eligible variables	Independent variables in order of elimination by parsimony
Seedling height	0.978	x_1 x_2 x_3 x_4 x_5
	0.972	x_2 x_3 x_4 x_5
	0.962	x_2 x_3 x_4
	0.911	x_2 x_4
	0.818	x_2

Where: x_1 = Fenuron rate in pounds per acre
x_2 = No. of dead overstory trees
x_3 = Basal area living and dead overstory trees
x_4 = No. of Grade 1 seedlings
x_5 = No. of seedlings deer browsed

Table 3. Fenuron Residues Remaining in Field Plots Estimated from Oat Bioassay Standards[1/]

Fenuron applied	Mineral soil depth	Soil texture	Textural characteristics			Oat yield	Fenuron residues[2/]	
			Sand	Clay	Silt			
lbs./A active	inches		. . . .	percent	. . . .	grams	lbs./A active	percent of initial rate
5	0-4	Sandy loam	68.3	19.2	12.5	1.67	None	None
10	0-4	Sandy loam	68.3	19.2	12.5	1.41	0.73	7.3
5	4-8	Sandy loam	65.8	20.7	13.5	1.15	None	None
10	4-8	Sandy loam	65.8	20.7	13.5	0.78	0.71	7.1
						Means sandy loam:	0.36	3.6

1/ Five months following broadcast (May) applications.

2/ Estimated from a series of fenuron soil mixtures containing the equivalent of 0, 0.5, 1.0, 1.5 and 2.0 lbs./A active fenuron per acre.

C. Total environmental evaluation

Throughout the five-year span of this investigation, no reports or evidence have been apparent that non-target organisms, including man, have been affected by this chemical. In fact, the reverse is true. Timber and wildlife production have been significantly improved through the use of this chemical compound.

SUMMARY

An outlined procedure for the ecosystem approach to evaluation of herbicides has been presented. As an example of the manner in which this outline can be utilized, the results obtained from a 5-year study with fenuron herbicide have been reported according to this skeleton model.

With appropriate modifications, this procedure is applicable to most ecosystems in which pesticides are used, whether these be forest, agricultural, or rangeland systems.

An attempt has been made to direct these guidelines to practitioners of pesticide application, with the intent of altering the current image of weed scientists towards a more positive approach to the pesticide critics.

EFFECTS OF SPLIT APPLICATIONS OF DALAPON ON PHRAGMITES

Donald N. Riemer[1/]

Phragmites (Phragmites communis Trin.) is a plant of world-wide distribution. While it is used for thatching and for other purposes in many parts of the world, it can also be a serious weed problem. It covers many acres of marsh in New Jersey where it rapidly becomes the dominant vegetation and often constitutes a fire hazard.

One of the standard recommendations for control of this species is 2,2-dichloropropionic acid (dalapon) at rates as high as 30 lb/A (1). In 1957 Santelmann and Meade (2) reported that dalapon was more effective in controlling johnsongrass (Sorghum halepense (L.) Pers.) when the herbicide was applied as split or repeat applications, 7 to 40 days apart. The present study was undertaken to determine if split applications would also improve the control of phragmites with this herbicide.

Methods and Materials

The site chosen for the experiment is a flat, low-lying marsh on the flood plain of the Raritan River in Central New Jersey. An extensive system of drainage ditches had been installed for mosquito control purposes. As a result the area is not swampy and free water is never found on the surface, although the water table is high and the soil is always moist. Phragmites has apparently been the dominant vegetation on this site for many years because the ground is covered with a deep layer of broken and partially decomposed phragmites stems. This layer is over 2 feet deep in some places.

The experiment was designed as a 3 x 2 x 2 factorial experiment with three replications. The first factor was three rates of dalapon (30, 24, and 18 lbs/A). The second factor was that these rates were either applied as a single application or divided and applied as two half-applications 15 days apart. The third factor was the addition or deletion of additional wetting agent to that already present in the commercial dalapon formulation.

Plots were 21 ft. by 21 ft. (.01 A), with 5-foot buffer zones between plots. Treatments were made with a knapsack sprayer using a spray volume of 100 gpa. The initial applications were made on May 21,

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1968 when many new shoots were 18 to 30 inches tall although some shoots were still emerging from the ground. Those plots receiving split applications were treated for the second time on June 6, 15 days after the initial treatment. At this time the tallest plants in the untreated areas were approximately shoulder-high.

Visual ratings of plant vigor and stand density were made periodically throughout the next three growing seasons. Ratings were always made by two independent observers and their results were averaged. The rating system used was 0 to 10, where 0 equals no visible effect on the plant and 10 equals complete control of all above-ground portions of the plant.

Results

The results of the additional wetting agent were erratic and showed no distinct trends. Therefore, this variable was disregarded in presenting the data in this paper and the ratings were averaged across both levels of wetting agent. Each bar in the graphs then, represents the average rating for 6 individual plots.

Figures 1-3 represent stand density ratings. Figure 1 shows that, with one exception, the split treatment of 15 + 15 lb/A reduced stand density slightly more than did a single treatment of 30 lb/A. The one exception was the rating at 13 months where the treatments showed identical ratings. During the third growing season, ratings dropped somewhat but the difference between the two methods of application remained about the same. Figure 2 shows a very different situation. Here, the single application (24 lb/A) is again consistently poorer than the 12 + 12 lb/A split rate but the difference between the two becomes greater and greater as time progresses. During the third growing season, (24 and 28 months on the graph), control, as measured by stand density, decreased sharply with the single application while it held up quite well with the split application. Figure 3 shows the results obtained with 18 lb/A and 9 + 9 lb/A. Here, the split applications again showed consistently better control than a single application but the difference between the two did not change appreciably with time. When the degree of control began to decrease in the third growing season, both treatments declined together.

Ratings on the vigor of the phragmites plants are presented in figures 4-6. These graphs do not show any pattern in regard to single vs. split applications. In some cases one method of application was best and in other cases the opposite was true. All treatments seriously reduced the vigor of the plants at the time of the first rating (4 months). During the second growing season, (12-15 months), vigor of the existing plants was only moderately affected and this was seen primarily as a

Fig. 1 Stand Ratings on Phragmites treated with 30 lb and 15 + 15 lb Dalapon/A

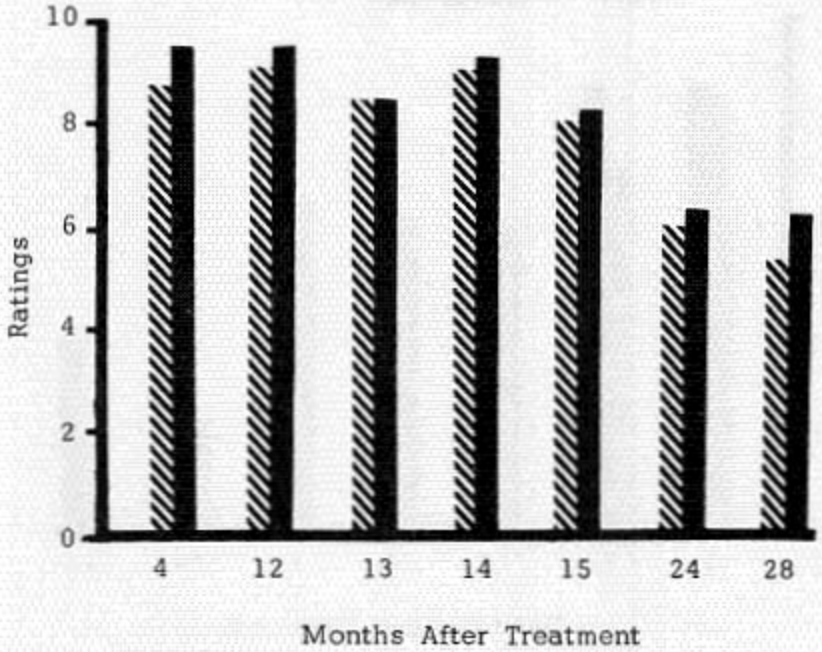


Fig. 2 Stand Ratings on Phragmites treated with 24 lb and 12 + 12 lb Dalapon/A

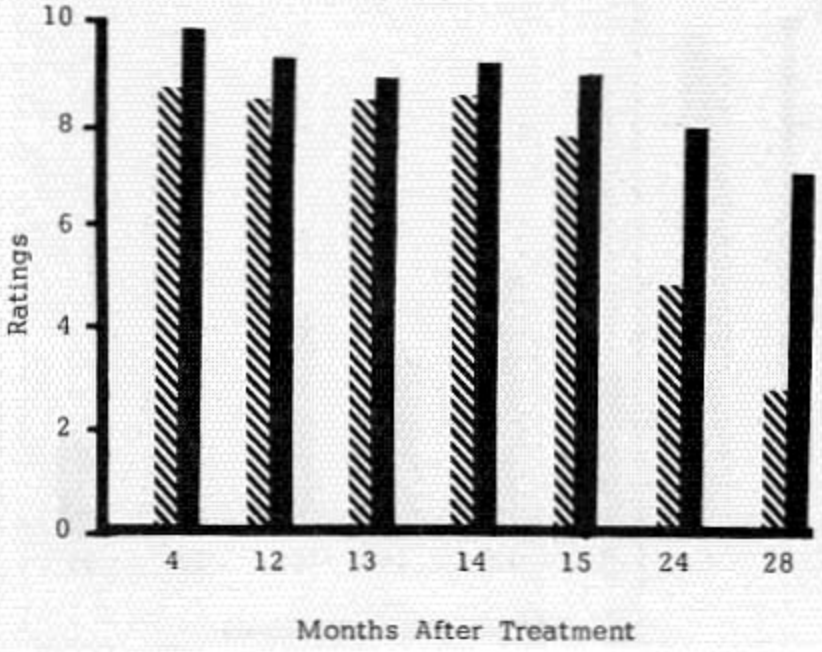


Fig. 3 Stand Ratings on Phragmites treated with 18 lb and 9 + 9 lb Dalapon/A

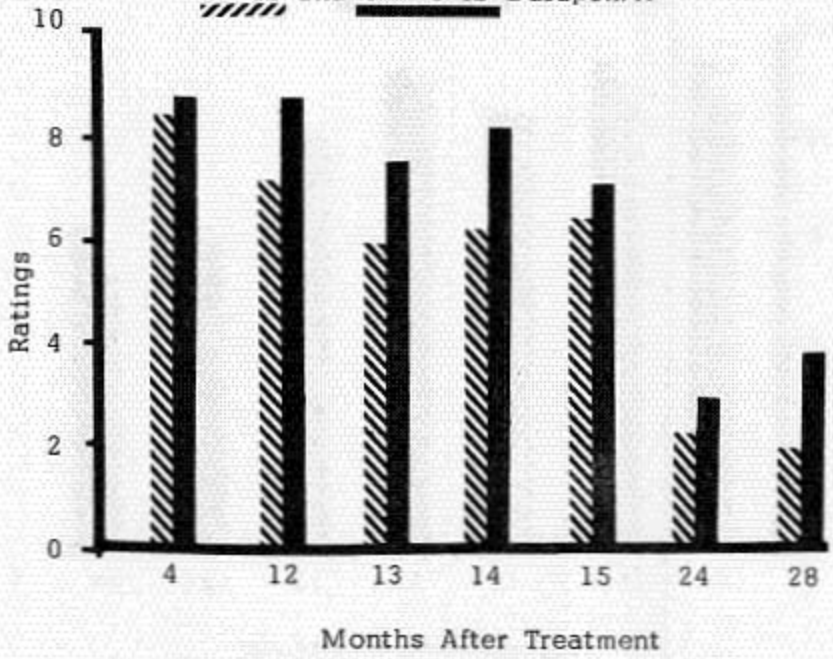


Fig. 4 Vigor Ratings on Phragmites treated with 30 lb and 15 + 15 lb Dalapon/A

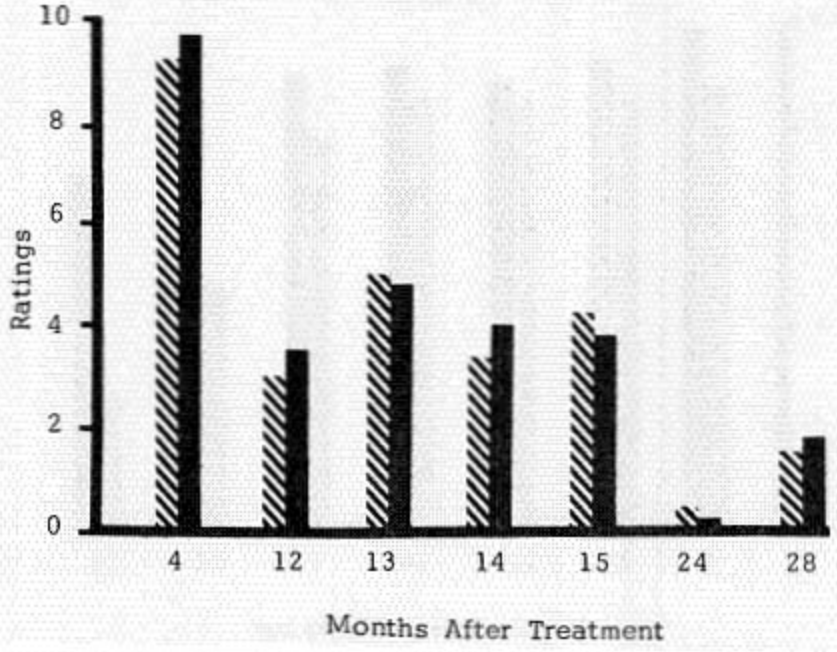


Fig. 5 Vigor Ratings on Phragmites treated with 24 lb and 12 + 12 lb Dalapon/A

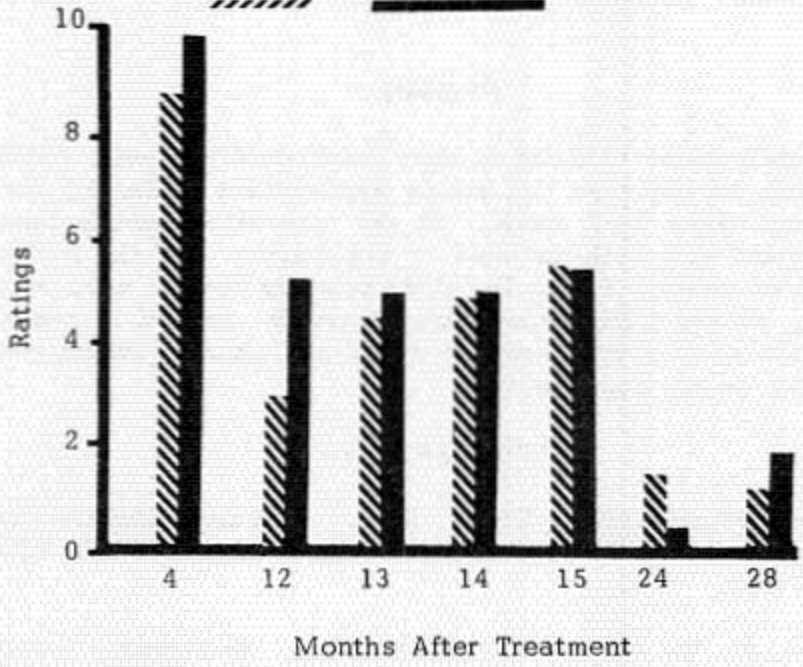
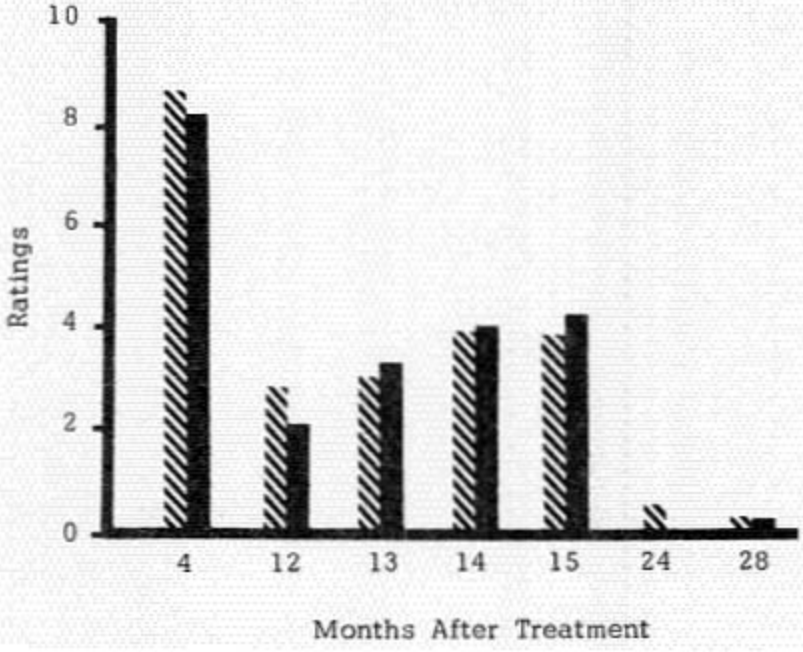


Fig. 6 Vigor Ratings on Phragmites treated with 18 lb and 9 + 9 lb Dalapon/A



reduction in height. During the third growing season, (24 and 28 months), there was almost no effect on the vigor of those plants occurring in the plots.

Summary

Split applications of dalapon gave consistently greater reduction of phragmites stand density than did single applications, although the differences in most cases were small. At the high rate, control lasted for 3 growing seasons with both methods of application. At the low rate, control decreased sharply during the third growing season with both methods of application. At the intermediate rate, however control lasted for 3 seasons with the split application but decreased sharply during the third summer with the single application.

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PRIMARY PRODUCTIVITY STUDIES OF THREE VERMONT LAKES 1/

James W. Morse and P. Howard Flanders 2/

Introduction

During the past decade many of Vermont's lakes have become plagued with massive algae production during the summer months. Small pond owners were the first to notice the immense amount of algae and its effects, then land owners on small, moderately shallow lakes. Finally lakes of all sizes and depths have experienced algae blooms. The undesirable effects of algae blooms are well understood.

Primary productivity is the production of organic matter from inorganic matter by plants utilizing solar energy. A critical nutrient is one where concentration varies inversely with primary productivity. If this nutrient approaches complete depletion during the growing season it can be considered a critical element. This critical element would be the object of nutrient control and application of Liebzig's Law of the Minimum in an attempt to decrease primary productivity. Numerous studies have shown that phosphorus is definitely a major mineral nutrient required by all algae, and in instances, may indeed be termed a critical nutrient.

During the summer of 1969 the present study was initiated to follow the development of algae and attempt to relate this development to phosphorus concentrations in three lakes in Vermont. The development of algae was measured in terms of determining about how many cells were present at times throughout the summer, and at what rate the cells were developing.

The main objective of the study was to determine the phosphorus-primary productivity relationship of Lake Memphremagog in northern Vermont and Canada. Because the lake is so large and the basin varies so much two smaller bodies of water of different stages of eutrophication were studied simultaneously. Shelburne Pond, which is highly eutrophic, and Lake Iroquois, which is moderately eutrophic, were the two lakes chosen for comparison. Both of these are located in northern Vermont.

Shelburne Pond is a 457 acre body of water draining 70 square miles of rural area. The pond contains 241 million cubic feet of water and has a mean depth of 13 feet. There are less than five camps located directly on the lake shore.

1/ Being published as Water Quality Surveillance Report No. II by the Department of Water Resources, Montpelier, Vermont.

2/ Aquatic Biologist and Sanitary Engineer, respectively. Department of Water Resources, Montpelier, Vermont.

Lake Iroquois has a surface area of 243 acres and a drainage area of 30 square miles. The mean depth of the lake basin is 19 feet and it contains 202 million cubic feet. Located along its shores are 75-100 camps.

Lake Memphremagog, an international body of water, has a surface area of 3,369 acres and contains 60,000 million cubic feet. The whole basin can be divided into three parts consisting of the Southern, Central, and Northern basins. The mean depths of the basins are: Southern, 27 feet; Central, 154 feet; and Northern, 41 feet.

There was one station located in Shelburne Pond and Lake Iroquois and three in Lake Memphremagog, two in the Southern basin and one in the Northern basin.

Shelburne Pond is not stratified and has no dissolved oxygen at the bottom. Lake Iroquois is stratified and also has no dissolved oxygen at the bottom. The Southern basin of Memphremagog is not stratified while the Central and Northern basins are. None of the three basins are void of dissolved oxygen at the bottom.

Materials and Methods

Dissolved Oxygen

Dissolved oxygen was analyzed according to Standard Methods for the Examination of Water and Wastewater, twelfth edition, using the azide modification of the Winkler Method.

Chlorophyll

Chlorophyll A and B were analyzed according to the method outlined in A Practical Handbook of Seawater Analysis (Strickland and Parsens, 1968) and in Analytical Techniques for the National Eutrophication Research Program (Federal Water Pollution Control Administration, February 1969). The volume of samples filtered varied from 100 ml to 500 ml depending on the plankton concentration. Chlorophyll concentrations were measured at the water surface, 0.5, 1.0, 1.5, 2.0, 3.0, 4.0, and 5.0 meters in agreement with the depth at which photosynthetic rate measurements were made.

Photosynthetic Rate Measurements

Photosynthetic rate measurements were made utilizing the in situ light and dark bottle method as described in Ryther, 1956. The depths chosen for study were surface, 0.5, 1.0, 1.5, 2.0, 3.0, 4.0, and 5.0 meters. At each depth three B.O.D. bottles were filled with water. One bottle was immediately fixed and readied for determination of dissolved oxygen. The second and third B.O.D. bottles, one clear and one wrapped with black tape and top covered with an aluminum foil cap, were filled with sample water, capped, suspended on a chain, and lowered to the depth from which they came. The chain of bottles was allowed to remain suspended for six hours, from as close to 1200 E.D.S.T. to 1800 E.D.S.T. as possible. At the end of six hours

dissolved oxygen in the two bottles, light and dark, was measured and the photosynthetic rate determined.

Phosphorus

Total and orthophosphorus were analyzed utilizing the Bausch and Lomb Spectronic 20 and the StannaVer Method using solutions as given in Hach Procedures for Water and Sewage Analysis using B. & L. Spectronic 20 Colorimeter, Hach Chemical Company.

Results and Discussions

Throughout the summer of 1969 studies were made to determine if phosphorus is a critical nutrient in Lake Iroquois, Shelburne Pond and Lake Memphremagog. Samples were taken in these lakes from May 1969 through October 1969.

Chlorophyll A concentrations were made to determine the amount of algae present and the results are recorded for the three lakes in Table I. In all three lakes the algae concentrations are high in early summer, then decrease during the mid-summer and rise again in late summer.

The rate of algal growth was measured indirectly by measuring the oxygen changes in a quantity of water containing plankton over a six hour period. These oxygen changes are directly related to the carbon assimilation of the plankton which corresponds to the rate of planktonic growth. Each lake demonstrates marked rises and falls of carbon assimilation.

It appears that the more eutrophic a body of water is the closer the correlation between the carbon assimilation and the chlorophyll A fluctuations. Further, the more eutrophic the body of water the greater is the carbon assimilation value. Table III presents the carbon assimilation value for the three lakes studied. From Table I and Table III it is seen that the carbon assimilation values are largest in Shelburne Pond and that the fluctuations are closely aligned with the chlorophyll A fluctuations. The same patterns are seen in Lake Iroquois and Station 6 on Lake Memphremagog. Station 6 in Lake Memphremagog is located on a more eutrophic part of the lake than Stations 7 and 19, and Station 19 might well be considered to be in a relatively oligotrophic section of the lake. At Station 7 and 19 on Lake Memphremagog the algae concentrations remain relatively low throughout the season and the correlation between the algae concentration and the rate of algal growth are not as evident as they are in the more eutrophic bodies of water.

Total phosphorus and orthophosphorus concentrations vary throughout the summer of 1969 in all three lakes. Algae concentrations should vary directly with total phosphorus and inversely with orthophosphorus concentrations. This is true because algae takes orthophosphorus from the water and incorporates it in their system as total phosphorus.

The total and orthophosphorus concentrations are shown in Table II. The phosphorus values in Table II may be compared with the chlorophyll A concentrations in Table I. The orthophosphorus concentration varies inversely with the chlorophyll A concentrations in Lake Iroquois, Shelburne Pond and Station 6 and 7 on Lake Memphremagog. The total phosphorus concentrations vary directly, in general, at the same stations. Station 19 on Lake Memphremagog does not demonstrate these correlations and it is evident that there is not a sufficient algal population at this station to establish the relationships of orthophosphorus uptake.

If orthophosphorus is to be considered a critical nutrient, then there is a concentration at which it could not support a substantial population and the existing population would decrease. It may be seen from Tables I and II that at an orthophosphorus concentration of 0.006 mg/l (measured as phosphorus), the algal populations do decrease at all lakes and all stations except Station 19 on Lake Memphremagog. This indeed indicates that orthophosphorus may be considered to be a critical nutrient and that the apparent critical concentration as 0.006 mg/l measured as phosphorus.

Conclusions

Algae concentrations, rates of algae growth, and ortho and total phosphorus values were determined on Lake Iroquois, Shelburne Pond and Lake Memphremagog during the summer of 1969. It is shown that, in general, algae concentrations are directly related to the rate of algae growth, that total phosphorus is directly related to algae concentrations, and that orthophosphorus concentrations are inversely related to algae concentrations. These relationships are more evident in eutrophic rather than oligotrophic bodies of water. Orthophosphorus in the bodies of water studied is a critical nutrient and its apparent critical value is 0.006 mg/l measured as phosphorus.

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TABLE I

MICROGRAMS CHLOROPHYLL A PER LITER

	May 1-June 5	June 6-30	July 1-31	August 1-31	Sept. 1-30	Oct. 1-31
Shelburne Pond	22	14	NA	45	NA	20
Lake Iroquois	22	12	NA	28	NA	18
Lake Memphremagog Southern Basin Sta. #6	3	28	12	12	20	NA
Lake Memphremagog Southern Basin Sta. #7	13	22	5	8	17	8
Lake Memphremagog Northern Basin Sta. #19	3	22	2	11	15	3

NA - Not Available

TABLE II

PHOSPHORUS CONCENTRATIONS - P mg/l

	May 1 - June 5	June 6-30	July 1-31	August 1-31	Sept. 1-30	Oct. 1-31
Shelburne Pond	.020 (.036)	.039 (.051)	NA (NA)	.006 (.150)	NA (NA)	.013 (.056)
Lake Iroquois	.003 (.005)	.035 (.039)	NA (NA)	.006 (.105)	NA (NA)	.009 (.029)
Lake Memphremagog Southern Basin Sta. #6	.023 (.023)	.013 (.020)	.006 (.019)	.013 (.350)	.006 (.016)	NA NA
Lake Memphremagog Southern Basin Sta. #7	.013 (.013)	.013 (.016)	.020 (.054)	.013 (.540)	.007 (.078)	.016 (.088)
Lake Memphremagog Northern Basin Sta. #19	.003 (.006)	.006 (.006)	.006 (.023)	.020 (.470)	.002 (.013)	.016 (.080)

Legend:

.01 - Ortho Phosphorus - P mg/l
(.02) - Total Phosphorus - P mg/l
NA - Not Available

TABLE III

MICROGRAM CARBON PER LITER PER DAY

	May 1-June 5	June 6-30	July 1-31	August 1-31	Sept. 1-30	Oct. 1-31
Shelburne Pond	450	370	NA	1502	NA	430
Lake Iroquois	350	170	NA	540	NA	240
Lake Memphremagog Southern Basin Sta. #6	145	175	900	620	960	NA
Lake Memphremagog Southern Basin Sta. #7	510	NA	480	625	495	235
Lake Memphremagog Northern Basin Sta. #19	160	260	500	220	105	140

NA - Not Available

UPTAKE AND TRANSLOCATION OF ^{14}C-LABELED ETHYL HYDROGEN PROPYLPHOSPHONATE (NIA 10637)

By E. F. Koldenhoven and A. A. Nethery [1/]

ABSTRACT

The patterns of foliar and root uptake and translocation of radioactively labeled ethyl hydrogen propylphosphonate (NIA 10637) were determined. Localization was determined by assaying the nutrient solution and plant parts for ^{14}C by liquid scintillation counting and by autoradiography. Root uptake of the labeled compound occurred within 1/2 hr after treatment, although very little localization was seen in the shoot portion of the plant in less than 4 hr. Translocation appeared to follow a source-to-sink pattern; however, localization was not restricted to the meristematic tissues. NIA 10637 also was readily absorbed through the leaves and translocated both basipetally and acropetally. Exudation of the compound by soybean roots did not occur to an appreciable extent in the first 48 hr following treatment.

[1/] Biologist and Research Biologist, Research and Development Department, Niagara Chemical Division, FMC Corporation, Middleport, N.Y.

MINERAL DEFICIENCY IN POTAMOGETON AND ITS INFLUENCE ON NAPTALAM UPTAKE AND ACCUMULATION

by

Robert M. Devlin and Robert W. Yaklich [1/]

INTRODUCTION

The management and control of aquatic weeds found in the genera Potamogeton is of major importance to cranberry growers of southeastern Massachusetts. In cranberry reservoirs and drainage and irrigation canals, pond weeds impede the flow of water through flumes or canals to such an extent that expensive regular cleaning is required. Low-gallonage sprinkler systems, now used extensively on cranberry bogs, require clean water for trouble-free operation. Cranberry bogs require occasional floodings, and during the growing season they also require drainage sufficient to carry off promptly all surface-standing water. Passageways for this water must be kept clear for efficient water management, a difficult task if aquatic weeds are abundant.

State laws limit aquatic weed control practices, and the fact that many of the ponds, lakes, and streams are used for the flooding and irrigation of cranberry bogs poses residue hazards if aquatic weed herbicides are employed. Thus, aquatic weed control measures must be used with the greatest circumspection to avoid movement of the pesticide from the irrigation canal to the crop plant, or from the treated reservoir through the sprinklers to the crop plant.

To achieve the most efficient control of aquatic weeds, such as those found in the genera Potamogeton, more information is needed on the chemical and physical factors controlling their growth and development. In this study the effect of nitrogen, phosphorus, and calcium deficiency on the growth of pond weed was observed. In addition, the influence of nitrogen and phosphorus deficiency on N-1-naphthylphthalamic acid (naptalam) uptake and accumulation was studied. Naptalam is the major herbicide present in Morcran, a formulated mixture that also contains isopropyl m-chlorocarbanilate (chloropropham). Morcran is the herbicide used in greatest amount by the southeastern Massachusetts cranberry growers.

MATERIALS AND METHODS

Cuttings of Potamogeton nodosus were grown in 5-gallon battery jars containing either a complete inorganic medium or inorganic media lacking nitrogen, phosphorus, or calcium. The floors of the jars were covered by a layer of pure white sand approximately 4 cm in depth. Before sand was added to the battery jars it was leached with 1.5% HCl and 1.5% NaOH and then washed with

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distilled water. All solutions were aerated for 1 hr before the cuttings were planted and for 2 hr daily thereafter. Temperature ($22 \pm 1^{o}C$), light intensity (800 ft-c) and light duration (continuous) were controlled by growing the plants in growth chambers (Percival E-54U model). In addition, a constant pH of 6.2 ± 0.2 was maintained in all growth media. Algal growth was controlled with periodic additions (at 4-day intervals) of 1 ppm $CuSO_4$ to the growth media. Deficiency symptoms were observed and recorded.

Sago pond plant tubers (Potamogeton pectinatus) were used to study the influence of nitrogen and phosphorus deficiency on naptalam uptake and accumulation. The tubers were allowed to grow under the same conditions described above for P. nodosus. Before planting tubers were weighed and their lengths measured. After 30 days the sago pond plants were removed and immersed in a 50 ppm solution of naptalam. Temperature, light, and pH were controlled as before. After 24 hr exposure to naptalam the plants were removed, washed thoroughly with distilled water, weighed, and their lengths measured. The plant tissues were then cut into small pieces and dried at $45^{o}C$ for 24 hr in preparation for extraction of naptalam. Before being extracted the dried plant tissues were ground into a fine powder by a Wiley mill. Each experiment was replicated four times.

Naptalam content of the plant tissues was determined, with only slight modification, by the method of Smith and Stone (2). Since the method has already been published in detail, only a brief description will be given in this paper. The method relies on the basic hydrolysis of naptalam in boiling 30% sodium hydroxide and the steam distillation of 1-napthylamine. Under the conditions of the study, steam distillation of the amine was complete when 15 ml of distillate had been collected.

In preparation for color development 5 ml of glacial acetic acid and 5 ml of distilled water were added to the 15 ml of distillate. Ten drops of freshly prepared diazonium reagent were then added to the diluted distillate. The diazonium reagent is composed of equal volumes of 1% sulfanilic acid and 0.12% sodium nitrite that have been allowed to react for about 4 min. The amine present in the distillate couples with diazotized sulfanilic acid to give an azo dye. After 30 min the intensity of the red color formed is read at 534 nm with a Beckman DU spectrophotometer. A linear relationship exists between the intensity of color and the amount of naptalam present.

RESULTS AND DISCUSSION

Cuttings of P. nodosus grown in a nutrient medium lacking nitrogen exhibited symptoms of nitrogen deficiency only four days after planting. These appeared as small circular yellow areas on the surface of the older leaves. By the seventh day the loss of chlorophyll was quite extensive. Not only was chlorosis observed in over one half of the leaf area but there was also a distinct loss of color by the stems. Ten days after planting some of the older leaves were completely white and the plants as a whole appeared very unhealthly. By the fifteenth day all plants were dead. Rapid chlorosis progressing

from the older leaves to the younger leaves is the typical response of green plants in general when grown in a medium lacking nitrogen. Chlorosis appears last in the younger leaves because of the high mobility of nitrogen in the plant. The younger leaves retain their nitrogen longer and also obtain nitrogen, when this element is in short supply, from the more mature leaves.

Absence of phosphorus also caused rapid death of P. nodosus cuttings. The most notable deficiency symptoms were the appearance of necrotic areas on the leaves and stems and an easily observed breakdown of the tissues of these structures. The necrotic areas were first observed on the older leaves four days after planting. After ten days in phosphorus deficient medium the leaves and stems were soft and obviously rotting. The plants were either dead at this point or dying. Like nitrogen, phosphorus is highly mobile in the plant. This accounts for the appearance of necrotic areas on the older leaves first. In other words, the younger leaves deplete the older leaves of their supply of phosphorus. The softness of the leaves and stems after 10 days in phosphorus deficient medium is no doubt due to the significance of phosphorus in membrane structure. Phospholipids are important constituents of cell membranes.

Symptoms of calcium deficiency were most spectacular. The first observed deficiency symptom was a rapid chlorosis at the tips of the younger leaves. Chlorosis in every case was followed by death of the affected tissues. Five days after planting small circular black dots could be seen on the surface of the leaf. These areas grew rapidly larger until they overlapped considerably and included practically the entire surface of the leaf. This advanced state of necrosis took twelve days to develop. Black necrotic areas were also quite noticeable on the stem and developed in much the same manner as on the leaves. By the fifteenth day all plants were dead or near death. Calcium deficiency symptoms appearing first in the younger leaves reflects the immobility of this element in the plant. It has been suggested that calcium plays an important role in the formation of cell membranes. For example, the calcium salt of lecithin, a lipid compound, may be involved in the formation or organization of cell membranes (1). The loss of this function may account for the rapid necrosis that occurs in calcium deficient plants.

The green color of sago pond plant tubers allowed to sprout and grow for 35 days in a nitrogen deficient medium was only slightly paler than the control. Also, the average length per plant was about 10 cm less than the control (Table 1). However, on a per plant basis, the dry weight of the nitrogen deficient plants was slightly higher (Table 1). The average length and dry weight of sago pond plants after growing for 35 days in phosphorus deficient medium were similar to the control (Table 1).

Table 1. The average lengths and dry weights of sago pond plant tubers 30 days after planting in complete inorganic medium (control) and in media lacking nitrogen or phosphorus. The uptake of naptalam on a per gram dry weight basis by nitrogen and phosphorus deficient sago plants and control plants is also included. Ten tubers per battery jar were planted and each experiment was replicated three times.

Treatment	Length cm	Dry weight, g	Naptalam uptake, ug/g
Control	38.07	0.1019	97.59
Minus N	30.06	0.1162	142.95
Minus P	41.65	0.1077	155.65

Sago pond plants slightly deficient in nitrogen or phosphorus take up and accumulate naptalam much more efficiently than the same plants grown in a complete inorganic medium (Table 1). Nitrogen deficient plants immersed in a 50 ppm solution of naptalam for 24 hr took up on a per gram dry weight basis 142.95 ug of naptalam compared to 97.59 ug for control plants. This represents an increase in naptalam uptake of 46%. Phosphorus deficient sago pond plants reacted in the same manner, taking up on a per gram dry weight basis 59% more naptalam than control plants (Table 1).

The accelerated uptake of naptalam by sago pond plants slightly deficient in nitrogen and phosphorus may have some practical significance. If we assume that other water weeds and herbicides are so affected then some correlation between the available nutrient supply in weed polluted waters and the amount of herbicide necessary to control certain submersed aquatic weeds could be established. In those cases where the supply of nitrogen or phosphorus is low, it is possible that control could be achieved with less than the normally recommended application of herbicide.

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EFFECTS OF HERBICIDES ON THE GERMINATION OF SOME TURFGRASS SPECIES

F. V. Juska and A. A. Hanson[1/]

Abstract

Four turfgrasses were seeded in greenhouse potting soil after it had been treated with seven herbicides. The grasses were seeded 7 days after treatment and at monthly intervals thereafter over a period of 3 months. N-butyl-N-ethyl-a,a,a-trifluoro-2,6-dinitro-p-toluidine (benefin) was most toxic to all grasses while calcium arsenate 69% active (calcium arsenate) and lead arsenate 96% active (lead arsenate) were the least toxic. Of the grasses planted, Kentucky 31 tall fescue and red fescue were most resistant to injury from the seven herbicides used in this study.

Introduction

Herbicides are used as preemergence treatments on lawns and other turf areas to control weedy annual grasses. Lead arsenate was probably the first herbicide used for preemergence weed control on golf courses. Calcium arsenate has been on the market for some time and many new herbicides have become available in recent years. Growers express concern over the time interval that must elapse after applying a specific herbicide as related to either seeding or reseeding turf areas.

The nature of the problem is evident from results obtained in Rhode Island (3). In one experiment, a mixture of three grasses--Kentucky bluegrass, Colonial bentgrass, and creeping red fescue--was planted on May 9 and 10 and, after mowing three times, treated with 15 and 30 lb bensulide on June 25. Ratings taken 1 week, 2 weeks, and 3 weeks after treatment showed no injury or very minor damage. The turf had recovered completely soon after treatment. In a second study, a seedbed treated with two formulations and two rates of bensulide on May 9 was seeded with the same seed mixture, 2, 4, 6, and 10 weeks after the chemical was applied. Grasses seeded 10 weeks after the chemical application were very sparse in stand by early September. The sparse stand was removed and another planting made 16 weeks after chemical treatment.

Information on the effect of herbicides used on new turfgrass seedings before emergence is available from other studies. In New York, Cornman et al. (1) planted ryegrass, bentgrass, red fescue, and Merion Kentucky bluegrass at 0, 1, 2, and 6 weeks after treating the seedbed with Bandane, bensulide, and terbutol. All seedings were rated 7 weeks after the area was treated. Some injury to red fescue and Merion Kentucky bluegrass was observed on Bandane plots seeded 1, 2, and 6 weeks after application. Bensulide and terbutol caused least severe injury to ryegrass but the most severe injury to Merion Kentucky bluegrass and red fescue. Terbutol inhibited germination of bentgrass.

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In greenhouse studies in Maryland, Juska (2) found that chlordane affected the germination of Merion Kentucky bluegrass and bentgrass for 3 or 4 months but had little effect on the germination of other turf species used. DMPA and DCPA remained toxic to germinating seedlings for 3 to 4 months. A possible difference between greenhouse and field results is evident in Juska's observation that calcium arsenate gave better control of annual bluegrass in the field than in the greenhouse.

There is a continuing need for comparative information on the relative effect of herbicides on the germination of turfgrasses. Results obtained from a greenhouse screening experiment that included seven herbicides for use before emergence and four turfgrasses are reported.

Materials and Methods

The greenhouse experiment included all combinations of two rates each of seven herbicides, recommended rate and twice the recommended rate, and three planting dates of four grasses. There were three replications. Flats, 2 ft square in area, were filled with greenhouse potting soil. The potting soil had a pH of 6.4 and tested very high in Mg, P_2O_5, and K_2O. The flats were treated at two rates with N-butyl-N-ethyl-a,a,a-trifluoro-2,6-dinitro-p-toluidine (benefin), O,O-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl) benzenesulfonamide (bensulide), dimethyl tetrachloroterephthalate (DCPA), calcium arsenate 69% active (calcium arsenate), lead arsenate 96% active (lead arsenate), 2,6-di-tert-butyl-p-tolyl methylcarbamate (terbutol), and polychlorodicyclopentadiene isomers (Bandane*). Lead and calcium arsenate were mixed with sand and applied to the soil with a quart jar that had a screen lid. The remainder of the herbicides were applied as a spray by placing flats on an endless belt set to move at 2 miles per hour. Herbicides were applied December 2, 1969, and the first planting of the grasses was made December 9, 1969. The grasses were: Merion Kentucky bluegrass, *Poa pratensis* L.; red fescue, *Festuca rubra* L.; Kentucky 31 tall fescue, *Festuca arundinacea* Schreb.; and annual bluegrass, *Poa annua* L.

The grasses were planted in groups of four, within the same flat, on December 9, 1969; January 20, 1970; and February 25, 1970. One-hundred seeds were planted in each row. Seedling emergence or survival was recorded on January 6, 1970; February 9, 1970; and March 26, 1970.

Results and Discussion

Average seedling emergence in soil treated with herbicides for preemergence weed control is shown in Table 1. Examination of these data suggests that benefin was the most toxic herbicide used in this study. None of the annual bluegrass germinated at the two application rates and three planting dates. Practically the same results were obtained from Merion Kentucky bluegrass. A few red and tall fescue seed germinated at the first planting, but fair germination was

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* Bandane is the trademark name for a formulation of polychlorodicyclopentadiene isomers sold by the Velsicol Chemical Corporation, Chicago, Illinois. Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture, and it does not imply approval to the exclusion of other products that may also be suitable.

obtained at the second and third plantings in flats treated at the recommended rate of 2 lb/A. At twice the recommended rate, germination was lacking or negligible for all grasses.

Bensulide at the recommended rate reduced the germination of Merion and annual bluegrass to a low level at all planting dates. However, the germination of tall fescue and red fescue was almost normal in the second and third planting. At the double rate of bensulide, the germination of tall fescue and red fescue was fair but somewhat lower than that obtained with the recommended rate.

DCPA treatments suppressed the germination of Merion and annual bluegrass at both application rates and all planting dates. Red fescue germination was somewhat affected while damage to tall fescue was moderate at both application rates.

Calcium- and lead arsenate-treated soils had little effect on the germination of the four grasses tested. These results differ from those obtained by Juska (2) under field conditions. In the field, calcium arsenate at 520 lb/A severely inhibited the germination of Merion Kentucky bluegrass, red fescue, bentgrass, and tall fescue, and stopped germination of annual bluegrass. Lead arsenate applied at 1090 lb/A inhibited the germination of these grasses somewhat except for annual bluegrass; however, in a planting made a month later, germination of annual bluegrass was inhibited severely. Water and temperature stress to which seedlings were subjected under field conditions could account for the difference between greenhouse and field results with these two chemicals. The very high level of P_2O_5 in the greenhouse potting soil, in addition to the absence of water and temperature stress, could contribute to the excellent germination of annual bluegrass in both calcium and lead arsenate treatments.

Terbutol substantially reduced the germination of both Merion Kentucky bluegrass and annual bluegrass at both rates of application. Fair germination was obtained for tall and red fescue at the recommended rate, and on the second and third planting dates in flats treated at twice the recommended rate.

At the first planting, the recommended rate of Bandane decreased germination of Merion Kentucky bluegrass to 4.8% and lowered the germination of the other three grasses. Germination increased with the second planting, and was normal in the third planting. At twice the recommended rate the germination of all grasses was lower, especially for the first and second planting dates.

There appeared to be some differential responses of grass species to herbicides. Therefore, general conclusions need verification. When all rates and dates are considered, it appears that of the four grasses used in this study, tall fescue generally resisted the effects of herbicide treatments better than the others, followed by red fescue. Grass species responded similarly to lead arsenate and calcium arsenate. Merion Kentucky bluegrass and annual bluegrass tended to be more sensitive to the herbicides tested. It is anticipated that emergence of these four grasses would be lower in the field than in the greenhouse because the deleterious effects of the herbicides could be increased by severe water and temperature stress. Similarly, seedling losses could increase with time both in the greenhouse and in the field. It is reasonable to expect, however, that acceptable germination levels obtained in this study could be achieved under field conditions by timing seeding operations with proper intervals between treatment and seeding and by providing supplementary irrigation.

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TABLE 1. AVERAGE GRASS SEEDLING EMERGENCE IN SOIL TREATED WITH HERBICIDES (shown as percentage of untreated control)

Herbicides and Grasses	Rates lb/acre	Planting Dates Dec 9	Jan 20	Feb 25	Rates lb/acre	Planting Dates Dec 9	Jan 20	Feb 25
Benefin	2				4			
Merion		0.0	0.0	1.1		0.0	0.0	1.1
Red fescue		1.9	14.3	32.2		0.0	2.0	4.0
Ky. 31		1.9	35.8	43.8		0.0	4.4	6.0
Poa annua		0.0	0.0	0.0		0.0	0.0	0.0
Bensulide	15				30			
Merion		3.8	15.2	1.1		0.0	0.0	0.0
Red fescue		25.6	75.2	56.0		6.2	35.5	50.1
Ky. 31		31.0	91.8	90.4		18.6	58.0	37.3
Poa annua		11.6	31.0	9.6		0.0	0.0	0.0
DCPA	10				20			
Merion		0.0	0.6	0.7		1.0	0.6	0.0
Red fescue		27.1	19.9	32.7		46.5	32.8	6.5
Ky. 31		67.5	78.2	76.4		67.9	67.1	67.7
Poa annua		4.7	0.0	4.7		7.6	0.0	0.0
Calcium arsenate	443				886			
Merion		69.1	100.0	44.2		85.1	100.0	91.1
Red fescue		81.9	84.4	61.6		78.5	89.4	57.4
Ky. 31		96.9	100.0	94.7		85.9	96.0	89.0
Poa annua		100.0	100.0	64.4		62.2	100.0	85.0
Lead arsenate	443				886			
Merion		74.5	100.0	100.0		56.7	100.0	100.0
Red fescue		81.6	83.0	100.0		96.6	90.1	77.9
Ky. 31		100.0	100.0	94.4		99.0	100.0	99.0
Poa annua		58.1	88.8	100.0		84.3	95.3	74.4
Terbutol	10				20			
Merion		4.8	15.5	5.6		0.0	0.0	1.8
Red fescue		20.3	50.7	30.6		6.6	40.0	43.3
Ky. 31		22.9	57.8	46.9		6.7	54.1	45.9
Poa annua		4.1	4.6	2.7		0.0	11.2	2.7
Bandane	30				60			
Merion		4.8	25.4	98.9		0.0	2.9	5.5
Red fescue		33.4	70.6	100.0		41.0	28.2	40.1
Ky. 31		37.5	92.9	100.0		41.2	33.5	61.3
Poa annua		11.6	31.6	100.0		4.1	3.3	17.8

EFFECT OF GIBBERELLIC ACID ON THE UPTAKE AND MOBILITY OF NAPTALAM IN BEAN PLANTS

Robert M. Devlin and Robert W. Yaklich [1/]

ABSTRACT

Bean plants (Phaseolus vulgaris L. cv. Black Valentine) pretreated for 24 hr with gibberellic acid (GA) absorb and accumulate considerably more N-1-naphthylphthalamic acid (naptalam) than untreated plants. All concentrations of GA from 2.9×10^{-6} to 8.6×10^{-4}M were effective in this respect, peak influence occurring at 6×10^{-4}M. Plants pretreated with this concentration took up 58% more naptalam than untreated plants. When the different parts of the plants were analyzed for naptalam separately, it was found that the leaf area (on a per g dry weight basis) was influenced most by GA pretreatment. The leaf area of bean plants pretreated with 2.9×10^{-4}M contained 212% more naptalam than the leaf area of untreated plants. The leaf area also included all stem and petiole tissue above and including the first true leaves. In contrast, the root systems of plants treated with the lower concentrations of GA used in this study (2.9×10^{-7} to 2.9×10^{-5}M) accumulated naptalam at a rate comparable to that of control plants. However, as the concentration of GA for pretreatment was raised above 2.9×10^{-5}M there was a noticeable increase in the amount of naptalam accumulated by the root system. Roots from plants treated with 8.6×10^{-4}M GA accumulated almost twice as much naptalam as control plants. The accumulation of naptalam by the hypocotyl and lower epicotyl (area of the stem between the cotyledonary node and the first true leaves) was not affected by GA.

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PHRAGMITES CONTROL FOR URBAN, INDUSTRIAL, AND WILDLIFE NEEDS

(Abstract)

Robert A. Beck[1/]

The common reed or phragmites (Phragmites communis Trin.) is a robust, tall perennial grass of worldwide distribution. It is a plant with mixed values. In southern Iraq, at the confluence of the Tigris and Euphrates Rivers, dense stands of this giant grass contributed to shaping and establishing a culture of marsh living that has lasted for centuries. There, phragmites reaches heights of 20 feet and is used for construction of dwellings and other buildings, forage for cattle, and making mats for export. In Europe, phragmites is harvested for making crude paper, insulation, and mats. When this giant grass is interspersed with open water or other vegetation rather than in solid stands, it provides useful habitat for waterfowl and other wildlife. Its aggressive ability to grow a "rip-rap" of perennial rootstocks protects roads, dikes, fills, and marsh edges from erosion.

Unfortunately the aggressive growth of phragmites, coupled with its ability to take over and dominate a marsh, creates problems. These problems are aggravated by multiple overlapping use of coastal areas, resulting in disturbed environments that pave the way for an explosive spread of phragmites. After phragmites becomes established, it resists encroachment of other vegetation and invades marginal terrestrial areas. Dead stalks of this grass are a serious fire hazard. This fire hazard is a major problem on industrial sites, canal banks, and right-of-ways for power and telephone lines. Stands of phragmites adjoining airfields are a serious hazard to jet airplanes because they are used as roosts by huge flocks of starlings and blackbirds.

Ecological studies reveal that phragmites is a very versatile plant. It can grow in terrestrial and flooded sites over 5 feet in depth. It will grow in soils of high or low fertility and in fresh or saline waters. However, growth is dwarfed in areas with low nutrients or high salt content. Phenological observations reveal slight variations in different geographical areas and perhaps by strain of plant. In Delaware, initial growth from rootstocks starts in April or May, depending on temperature. This is followed by a period of rapid growth from May into the first week of June. A standstill period occurs from the second week of June into the first week of August. Tasseling starts in the first part of August, followed by flowering and early fruiting from the last week of August into the first week of September. Seeds continue to ripen in September. Extensive

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growth of runners or rhizomes starts in late May and continues into September. These runners grow above ground on hard soils and underground in light peaty soils. Runners grow as much as 30 feet during one season in nonflooded sites and 20 feet in flooded sites. If water is held at a depth of 1 foot, floating runners eventually lodge along the edge of the phragmites growth and die. With less water, these runners establish new growth and extend the zone of invasion. Seeds are often considered sterile, but in Maryland, Delaware, and New Jersey seeds have been observed germinating on wet mudflats. These seedlings are frail and are readily killed by flooding. However, after rootstock growth has started they can withstand flooding.

Studies on control of phragmites show that there are three sites to consider: (1) dry, (2) dry-wet (dry on top, wet below), and (3) flooded or tidal. In dry sites, amitrole-T is effective at rates of 12 lb. a.i./A; dalapon at 30 lb. a.e./A; and a combination of amitrole-T + dalapon at 2 lb. a.i. + 10 lb. a.e./A. The period for treatment of dry sites is during rapid growth when phragmites are about 2½ feet high or early furiting. Erbon also is effective in dry sites at rates of 15-20 lb. a.i./A, if applied at least 3 months before frost. In dry-wet sites, amitrole-T is effective at rates of 15 lb. a.i./A; dalapon at 30-40 lb. a.e./A; and amitrole-T + dalapon at 4 lb. a.i. + 20 lb. a.e./A. The period for treatment in dry-wet sites is during standstill to early fruiting. Erbon can also be used in these sites. In flooded or tidal sites, amitrole-T provides control at rates of 15-20 lb. a.i./A and amitrole-T + dalapon at 4 lb. a.i. + 20 lb. a.e./A. Dalapon alone and erbon are not effective. The period for treatment in flooded or tidal sites is during flowering and early fruiting. These treatments have been successfully applied with aerial and ground spray equipment. Ground spray equipment requires higher gallonage of water carrier. This makes it necessary to add wetting agent, such as household detergent to cause spray to form a film on the leaf blade.

The creation of edge and intersperion of vegetation is a major means of improving habitat for wildlife. These procedures applied to solid stands of phragmites also prevent damage from fires. For example, along the Chesapeake and Delaware Canal a large stand of phragmites was divided into blocks by treating strips. The resulting blocks were 100 feet on a side and the treated strips were 60 feet wide. This management area became a major attraction for hunters of mourning doves, rabbits, pheasants, and deer. The strips also serve as fire lanes that prevented damage to installations along the canal.

EVALUATION OF CHEMICALS FOR CRABGRASS CONTROL IN TURFGRASS - 1970 1/

B. C. Troutman and J. A. Jagschitz 2/

Preemergence and postemergence herbicides are used to control crabgrass (Digitaria ischaemum (Schreb.) Muhl.) in turfgrass areas. In an attempt to find less phytotoxic and more effective herbicides for crabgrass control, two studies were initiated at the Rhode Island Agricultural Experiment Station in 1970.

Seven commercial standards and ten experimental chemicals for preemergent control were evaluated in the first study. Three of the experimental chemicals selected had shown promise in 1969 tests (1, 2,). The effectiveness of several chemicals for postemergent control with emphasis on phytotoxic effects to Exeter Colonial bentgrass (Agrostis tenuis Sibth.) Merion Kentucky bluegrass (Poa pratensis L.) and Pennlawn Red fescue (Festuca rubra L.) were evaluated in the second study.

Materials and Methods

The preemergence evaluation test (No. 1) was conducted on turf established in the fall of 1966. It contained Red fescue and Kentucky bluegrass maintained at 1½ inch height with weekly mowing. The area was overseeded with crabgrass in February, 1970. A 10-6-4 grade fertilizer was applied on May 25, and July 21, at 5 and 10 lb per 1,000 sq ft respectively. Water was applied during the test period to enhance crabgrass germination and avert drought.

The herbicides, formulations, and pounds of active ingredient per acre used are shown in Table 1. These were applied on April 30, 1970, with the exception of two RP-17623 treatments which were made April 8 and three chemicals, alachlor, S-15544, and S-14786, which were applied on May 4. The chemicals were applied to plots measuring 4 x 5 ft in three randomized complete blocks. There were nine untreated plots in each block. Granular materials were applied by hand, and sprays were applied at 272 gpa with a pressure sprayer adjusted to 30 psi.

Visual estimates of turfgrass injury were made monthly from the time of the first treatment until September 10. The scale used was 0 to 10 with 0 indicating no injury relative to check plots and 10 brown or dead turf. Crabgrass emergence started about June 16 and reached 98% by July 13. Estimates of crabgrass cover in each plot were made September 10 and percent control was obtained by comparing treated to untreated plots.

The turfgrasses used in Test No. 2, postemergence evaluation, were established in the fall of 1964, and maintained at 3/4 inch height. Chemicals

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were applied to plots measuring 4 x 4 ft in three randomized complete blocks on each of the following turfgrasses: 1) Merion Kentucky bluegrass, 2) Pennlawn Red fescue, and 3) Exeter Colonial bentgrass. Crabgrass was present in natural stands at the beginning of the test.

The chemicals, formulations, and pounds of active ingredient per acre used are listed in Table 2. These were applied as sprays at a rate of 215 gpa from a pressure sprayer adjusted to 30 psi. Two applications were made at the rates listed in Table 2, the first on July 22 and the second on July 30. The DSMA + siduron treatment received siduron only at the first application.

Visual estimates of turfgrass injury were made weekly using the scale described in Test No. 1. Estimates of crabgrass cover were made at the time of the first application and on September 10. Percent control was based on the reduction in crabgrass with consideration given to population changes in the untreated plots.

Results and Discussion

Test No. 1 -- Preemergent evaluation

The results of chemicals for preemergent control of crabgrass are presented in Table 1. Of the seven standard materials, benefin produced good control (81%) and bandane, bensulide, DCPA, nitralin, siduron, and terbutol produced excellent control (89-100%). None of these chemicals produced more than slight turf injury (less than 2.0) indicating good turf tolerance.

Of the ten newer chemicals under investigation, eight failed to provide better than 53% control at the rates used. These were M-3251, NC-8438, NIA-20439, alachlor, BAS-2903-H, M-3447, S-15544, and S-14786. The latter five materials produced only slight turf injury and should be tested further at higher dosage rates in an attempt to improve crabgrass control. The other three materials, M-3251, NC-8438, and NIA-20439, produced moderate (2.0 to 3.9) to severe (greater than 4.0) injury to the turf and success by increasing dosage rates appears limited.

The two remaining experimentals, NC-5651 and RP-17623, provided excellent control with only slight injury to the turf. These materials show considerable promise as potential chemicals for selective crabgrass control in turfgrass.

Test No. 2 -- Postemergence effectiveness

The data in Table 2 shows that the two new materials, M-3447 and NC-8438, provided excellent crabgrass control as did MAMA, DSMA and the combination of DSMA + siduron. Turf injury however, varied considerably depending on the chemical used and the grass species treated.

All chemicals produced moderate injury to bluegrass and fescue with the exception of DSMA and DSMA + siduron which caused only slight injury to bluegrass. Readings made in September (seven weeks after treatment) indicate

TABLE 1. Crabgrass control and turfgrass injury from preemergent treatments applied to bluegrass-fescue turfgrass in the spring of 1970.

Herbicide and formulation	% ai	Rate lb ai/A	Maximum turfgrass injury *	Percent crabgrasss control Sept.
bandane (verm)	10	35	.2	97
benefin (gran)	2.5	2	1.1	81
bensulide (clay)	12.5	10	.2	99
DCPA (gran)	5	10	1.6	99
siduron (cob)	4.57	12	.3	94
terbutol (verm)	5	10	.0	99
alachlor (clay)	10	2	.0	11
" "	"	4	.0	16
BAS-2903-H (EC)	4 lb/gal	4	.7	0
" "	"	8	.7	14
BAS-2903-H (clay)	20	4	.0	5
" "	"	8	.2	3
M-3251 (gran)	5	6	.2	10
" "	"	12	1.5	3
" "	"	18	2.2	11
M-3447 (EC)	8 lb/gal	12	1.5	14
NC-5651 (WP)	20	8	.5	97
" "	"	10	.6	98
" "	"	16	1.1	100
NC-8438 (WP)	18.5	2	.9	29
" "	"	4	1.8	53
" "	"	8	3.9	50
NIA-20439 (WP)	50	4	3.2	11
" "	"	8	5.2	14
RP-17623 (gran) April 8	5	4	.1	89
" " "	"	8	1.2	97
RP-17623 (gran)	"	4	.7	97
" "	"	8	1.6	99
S-15544 (EC)	2 lb/gal	3	.4	14
" "	"	6	.2	23
S-14786 (WP)	50	2.5	.2	8
" "	"	5	.2	48
nitralin (clay)	2	2	1.1	94

Untreated plots averaged 60% crabgrass cover

* Turf injury scale 0-10 (0= same as in check plots, 10= complete brown or kill) from April to September.

that none of the bluegrass or fescue plots were more than slightly injured by any chemical.

Injury to bentgrass was severe from MAMA, M-3447, and NC-8438, and moderate from the DSMA or DSMA + siduron treatments. Turf recovery was good by September except in plots treated with M-3447 and NC-8438. Injury from NC-8438 was moderate while that from M-3447 was severe and showed little evidence of recovery.

TABLE 2. Percent crabgrass control and injury to three grass species from postemergent treatments applied July 22 and 30, 1970.

Herbicide and formulation	Rate per Treatment lb ai/A	Percent crabgrass control Sept.	Turfgrass Injury* Bluegrass Max.	Bluegrass Sept.	Bentgrass Max.	Bentgrass Sept.	Fescue Max.	Fescue Sept.
DSMA (WSP)	4	93	.8	.1	2.0	.0	3.7	.7
DSMA (WSP) + siduron (WP)	4 + 10 **	98	1.5	.0	2.2	.1	3.7	.8
MAMA (liq.)	3.9	94	2.3	.5	4.2	.1	3.3	.4
M-3447 (EC)	12	96	2.2	.9	7.5	7.3	3.5	.9
NC-8438 (WP)	2	93	3.5	.3	5.1	3.4	3.3	1.1

* Scale 0-10 (0= same as untreated plots, 10=complete kill or brown) from July to September

** Siduron was applied only with the first treatment

Conclusions

Two experiments were conducted in lawn-type turfgrass to evaluate new and standard chemicals for pre and postemergent control of crabgrass. Special emphasis was placed on the phytotoxic effect of the postemergent treatments on bluegrass, fescue and bentgrass. The following conclusions are drawn based on the results of these studies:

1. Excellent crabgrass control with only slight turfgrass injury was obtained from the standard preemergent herbicides bandane, bensulide, DCPA, nitralin, siduron, and terbutol as well as from two experimentals NC-5651 and RP-17623. The standard material, benefin, provided good control with slight turf injury.

2. The experimental chemicals alachlor, BAS-2903-H, M-3447, S-14786, S-15544, M-3251, NC-8438, and NIA-20439, showed very poor crabgrass control and severity of injury to the turfgrass will eliminate the last three from evaluation at higher rates.

3. DSMA, DSMA + siduron, MAMA, M-3447, and NC-8438 produced excellent postemergent control of crabgrass. Moderate injury to the bluegrass and fescue turf occurred in all treatments except DSMA, and DSMA + siduron. These produced only slight injury to bluegrass. Injury to bentgrass was severe from MAMA, M-3447, and NC-8438 and moderate from DSMA, and DSMA + siduron. Generally, injury to fescue, bluegrass, and bentgrass injury was slight by the seventh week. Exceptions were bentgrass plots treated with M-3447, where injury was severe, and bentgrass plots treated with NC-8438, where injury was moderate.

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Appendix

A list of the chemicals used and the company supplying them.

Herbicide	Company	Herbicide	Company
MAMA	Chevron	terbutol	Hercules
bandane	Velsicol	alachlor	Monsanto
benefin	Elanco	BAS-2903-H	BASF
bensulide	Stauffer	M-3251, M-3447	Dow
DSMA	Cleary	NIA-20439	Niagara
DCPA	Diamond Shamrock	NC-5651, NC-8438	Fisons
nitralin	Shell	RP-17623	Rhodia
siduron	Du Pont	S-14786, S-15544	Gulf

THE INFLUENCE OF GIBBERELLIC ACID ON THREE SELECTIONS OF JOHNSONGRASS

G. W. Burt[1/]

Three selections of johnsongrass (Sorghum halepense (L.) Pers.) grown in the greenhouse in 15 cm diameter pots were sprayed with a total of 30, 0.30, and .0030 mg gibberellic acid (GA) in two equal applications at 3 and 9 weeks after planting rhizome pieces. Plants were harvested 13 weeks after planting and the weight of roots, rhizomes, and stems were recorded. The presence or absence of flowering and the height of all plants was also recorded at 13 weeks. Plants were collected near Hagerstown, Maryland, a northern, cool region (N); Princess Anne, Maryland, a warm, intermediate region (NS); and Stoneville, Mississippi, a warmer, southern region (S).

At 30 mg of GA the weight of the roots, rhizomes, and stems of all selections were approximately ½ of the control. The 0.30 mg GA treatment increased rhizome weight in the N selection but did not affect the rhizome weight in the S and NS selections. Root weight was decreased by the 0.30 mg GA treatment in both the N and NS selections but not in the S selection.

The plant height of the S and NS selections increased with increasing GA concentration. Under the 30 mg GA treatment, however, the N selection had a drastic reduction of height. All concentrations of GA prevented flowering in the S selection. In the N and NS selections only the highest concentration of GA prevented flowering.

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EVALUATION OF EXPERIMENTAL AND COMMERCIAL PREEMERGENCE CRABGRASS CHEMICALS FOR TURF

J. M. Duich and D. V. Waddington[1/]

ABSTRACT. Creeping red fescue was more susceptible to injury than Kentucky bluegrass when treated with four commercial and seven experimental preemergence crabgrass control chemicals. NC-5651 was the outstanding experimental chemical based on crabgrass control and turfgrass tolerance. All other chemicals varied in degree of control or injury to turfgrasses.

INTRODUCTION

High levels of control and turfgrass tolerance are the major criteria in evaluating preemergence crabgrass chemicals. Since control level generally exceeds turfgrass tolerance to date, the development of safer chemicals continues as a need for the management of cool-season turfgrasses. The objectives of this study were to evaluate the performance of seven experimental and four commercial chemicals for preemergence control on two turfgrass species.

MATERIALS AND METHODS

This research project was conducted at the Joseph Valentine Turfgrass Research Center, Pennsylvania State University. The soil type was Hagerstown silt loam and the two adjacent turf areas consisted of 7-year-old stands of a 'Delta' and 'Newport' Kentucky bluegrass (*Poa pratensis* L.) mixture, and 'Pennlawn' creeping red fescue (*Festuca rubra* L.). Turf was maintained at a 1.25-inch height of cut, and received supplemental irrigation to avoid any prolonged drying. Crabgrass species consisted of *Digitaria ischaemum* and *D. sanguinalis*. Mixed seed lots were seeded in previous years with subsequent natural reseeding providing the present stand.

Plots were 3 x 20 ft with two replications on each turf species. Single date treatments were applied on May 7, 1970. Sprays were applied with a two-nozzle boom at 35 psi and 45 gpa, and dry formulations with a 3-foot drop spreader. Immediately following application, approximately 0.28-in of water was applied by traveling sprinklers.

Initial germination was observed May 14-17, and additional emergence was noted on June 14-16, June 27-July 12, and July 25-29. The major germination period was June 27-July 12. Since moisture was not limiting, temperature is

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believed to be the key factor controlling germination over the 11-week period. Each treatment plot had an adjacent 3 x 20 ft control plot for comparative purposes. On August 7 control plot crabgrass populations ranged from 11 to 62 plants per square foot, with 50 readings averaging 27 plants. Crabgrass control, turf discoloration, and thinning were estimated by two or three individuals throughout the season.

The four commercial chemicals applied at label rates were DCPA, siduron, benefin and bensulide. Experimentals were 2-tertiobutyl-4-(2,4-dichloro-5-isopropyloxyphenyl)-5-oxo-1,3,4-oxadiazoline(RP-17623), NC-5651 (unrevealed), 2-ethoxy-2,2-dihydro-3,3-dimethyl-5-benzofuranyl methanesulphonite (NC-8438), α-(2,2,2-trichloroethyl) styrene (M-3251 and M-3447), S-14786 (unrevealed), S-15544 (unrevealed), and 2-chloro-n-(1-methyl-2-propynyl) acetanilide (2903-H). Chemical treatment rates, crabgrass control, and turfgrass response are shown in table 1.

RESULTS

The commercial standards resulted in control and turf response within ranges reported during the past 10 years. Turf thinning was limited to red fescue from DCPA and bensulide. Bensulide did not control above 90%, whereas DCPA control was near complete.

RP-17623 formulation differences were apparent in both control and injury. The granular control ranged from 62-92% at 2, 3 and 4 lbs, with the highest rate thinning fescue 15%. The emulsion control ranged from 88-100% with fescue discoloration and thinning resulting from all rates. The 4 lb rate also discolored bluegrass temporarily. RP-17623 ec formulation also exhibited good activity on dandelion *Taraxacum officinale*, black medic *Medicago lupulina*, and white clover *Trifolium repens*.

NC-5651 resulted in excellent control with no discoloration or injury to bluegrass or fescue. Complete control was obtained with 12 and 16 lbs, and approximately 60 and 96% control with 4 and 8 lbs, respectively. NC-8438 proved to be injurious to both species at the 8 lb rate which gave 90% crabgrass control. Lower rates were less effective in control with only moderate control, 40-72%, occurring at minimum injury rates.

M-3251 granular and its emulsion counterpart, M-3447, resulted in only 55 to 80% control at the 18 lb high rate with very significant discoloration and injury to turf, especially fescue.

S-14786 was non-injurious to turf, but the highest rate tested, 4 lbs, was limited to 60-70% control. Further testing at rates above 4 lbs appear warranted in view of turf tolerance. S-15544 gave poor control with slight fescue discoloration noted at 3 and 5 lbs. Both 2903-H granular and emulsion were ineffective at the 4, 6 and 8 lb test rates.

As commonly noted, creeping red fescue was found to be more susceptible to chemical discoloration and thinning than Kentucky bluegrass. The latter species also averaged 11% higher chemical control due to inherent density.

All injurious spray treatments were apparent within 7-10 days, whereas dry treatments were often not apparent within one month. No crabgrass species differences were noted for any of the chemical treatments.

CONCLUSIONS

Creeping red fescue was found to be more susceptible to discoloration and injury than Kentucky bluegrass when treated with four commercial and seven experimental preemergence crabgrass chemicals.

Among commercial chemicals, DCPA and benefin injured the fescue slightly, whereas siduron and bensulide showed no turf effect. DCPA resulted in near perfect crabgrass control, followed by siduron, benefin and bensulide; the latter averaging 86% control.

NC-5651 was the outstanding experimental with complete control and no visible turf injury at the 12 and 16 lb rates. RP-17623 emulsion outperformed the granular formulation, but high control levels were offset by fescue injury.

S-14786 appears promising on the basis of no injury to bluegrass and fescue, but control was limited to 60-70% at 4 lbs, the maximum rate tested.

NC-8438, M-3251, M-3447, S-15544 and 2903-H experimentals rated appreciably lower due to poor crabgrass control and/or turfgrass injury.

Table 1. Effect of chemicals on preemergence crabgrass control, and discoloration and injury to Kentucky bluegrass and creeping red fescue turf. Applied May 7, 1970. University Park, Pa.

Treatment	a.i./A	% Crabgrass control-Sept		% Maximum discoloration		% Thinning	
		KBG	CRF	KBG	CRF	KBG	CRF
DCPA 75 w	10	99+	100	0	10	0	10
siduron 50 w	10	97	95	0	0	0	0
benefin 2.5 g	2.5	92	88	0	5	0	20
bensulide 7 g	12	87	85	0	0	0	0
RP-17623 2 g	2	75	62	0	0	0	0
	3	79	70	0	0	0	tr
	4	92	85	0	5	0	15
RP-17623 3.3 ec	2	90	88	0	tr	0	tr
	3	98	95	0	40	0	10
	4	100	100	10	50	0	20
NC-5651 20 w	4	61	63	0	0	0	0
	8	96	96	0	0	0	0
	12	100	100	0	0	0	0
	16	100	100	0	0	0	0
NC-8438 18.5 w	2	72	40	tr	20	0	tr
	4	85	80	25	60	tr	25
	8	90	90	30	85	5	40
M-3251 5 g	6	12	10	0	30	0	0
	12	50	30	tr	70	5	10
	18	80	55	20	80	10	25
M-3447 8 ec	6	30	30	0	tr	0	0
	12	40	30	0	10	0	tr
	18	65	60	10	85	5	50
S-14786 50 w	2	10	10	0	0	0	0
	3	35	20	0	0	0	0
	4	70	60	0	0	0	0

Table 1. (cont.)

Treatment	a.i./A	% Crabgrass control-Sept		% Maximum discoloration		% Thinning	
		KBG	CRF	KBG	CRF	KBG	CRF
S-15544 2 ec	1.5	0	0	0	0	0	0
	3	5	10	0	10	0	0
	5	20	20	tr	15	0	0
2903-H 20 g	4	0	5	0	0	0	0
	6	15	20	0	0	0	0
	8	30	25	0	0	0	0
2903-H 4 ec	4	0	0	0	0	0	0
	6	0	0	0	0	0	0
	8	10	15	0	0	0	0
Average		66	55	3	16	1	6

THE EFFECT OF DALAPON ON THE FLOWERING OF 3 JOHNSONGRASS SELECTIONS

G. W. Burt[1/] and I. M. Wedderspoon[2/]

Three selections of johnsongrass (Sorghum halepense (L.) Pers.) were grown in 15 cm diameter pots from rhizome pieces in the greenhouse for 14 weeks (Experiment 1) and 9 weeks (Experiment 2) and received a maximum total application of dalapon of 20 mg (Experiment 1) and 15 mg (Experiment 2) in 3 applications. Weekly measurements of plant height, stem number, leaf number, and number of plants in flower were recorded for all treatments. Plants were collected near Hagerstown, Maryland, a northern, cool region (N); Princess Anne, Maryland, a warm, intermediate region (NS); and Stoneville, Mississippi, a warmer, southern region (S).

Time to flowering of control plants increased in the order, N, NS, and S, respectively in both experiments. The N selection flowered a minimum of 2 weeks earlier than the other selections. This was associated with a more rapid stem elongation of the N selection and not with a greater number of leaves or stems. In Experiment 1, dalapon prevented flowering at all concentrations in the NS selection. In the N selection, flowering occurred only at the lowest dalapon treatment (10 mg) but some flowering occurred at all levels in the S selection. In Experiment 2, all but the lowest concentration of dalapon (5 mg) prevented flowering in the NS selection whereas the N and S selections flowered under the highest dalapon treatment (15 mg).

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CRABGRASS AND GOOSEGRASS CONTROL WITH SEVERAL PREEMERGENCE HERBICIDES

R. E. Engel and K. J. McVeigh[1/]

Abstract. Nine different standard and experimental herbicides were studied for crabgrass (Digitaria spp.) and goosegrass (Eleusine indica) control on established turf. The crabgrass test was on Kentucky bluegrass lawn turf and the goosegrass was on a mixed turf of bentgrass and annual bluegrass cut to ¼-inch. Treatments were made at the optimum rate for the standard materials and at multiple rates for the experimental materials in early to mid-spring. Weed control and injury estimates were made in late summer. Among the five new preemergence herbicides, RP 17623 was equivalent to or better than the market types for crabgrass control. It can prevent goosegrass, but it was too injurious to bentgrass-annual bluegrass turf at rates used. The effectiveness and safety of lower rates should be determined. The other four experimental herbicides were not effective at the rates used. When used for goosegrass control, NC 5651 gave as good or better control than the available herbicides. This chemical is worthy of further study for control of this weed. BAS 2903-H, DOWCO 221, and NC 6627 showed no promise for crabgrass or goosegrass as used. Among the available herbicides, previous observations were confirmed. DCPA gave the best control when it was applied in mid-April rather than later in the spring. While siduron has been effective at rates of 8 or 10 lb/A, appreciably higher rates are required on occasions.

Introduction

Preemergence crabgrass control has become a popular treatment on many turf areas. There is still great interest in finding new preemergence herbicides that could offer such advantages as smaller quantities of chemical per acre, greater safety to the turf, and/or better weed control. Attempts to control goosegrass with the currently available chemicals often prove unsatisfactory. NC 5651 (undisclosed chemical compound) and RP 17623 (2-tertiobutyl-4-(2,4-dichloro-5-isopropyloxphenyl)-5-oxo-1,3,4-oxadiazoline) have shown promise in previous tests (2, 3, and 4). The purpose of the current study was to evaluate several newer types of chemicals for possible advantages over standard types for control of crabgrass and goosegrass.

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Methods and Procedures

A crabgrass control test was established on Kentucky bluegrass lawn turf cut to $1\frac{1}{2}$ inches and a goosegrass control test was established on a mixed turf of bentgrass and annual bluegrass cut to $\frac{1}{4}$-inch. The soils were loam and sandy loam, respectively. The crabgrass test was overseeded with crabgrass on March 27 and the goosegrass test had an adequate natural seeding. Less than average rainfall was received in June, July, and August. Germination occurred in late spring on the crabgrass test. Generous watering on July 17, 20, and 23, and precipitation on July 29 enabled the crabgrass to develop good cover and mature growth. No goosegrass had germinated at the time of treatment. The goosegrass test received water one or more times per week.

Drop spreaders were used for both tests. Plots were 3' x 20' and 2' x 10', respectively. All spray applications were made at a rate of 40 gallons/acre.

The chemicals, rates, and application dates of the treatments are listed in Tables 1 and 2. All applications were spring treatments. Ratings for weed control and turf injury were made as percentage estimates in late summer.

The chemicals used were as follows:

bensulide	O,O-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl)benzenesulfonamide
Bandane	polychlorodicyclopentadiene isomers
DCPA	dimethyl tetrachloroterephthalate
benefin	N-butyl-N-ethyl-a,a,a,-trifluoro-2,6-dinitro-p-toluidine
DOWCO 221	a-(2,2,2-trichloroethyl) styrene
RP 17623	2-tertiobutyl-4-(2,4-dichloro-5-isopropyloxphenyl)-5-oxo-1,3,4-oxadiazoline
siduron	1-(2-methylcyclohexyl)-3-phenylurea
BAS 2903-H	3-isopropyl-2,1,3-benzothiadiazinone-(4)-2,2-dioxide
NC 5651	chemistry not disclosed
NC 6627	chemistry not disclosed

Results and Discussion

A good stand of crabgrass developed on the test site in late spring. Dry weather slowed seedling growth of the crabgrass until the irrigation and rains of late July. A good stand and cover of crabgrass developed adequately to permit control ratings by August.

Crabgrass Control

Among the experimental materials (BAS 2903-H, DOWCO 221, NC 5651, NC 6627, and RP 17623), at the rates applied, only RP 17623 showed promise for crabgrass control in turf (Table 1). Treatment with this chemical at rates of 2, 3, or 4 lb/A in April gave 81-96% crabgrass control. Application of 3 lbs of granular preparation on May 21 gave only 73% control as compared with 81 and 92% obtained with the same rate applied on April 16 and 29, respectively. An emulsifiable formulation of RP 17623 applied at 3 lb/A gave 95% crabgrass control. Good crabgrass control was obtained at the New Jersey Agricultural Experiment Station in 1968 and 1969 (2). Of the remaining experimentals, NC 6627 at 4 lb/A gave good control of crabgrass, but it caused 93% kill of the turf.

Several of the herbicides that are in commercial use were evaluated. DCPA gave a top performance of 96% control when applied on April 16. Control decreased progressively with the April 16 and May 21 applications. Doubling the 2 lb rate of benefin did not raise its level of performance. Siduron, a material that is applied at a wide range of rates, gave 26 and 65% control with 9 and 12 lb/A, respectively. This suggests that high rates of application are required for this chemical on occasion. These results are in agreement with some earlier data (1).

Goosegrass Control

The four commercially available preemergence herbicides (Bandane, benefin, bensulide, and DCPA) gave 60, 43, 20, and 70% control, respectively (Table 2). RP 17623 gave 53 and 93% control at 2 and 4 lb/A. However, severe and long-term injury occurred which makes these rates unacceptable. A lower rate is worthy of trial. NC 5651 gave 57 and 77% control at rates of 9 and 12 lb/A with no significant turf injury. This material should be studied further at these and higher rates.

Table 1. Crabgrass control obtained in 1970 on lawn turf with several preemergence herbicides.

Chemical		Rate ai/A	Applic. Date	% Crabgrass Control
bensulide	gr	10	Apr. 16	62
DCPA	wp	12	Apr. 16	73
DCPA	gr	12	Apr. 16	96
DCPA	gr	12	Apr. 26	88
DCPA	gr	12	May 21	46
benefin	gr	2	Apr. 16	57
benefin	gr	4	Apr. 16	57
siduron	gr	9	Apr. 16	26
siduron	gr	18	Apr. 16	65
BAS 2903-H	ec	6	Apr. 16	0
BAS 2903-H	gr	8	Apr. 16	3
DOWCO 221	gr	8	Apr. 16	2
NC 5651	wp	12	Apr. 16	5
NC 6627	wp	4	Apr. 16	*
RP 17623	ec	3	Apr. 16	95
RP 17623	gr	2	Apr. 16	81
RP 17623	gr	3	Apr. 16	81
RP 17623	gr	4	Apr. 16	96
RP 17623	gr	3	Apr. 29	92
RP 17623	gr	3	May 21	73

*Controlled crabgrass but gave 93% kill of the turf.

Table 2. Goosegrass control obtained with preemergence herbicides in 1970 on ¼-inch bentgrass-annual bluegrass turf.

Chemical		Rate ai/A[a]	% Goosegrass Control (Aug.)	% Turf injury (Aug.)
Bandane	gr	45	60	13
benefin	gr	2	43	0
bensulide	gr	10	20	0
DCPA	gr	12	70	0
DCPA	gr	15	67	0
BAS 2903-H	gr	4	17	0
BAS 2903-H	gr	8	20	0
DOWCO 221	gr	4	0	0
DOWCO 221	gr	8	0	0
RP 17623	gr	2	82	53[b]
RP 17623	gr	4	93	93[b]
NC 5651	wp	9	57	0
NC 5651	wp	12	77	0
NC 6627	wp	1	0	92[b]
NC 6627	wp	2	30	100[b]

[a] Applied May 27, 1970.
[b] Turf recovery incomplete November 5, 1970.

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EFFECT OF ACTIVATED CHARCOAL ON THE FUTURE PERFORMANCE OF CHEMICALS FOR PREEMERGENCE CRABGRASS CONTROL IN TURFGRASS [1]

John A. Jagschitz [2]

Recent agricultural research has shown that activated charcoal can be used to adsorb various chemicals and reduce harmful effects they may have on plant growth (1,2,3,4,5). One test demonstrated the value of using charcoal in turfgrass seedbeds which contained herbicide residues (3). Herbicide toxicity was reduced and turfgrass seedlings safely emerged from the soil.

However, the use of charcoal in turfgrass areas might affect the future performance of chemicals. This would especially be true for preemergent type weed control chemicals where the charcoal could adsorb them and reduce their effectiveness. A test was initiated at the Rhode Island Agricultural Experiment Station to study the influence of charcoal, applied to established turf, on the subsequent effectiveness of chemicals used for preemergent crabgrass control.

Materials and Methods

The turfgrass, in the test area, was established in the fall of 1966, with red fescue (*Festuca rubra* L.) and Kentucky bluegrass (*Poa pratenses* L.) on Bridgehampton silt loam. The sod was maintained at a cutting height of one inch and fertilized during the summers with a 10-6-4 grade fertilizer at the rate of 10 to 15 lb per 1,000 sq ft. A good stand of crabgrass (*Digitaria ischaemum* (Schreb.) Muhl.) was present during the 1967 season from prior over-seeding, and the plots were overseeded again in 1968, 1969, and 1970, to ensure good stands.

Treatments were applied to plots measuring 5 x 5 ft in three randomized complete blocks, with three untreated plots in each block. Activated charcoal (Aqua Nuchar, West Virginia Pulp and Paper Co.) was applied as a spray in water at the rate of 500 gallons per acre with a hand sprayer on November 17, 1967. The rates of charcoal, as well as the rates and dates of applications of herbicides are shown in Tables 1 and 2. All herbicides were granular formulations and were applied by hand in the latter part of April.

Visual estimates of turfgrass injury were made between April and October of each year. The scale used was 0-10 with 0 representing no injury and 10, brown or dead turf. Crabgrass emergence usually started in June and reached its maximum by July. Estimates of crabgrass cover in each plot were made in early September of each year. Percent control was obtained by comparing treated plots with untreated plots.

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Results and Discussion

The results from using bensulide for preemergent crabgrass control in turf grass, previously treated with activated charcoal are presented in Table 1. Bensulide effectiveness was dependent upon the rate of charcoal used, the amount of bensulide applied, and the time elapsed between applications of charcoal and bensulide.

At the standard 10 lb rate of bensulide applied in 1968, (5 months after charcoal application) there was a reduction in crabgrass control from 93 to 78% where 100 lbs of charcoal was applied and to 31% where 400 lbs was applied. The adsorptive effect of the charcoal on herbicide activity at the surface would have been decreased considerably had a similar rate of charcoal been mixed with a layer of soil as in the preparation of seedbeds. Unpublished results from charcoal seeding tests (2) where 300 lbs of charcoal was mixed in the top-inch of soil showed only a 15% reduction in crabgrass control from bensulide use the following year.

When the 10 lb rate of bensulide was applied in 1969, (17 months after charcoal use) or was re-applied to plots treated in 1968, there was a reduction in effectiveness only with 400 lbs of charcoal. Re-treatment with bensulide in 1970 showed no decrease in crabgrass control.

Higher rates of bensulide counteracted the retarding effect of charcoal. Good control (93%) was obtained with 20 lbs of bensulide in areas treated five months earlier with 100 lbs of charcoal. An application of 40 lbs of bensulide was required to obtain good control where 200 lbs of charcoal was used. However, at this rate, injury to the turf was considered objectionable. Control was still slightly reduced with 40 lbs of bensulide where 400 lbs of charcoal had been used.

One aspect of this test was to determine if the bensulide that was adsorbed by charcoal would be released in later years and be reflected as crabgrass control or turfgrass injury. The data in this test do not clearly indicate such a trend.

The results pertaining to the effectiveness of five other crabgrass herbicides are presented in Table 2. Bandane, nitralin and tri-calcium arsenate were not influenced by the 100 lb rate of charcoal applied five months earlier. Had higher rates of charcoal been used the effectiveness of these herbicides might have been reduced since bandane and nitralin have responded to charcoal adsorption in other tests (3).

Siduron and DCPA showed a reduction in effectiveness when applied at the standard (low) rate in 1968 (5 months after charcoal use) where 100 lbs of charcoal was used. At double standard strength crabgrass control was not affected. No reduction was evident from the standard treatment made in 1969 (17 months after charcoal application) where up to 400 lbs of charcoal was used.

During the test it was noted that plots treated with bandane, DCPA and tri-calcium arsenate contained less fescue and more bluegrass than untreated plots. There also were indications that bandane, bensulide and tri-calcium arsenate have residual activity, especially at high rates, which give some

Table 1. Effect of charcoal applied to established turfgrass on the future effectiveness of bensulide as a preemergent crabgrass herbicide.

bensulide Treatment Year & Rate	Percent Crabgrass Control											
	1968 (lb/A charcoal 1967)				1969 (lb/A charcoal 1967)				1970 (lb/A charcoal 1967)			
	0	100	200	400	0	100	200	400	0	100	200	400
1968 + 69 + 70												
10 lb ai/A	93	78	40	31	-	93	88	79	-	100	100	99
1969 + 70												
10 lb ai/A	-	-	-	-	82	76	78	74	99	99	99	97
1968												
20 lb ai/A	99	93	80	36	78	56	57	17	0*	46	5	32
40 lb ai/A	100	99	98	89	99*	94*	96*	72	67*	75	85*	44
80 lb ai/A	100	-	99	-	99	-	99*	-	98*	-	91*	-
1969												
20 lb ai/A	-	-	-	-	-	94	98	93	-	86	93	78
40 lb ai/A	-	-	-	-	-	-	99	99	-	-	99	97

* Objectionable turfgrass injury (2.0 to 3.9 on scale from 0-10)

Table 2. Effectiveness of various preemergence crabgrass herbicides when used in established turfgrass previously treated with charcoal.

Herbicide and Year of Treatment	Rate lb ai/A	Percent Crabgrass Control					
		1968 charcoal 1967 lb/A		1969 lb/A charcoal 1967			
		0	100	0	100	200	400
1968							
bandane	35	86 f	85 f	33	-	-	-
"	70	99 f	96 f	97 f	80 f	-	-
DCPA	10	99 f	80 f	13	-	-	-
"	20	100 f	99 f	33 f	13 f	-	-
nitralin	1.5	84	83	5	-	-	-
"	3	95*	94*	5	14	-	-
siduron	12	89	77	6	-	-	-
"	24	99	95	11	6	-	-
tri-Ca arsenate	109	77	78	55	-	-	-
" " "	418	93	92	80	80 f	-	-
1968 + 1969							
bandane	35	86 f	85 f	-	98 f	-	-
DCPA	10	99 f	80 f	-	97 f	-	-
nitralin	1.5	84	83	-	95	-	-
siduron	12	89	77	-	96	-	-
tri-Ca arsenate	209	77	78	-	100 f	-	-
1969							
DCPA	10	-	-	-	95	95	95
siduron	12	-	-	-	97	99	93
tri-Ca arsenate	209	-	-	-	-	96	-

f Reduction in fescue and increase in bluegrass.

* Objectionable turfgrass injury (2.0 to 3.9 on scale from 0-10).

crabgrass control the year following treatment.

Another interesting observation was made in early April, 1968, before the herbicides were applied. The grasses treated with charcoal the previous November started to grow earlier or were growing faster. Clippings harvested from the plots showed increased growth with increased use of charcoal, with a 90% increase in clipping weights for plots treated with 400 lbs of charcoal. This temporary flush of growth may have been due to early soil warming from heat absorbed by the black charcoal or to the adsorption of harmful substances in the soil.

Summary and Conclusions

In the fall of 1967, activated charcoal was applied to established turfgrass. In subsequent years preemergent crabgrass herbicides were applied to determine if the charcoal would affect their performance. The following conclusions are drawn on the results of this study:

1. The effectiveness of standard rates of bensulide, DCPA, and siduron was reduced when applied to turfgrass treated five months earlier with 100 lbs per acre of charcoal. No reduction at these rates were noted with bandane, nitralin, and tri-calcium arsenate.

2. Higher rates of charcoal caused greater reductions in herbicide effectiveness, while increased rates of herbicides counteracted the retarding effect of charcoal.

3. Charcoal applications made 17 months before herbicide treatments were far less inhibiting than those made at 5 months.

4. There was little indication that adsorbed herbicides are released in later years and reflected as crabgrass control or turf injury.

5. Residual activity from bandane, bensulide, and tri-calcium arsenate was noted the year following treatment.

6. Grass treated with charcoal in the fall started to grow earlier or grew faster in early spring.

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Appendix

The chemical name and source of the herbicides used were as follows:

Herbicide	Company	Chemical Name
bandane	Velsicol	polychorodicyclopentadiene isomers
bensulide	Stauffer	O,O-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl) benzenesulfonamide
DCPA	Diamond Shamrock	dimethyl tetrachloroterephthalate
nitralin	Shell	4-(methylsulfonyl)-2-6 dinitro-N, N-dipropylaniline
siduron	DuPont	1-(2-methylcyclohexyl)-3-phenylurea
tri-Ca arsenate	Rhodia	tricalcium arsenate

RESPONSE OF TURFGRASSES AND BROADLEAVED WEEDS TO VARIOUS HERBICIDES[1/]

John A. Jagschitz[2/]

Research has shown that combinations rather than single herbicides provide more effective, broad-spectrum control of the broadleaved weeds common to turfgrass (1,2,3). Effective weed control can also be influenced by date of treatment (2) as well as by choice of herbicide.

Five studies were initiated at the Rhode Island Agricultural Experiment Station to investigate various chemical combinations and rates, and to test newer chemicals for the control of white clover (*Trifolium repens* L.), mouseear chickweed (*Cerastium vulgatum* L.) and dandelion (*Taraxacum officinale* Weber.). The effect of time of treatment on weed control and on phytotoxicity to three turfgrass species was also studied. The species used were red fescue (*Festuca rubra* L.), Kentucky bluegrass (*Poa pratenses* L.) and Colonial bentgrass (*Agrostis tenuis* Sibth).

Materials and methods

Dry granular herbicides were applied by hand to moist turf; liquid materials were applied as sprays in water at the rate of 40 gallons to the acre. Estimates of weed coverage were made at the time of treatment and about 12 weeks later. Control was based on the reduction in weed cover after considering the change in cover on the untreated plots. Observations of turf injury were made periodically during the test period. Injury was recorded using a scale, 0 to 10; 0 representing the appearance of the untreated plots and 10 being completely brown or dead turf. The design used in all tests was a randomized complete block with a minimum of two untreated plots in each block.

Weed control tests

The chemicals, rates, and date of treatment for three weed control tests are presented in Tables 1 and 2. The turf was more than five years old and was maintained at a height of one inch. An area of bentgrass-fescue was used for the May trials and of bluegrass-fescue for the August trials. The May tests had plots measuring 3 x 5 ft with four replications and the August test had plots measuring 4 x 4 ft with three replications.

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2/ Assistant Professor, Department of Plant and Soil Science

Turf tolerance tests

The chemicals, rates, and date of treatment for the two turfgrass tolerance tests are presented in Table 3. The turf in the May study was three years old and that of the August study was more than five years old. All grasses were maintained at a height of one inch. The varieties of grasses treated were Exeter Colonial bentgrass, Jamestown red fescue, Merion Kentucky bluegrass (August) and R.I.-P.P.#1 bluegrass (May). The May study had plots measuring 3 x 3 ft and the August study had plots measuring 4 x 4 ft with three replications.

Results and Discussion

Herbicide combinations for weed control

The results of various combinations of herbicides applied at 3 different dates for clover, chickweed, and dandelion control in turfgrass are presented in Table 1. The data indicate that certain herbicide treatments were more effective than others and were influenced by the rates used and the date of treatment.

Excellent control was obtained from the 2-way combination of 2,4-D + silvex at 1 + 1/2 lb (active ingredient per acre) although it caused slightly more injury to the turfgrass. Good results were obtained from 2,4-D at 1 lb combined with 1/5 and 1/4 lb of dicamba, or with 1 lb of mecoprop, the latter being slightly less injurious to the turf. The combination of 2,4-D + 2,4-DP was not effective, but higher rates should be investigated.

Halving the rate of dicamba, mecoprop, or silvex used in the 2-way combination with 1 lb of 2,4-D reduced effectiveness. However, combining two of the chemicals at low rates with 2,4-D to make 3-way combinations improved control. The following appeared promising: (1) 2,4-D + dicamba + mecoprop at 1 + 1/16 + 1/2 lb, (2) 2,4-D + dicamba + silvex at 1 + 1/16 + 1/4 lb, and (3) the ester formulations of 2,4-D + silvex + 2,4-DP at 1/2 + 1/2 + 1/4 lb and at 3/4 + 3/8 + 1/2 lb. These 3-way combinations should be studied further and at slightly higher rates to improve their effectiveness.

There was a tendency for dandelion to be more susceptible to herbicides when treated on May 28. Dandelions had just finished flowering and may be more easily controlled at this stage. Chickweed was difficult to control on May 15 and easy to control in August. In August the chickweed plants were diseased and this may have contributed to their susceptibility. Poor control, especially of chickweed, from treatments made on May 15 may have been due to low temperatures and cloudy conditions after treatment and to rains which occurred about 30 hours later.

TABLE 1. Effect of herbicides and time of treatment on turfgrass injury and the control of white clover, mouseear chickweed and dandelion during the 1970 season.

Chemical and Formulation	Rate lb ai/A	Percent Control: Clover (Treated) May 15	Clover (Treated) May 28	Clover (Treated) Aug 4	Chickweed (Treated) May 15	Chickweed (Treated) May 28	Chickweed (Treated) Aug 4	Dandelion (Treated) May 15	Dandelion (Treated) May 28	Dandelion (Treated) Aug 4
2,4-D	1.0	27	86	65	32	83	71	64	99[t]	96[t]
2,4-D + dicamba	1.0 + .063	91	-	89	31	-	100	80	-	92[t]
" + "	1.0 + .125	-	-	98	-	-	100	-	-	91[t]
" + "	1.0 + .20	99	100	-	51	100	-	93	99[t]	-
" + "	1.0 + .25	-	-	99	-	-	100	-	-	99[t]
2,4-D* + silvex*	1.0 + .25	63	-	77	50	-	100	77	-	85
" + "	1.0 + .5	93	99	99	95	99	100	97[t]	98[t]	90[t]
2,4-D + mecoprop	1.0 + .5	96	-	-	76	-	-	83	-	-
" "	1.0 + 1.0	99	100	89	83	100	100	93	99	81[t]
2,4-D + 2,4-DP	1.0 + .25	66	-	-	25	-	-	59	-	-
" + "	1.0 + .5	84	-	-	45	-	-	79	-	-
2,4-D*a + dicamba + silvex*	1.0 + .063 + .25	96	-	99	80	-	100	80	-	91[t]
2,4-D* + dicamba + silvex*	1.0 + .063 + .5	-	-	99	-	-	100	-	-	86[t]
" + " + "	1.0 + .125 + .5	100	-	100	99	-	100	97	-	86[t]
2,4-D + dicamba + mecoprop	1.0 + .063 + .5	99	-	-	84	-	-	89	-	-
" + " + "	1.0 + .09 +1.0	98	-	99	96	-	100	97	-	81[t]
2,4-D + dicamba + 2,4-DP	1.0 + .063 + .25	87	-	-	41	-	-	81	-	-
" + " + "	1.0 + .063 + .5	98	-	-	76	-	-	84	-	-
2,4-D + silvex* + mecoprop	1.0 + .25 + .5	99	-	-	64	-	-	91	-	-
2,4-D + silvex* + 2,4-DP	1.0 + .25 + .5	97	-	-	92	-	-	74	-	-
2,4-D + silvex + 2,4-DP	.5 + .5 + .25	85	-	-	30	-	-	50	-	-
2,4-D*+ silvex* + 2,4-DP*	.5 + .5 + .25	95	-	-	91	-	-	82	-	-
2,4-D + silvex + 2,4-DP	.75+ .375 + .5	97	99	100	66	100	100	79	99[t]	87[t]
2,4-D*+ silvex* + 2,4-DP*	.75+ .375 + .5	99	-	-	100	-	-	99	-	-

t Turfgrass injury 1.0 to 1.9 on a scale 0-10 (0 = none as untreated grass, 10 = complete brown or kill). unmarked treatments had less injury.

* Ester formulation, others are amine or acid.

*a Ester used in August.

Evaluation of new materials

The control of clover, chickweed, and dandelion in turfgrass with several new chemicals is presented in Table 2. Good control of chickweed was produced by BAS-3510-H, but control of clover and dandelion was poor. Possibly higher rates should be investigated since there was only slight injury (less than 2.0) to the turfgrass. UNI-1068 also gave good control of chickweed and poor control of clover and dandelion, but injury to the turfgrass was severe (4.0 or greater).

MH at 1 lb was ineffective for weed control. When MH was added to 1 lb of 2,4-D there was no change in the degree of control of clover or dandelion above that obtained from the 2,4-D alone, while there was a slight decrease in chickweed control (see 2,4-D data in Table 1). Adding MH to chlorflurenol did not alter chlorflurenol's effectiveness. Both combinations caused moderate injury (2.0 to 3.9) to the turfgrass.

Chlorflurenol produced good control of clover, chickweed and dandelion. Injury to the turf was moderate when applied in May and severe when applied in August. The injury appeared as a temporary white or bleached color on the grass, reaching a peak about 2-3 weeks after treatment.

Herbicide phytotoxicity to turfgrass species

Visual estimates of injury to red fescue, Kentucky bluegrass, and Colonial bentgrass from herbicides applied in May and August are presented in Table 3. The data indicate that: (1) fescue and bluegrass were more tolerant to herbicide treatments than bentgrass, and (2) turfgrasses were more tolerant to herbicides applied in May than to those applied in August.

None of the herbicides applied in May caused more than slight injury to fescue, bluegrass or bentgrass, although 2,4-D + silvex at the double rate (2 + 1 lb) produced the most injury. Herbicides applied at standard rates in August to fescue and bluegrass did not cause more than slight injury. However, 2,4-D + dicamba + silvex at 1 + 1/8 + 1/2 lb caused the most injury. At the double rate, 2,4-D + dicamba was slightly more phytotoxic to fescue than 2,4-D + mecoprop, which in turn was slightly more phytotoxic than 2,4-D + silvex. When bluegrass was treated the reverse was true.

Most of the herbicides applied to bentgrass at standard rates in August caused moderate injury. Treatments which contained 2,4-D + silvex caused the greatest injury while those with 2,4-D + dicamba and 2,4-D + mecoprop the least. At double rates, injury was moderate from 2,4-D + dicamba and 2,4-D + mecoprop, but severe from 2,4-D + silvex.

TABLE 2. Turfgrass injury and weed control from various chemicals applied during the 1970 season.

Time of Treatment and Chemical	Rate lb ai/A	Percent Control			Maximum Turf Injury*
		Clover	Chickweed	Dandelion	
May 28, 1970					
BAS - 3510-H (WP)	2.0	50	93	45	.3
" " "	3.0	44	99	20	.3
Chlorflurenol	1.0	98	86	89	2.5
" "	2.0	99	98	93	3.5
MH	1.0	17	22	36	1.7
MH + Chlorflurenol	1.0 + 1.0	97	93	92	2.3
MH + 2,4-D	1.0 + 1.0	88	52	94	2.7
August 4, 1970					
BAS - 3510-H	6.0	18	100	29	1.2
Chlorflurenol	2.0	100	100	88	6.2
UNI - 1068	(4 gal/A)	39	100	18	4.0

* Turf injury scale 0-10 (0 = same as in untreated area; 10 = complete brown or kill) for six week period after treatment.

TABLE 3. Turfgrass injury to Red fescue, Kentucky bluegrass and Colonial bentgrass from various herbicides used in May and August for broadleaved weed control.

Herbicide	Rate lb ai/A	Maximum Turfgrass Injury* (Time of Treatment) (May 15, 1970) Fes	Blue	Bent	(August 4, 1970) Fes	Blue	Bent
Standard Rates							
2,4-D	1.0	-	-	-	.4	.7	.9
2,4-D + dicamba	1.0 + 0.20	.0	.0	.0	-	-	-
" "	1.0 + 0.25	-	-	-	1.1	.7	1.7
2,4-D + mecoprop	1.00 + 1.00	.0	.0	.0	.7	1.2	2.2
2,4-D + silvex	1.0 + 0.50	.6	.0	.5	1.2	1.4	3.2
2,4-D + dicamba + mecoprop	1.0 + 0.09 + 1.0	.3	.0	.0	.8	.5	1.7
2,4-D + dicamba + silvex	1.0 + 0.063 + 0.5	-	-	-	1.0	1.2	3.4
" " "	1.0 + 0.125 + 0.5	.3	.0	.8	1.9	1.6	3.9
Double Rates							
2,4-D + dicamba	2.0 + 0.40	.2	.0	.2	-	-	-
" "	2.0 + 0.50	-	-	-	1.9	.6	3.7
2,4-D + mecoprop	2.00 + 2.00	.2	.3	.3	1.4	1.4	3.8
2,4-D + silvex	2.0 + 1.00	1.5	.5	1.2	1.0	1.9	4.7

* Turf injury scale 0-10 (0-1.9 slight, 2.0 to 3.9 moderate and greater than 4.0 severe).

Conclusions

Three tests were conducted to evaluate various herbicide combinations and rates, and to test some newer chemicals, for the control of white clover, mouseear chickweed, and dandelion in lawn-type turfgrass. Two additional studies, one in May and the other in August, studied the tolerance of red fescue, Kentucky bluegrass, and Colonial bentgrass to the herbicides. The following conclusions are drawn from the results of these tests:

1. Two-way combinations which provided good control of clover, chickweed, and dandelion were as follows: (a) 2,4-D + silvex (1 + 1/2 lb per acre), (b) 2,4-D + dicamba (1 + 1/5 lb), and (c) 2,4-D + mecoprop (1 + 1 lb).

2. The following 3-way combinations appeared promising for broad-spectrum weed control and should be investigated further at slightly higher rates: (a) 2,4-D + dicamba + mecoprop (1 + 1/16 + 1/2 lb), (b) 2,4-D + dicamba + silvex (1 + 1/16 + 1/4 lb), and (c) the ester formulation of 2,4-D + silvex + 2,4-DP (3/4 + 3/8 + 1/2 lb).

3. Good chickweed control, and poor dandelion and clover control was produced by BAS-3510-H and UNI-1068. The latter caused severe injury to the turfgrass.

4. Chlorflurenol at 1 and 2 lb per acre controlled clover, chickweed, and dandelion, but caused injury to the turf (white, bleached grass blades).

5. Adding MH to chlorflurenol or 2,4-D did not alter their effectiveness for clover and dandelion control. Chickweed control was unchanged with chlorflurenol, but with 2,4-D there was a slight reduction in chickweed control.

6. Herbicides applied in August caused more injury to turfgrass, especially bentgrass, than when applied in May. The use of herbicides in the summer should be avoided.

7. The herbicide combination of 2,4-D + silvex caused more injury to turfgrass, especially bentgrass, than those of 2,4-D with dicamba, or mecoprop.

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Appendix

The chemical and source of supply used in this test was as follows:

Chemical	Company
2,4-D	Amchem, Chevron, Dow, Rhodia, Sherwin-Williams and Velsicol
2,4-DP	Amchem
BAS-3510-H	BASF
Chlorflurenol	Mallinckrodt
dicamba	Amchem, Chevron, Sherwin-Williams and Velsicol
mecoprop	Rhodia, and Sherwin-Williams
MH	UniRoyal
silvex	Amchem, Dow and Velsicol
UNI-1068	UniRoyal

EFFECT OF FOUR GROWTH RETARDANTS ON KENTUCKY 1/,2/ BLUEGRASS AND RED FESCUE USED FOR ROADSIDE TURF

A. T. Dore, R. C. Wakefield and J. A. Jagschitz 3/

I INTRODUCTION

An important use of plant growth retardants is to control grass growth and reduce the number of mowings along highways (3,5). Extensive investigations with maleic hydrazide at the Rhode Island Agricultural Experiment Station have shown that proper treatment with this chemical can effectively retard the growth of grasses without being detrimental to the attractiveness of roadside turf (2). Despite the apparent effectiveness of MH, proper timing (5) and weather conditions (4) still present problems.

This experiment involved four chemicals (two experimental) used alone, and in certain combinations at different rates (1) to determine their effectiveness in retarding grass growth.

II MATERIALS AND METHODS

Pure stands of Park Kentucky bluegrass (Poa pratensis L.) and Pennlawn red fescue (Festuca rubra L.) were established in 1967 on Bridgehampton silt loam at the University of Rhode Island. The grasses had been maintained at a low fertility level and stands were uniformly good. Sites were raked manually to remove dead undergrowth, cut to four inches and then fertilized with 10-6-4 at 1000 lb per acre on May 5, 1970, prior to application of test materials. On May 15, the test areas were sprayed with a mixture of 2,4-D + dicamba at 1 lb + $\frac{1}{4}$ lb per acre to control broadleaved weeds.

All chemicals were applied on May 7 with a bicycle sprayer having a 6-foot boom with four spray nozzles 14 inches apart delivering 50 gallons per acre. Chemicals used in this experiment together with rates of application are listed in Table 1. Additional information concerning the materials and the manufacturers is presented in the Appendix. There were 11 treatments on 6 x 20 foot plots randomized in three complete blocks for the bluegrass and the same for the fescue. Fifteen feet of each plot that received a weekly observation program was referred to as the "mowed section". Ten

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height measurements were recorded weekly from each plot. If at least six of these measurements were 6 inches or more and occurred in two of the three blocks, the grass was harvested and dried to a constant weight. A 21-inch rotary mower with sample bag attached to chute was set at 4 inches and pushed twice the length of the 15-foot plot for a harvested area of 52.5 square feet.

A 3-foot section of each plot was left unmowed to study the effect of the chemicals on uncut grass. About 2 months after treatment (July 6), seed-head counts and dry weights of material exceeding 4 inches were taken from an area measuring 2 square feet in each plot.

III RESULTS AND DISCUSSION

A. Mowed Plots

Data on the growth and visual appearance of Kentucky bluegrass and red fescue following chemical treatment are presented in Tables 1 and 2. Dry weights of grass were totaled for the cuttings made during a six week period. Accumulated growth above the 4-inch cutting height is similarly presented. Visual ratings for appearance at 3, 6, and 8 weeks were selected as representative readings for the experimental period.

1) Kentucky bluegrass

a. Growth Measurements

Data for total dry weights and accumulated height above 4 inches after 6 weeks revealed that all chemical treatments had resulted in some growth suppression.

MBR-6033 substantially reduced growth at both 3 and 6 pounds per acre with the higher rate being particularly effective.

Similarily, NC-8438 resulted in markedly reduce growth compared to check plots.

Maleic hydrazide (MH), a standard growth retardant for many years was used at a minimum 4 lb per acre rate and was effective although more growth resulted than might normally be expected. A slightly higher rate (5 or 6 lb) would perhaps have been more advisable.

Plots treated with chlorflurenol (CF) at 2 and 3 lb were similar in dry weight but the higher rate more effectively reduced elongation of leaves as measured by accumulated height above four inches over the 6-week period. Chlorflurenol + MH reduced growth with only minor differences among the three combinations used.

b. Appearance Ratings

As shown in Table 1, ratings for appearance of turf after treatment revealed varying degrees of discoloration depending on the materials and rates used.

MBR-6033 produced an initial "tip burn" on leaves that was most objectionable at the higher rate. This disappeared approximately 3-4 weeks after treatment.

Serious delayed injury occurred with NC-8438 which was thought to be due to a rather complete suppression of new tiller growth. This resulted in very thin plots particularily at the higher rates 4-5 weeks after treatment.

Grass treated with chlorflurenol developed a whitish cast on leaves which caused a lower color rating initially.

After 8 weeks all grasses were comparable to the check except for the NC-8438 treated plots which were poor in appearance throughout the remainder of the growing season. The stands were exceedingly thin during the midsummer period and only a gradual increase in density occurred thereafter.

2) Red Fescue

a. Growth Measurements

For the same 6-week period, all treatments applied to red fescue produced lower total dry weights and heights than the check. In general, the experimental materials reduced growth of red fescue more than Kentucky bluegrass.

MBR-6033 reduced the volume of growth considerably below that of the check.

As with Kentucky bluegrass, NC-8438 reduced growth but produced objectionable injury to stands at the rates used.

Chlorflurenol was consistently effective with no particular advantage shown in combinations with MH.

b. Appearance Ratings

Three weeks after application of chemicals, MBR-6033, NC-8438 and MH treated red fescue was green and dense. However, injury began to show up at about 4 weeks with NC-8438 at the low rate which became severe by the eighth week at the higher rate of application. Other treatments mentioned remained very satisfactory.

Chlorflurenol applied alone and in combination with MH gave a whitish cast to the leaves of red fescue, similar to the treatments on Kentucky bluegrass. This condition persisted through the sixth week when CF was used at the higher rates i.e. 2 or 3 lb but was only noted through the third week at the 1 lb/A combination.

Results with both Kentucky bluegrass and red fescue indicated that effective growth control was possible with MH, MBR-6033 and CF. Combinations appeared promising. Growth suppression could not always be achieved without some injury or discoloration to turf. Results of these experiments suggest the need for further testing at varying rates and with various combinations of chemicals. Since grasses exhibit varying responses, further work with grass mixtures would appear to be practical.

B. Unmowed Plots

In adjacent, unmowed plots the effect of growth retardants were evaluated on July 6, 2 months after treatment. Data on dry weights and seedhead counts for Kentucky bluegrass and red fescue are summarized in Table 3.

1) Kentucky Bluegrass

Dry weights from 2 months of unmowed grass indicated that MBR-6033 at both rates, MH at 4 lb and NC-8438 at 8 lb effectively reduced the weight of the grass compared to the check plots. The low yields of NC-8438 plots was chiefly due to extensive injury to the turf.

All treatments significantly reduced the number of seedheads. MBR-6033 at both rates, NC-8438 at 8 lb and especially MH were outstanding in this respect. On the NC-8438 plots, especially at the high rate, many seedheads were produced in the lower 4 inches of the turf, but only seedheads in the upper 4 inches were counted.

2) Red Fescue

All treatments yielded clippings with significantly lower dry weights than the check. Plots treated with NC-8438 at 8 lb had low dry weights due to extensive injury to the turf.

All treatments had fewer seedheads than the check. Despite the number of seedheads at the lower levels the very low count for plots treated with NC-8438 at 8 lb indicated only the number of seedheads that extended above the 4-inch level.

IV SUMMARY AND CONCLUSIONS

Kentucky blugrass and red fescue were treated with various growth retarding chemicals. Results were evaluated on the basis of total dry weight of clipping and accumulated height of growth over four inches on regularly mowed turf. In addition non-mowed turf was evaluated for total growth produced and degree of seedhead suppression.

Results may be summarized as follows:

1) Growth suppression of vegetative growth and seedheads occurred with MBR-6033, NC-8438, maleic hydrazide and chlorflurenol. However, there was a range of effectiveness depending on the material used, rates of application and the species of grass.

2) Turf injury as discoloration of vegetation often accompanied growth retardation.

3) MBR-6033 was effective at 3 and 6 lb per acre but with some leaf "tip burn" occurring on Kentucky bluegrass particularily at the higher rate.

4) NC-8438 retarded growth of both species at 4 and 8 lb but caused severe delayed injury to stands of grass.

5) Chlorflurenol at 1, 2, and 3 lb was fairly effective as a growth retardant alone and in combination with maleic hydrazide and was most satisfactory at 1 lb with maleic hydrazide.

6) Maleic hydrazide was fairly satisfactory at 4 lb.

7) Growth of red fescue was more effectively retarded than Kentucky bluegrass and was less subject to injury or discoloration.

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APPENDIX

Growth retardants used in this study were as follows (companies supplying materials are noted):

1. MBR - 6033. Available as the diethanolamine salt. Formulated as a 20% W/V active solution. Chemistry of material not yet released. 3-M Company.

2. NC - 8438. 2-ethoxy-2, 3-dihydro - 3, 3-dimethyl-5-benzofuranyl methane-sulphonate. 25% W.p. Fisons Corporation.

3. Maleic hydrazide (MH). (DEA-MH-(P-342). 1,2-dyhydro-3, 6-pyridazinedione. 1.5 lb ai/gal. UniRoyal.

4. Chlorflurenol (CF). (Maintain CF - 125). Methyl-2-chloro-9-hydroxyfluorene-9-carboxylate--8.8%; Methyl 9-hydroxyfluorene-9-carboxylate-- 2.1%; Methyl 2, 7 dichlore-9-hydroxyfluorene-9-carboxylate-- 1.6%. 1 lb ai/gal. U.S. Borax.

TABLE 1. EFFECT OF SEVERAL GROWTH RETARDANTS ON REGULARLY MOWED KENTUCKY BLUEGRASS TURF.

Chemical	Rate lb ai/A	Total Dry Wts (6 wks) lb/A	Accumulated Height (6 wks) inches	Appearance Ratings* 3 wks	6 wks	8 wks
MBR-6033	3	133 e**	5.5 f	5.8 cd	7.5 bc	8.5 bc
MBR-6033	6	75 f	3.4 g	4.0 e	6.0 d	7.2 d
NC-8438	4	149 e	6.7 e	7.8 ab	3.7 e	5.8 e
NC-8438	8	50 f	3.1 g	7.7 ab	2.8 f	3.5 f
MH	4	207 d	6.7 e	8.0 ab	4.0 e	8.8 abc
CF	2	299 b	8.6 c	6.2 cd	7.8 b	9.0 ab
CF	3	274 bc	7.4 d	5.0 de	7.8 b	8.7 abc
CF+MH	1+2	249 c	7.4 d	6.8 bc	7.8 b	8.7 abc
CF+MH	1+3	290 b	9.5 b	8.8 a	9.0 a	9.7 a
CF+MH	2+2	249 c	7.4 d	6.0 cd	8.5 a	9.2 ab
Check	-	365 a	10.7 a	8.0 ab	7.5 bc	8.2 bcd

*Refers chiefly to color, but also is an indication of density. Ratings 1 (poorest) - 10 (most desirable).

**Means followed by different letters indicate significant differences at Duncan's 5% level.

TABLE 2. EFFECT OF SEVERAL GROWTH RETARDANTS ON REGULARLY MOWED RED FESCUE TURF.

Chemical	Rate lb ai/A	Total Dry Wts (6 wks) lb/A	Accumulated Height (6 wks) inches	Appearance Ratings* 3 wks	6 wks	8 wks
MBR-6033	3	182 c**	7.8 c	8.8 bcd	8.7 a	7.5 ab
MBR-6033	6	91 e	6.1 e	9.8 a	8.2 a	6.8 b
NC-8438	4	58 f	3.5 g	9.3 abc	5.7 de	8.2 ab
NC-8438	8	33 g	2.2 h	9.5 ab	7.7 abc	2.3 c
MH	4	141 d	9.4 b	9.0 bcd	7.8 ab	8.0 ab
CF	2	241 b	6.7 d	5.0 e	6.5 cde	7.2 ab
CF	3	174 c	6.5 de	5.3 e	4.8 e	7.3 ab
CF+MH	1+2	141 d	5.9 e	5.0 e	7.0 a-d	7.8 ab
CF+MH	1+3	199 c	6.1 e	5.7 e	8.2 ab	8.7 a
CF+MH	2+2	182 c	4.8 f	4.8 e	5.8 cde	8.0 ab
Check	-	324 a	10.7 a	8.5 cd	8.2 ab	7.0 b

*Refers chiefly to color, but also is an indication of density. Ratings 1 (poorest) - 10 (most desirable).

**Means followed by different letters indicate significant differences at Duncan's 5% level.

TABLE 3. EFFECT OF GROWTH RETARDANTS ON DRY WEIGHTS AND SEED-HEAD COUNTS OF KENTUCKY BLUEGRASS AND RED FESCUE, JULY 6, 1970.

	Rate	KENTUCKY BLUEGRASS		RED FESCUE	
Chemicals	lb ai/A	Dry Wts lbs/A	Seedheads per sq ft	Dry Wts lbs/A	Seedheads per sq ft
MBR-6033	3	210 bc*	2.33 d	831 cde	37.33 de
MBR-6033	6	224 bc	2.67 d	384 efg	8.67 ef
NC-8438	4	448 ab	15.67 cd	272 fg	15.67 def
NC-8438	8	8 e	1.33 d	49 g	1.33 f
MH	4	224 bc	1.00 d	975 bcd	48.00 cd
CF	2	512 ab	26.33 bc	752 c-f	74.33 bc
CF	3	672 a	18.33 cd	576 def	32.33 def
CF+MH	1+2	416 abc	10.67 cd	1119 bc	46.33 cd
CF+MH	1+3	528 ab	15.00 cd	656 c-f	25.33 def
CF+MH	2+2	831 a	15.00 cd	672 c-f	32.00 def
Check	-	752 a	56.67 a	1871 a	133.00 a

*Means followed by different letters indicate significant differences at Duncan's 5% level.

THE EFFECT OF GROWTH REGULATORS ON TURFGRASS SPECIES

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Abstract. Six chemicals were evaluated for growth retardant effects on Merion Kentucky bluegrass, Pennlawn red fescue, and Manhattan perennial ryegrass. The majority of the treatments caused reduced vertical growth which dissipated differentially with time. Significant seedhead repression was observed with Maleic hydrazide at 3, 6, and 9 lb/A; MHFC + MH at 1 + 3 lb/A; NC-8438 at 4 lb/A and 8 lb/A; and MBR 6033 at 6 and 8 lb/A. Abnormal yellow coloring of foliage was observed where MH was applied at 6 and 9 lb/A; or MHFC at 2, 3, and 5 lb/A on the three grasses tested. The degree of injury was proportional to the rate of chemical applied. Leaf curling was most severe with applications of MH at 9 lb/A, NC-8438 at 4 and 8 lb/A, and MBR 6033 at 6 and 8 lb/A rates. In general, clipping weight decreased with high rates of growth regulators. The most effective treatments at the 16th day harvest were MH at 9 lb/A, MBR 6033 at 8 lb/A, and NC-8438 at 4 and 8 lb/A. Ranking of treatments changed after 16 days. The most effective treatments in reducing clipping weights 47 days post-treatment were NC-8438 at 8 lb/A and MH at 9 lb/A. The three grass species did not appear to react consistently with all chemicals.

Introduction

A recent renewal of interest in the effects of growth regulators on turf has been due to (1) the formulation of new materials, and (2) the need to reduce the high mowing costs on turfgrass, roadsides, and recreation areas. Growth regulators could serve by reducing the number of mowings needed during the growing season and provide suppression of seed stalks of perennial grasses. Results from use of several growth regulator compounds on pure stands of Merion Kentucky bluegrass, Pennlawn red fescue, and Manhattan perennial ryegrass are the topic of this paper.

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Review of Literature

Turfgrass growth control is not a new idea. Maleic hydrazide as a grass growth inhibitor has been studied since 1949 (Engel and Ahlgren). Change in grass composition of turf has been reported following repeated applications of Maleic hydrazide[2/] over several years (Yemm, 1962). Tests conducted on turf areas adjacent to airfield pavements using Maleic hydrazide applied in April at 4 and 6 lb rates eliminated 5 mowings for the growing season. Maleic hydrazide applied in October 1961 at a 6 lb rate eliminated mowing until June 1962 (Williams, 1962).

Recent studies in chemical control of Poa annua L. in turfgrass and the effects of various chemicals on seed production indicate that the use of ethrel, Maleic hydrazide, and MF-415 + 416[3/] appear promising for preventing seed production of annual bluegrass (Jagschitz, 1970).

Methods and Procedures

The growth regulator tests initiated on May 3, 1970 on the turf research area at the New Jersey Agricultural Experiment Station, New Brunswick, New Jersey, consisted of six growth regulators sprayed on plots of Merion Kentucky bluegrass (Poa pratensis L.), Manhattan perennial ryegrass (Lolium perenne L.) and Pennlawn red fescue (Festuca rubra L.). The soil on the test site was Nixon loam. Cutting height was maintained at 3/4 inch for Merion Kentucky bluegrass and $1\frac{1}{2}$ inch for the Pennlawn and Manhattan turf during the preceding year. Fertilization consisted of 40 lb of 10-6-4 applied per 1000 ft^2 in four applications during the fall of 1969 and the spring of 1970. The grass was in the early stages of its flush of spring growth period when the growth regulators were applied.

Growth regulators were sprayed on plots measuring 3 x 20 ft, 3 x 18 ft, and 3 x 15 ft for the Merion Kentucky bluegrass, Manhattan ryegrass, and Pennlawn red fescue, respectively. A randomized block design was used, and treatments were replicated three times. Twenty entries were included in each replication plus two additional controls in the Merion test. Twelve entries and five entries made up the Manhattan ryegrass and Pennlawn red fescue tests, respectively. All wettable powders and emulsifiable concentrates were applied in water by use of a CO_2 powered knapsack sprayer calibrated to deliver 40 gpa of spray material.

2/ MH-30, U.S. Rubber Corporation.
3/ Posan (TM), Mallinkrodt Chemical Works.

The following chemical preparations were used in this study:

	Formulation %
MH[1/]	
diethanolamine salt of 6-hydroxy-3(2H)-pyridazinone	30.0
MH[2/]	
diethanolamine salt of 6-hydroxy-3(2H)-pyridazinone	22.0
inert ingredients	78.0
MHFC[3/]	
methyl-2 chloro-9-hydroxyfluorene-9-carboxylate	8.8
methyl 9-hydroxyfluorene-9-carboxylate	2.1
methyl 2,7-dichloro-9-hydroxyfluorene-9-carboxylate	1.6
inert ingredients	87.5
MHFC[4/]	
methyl-2 chloro-9-hydroxyfluorene-9-carboxylate	8.5
methyl 9-hydroxyfluorene-9-carboxylate	2.3
methyl 2,7-dichloro-9-hydroxyfluorene-9-carboxylate	1.7
inert ingredients	87.5
NC-8438[5/]	
(2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl) methanesulphonate	wettable powder 20% a.i.
MBR 6033[6/]	
chemistry undisclosed	e.c. 20% a.i.

1/ Maleic hydrazide MH-30 (equivalent to 30% MH - 1 gallon contains 3 lb MH). Registered Trade Mark Naugatuck Chemical Division, United States Rubber Company.

2/ MH formulation used with MHFC.

3/ Maintain CF-125(R) hereafter designated MHFC in tables, Trademark of United States Borax and Chemical Corporation.

4/ Po-sanA Mallinckrodt Chemical Works.

5/ Experimental compound, Fisons Corporation, Agricultural Chemicals Division, Wilmington, Massachusetts.

6/ Experimental compound, 3M Company, St. Paul, Minnesota.

Visual ratings of turf injury, measurements of blade height, estimated number of seed heads, and clipping weights were taken in May and June. Clipping weights were sampled on the Kentucky bluegrass test at 2-5/8 inches on May 19 (16 days). A 26-inch reel mower with catch basket was used to harvest an eight foot swath from each plot. Samples were air-dried, weighed for averages and the data transformed ($\sqrt{n+1}$) and subjected to analysis of variance. Duncan's Multiple Range Test (DMRT) was used to evaluate significance between means. Data in tables represent an average of untransformed weights with DMRT rankings. Clipping weights for Manhattan ryegrass and Pennlawn red fescue were taken on June 26 (54 days) using the same harvesting technique and data treatment.

Clipping weights taken at two stages on June 19 (47 days) provide a measure of growth and density on the Kentucky bluegrass test. Clippings obtained above 4-3/4 inches reflect differences in height and total growth for all treatments. A second clipping sample was obtained by following the 4-3/4 inch mowing with cutting to 3 inches to obtain a density measurement.

Height of vertical growth of Kentucky bluegrass was estimated from the means of four ruler measurements per plot; their significance was evaluated with DMRT values. Height measurements were repeated on June 1 (29 days) and June 16 (44 days) on both the mowed and unmowed portions of the plots, prior to second mowing, to determine any effects of the first mowing on residual action of the treatments.

Visual ratings of color and leaf curl (Merion exhibited varying degrees of leaf curvature and blade angle) were used as measures of growth regulator injury to the turf. Color was rated on the basis of percentage loss of normal color. Leaf curl was rated on a 1 to 5 scale where 5 = most severe, 1 = least severe, and 0 = control.

Visual estimates of percentage of normal stand of seedheads were made (0 = normal seed stalk, 10 = 100% suppression of seed stalks). Seed stalk estimates were made 47 days following treatments on Merion Kentucky bluegrass and 30 days after treatment on Pennlawn red fescue and Manhattan ryegrass.

Results and Discussion

MH, MBR 6033, and NC-8438 were effective in retarding growth, as shown by the clipping weight and height data (Tables 1 and 2). Reduction in clipping weight was in direct proportion to increments of chemicals (Table 2). The most effective treatments on Kentucky bluegrass at the 16th day harvest were MH at 9 lb/A, MBR 6033 at 8 lb/A, and NC-8438 at 4

Table 1. Height and seedhead reduction of Merion Kentucky bluegrass produced by five different growth inhibitor preparations applied May 3, 1970.

Chemical	Rate, lb a.i./A	Ht. at 16 days (cm)[a]	Ht. of unmowed at 29 days (cm)[a]	Ht. of mowed at 29 days (cm)[a,c]	Ht. of unmowed at 44 days (cm)[a]	Ht. of mowed at 44 days (cm)[a,c]	Seedhead suppression on unmowed at 44 days[b]
Control	-	7.4abc	26.6defg	13.5bc	29.4cde	19.0bcdef	0.3g
MH	3	5.8ab	22.5abcdefg	10.6ab	26.5bcd	14.6abc	7.7a
MH	6	6.7abc	22.4abcdefg	10.8ab	26.7bcd	15.6abcdef	8.0a
MH	9	5.1a	15.4a	7.1a	18.8a	12.1a	8.0a
MHFC	1	7.1abc	27.5efg	18.4c	29.4cde	20.8f	2.0e
MHFC	2	7.2abc	25.9cdefg	11.8ab	33.1de	19.4bcdef	4.3d
MHFC	3	6.3abc	27.5efg	10.7ab	27.1bcde	15.6abcdef	4.0d
MHFC	5	6.2abc	16.7ab	7.3a	25.4bc	14.1ab	6.3b
MHFC + MH	.25 + .50	8.6c	28.9g	13.5bc	31.7de	18.6bcdef	0.7f
MHFC + MH	.50 + 1.0	7.9bc	28.6g	14.2bc	34.1e	20.2def	0.7f
MHFC + MH	1 + 2	6.9abc	27.7efg	14.5bc	28.8cde	19.6cdef	5.3c
MHFC + MH	1 + 3	6.5abc	22.1abcdefg	11.4ab	25.9bc	16.1abcdef	8.0a
MHFC + MH	1 + 3	6.1abc	23.6abcdefg	14.1bc	27.9cde	14.2abc	7.7a
MBR 6033	1	7.9bc	28.1fg	12.9b	30.1cde	20.6ef	2.7e
MBR 6033	2	6.5abc	24.6bcdefg	13.2bc	30.2cde	20.5ef	2.6e
MBR 6033	4	5.5ab	19.1abcde	11.7ab	26.4bcd	20.4ef	6.3b
MBR 6033	6	5.2a	19.7abcdef	10.0ab	25.9bc	18.6bcdef	7.7a
MBR 6033	8	5.1a	17.7abc	9.3ab	20.6ab	18.4bcdef	7.3a
NC-8438	4	5.1a	22.2abcdefg	9.4ab	23.5abc	14.9abcd	8.0a
NC-8438	8	5.1a	18.1abcd	7.4a	23.5abc	14.2abc	7.7a

a/ Means having a letter in common are not significantly different at the 5% level (Duncan's Multiple Range Test).

b/ Seedhead suppression scale 0 to 10; 0 = no effect and 10 = most suppression.

c/ Mowed previously at 16 days.

Table 2. Clipping weights and turf injury on Merion Kentucky bluegrass from five different growth inhibitor preparations applied May 3, 1970.

Chemical	Rate, lb a.i./A	Clipping wt. at 16 days (g)[a]	Clipping wt. above 4-3/4" at 47 days (g)[a]	Clipping wt. at 3 to 4-3/4" strata after 47 days (g)[a]	Leaf curl injury at 17 days[b]	Loss of normal color at 29 days (%)
Control	-	244g	111g	224f	0.3	0
MH	3	127abcd	40bcd	153cdef	2.3	2
MH	6	194defg	46bcde	141cde	2.0	17
MH	9	106ab	8a	47a	4.3	33
MHFC	1	229efg	104fg	193f	1.0	0
MHFC	2	227efg	86efg	160cdef	1.8	22
MHFC	3	221efg	56bcdef	175def	1.0	25
MHFC	5	187cdef	31b	150cdef	1.3	45
MHFC + MH	.25 + .50	231efg	101fg	181ef	0.0	0
MHFC + MH	.50 + 1.0	293g	114g	166def	0.0	2
MHFC + MH	1 + 2	206defg	109g	201f	2.3	0
MHFC + MH	1 + 3	161bcde	35bcd	153cdef	3.3	8
MHFC + MH	1 + 3	140abcd	64cdefg	178ef	3.0	12
MBR 6033	1	220efg	107fg	136cd	1.8	0
MBR 6033	2	144abcde	89efg	190f	1.8	0
MBR 6033	4	114abc	81efg	189f	3.7	0
MBR 6033	6	111abc	68defg	181ef	4.0	0
MBR 6033	8	82a	54bcde	177def	4.0	0
NC-8438	4	97ab	24bc	107bc	3.7	20
NC-8438	8	110ab	4a	62ab	4.3	42

[a] Means having a letter in common are not significantly different at the 5% level (Duncan's Multiple Range Test).

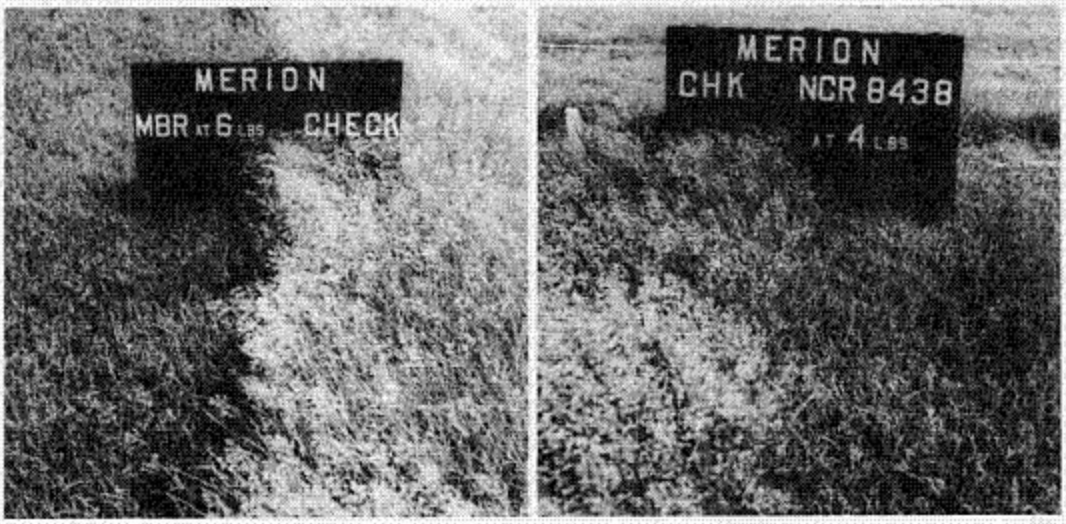
[b] Leaf curl scale 0 to 5; 0 = no effect and 5 = most injury.

and 8 lb/A. The relative ranking of the chemicals changed during the time period between 16 and 47 days. MBR 6033 applied at 8 lb/A was very effective at 16 days but its effect diminished by 47 days. The most effective treatments at 47 days were NC-8438 at 8 lb/A and MH at 9 lb/A. These two treatments were also most effective in reducing clipping weights above the height of 3 to 4-3/4 inches. Similar differences in growth were obtained from reclipping the same plots at 3 inches after the 4-3/4 inch mowing. The respective ranking of treatments based on reclipping weights remained essentially the same as the first clipping on that date (Table 2).

The height measurements at 16 days on Kentucky bluegrass showed that the majority of the treatments reduced vertical growth; however, when statistically tested the means appear closely grouped. The height measurements at 29 days on the mowed section had fewer discrete groupings among treatment means than the unmowed section. This, plus the fact that regrowth was generally good between mowings, suggests that mowing caused some dissipation of retardants. The treatments which produced the least vertical growth in the unmowed plots also produced the least in the mowed plots at this stage. The height measurements at 44 days again had very distinct groupings. The retardation effects appeared to be decreasing and only the highest rates of the materials were giving obvious growth control as measured by height and weight reduction in either unmowed or mowed plots (Tables 1 and 2, Figures 1 and 2).

Seedhead numbers on Kentucky bluegrass were significantly reduced by treatments with MH at 3, 6, and 9 lb rates as well as MHFC + MH at 1 + 3 lb, NC-8438 at 4 and 8 lb, and MBR 6033 at 6 and 8 lb/A (Table 1, Figures 1 and 2). Only the best of the above treatments were sufficiently free of distractive seedheads for fine turf purposes.

Severe loss of greenness was characteristic of MH at 6 and 9 lb/A, MHFC at 2, 3, and 5 lb/A, and NC-8438 at 4 and 8 lb/A rates, in all species tested. MBR 6033 did not produce any abnormal color in the Merion but did in the Pennlawn and Manhattan (Tables 2, 3, and 4). All injured turf recovered during July and August.



Figures 1 and 2. Growth and seedhead suppression caused by MBR 6033 and NC-8438 at rates indicated, applied May 3, photographed May 28.

Leaf curl of the treated Kentucky bluegrass plots was a characteristic response of the higher rates of certain chemicals. The degree of this injury was proportional to the increments of chemical. The most severe effects occurred with treatments of MH at 9 lb/A, NC-8438 at 4 and 8 lb/A, and MBR 6033 at 6 and 8 lb/A rates.

In the Manhattan ryegrass test the most effective treatments for reducing clipping weight and height were MHFC + MH at 1 + 2 and 1 + 3 lb, and MH at 3 and 9 lb/A. The discoloration injury was proportional to the growth suppression in terms of both height and average clipping weight. The 3 and 9 lb rates of MH, and MH + MHFC at 1 + 3 lb/A produced severe browning of the turf (Table 3).

In the Pennlawn test MHFC at 2 lb/A and MH at 6 lb/A significantly reduced the clipping weights and seedhead production while producing severe browning of the turf (Table 4).

The discoloration injury and leaf curl on the three turfgrass species associated with high rates of certain growth regulators is largely unacceptable in the management of fine turf. This degree of injury might be acceptable for turf areas under less intensive management if loss of stand does not occur. This might apply particularly where vertical height control, seedhead suppression, and minimizing the number of costly mowings are of primary concern.

Table 3. Manhattan perennial ryegrass response to growth regulators applied May 3, 1970

Chemical	Rate lb/A a.i.	Clipping wt. at 54 days (g)1/	Ht. of growth at 30 days (cm.)1/	Loss of color at 30 days %
Check	-	245.0a	14.6cd	0
MHFC+MH	1+2	62.0bc	13.1bcd	22
MHFC	1	169.0ab	12.4abcd	17
MHFC	2	171.0ab	15.9d	17
MHFC+MH	1+3	11.7c	8.1a	57
MH	3	50.3bc	10.3abc	47
MH	9	49.0bc	9.4ab	42
MBR-6033	1	128.0abc	11.8abcd	0
MBR-6033	4	103.0abc	12.7bcd	17
MBR-6033	8	172.0ab	9.6ab	38
NC-8438	4	139.0abc	13.1bcd	0
NC-8438	8	151.0abc	13.2bcd	0

1/ Means having a letter in common are not significantly different at the 5% level. (Duncan's Multiple Range Test)

Table 4. Pennlawn red fescue response to growth regulators applied May 3, 1970

Chemical	Rate lb/A a.i.	Loss of color at 30 days %	Ht. of growth at 17 days (cm.)1/	Seedhead suppression at 30 days2/	Clipping wt. at 54 days (gm)1/
Check	-	0	15.6c	0	190c
MHFC+MH	.50+1.0	10	11.3ab	3.0	199c
MHFC	2	45	9.6a	8.8	52ab
MH	6	50	11.9ab	9.1	58a
MBR-6033	2	20	14.3bc	1.8	181c
NC-8438	4	10	11.8ab	5.8	123bc

1/ Means having a letter in common are not significantly different at the 5% level. (Duncan's Multiple Range Test)

2/ Seedhead suppression scale 0-to10, 0=no effect and 10=most suppression.

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REDUCTION IN WATER LOSS IN SOYBEANS AS EFFECTED BY SOME N-PHENYLUREA HERBICIDES

M. M. Lay and R. D. Ilnicki[1/]

Abstract

The objectives of the study reported herein were as follows: (a) to determine the relationship of molecular structure of substituted urea herbicides to the degree of water loss from soybean plants (Glycine max Merr. var. Adelphia) when applied in nutrient solution or foliarly; (b) to investigate the relationship of the activity of various urea herbicides as transpiration inhibitors to their activity as Hill-reaction inhibitors; and (c) to study the effect of diuron on water loss in excised shoots and intact plants of soybeans.

Nine compounds of the substituted urea type which included 1,1-dimethyl-3-phenylurea (fenuron), 3-(p-chlorophenyl)-1,1-dimethylurea (monuron), 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron), 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron), 3-(3-chloro-4-bromo=phenyl)-1-methoxy-1-methylurea (chlorbromuron), 3-(p-bromophenyl)-1-methoxy-1-methylurea (metobromuron), 1,1-dimethyl-3-(α,α,α-trifluoro-m-tolyl)urea (fluometuron), 3-(3,4-dichlorophenyl)-1-methylurea (DMU), and 3-(3,4-dichlorophenyl)-1-methoxyurea were applied at several equimolar levels in nutrient solution to excised shoots of soybeans or applied to the foliage as a spray.

Water loss was expressed by transpiration rate which was determined as grams per hour per sq. dec. of leaf area. Leaf area was determined by tracing the leaves onto paper and measuring patterns with a planimeter to the nearest 0.01 cm^2.

Excised shoots were held in a half-strength complete nutrient solution for 96 hours at chemical concentrations of 2×10^{-6}M. The relative reduction of water loss, based on cumulative transpiration after herbicide treatment was in the following order for the chemicals evaluated: diuron > monuron > DMU > fluometuron > metobromuron > chlorbromuron > linuron > fenuron > 3-(3,4-dichlorophenyl)-1-methoxyurea < untreated control. All chemicals reduced water loss at 4×10^{-6}M concentration when applied via nutrient solution.

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Reductions of water loss from foliage applications, however, were in the following order: linuron > monuron > DMU > metobromuron > fenuron > 3-(3,4-dichlorophenyl)-1-methoxyurea > fluometuron > diuron > chlorbromuron > untreated control.

In Hill-reaction studies in vitro, the inhibition of the Hill-reaction was measured by spectrophotometer measurement of the reduction of 2,6-dichlorophenolindophenol (1.1×10^{-4}M). Chloroplasts were suspended in a 0.02M phosphate buffer solution containing 0.05% KCl. The pH of the solution was 6.5 and the chlorophyll concentration was 1.3 mg/ml. At 2×10^{-6}M all herbicides inhibited the Hill-reaction.

When roots were removed and stems suspended in nutrient solution, diuron concentrations ranging from 10^{-7}M to 10^{-6}M stimulated water loss. At higher concentrations, water loss was reduced. However, when roots of intact plants were suspended in the solution, water loss was reduced as concentrations were reduced from 8×10^{-6}M down to 2×10^{-6}M. When the same rate of diuron was used, the reduction of water loss was greater for excised shoots than for intact plants.

Results from water loss studies indicate that compounds having methyl groups in the 1-N position reduce water loss more than those with methoxy groups, when applied in nutrient solutions. However, compounds with one methoxy group reduce water loss more than those containing methyl groups when applied foliarly. The data also suggest that photosynthetic inhibition could be a mechanism of action for causing stomatal closure and thus cause reduced water loss.

THE UPTAKE AND TRANSLOCATION OF NAPTALAM-C-14 AND CHLORPROPHAM-C-14 IN VACCINIUM MACROCARPON, VAR. EARLY BLACK

by

Robert W. Yaklich and Robert M. Devlin[1/]

ABSTRACT

The uptake and translocation of C-14 label from naptalam and chlorpropham was followed in the cranberry plant. The pattern of C-14 label uptake was similar for both herbicides with the greatest concentration of label found in the roots followed by stems and leaves. The uptake of the C-14 label increased with length of exposure to the two herbicides.

INTRODUCTION

One of the most popular herbicides used by southeastern Massachusetts cranberry growers is a formulated mixture of N-1-naphthylphthalamic acid (naptalam) and isopropyl m-chlorocarbanilate (chlorpropham). In an earlier publication, Devlin and Demoranville (2) showed that cranberry vines were very tolerant of the naptalam-chlorpropham mixture. Research was undertaken to elucidate this selectivity. The present paper describes results of an investigation to determine the uptake and translocation of naptalam and chlorpropham in the cranberry plant (Vaccinium macrocarpon Ait., var. Early Black.

MATERIALS AND METHODS

Cranberry plants were obtained by vegetative propagation and transferred to 125 ml erlenmeyer flasks containing 80 ml of Hoaglands No. 1 nutrient solution (3). The flasks were covered with aluminum foil and the plant held erect by cotton plugs. One-half of the flasks contained 0.5 µc naptalam-C-14 (phthallic label, specific activity 0.5 mc/mm), and the other half 0.5 µc chlorpropham-C-14 (ring label, specific activity 4.3 mc/mm). Duplicate plants for each compound were allowed to absorb the herbicide for 1, 3 and 7 days. All growth and treatments were performed in the greenhouse. No special control of physical conditions was attempted, but all comparable treatments were made simultaneously and so were subjected to the same environmental fluctuations.

After the prescribed treatment period the plants were removed and the roots washed. The plants were then separated into roots, stems, and leaves and pressed in a plant press. After 10 days, they were removed and autoradiographed (1) using Kodak, single coated X-ray film SB-54 and allowed to develop for 14 days. One plant from each duplicate was extracted for total radioactivity. Those treated with naptalam were extracted with redistilled methanol and those treated with chlorpropham with redistilled diethyl ether. The plants were

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extracted 3 times and the extracts were evaporated to dryness in scintillation vials. After extraction, the plant material was dried at 45°C for 24 hrs and weighed.

Radioactive materials were counted by liquid scintillation using a Nuclear-Chicago liquid scintillator, Model 6804. Each scintillation vial contained 10 ml of toluene solution (5.0 g of PPO and 0.1 g of POPOP per liter of solution). Untreated plants were extracted in the same manner and used to correct for quenching by assuming that interfering compounds were equal in the various replicates. Subsamples were taken from the scintillation vials and counted on a Nuclear-Chicago low-background, Q-gas counting system, Model 4312, as a check for accuracy.

RESULTS

Uptake of naptalam. After one day of treatment with naptalam-C-14 the C-14 label was apparent in the root and had migrated into the lower stem. No evidence of radioactivity in the leaves could be detected in the autoradiograph. After three days of treatment radioactivity was observed in the roots, lower stem, and lower leaves. However, there was no image on the autoradiograph for the upper stem and leaves. After seven days the C-14 label was discernable in all portions of the plant. By far the most radioactivity was found in the roots with the leaves and stems containing just enough C-14 label to make an image on the autoradiograph. None of the autoradiographs of naptalam-treated plants displayed sharp images for the translocation of the C-14 label into the veins of the leaves.

Uptake of chlorpropham. Cranberry vines treated for one day with chlorpropham-C-14 were labeled in the roots, lower stem and leaves. After three days the C-14 label produced images for all parts of the plant, although the upper stem and leaves were only faintly visible. The autoradiograph from the plant treated for seven days contained heavy labeling, especially in the roots. The image of the stem and leaves were much more distinct than in the 3-day treatment. Also, the images of the leaf veins were prominent.

Total radioactivity determination. The results of the radioactivity determinations on the different plant parts showed an increase of the radioactive label with time (Table 1). The highest amount of radioactivity was found in the roots followed by the stem and leaves in that order. These results compare with the autoradiograph studies.

Table 1. Amount of radioactivity extracted from cranberry plants treated with naptalam-C-14 and chlorpropham-C-14.

Plant Section	Radioactivity (dpm/g dry wt.)[a]					
	Naptalam			Chlorpropham		
	Time after treatment (days)					
	1	3	7	1	3	7
Leaves	1,009	1,691	1,627	316	2,061	2,834
Stem	0	2,844	18,728	981	11,081	45,808
Root	14,609	35,775	38,011	335,526	505,329	739,602

[a] One plant was used for each treatment period.

DISCUSSION

From the results presented, it is apparent that the C-14 label from both herbicides was absorbed and translocated when applied through the root medium. Thus, it appears that the tolerance displayed by the cranberry plant to the herbicide formulation (naptalam-chlorpropham) was not due to the lack of absorption and translocation. However, it is not known whether there is a synergistic or antagonistic influence on uptake and translocation when naptalam and chlorpropham are applied as a formulated mixture. Further research will give a better understanding of these relationships.

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EFFECTS OF THE ADDITION OF SURFACTANTS AND VEGETABLE-MINERAL OIL COMBINATIONS FOR TURFGRASS WEED CONTROL[1/]

K. J. McVeigh, R. E. Engel and R. D. Ilnicki[2/]

Abstract

Twelve different spray adjuvants were used in turf herbicide treatments to determine if they increased herbicidal efficiency. The phytobland parafin base oil (Sun Oil Co. #11) was used alone and in experimental formulations containing #11 plus vegetable oils. The vegetable oils from safflower, linseed, rapeseed, sunflower, cottonseed, soybean, and peanut were evaluated. The spray adjuvants used were AL-209 and AL-411F (Atlas Chemical Co.) and TRONIC (Colloidal Products Inc.). The herbicide (2,4-dichlorophenoxy) acetic acid (2,4-D) was evaluated with the adjuvants for the control of broadleaf plantain (Plantago major) and dandelion (Taraxacum officinale) while the herbicide disodium methanearsonate (DSMA) was used with the same materials for the control of crabgrass (Digitaria sanguinalis). All evaluations were conducted in the field on a predominantly bluegrass (Poa pratensis) turf.

Slight differences in degree of control were noted with certain combinations. The lower rates of herbicide in combination with the adjuvants were generally superior to the herbicide alone.

1/ From a thesis by K. J. McVeigh in partial fulfillment of the requirement for the M.S. degree at Rutgers University.

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EFFECT OF ATRAZINE ON ION UPTAKE BY CORN

W. F. Smith and K. J. McVeigh[1/]

Abstract. Corn plants (Zea mays, var. N.J. 9) treated in solution culture with 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine (atrazine) at concentrations of 0.5, 1.5, and 4.5 ppm contained more total K, Mg, and P in specific plant tissue than did untreated controls. Data expressed as total amount of element (percent x dry weight) are considered better indicators of ion uptake than percent of element in tissue alone. A concentration of 0.5 ppm atrazine resulted in a 24% increase of K in stems, 16% increase of K in leaves, 23% increase of P in leaves, and 71% increase of Mg in roots. Atrazine at 1.5 ppm resulted in an 85% increase of Mg in roots. The 4.5 ppm atrazine level resulted in increases of 22% P in leaves and 45% Mg in roots.

Introduction

Changes in the mineral composition of higher plants resulting from applications of triazine herbicides have been reported by various investigators. Freney (3) has shown that low concentrations of simazine resulted in increased amounts of P, Mg, and K in the tops of corn plants. Adams (1) has reported increases in the mineral content of soybeans treated with sublethal doses of atrazine. MacKenzie (4) and co-workers have published data indicating that 1-10 ppm atrazine in a soil mix increased the percentage of P, K, and Ca and additional micronutrients in corn tissue.

The objective of the experiment reported here was to determine the effect of three concentrations of atrazine on the Ca, Mg, P, and K content of corn root, stem, and leaf tissue. The data are reported in both percentage and total amount of the element in the plant. The data for total amount are considered a reflection of ion uptake.

Materials and Methods

The experiment was designed as a randomized complete block consisting of four treatments: control, 0.5, 1.5, and 4.5 ppm atrazine, replicated three times.

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Three 14-day-old corn seedlings were transplanted into 3.5-liter solution culture jars. The corn received a complete nutrient solution consisting of the following concentration of elements (ppm): 56 N as NO_3, 28 N as NH_4, 30.9 P, 78 K, 80 Ca, 24 Mg, 88 S, 2 Fe-EDTA, 0.1 B, 0.01 Cu, 0.1 Zn, 0.01 Mo, 0.32 Cl, and 0.25 Mn. Jars were siphoned and refilled each week with fresh solution. Serial dilutions of 97.6% technical atrazine[2/] were used to prepare desired concentrations of the herbicide. Treatments were started two weeks after transplanting and were continued for 14 days. At the end of the treatment period, plants were harvested, divided into leaves, stems, and roots, dried, and dry weights recorded.

One gram samples from each tissue were digested and analyzed for Ca, K, and Mg using the Perkin Elmer atomic absorption spectrophotometer. Phosphorus was measured by the molybdate blue colorimetric procedure of Dickman and Bray (2).

The data obtained were expressed as percent element in tissue as well as total amount of element in tissue (percent x dry weight). All data were subjected to analysis of variance and Duncan's Multiple Range Test.

All experiments were conducted in the Rutgers Plant Physiology greenhouse under conditions of available light during the months of March and April 1970.

Results and Discussion

Results for dry weight, percent of each element, and total amount of each element are presented in Tables 1 through 4.

Dry weights were significantly different at the 10 percent level but not at the 5 percent level. Lack of significant differences at the 5 percent level might lead one to assume percentage data alone would reflect ion uptake. If this were the case and the data were analysed based on the assumption that there was no change in dry weights due to treatments, 10 significant increases in percentage data could be reported with the majority of increases occurring at the 4.5 ppm level.

Significant differences reported for total amount of element present in each tissue do not necessarily coincide with those reported for percentage data. An example of this fact can be seen by examining the data for K in roots. Percentage data indicates a significant increase in K occurred

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2/ Supplied by the Geigy Chemical Corporation, Ardsley, New York.

in roots treated with 4.5 ppm atrazine. However, no significant increase was obtained for total amount of K in roots at the same level. The explanation for this lack of agreement between data is attributed to a real reduction in dry weight caused by the herbicide. The point to be emphasized from these data is that even though no significant differences in dry weight are obtained at some arbitrary probability level, caution should be exercised before concluding that percentage data alone reflect changes in ion uptake.

Further examination of the data indicates the 0.5 ppm level of atrazine caused significant increases in total amount of K in stems, K in leaves, and P in leaves. At the 1.5 ppm level, Mg in roots was increased and at 4.5 ppm, P in leaves and Mg in leaves were increased. The data do not suggest any consistent pattern for greater accumulation of ions in one tissue. However, one observation does remain consistent for all tissues; no increase in Ca resulted under any treatment. If Ca is assumed to be taken up passively as is suggested by the data of Moore (5) and K, Mg, and P actively, then it seems probable that the herbicide may be stimulating energy processes involved in active uptake.

Table 1. Average dry weight of corn plants treated with atrazine (g/plant).

	Roots	Stems	Leaves
Control	2.5a[1/]	2.3a	4.5a
0.5	2.5a	2.3a	4.6a
1.5	2.9a	2.2a	4.7a
4.5	1.8a	1.5a	3.8a

1/ Averages in the same column followed by a common letter are not significantly different from each other according to Duncan's Multiple Range Test at the 5 percent level.

Table 2. Mineral content of roots of corn plants treated with atrazine.

	Ca		K		Mg		P	
	%[1]	mg[2]	%	mg	%	mg	%	mg
Control	0.31a[3]	7.7ab	2.1ab	52.5a	0.17a	2.4a	0.89a	23.3a
0.5	0.39a	9.6b	2.6bc	65.0a	0.29b	7.2bc	0.92a	23.0a
1.5	0.33a	9.6b	1.9a	55.1a	0.27ab	7.8c	1.01ab	29.3a
4.5	0.34a	6.1a	2.8c	50.4a	0.34b	6.1b	1.18b	21.2a

Table 3. Mineral content of stems of corn plants treated with atrazine.

	Ca		K		Mg		P	
	%	mg	%	mg	%	mg	%	mg
Control	0.45a	10.4a	4.1a	94.3a	0.24a	5.5a	1.07a	24.6a
0.5	0.47a	10.8a	5.1b	117.3b	0.25a	5.7a	1.04a	25.9a
1.5	0.48a	10.6a	4.3ab	94.6ab	0.33ab	7.2a	1.03a	22.7a
4.5	0.58a	8.7a	4.8b	82.0a	0.41b	6.1a	1.16a	17.4a

Table 4. Mineral content of leaves of corn plants treated with atrazine.

	Ca		K		Mg		P	
	%	mg	%	mg	%	mg	%	mg
Control	0.42a	18.9a	2.9a	130.5a	0.12a	5.4a	0.82a	36.9a
0.5	0.38a	17.5a	3.3b	151.8b	0.12a	5.5a	1.01ab	45.4b
1.5	0.40a	18.8a	3.0ab	141.0a	0.16a	7.5a	0.84ab	39.5ab
4.5	0.47a	17.9a	3.7c	140.6a	0.17a	6.4a	1.19b	45.2b

1/ Average percent element in tissue.
2/ Average total amount of element in tissue expressed in milligrams.
3/ Averages in the same column followed by a common letter are not significantly different from each other according to Duncan's Multiple Range Test at the 5 percent level.

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OPTIMUM PARAMETERS OF MEASUREMENT AND ENVIRONMENTAL CONTROL OF VARIABILITY IN BLACK VALENTINE BEAN PLANTS GROWN FOR EXPERIMENTAL USE

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ABSTRACT

The production of suitable plant material is a basic problem to all investigators, particularly those involved in programs evaluating large numbers of test compounds where space, time, and equipment are limited. To reduce this problem investigations were conducted to determine the conditions under which beans (Phaseolus vulgaris L. var. Black Valentine) could be grown in solution culture to insure the most desirable population of test plants combining minimum variability with rapid growth and normal development, thus reducing the number of replications required.

Seeds were germinated in white silica sand in the growth chamber at 25 ± 2 C and 55 ± 5% relative humidity. Seedlings were transplanted to solution culture when ca 10-12 cm tall and were held at 25 C for 24 hours until transferred to the various temperature regimes. Illumination of 1400 ± 100 ft-c was provided by a mixture of fluorescent and incandescent lamps. Environmental parameters investigated included: temperature, 20, 25, and 30 C; concentration of Hoagland's nutrient solution, 0.25-, 0.5-, and 1.0-strength; and aeration vs nonaeration. A total of 15 growth measurements were obtained for each plant: interim heights at 3, 7, and 12 days; height at the termination of the experiment, i.e., 14 days; and fresh and dry weights of tops, roots, selected trifoliolates, and total plant (tops plus roots) at termination of experiment.

Under our conditions the combination of 25 C, 0.5-strength nutrient solution, and aeration provided the best population of bean plants. The statistical analysis indicated that the measurements most sensitive to these variables were in order of rank: (1) fresh weight of tops, (2) dry weight of tops, and (3) fresh weight of total plant or height at 7 days. Coefficients of variation indicated that the least variable measurements were in rank: (1) fresh weight of tops, (2) fresh weight of second trifoliolates, (3) combined fresh weight of total plant, and (4) dry weight of tops. Fresh weight of tops showed the most sensitive response to these environmental factors and exhibited the least variability. Fresh and dry weights of roots and trifoliolates were relatively insensitive to these treatments. Interim heights at 7 and 12 days and dry weight of roots were the most variable measurements recorded.

It should be realized that the results of this study do not necessarily indicate the specific measurements which should be used in evaluating a particular pesticide or other chemical, but rather indicate the degree of variability and the sensitivity of the Black Valentine bean plant to these environmental factors. When proper growth conditions are not provided, sporadic growth of test plants may result and necessitate larger populations of experimental plants to compensate for increased variability.

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EFFECT OF ADJUVANTS ON THE FOLIAR ABSORPTION OF BROMACIL BY BLACK VALENTINE BEANS

W. Hurtt[1/]

ABSTRACT

Although 5-bromo-3-sec-butyl-6-methyluracil (bromacil) is generally thought of as a grass killer, it is also known to be effective against dicotyledonous plants. Previous root-uptake studies in solution culture in this laboratory have shown that 0.2 mg/L of bromacil will cause death of bean plants (*Phaseolus vulgaris* L. var. Black Valentine) in 8 days. Because the Black Valentine bean plant exhibited such sensitivity to bromacil in this idealized growth chamber system, it was logical to ask what the comparative phytotoxicity would be for foliar applications. This study was initiated to determine if a significant phytotoxic effect could be obtained from foliar applications of technical grade bromacil to Black Valentine bean plants, to compare several adjuvants with respect to their ability to potentiate foliar absorption, and to evaluate uptake directly through petioles when the leaf blade has been removed.

Nine-day-old plants in solution culture were treated with 100 μg of bromacil by applying ten 10-μl droplets of a 500 mg/L solution of bromacil to each primary leaf. The chemical was applied in water, in 0.2% (v/v) Tween 20, in 0.2% (v/v) WK,[2/] and in 10% (v/v) AL 411-F,[3/] a blend of an adjuvant and a nonphytotoxic paraffinic spray oil. The plants were harvested 8 days later. Bromacil alone caused less than 4% inhibition of dry weight of tops. The bromacil + adjuvant treatments caused from 28 to 30% inhibition of top weight and from 26 to 29% inhibition of root weight. These treatments were not significantly different from each other ($P < 0.05$). The experiment was repeated with 11-day-old beans with a 20% (v/v) level of 411-F. The data from this experiment also indicated that the bromacil + adjuvant treatments were not significantly different from each other.

Eighteen-day-old bean plants growing in solution culture were treated with 100 μg bromacil in 1 ml by excising one primary leaf blade from each plant and placing the petiole in a small vial containing the herbicide but no adjuvant. Controls were treated with water. The vials were refilled with water as needed over the 8-day-treatment period. Some leaves abscised on all plants and a few plants died from the bromacil treatment. Bromacil caused 83% inhibition in height growth ($P < 0.1$), 61% inhibition of top weight ($P < 0.05$), and 65% inhibition of root weight ($P < 0.1$).

Previous studies showed that bean plants died from a 200 μg application of bromacil to 1 liter of nutrient solution. The results of this study show

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that a foliar application of 100 μg of herbicide + adjuvant will, at best, cause a 30% inhibition of root or shoot growth, whereas 100 μg of herbicide applied to a petiole, from which the blade has been detached, will cause a 60 to 65% inhibition of root or shoot growth. These data suggest that the minimal phytotoxicity of foliarly-applied bromacil is attributable to limited foliar absorption by intact leaves.

SOIL-APPLIED HERBICIDES IN THE CONTROL OF TEMPERATE ZONE GRASSES, BROADLEAF WEEDS AND WOODY PLANTS

R. D. Shipman 1/ and R. C. Bunker 2/

INTRODUCTION

For a period of eighteen months, studies have been in progress on the effectiveness, rapidity of action and duration of vegetation response in native stands of central Pennsylvania grasses, broadleaf weeds and woody plants.

MATERIALS AND METHODS

A total ecological assessment of the vegetation response is being made with granular/pelleted and/or liquid spray formulations of bromacil, Tandex, picloram, diuron and fenuron.

The duration of residues and rates of leaching and degradation of bromacil, Tandex and picloram is being evaluated by bioassay techniques in soil samples taken from treated areas at periodic intervals following treatment. Laboratory studies are being conducted employing oats and cucumber seeds as test plants for the determination of soil residues and degradation of the above-named herbicides.

Residue determinations are made from composited soil samples obtained at four soil depths (0-3, 3-6, 6-12 and 12-18 inches) at each of four major soil types collected at 1, 3, 6, 12 and 18 months after treatment. Duplicate plots of the medium and heavy rates of application of granular bromacil, Tandex and picloram have been established in field plots from which the soil samples are obtained for bioassay.

At each of four test sites, 11 chemical treatments plus controls, replicated three times on 200 square foot plots (10 x 20 feet) were established in March, 1969. All chemicals were applied to the test plots during the period May 3-13, 1969. The chemicals being tested are:

	Chemical	Formulation	Rates in lb/acre (a.i.)		
1.	Bromacil	85% granule	5	10	20
2.	Bromacil	80% WP	5	10	20
3.	Diuron	8% granule	10	20	30
4.	Tandex	50% granule	5	10	20
5.	Tandex	80% WP	5	10	20
6.	Fenuron	25% pellet	10	20	30

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	Chemical	Formulation	Rates in lb/acre (a.i.)		
7.	Picloram	10% pellet	2	5	10
8.	Picloram plus bromacil (1:4)	11.25% pellet plus 45% granule	6 1/4	12 1/2	25
9.	Picloram plus Tandex (1:4)	10% pellet plus 45% granule	6 1/4	12 1/2	25
10.	Picloram plus diuron (1:8)	33.3% granule plus 8% granule	11 1/4	22 1/2	25
11.	Diuron plus bromacil (1:1)	5% granule plus 4% granule	5 5/8	11 1/4	22 1/2

Evaluations of the area-wise response as well as individual species response occurring on treated and control plots, are rated on a scale of 0 to 10 in which 10 represents complete effect (topkill or defoliation). The percent of kill on an areawise basis is being made at 1, 2, 3, 4, 6, 12 and 18 months after treatment. All species have been identified and taxonomically classified and this information will be used as a basis for a susceptibility rating by chemical and rate applied.

To assess the successional stages of the treated and untreated vegetation, all plots were photographed at 5 and 17 months after treatment.

During the 1969 and 1970 growing seasons, soil moisture readings at 4 and 12 inch depths were obtained every third day at three stations on each of the four soil types represented. At identical sampling intervals, records were obtained on the amount of rainfall, maximum-minimum air temperature, and surface soil temperature on each site.

Additionally, the soils at each location have been characterized according to soil texture (by horizons), bulk density and nutrient content including N, P, K, Ca and Mg levels. Other chemical soil factors being measured are pH and organic matter content. The degree of soil moisture depletion at each site is being determined by a soil pit of known dimensions (2 x 3 x 6 feet) in which the water depths are measured periodically throughout the growing season.

SUMMARY

An attempt will be made to statistically quantify the effects of the external environment (soils, climate and vegetation) on the response of various herbicides applied.

The major long-term objective of these trials is to provide data about soil-applied herbicides that can be evaluated on the basis of the total ecosystem concept.

β-PINENE POLYMERS: A NEW METHOD OF INCREASING THE EFFICACY OF FOLIARLY-APPLIED HERBICIDES

W. Hurtt and A. R. Templeton[1/]

ABSTRACT

Increasing concern and awareness of pesticide residues has accentuated the need for better methods of controlling residue levels. Increasing their efficacy, reducing their loss from application site to the biosphere, and temporarily protecting them from degrading environmental stresses are methods by which rate reductions and subsequent lower residue levels may be achieved. The purpose of this study was to determine if polymers of β-pinene (Pinolene)[2/] could be used to enhance the phytotoxicity of a commercial formulation of the dimethylamine salt of (2,4-dichlorophenoxy)acetic acid (2,4-D). Pinolene, a natural non-toxic product derived from pine resins, has a tolerance exempt status for agricultural use as an adjuvant and has been reported to prolong the effects of several insecticides and fungicides. The results presented herein are the first reported data concerned with Pinolene-herbicide combinations and conclusively demonstrate that Pinolene significantly enhances the phytotoxicity of 2,4-D.

Test plants were grown in 1-qt pots containing standard greenhouse soil for 3-4 days following emergence in the greenhouse and then transferred to growth chambers at 23 ± 1 C for ca 12-14 days to retard excessive internode elongation. Several days prior to treatment the plants were returned to the greenhouse for acclimatization. Treatments were applied 23 days after planting with an atomizer-type sprayer at 1.5 psi. The total volume of application was equivalent to 38 gpa with water as the diluent in all treatments. Two formulations of Pinolene were used in preliminary studies. We arbitrarily chose the Pinolene-17 formulation for use in these experiments. Because light is presumably required to initiate the polymerization of Pinolene, all plants including the controls were placed outside for a 3- to 4-hour period after spray application. During this period the plants were exposed to measured light intensities varying from 3000 to 7000 ft-c in experiment one and 2000 to 3000 ft-c in experiment two. In both experiments the plants were subjected to wind gusts estimated at 5 to 15 mph. With one noted exception temperatures in the greenhouse were maintained at 25 ± 2 C. Fresh and dry weight determinations were made of plant tops 11 days after treatment.

In experiment one, soybeans (*Glycine Max* var. Lincoln) and common beans (*Phaseolus vulgaris* L. var. Black Valentine) were treated with 1 gpa of Pinolene, 0.05 lb/A 2,4-D and 0.05 lb/A 2,4-D + 1 gpa of Pinolene. This rate of 2,4-D had previously been determined to give a sublethal response such that any enhancement would be readily apparent. When the plants were placed outside they were exposed to temperatures that gradually increased from 20 to 25 C; however, when they were returned to the greenhouse they were subjected

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[2/] Distributed by Miller Chemical and Fertilizer Corporation.

to environmental stresses in which temperature peaked at 36 C and relative humidity dropped to 24%. The soybean dry weight data showed that the addition of Pinolene increased the phytotoxicity of 2,4-D from 35% inhibition of growth to 66% ($P < 0.05$), and the Black Valentine bean data showed an increase in effectiveness from 17% to 43% ($P < 0.01$). Pinolene alone did not significantly affect the growth of the plants.

In experiment two, morning glory (Ipomoea purpurea var. Heavenly Blue) and radish (Raphanus sativus var. Scarlet Globe) were added to the previous species tested. Additional growth parameters used as a measure of phytotoxicity were weight of roots (radish only) and growth in height from day of treatment to day of harvest for both genera of bean. The treatments were 1 gpa of Pinolene, 0.1 lb/A 2,4-D, and 0.05 lb/A 2,4-D + 1 gpa of Pinolene. When the treated plants were placed outside they were exposed to temperatures that varied between 11 and 14 C. The data for this experiment, again, showed that Pinolene alone had no significant effect on plant growth. The respective 2,4-D and 2,4-D + Pinolene inhibition comparisons for dry weight or height were as follows: Black Valentine bean, 32% vs 34%; Black Valentine bean height, 84% vs 82%; soybean, 36% vs 42%; soybean height, 85% vs 82%; morning glory, 43% vs 38%; radish tops, 46% vs 37%; and radish roots, 67% vs 50%. These values were not significantly different at $P < 0.01$.

Although Pinolene has been shown to protect other pesticides from degrading environmental stresses, we cannot make such a statement for 2,4-D at this time since we have not specifically studied these factors. However, we can unequivocally state that under these observed temperatures, light intensities, and wind velocities, Pinolene significantly ($P < 0.01$) doubled the phytotoxicity of 2,4-D.

SOIL INCORPORATION METHODS AND HERBICIDE EFFECTIVENESS[1,2]

D. W. Davis and R. D. Sweet[3]

INTRODUCTION

Soil incorporation of some pre-emergence herbicides is recognized as an effective method of application to obtain better weed control and in discussing this with vegetable growers in New York State, the question often arises as to which tool is the most efficient. Although much of the incorporation in the New York vegetable growing area has been done with the double disc or spring tooth harrow, there is very little conclusive evidence that one is more effecti than the other. Workers outside New York and New England have made experimental comparative tests with various incorporation tools and herbicides (1, 2, 4) but it seemed desirable to have data for New York soils and the tools most vegetable growers use for incorporation of herbicides.

In addition to evaluating plant responses to various herbicide and incorporation treatments in field plots, a bio-assay of soil samples was run to try to determine the location of the chemicals in the soil six weeks after application.

METHODS AND MATERIALS

Two experiments were conducted in field studies near Ithaca, New York between late June and November 1970. In the first experiment, there were two rates of six chemicals, and a no-chemical check. Four different implements were used for incorporation treatments, and a no-tillage check. EPTC, trifluralin, and nitralin were chosen for use in these experiments because they are accepted and used in the area and are considered to be more effective when incorporated (1, 3, 4). Three newer chemicals, alachlor, Lilly's EL-179, and Stauffer's R-7465 were selected to learn more about their response to incorporation.

Plot size was 12' x 40' for each rate of each chemical and these were sub-divided for each method of incorporation into plots 8' x 12'. The implements used were double disc, spring tooth harrow, rotovator, and finger weeder (or potato weeder).

On June 22, 1970, a Howard gravelly loam soil was fitted with disc and meeker harrow. The soil is well drained and quite stoney and the organic content is about 4%. There was good soil moisture and the surface was damp to dry at the time of applying the herbicides. The first of two replications was treated and all plots incorporated before the second replication was treated.

1/ Paper No. 610 of the Department of Vegetable Crops, Cornell University, Ithaca, New York.

2/ This research was partially supported by a grant-in-aid from the Agway, Stauffer and Shell Chemical Companies.

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Thus the time lag between treating and incorporating was not more than 30 minutes for any chemical.

The wettable powder formulation of R-7465 and nitralin, and the emulsifiable formulation of EPTC, alachlor, trifluralin, and EL-179 was used. EPTC was applied at 3 and 4 lbs/A a.i.; R-7465 at 0.75 and 1.5 lbs.; alachlor at 2 and 3 lbs.; trifluralin at 0.5 and 0.75 lbs.; EL-179 at 0.75 and 1 lb.; and nitralin at 0.75 and 1 lb. These rates were picked to try to provide a range between marginal and good weed control so the incorporation method might show enhancement. Spraying was done with a hand-carried small plot sprayer powered with carbon dioxide.

Accurate and uniform depth of incorporation was not easy to maintain because of the soil type but an effort was made to try to operate the disc so it was running at an average depth of 5 to 6 inches, the spring harrow about 6 inches, the rotovator 3 inches, and the finger weeder 3/4 inch.

Test species of Japanese millet, annual ryegrass, sweet corn, leaf lettuce, and cucumber were planted in rows over half of each plot. The other half was left open for better observation of natural weed response. Air temperatures were up to 83° F and soil surface 95° F to 105° F at mid-day, with low relative humidity during the three days following planting. On June 25 it was necessary to apply about 1/2 inch of irrigation in order to obtain germination. During the next three weeks the weather continued to be generally warm and dry.

A second experiment started September 7, 1970, was similar to the first but was on Eel silt loam soil which is a moderately well drained bottom land free of gravel and over 4% organic content. This experiment included the same incorporation implements but only three herbicides, EPTC at 3 and 5 lbs/A a.i., trifluralin at 0.5 and 0.75 lbs., and nitralin at 1 and 1.5 lbs. Plot size was 12' x 14' for each treatment of chemical, rate, and incorporation method. Buffer strips 2' wide were left between plots to avoid the possibility of moving treated soil from one plot to another. Test species planted were reduced to oats, annual ryegrass, and leaf lettuce. At the time the chemicals were applied, the soil surface was dry or drying in the presence of a warm sun but the soil beneath the surface was quite moist. The weather in the three weeks following planting was rainy and cool with daytime temperatures in the 60's and nighttime temperatures in the 40's. Soil surface temperatures were near that of the air.

Evaluation of the crops was made on stand, vigor and color as compared to growth in the no-chemical check plots. No evaluation was made of the natural weed growth because of lack of uniformity in the plot area and occasional night frosts while the experiment was in progress.

Six weeks after treating and planting the second experiment soil samples were taken for a bio-assay to determine the location of the herbicide at that time and if any differences in location might have occurred from using different incorporating tools.

Soil samples were taken from only those plots treated with the low rate of each herbicide and the no-chemical plot. Four locations were sampled within each plot and four depths were sampled at each location: the top 1 inch, the second inch, the layer between 2 and 3.5 inches, and between 3.5 and 5 inches. The soil samples were placed directly in Petri dishes and the bio-assay conducted in them.

Oats were used for the bio-assay in all treatments with an average of 20 seeds placed in the bottom of each dish. For EPTC, stand counts and observations of plant growth two weeks after planting made up the evaluation of residual activity. For trifluralin and nitralin treated soils, observations of root injury were made to indicate residual herbicidal activity.

RESULTS AND DISCUSSION

The results from the field evaluation of both experiments are shown in Tables 1 and 2. In the first experiment the results within one rate of chemical show some unexpected trends. Although species are somewhat variable, generally the best control of seeded annual grasses and broadleaves was obtained by either the finger weeder, which stirs the soil only to a depth of about 0.75 inch, or with no incorporation. However, the disc, which is the most popular incorporation tool in New York, gave the poorest control. Corn, on the other hand seemed to be less injured by surface applications, with the exception of the high rate of EPTC, than by the several incorporation treatments. No definite trends were apparent in the naturally occurring species. Although the advantage of shallow incorporation over deep, thorough incorporation is not generally recognized, these findings corroborate those of Weise and Smith (5) working on silt loam in the Southwest. They found that nitralin, trifluralin, and alachlor performed best with shallow or no incorporation. They did not find any herbicide of the 7 investigated that were improved by deep incorporation.

The results from the second experiment were slightly different from the first. With EPTC, regardless of rate or method of incorporation, or no incorporation, the grasses were completely eliminated. With trifluralin and nitralin, the finger weeder incorporation and the no-incorporation treatments gave the best grass control but were only slightly better than the disc, spring tooth harrow, and rotovator (Table 2).

The differences in weather conditions and soils in the two experiments probably accounted for some of the differences in results, but the combined results lead to the conclusion that either shallow incorporation, or no-incorporation is better than incorporation by other methods. However, this may be only partially true. In these two field experiments rainfall and irrigation may have been more effective as incorporation methods than the use of the disc, spring tooth harrow, or rotovator. Furthermore, if loss of

Table 1. Ratings[1/] of planted and natural species, Experiment I.

Rate	Chemical	Tillage	Growth of Planted Species					B.L. Weed Control		
			Mil.	R.gr.	Corn	Let.	Cuc.	Rag.	R.R.	BYG
3#	EPTC	Disc	3.5	4.0	7.0	5.0	6.0	5.0	5.0	7.5
		S.T.	1.5	1.5	6.5	4.0	5.0	4.5	5.5	9.0
		Roto	1.0	1.5	6.5	4.5	3.0	4.5	5.5	9.0
		F.W.	1.0	1.0	7.0	2.5	3.5	7.0	6.0	9.0
		None	1.5	1.5	8.0	3.0	5.0	5.5	4.5	7.0
4#	EPTC	Disc	2.5	2.5	8.5	4.5	4.0	7.0	7.0	9.0
		S.T.	1.5	1.0	5.0	2.5	2.5	5.0	7.0	9.0
		Roto	1.0	1.0	7.5	2.0	2.0	6.0	7.0	9.0
		F.W.	1.0	1.0	8.0	2.0	3.0	5.0	6.5	9.0
		None	1.0	1.0	6.0	2.5	5.0	5.5	6.0	9.0
1/2#	trifluralin	Disc	2.0	4.5	5.5	8.5	7.5	4.0	8.0	9.0
		S.T.	1.5	2.5	4.5	6.0	5.0	5.0	8.0	8.5
		Roto	1.5	2.0	3.0	7.5	4.5	5.5	8.5	9.0
		F.W.	1.0	1.0	3.5	4.0	3.0	5.0	7.0	9.0
		None	1.0	1.0	6.5	2.0	3.0	5.5	7.0	9.0
3/4#	trifluralin	Disc	2.0	3.0	5.6	8.5	7.0	4.0	7.0	9.0
		S.T.	1.5	2.5	4.5	6.0	5.0	5.0	8.0	8.5
		Roto	1.5	2.0	3.0	7.5	4.5	5.5	8.5	9.0
		F.W.	1.0	1.0	3.5	4.0	3.0	5.5	6.0	9.0
		None	1.0	1.0	6.5	2.0	3.0	5.5	7.0	9.0
3/4#	R-7465	Disc	3.0	4.0	4.5	3.5	5.0	4.5	7.5	9.0
		S.T.	2.0	2.0	4.5	2.0	3.5	6.5	8.0	8.5
		Roto	2.0	3.0	4.5	1.5	3.0	7.0	8.0	9.0
		F.W.	1.0	1.0	6.5	2.0	5.0	6.0	7.0	9.0
		None	1.0	1.5	6.5	2.0	4.0	5.5	6.0	9.0
1 1/2#	R-7465	Disc	1.5	2.5	3.5	2.5	3.0	4.5	7.5	8.0
		S.T.	1.0	2.0	3.5	1.5	2.5	8.0	8.5	9.0
		Roto	1.0	2.0	3.0	2.0	2.0	8.5	9.0	9.0
		F.W.	1.0	1.0	5.5	1.0	3.5	6.5	8.0	9.0
		None	1.0	1.0	5.0	1.0	3.5	8.0	8.5	9.0
2#	Alachlor	Disc	2.0	1.5	7.0	2.0	3.5	5.0	8.0	9.0
		S.T.	1.0	1.5	8.0	1.0	2.5	6.5	8.5	9.0
		Roto	1.5	1.5	7.0	1.5	2.5	6.5	8.5	9.0
		F.W.	1.0	1.0	8.0	1.0	1.0	8.0	8.5	9.0
		None	1.0	1.0	7.5	1.0	1.0	7.5	9.0	8.5
3#	Alachlor	Disc	1.5	1.5	8.5	2.0	2.5	5.5	8.0	9.0
		S.T.	1.0	1.0	8.0	1.0	1.5	7.0	9.0	9.0
		Roto	1.0	1.0	7.0	1.0	2.0	7.0	9.0	9.0
		F.W.	1.0	1.0	7.5	1.0	1.0	8.5	8.5	9.0
		None	1.0	1.0	8.0	1.0	1.0	8.5	9.0	9.0

Table 1. Continued

Rate	Chemical	Tillage	Growth of Planted Species					B.L. Weed Control		
			Mil.	R.gr.	Corn	Let.	Cuc.	Rag.	R.R.	BYG
3/4#	EL-179	Disc	2.0	4.5	6.5	9.0	7.5	7.0	7.0	9.0
		S.T.	2.0	4.0	4.5	8.0	8.5	5.5	7.0	9.0
		Roto	2.0	3.5	5.5	8.5	7.5	7.0	8.5	9.0
		F.W.	1.0	2.0	6.0	6.0	7.0	5.5	6.0	9.0
		None	1.0	2.0	9.0	6.0	7.0	7.0	6.0	9.0
1#	EL-179	Disc	2.5	4.5	6.5	7.0	7.5	6.5	7.0	9.0
		S.T.	1.5	3.0	7.0	6.0	7.0	5.0	8.0	9.0
		Roto	1.5	3.0	5.5	8.0	7.5	5.5	8.0	9.0
		F.W.	1.0	2.0	7.0	5.5	6.0	6.0	6.5	9.0
		None	1.5	1.5	8.5	5.5	5.6	5.6	6.5	9.0
3/4#	nitralin	Disc	2.0	4.0	6.0	6.5	8.0	8.0	7.0	9.0
		S.T.	1.5	2.0	3.0	5.0	5.0	6.0	8.5	8.5
		Roto	1.5	2.0	4.5	6.0	4.5	7.0	8.5	9.0
		F.W.	1.5	2.0	7.0	4.0	6.0	7.0	7.0	9.0
		None	1.0	1.0	8.0	3.0	6.0	6.5	8.0	9.0
1#	nitralin	Disc	1.5	3.0	5.5	6.5	7.0	7.5	6.0	9.0
		S.T.	1.5	2.0	4.0	5.0	6.0	6.5	8.5	9.0
		Roto	1.5	1.5	3.5	5.0	4.5	7.0	8.0	9.0
		F.W.	1.0	1.0	6.5	4.0	7.0	7.5	7.5	9.0
		None	1.0	1.0	6.0	3.0	7.0	5.0	8.0	9.0
none		Disc	9.0	9.0	9.0	9.0	9.0	1.0	6.0	6.0
		S.T.	9.0	9.0	9.0	9.0	9.0	5.5	3.0	7.5
		Roto	9.0	9.0	9.0	9.0	9.0	7.0	3.5	8.5
		F.W.	9.0	9.0	8.5	9.0	9.0	7.5	3.0	7.5
		None	9.0	9.0	9.0	9.0	9.0	6.5	2.0	8.0

1/ 9=perfect growth of planted species
7=moderate stunting, but recovery
3=severe persistent stunting
1=complete kill

9=complete weed control
7=nearly complete weed control
5=partial but unacceptable control
1-no control

Table 2. Ratings[1/] of planted species, Experiment II.

Chemical	Tillage	lb/A	Oats	An. Rye-grass	lb/A	Oats	An. Rye-grass
EPTC	Disc	3	1.0	1.0	5	1.0	1.0
	S.T.		1.0	1.0		1.0	1.0
	Roto		1.0	1.0		1.0	1.0
	F.W.		1.0	1.0		1.0	1.0
	None		1.0	1.0		1.0	1.0
trifluralin	Disc	1/2	4.0	2.3	3/4	4.3	2.0
	S.T.		3.0	2.0		2.6	1.3
	Roto		5.3	4.0		4.0	2.6
	F.W.		2.3	1.6		2.3	1.0
	None		3.0	1.0		2.6	1.0
nitralin	Disc	1	5.3	1.6	1 1/2	5.6	1.0
	S.T.		4.3	3.0		4.3	2.6
	Roto		4.6	3.0		4.0	3.0
	F.W.		4.3	2.3		3.0	2.0
	None		3.6	3.0		4.0	2.0
Untreated Check	Disc		9.0	9.0			
	S.T.		9.0	9.0			
	Roto		9.0	9.0			
	F.W.		9.0	9.0			
	None		9.0	9.0			

1/ 9=perfect growth of planted species; 7=moderate stunting, but recovery; 3=severe, persistent stunting; 1=complete kill.

chemical by volatility, photochemical decomposition, or steam distillation is a means of rapid chemical loss with certain chemicals and if loss of chemical is the limiting factor, then some form of soil incorporation would be desirable.

The results of the bio-assay of soil samples of EPTC and trifluralin treatments (Table 3) show the greatest residual activity to be in the top inch when incorporated with the finger weeder. The rest of the bio-assay results do not show any significant residual chemical activity.

This tends to show that very little movement of chemical took place in the period between plant emergence in the field plots and the time of obtaining soil samples e.g. between the first and sixth weeks of the experiment.

Table 3. Growth of oats in soil samples from incorporation experiment.

		EPTC (Stand)	trifluralin (Root injury)	nitralin (Root injury)
Surface appl. no incorp.	top 1"	A	A	A
	1" to 2"	A	A	A
	2" to 3 1/2"	A	A	A
	3 1/2" to 5"	A	A	A
Disc	top 1"	A	A	A
	1" to 2"	A	A	A
	2" to 3 1/2"	B	A	A
	3 1/2" to 5"	A	A	A
Rotovator	top 1"	A	A	A
	1" to 2"	A	A	A
	2" to 3 1/2"	B	A	A
	3 1/2" to 5"	B	A	A
Spring tooth harrow	top 1"	B	A	A
	1" to 2"	A	A	A
	2" to 3 1/2"	B	A	A
	3 1/2" to 5"	A	A	A
Finger weeder	top 1"	C	B	A
	1" to 2"	A	A	A
	2" to 3 1/2"	B	A	A
	3 1/2" to 5"	B	A	A

No chemical, No incorporation = "A" at all depths

A=Normal to slight stand reduction, or root injury
B=Moderate stand reduction, or root injury
C=Severe stand reduction, or root injury

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EVALUATION OF SEVERAL METHODS FOR PROCESSING PLANTS FOR AUTORADIOGRAPHY

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ABSTRACT

Autoradiography is a widely used and an excellent tool for studying the distribution and localization of labeled herbicides and growth regulators in plants. Relatively few scientists, however, are cognizant of the possible errors in interpretation that may result from the occurrence of pseudoimages and other anomalies due to improper preparation of plant material. In the present study three methods of drying plants for autoradiography were compared with respect to the occurrence of pseudoimages.

Comparisons were made of freeze-drying, oven-drying, and air-drying techniques using bean plants (*Phaseolus vulgaris* L. var. Black Valentine) and white ash seedlings (*Fraxinus americana* L.) as test species. All plants were grown in nutrient solution in a growth chamber at ca 25 C under 1400 ft-c of light. Carboxyl ^{14}C-labeled 4-amino-3,5,6-trichloropicolinic acid (picloram) was used as a representative auxin-type herbicide. It was foliarly-applied as 10-µl droplets, each plant receiving 24 µg (0.1 µc) in 100 µl solution containing a surfactant. Beans and ash plants were harvested 5 and 9 days after treatment respectively. Plants dried by lyophilization were first quick-frozen in crushed dry ice. Bean plants to be oven-dried were divided into two groups: (1) plants dried intact and (2) plants sectioned at five points to restrict movement of fluids during the drying process. All plants destined for either air- or oven-drying were loosely stacked between blotters. Temperatures and time for oven-drying were 95 C for 1 hour, followed by 2 days at 55 C and for air-drying were 25 C at 50% relative humidity for 10 days.

Freeze-drying was found to be the best method for preparation of plants for autoradiography and oven-drying the least effective method. Comparisons of oven- and freeze-dried plants showed that pseudoimages were consistently produced by the oven-drying process, especially in bean plants. These false images were particularly characterized by peripheral movement of the label in the treated leaves. Sectioning did not prevent this movement. Air-drying ranked second to freeze-drying as a preparation technique. Pseudoimages produced by air-dried plants appeared to be relatively minor compared to those of the oven-dried plants. The apparent presence of the label in the roots appeared to be the principal anomaly in air-dried bean plants. Freeze-drying was not as essential for the woody plants as for the herbaceous bean plants. Air-dried ash produced excellent quality autoradiographs very similar to those of the freeze-dried ash. However, it must be realized that metabolic degradation of the labeled compound may occur during the air-drying process, resulting in probable loss of the one-for-one relationship between the compound under study and the radioactive tracer.

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A-820 SELECTIVITY AND BIOLOGICAL PERFORMANCE ON VEGETABLE CROPS

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Abstract. A-820 (Amchem 70-25), a new preplant incorporated herbicide, was tested at several locations in northeastern United States. The following vegetable crops tolerated at least 1.5 pounds active ingredient per acre: direct-seeded tomatoes, snap beans, lima beans, red kidney beans, and cantaloupes; and transplanted tomatoes, peppers, sweet potatoes, broccoli, and cabbage. Cucumbers and watermelons were marginally tolerant. Weed species controlled included redroot pigweed (*Amaranthus retroflexus*), common lambsquarters (*Chenopodium album*), Pennsylvania smartweed (*Polygonum pensylvanicum*), common purslane (*Portulaca oleracea*), giant foxtail (*Setaria faberii*), large crabgrass (*Digitaria sanguinalis*), fall panicum (*Panicum dichotomiflorum*), goosegrass (*Eleusine indica*), stinkgrass (*Eragrostis* sp.) The margin of safety between weed control and crop injury appears to be greater than that observed for other preplant incorporated herbicides. The rate advisable for vegetable crops appears to be 1.5 to 2.0 pounds active ingredient per acre.

Introduction

A-820 is the Amchem Products, Inc. designation for a new herbicide of the dinitro aniline class.

The principle formulation tested during 1970 was Amchem 70-25, an orange-colored emulsifiable concentrate containing 4 pounds active ingredient per gallon. Limited testing was also conducted with a 4 percent granular formulation. The latter was used primarily for crabgrass control in turf.

Toxicity studies of Amchem 70-25 show the following:

Acute oral toxicity - albino rats	-	LD_{50} = 2,500 mg/kg
Acute dermal toxicity - albino rabbits	-	LD_{50} = 4,600 mg/kg
Acute aerosol inhalation - albino rats	-	LC_{50} = 50 mg/L air (four hour exposure period)
Eye irritation - albino rabbits	-	64.0/110 (extremely irritating)

Various application methods were studied. Preplant power incorporation 2 to 3 inches deep gave best weed control. However, under very dry soil conditions in irrigated areas, preemergence activity was similar to that in preplant incorporation trials.

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Weed control may be reduced by low temperature as observed in trials conducted in Oregon on peas and lentils. Weed control was poorer when A-820 was applied early in the growing season than later in the growing season and at higher temperature.

Materials and Methods

The vegetable crops under test at the Amchem Research Farm in Ambler, Pa. were as follows: Black Valentine snapbeans, Fordhook 242 lima beans, red kidney beans, Campbell 29 tomatoes, Yolo Wonder peppers, Waltham 29 broccoli, Marian Market cabbage, Early Fortune cucumbers, Hales Best Jumbo cantaloupes, and New Hampshire Midget watermelons.

Weed species evaluated included: redroot pigweed (*Amaranthus retroflexus*), common ragweed (*Ambrosia artemisiifolia*), velvetleaf (*Abutilon theophrasti*), wild mustard (*Brassica kaber* var. *pinnatafida*), common lambsquarters (*Chenopodium album*), tall morningglory (*Ipomoea purpurea*), Pennsylvania smartweed (*Polygonum pensylvanicum*), common purslane (*Portulaca oleracea*), and giant foxtail (*Setaria faberii*).

A-820 was applied at rates of 1.5, 2.5, and 3.5 pounds active ingredient per acre with a bicycle sprayer in a volume of 40 gallons water per acre. All plots were rotovated 2 to 3 inches deep within 30 minutes after application. Plot sizes were 8 by 10 feet and 8 by 20 feet, two rows per crop and three to four replications. Planting and evaluation dates are shown in Table 1.

A cooperative test was conducted with Dr. Joseph C. Cialone, Dept. of Soils and Crops, Rutgers - The State University, New Brunswick, New Jersey. Test location was at the Soils and Crops Research Center, Adelphia, New Jersey. Treatments of A-820 (Amchem 70-25) were preplant incorporated on May 8, 1970 at rates of 1.5 and 3.0 pounds active ingredient per acre. Three replications of Heinz 1409 tomatoes and Marketmore cucumbers were direct seeded within two hours following treatment and power incorporation.

A cooperative test was also conducted with Mr. Dwain Altman, University of Maryland, Dept. of Horticulture, Vegetable Research Farm, Salisbury, Maryland. A-820 (Amchem 70-25) was preplant incorporated at logarithmic rates from 6.0 pounds to 0.18 pound active ingredient per acre. Vegetable crops tested included transplanted Roma tomatoes and Nemagold sweet potatoes and direct-seeded Bountiful snapbeans, NK-199 sweet corn, Marketmore cucumbers and Roma tomatoes. Treatment was applied May 27, 1970 and incorporated immediately 2 to 3 inches deep. Crops were planted on May 28, 1970 and irrigated with 0.5 inches of water on the same day.

Results and Discussion

Table 1 is a summary of annual broadleaved weed and annual grass control and crop injury ratings at the Amchem Research Farm, Ambler, Pa. The rating system is 0 to 100; 0 represents no control or no crop injury and 100 represents complete kill of weeds or crop.

In eight tests, annual broadleaved weed and annual grass control averaged

75 percent and 95 percent respectively at 1.5 pounds active ingredient per acre. Watermelons and cucumbers were slightly stunted. Later observations indicated vigorous growth and normal fruit production.

In seven tests at 2.5 pounds active ingredient per acre, broadleaved weed and grass control were 82 percent and 98 percent respectively with slight stunting of cucumbers and moderate stunting of watermelons. Later observations indicated that cucumbers had completely recovered. Watermelons continued to show growth inhibition.

In four tests at 3.5 pounds per acre, broadleaved weed and grass control were 83 percent and 98 percent respectively. Transplanted tomatoes were slightly stunted; however there was no detrimental effect on yield. Lower rates showed no effect on vegetative growth.

Table 1. Annual weed control and crop selectivity with preplant incorporated treatments of A-820, Amchem Research Farm, Ambler, Pa. 1970.

Crop	Date planted	Date rated	Rate (lb/A)	Percent weed control* Broadleaves	Grasses	Crop injury*
Direct-seeded						
Snapbeans	5-4	6-18	1.5	86	90	0
			2.5	85	95	0
			3.5	90	98	0
Lima beans	5-12	6-19	1.5	82	95	0
			2.5	83	97	0
			3.5	85	100	0
Red kidney beans	5-15	6-22	1.5	58	100	0
Cucumber	6-17	7-17	1.5	70	90	5
			2.5	80	100	5
Cantaloupe	6-25	7-24	1.5	86	97	0
			2.5	90	98	0
Watermelon	6-25	7-24	1.5	86	98	10
			2.5	91	98	30
Transplanted:						
Tomatoes	5-21	6-21	1.5	67	98	0
			2.5	71	100	0
			3.5	75	100	8
Peppers	5-21	6-21	1.5	67	98	0
			2.5	71	100	0
			3.5	75	100	0
Broccoli and cabbage	5-28	6-25	1.5	67	90	0
			2.5	77	100	0
			3.5	83	100	0
Averages: 8 tests			1.5	75	95	
7 tests			2.5	82	98	
4 tests			3.5	83	99	

* Rating system 0 - 100: 0 = no control or crop injury.
100 = complete kill of weeds or crop.

Table 2 shows the average weed control by species at the Amchem Research Farm, Ambler, Pa. The data from nine separate tests is included in the averages. The numbers in parentheses represent the number of tests in which the species was abundant enough to rate.

At 1.5 pounds per acre there was excellent control of redroot pigweed, lambsquarters, Pennsylvania smartweed, purslane, and giant foxtail. Control of velvetleaf, wild mustard, and tall morningglory was not commercially acceptable. Ragweed was not controlled.

At 2.5 pounds per acre, there was excellent control of tall morningglory in addition to the excellently controlled species mentioned above. Wild mustard control was commercially acceptable and velvetleaf control marginally acceptable. Ragweed was not controlled.

At 3.5 pounds per acre there was excellent control of all species listed in Table 2 except wild mustard, which showed very good control, and ragweed, which was tolerant.

Although the barnyardgrass (Echinochloa crusgalli) population was spotty, control appeared to be excellent.

Table 2. Weed control evaluations by species and rate with preplant incorporated treatments of A-820. Amchem Research Farm, Ambler, Pa. 1970.

	Percent weed control Rate (lb ai per acre)		
Species	1.5	2.5	3.5
Redroot pigweed	96 (8)*	96 (7)	98 (5)
Common ragweed	0 (9)	0 (8)	0 (6)
Velvetleaf	63 (3)	77 (3)	92 (1)
Wild mustard	61 (5)	85 (4)	88 (4)
Common lambsquarters	99 (8)	99 (7)	99 (8)
Tall morningglory	79 (6)	92 (5)	96 (3)
Pennsylvania smartweed	93 (6)	98 (5)	98 (6)
Common purslane	90 (1)	-- --	100 (1)
Giant foxtail	93 (9)	98 (9)	99 (9)

*Number of tests in which species was rated.

The senior author evaluated the replicated test conducted by Dr. Joseph C. Cialone at the New Jersey Soils and Crops Research Center, Adelphia. Direct-seeded tomatoes tolerated 3 pounds per acre. Cucumber stand and vigor was slightly reduced (15 percent) at 1.5 pounds per acre and moderately reduced (30 percent) at 3.0 pounds per acre. Control of lambsquarters, the predominant weed species, was excellent at both rates. Although the annual grass population was sparse, control of large crabgrass (Digitaria sanguinalis) and fall panicum (Panicum dichotomiflorum) was rated excellent at 1.5 and 3.0 pounds per acre.

The senior author also evaluated the logarithmic test conducted by Mr. Dwain Altman at the Maryland Vegetable Research Farm. Direct-seeded and

transplanted tomatoes and direct-seeded snapbeans tolerated 3.0 pounds per acre. Sweet potatoes and cucumbers tolerated 2.0 pounds and sweet corn 0.5 pound per acre. Lambsquarters was controlled to 1.0 pound per acre and annual grasses including large crabgrass, goosegrass (*Eleusine indica*), and stinkgrass (*Eragrostis* sp) were controlled to 0.5 pound per acre.

In trials conducted at Amchem Research Farms in California and Mississippi, additional vegetable crops that tolerated A-820 at 1.5 pounds active ingredient per acre and higher included: mung beans, pinto beans, okra, white potatoes, lettuce and carrots. Additional weed species controlled were: barnyardgrass (*Echinochloa crusgalli*), (*Panicum* spp), ryegrass (*Lolium* sp), and seedling johnsongrass (*Sorghum halepense*).

CHEMICAL WEEDING OF CUCUMBERS

Charles J. Noll[1]

A variety of herbicides were used to weed seeded cucumbers (Cucumis sativus) and applied as pre-planting soil incorporation treatments and pre-emergence treatments. Some herbicides were used at two rates and others in combination. A delay in planting after field preparation followed by a pre-emergence treatment with herbicides was also included in the trials. The most promising incorporation treatment was 0,0-diisopropyl phosphorodithioata S-ester with N-(2-mercaptoethyl) benzenesulfonamide (bensulide) in combination with N-1-naphthylphthalamic acid (naptalam) or followed by 3-amino-2,5-dichlorobenzoic acid (chloramben)or 2-sec-butyl-4,6-dinitrophenol (dinoseb). The most promising pre-emergence treatments were 4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline (nitralin), chloramben ester or the combination application of napalam with nitralin or chloramben. The delayed planting pre-emergence treatments generally resulted in poorer yields.

Materials and Methods

The weeding trials were conducted at the Horticultural farm located 10 miles west of University Park. The soil a Hagerstown silt loam was plowed in the fall of 1969 and the seedbed prepared June 23, 1970. The soil incorporation treatments were applied and the field seeded to the variety veridark the same day. The pre-emergence applications were made one or three days after seeding. The delayed plantings were seeded seven days after the seedbed was prepared and the herbicides applied the next day. An estimate of weed control was made July 29 and August 14 using a 1 to 9 scale. One is full weed growth and 9 is complete weed control.

Single row plots were 32 feet long and 5 feet wide. Treatments were randomized in each of 6 blocks. All herbicides were applied in a 2 foot bands over the row. Cultivation controlled the weeds between the rows. A once over harvest was made August 14. Records were made of stand of plants, number of fruit and weight of fruit. Weed present in the field were lambsquarters (Chenopodium album L.), pigweed (Amaranthus retroflexus L.), yellow foxtail (Setaria glauca (L.) Beauv.), and purslane (Portulaca oleracea L.)

Results

The results are presented in Table 1. All herbicides significantly reduced the weed population. The stand of plants was significantly increased with a delay in seeding but this did not result in an increase in yield. A number of chemicals or combination of chemicals offer promise of the weeding of this crop.

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Table 1. Weed Control, number of plots, number and weight of fruit of cucumbers under chemical herbicide treatment.

	Treatment	Active Rate lbs/A	Application Days from Planting	AVERAGE PER PLOT Weed Control 1-9 July 29	Aug 14	Stand of Plants	Harvest Record No. Fruits	Wt. Fruit lbs.
1	Nothin	---	---	2.3	1.3	20.8	10.5	7.0
2	M & B 9057	4	Inc-0	6.0	4.3	21.2	17.2	12.6
3	EL 179	1	"	7.7	4.8	22.2	18.8	10.8
4	SD 30187	3/4	"	6.2	2.7	26.5	15.2	10.7
5	"	1 1/2	"	6.8	3.5	19.2	9.2	6.5
6	SD 25279	2	"	1.2	1.3	23.3	7.7	4.4
7	"	4	"	3.7	2.2	21.0	10.0	6.3
8	SD 25644	2	"	4.5	2.5	20.5	9.2	6.3
9	Chloramben + Naptalam	3 + 4	"	9.0	8.8	4.7	6.0	4.6
10	Bensulide + Naptalam	6 + 4	"	8.7	8.0	20.5	30.2	18.4
11	" & "	6 & 4	Inc-0 & Pre +1	8.5	5.5	19.2	20.5	14.8
12	" & Chloramben	6 & 3	" & "	9.0	8.8	14.0	19.2	15.1
13	" & Dynap	6 & 4 1/2	" & "	9.0	8.5	18.0	22.8	16.2
14	" & Dinoseb	6 & 1 1/2	" & "	8.0	4.5	14.5	19.0	15.9
15	Bensulide	6	Inc-0	5.8	3.7	21.2	18.7	15.6
16	Naptalam	6	Pre+1	6.8	3.8	17.7	11.5	7.8
17	Chloramben	3	"	9.0	8.3	10.3	15.3	10.8
18	Nitralin wp.	2	"	8.3	6.0	15.0	21.5	18.3
19	Nitralin ec.	2	"	7.8	6.2	14.0	16.8	15.3
20	ACP 65-81B Amiben Ester	3	"	8.3	6.5	14.8	19.3	16.7
21	ER 5461	2	"	7.0	3.5	16.3	18.2	14.8
22	NIA 20439	5	"	8.8	7.8	14.5	6.8	3.4
23	Naptalam + Nitralin	3 + 1	"	9.0	7.3	23.3	21.5	15.6
24	" "	6 + 2	"	9.0	8.2	23.7	27.2	21.8
25	" + Chloramben	3 + 1	"	9.0	7.2	22.3	21.8	18.8
26	" "	6 + 2	"	9.0	8.5	16.8	25.7	15.0
27	Dinoseb + Naptalam (Dynap)	1 1/2 + 3	Pre+3	8.7	7.3	12.5	22.3	16.1

Table 1. (Continued) - Page 2

Treatment	Active Rate lbs/A	Application Days from Planting	AVERAGE PER PLOT Weed Control 1-9 July 29	Weed Control 1-9 Aug 14	Stand of Plants	Harvest Record No. Fruits	Harvest Record Wt. Fruit lbs.
28 Dinoseb + Chloramben (Dynoram)	1 1/2 + 3	Pre+3	9.0	7.3	7.8	12.8	11.2
29 Dinoseb + Naptalam + Chloramben	1 1/2 + 3 + 3	"	9.0	9.0	8.2	12.7	9.0
30 Dinoseb	1 1/2	"	6.3	2.8	21.2	15.3	12.5
31 DCPA	8	"	7.7	4.8	12.3	14.3	11.5
32 Nothing	---	---	2.5	1.2	17.8	5.0	2.9
33 Paraquat	1	Planting Delay +7 Pre +1	6.8	3.2	48.7	17.7	8.0
34 "	2	" " "	7.0	4.5	55.2	24.2	10.3
35 Dinoseb (Dow General)	1 1/2	" " "	8.7	7.2	43.5	29.8	14.0
36 " "	3	" " "	8.8	7.8	39.0	24.2	12.3
Least Significant Difference	5%		1.1	1.2	7.9	7.6	5.6
" " "	1%		1.2	1.5	9.2	8.9	6.5

MUSKMELON AND CUCUMBER RESPONSE TO DINOSEB AND OTHER HERBICIDES[1,2]

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ABSTRACT

Three years of field experimentation showed dinoseb and DCPA preplant incorporated were safe and effective herbicides for muskmelon (Cucumis melo var. reticulatus) grown on clear plastic. Trifluralin was injurious. Cucumber (Cucumis sativus) was sensitive to dinoseb. Ventilating the plastic or delaying planting following dinoseb applications reduced crop injury.

INTRODUCTION

Plastic mulches have been used extensively in the production of muskmelons (Cucumis melo var. reticulatus) and cucumbers (Cucumus sativus) in the past few years (3). With clear plastic, herbicides are needed to control weeds under the mulch. Dinoseb (2-sec-butyl-4,6-dinitrophenol) has been used for weed contr under clear plastic. A waiting period of 2 weeks after treatment is needed before the crops can be transplanted, (Buchholz), (1). Dickerson and Sweet (2) reported on several other herbicides for use in muskmelons and they also recommended a two week delay between dinoseb treatment and transplanting. Growers in the field, however, sometimes report crop injury with dinoseb even when the two week waiting period was observed. It was thought this might be due to the dinoseb vapors not being dissipated over the two weeks and, therefore, the plastic should be vented before the plants were set.

The purpose of the studies presented here were two fold; first, to compare the effect of several dinoseb treatments on muskmelon and cucumber yield and second, to determine the response of muskmelons to several other herbicides given in Table 4.

EXPERIMENTAL

The experiments were conducted during 1968-1970. Three experiments were conducted to compare Gold Star muskmelon yield response to several herbicide treatments. In addition, special tests were conducted to evaluate the effect of various treatments of dinoseb on the yield of Gold Star muskmelon and Table-green cucumbers. To simplify presentation, the dates of seeding, planting and treating as well as other information is presented in Table 1 for all experiments.

1/ Paper No. 627 of the Department of Vegetable Crops, Cornell University, Ithaca, New York.

2/ This research was partially supported by a grant-in-aid from the Dow Chemical Company.

3/ Research Assistant and Professor, respectively.

Table 1. Dates of planting, transplanting and treating in the experiments reported.

Year	Crop plant	Crop trans.	Treatments dinoseb	Treatments dyanap	Treatments at plant	Plot length ft.	No. reps.	Leaves at trans.
1968	5/22	6/17	6/6	6/14	6/17	25	4	3
1969	5/13	5/28	5/28[a]	--	5/28	25	2	1
1970	5/15	5/29	--	--	5/29	20	2	1
1970 Dinoseb test on muskmelons								
	5/8	5/22	5/9	--	5/22	20	3	1
1970 Dinoseb test on cucumbers								
	5/8	5/22	5/9	--	5/22	20	3	1-2

[a] These plots were transplanted two weeks later than the rest of the experiment.

The necessary transplants for the experiments were grown in a 80°-70° F (day-night) greenhouse in Cornell Mix A[4]. The containers used were three inch plant bands in all years except 1968 when three inch peat pots were used. Several seed were placed in each container and on emergence these were thinned to two healthy plants per container. The plant bands and peat pots were removed on transplanting to ensure maximum root and hypocotyl exposure to treated soil.

The methods of setting up the experiments were the same in all years and are described below. The soil, an Arkport fine sandy loam, was spring plowed and fitted to a fine seed bed. The herbicide was sprayed on the surface using a CO_2 pressurized hand held sprayer which delivered 35-40 gallons per acre. Surface treatments were left undisturbed and where incorporation was needed it was accomplished by discing once in both directions to a depth of 4 inches. All rates of application are given as pounds of active ingredient per acre in this paper. Soon after treatment clear plastic mulch, 4 feet wide and 1.5 ml in thickness was laid over the treated area using a mechanical plastic layer.

Except in the two special dinoseb tests in 1970, where the holes were cut 2 days before planting in the venting treatments, holes were cut in the plastic at 3 foot intervals on the day of transplanting using a bulb planter. Two plants were transplanted per hole after removal of the plant band and watered with one cup of 10-52-17 starter solution. No hot caps were used in any year. Artificial irrigation was used to supplement natural rainfall. All experiments were designed as randomized complete blocks with two to four replications.

The muskmelons were harvested when they started to change from green to yellow and slipped easily from the vine. The cucumbers were harvested when the fruit were of marketable size approximately 6 inches or less in length.

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[4] A mixture of approximately 50% (by volume) of sphagnum peat moss and horticultural vermiculite with nutrients added.

Table 2. Summary of average number and weight of muskmelon fruit per plot of eight hills in 1968 and 1969 and six hills in 1970 in herbicide evaluation tests.

			Year					
			1968		1969		1970	
Treatment	lb/A	Timing	No. Fruit	Wt. Fruit	No. Fruit	Wt. Fruit	No. Fruit	Wt. Fruit
chloramben (AS)	4.0	pre	50.0*	162.6	--	--	--	--
chloramben (ME)	2.0	"	--	--	44.0	131.5	--	--
naptalam (NPA)	3.0	"	--	--	56.0	173.4	--	--
bensulide	4.0	ppi	--	--	--	--	44.5	128.9
"	6.0	"	--	--	--	--	50.5	142.2
dinoseb (Premerge)	4.5	2 wk. before	43.7	144.2	40.5	119.9[a]	--	--
dyanap	3.0	2 days before	40.5	137.5	--	--	--	--
"	6.0	"	38.2	115.3	--	--	--	--
DCPA	8.0	ppi	--	--	--	--	56.0	140.7
"	12.0	"	39.0	130.5	48.5	134.7	49.5	127.7
trifluralin	.75	"	--	--	43.0	126.4	43.5	122.8
nitralin	2.0	pre	42.2	142.5	--	--	--	--
control			38.5	135.4	50.5	143.0	50.0	132.9
LSD .05[b]			10.4	49.3ns	12.8ns	39.9ns	15.9ns	53.6ns

a/ These plots were transplanted two weeks later then the rest of the experiment.
b/ Means followed by an asterisk are significantly different from the control.

Multiple harvests were made and the number and weight of fruit recorded. When the plants were rated a rating system of 1 to 9, where 9=perfect crop; 7= slightly injured but acceptable crop and 1=complete kill of crop, was used.

RESULTS AND DISCUSSION

The results of the herbicide evaluation tests 1968-1970 on muskmelons are presented in Table 2. A great deal of variability was present in the tests, however, certain trends can be noted. DCPA at 8 and 12 lbs/A preplant incorporated performed well in all years. Trifluralin at 3/4 lb/A caused a reduction in number and weight of fruit harvested in the two years it was used. Dinoseb at 4 1/2 lbs/A in 1969 resulted in lower number and weight of fruit but the reduction was most likely due to this treatment being transplanted two weeks later than the other treatments. The ammonium salt (AS) of chloramben at 4 lbs/A resulted in an increase in number and weight of fruit whereas the methyl ester (ME) at 2 lbs/A reduced yield. All other herbicides resulted in yields as good as or better than the no chemical control treatment.

Table 3. Summary of number and weight of fruit of muskmelons and cucumbers in plots of six hills exposed to several dinoseb treatments.

Treatment	lb/A	Crop: Muskmelon No. Fruit	Muskmelon Wt. Fruit	Muskmelon Rating	Cucumber No. Fruit	Cucumber Wt. Fruit	Cucumber Rating[a]
dinoseb, 2 wk. pre, no vent (Premerge)	4.5	38.6	86.5	9.0	234.0	165.9	8.3
" " "	6.0	34.0	81.7	9.0	209.0	142.6	8.0
" " vent	4.5	32.6	83.4	9.0	187.6*	138.5	8.6
" " "	6.0	35.3	90.2	9.0	219.6	149.5	8.6
" at plant	4.5	37.6	90.6	8.3	206.0	143.8[b]	7.0
" "	6.0	46.6	127.9	7.3	179.6*	129.2[c]*	5.0
DCPA ppi	8.0	-	-	-	228.0	157.4	9.0
" "	12.0	-	-	-	213.0	146.8	8.6
control		35.0	104.8	8.3	239.0	166.1	9.0
LSD .05[d]		18.5ns	60.4ns	-	45.5	29.0	-

a/ Rating: Crop: 9=perfect crop; 7=slightly injured but acceptable crop; 1=complete kill of crop.

b/ Yield with 50-60 percent of initial plants replaced 10 days after start of experiment.

c/ Yield with 80 percent of initial plants replaced 10 days after start of experiment.

d/ Means followed by asterick are significantly different from control.

Table 4. List of herbicides used in this study.

naptalam (NPA)	N-1-naphthylphthalamic acid
bensulide	O,O-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl)benzenesulfonamide
chloramben (AS)	ammonium salt of 3-amino-2,5-dichlorobenzoic acid
chloramben (ME)	methyl ester of 3-amino-2,5-dichlorobenzoic acid
dinoseb (Premerge)	mixture of alkanolamine salts of 2-sec-butyl-4,6-dinitrophenol
dyanap	mixture of 2 parts naptalam and 1 part dinoseb
DCPA	dimethyl tetrachloroterephthalate
nitralin	4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline
trifluralin	a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine

The results of the special tests using dinoseb and various venting treatments are presented in Table 3. A comparison of the muskmelon ratings shows the plants were slightly injured by the dinoseb at 6 lbs/A applied at transplanting. Note, however, that with all treatments except the dinoseb at planting at 6 lbs/A, the weight of fruit was reduced. The high yield with this treatment was unexpected considering the amount of dinoseb present at transplanting. During harvest it was noted vine growth was greater on the plots on one side of the field. Examination of the experimental area showed that side had better soil conditions than the other. Two of the plots for this treatment happened to be on the good side and this probably contributed to the higher yield. With the Gold Star variety of muskmelon no significant yield reductions were noted, however, other varieties may be more susceptible to dinoseb and further work needs to be done on possible differential varietal responses.

Venting the plastic appeared to be beneficial at the high rate of dinoseb. However, the difference was not great so it would appear that in this experiment most of the dinoseb had been dissipated prior to venting. The weather was moderate and sunny during the two week waiting period before transplanting. Perhaps if the weather had been cold and dull or hot caps had been used, greater differences would have been seen between venting and not venting as noted by Buchholz (1).

In contrast to muskmelon the cucumber was very susceptible to dinoseb. Severe injury was obtained with dinoseb applied at transplanting, (Table 3). A marked reduction in number and weight of fruit was also seen. It should be pointed out that about 80 percent of the plants in the 6 lbs/A rate at planting treatment and 50-60 percent at the 4 1/2 lbs/A treatment were replaced 10 days after transplanting. All the replaced plants survived, however, the yield was still reduced. No plants were replaced in the other treatments of the experiment. DCPA performed well, however, a slight decrease in number and weight of fruit was seen at both rates with the higher rate showing the greatest reduction. No data on weed control is presented in this paper but it should be noted weed control was excellent with all dinoseb treatments. DCPA also showed excellent weed control with only a few stunted purslane (*Portulaca oleracea* L.) plants seen at the low rate.

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SYMPTOMATIC EFFECTS OF DICHLOBENIL ON THREE SPECIES OF NEEDLED EVERGREENS[1]

Dean W. Wiegers[2] and J. R. Havis[3]

(ABSTRACT - Publication intended in Weed Research)

In controlled greenhouse studies 2,6-dichlorobenzonitrile (dichlobenil) was applied at various concentrations in soil layers around roots or stems of two or three-year old seedlings of red pine, and Norway spruce, and around the stems of both seedlings and rooted cuttings of American arborvitae.

The placement of dichlobenil in the root zone of red pine caused marked browning in the stems near the soil level, apparently caused by destruction of cortical cells. Root treatment of Norway spruce seedlings did not produce browning, but resulted in swelling in the lower stems, caused by proliferation of the cortex and the phelloderm. The root zone treatment of Norway spruce also resulted in the accumulation of a darkly stained material in the pericycle.

The placement of dichlobenil around the lower stems failed to produce a significant response on red pine. On the other hand, placement around the lower stems of spruce seedlings and arborvitae rooted cuttings produced a marked swelling response in the treated area. Arborvitae seedlings did not show response to stem application.

These results demonstrated species variability in sensitivity to dichlobenil. Furthermore, it is suggested that the stem browning of red pine and the stem swelling of spruce seedlings and arborvitae rooted cuttings illustrated different physiological responses to the herbicide.

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A FOUR YEAR SUMMARY OF WEED CONTROL IN WHITE POTATOES IN UPSTATE NEW YORK

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ABSTRACT

Forty-five potato herbicide treatments were studied from 1967 through 1970. The following weed species were rated: redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), wild mustard (Brassica kaber DC.), and green foxtail (Setaria viridis L.). Both broadleaf and grassy weed control was obtained with 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron), 2'-chloro-2,6-diethyl-N-=methoxymethylacetanilide (alachlor) with 2-sec-butyl-4,6-dinitrophenol (dinoseb), dinoseb with 2,2-dichloropropionic acid (dalapon) or N,N-dimethyl-2,2-diphenylacetamide (diphenamid) or alachlor or VCS 438 and 4-Amino-6-5-butyl-3(methylthio)-astriazin-5(4H)-one (BAY 94337). The thiolcarbamates were weak on lambsquarters and did not control mustard.

INTRODUCTION

Today there are numerous potato herbicides available. The choice of a herbicide program by the farmer is based on several factors including the type of weed problem in his farm or field. This study reports on a selected number of herbicides, herbicide combinations and their relative control of certain weed species.

METHODS & MATERIALS

From 1967-1970 potato herbicide field experiments were conducted at the Agway Product Development Farm, Lafayette, New York. The soil type at this location is a gravelly silt loam - well drained and suited to potato production. The experimental design was a randomized complete block with four replications. Plots consisted of two rows of potatoes either 6 X 30 or 6 X 24.

Katahdin variety was planted in all four years. Date of planting in 1967 was mid-May and in 1968-70 mid to late April.

While weather conditions varied between the four years, it was not felt to be a significant factor in herbicide effectiveness.

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The plots were not cultivated or hilled except in 1969 when they received one hilling operation.

Treatments were applied with a hand carried CO_2 type sprayer. Volume was 60 gallons per acre and pressure 30-50 psi.

Post planting or lay-by incorporation treatments were band-raked. Postemergence applications were made when the potatoes were 2-3" tall and weeds in 4-6 leaf stage.

The weed populations varied somewhat from year to year. The weed species rated were: redroot pigweed, common lambsquarters, wild mustard, and green foxtail. Observations and weed ratings were made several times during each season. A scale of 0-10 was used - 0 equals no control, 10 equals 100% control.

RESULTS & DISCUSSIONS

The results summarized in table 1 represent selected treatments from a total of over 102. Treatments or compounds no longer in a market position are not reported. The data on each treatment represent one to four years of study.

The urea compounds gave broad spectrum control except that at lower rates they were somewhat weak on green foxtail. 3-(hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea (norea) controlled green foxtail but was less effective on redroot pigweed than the other ureas. When linuron was combined with a grass killer such as dalapon or alachlor, grass control improved.

Alachlor by itself was weak on lambsquarters but gave excellent control of green foxtail. In combination with dinoseb broadleaf weed control was excellent including control of lambsquarters.

Dinoseb was applied as a delayed preemergence treatment (weeds emerged but not potatoes) and controlled broadleaf weeds at lower rates and broadleaf weeds and green foxtail at higher rates. Dinoseb plus dalapon, diphenamid or alachlor gave excellent broad spectrum control.

3-amino-2,5-dichlorobenzoic acid (amiben) plus diphenamid was very weak on lambsquarters. The methyl ester of amiben was used in these tests.

VCS 438 by itself was weak on lambsquarters but was excellent in combination with either alachlor or dinoseb. A flowable formulation of VCS 438 was also used in 1969 with similar results.

The thiolcarbamates S-ethyl-dipropylthiocarbamate (EPTC) and S-propyl dipropylthiocarbamate (vernolate) controlled green foxtail, were weak on lambsquarters and did not control mustard. 2,4-dichlorophenyl p-nitrophenyl ether (nitrofen) also did not control mustard.

BAY 94337 was the most outstanding material in those tests. It provided excellent broadleaf weed control, both pre and postemergence. No visual symptoms of injury were noted with either the pre or post-emergence applications of this compound.

2-tertiobutyl-4-(2.4 dichloro-5-isopropyl-oxyphenyl)-5-oxo-1,3,4-oxadiazoline (RP 17623) from Rhodia was more effective on broadleaf weeds than on green foxtail.

The grass killer α-(2,2,2-trichloroethyl) styrene (Dowco 221) was very effective on green foxtail and when used with dinoseb gave fairly good broadleaf weed control.

CONTROL OF SELECTED WEED SPECIES IN POTATOES 1967-70

Herbicide & Formulation	Rate #/A	Method of Application	Years Tested	Average Weed Control: Redroot Pigweed	Lambs-quarters	Wild Mustard	Green Foxtail
metabromuron (50W)	2.0	Pre	67-70	9.1	9.4	10.0	7.4
metabromuron (50W)	4.0	Pre	67-70	9.9	9.9	10.0	9.3
chlorobromuron (50W)	2.0	Pre	67-70	9.9	8.8	10.0	7.1
chlorobromuron (50W)	4.0	Pre	67-70	9.7	9.8	10.0	10.0
linuron (50W)	1.0	Pre	67-70	8.5	8.5	9.9	7.0
linuron (50W)	1.5	Pre	68-70	8.3	8.9	10.0	9.1
linuron (50W)	2.0	Pre	67	10.0	---	---	---
linuron + dacthal (67.5W) 1:8	9.1	Pre	70	9.0	9.3	10.0	10.0
norea (80W)	2.0	Pre	69,70	7.5	7.5	---	9.7
norea (80W)	4.0	Pre	69,70	7.4	9.7	---	9.9
linuron + alachlor (4E) 1:2	2.25	Pre	70	9.5	9.3	---	9.5
linuron + alachlor (4E) 1:2	4.5	Pre	70	10.0	9.3	---	10.0
linuron (50W) + dalapon (85S)	.75 + 2.6	Pre	70	9.0	9.5	10.0	8.5
alachlor (4E)	1.5	Pre	69	10.0	7.3	---	10.0
alachlor (4E)	3.0	Pre	69	10.0	6.3	---	10.0
alachlor (4E) + alachlor (10G)	1.0 + 2.0	Pre + Post	70	8.5	3.3	8.0	10.0
alachlor (4E) + dinoseb (3E)	2.0 + 3.0	Pre	70	8.0	9.0	10.0	10.0
dinoseb (3E)	3.0	Pre (Delayed)	67,69,70	8.3	5.4	---	6.2
dinoseb (3E)	4.0	Pre (Delayed)	68-70	9.5	9.5	10.0	7.5
dinoseb (3E)	6.0	Pre (Delayed)	67-70	9.1	8.0	10.0	8.4
dinoseb (3E) + dalapon (85S)	3.0 + 3.0	Pre (Delayed)	67,68	9.5	9.5	10.0	8.5

Control of Selected Weed Species in Potatoes 1967-70

Herbicide & Formulation	Rate #/A	Method of Application	Years Tested	Average Weed Control: Redroot Pigweed	Lambs-quarters	Wild Mustard	Green Foxtail
dinoseb + diph. (3.5E) 1.5:2.0	5.2	Pre	70	9.3	9.5	---	9.5
dinoseb + diph. (3.5E) 1.5:2.0	7.0	Pre	70	9.5	10.0	---	9.3
amiben (2E) + diph. (80W)	1.0 + 2.0	Pre	70	8.0	.5	7.3	8.3
amiben (2E) + diph. (80W)	1.5 + 3.0	Pre	70	10.0	2.5	7.8	9.0
VCS 438 (75W)	2.0	Pre	70	6.5	4.5	9.8	5.7
VCS 438 (75W)	2.5	Pre	69	9.0	7.0	---	9.0
VCS 438 (75W)	3.0	Pre	70	9.0	7.8	10.0	10.0
VCS 438 (75W) + alachlor (4E)	2.0 + 1.5	Pre	70	9.7	8.8	10.0	10.0
VCS 438 (75W) + alachlor (4E)	3.0 + 2.0	Pre	70	9.8	9.8	10.0	10.0
VCS 438 (75W) + dinoseb (3E)	2.0 + 1.5	Pre	70	8.0	8.3	9.8	9.0
VCS 438 (75W) + dinoseb (3E)	3.0 + 2.0	Pre	70	9.5	9.3	10.0	9.8
EPTC (6E)	6.0	PPI	67,68	7.0	6.5	0.0	10.0
EPTC (6E) + trifluralin (4E)	4.0 + 1.0	PPI	68	8.5	5.5	0.0	10.0
vernolate (6E)	3.0	Drag Off	68	8.5	8.7	---	10.0
nitrofen (2E)	3.0	Pre	68	8.5	5.0	0.0	9.5
nitrofen (2E)	4.0	Pre	68	10.0	9.0	0.0	10.0
BAY 94337 (70W)	.5	Pre	69,70	9.2	8.4	---	9.0
BAY 94337 (70W)	1.0	Pre	69,70	10.0	9.9	---	10.0
BAY 94337 (70W)	2.0	Pre	69	10.0	10.0	---	9.5
BAY 94337 (70W)	.5	Post	70	10.0	9.0	10.0	7.3
BAY 94337 (70W)	1.0	Post	70	10.0	10.0	10.0	6.0
RP 17623 (2E)	2.0	Pre	70	10.0	10.0	10.0	7.8
Dowco 221 (8E)	12.5	Pre	70	2.5	0.0	0.0	10.0

COMPARATIVE PHYTOTOXICITY AMONG FOUR ARSENICAL HERBICIDES

J. L. Michael[1/] and R. M. Sachs[1,2/]

ABSTRACT

Cacodylic acid (hydroxydimethyl arsinic oxide, CA) was a more effective herbicide than monosodium methanearsonate (MSMA) or sodium arsenate and equal or superior to sodium arsenite when all were foliar-applied at equimolar levels. However, when root applications were made sodium arsenite was by far the most phytotoxic. A comparative study of absorption, transport, and metabolism by the leaves revealed that MSMA and CA were transported about equally from the leaves to the terminal bud and expanding leaves; sodium arsenite and sodium arsenate were translocated in much smaller amounts than CA and MSMA. There was no indication that CA or MSMA was demethylated to form inorganic arsenate or reduced to a trivalent arsenic compound. Studies with ^{14}C-MSMA on Black Valentine beans revealed, however, that a substantial portion of the ^{14}C and arsenic recovered, perhaps 40% was bound rapidly to another molecule to form a ninhydrin-positive complex. There was some indication that arsenate combined with some component of plant tissues. Also, arsenite may have been oxidized to arsenate.

Sodium arsenite, although not transported, was a fast-acting contact herbicide, particularly in Black Valentine beans and soybeans, thus accounting for its parity with CA in these species. When root-applied, sodium arsenite inhibited the root system at 1/10 the concentration of sodium arsenate and 1/100 that of CA and MSMA. Sodium arsenite and arsenate were absorbed equally readily by the root systems of Black Valentine beans, thus sodium arsenite was intrinsically a more effective inhibitor of processes regulating growth in beans than sodium arsenate. Arsenite was absorbed by the root system about twice as readily as MSMA but was at least 20- to 80-fold more phytotoxic; hence, the difference in activity between MSMA and sodium arsenite could not have been the result of differences in absorption but must have been due to intrinsic properties of the compounds. The tissue concentration of sodium arsenite, corrected for external concentration, was about 30-fold greater than that for CA; hence the differences in phytotoxicity observed between the two compounds were probably the result of differences in relative ease of absorption.

There was no experimental evidence that root-applied cacodylic acid was altered in plant tissues or the nutrient solution over a 10-day period; in particular, no arsine gas was detected in an experiment in which the atmosphere was monitored for 5 days.

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EVALUATION OF HERBICIDES FOR ANNUAL WEED CONTROL IN WHITE POTATOES (1970)

Daniel H. Fricke [1/]

Abstract

A number of chemical herbicides were applied alone or in combination to white potatoes at pre-emergence, first cultivation or lay by. Populations of annual grass and broadleaf weeds were generally light. Differences in crop damage 10 days after emergence and in potato yields resulted. Several treatments producing low levels of potato plant damage gave excellent weed control and yields not significantly lower than the cultivated check.

Introduction

The following paper represents a progress report in evaluation of herbicides for control of white potatoes on Long Island. Two experiments conducted during 1970 are reported, evaluating herbicides used singly and in combinations which showed promise in previous years (1,2,).

Procedure

The experiments were conducted on a commercial farm which had a history of high populations of annual broadleaf and grassy weeds. The Katahdin potato variety was planted in 34 inch rows on April 28. Fertilization included 1500 pounds per acre of 10-20-10 banded at planting, and sidedressing on June 4 with 200 pounds per acre of UREA (45% nitrogen) and 200 pounds per acre of sulphate of potash-magnesium. During the growing season potatoes were irrigated twice and a preventative insect and disease spray program followed.

Plot size in both experiments was 2 rows wide by 30 feet long. Experimental design was a randomized block with each treatment replicated four times. Herbicides used in the experiments are listed in Table 1. Spray formulations of herbicides were applied with a tractor mounted 2 row boom sprayer using a pressure of 35 p.s.i. and a volume of 38 gallons per acre. Granular materials were applied with a hand held, gravity flow, funnel type applicator; EPTC granular treatments in Experiment II were applied with a tractor mounted, 2 row Gandy applicator.

Because no rain fell after planting a Meeker harrow was used May 5 to firm the planter ridges and on May 13 pre-emergence or drag-off incorporated treatments were applied. Three days of rain followed, totaling 2 inches, and on May 20 the pre-emergence treatments were applied to a moist soil surface with about 10% of the potatoes already emerged after the delay caused by rain. An additional 1.0 inch of rain fell on May 24-25. The

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early post emergence treatment was applied on May 29. Observations for phytotoxic effects were made on June 2. The first cultivation was made on June 9, when the herbicide treatments listed were applied. On June 23 hilling was done and the lay by treatments applied.

Table 1 - Herbicides Used in 1970 Potato Herbicide Evaluations

Common Name	Trade Name	Chemical Name
linuron	Lorox	3(3,4-dichlorophenyl-1-methoxy-1-methylurea
alachlor	Lasso	2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide
metabromuron	Patoran	3-(p-bromophenyl)-1-methyl-1-methoxyurea
chlorobromuron	Maloran	3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea
norea	Herban	3-(hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea
EPTC	Eptam	S-ethyl dipropylthiocarbamate
trifluralin	Treflan	a,a,a,-trifluro-2,6 dinitro-N,N-dipropyl-p-toluide
	Bayer 94337	4-amino-6 t-butyl-3-(methylthio)-as-triazin-5-(4H)-one
	VCS 438	Chemical name not available
DCPA	Dacthal	dimethyl tetra chloro terephthalate
vernolate	Vernam	S-propyl dipropyl dithio carbamate
	Proprietory Mixtures	
DCPA-linuron	Dacthal 60-Lorox 7.5	
CIPC plus adjuvant PPG 124	Furloe	Isopropyl m-chlorocarbanilate p-chlorophenyl N-methyl carbamate

Ratings for weed control were made on September 10 and vines killed September 14. Potatoes were harvested and total weights measured on one of each two test rows on October 8. Rye cover crop was planted following harvest and rated for stand and vigor on November 4.

Principal weed species present were: barnyard grass (Echinochloa crusgalli (L.) Beau), ladysthumb (Polygonum spp.) and wild mustard (Brassica spp.).

Results

The treatments compared in the two experiments are listed in tables 2 and 3. Experiment I, Table 2, lists the treatments and results where herbicides were applied singly and Experiment II, Table 3, lists the treatments and results in the combination treatments compared.

A number of the treatments in both experiments resulted in observable crop damage when rated 10 days following emergence of the potatoes. Damage was rated separately for chlorosis, necrosis and stunting.

Experiment I

In Experiment I higher chlorosis resulted after pre-emergence treatments with both rates of VCS 438, linuron 50 WP, all chlorobromuron treatments and alachlor. The treatments resulting in higher ratings for both necrosis and stunting included the early post emergence chlorobromuron and the pre-emergence alachlor treatments. CIPC caused severe stunting only.

Weed populations were generally low in both experiments. In Experiment I, most treatments resulted in commercially acceptable control of both annual grasses and broadleaf weeds. The CIPC treatments where stunting of the potato crop became more severe later in the growing season, resulted in heavier weed population than the cultivated check treatments with normal crop growth.

Significant differences in potato yield were found at the 5% level using Duncan's Multiple range test. In this experiment the yield of the check was highest and those treatments with yields significantly lower were the VCS 438 at 3 lbs., CIPC at both 2 and 4 lbs., and alachlor. Yields of both CIPC treatments were significantly lower than all other treatments.

Experiment II

In Experiment II, Table 3, those treatments which resulted in higher ratings for chlorosis were linuron pre-emergence plus EPTC at first cultivation, DCPA-linuron pre-emergence at the higher rate, VCS 438-alachlor pre-emergence, linuron-alachlor pre-emergence, linuron pre-emergence plus alachlor 10G first cultivation, linuron pre-emergence plus linuron at lay by, chlorobromuron pre-emergence plus chlorobromuron at lay by and alachlor-chlorobromuron pre-emergence. Treatments resulting in

higher ratings for both necrosis and stunting were the VCS 438-alachlor pre-emergence, linuron-alachlor pre-emergence, and the alachlor-chlorobromuron pre-emergence.

Most treatments resulted in commercially acceptable weed control. Those appearing to result in less than commercially acceptable levels were the check, linuron-EPTC tank mix incorporated at drag-off and alachlor-chlorobromuron pre-emergence.

Treatments in Experiment II resulted in significant differences in potato yield. The following pre-emergence treatments resulted in yields significantly lower than the cultivated check: DCPA-metabromuron, DCPA-linuron at both rates, linuron-alachlor, and alachlor-chlorobromuron.

Effect On Rye Cover Crop

Only three of the treatments appeared to have an effect on the rye cover crop. Treatments in Experiment I resulted in the following percent of normal stand and vigor of the cover crop, vernolate 6E at 4.5 lbs. - 70%, norea at 3.0 lbs. - 80% and CIPC at 4 lbs. -40%.

Discussion

Because of the relatively light weed population, due in part at least to heavy potato vine growth, many of the treatments evaluated appeared to give satisfactory weed control, and differences between treatments were small except in some cases where crop damage allowed weeds to be more competitive.

Phytotoxic effects on the potato crop however were more pronounced than had been experienced in previous years (1,2). The higher levels of phytotoxicity may have been due to high soil moisture at the time of and following application plus the fact that the pre-emergence treatments were actually applied when 10% of the potatoes had already emerged.

The following herbicide treatments resulted in good control of both annual grasses and broadleaf weeds, low crop damage and yields not significantly lower than the cultivated checks: incorporated at drag off treatments of EPTC 6E or 7E, vernolate 6E or 7E and trifluralin 4 EC and pre-emergence treatments of Bayer 94337, norea, linuron 50W and chlorobromuron 50W at 2.0 and 3.0 lbs. Herbicide combinations with the same criteria included linuron PE plus EPTC G at first cultivation, chlorobromuron PE plus EPTC G at first cultivation, linuron PE plus alachlor G at first cultivation, trifluralin plus linuron at drag off incorporated, trifluralin drag off incorporated plus linuron G at lay by, linuron at PE plus lay by, and chlorobromuron PE plus lay by.

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Table 2 - 1970 Potato Herbicide Experiment I - Singly Applied Herbicides

Treatment Material & Formulation	Lbs. Aia	Timing & Method	General[a] Weed Control	Yield[b] Cwt.	Yield[b] Sig.[c] Diff.	Crop damage[a] 10 days after emergence Chlor.	Crop damage[a] 10 days after emergence Nec.	Crop damage[a] 10 days after emergence Stunt
1 EPTC 6E	4.5	D.O. Inc.	8.2	305	abc	1.2	1.2	1.2
2 EPTC 7E	4.5	D.O. Inc.	8.2	324	abc	1.5	1.0	1.5
3 Vernolate 6E	4.5	D.O. Inc.	8.2	319	abc	1.2	1.2	1.7
4 Vernolate 7E	4.5	D.O. Inc.	8.4	306	abc	1.5	1.5	1.7
5 Trifluralin 4 EC	1.0	D.O. Inc.	7.7	307	abc	1.0	1.0	1.7
6 Bayer 94337 70W	0.5	PE	7.5	320	abc	1.0	1.0	1.5
7 Bayer 94337 70W	0.75	PE	7.5	323	abc	1.0	1.0	1.0
8 Bayer 94337 70W	1.0	PE	8.0	327	abc	1.5	1.2	1.0
9 linuron 10G	1.5	PE	7.1	324	abc	1.2	1.2	1.7
10 VCS 438 75W	1.5	PE	7.2	308	abc	3.7	2.2	2.0
11 VCS 438 75W	3.0	PE	6.9	253	bc	3.7	1.7	2.2
12 norea 80W	2.0	PE	7.6	269	abc	1.7	1.5	2.0
13 norea 80W	3.0	PE	7.6	270	abc	2.0	1.2	1.2
14 linuron 50W	1.5	PE	7.6	299	abc	3.2	1.7	1.7
15 CIPC 20G	2.0	PE	2.0	109	d	1.0	1.2	4.0
16 CIPC 20G	4.0	PE	3.0	147	d	1.0	1.0	4.7
17 chlorobromuron 50W	2.0	PE	7.9	292	abc	3.7	2.5	2.5
18 chlorobromuron 50W	2.5	PE	7.3	334	ab	3.7	2.5	2.0
19 chlorobromuron 50W	3.0	PE	7.6	305	abc	4.0	2.2	2.0
20 chlorobromuron 50W	2.0	Early Post	7.3	269	abc	4.2	4.2	4.2
21 chlorobromuron 75W	2.5	PE	6.7	308	abc	3.5	2.0	2.5
22 chlorobromuron 10G	3.0	PE	6.9	285	bc	3.5	1.5	2.0
23 alachlor 4 ec	4.0	PE	7.3	232	c	2.5	5.7	5.2
24 check			5.9	358	a	1.2	1.0	1.0

a - weed control or crop damage rating scale, 1-9
1= no crop injury or weed control
9= crop eliminated or 100% weed control

b - Potato yield, cwt. per acre, total harvested weight

c - Yield means with identical letters not significant at the 5% level. (Duncan's multiple range test).

Table 3 - Experiment II - Combinations

Treatment	Lbs. Aia	Timing & Method	General[a] Weed Control	Yield[b] Cwt/A	Yield[b] Sig.[c] Diff.	Crop damage[a] 10 days after emergence Chloro	Nec.	Stunt
26 Check			6.5	361	a	1.5	1.3	2.0
27 linuron 50W	1.0	Tank mix	6.8	335	abc	2.0	1.5	2.3
EPTC 6E	3.0	D.O. inc.						
28 linuron 50W	1.0	PE	8.8	305	abcd	3.5	2.3	2.5
EPTC 5G	4.0	inc. 1st cult.						
29 chlorobromuron 50W	2.0	PE	8.8	301	abcd	4.3	2.3	2.5
EPTC 5G	4.0	inc. 1st cult.						
30 DCPA 60W	6.0	PE	7.8	280	cde	3.3	2.5	3.0
linuron 7.5W	0.75							
31 DCPA 60W	12.0	PE	7.8	227	e	3.8	4.0	2.8
linuron 7.5W	1.5							
32 VCS 438 75W	1.25	PE	7.5	313	abcd	4.5	6.0	5.8
alachlor 4 EC	2.0							
33 linuron 50W	1.0	PE	7.2	272	cde	4.0	6.5	6.0
alachlor 4 EC	2.0							
34 linuron 50W	1.0	PE	7.8	346	ab	4.0	2.0	2.0
alachlor 10G	2.0	1st cult.						
35 trifluralin 4 EC	0.75	D.O. inc.	8.2	334	abc	1.3	1.3	1.3
linuron 50W	1.0							
36 trifluralin 4 EC	0.75	D.O. inc.	8.8	325	abc	1.0	1.0	1.5
linuron 10G	1.0	lay by						
37 linuron 50W	1.0	PE	7.8	318	abc	4.0	2.5	2.3
linuron 10G	1.0	lay by						
38 chlorobromuron 50W	1.5	PE	8.8	303	abcd	4.3	2.3	2.5
chlorobromuron 10G	1.5	lay by						
39 alachlor 4 EC	2.0	PE	6.5	250	de	4.5	7.0	5.8
chlorobromuron 50W	2.0							
40 DCPA 75W	6.0	PE	7.2	288	bcde	2.0	1.8	2.0
metabromuron 50W	1.0							

a,b,c - see footnotes Table 2

POTATO VINE KILLING[1]

S. Dallyn and P. A. Schippers[2]

Abstract

1,1'-dimethyl-4,4'-bipyridinium (paraquat) applied to Katahdin at three stages of maturity, and to Peconic and Russet Burbank at one, did not affect suberization or visible storage characteristics to Nov. 5. Samples will continue in storage until early spring. A number of treatments produced satisfactory vine kill and did not harm rye cover crop seeded shortly after harvest. Weeds were not a serious problem in any of the plots. Ammonium nitrate at 120 lb/A, as well as several other additives, increased the effectiveness of most materials.

Introduction

The program in 1970 was conducted along two main lines. The first was a series of experiments with paraquat to determine its effect on suberization and storability of the tubers. The second was a conventional test of a number of materials to determine their usefulness as vine killers. In none of the test areas were weeds a serious problem.

Methods

Experiment I. Katahdins, planted May 1, were killed early - August 6; midseason - August 13, and late - August 25. At the early stage of growth vines were vigorous and upright; midseason, natural senescence just starting; late, vines 40-50% down. Peconics, planted April 24, were killed Aug. 6 and Russet Burbanks planted May 5 were killed Aug. 25 - both varieties at the midseason stage. The materials were applied with a brush boom sprayer, 300 psi and 100 gallons per acre. Plots were three rows wide by 30 feet long, replicated three times. Weather conditions on all three days favored rapid kill - clear and bright with temperatures 75-80 F. Vine kill was rated 3, 5 and 10 days after application.

The plots were harvested 12 to 14 days after killing, yield data obtained, and samples taken for storage. One set of samples was placed immediately at 40 F and 85% R.H. A duplicate set was placed at 60-70 F and 95-100% R.H. for three weeks, to allow curing, then moved into the same storage room as the first group. Weight losses during storage to Nov. 5 gave an indication of the degree of wound healing which had occurred. Additional observations on quality will be taken throughout the storage period.

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Treatments were as follows:

1. Paraquat (2 lb/gal) 1 pt/A plus 8 oz X-77[3]

2. Ditto #1 plus 120 lbs ammonium nitrate

3. Paraquat 2 pt/A plus 8 oz X-77

4. Ditto #3 plus 120 lbs ammonium nitrate

5. 4,6-dinitro-o-sec-butylphenol (dinoseb)[4] (5 lb/gal) 1 qt/A plus 120 lbs ammonium nitrate

6. Sodium arsenite (9½ lbs/gal arsenic trioxide) 3 qts/A plus 120 lbs ammonium nitrate

7. Check - vines rotocut immediately prior to harvest

Experiment II. Katahdins, planted May 5, were sprayed with a number of vine killers on Aug. 26, just as the vines were starting to go down. The day was clear and bright, temperature 80 F, with conditions favoring a rapid kill. The crop was harvested Sept. 16 and samples placed in storage. These will be examined in late winter or early spring and rated on their performance. In addition to materials already mentioned the following were also used:

2-(ethylamino)-4-(isopropylamino)-6-(methylthio)-s-triazine (ametryne) 2E and 80W formulations

dinoseb[5] formulated mixture of diesel oil containing 2½ lbs dinoseb/gal

Tronic spreader - activator[6]

Booster Plus E - spray additive[7]

GA-2-219, phytotoxic oil[8]

GA-7-03, surfactant[8]

Results

Experiment I. The yield and vine killing data for Katahdin are given in Table 1 and for Peconic and Russet Burbank in Table 2. Tables 3 and 4 contain a summary of the storage data through Nov. 5.

3/ Spreader-activator, Ortho
4/ Dow General
5/ General Weed Killer E - Dow
6/ Colloidal Products
7/ Agway
8/ Geigy

Table 1. Results with several vine killing treatments applied to Katahdin at three stages of maturity.

	Early				Midseason				Late			
Tr.[a]	Yield Cwt/A	Vine Kill Rating[b] 3	5	10	Yield Cwt/A	Vine Kill Rating 3	5	10	Yield Cwt/A	Vine Kill Rating 3	5	10
1	185	2	3	5	231	2	3	7	218	4	5	9
2	158	4	4	6	206	3	6	8	203	5	7	9
3	172	5	6	8	222	3	5	9	203	4	7	9
4	176	8	8	9	231	5	7	9	234	7	8	9
5	185	7	7	8	225	5	6	8	220	7	8	8
6	172	8	8	9	199	6	6	9	198	8	9	9
7	209	1	1	1	228	1	1	1	194	1	1	1
LSD 5%	NS				21				35			

a/ See "methods" for complete description

b/ Vine kill rated 3, 5 and 10 days after application
Rating scale - 1: no kill
3: 50% kill of leaves
5: 100% " "
7: 100% " " ; 50% kill of stems
9: 100% " " and stems

Table 2. Results with several vine killing treatments applied to Peconic and Russet Burbank potatoes.

	Peconic				Russet Burbank			
Treatment[a]	Yield Cwt/A	Vine Kill Rating[b] 3	5	10	Yield Cwt/A	Vine Kill Rating 3	5	10
1	320	2	3	4	135	2	3	6
2	311	3	4	7	150	5	6	8
3	304	4	5	7	158	5	6	9
4	275	5	6	8	172	5	6	9
5	261	4	4	6	166	5	6	8
6	310	4	5	8	134	7	8	9
7	369	1	1	1	152	1	1	1
LSD 5%	NS				NS			

a/ and b/ see footnotes Table 1

Table 3. Percent weight loss per month to Nov. 5, of cured and non-cured samples of three varieties stored at 40 F, 85% R.H. Katahdin data shown were from the late killing date.

Field Treatment	Peconic Curing -	Peconic Curing +	R.B. Curing -	R.B. Curing +	Katahdin Curing -	Katahdin Curing +	Average Curing -	Average Curing +	Average
1	2.13	1.11	2.88	1.59	2.22	1.64	2.41	1.45	1.93
2	2.16	1.11	2.78	1.97	2.45	1.52	2.46	1.53	2.00
3	2.06	1.15	2.59	1.68	2.40	1.62	2.35	1.48	1.92
4	2.35	1.00	2.66	1.70	2.39	1.64	2.47	1.45	1.96
5	2.10	1.23	2.70	1.72	2.48	1.70	2.43	1.55	1.99
6	2.21	1.31	2.67	1.56	2.39	1.82	2.42	1.53	1.98
7	2.14	1.59	3.01	1.82	2.36	1.63	2.50	1.68	2.09
Average	2.17	1.20	2.76	1.72	2.38	1.65	2.43	1.52	1.98
	1.68		2.24		2.02				

Highly significant main effects: variety and curing
Highly significant interaction: variety x curing
No influence of field treatment

There were no visible differences between the samples of the Katahdin and Russet Burbank varieties. The cured samples of Peconic were slightly darker in appearance than the uncured. Peconic check samples were definitely darker than those from plots which had been vine killed - probably a reflection of skin maturity and amount of skinning which occurred during harvest.

Table 4. Percent weight loss per month, to Nov. 5, of cured and non-cured Katahdins killed at three stages of maturity and stored at 40 F and 85% R.H.

Field Treatment	Early Curing -	Early Curing +	Midseason Curing -	Midseason Curing +	Late Curing -	Late Curing +	Average Curing -	Average Curing +	Average
1	2.75	1.36	2.35	0.85	2.22	1.64	2.44	1.28	1.86
2	3.70	1.37	1.96	0.88	2.45	1.52	2.70	1.26	1.98
3	3.36	1.22	2.70	1.18	2.40	1.62	2.82	1.45	2.14
4	3.36	1.38	2.59	1.25	2.39	1.64	2.78	1.43	2.10
5	3.27	1.38	2.83	1.22	2.48	1.70	2.86	1.43	2.15
6	4.02	1.29	2.34	0.89	2.39	1.82	2.92	1.33	2.12
7	4.04	1.63	2.76	1.42	2.36	1.63	3.05	1.56	2.31
Average	3.50	1.42	2.50	1.10	2.38	1.65	2.80	1.39	2.09
	2.46		1.80		2.02				

Highly significant main effects: Harvest date and curing
Significant main effect: Field treatments: Sign. diff. between tr. 1 and 7
Highly significant interaction: Harvest date x curing: curing effect was less with more mature crop

Experiment II. A summary of the more extensive experiment on vine killing is given in Table 5. No significant differences in yield occurred and these figures have not been included.

Table 5. Effect of a number of treatments on vine kill with the Katahdin variety of potatoes.

Treatment[a]	Vine Kill Rating[b] 3 days	5 days	10 days
1. Dinoseb 1 qt/A	4	5	7
2. " " + 5 gal diesel fuel	5	5	6
3. " " + 1 qt Tronic	5	7	8
4. " " + 2 qts Booster Plus E	5	7	8
5. " " + 120 lbs ammonium nitrate	5	7	8
6. " 2 qt/A	6	8	9
7. " " + 5 gal diesel fuel	6	8	9
8. " " + 1 qt Tronic	7	8	9
9. " " + 2 qts Booster Plus E	7	8	9
10. " " + 120 lbs ammonium nitrate	8	8	9
11. Sodium arsenite 3 qts	8	8	9
12. " " " + 120 lbs ammonium nitrate	8	9	9
13. Paraquat 1 pt	4	7	9
14. " " + 120 lbs ammonium nitrate	6	8	9
15. Ametryne 2E, 2 lbs/A	2	5	8
16. " " " + 2 gal GA-2-219	4	6	8
17. " " " + 2 qts GA-7-03	4	6	7
18. " " " + 120 lbs ammonium nitrate	5	7	8
19. " 80W "	2	5	7
20. " " " + 2 gal GA-2-219	4	6	7
21. " " " + 2 qts GA-7-03	4	5	7
22. " " " + 120 lbs ammonium nitrate	4	6	8
23. Dinoseb formulation 2 qts/A	6	8	8
24. " " 4 qts/A	6	8	9
25. Check	1	1	1

a/ See "methods" for further details
b/ Rating - 1: no kill
3: 50% kill of leaves
5: 100% " "
7: 100% " " ; 50% of stems
9: 100% " " and stems

Rating Dates: Applied 8/26/70
3 days 8/29/70
5 days 8/31/70
10 days 9/ 5/70

Discussion

The primary objective of the first series of treatments was to determine whether paraquat had any effect on storability of the crop. Observations to date indicate that it did not, nor did there appear to be any effect on suberization.

Conditions on all three killing dates were similar, thus no information was obtained on the importance of weather, through its effects on speed of kill. These results are in accordance with most of the published information on the subject, though at variance with those of Jones (1). Vine kill was satisfactory with all treatments except #1. One pint of paraquat was not sufficient, particularly if the vines were still actively growing. The addition of ammonium nitrate to paraquat markedly improved its activity. No effect of any treatment was noted on a rye cover crop seeded the first week in September.

In the main experiment on materials, dinoseb at 1 qt/A was a borderline dosage. The addition of diesel fuel was of no benefit but the other three additives all improved its performance. At 2 qts/A all treatments with dinoseb were effective. Sodium arsenite, paraquat, and the dinoseb formulation also produced good vine kill. Ametryne was relatively slow acting but by the end of ten days reasonably good kill had been obtained. At the rates used in this experiment there were no harmful effects on the cover crop, though Scudder (2) reported residues of this material toxic to oats up to 80 days after application. Fall rye at 2 bu/A was seeded Sept. 23 and observations on Nov. 13 indicated an excellent uniform growth of the crop over the entire area.

LITERATURE CITED

1. Jones, E. O. 1970. Unpublished results. Dept. Plant Path., Cornell Univ.

2. Scudder, W. J. 1968. Ametryne as a pre-harvest dessicant for Irish potatoes. Proc. Southern Weed Sci. Soc. 21: 203-206

POTATO VINE KILLING IN MAINE - 1969

H. J. Murphy and M. J. Goven[1]

The following paper reports the results of potato vine killing studies conducted in Maine during the 1969 growing season. Evaluation of harvested tubers was made during the 1969-70 storage period and emergence trials were conducted during the 1970 growing season.

Materials and Methods:

All chemicals unless otherwise indicated were applied in 80 gallons of water per acre at 40 pounds pressure to actively growing Katahdin potato vines on the dates indicated in each table. A compressed air sprayer equipped with a two-nozzle brush-type boom was used for foliar application of the vine desiccants. Plots consisted of single rows, 25 feet long, with single buffer rows between treatments. Plots were arranged in randomized blocks with treatments replicated six times.

Using a five-step rating system as listed in Table 1, vine kill ratings were made at weekly intervals following application of vine desiccants.

Table 1. Potato vine-kill rating code. Maine - 1969.

1. Poor or no kill of leaves or stems.
2. 90% of leaves killed but poor stem kill.
3. 100% of leaves and 40% of stems killed.
4. 100% of leaves and 70% of stems killed.
5. 100% of leaves and stems killed.

Approximately 15 pounds of tubers were collected from each plot at harvest time and stored at 50°F. for examination during the winter storage season. Storage studies consisted of observing tubers from each treatment for storage disorders and examination of individual tubers for internal and possible external discolorations which might be caused by use of chemical desiccants. From these storage samples tubers were also available upon request by chemical suppliers for residue analysis.

Tubers, snipped and examined for vascular discoloration, were bulked by treatment and stored at 38°F. In the spring of 1970, tubers from each treatment were planted in replicated emergence and yield trials to determine possible side effects of the desiccants on sprouting, emergence, vigor, and yield of tubers.

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Results and Discussion:

Data presented in Table 2 compare the effects of several commercial desiccants on vines, tubers, and plant emergence. The standard treatment at the start of this study was 8 pounds of AS_2O_3 from sodium arsenite. Since sodium arsenite can no longer be used for potato vine destruction, either of the dinitro compounds should probably be considered as standards for comparative purposes.

Data presented in Table 2 indicate that Des-I-Cate was the best treatment for potato vine desiccation in 1969. Paraquat at all rates used gave good vine desiccation. The lower rate of 1 pint per acre of Paraquat was about as good as the 2 pint rate for potato vine killing in 1969. Dow General and Premerge were better than sodium arsenite for vine killing in 1969. The eight pound rate of AS_2O_3 was better than the 4 pound rate. The addition of liquid nitrogen to sodium arsenite did not increase the activity of the arsenic trioxide in 1969.

Data presented in Table 2 also indicate that none of the chemical desiccants affected plant emergence from treated tubers; nor was vascular discoloration of tubers enough to be of any consequence. Since no treatment had 0.3% of tubers showing discoloration in tubers from treated plots could be associated with chemical desiccants.

Data presented in Table 3 indicate the performance of two numbered chemical desiccants compared to a sodium arsenite standard treatment. RP2929 with oil gave good vine kill with the 4 pound rate slightly superior to the 2 pound rate and also better than sodium arsenite. RP17623 did not perform well for vine desiccation and also caused some increased vascular discoloration. None of the compounds affected plant emergence.

Table 4 presents source and chemical names of compounds used in the 1969 potato vine killing tests in Maine.

Summary:

Potato vine killing studies conducted in Maine during 1969 indicated Paraquat, dinitro compounds, RP2929 with oil and 8 pounds of AS_2O_3 gave satisfactory vine kill. RP17623 and 4 pound rates of AS_2O_3 did not provide satisfactory vine kill. None of the treatments used in 1969 caused excessive vascular discoloration or affected emergence when plants were grown from treated tubers in 1970.

Table 2. Effect of several chemicals on potato vine desiccation, vascular discoloration of tubers, and emergence of plants from tubers used for seed. Katahdin Variety. Maine - 1969.

Treatments[1]			Vine kill ratings[2]		Percent vascular discoloration[3]			Percent emergence
Material	Rate/Acre	Additive	Aug. 28	Sept. 5	Slight	Medium	Severe	1970
No treatment			1.0	1.0	0.3			100
Sodium Arsenite	8 lbs. AS O		2.7	3.0	0.7	0.2		100
Sodium Arsenite	4 lbs. AS O	10 lbs. N(Uran)	2.0	2.4				100
Sodium Arsenite	8 lbs. AS O	10 lbs. N(Uran)	2.7	3.0	0.7		0.1	100
Premerge	3 qts.	5 gals. #2 oil plus 1 pt. emulsifier	3.1	3.3	0.7			100
Dwo General	2 qts.	5 gals. #2 oil	3.3	4.0	0.7			100
Paraquat	1 pt.	8 oz. X-77	3.1	4.3	0.3			100
Paraquat1	1½ pts.	8 oz. X-77	4.0	4.5	0.3			100
Paraquat	2 pts.	8 oz. X-77	4.5	4.7	0.4	0.1		100
Des-I-Cate	2 gals.	5 gals. #2 oil	5.0	5.0	0.3			100
		L.S.D. (0.05)	0.5	0.4				

[1] Materials applied August 22, 1969. Weather clear. Temperature 65°F. Soil conditions very wet. Vines exceptionally green and vigorous. Precipitation from kill date through rating period 0.95 inches.

[2] Kill rating code presented in Table 1.

[3] Examinations made on 15 pound samples from each of six replicates on December 30, 1969.

Table 3. Effect of RP2929 and RP17623 on potato vine desiccation, vascular discoloration of tubers, and emergence of plants from tubers used for seed. Katahdin Variety. Maine - 1969.

Treatments[1]			Vine kill ratings[2]		Percent vascular discoloration[3]			Percent emergence
Material	Rate/Acre	Additive	Sept. 3	Sept. 10	Slight	Medium	Severe	1970
No treatment			1.0	1.0	2.8			100
Sodium Arsenite	8 lbs. AS_2O_3		3.5	4.0	0.2	0.1	0.1	100
RP2929	2 lbs.	5 gals. #2 oil	4.2	4.0*	0.0			100
RP2929	4 lbs.	5 gals. #2 oil	4.7	4.5*	1.0			100
RP17623	2 lbs.		2.0	2.0	2.6			100
RP17623	4 lbs.		2.0	2.0	4.7	1.3		100
RP17623	2 lbs.	5 gals. #2 oil	2.2	3.0	4.5			100
RP17623	4 lbs.	5 gals. #2 oil	2.5	3.2	4.0		1.0	100
		L.S.D. (0.05)	0.3	0.5				

* Some regrowth at time of last reading.

[1] Materials applied August 26. Weather mostly clear to some cloudiness. Soil conditions wet. Temperature 70°F. Vines vigorous and green. Precipitation from kill date through rating period 5.51 inches.

[2] Kill rating code presented in Table 1.

[3] Examinations made on 15 pound samples from each of six replicates on December 22, 1969.

Table 4. Chemicals used for Maine potato vine killing studies - 1969.

Compound	Active Ingredient	Source
Sodium Arsenite	Arsenic trioxide	C. W. Staples Company, Inc.
Premerge	4, 6-dinitro-O-sec-butylphenol	Dow Chemical Company
Dow General	4, 6-dinitro-O-sec-butylphenol	Dow Chemical Company
Paraquat	1, 1-dimethyl-4, 4-bipyridium dichloride	Chevron Chemical Company
Des-I-Cate	Mono-(N, N-dimethylathylanion salt of endothal)	Pennwalt Corporation
RP2929	4-dimethylaminothiocyanobenzene	Rhodia (Chipman Division)
RP17623	2-tertiobutyl-4-(2, 4-dichloro-5 isopropyloxyphenyl)-5-oxo-1, 3, 4-oxadiazoline	Rhodia (Chipman Division)

WEED CONTROL IN WHITE POTATOES IN MAINE - 1970

H. J. Murphy and M. J. Goven[1]

Eighteen herbicides were tested in Maine during the 1970 season for control of broadleaved weeds, annual grasses, and quackgrass (Agropyron repens). In Maine we are looking for herbicides which have broad spectrum weed control, are flexible as to time of application, and they must not have adverse effects on vines or affect quality of tubers for seed purposes.

Rainfall in 1970 as presented in Table 1 was above normal during May and June and below normal during July and August. Soil moisture conditions were favorable for annual grass control during the early part of the growing season, but growth of broadleaved weeds was slightly suppressed until mid-July.

Procedure

Three blocks of Katahdin potatoes were planted on May 23, May 30, and June 5, 1970, at Aroostook Farm, Presque Isle, Maine. All plots were fertilized with 1400 pounds of 10-10-10 fertilizer placed in conventional row sidebands. Seedpieces were spaced 8 inches apart and covered with not more than 1½ inches of soil. Soil type at all three test locations was Caribou gravelly sandy loam with organic matter content of 4.62 percent. Plot areas were fall plowed and harrowed twice before planting in 1970. Previous crop on two blocks was Japanese Millet and Red clover on the third block. No chemical herbicides were applied to either crop during 1969.

Experimental designs for all three tests reported in this paper were randomized complete blocks with each treatment replicated six times. Plot size was two 20-foot rows with untreated buffer rows between treated plots. Herbicides were applied with one pass of a small plot sprayer using a pressure of 40 pounds and a volume of 80 gallons of mixture per acre. Herbicides were applied on the following dates:

	Test I	Test II	Test III
Preplant Inc. (PP.)		June 5	
Planting (PL.)		June 9	
Preemergence (PE.)	June 11	June 12	June 12
Emergence (EM.)	June 22	June 26	
Layby (LB.)			June 14

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Table 1. 1970 Rainfall - Presque Isle, Maine.

May	3	0.57		July	1	0.06	
	5	T			4	0.02	
	6	0.72			5	0.17	
	7	0.17			9	T	
	8	0.14			10	0.70	
	9	0.01			11	1.18	
	10	0.02			12	0.36	
	11	0.56			13	0.05	
	12	0.11			15	0.02	
	13	0.63			16	0.02	
	14	0.01			17	0.03	
	17	0.07			18	0.02	
	18	0.74			19	0.20	
	19	0.07			22	0.06	
	20	0.01			27	0.12	
	22	0.13			28	0.03	
	23	0.02			29	T	3.04
	25	T		Aug.	2	0.01	
	26	0.21			3	0.07	
	27	0.05			4	0.25	
	31	0.01	4.25		5	0.01	
June	1	0.15			12	0.82	
	2	0.87			13	0.19	
	3	0.02			14	0.08	
	5	T			17	0.02	
	6	0.74			20	T	
	7	0.01			21	0.10	
	8	0.01			23	0.42	
	11	T			24	0.58	
	12	0.01			26	0.20	
	18	T			29	0.12	
	19	1.10			30	T	
	20	0.16			31	0.27	3.14
	25	0.05					
	27	0.70					
	28	0.23					
	30	0.52	4.57				

Weed control ratings were made on dates indicated in Tables 3, 4, and 5 which also note the weed species present in each block. Vines were mechanically rotobeated before harvest, yield of tubers measured, and 25 pounds of tubers from each plot saved for storage studies and residue analysis.

Common name and chemical designation of herbicides in Maine trials are presented in Table 2.

Results

Test I: Data presented in Table 3 indicate that all herbicides, except EL119 at all rates and Herban at 1.2 and 2.0 pounds per acre, gave satisfactory broadleaved weed control (4.0 rating or higher). Potato plants on plots treated with RP17623 had serious symptoms of phytotoxicity at time of weed ratings on June 29, but symptoms slowly disappeared by mid-summer. Annual grasses were satisfactorily controlled (3.5 plus) by DNBP plus Dalapon, Linuron, Bay 94337 at the one pound rate, and by Paraquat. Paraquat was the only material in Test I that gave adequate full season control of quackgrass.

Yield data in Table 3 indicate that lack of weed control by EL119 reduced yields and possibly RP17623 also reduced yields.

Test II: Data presented in Table 4 indicate that only VC438, Linuron, and DNBP plus Dalapon gave satisfactory broadleaved weed control (4.0 or higher). R7465 applied preplant appeared to improve with time for controlling both broadleaved weeds and grasses. EL179 at 3.0 pounds per acre, R7465 applied preplant, and VC438 gave effective full season annual grass control (3.5 plus). Quackgrass was controlled by EL179, M3447, R7465, VC438, and DNBP plus Dalapon. Yield of tubers was not affected by any of the herbicides included in Test II.

Test III: This test was designed primarily for testing combinations of herbicides for broadleaved and annual grass control. Data presented in Table 5 indicate Alachlor + DNBP, Alachlor + Linuron, Alachlor + VC438, DNBP + VC438, and Dalapon + VC438 combinations were all effective for controlling broadleaved weeds and annual grasses. Alachlor at 6.0 pounds per acre, DNBP at 4.0 and 6.0 pounds per acre, Linuron, and VC438 were as effective alone as the combinations for weed control. None of the herbicides in Test III gave good quackgrass control. Yield of tubers was not greatly different between herbicides used.

Table 2. Herbicides used on white potatoes in Maine - 1970.

Trade Name	Common Name	Chemical Name
Dachthal	DCPA	Dimethyl ester of tetrachloroterephthalate.
Dowpon	Dalapon	2, 2-dichloropropionic acid.
Eptam 6E	EPTC	S-ethyl dipropylthiocarbamate.
Herban 80W	Norea	3-(hexahydro-4, 7-methanoindan-5yl)-1, 1-dimethylurea.
Lasso 4E	Alachlor	2-chloro-2, 6-diethyl-N (methyoxymethyl) acetonilide.
Lorox 50W	Linuron	3-(3, 4-dichlorophenyl)-1-methoxy-1-methyl-urea.
Maloran 50W	Chlorobromuron	3-(4-bromo-3 chlorophenyl)-1-methoxy-1-methylurea.
Maloran 75W	Same	Same.
Paraquat CL		1, 1'-dimethyl-4, 4'bipyridium dichloride.
Patoran 50W	Metobromuron	3-(P-bromophenyl)-1-methyl-methoxy-urea.
Premerge	DNBP	4, 6-dinitro-o-sec butylphenol.
Shamrox		60% DCPA plus 7.5% Linuron.
Bay 94337 70W		4-Amino-6-t-butyl-3-(methylthio)-as-triazin-5 (4H)-one.
EL179 6E		4-isopropyl-2, 6-dinitro-N, N-dipropylaniline.
EL119 75W		3, 5 Dinitro-N, N-dipropylsulfanilamide.
M3447 8E		α(2, 2, 2-trichloroethyl) styrene.
R 7465 50W		2-(α Napthoxy)-N, N-diethylpropionamide.
RP17623 3.3E		2-tertiobutyl-4-(2, 4-dichloro-5-isopropyloxyphenyl)-5-oxo-1, 3, 4-oxadiozoline.
VC438	Tunic	2-(3, 4-dichlorophenyl)-4-methyl-1, 2, 4-oxadiozolidine-3, 5-dione.

Table 3. Yield and weed control in white potatoes following application of various herbicides. Test I. Maine - 1970.

Treatments Pounds of active material per acre		Yield Cwt./A.	Weed Control Ratings[1] Broadleaf[2] 6/29	Broadleaf[2] 9/1	Annual Grass[3] 6/29	Annual Grass[3] 9/1	Quack Grass[4] 6/29	Quack Grass[4] 9/1
	Check - no treatment	116f	1.0	1.0	1.0	1.0	1.0	1.0
4.5#	DNBP, EM.[5]	191b-d	5.0	3.7	4.5	3.0	2.5	1.2
4.5#	DNBP + 5# Dalapon, EM.	236a	5.0	4.0	4.7	3.5	3.0	3.3
1.0#	Linuron, PE.	247a	5.0	4.0	5.0	3.8	2.3	1.3
0.75#	EL119, PE. (75W)	97f	1.0	1.0	1.0	1.0	1.0	1.0
1.5#	EL119, PE. (75W)	111f	1.0	1.2	1.0	1.5	1.0	1.0
3.0#	EL119, PE. (75W)	105f	1.0	1.0	1.0	1.0	1.0	1.0
0.25#	Bay 94337, PE.	225ab	5.0	3.7	4.2	3.2	1.8	1.3
0.5#	Bay 94337, PE.	249a	5.0	4.0	4.5	3.0	2.2	1.5
1.0#	Bay 94337, PE.	255a	5.0	4.3	5.0	4.3	2.7	1.5
1.2#	Herban, PE.	195b-d	3.7	2.8	2.8	1.3	1.0	1.0
2.0#	Herban, PE.	215a-c	3.8	2.8	2.8	1.8	1.2	1.5
2.8#	Herban, PE.	216a-c	4.2	3.7	3.3	2.7	1.8	1.0
1.6#	RP17623, PE.	179cd	5.0	4.0	5.0	3.2	2.2	1.0
2.5#	RP17623, PE.	160de	5.0	3.2	5.0	3.0	2.3	1.0
2.0#	Metobromuron, PE	256a	5.0	4.2	5.0	4.0	2.5	2.0
3.0#	Metobromuron, PE.	251a	5.0	4.0	5.0	3.8	2.8	2.2
2.0#	Chlorobromuron, EM. (50WP)	223ab	5.0	3.8	5.0	3.7	2.2	2.2
3.0#	Chlorobromuron, EM. (50WP)	236a	5.0	4.0	5.0	3.8	2.5	2.3
2.0#	Chlorobromuron, EM. (75WP)	217a-c	5.0	4.0	4.8	4.0	1.8	2.0
3.0#	Chlorobromuron, EM. (75WP)	240a	5.0	4.0	4.8	3.5	2.5	2.7
0.5#	Paraquat, EM.	242a	5.0	3.8	5.0	4.0	5.0	3.8
	L.S.D. (0.05)	35						

[1]Weed control ratings: 1 = no control; 5 = excellent control.
[2]Broadleaf weed species: Chenopodium album, Brassica campestris, Brassica rapa, Amaranthus retroflexus, and Polygonum persicaria.
[3]Annual grass: Echniochloa crusgalli and Setaria viridis.
[4]Quackgrass: Agropyron repens.
[5]EM = applied at emergence; PE = applied pre-emergence.

Table 4. Yield and weed control in white potatoes following application of various herbicides. Test II. Maine - 1970

Treatments Pounds of active material per acre		Yield Cwt./A	Weed Control Ratings[1] Broadleaf[2] 7/15	Broadleaf[2] 9/2	Annual Grass[3] 7/15	Annual Grass[3] 9/2	Quackgrass[4] 7/15	Quackgrass[4] 9/2
	Check - no treatment	239b	1.0	1.0	1.0	1.7	1.0	1.0
0.75#	EL179, PP. (6EC)	261ab	2.7	2.5	2.8	3.8	2.7	2.7
1.5#	EL179, PP. (6EC)	267ab	1.8	2.0	2.3	3.0	2.2	3.3
3.0#	EL179, PP. (6EC)	245ab	3.2	2.7	4.0	4.3	3.8	4.5
4.0#	M3447, PP.	245ab	1.3	1.5	1.3	3.2	1.3	3.7
8.0#	M3447, PP.	267ab	1.1	1.0	1.2	3.2	1.2	4.2
3.0#	EPTC, PP.	267ab	2.1	3.3	2.2	3.3	2.2	3.3
3.0#	EPTC + 1.0# R7465, PP.	266ab	2.5	3.8	3.0	3.8	3.0	4.7
1.0#	R7465, PP.	267ab	2.5	3.5	2.8	3.7	2.8	4.0
2.0#	R7465, PP.	253ab	2.3	3.2	3.2	3.7	2.7	4.2
4.0#	R7465, PP.	245ab	3.0	3.3	3.3	3.7	3.5	5.0
6.0#	DCPA, PL.	280ab	3.0	2.8	3.2	2.5	3.2	3.0
6.0#	DCPA + 0.75# Linuron, PL.	254ab	1.3	1.7	1.2	1.7	1.2	3.3
1.0#	R7465, PE.	254ab	2.3	2.0	2.5	2.0	2.3	2.0
2.0#	R7465, PE.	261ab	2.2	2.3	2.5	2.2	2.2	3.3
4.0#	R7465, PE.	282ab	2.2	2.0	3.0	2.3	3.0	3.5
1.5#	VC438, PE.	272ab	4.8	4.8	4.3	4.7	4.2	4.0
2.0#	VC438, PE.	283a	5.0	4.8	4.5	2.7	4.5	3.7
3.0#	VC438, PE.	265ab	5.0	4.8	5.0	2.8	4.3	4.3
3.5#	VC438, PE.	280ab	5.0	4.7	5.0	3.3	4.5	4.3
1.0#	Linuron, PE.	251ab	4.8	3.7	4.8	3.3	4.3	3.0
4.5#	DNBP + 5# Dalapon, EM.	263ab	5.0	4.5	4.8	2.0	4.5	3.8
	L.S.D. (0.05)	34						

[1]Weed control ratings: 1 = no control; 5 = excellent control.
[2]Broadleaf weed species: Chenopodium album, Brassica campestris, Brassica rapa, Amaranthus retroflexus, and Polygonum persicaria.
[3]Annual grass: Echinochloa crusgalli and Setaria viridis.
[4]Quackgrass: Agropyron repens.
[5]PP = applied preplant; PL = applied at planting; EM = applied at emergence; PE = applied pre-emergence.

Table 5. Yield and weed control in white potatoes following application of various herbicides. Test III. Maine - 1970.

Pounds of active material per acre	Treatments	Yield Cwt./A.	Weed Control Ratings[1] Broadleaf[2] 6/29	Broadleaf[2] 8/31	Annual Grass[3] 6/29	Annual Grass[3] 8/31	Quackgrass[4] 6/29	Quackgrass[4] 8/31
	Check - no treatment	269bc	1.0	1.0	1.0	1.0	1.0	1.0
4.5#	DNBP + 5# Dalapon, PE.[5]	312ab	5.0	4.5	3.3	3.8	2.3	3.0
2.0#	Alachlor, PE.	286a-c	2.1	3.0	1.8	2.3	1.0	1.5
4.0#	Alachlor, PE.	287a-c	2.8	4.0	3.2	3.3	1.3	2.0
6.0#	Alachlor, PE.	290a-c	4.5	3.7	3.7	3.7	1.3	2.0
2.0#	Alachlor + 2.0# DNBP, PE.	322a	5.0	4.5	3.2	3.7	1.2	1.3
4.0#	Alachlor + 4.0# DNBP, PE.	315ab	5.0	4.7	4.3	3.0	1.8	1.7
6.0#	Alachlor + 6.0# DNBP, PE.	301a-c	5.0	4.5	5.0	4.0	2.0	2.0
2.0#	Alachlor + 0.75# Linuron, PE.	283a-c	5.0	5.0	5.0	2.0	2.8	2.2
4.0#	Alachlor + 1.5# Linuron, PE.	282a-c	5.0	4.8	5.0	3.2	2.8	2.0
2.0#	DNBP, PE.	311ab	5.0	4.8	2.0	3.2	1.5	2.3
4.0#	DNBP, PE.	301a-c	5.0	3.8	4.3	3.5	1.7	2.3
6.0#	DNBP, PE.	299a-c	5.0	4.3	4.8	3.0	1.7	2.2
0.75#	Linuron, PE.	311ab	5.0	4.3	5.0	3.8	2.0	2.3
1.5#	Linuron, PE.	299a-c	5.0	4.0	5.0	3.3	2.7	2.6
1.5#	Alachlor + 2.0# VC438,PE.(75W)	310ab	5.0	4.2	5.0	3.0	2.5	1.8
2.0#	DNBP + 2.0# VC438, PE.(75W)	307ab	5.0	4.5	5.0	3.7	2.2	2.3
3.0#	Dalapon +2.0# VC438, PE.(75W)	317ab	5.0	4.5	5.0	3.3	2.7	2.5
2.0#	VC438, PE. (75W)	320a	5.0	4.5	4.5	3.3	3.0	2.0
1.0#	RP17623, LB. (2G)	271bc	1.0	2.7	1.0	2.2	1.0	1.0
2.0#	RP17623, LB. (2G)	261c	1.0	2.3	1.0	1.7	1.0	1.0
3.0#	RP17623, LB. (2G)	255c	1.0	2.5	1.0	1.8	1.0	1.3
	L.S.D. (0.05)	39						

[1]Weed control ratings: 1 = no control; 5 = excellent control.
[2]Broadleaf weed species: Chenopodium album, Brassica campestris, Brassica rapa, Amaranthus retroflexus, and Polygonum persicaria.
[3]Annual grass: Echinochloa crusgalli and Setaria viridis.
[4]Quackgrass: Agropyron repens.
[5]PE = applied pre-emergence; LB = applied as a layby.

Conclusions

In Maine during 1970, eighteen herbicides at various dosage levels were tested for broadleaved weed, annual grass, and quackgrass control in white potatoes. In general, the presently recommended herbicides in Maine such as DNBP, EPTC, Linuron, Paraquat, and Metobromuron were as good as the newer candidate compounds.

Of the candidate compounds Bay 94337, VC438, Alachlor + DNBP should be tested further for weed control in white potatoes providing that storage and emergence tests of tubers show no adverse conditions.

CHICKWEED CONTROL IN BARLEY AND WHEAT WITH SEVERAL HERBICIDE-LIQUID NITROGEN FERTILIZER MIXTURES

W. J. McAvoy and R. D. Ilnicki[1/]

Introduction

In the eastern United States, chemical weed control in winter wheat (Triticum aestivum, var. Redcoat) and barley (Hordeum vulgare, var. Wong) is usually practiced in the spring. Often spraying operations are delayed because of muddy fields. This could prove detrimental to small grain yields. It was of interest to determine the effects on weed control and tolerance of barley and wheat when herbicides were applied at two different stages of growth.

Fall-planted small grains often are fertilized in the spring with a broadcast or topdress application of nitrogen fertilizer. Since both weed control and fertilization are done in the spring, it was proposed that the two operations may be combined into one.

Materials and Methods

The site of the experiments was located at the Rutgers University Soils and Crops Research Station at Adelphia, New Jersey.

In the 1969 experiment, the seedbed was prepared on Freehold sandy loam soil in an area infested with common chickweed (Stellaria media (L.) Cyrillo). Barley and wheat were planted in the fall of 1968. Each plot consisted of 5 drill bands and was 13½ ft long.

The herbicides and combinations used were (2,4-dichlorophenoxy) acetic acid (2,4-D), 3,6-dichloro-o-anisic acid (dicamba), 3,5-dibromo-4-hydroxybenzonitrile (bromoxynil), 2,4-D + dicamba, and 2,4-D + bromoxynil sprayed with and without liquid nitrogen fertilizer on April 3 and April 25, 1969. Three rates of the fertilizer were used; 0, 30, and 60 lb N/A with three replications of each treatment for both barley and wheat in a randomized block design.

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The treatments were applied with a two-nozzle boom using 730616 TeeJet[2/] spray tips at a pressure of 30 psi, carbon dioxide serving as the pressure source. The spray volume was 40 gpa.

On April 3, barley was 4 inches tall and the number of tillers ranged from 4 to 8, averaging 6. Wheat was 3 inches tall and the number of tillers ranged from 4 to 8, averaging 5.

On April 25, barley was in the early joint stage, about 12 inches tall, and the number of tillers ranged from 7 to 12, averaging 8. Wheat was also in the early joint stage, about 15 inches tall, and the number of tillers ranged from 12 to 25, averaging 20. Common chickweed was 4 to 6 inches tall at medium flower (50%) on April 3, and 5 to 7 inches tall at full flower (100%) on April 25.

Common chickweed control and barley and wheat injury ratings were taken on April 28 and May 14, 1969. A rating scale of 0 to 9 was used in which 0 = essentially no effect on stand or vigor and 9 = complete elimination of stand.

The barley and wheat were harvested on June 30 and threshed on July 1, 1969. The seed was cleaned, weighed, and yields converted to bu/A.

In the 1970 experiment, the seedbed was prepared on Sassafras loam infested with common chickweed. The plot size, rates of liquid nitrogen fertilizer, application technique, and herbicides were the same as those used in 1969.

A randomized block design with four replications was used. In this experiment some treatments involved applying the herbicide first, followed by the fertilizer a few days later and vice versa. On April 17, the herbicide-fertilizer mixtures and first half of the split applications were applied. On April 27, the second half of the split applications were applied.

On April 17, barley height was 8 to 12 inches, averaging 10 inches, and tillers ranged from 6 to 13, averaging 8. Wheat height was 10 to 12 inches, averaging 11 inches, and tillers ranged from 4 to 12, averaging 8. On April 27, barley height was 10 to 16 inches, averaging 14 inches, and tillers ranged from 6 to 14, averaging 10. Wheat height was 12 to 16

2/ Tradename of Spraying Systems Company, Bellwood, Illinois.

inches, averaging 14 inches, and tillers ranged from 7 to 15, averaging 14. Chickweed height ranged from 4 to 7 inches on both dates. Barley was harvested June 17 and wheat July 15, 1970.

Results and Discussion

Chickweed control was greater at the higher rates of the herbicide when used alone and in several combinations (Tables 1 and 2). Earlier applications produced better chickweed control than later applications. Results in wheat and barley were similar.

Generally, chickweed control was reduced as the nitrogen levels increased from 0 to 60 lb/A. Where herbicide followed fertilizer, the 2,4-D + dicamba treatments at the rate of $\frac{1}{2}$ + $\frac{1}{4}$ lb a.i./A resulted in better chickweed control than when fertilizer followed herbicide treatments.

Reductions in barley vigor were produced by 2,4-D, dicamba, bromoxynil, 2,4-D + dicamba, and 2,4-D + bromoxynil. Most reductions were short-lived and later outgrown. Notable exceptions were dicamba at $\frac{1}{4}$ lb a.i./A, 2,4-D + dicamba at $\frac{1}{2}$ + $\frac{1}{4}$ and 3/4 + $\frac{1}{4}$ lb a.i./A, and 2,4-D + bromoxynil at 3/8 + 3/8 and $\frac{1}{2}$ + 3/8 lb a.i./A. As the nitrogen level increased, the reductions were less noticeable. These same treatments also produced a "sprawled" growth habit contrasted with an erect growth in normal plants. The severity of this sprawled growth habit also decreased with increased rates of nitrogen fertilizer. These characteristics were less pronounced in wheat.

In the 1970 experiment, there was an initial superficial nitrogen burning of the edges of the lower leaves on the first application date. After four days the plants appeared to have recovered from the leaf burn. On the second date leaf burn was negligible at 60 lb N/A.

In the 1969 experiment, the later date generally yielded more than the earlier date. Yields for 2,4-D + bromoxynil at 3/8 + 3/8 lb a.i./A were greater than at $\frac{1}{2}$ + 3/8 lb a.i./A. In barley, increasing the fertilizer level from 0 to 30 lb N/A for the early date and from 30 to 60 lb N/A for the later date stimulated yield. There were significant differences within dates, replications, and nitrogen fertilizer levels at the 5% level of probability but there were no significant differences in herbicide treatments. Interestingly enough, the highest grain yields were produced on the late date of application but the best chickweed control resulted from the early date of application. A possible explanation for this increased yield is that the herbicide stimulated the small grains when they were more actively growing at the later date. Chickweed was too large at the late date to be seriously affected by the herbicides.

Summary

Combinations of 2,4-D and dicamba gave good chickweed control in winter wheat and barley when applied in early April. Effectiveness was reduced by applying with liquid nitrogen fertilizer or by delaying application until late April. Bromoxynil treatments and 2,4-D and dicamba applied alone were ineffective. Grain yields from plots treated in late April were higher than from those treated in early April. Several herbicide treatments temporarily reduced barley vigor and leaf tissue injury from the liquid nitrogen fertilizer in early April was outgrown in several days, whereas tissue injury was negligible in late April.

Table 1. Chickweed control and barley yields in the 1969 and 1970 experiments for herbicide-liquid nitrogen fertilizer mixtures.

Trmt. No.	Herbicide	Rate, lb a.i./A	1969 Early Application Chickweed Stand	1969 Early Application Chickweed Vigor	1969 Early Application Yield bu/A	1969 Late Application Chickweed Stand	1969 Late Application Chickweed Vigor	1969 Late Application Yield bu/A	1970 Application Chickweed Stand	1970 Application Chickweed Vigor	1970 Application Yield bu/A
0 lb nitrogen											
1.	2,4-D	½	0.0	1.0	48.4	0.0	0.0	56.9	0.3	1.0	66.1
2.	dicamba	1/8	0.7	3.0	50.7	0.0	0.0	56.7	1.3	1.3	65.7
3.		¼	0.0	6.3	50.4	0.0	2.7	57.3	2.8	4.8	50.1
4.	bromoxynil	3/8	0.0	0.0	47.8	0.0	0.0	52.8	1.3	2.0	67.0
5.	2,4-D + bromoxynil	3/8 + 3/8	0.6	3.7	54.6	0.0	0.7	63.7	6.3	6.8	61.4
6.		½ + 3/8	0.0	0.3	48.9	0.3	0.0	53.5	7.8	8.3	43.4
7.	2,4-D + dicamba	3/8 + ¼	0.0	7.7	46.9	0.0	3.7	65.0	6.3	7.5	62.6
8.		½ + ¼	0.0	8.7	49.1	0.0	3.0	71.9	7.5	7.5	57.4
9.		3/4 + ¼	0.0	8.0	47.1	0.0	6.3	65.6	-	-	-
10.	check	-	0.0	0.0	46.3	0.0	0.0	56.3	0.3	0.5	62.8
30 lb nitrogen											
11.	2,4-D	½	0.0	0.0	44.8	0.0	0.3	66.0	0.5	0.3	70.3
12.	dicamba	1/8	0.0	0.0	48.8	0.0	0.0	38.9	0.0	0.0	57.7
13.		¼	0.0	0.0	48.5	0.0	2.0	57.7	1.8	0.8	68.4
14.	bromoxynil	3/8	0.0	0.0	55.2	0.0	0.3	65.5	1.0	1.3	71.3
15.	2,4-D + bromoxynil	3/8 + 3/8	0.0	0.0	50.2	0.0	1.0	57.6	8.5	8.5	70.0
16.		½ + 3/8	0.0	0.0	49.3	0.0	0.7	49.7	9.0	-	50.4
17.	2,4-D + dicamba	3/8 + ¼	3.0	8.9	61.2	0.0	3.3	61.2	5.5	5.0	61.5
18.		½ + ¼	0.0	8.7	61.5	0.0	3.0	74.2	8.8	7.8	52.2
19.		3/4 + ¼	5.3	8.9	63.4	0.0	3.3	67.8	-	-	-
20.	nitrogen	30	0.0	0.0	46.6	0.0	0.0	64.3	0.0	0.3	53.7
60 lb nitrogen											
21.	2,4-D	½	0.0	0.0	56.8	0.0	0.0	71.0	0.0	0.5	75.3
22.	dicamba	1/8	0.0	1.7	51.7	0.0	0.0	61.3	0.3	1.5	82.3
23.		¼	0.0	6.7	49.0	0.0	1.7	58.1	1.3	1.5	73.4
24.	bromoxynil	3/8	0.0	2.3	61.3	0.0	0.0	59.3	1.0	2.3	62.4
25.	2,4-D + bromoxynil	3/8 + 3/8	0.0	0.0	72.0	0.0	1.0	60.5	1.3	2.3	69.5
26.		½ + 3/8	0.0	0.0	59.0	0.0	0.0	53.1	0.3	1.3	77.6

Table 1 cont.

Trmt. No.	Herbicide	Rate, lb a.i./A	1969 Early Application Chickweed Stand	1969 Early Application Chickweed Vigor	1969 Early Application Yield bu/A	1969 Late Application Chickweed Stand	1969 Late Application Chickweed Vigor	1969 Late Application Yield bu/A	1970 Application Chickweed Stand	1970 Application Chickweed Vigor	1970 Application Yield bu/A
27.	2,4-D + dicamba	3/8 + ¼	0.0	6.0	45.5	0.0	2.3	68.5	3.8	6.0	74.1
28.		½ + ¼	0.0	5.7	57.9	0.0	0.0	73.0	6.3	7.0	65.9
29.		3/4 + ¼	3.0	8.9	52.8	0.0	1.3	61.6	-	-	-
30.	nitrogen	60	0.0	0.0	43.6	0.0	0.0	69.6	0.0	0.5	52.4
30 lb nitrogen followed by herbicide several days later											
31.	2,4-D	1							0.0	1.0	57.9
32.	dicamba	¼							0.5	5.0	61.7
33.	bromoxynil	3/8							0.3	1.5	62.4
34.	2,4-D + dicamba	½ + ¼							1.0	5.0	58.6
35.	2,4-D + bromoxynil	½ + 3/8							0.5	3.3	61.3
60 lb nitrogen followed by herbicide several days later											
36.	2,4-D	1							0.5	5.3	31.2
37.	dicamba	¼							0.8	5.0	65.7
38.	bromoxynil	3/8							0.3	1.0	60.6
39.	2,4-D + dicamba	½ + ¼							3.8	6.5	72.8
40.	2,4-D + bromoxynil	½ + 3/8							0.0	2.5	78.7
Herbicide followed by 30 lb nitrogen several days later											
41.	2,4-D	1							1.0	2.3	59.2
42.	dicamba	¼							0.8	2.5	66.8
43.	bromoxynil	3/8							0.0	0.3	63.3
44.	2,4-D + dicamba	½ + ¼							6.5	6.5	69.8
45.	2,4-D + bromoxynil	½ + 3/8							0.3	2.0	69.0
Herbicide followed by 60 lb nitrogen several days later											
46.	2,4-D	1							1.0	1.8	65.1
47.	dicamba	¼							2.5	4.0	80.4
48.	bromoxynil	3/8							0.3	1.0	70.7
49.	2,4-D + dicamba	½ + ¼							7.5	7.5	55.6
50.	2,4-D + bromoxynil	½ + 3/8							0.5	2.5	62.7

Table 2. Chickweed control and wheat yields in the 1969 and 1970 experiments for herbicide-liquid nitrogen fertilizer mixtures.

Trmt. No.	Herbicide	Rate, lb a.i./A	1969 Early Application Chickweed Stand	1969 Early Application Chickweed Vigor	1969 Early Application Yield bu/A	1969 Late Application Chickweed Stand	1969 Late Application Chickweed Vigor	1969 Late Application Yield bu/A	1970 Application Chickweed Stand	1970 Application Chickweed Vigor	1970 Application Yield bu/A
0 lb nitrogen											
1.	2,4-D	½	0.0	0.0	52.6	0.0	1.3	69.7	2.3	3.0	53.5
2.	dicamba	1/8	0.0	2.0	64.4	0.0	2.0	67.2	2.0	2.5	49.7
3.		¼	6.0	6.7	65.5	0.0	2.0	70.1	2.8	3.3	45.0
4.	bromoxynil	3/8	0.7	1.0	67.7	0.0	1.0	61.6	3.3	3.5	52.6
5.	2,4-D + bromoxynil	3/8 + 3/8	4.7	3.0	68.9	0.0	1.0	73.8	3.3	3.0	35.7
6.		½ + 3/8	0.0	0.0	67.6	0.0	1.3	68.6	8.8	8.8	58.3
7.	2,4-D + dicamba	3/8 + ¼	8.7	8.3	63.6	0.0	1.7	67.1	8.0	8.0	46.2
8.		½ + ¼	7.0	8.3	67.9	0.0	3.7	69.5	8.0	8.0	52.4
9.		3/4 + ¼	3.0	6.3	67.1	0.0	4.3	66.5	-	-	-
10.	check	-	0.0	0.0	61.6	0.0	0.3	71.6	0.0	0.0	61.1
30 lb nitrogen											
11.	2,4-D	½	0.0	0.0	70.3	0.0	0.3	88.2	2.3	3.5	62.5
12.	dicamba	1/8	0.7	0.0	66.3	0.0	0.7	74.1	1.0	1.3	52.2
13.		¼	5.3	6.7	73.5	0.0	5.7	70.1	2.5	2.8	48.9
14.	bromoxynil	3/8	0.0	0.0	68.3	0.0	1.0	80.3	2.8	2.8	59.1
15.	2,4-D + bromoxynil	3/8 + 3/8	1.7	0.0	68.7	0.0	1.0	76.5	8.5	8.5	37.5
16.		½ + 3/8	0.0	0.3	67.2	0.0	1.0	71.4	8.8	8.8	21.7
17.	2,4-D + dicamba	3/8 + ¼	8.3	8.7	69.1	0.0	4.3	73.4	8.3	8.0	44.0
18.		½ + ¼	4.0	4.0	71.5	4.0	4.0	74.1	8.5	8.5	23.8
19.		3/4 + ¼	7.3	5.6	68.4	7.3	5.6	71.1	-	-	-
20.	nitrogen	30	0.0	0.0	76.2	0.0	0.0	73.5	0.0	0.0	57.8
60 lb nitrogen											
21.	2,4-D	½	1.3	0.0	74.8	0.0	0.3	81.1	1.3	1.8	69.0
22.	dicamba	1/8	0.0	0.0	74.3	0.0	1.3	71.6	1.5	2.0	56.4
23.		¼	0.0	1.0	69.4	0.0	3.7	74.0	3.8	3.5	50.1
24.	bromoxynil	3/8	0.0	0.0	73.5	0.0	0.0	76.9	1.8	1.3	61.1
25.	2,4-D + bromoxynil	3/8 + 3/8	0.0	0.0	68.8	0.0	0.7	71.6	3.5	3.3	53.7
26.		½ + 3/8	0.0	0.0	75.7	0.0	2.5	78.1	3.0	4.3	57.2

Table 2 cont.

Trmt. No.	Herbicide	Rate, lb a.i./A	1969 Early Application Chickweed Stand	Chickweed Vigor	Yield bu/A	1969 Late Application Chickweed Stand	Chickweed Vigor	Yield bu/A	1970 Application Chickweed Stand	Chickweed Vigor	Yield bu/A
27.	2,4-D + dicamba	3/8 + ¼	6.0	7.3	70.8	0.0	0.0	79.6	7.5	7.0	55.0
28.		½ + ¼	8.3	7.0	76.9	0.0	0.0	76.6	8.3	8.3	47.0
29.		3/4 + ¼	8.7	8.3	69.9	0.0	0.0	68.4	-	-	-
30.	nitrogen	60	0.0	0.0	68.3	0.0	1.0	76.4	0.0	0.0	52.9
30 lb nitrogen followed by herbicide several days later											
31.	2,4-D	1							3.3	3.3	59.3
32.	dicamba	¼							1.5	3.3	39.9
33.	bromoxynil	3/8							1.5	1.5	59.4
34.	2,4-D + dicamba	½ + ¼							3.5	4.8	33.9
35.	2,4-D + bromoxynil	½ + 3/8							3.5	3.8	56.0
60 lb nitrogen followed by herbicide several days later											
36.	2,4-D	1							5.5	5.5	60.8
37.	dicamba	¼							3.5	4.3	40.8
38.	bromoxynil	3/8							2.3	2.0	56.0
39.	2,4-D + dicamba	½ + ¼							5.3	7.5	39.3
40.	2,4-D + bromoxynil	½ + 3/8							4.0	4.0	60.4
Herbicide followed by 30 lb nitrogen several days later											
41.	2,4-D	1							5.5	5.5	55.7
42.	dicamba	¼							4.8	5.5	51.7
43.	bromoxynil	3/8							2.3	3.0	66.9
44.	2,4-D + dicamba	½ + ¼							7.8	7.8	52.6
45.	2,4-D + bromoxynil	½ + 3/8							1.8	3.0	53.4
Herbicide followed by 60 lb nitrogen several days later											
46.	2,4-D	1							4.8	5.3	66.3
47.	dicamba	½							6.5	6.8	51.8
48.	bromoxynil	3/8							2.3	2.5	70.4
49.	2,4-D + dicamba	½ + ¼							8.8	8.8	52.8
50.	2,4-D + bromoxynil	½ + 3/8							4.0	3.8	62.3

Toxicity of Paraquat-Treated Plant Tissue to *Lemna minor* L.

D. A. Braden and J. C. Cialone[1/]

Abstract.

1,1'-dimethyl-4,4'-bipyridinium ion (paraquat) is a very active postemergence herbicide, which, when strongly absorbed to colloidal particles in the soil, is de-activated herbicidally. Chemically, the reduction of paraquat forms a stable, free radical which can be re-oxidized. Paraquat free-radical formation in plants is necessary for toxicity. Although paraquat is susceptible to photochemical decomposition, loss of the herbicide following foliar application is limited as paraquat is rapidly absorbed by plant tissues.

Clippings taken from ryegrass (*Lolium* L.) plants which had been treated with paraquat at dosages of 0., 0.5, and 1.0 lbs/A were exposed to sunlight, dried and finely ground. The plant tissue was suspended in water for 24 hrs. and common duckweed (*Lemna minor* L.) was introduced into the suspensions. The suspensions of treated *Lolium* and *L. minor* were exposed to sunlight in a glass house. The number of chlorotic or dead *L. minor* plants was counted at various intervals and after 96 hours the *L. minor* present in all paraquat-treated *Lolium* suspensions exhibited chlorosis, and death resulted in certain treatments while no visible symptoms of injury were evident in the controls.

The sensitivity of *L. minor* to paraquat is well documented; the toxicity evident here suggests the possibility that paraquat present in the *Lolium* was toxic to the *L. minor*.

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WEED CONTROL IN TRANSPLANT ONIONS GROWN ON MINERAL SOILS-1970[1]

William J. Sanok[2] and Stewart L. Dallyn[3]

Abstract

Both chloroxuron (3-(p-(p-chlorophenoxy)phenyl)-1,1-dimethyl-urea) and propachlor (2-chloro-N-isopropylacetanilide) were effective in controlling pineapple weed (Matricaria matricarioides) and galinsoga (Galinsoga spp.) early in the season. Where purslane (Portulaca oleracea) or other weed species are present, chloropropham (isopropyl m-chlorocarbanilate) or DCPA (dimethyl tetrachloroterephthalate) might be needed to provide good control.

Introduction

The main weed problems in onion fields on Long Island for several years have been pineapple weed and galinsoga. These two species are resistant to DCPA and chloropropham, the two primary onion herbicides used on mineral soil.

Material and Methods

The chemicals used at the Research Farm on a commercial farm were DCPA, chloropropham, nitrofen (2,4- dichlorophenyl p-nitrophenyl ether), propachlor, chloroxuron and BAS 2903H. In both locations, Texas-grown Early Harvest onion (Allium cepa) transplants were used. The soils in both places were sandy loams.

A. Trial at the L.I. Vegetable Research Farm

Plants were set 4" apart in 34" rows on April 16th. One half of the experimental area was treated with 12 lbs. AIA DCPA immediately after setting.

The May 12th application was an overall spray with the later applications being directed toward the base of the plants.

All treatments, including the check, were hand weeded and cultivated as necessary to prevent any damage caused by weed competition.

Treatments 1, 3, 4 and 8 were not effective in controlling purslane so an application of chloropropham was made on July 9th after hand weeding and cultivating.

Weed control ratings were made three times during the growing season and the bulbs harvested on August 6th.

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[3] Professor, Cornell University, L.I. Vegetable Research Station

B. Trial on a Commercial Farm

This trial was conducted on plants set on April 20th 3 in. apart with 3 rows to a bed. The beds were 6 feet across. The plots were one bed wide and 25 feet long with four replications.

The first application was made on May 11th with all materials applied as overall sprays. On treatment #3, chloroxuron was applied at 2 lbs. AIA three times at two-week intervals. At the time of application, there was a flush of pineapple weed and galinsoga in the cotyledon stage.

Ratings were made on June 25th and on those plots where control was poor hand weeding was necessary. The hand weeding was late and as a result some reduction in yield occurred. The onions were harvested on July 29th.

Results and Discussion

Data from the two experiments are summarized in tables 1 and 2.

Research Farm

1) Chloroxuron and propachlor were relatively short lived and required an application of chloropropham in July to control purslane.

2) Three applications of chloropropham reduced onion yields.

3) Nitrofen alone was not effective on the weeds present.

4) None of the treatments had any effect on rye cover crop.

Commercial Farm

1) All treatments containing chloroxuron or propachlor either alone or in combination with DCPA gave good weed control and did not require hand weeding.

2) There was some damage to the onion leaves by late applications of chloroxuron; however, these later applications greatly extended the effectiveness of this material.

General Comments

1) A number of good herbicides are available for use on onions. The choice of materials should be dependent upon the weed species present.

2) Rotation of chemicals or combinations should be used to prevent the buildup of hard-to-kill weeds.

Table 1. Results of several herbicides on weed control[a] and yield of onions on the Research Farm

			DCPA			No DCPA		
Material	Lbs. AIA	Date Applied	Yield bu/acre	3"Min.	Weed Control[f]	Yield bu/acre	3"Min.	Weed Control
1. Chloroxuron (50 WP)[b]	4	5/2	533	354	4.0	522	350	3.5
2. "	2+2+2[c]	5/10	516	313	4.7	516	336	4.4
3. Propachlor (65 WP)[b]	6	5/12	574	440	4.2	502	326	3.8
4. Nitrofen (50 WP)[b]	6	5/12	550	394	3.8	511	345	3.0
+ Chloroxuron	2	6/3						
5. Chloroprophram (4 lbs./gal.)	4+4+6[d]	5/12	468	282	3.9	548	403	3.3
6. "	4	5/12	534	385	4.0	570	457	3.7
+BAS 2903H (4 lbs/gal)	4	6/2						
7. Chloroprophram	4	5/12	536	405	4.1	542	380	3.8
+BAS 2903H	6	6/2						
8. Chloroxuron + 2% oil[b/e]	2	5/12	573	440	4.2	610	504	3.6
9. Check			604	491	1.0[g]	604	491	1.0
		LSD 5%	95	120		95	120	

[a] Major weeds were pineapple weed, smartweed, lambsquarter, purslane and annual grasses.

[b] Treatments 1, 3, 4 and 8 required an application of chloroprophram on July 9th because of a heavy infestation of purslane.

[c] Chloroxuron was applied on May 10, June 6 and July 9.

[d] Chloroprophram was applied on May 12, June 2 and July 9.

[e] Oil used was Volck 70, Chevron Chem.

[f] 1-no weed control, 5-complete control.

[g] No DCPA on either check.

Table 2. Results of several herbicides on weed control[a] and yield of onions on the Commercial Farm.

Treatment	Lbs. AIA	Weed Control[b]	Yields Lbs. per plot
1. Chloroxuron (WP)	4	4.5	106.0
2. "	4+2% oil[c]	4.6	99.7
3. "	2+2% oil + 2 + 2[d]	5.0	96.2
4. Propachlor (WP)	6	4.6	103.5
5. "	8	4.6	112.0
6. DCPA (WP)	10	2.0	90.7
7. Nitrofen (WP)	1	2.1	92.7
8. "	2	2.1	99.5
9. Chloroprophram (EC)	3	2.5	97.2
10. Chloroxuron	4	4.6	115.5
+ DCPA	10		
11. Propachlor	6	4.6	105.5
+DCPA	10		
12. Nitrofen (EC)	1	2.1	91.7
13. "	2	2.6	96.2
14. Check	--	1.1	78.5
		LSD 5%	16.0

[a] Major weeds were pineapple weed, galinsoga and a low population of annual grasses.

[b] Ratings made on June 25th--1-no control, 5-complete control.

[c] Volck 70 oil Chevron Chem.

[d] Volck 70 oil was used with the first application. Additional applications were made on May 28th and June 11th.

CHEMICAL WEEDING OF ONIONS GROWN FROM TRANSPLANTS

Charles J. Noll[1]

Onions (Allium cepa) grown in mineral soils from transplants were weeded with a variety of herbicide applied alone or in combination and as preplant incorporation, pre-emergence or post-emergence applications. The most promising treatments were 2-chloro-N-(1-methyl-2-propynyl) acetanilide (BAS 2903-H) applied one day after transplanting, 2-tertiobutyl-4-(2,4-dichloro-5-isopropyloxyphenyl)-5-oxo-1,3,4-oxadiazoline (RP 17623) applied one day or 30 days after transplanting, 2-chloro-N-isopropylacetanilide (propachlor) applied in three applications 2, 30, and 60 days after transplanting and 2-chloro-2', 6'-diethyl-N (methoxymethyl) acetanilide (alachlor) applied 2 and 30 days after transplanting. The best combination treatments were combinations of dimethyl tetrachloroterephthalate (DCPA) with 3- p-(p-chlorophenoxy) phenyl -1, 1-dimethyl-urea (chloroxuron), 2,4-dichlorophenyl p-nitrophenyl ether (nitrofen) or propachlor.

Materials and Methods

The weeding trials were conducted at the Horticultural farm located 10 miles west of University Park. The soil, a Merrill loam, was plowed in the fall of 1969 and the seedbed prepared May 4, 1970. Pre-planting incorporation treatments were made the same. Transplanting, variety Sweet Spanish took place May 6 and 7 and the pre-emergence treatments were applied the 7th or 8th of May. Post-emergence treatments were applied 30 or 60 days after transplanting. An estimate of weed control was made June 12 and July 20, and an injury rating July 25 on a one to nine rating scale. One is least desirable and nine most desirable.

Single row plots were 18 feet long and 2 feet wide. Treatments were randomized in each of 6 blocks. The entire area of the plot was treated with an herbicide. Cultivation was practiced. Weeds present in the field were yellow foxtail (Setaria glauca (L.) Beauv.), pigweed (Amaranthus netroflexus L.), lambsquarters (Chenopodium album L.), and bardyardgrass (Echinochlora crosgalli (L.) Beauv.). The onions were harvested August 27.

Results

The results are presented in Table 1. All herbicides significantly reduced the weed population without reducing the number of bulbs harvested as compared to the unweeded plots. One chemical S-isopropyl 5-ethyl-2-methyl-piperidine-1-carbothioate (R-12001) injured the onions as recorded in the injury rating and in the weight of harvested bulbs. A number of chemicals look promising for the weeding of this crop when grown in mineral soils.

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Table 1. Weed control, injury, and harvest records of transplanted onions under chemical herbicide treatments.

	Treatment	Active Rate lbs/A	Application Days from Planting	AVERAGE PER PLOT Weed Control 1-9 June 12	Weed Control 1-9 July 20	Injury 1-9	Harvest Record No Bulbs	Harvest Record Wt Bulbs lbs
1	Nothing	---	---	3.8	3.3	9.0	72	20.3
2	Nothing	---	---	2.8	2.3	9.0	58	16.9
3	Nitralin	1	Inc -2	8.5	8.8	9.0	58	21.0
4	"	2	"	8.2	8.7	7.0	42	10.7
5	R 12001	2	"	6.7	7.5	5.0	50	8.7
6	"	3	"	8.0	7.8	4.0	45	7.4
7	BAS 2903 H	4	Pre +1	9.0	9.0	9.0	66	24.8
8	"	6	"	9.0	8.7	9.0	59	22.1
9	DCPA	10	"	6.0	8.5	9.0	70	26.4
10	RP 17623	4	"	9.0	8.7	9.0	63	26.5
11	"	4	Post +30	9.0	9.0	9.0	64	26.9
12	Propachlor	5&5&5	Pre +2 & Post +30 +60	9.0	9.0	9.0	71	24.7
13	"	10 & 5	" +2 & " +30	9.0	9.0	9.0	61	20.1
14	Chloroxuron	4&2&2	" +2 & " +30 +60	9.0	8.8	9.0	52	19.2
15	"	4&3&3	" +2 & " +30 +60	9.0	9.0	9.0	52	18.6
16	Chloroxuron + Spreader	4&2&2	" +2 & " +30 +60	8.8	9.0	9.0	55	13.9
17	Alachlor	2&2	" +2 & " +30	8.8	9.0	9.0	59	22.2
18	DCPA & Chloroxuron	10 & 2	" +2 & " +30	9.0	8.7	9.0	63	23.8
19	DCPA & Nitrofen wp	10 & 4	" +2 & " +30	8.5	8.5	9.0	66	24.6
20	DCPA + Propachlor	5 + 5	" +2	9.0	8.4	9.0	65	24.8
21	Nitrofen wp	3	Post +30	7.7	6.5	9.0	58	20.7
22	"	4 1/2	"	7.5	7.0	9.0	61	20.6
	Least Significant Difference	5%		1.4	1.4	1.9	NSD	5.9
	" " "	1%		1.7	1.7	NSD	NSD	7.2

WEED CONTROL IN CARROTS

Richard A. Ashley[1]

Abstract

Several herbicides and herbicide combinations were evaluated for weed control and crop injury in carrots. Chlorobromuron at 1½ or 2 lbs./A postemergence, linuron 1 lb./A postemergence, and combinations of nitrofen at 3 lbs./A pre and linuron 1/2 lb./A post, nitrofen 6 lbs./A pre and linuron 1/4 or 1/2 lb./A post and M-3447 at 4 lbs./A PPI and linuron at 1/2 lb./A post gave excellent full season control of lambsquarters, pigweed, purslane, crabgrass and witchgrass.

Linuron at 1 lb./A preemergence gave a significant yield reduction as compared to the chemical check treatment of linuron at 1 lb./A postemergence. There was no significant difference in weed control from the two treatments.

Introduction

Reports from Connecticut growers of reduced carrot stands where linuron 1 lb. ai/A was applied preemergence indicated a need for more knowledge concerning the response of carrots to this herbicide. An experiment was conducted at the University of Connecticut Vegetable Research Farm, North Coventry, Connecticut to determine the response of carrots to pre and postemergence application of linuron and other herbicides and to evaluate alternate treatments which would reduce or eliminate the use of linuron.

Materials and Methods

Carrots (Daucus carota var. sativa) cv. Royal Chantenay were seeded 1/2 to 3/4 inches deep in 36-inch rows on June 12, 1970. Seeding was done with a Planet Jr. seeder at a rate of 3 lbs./A. Soil type was a Merrimac fine sandy loam. A treated plot consisted of one row 10 feet long. Treatments were replicated 3 times.

Preplant incorporated applications of M-3447 (a(2,2,2 trichloroethyl) styrene) at 4 lbs./A were made June 12, 1970 to 2 plots. The herbicide was incorporated to approximately 1 inch with a rake within 15 minutes of application. Postemergence applications of linuron at 1/4 and 1/2 lb./A were superimposed on these plots at a later date to complete the experimental treatments.

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Preemergence applications of chlorobromuron at 1½ and 2 lbs./A, chloroxuron at 3 and 4 lbs./A, linuron at 1 lb./A and nitrofen at 3 and 6 lbs./A were made June 16, 1970. Two additional plots were treated on the date with nitrofen at 3 lbs./A and 2 with 6 lbs./A for later treatment with linuron postemergence at 1/4 and 1/2 lb./A.

Postemergence applications of chlorobromuron at 1½ and 2 lbs./A chloroxuron at 3 and 4 lbs./A and linuron at 1 lb./A were made on July 13, 1970 to previously untreated plots. In addition, linuron at 1/4 and 1/2 lb./A was applied as an overtreatment to plots previously treated with M-3447 at 4 lbs./A and nitrofen at 3 and 6 lbs./A as described earlier. In untreated plots, pigweed and lambsquarters were 3-5 inches high and crabgrass 1-2 inches high at time of treatment. In M-3447 treated plots, pigweed and lambsquarters were 3-6 inches tall while in nitrofen treated plots, these weeds were only 1/2 to 2 inches tall at time of postemergence treatment. Also some crabgrass had just germinated and was 1/2 to 1 inch tall. All treatments were applied with a knapsack sprayer using 1 quart of water per plot.

Predominant weed species present in the experimental area were: large crabgrass (*Digitaria sanguinalis* (L.) Scop.), witchgrass (*Panicum capillare* L.), lambsquarters (*Chenopodium album* L.), redroot pigweed (*Amaranthus retroflexus* L.) and purslane (*Portulaca oleracea* L.).

Weed ratings were taken to determine the control of the above broadleaf weeds and annual grasses using a 0 to 10 scale with 0 indicating no effect and 10 representing complete kill. Similar ratings were taken for crop stand and vigor.

Yield data were taken on September 25, 1970 to determine the effect of the treatments, if any, on yield.

Results and Discussion

Excellent full season control of lambsquarters, pigweed, purslane, crabgrass and witchgrass was obtained with chlorobromuron at 1½ or 2 lbs./A postemergence, linuron at 1 lb./A post and the combination treatments of nitrofen at 3 lbs./A pre + linuron at 1/2 lb./A post, nitrofen at 6 lbs./A pre + linuron at either 1/4 or 1/2 lb./A post and M-3447 at 4 lbs./A PPI + linuron at 1/2 lb./A post. The August 24, 1970 weed control rating showed complete control of lambsquarters, pigweed and purslane by chlorobromuron at 1½ or 2 lbs./A post and linuron 1 lb./A post (Table 1). Comparable figures for annual grass control were 8.0 and 7.8 for chlorobromuron post at 1½ and 2 lbs./A respectively with witchgrass as the incompletely controlled species (Table 2). Linuron at 1 lb./A post had a rating of 8.0 with both crabgrass and witchgrass present.

On August 24, 1970, the combination treatments received the following rating for broadleaf weed control: nitrofen 3 lbs./A pre + lunuron 1/2 lb./A post 8.8, nitrofen 3 lbs./A pre + linuron 1/4 lb./A post 9.0, nitrofen 6 lbs./A pre + linuron 1/2 lb./A post 9.7 and M-3447 4 lbs./A pre + linuron 1/2 lb./A post 9.8. In all cases, lambsquarters was the incompletely controlled broadleaf weed.

Comparable ratings for annual grass control were: 8.0 for nitrofen 3 lbs./A pre + linuron 1/2 lb./A post, 9.3 for nitrofen 6 lbs./A pre + linuron 1/4 lb./A post, 9.2 for nitrofen 6 lbs./A pre + linuron 1/2 lb./A post and 7.3 for M-3447 4 lbs./A pre + linuron 1/2 lb./A post. In all nitrofen-linuron plots, the incompletely controlled species was crabgrass while in the M-3447 + linuron plots, crabgrass was controlled completely but witchgrass came in very strong during the month of August. This is illustrated by a July 22, 1970 annual grass control rating for this treatment of 9.3.

Chlorobromuron at 1½ and 2 lbs./A pre and chloroxuron at 3 and 4 lbs./A post gave good control of the broadleaf species present but failed to control witchgrass. Considerable crabgrass was also present in the chloroxuron plots. Broadleaf weed control ratings on August 24, 1970 were 8.3 and 8.7 for chlorobromuron at 1½ and 2 lbs./A pre respectively and 9.3 and 9.5 for chloroxuron at 3 and 4 lbs./A post respectively. Annual grass control ratings were: 5.0 for chlorobromuron at 1½ lb./A pre and 6.0 for chlorobromuron at 2 lbs./A pre; 1.7 for chloroxuron at 3 lbs./A post and 4.0 for chloroxuron at 4 lbs./A post.

Nitrofen at 3 and 6 lbs./A gave excellent control of crabgrass and witchgrass at both rates. Control of lambsquarters was poor. Broadleaf weed control ratings for nitrofen at 3 lbs./A were 6.7 on July 22 and 1.0 on August 24, 1970. Annual grass ratings for the same dates were 9.0 and 8.3 respectively. Corresponding figures for broadleaf weed control by nitrofen at 6 lbs./A were 8.0 for the July 22 rating and 2.0 for the August 24, 1970 rating. Annual grass control was 9.8 and 9.7 on the same dates.

Significant yield reductions resulted from the use of linuron at 1 lb./A preemergence as compared to the linuron 1 lb./A postemergence treatments (Table 3). Linuron 1 lb./A post was considered the control treatment. There was no significant difference in weed control between the two treatments. Yields on plots treated with linuron 1 lb./A pre were 16.7 lbs. as compared to 29.7 lbs. where linuron was applied at 1 lb./A postemergence. No treatment yielded significantly more than linuron at 1 lb./A post and all other treatments yielding less showed corresponding reductions in weed control.

Table 1. Evaluation of several herbicides and herbicide combinations for broadleaf weed control in carrots.

Treatment[2]		Weed Control Ratings[1] July 22, 1970	Weed Control Ratings[1] Aug. 24, 1970	Weeds Not Controlled
Chlorobromuron, 1½ lbs./A	Pre	9.3	8.3	Lambsquarters
" 2 lbs./A	Pre	9.5	8.7	"
" 1½ lbs./A	Post	10.0	10.0	
" 2 lbs./A	Post	10.0	10.0	
Chloroxuron, 3 lbs./A	Pre	7.3	2.3	Lambsquarters, pigweed, purslane
" 4 lbs./A	Pre	8.5	6.7	Lambsquarters
" 3 lbs./A	Post	9.3	9.3	"
" 4 lbs./A	Post	9.5	9.5	"
Linuron, 1 lb./A	Pre	9.8	8.8	Lambsquarters, pigweed
" 1 lb./A	Post	10.0	10.0	
Nitrofen, 3 lbs./A	Pre	6.7	1.0	Lambsquarters, pigweed
" 6 lbs./A	Post	8.0	2.0	Lambsquarters, pigweed
Nitrofen, 3 lbs./A Linuron, 1/4 lb./A	Pre + Post	8.5	4.7	Lambsquarters
Nitrofen, 3 lbs./A Linuron, 1/2 lb./A	Pre + Post	9.3	8.8	Lambsquarters
Nitrofen, 6 lbs./A Linuron, 1/4 lb./A	Pre + Post	9.5	9.0	Lambsquarters
Nitrofen, 6 lbs./A Linuron, 1/2 lb./A	Pre + Post	9.8	9.7	Lambsquarters
M-3447, 4 lbs./A Linuron, 1/4 lb./A	PPI + Post	9.0	7.7	Lambsquarters
M-3447, 4 lbs./A Linuron, 1/2 lb./A	PPI + Post	10.0	9.8	Lambsquarters
LSD 1%		1.2	2.9	
LSD 5%		0.9	2.2	

1. Average of 3 replications. 10 = complete kill, 0 = no effect.
2. Preplant incorporated treatments applied 6/12/70, preemergence treatments applied 6/16/70, postemergence treatments applied 7/13/70.

Table 2. Evaluation of several herbicides and herbicide combinations for annual grass control in carrots.

Treatment[2]		Weed Control Ratings[1] July 22, 1970	Weed Control Ratings[1] Aug. 24, 1970	Weeds Not Controlled
Chlorobromuron, 1½ lbs./A	Pre	6.0	5.0	Witchgrass
" 2 lbs./A	Pre	8.0	6.0	Witchgrass
" 1½ lbs./A	Post	9.0	8.0	Witchgrass
" 2 lbs./A	Post	9.7	7.8	Witchgrass
Chloroxuron, 3 lbs./A	Pre	4.3	4.0	Crabgrass, witchgrass
" 4 lbs./A	Pre	7.3	5.7	Crabgrass, witchgrass
" 3 lbs./A	Post	5.7	1.7	Crabgrass, witchgrass
" 4 lbs./A	Post	5.0	4.0	Crabgrass, witchgrass
Linuron, 1 lb./A	Pre	9.5	6.7	Crabgrass, witchgrass
" 1 lb./A	Post	9.5	8.0	Crabgrass
Nitrofen, 3 lbs./A	Pre	9.0	8.3	Crabgrass
" 6 lbs./A	Post	9.8	9.7	Crabgrass
Nitrofen, 3 lbs./A Linuron, 1/4 lb./A	Pre + Post	9.0	6.7	Crabgrass
Nitrofen, 3 lbs./A Linuron, 1/2 lb./A	Pre + Post	9.3	8.0	Crabgrass
Nitrofen, 6 lbs./A Linuron, 1/4 lb./A	Pre + Post	9.5	9.3	Crabgrass, witchgrass
Nitrofen, 6 lbs./A Linuron, 1/2 lb./A	Pre + Post	9.7	9.2	Crabgrass, witchgrass
M-3447, 4 lbs./A Linuron, 1/4 lb./A	PPI + Post	7.7	5.3	Crabgrass, witchgrass
M-3447, 4 lbs./A Linuron, 1/2 lb./A	PPI + Post	9.3	7.3	Crabgrass, witchgrass
LSD 1%		1.2	3.3	
LSD 5%		0.9	2.5	

1. Average of 3 replications. 10 = complete kill, 0 = no effect.
2. Preplant incorporated treatments applied 6/12/70, preemergence treatments applied 6/16/70, postemergence treatments applied 7/13/70.

Table 3. Effect of several herbicides and herbicide combinations on yield of carrots.

Treatment		Yield[1] Lbs./Plot
Chlorobromuron, 1½ lbs./A	Pre	6.2
" 2 lbs./A	Pre	11.8
" 1½ lb./A	Post	22.5
" 2 lbs./A	Post	24.7
Chloroxuron, 3 lbs./A	Pre	3.8
" 4 lbs./A	Pre	10.2
" 3 lbs./A	Post	5.3
" 4 lbs./A	Post	5.9
Linuron, 1 lb./A	Pre	16.7
" 1 lb./A	Post	29.7
Nitrofen, 3 lbs./A	Pre	9.5
" 6 lbs./A	Post	12.0
Nitrofen, 3 lbs./A Linuron, 1/4 lb./A	Pre + Post	17.5
Nitrofen, 3 lbs./A Linuron, 1/2 lb./A	Pre + Post	29.1
Nitrofen, 6 lbs./A Linuron, 1/4 lb./A	Pre + Post	25.9
Nitrofen, 6 lbs./A Linuron, 1/2 lb./A	Pre + Post	34.6
M-3447, 4 lbs./A Linuron, 1/4 lb./A	PPI + Post	13.0
M-3447, 4 lbs./A Linuron, 1/2 lb./A	PPI + Post	23.9
LSD 1%		11.7

1. Average of 3 replicates.

WEED CONTROL IN MARIGOLDS, PANSIES AND PETUNIAS

Richard A. Ashley[1/]

Abstract

Preplant incorporated, at transplant and post-transplant applications of several herbicides and herbicide combinations were evaluated for weed control and crop injury on marigolds, petunias and pansies. Excellent full season weed control was obtained with alachlor 4EC or 10G at 3, 6 and 12 lbs./A post-transplant. Considerable crop injury resulted from the use of alachlor preplant incorporated or at transplanting. Chloroxuron 50WP gave severe crop injury but the 5G formulation gave good early weed control when applied to established plants. The combination of chloroxuron 80W and M-3447 8EC preplant incorporated gave good early weed control.

Introduction

Experiments were conducted at the University of Connecticut Vegetable Research Farm in North Coventry, Connecticut to evaluate several herbicides and herbicide combinations for weed control and crop injury to marigolds, pansies and petunias. Preplant incorporated, at transplant and post-transplant applications were studied.

Materials and Methods

Marigold 'Petite Yellow', pansy 'King Sized Mixed', and petunia 'Tangerine' transplants purchased from commercial sources were set into the field June 2, 4, and 5, 1970. These were planted in plots consisting of single 6-foot long rows of each species, with plants 1 foot apart on the row and 3 feet between rows within each plot. Treatments were made utilizing a randomized block experimental design with 3 replications. Soil type was a Merrimac fine sandy loam.

Preplant incorporated applications of the herbicides listed in Table 1 were made June 2 and 4, 1970. Herbicides were incorporated to a depth of 1-1½ inches by raking immediately after application.

At transplant, applications of treatments listed in Table 1 were applied on June 4 and 5, 1970 to each plot as transplanting was completed.

Post-transplant treatments were applied June 23 and 24, 1970 to clean cultivated plants. All granular applications were made with a hand shaker. Spray applications were made using a knapsack sprayer. One-half gallon of spray was used per plot. All combination treatments were applied as tank mixes.

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The predominant weed species in the experimental area were lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), purslane (Portulaca oleracea L.), carpetweed (Mullugo verticillata L.), galinsoga (Galinsoga ciliata (Rof.) Blake), large crabgrass (Digitaria sanguinalis (L.) Scop.) and witchgrass (Panicum capillare L.).

Weed ratings were taken based on the above species to determine control of broadleaf weeds and annual grasses. A 0 to 10 scale was used with 0 indicating no effect and 10 representing complete kill. Similar ratings were made for crop injury.

Results and Discussion

Preplant Incorporation

Among preplant incorporated treatments, acceptable control of the broadleaf weed species present was obtained with alachlor 4EC at 6 lbs./A and 4EC or 10G at 12 lbs./A, bensulide at 12 lbs./A, M-3447 8EC + chloroxuron 80W at 2 + 4 lbs./A and trifluralin + alachlor at 1/2 + 3 or 1 + 1½ lbs./A. Alachlor treated plots gave ratings on August 24, 1970 of 5.7 for 6 lbs. of 4EC, 6.3 for 12 lbs. of 4EC and 8.3 for 12 lbs. of 10G material. In all cases, lambsquarters was the sole broadleaf not controlled. Alachlor 4EC at 3 lbs./A and 10G at 6 lbs./A also gave acceptable broadleaf control through the July 14, 1970 rating.

Bensulide 4EC at 12 lbs./A had a broadleaf weed control rating of 6.3 on August 24, 1970. The July 14 rating had shown ratings of 8.3 for both the 6 and 12 lbs./A rates. Carpetweed and galinsoga were prominant in bensulide treated plots with varying amounts of pigweed, lambsquarters and purslane also present.

The combination of M-3447 + chloroxuron at 2 + 4 lbs./A performed well early with a July 14, 1970 broadleaf control rating of 8.0, but this decreased to 5.7 by August 24. Pigweed and lambsquarters were not controlled.

Trifluralin + alachlor at ½ + 3 and 1 + 1½ lbs./A gave broadleaf weed control ratings of 6.3 and 8.3 respectively on August 24. These treatments had provided excellent early control with July 14 ratings of 8.8 for trifluralin + alachlor at ½ + 3 lbs./A and 9.2 for the 1 + 1½ lbs./A dosage. Lambsquarters and pigweed were the species incompletely controlled.

All preplant incorporated treatments gave excellent full season control of crabgrass and witchgrass except chloroxuron at 2, 4 or 8 lbs./A.

Significant crop injury was observed on marigolds, petunias and pansies from preplant incorporated applications of alachlor 4EC or 10G (Table 1). Injury took the form of severe stunting and persisted through mid July. Severity of injury increased with increasing rate but no significant stand reduction occurred.

Slight injury from trifluralin-alachlor combinations was also observed. Affected plants eventually outgrew the injury but in most cases did not obtain a size at maturity comparable to those in untreated control plots.

At-Transplant Application

With at-transplant application, weed control was generally very good (Table 2), but crop injury was frequently severe. Chloroxuron 50W at 4 lbs./A caused a 70% reduction in the stand of marigolds and 60% reduction in the stand of pansies. At 8 lbs./A, a 90% reduction of marigolds, 70% reduction of petunias and 80% reduction of pansy stands occurred. At 16 lbs./A, all crop plots were killed. Chloroxuron 5G caused less injury but stand reductions of 30% for marigolds were observed at the 8 lbs. and 16 lbs./A rate and 30% of pansies at 16 lbs./A. Considerable foliage burn and stunting also occurred.

Alachlor 4EC caused 30% reduction in marigold stands and 10% reduction in pansy stands when applied at 6 lbs./A. The 10G formulation caused less injury but 10% stand reductions were observed for each crop at the 12 lbs./A rate. Again, on alachlor treated plots, severe stunting also occurred at the higher rates. As could be expected, combinations of alachlor 4EC and chloroxuron 50W also caused significant stand reductions.

Post-Transplant Application

Post-transplant herbicide application to established bedding plants gave improved selectivity. Significant crop injury still resulted from applications of chloroxuron 50W and combinations of chloroxuron 50W and alachlor 4EC, but stand reduction only occurred from the higher rates of chloroxuron alone or in combination (Table 3). There was some evidence of injury to marigolds from alachlor at high rates.

Excellent full season weed control and negligible crop injury was obtained from alachlor 4EC and 10G at 3, 6 and 12 lbs./A and combinations of alachlor 10G + chloroxuron 5G at 3 + 2 lbs. and alachlor 4EC and diphenamid 50W at 3 + 2 lbs./A

Combinations of M-3251 5G and chloroxuron 5G gave excellent control of crabgrass and witchgrass at all rates tested, but failed to control the broadleaf species for the full season. However, broadleaf control for the first month was very good.

Chloroxuron 5G at 8 and 16 lbs./A gave good full season control of the broadleaf weed species present. On August 24, 1970, the broadleaf weed control rating was 6.3 and 8.3 for the 8 and 16 lbs./A rates respectively. Annual grass control ratings on the same date were only 4.0 and 5.3 with crabgrass and witchgrass the incompletely controlled species. Annual grass control was very good for the first month with the July 14, 1970 rating of 7.7 and 9.2 for chloroxuron 5G at 8 and 16 lbs./A respectively.

Table 1. Evaluation of several preplant incorporated herbicides and herbicide combinations for weed control and crop injury on marigolds, petunias, and pansies.

Treatment[1]	Rate	Crop Vigor Ratings[2]			Weed Control Ratings[2]				Weeds
					7/14/70		8/24/70		Incompletely
	Lb. ai/A	Marigolds	Petunias	Pansies	ABLW[3]	AGW[4]	ABLW[3]	AGW[4]	Controlled
M-3447 8EC	4	0	0	0	0	9.0	0	10.0	(Pigweed
"	8	0	0	0	3.0	10.0	0	10.0	(purslane
"	16	0	0	0	4.0	10.0	1.0	10.0	(lambsquarters
M-3251 5G	4	0	0	0	0.7	10.0	0	10.0	"
"	8	0	0	0	3.3	10.0	0	10.0	"
"	16	0	0	0	4.3	10.0	1.0	10.0	"
Alachlor 4EC	3	3	1	2	7.3	9.3	4.0	9.8	Lambsquarters
"	6	4	2	5	9.3	9.7	5.7	9.3	"
"	12	6	4	4	9.0	10.0	6.3	10.0	"
Alachlor 10G	3	4	2	2	5.7	10.0	0	10.0	Lambsquarters
"	6	6	3	4	8.3	10.0	4.0	10.0	"
"	12	7	3	6	9.7	10.0	8.3	10.0	"
Bensulide 4E	3	0	2	0	5.0	10.0	0.7	9.0	(Galinsoga, pigweed,
"	6	0	0	0	8.3	9.8	4.0	9.0	(lambsquarters,
"	12	0	0	0	8.3	9.3	6.3	9.0	(carpetweed
M-3447 + Chloroxuron 80W	2+2	0	0	0	4.7	8.0	0.7	9.3	
"	2+4	0	0	0	8.0	8.7	5.7	8.3	(Lambsquarters
"	4+2	0	0	0	4.7	9.0	0	9.3	(pigweed
Chloroxuron 80W	2	0	0	0	2.3	2.7	0.7	0	(Lambsquarters
"	4	0	3	0	6.3	3.3	3.0	5.3	(pigweed
"	8	1	1	1	7.3	5.0	3.0	3.7	(witchgrass
Trifluralin	1	0	0	0	6.7	9.7	2.7	9.7	Lambsquarters
Trifluralin + alachlor	½+1½	2	0	0	8.8	10.0	4.0	9.7	
"	½+3	2	0	2	8.8	10.0	6.3	10.0	(Lambsquarters
"	1+1½	1	1	2	9.2	10.0	8.3	9.3	(pigweed
LSD 1%		-	-	-	3.4	4.3	3.7	1.7	
LSD 5%		2	2	2	2.5	3.3	2.7	1.3	

1. Applied 6/2 and 6/4/70.
2. Average of 3 replicates. 10 = complete kill, 0 = no effect.
3. Annual broadleaf weeds.
4. Annual grassy weeds.

able 2. Evaluation of several herbicides and herbicide combinations applied at transplanting for weed control and crop injury on marigolds, petunias and pansies.

reatment[1]	Rate	Crop Injury Ratings[2]						Weed Control Ratings[2]				Incompletely
		Stand			Vigor			7/14/70		8/24/70		
	Lb. ai/A	Marigolds	Petunias	Pansies	Marigolds	Petunias	Pansies	ABLW[3]	AGW[4]	ABLW[3]	AGW[4]	Controlled
hloroxuron 50W	4	7	0	6	8	5	9	9.7	9.3	8.7	8.3	(Lambsquarters
	8	9	7	8	9	8	9	9.8	10.0	9.0	9.5	(pigweed,
	16	10	10	10	10	10	10	10.0	10.0	9.7	10.0	(witchgrass.
hloroxuron 5G	4	0	0	0	1	0	2	5.3	3.3	2.0	0	(Lambsquarters
	8	3	0	0	4	5	3	7.0	5.0	6.0	2.7	(crabgrass,
	16	3	0	3	3	5	8	8.3	6.7	6.0	3.7	(witchgrass.
lachlor 4EC	3	0	0	0	2	1	4	9.5	10.0	8.0	10.0	Lambsquarters
	6	3	0	1	6	3	4	10.0	10.0	9.3	10.0	——
	12	1	1	1	7	3	1	10.0	10.0	9.3	10.0	——
lachlor 10G	3	0	0	0	3	2	1	8.0	10.0	3.0	9.3	Lambsquarters
	6	0	0	0	4	2	3	9.5	10.0	7.0	10.0	"
	12	1	3	1	6	2	5	10.0	10.0	9.2	10.0	——
lachlor 4EC + chloroxuron 50W	1½+2	10	1	5	10	4	5	10.0	10.0	9.0	10.0	——
	2+3	10	2	5	10	6	9	10.0	10.0	9.8	10.0	——
	1½+4	9	6	9	9	9	9	10.0	10.0	9.5	9.8	——
lachlor 10G + chloroxuron 5G	1½+2	0	0	0	0	3	1	8.0	10.0	4.7	9.0	(Lambsquarters
	3+2	0	0	0	1	1	4	9.2	10.0	7.3	10.0	(pigweed.
	1½+4	0	0	0	1	1	0	9.2	10.0	7.3	8.7	
-3251 5G + chloroxuron 5G	2+2	0	0	0	0	0	0	2.3	7.3	0.7	7.3	(Pigweed,
	2+4	3	1	1	3	3	1	5.3	8.7	1.7	7.0	(lambsquarters
	4+2	0	0	0	0	0	0	1.3	10.0	0	9.0	(witchgrass
CPA 75W	12	0	0	0	1	1	4	10.0	9.7	9.0	9.7	——
-3251 5G	4	0	0	0	0	0	0	0	7.3	0	9.0	(Pigweed,
	8	0	0	0	0	0	0	0.3	10.0	0	8.7	(lambsquarters
	16	0	0	0	0	0	0	1.0	10.0	0	9.7	
SD 1%		–	–	–	–	–	–	2.2	2.7	3.6	2.2	
SD 5%		3	3	3	3	3	3	1.7	2.0	2.7	1.7	

. Applied 6/4 and 6/5/70.
. Average of 3 replicates. 10 = complete kill, 0 = no effect.
3. Annual broadleaf weeds.
4. Annual grassy weeds.

Table 3. Evaluation of several post-transplant herbicides and herbicide combinations for weed control and crop injury on marigolds, petunias and pansies.

Treatment[1]	Rate	Crop Vigor Ratings[2]			Weed Control Ratings[2] 7/14/70		Weed Control Ratings[2] 8/24/70		Weeds Incompletely Controlled
	Lb. ai/A	Marigolds	Petunias	Pansies	ABLW[3]	AGW[4]	ABLW[3]	AGW[4]	
Chloroxuron 50W	4	1	4	2	9.0	9.0	7.3	7.3	(Lambsquarters, (purslane, (witchgrass.
"	8	4	5	5	9.3	9.3	8.3	9.0	(Lambsquarters, (purslane.
"	16	10	9	10	10.0	9.8	9.2	9.2	———
Chloroxuron 5G	4	0	0	0	7.0	8.7	5.0	4.3	(Lambsquarters, (pigweed, purslane, (crabgrass, witchgrass.
"	8	0	0	0	7.7	8.7	6.3	4.0	"
"	16	0	1	0	9.2	8.3	8.3	5.3	(Lambsquarters, crab- (grass, witchgrass, (pigweed.
Alachlor 4EC	3	0	0	0	9.2	9.7	8.0	7.0	(Lambsquarters,
"	6	2	1	0	9.8	9.5	8.7	8.7	(crabgrass.
"	12	2	0	1	10.0	9.8	9.0	9.2	———
Alachlor 10G	3	0	0	0	9.2	9.7	7.0	7.3	(Lambsquarters,
"	6	0	1	0	9.7	9.8	8.3	8.0	(crabgrass.
"	12	1	1	0	10.0	9.7	9.3	9.3	———
Alachlor 4EC + chloroxuron 50W	1½+2	3	2	4	9.7	8.7	9.0	8.3	Witchgrass
"	3+2	5	3	3	10.0	9.3	8.7	7.7	(Lambsquarters, (witchgrass.
"	1½+4	9	9	8	10.0	9.3	9.3	8.0	Witchgrass
Alachlor 10G + Chloroxuron 5G	1½+2	0	1	0	8.7	6.7	6.7	5.3	(Lambsquarters,
"	3+2	0	0	0	9.5	9.7	8.0	9.0	(purslane,
"	1½+4	0	0	0	8.7	9.0	5.7	7.3	(witchgrass.
M-3251 5G + chloroxuron 5G	2+2	0	0	0	7.0	10.0	3.0	9.0	(Lambsquarters,
"	2+4	0	0	0	7.7	10.0	5.3	8.7	(purslane,
"	4+2	0	0	0	8.0	10.0	5.0	8.0	(pigweed.

Table 3 (continued)

Treatment[1]	Rate	Crop Vigor Ratings[2]			Weed Control Ratings[2]				Weeds
					7/14/70		8/24/70		Incompletely
	Lb. ai/A	Marigolds	Petunias	Pansies	ABLW[3]	AGW[4]	ABLW[3]	AGW[4]	Controlled
Diphenamid 50W	4	0	0	0	8.7	9.7	3.0	9.0	(Lambsquarters, (galinsoga, (pigweed.
Diphenamid 50W + Alachlor 4EC	2+1½	0	0	0	8.3	9.0	3.3	8.3	(Lambsquarters, (witchgrass.
"	2+3	1	1	0	9.3	9.2	7.0	8.3	
"	4+1½	0	0	0	9.0	9.3	6.0	8.3	
LSD 1%		–	–	–	1.7	1.6	3.7	3.6	
LSD 5%		2	2	2	1.3	1.2	2.8	2.7	

1. Applied 6/23 and 6/24/70.
2. Average of 3 replicates. 10 = complete kill, 0 = no effect.
3. Annual broadleaf weeds.
4. Annual grassy weeds.

WEED CONTROL IN CONTAINER-GROWN NURSERY STOCK

(Abstract)

J. F. Ahrens[1/]

Hand weeding in nursery containers is expensive, burdensome and removes soil from the containers. Fumigation to prevent weeds in container media is effective only for the first season and has not been accepted by nurserymen.

In attempts to solve this problem, the use of preemergence herbicides in containers was investigated starting in 1965. During 1970, the use of slitted fiberglass disks that are placed on the containers also was investigated. In all cases, granular formulations of herbicides were applied by running a calibrated applicator directly over a block of containers. Each herbicide treatment was applied over two or three blocks of five or more cans of each variety of plant. At first, selected weed seeds were sown over the containers and weeds were counted at monthly intervals. Later, weed seeds were sown over plantless containers that held the same soil mix as the planted containers and were otherwise treated the same. This method saved labor and allowed studies of leaching of the herbicides without sacrificing large numbers of valuable plants. "Natural" weed populations in the planted containers also were counted at intervals during the summer. Soil mixes ranged from sand-peat to sand-peat-humus-perlite.

No single herbicide or combination of herbicides controlled all weeds in containers without risk of injury to one or more species of plants. However, trifluralin [a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine] at 2 or 3 lb/A effectively controlled annual grasses and reduced broadleafed weed populations without injury to any plant treated and simazine [2-chloro-4,6-bis (ethylamino)-s-triazine] at 1½ lb/A effectively controlled broadleafed weed populations without serious injury to most plants. Deciducus flowering shrubs were the most sensitive to injury from simazine. Total weed populations were reduced by 75-95 per cent with combinations of simazine and trifluralin, with no injury greater than that caused by simazine alone. Other effective grass killers that combined well with simazine with minimal plant injury included nitralin [4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline] at 2 lb/A, DCPA [dimethyl tetrachloroterephthalate] at 9 lb/A, bensulide [O,O diisopropyl phosphorodithioate S-ester with N-(2-mercapto-ethyl) benzenesulfonamide] at 8 lb/A and alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] at 4 lb/A.

Fiberglass disks generally were effective longer than the herbicide treatments even though weeds grew in the slits and on the edges of the disks. However, the disks are not adaptable to all container shapes and currently are much more expensive than herbicides, so the need for herbicides continues. Further work with herbicides and with mulches such as the fiberglass disk is needed to determine the limitations of each in given container plant cultures.

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CHEMICAL CONTROL OF CRABGRASS (DIGITARIA SPP.) AND OTHER WEEDS IN NURSERY PLANTINGS WITH FALL AND SPRING APPLICATIONS

J. F. Ahrens[1]

Introduction

One of the major problems in the control of weeds in commercial nursery plantings is labor availability in the spring for applying herbicides, cultivating or hoeing. Consequently, nurseries often find themselves with costly weed removal in June as the digging season slows and labor becomes more available. Fall applications of simazine have controlled most of the broadleafed weeds, but annual grasses, particularly crabgrasses (Digitaria spp.) emerging in May and June have been resistant. Early spring applications of certain herbicides can control the weeds (1), but poor field conditions, weather and the labor situation in the spring suggest that fall applications would be more practical. The objective of this study was to evaluate herbicides alone and in combination for fall and spring use, with particular emphasis on the control of crabgrasses in relatively sensitive ornamental plants.

Methods

Herbicides were applied during the fall of 1969 and spring of 1970 at two locations that were infested with crabgrasses in 1969. Sprays were applied in 50 gal of water per acre and granules were applied with a calibrated auger-feed applicator.

The following herbicides and formulations were included at one or both locations:

a. simazine /2-chloro-4,6-bis (ethylamino)-s-triazine/, G and wp
b. trifluralin /a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine/, G and ec
c. nitralin /4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline/, G and wp
d. dichlobenil /2,6-dichlorobenzonitrole/, G
e. DCPA /dimethyl tetrachloroterephthalate/, wp
f. bensulide /O,O diisopropyl phosphorodithioate S-ester with N-(mercapto=ethyl) benzenesulfonamide/ G and ec
g. diphenamid /N,N-dimethyl-2,2-diphenylacetamide/, G and wp
h. fluometuron /1,1-dimethyl-3-(a,a,a-trifluoro-m-tolyl) urea/, G
i. chlorobromuron /3-(4-bromo-3-chlorophenyl)-1-methozy-1-methylurea/, G
j. norea /3-(hexahydro-4,7-methanoindan-5-yl)-1,1-dimethylurea/, wp

At Windsor, the herbicides were applied on a newly plowed and disked field of Merrimac sandy loam. Fall applications except dichlobenil were made on October 24, 1969 and the first rain fell on November 2. Dichlobenil

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was applied on November 18 with rain falling the next day. Spring applications were made on April 6, 1970 with the next rain falling on April 18. Plots were 3 x 16 ft with three replicates in a randomized complete block design. Eight seedlings (3-0) of white pine (Pinus strobus) were planted in each plot between May 7 and 15, disturbing the surface soil to a minimum degree.

At Bloomfield, a field of established azalea hybrids and mountain laurel in Merrimac loamy sand was used as the test area. The fall treatments were made on November 11, 1969 and the spring treatments were made on April 17, 1970. The first rains following treatments occurred on November 12 and April 18 respectively. The plants were dormant at the times of treatment. The planting was mixed and not all of the treatments were applied over the same varieties. Plots were two rows (6 ft) wide and 15 ft long and, for weed control evaluations, the fall treatments were replicated four times and the spring treatments three times.

At both locations weed control and plant injury were evaluated visually in June, July, August and September. After each evaluation the weeds were pulled and hoed and the plots were cultivated. Oats (Avena sativa) were sown in September at Windsor to evaluate residual effects of the herbicides. June and August 1970 had about two thirds of the normal rainfall but July had only about one third of normal rainfall. Supplementary irrigation was applied several times at Windsor but not at Bloomfield during 1970.

The principal annual grasses at Windsor were crabgrasses (Digitaria sanguinalis (L.) Scop. and D. ischaemum (Schreb.) Muhl.). In July the main broadleafed weeds were carpetweed (Mollugo verticillata L.) and lambsquarters (Chenopodium album L.) and in September purslane (Portulaca oleracea L.) and carpetweed were predominate.

Weeds were present at Bloomfield at the time of treatment in the fall and spring. These included the predominant Canada fleabane (Erigeron canadensis L.), red sorrel (Rumex acetosella L.) and common chickweed (Stellaria media(L.) Cyrill.). Annuals invading in the spring and summer primarily included crabgrasses, lambsquarters and carpetweed.

Results and Discussion

Effects of the herbicide treatments at Windsor on weed control, oat cover crop and injury to the white pine seedlings are given in Table 1 and effects of the treatments at Bloomfield on weed control and injury to azaleas are given in Tables 2 and 3. Comments on the results with each herbicide are given below.

Simazine - At Windsor, differences between granular and wettable powder forms of simazine were marked. Applied in the fall, granular simazine was more effective than wettable simazine, but applied in the spring the reverse was true. These differences are explained by the fact that granular simazine is more persistent but slower acting than wettable simazine (1).

At Bloomfield, granular simazine in the fall controlled the fall weeds and annual broadleafed weeds but the high rate of 3 lb/A controlled crabgrasses only until June. Combining simazine with grass killers such as trifluralin, nitralin, bensulide or diphenamid in the fall or spring generally improved the spectrum of weed control as expected.

Several azalea varieties were injured by simazine at 3 lb/A in the fall. This injury showed up as chlorotic and necrotic lower leaves in June. At 1½ lb/A in the fall, however, simazine caused minor injury to Azalea mollis but none to several Knaphill-Exbury and pontica hybrids. The combination of simazine plus trifluralin in the fall caused no more injury than simazine alone. Simazine at 2 lb/A in the spring or at 1½ lb/A in combination with other herbicides did not greatly injure A. Satan or Kalmia latifolia.

The results in general show that simazine at low rates can be used to advantage in the fall or spring in sensitive nursery crops such as azaleas when combined with complimentary herbicides. However, if simazine is used in the fall to control annual weeds in the spring, it appears essential to use the granular form.

Trifluralin - Both the emulsifiable and granular forms of trifluralin controlled crabgrasses in June and July following fall applications at 2 or 4 lb/A and the higher rates reduced stands of oats in the fall. No consistent differences could be seen between fall and spring applications of granular trifluralin. Air movements during application can easily affect distribution of the fine trifluralin granules. Trifluralin at 2 or 4 lb/A caused no injury to several azalea hybrids, Kalmia or to white pines.

Nitralin - Both the wettable powder and granular forms of nitralin, applied at 2 or 4 lb/A in the fall or in the spring were effective against crabgrasses and the annual broadleafed weeds during the entire season. No differences could be seen between fall and spring or between wettable or granular forms in weed control or effects on the oat cover crop. Combining nitralin with simazine satisfactorily controlled fall weeds in addition to the annual weeds. At 2 lb/A in the fall, nitralin caused no injury to several azalea hybrids, but at 4 lb/A it reduced the vigor of A. coccinea speciosa and A. Harvest Moon. Spring applications at 2 or 4 lb/A caused no injury to A. Satan, A. Fireglow or Kalmia.

Diphenamid - Fall applications of diphenamid wettable powder or granules at 5 or 10 lb/A were ineffective against weeds in June, but April applications were effective in June and July. It is likely that diphenamid leaches too deeply following fall applications, enabling annual weeds to grow above its effective residues. Combining diphenamid with simazine in the spring, as in current nursery practice, was an effective treatment. Diphenamid caused no injury to any of the azalea hybrids, Kalmia or white pine.

Dichlobenil - November applications at Windsor were less effective in controlling weeds than April applications, but cover crops were affected to a greater degree by the November applications, indicating greater persistence probably due to leaching to greater depths. At Bloomfield, November applications of dichlobenil were more effective against weeds, more persistent and

caused more injury to azaleas than April applications. Since persistence and selectivity of dichlobenil are related to its volatility and depth of penetration into soil (2), these results are not surprising. With 4 or 8 lb/A in the fall, injury to azaleas ranged from slight to severe, with growth depression, necrotic leaf tips and mortality. A. Harvest Moon was much more tolerant of dichlobenil than A. coccinea speciosa, A. mollis or A. Persil. April applications at 4 lb/A caused no injury to A. Persil, A. Nancy Waterer, A. Fireglow or Kalmia.

Bensulide - Fall and spring applications of bensulide were equally effective against crabgrasses and erratic against broadleafed weeds. Lambsquarters and purslane were controlled but not carpetweed. Simazine plus bensulide was an effective combination. Bensulide at 8 lb/A caused no injury to the several azaleas mentioned above or to Kalmia.

Fluometuron - Fall applications varied in their effectiveness against weeds, but severely injured nursery stock at both locations. At 4 or 8 lb/A in the fall, fluometuron killed or severely injured most of the azaleas. Injury from April applications was less severe but intolerable on A. Satan, A. Fireglow and Kalmia.

Chlorobromuron - Fall applications of chlorobromuron also were less effective against weeds and more injurious to azaleas than April applications. However, chlorobromuron was less injurious to azaleas and white pines than fluometuron. At 4 lb/A, fall applications caused no injury to several azaleas and at 8 lb/A moderate injury was observed in A. coccinea speciosa but not in A. Harvest Moon or A. mollis. Spring applications of 4 or 8 lb/A caused no injury to A. Nancy Waterer, A. Persil or Kalmia and 4 lb/A controlled annual weeds for at least 3 months.

Norea - Fall applications were less effective against weeds than spring applications and more injurious to azaleas. At 4 lb/A in the fall, injury to several azaleas ranged from none to moderate and at 8 lb/A injury ranged from moderate to severe. April applications caused no injury to azaleas or to Kalmia and, while not adequately controlling fleabane or red sorrel, norea at 4 lb/A controlled annual weeds for the season.

DCPA - October or April applications of DCPA at 9 lb/A effectively controlled the annual weeds until July without injuring white pines. Combinations of DCPA with simazine could be expected to control a broader spectrum of weeds (3).

Summary and Conclusions

A number of herbicides were applied in the fall or in the spring to control weeds and particularly crabgrasses through the spring season in established azaleas and mountain laurel and before planting seedlings of white pine.

Herbicide applications in the fall generally caused more injury to established azaleas than applications in April, probably because of more leaching of herbicide to root zones. At the same time weed control was greatly reduced

with fall applications of herbicides such as diphenamid, chlorobromuron, fluometuron, norea and wettable simazine.

Simazine in the fall or spring was effective against weeds starting in the fall and annual broadleafed weeds starting in the spring. Applied in the fall, granular simazine was more effective and more persistent than the wettable powder but, applied in the spring, wettable simazine was more effective against crabgrasses. While the rate of 3 lb/A of granular simazine in the fall injured established azaleas, 1½ lb/A alone or combined with trifluralin caused only minor temporary injury. Granular simazine remains a very effective herbicide for fall use.

Trifluralin, nitralin, bensulide and DCPA were all very effective against crabgrasses when applied in the fall or in April, but neither controlled established seedlings of Canada fleabane or red sorrel. Sprays or granules of trifluralin and nitralin did not markedly differ in effectiveness when applied in the fall. Nitralin was particularly persistent and injurious to azaleas at the high rate of 4 lb/A in the fall. However, the lower rate of 2 lb/A was effective without injury and could be a useful treatment in nursery plantings. All four herbicides could be effectively combined with simazine for broad spectrum weed control.

Dichlobenil was more effective in the fall for the control of established weeds but it also was more injurious to azaleas than when applied in the spring. Experience has shown that dichlobenil is always hazardous for use on certain varieties of azalea (4), but it is an effective herbicide for the control of winter annual and perennial weeds in many other nursery plants.

Three substituted urea herbicides were included in these tests: norea, fluometuron and chlorobromuron. Fluometuron was excessively injurious to azaleas and white pines. Both norea and chlorobromuron were less effective when applied in the fall and more injurious to azaleas than when applied in the spring. In April wettable norea was effective longer against crabgrasses and established weeds than granular chlorobromuron. Norea remains an effective herbicide for broad spectrum control of annual and certain winter annual weeds in nurseries.

Diphenamid was ineffective as a fall application but it was effective in the spring, either alone to control annual grasses or combined with simazine to control a broad spectrum of weeds.

These results show that several herbicides or herbicide combinations can be safely applied in the fall or in the early spring to control weeds in nurseries until June or later.

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Table 1. Weed control, effects on oat cover crop and injury to White Pine seedlings planted in soil treated in the fall (F) or spring (S) at Windsor.

Herbicide and formulation	Rate, a.i. lb/A	Timing	Percentage control: Crabgrass 6/9	Crabgrass 7/22	Broadleaves 7/22	Broadleaves 9/17	% stand of oats 10/21	Injury to Pine[1/]
controls	-	-	39	21	00	00	97	0
simazine, wp	2	F	10	0	36	20	90	0
simazine, wp	4	F	53	20	43	16	93	0
simazine, wp	2	S	97	83	80	10	97	0
simazine, G	2	F	70	53	67	20	93	0
simazine, G	4	F	92	83	73	30	67	0
simazine, G	2	S	80	53	83	53	93	0
trifluralin, ec	2	F	97	98	63	30	90	0
trifluralin, ec	4	F	100	98	86	56	63	0
trifluralin, G	2	F	90	68	73	33	87	0
trifluralin, G	4	F	100	97	82	10	67	0
trifluralin, G	2	S	97	93	82	27	95	0
trifluralin, G	4	S	97	97	85	23	80	0
nitralin, wp	2	F	100	95	91	80	60	0
nitralin, wp	4	F	100	98	98	95	10	0
nitralin, G	2	F	98	99	88	83	53	0
nitralin, G	4	F	97	93	95	92	17	0
nitralin, G	2	S	93	91	78	50	57	0
nitralin, G	4	S	97	92	58	78	32	0
simazine +	2+2	F	97	87	85	33	90	0
trifluralin, G	2+2	S	100	93	92	37	72	0
simazine + nitralin, G	2+2	F	97	96	96	83	45	0
dichlobenil, G	4	F	85	60	69	10	32	0
dichlobenil, G	8	F	100	93	90	76	17	2.0
dichlobenil, G	4	S	92	80	57	0	70	0
DCPA, wp	9	F	97	87	85	47	92	0
DCPA, wp	18	F	100	97	92	80	13	0
DCPA, wp	9	S	100	98	90	27	90	0
bensulide, ec	8	F	98	96	63	53	100	0
bensulide, ec	16	F	100	100	63	57	83	0
bensulide, ec	8	S	97	98	53	0	95	0
diphenamid, wp	5	F	83	53	33	13	95	0
diphenamid, wp	10	F	53	43	27	30	90	0
diphenamid, wp	5	S	100	83	85	43	60	0
diphenamid, G	5	F	63	60	27	30	83	0
diphenamid, G	10	F	63	30	40	27	83	0
diphenamid, G	5	S	100	87	85	62	65	0
fluometuron, G	4	F	63	27	30	30	90	3.7
fluometuron, G	8	F	67	47	76	50	70	5.7
chlorobromuron, G	4	F	78	60	73	63	90	0
chlorobromuron, G	8	F	90	76	97	88	93	0

1/ 0=no injury, 10=dead plants

Table 2. Percentage weed control with treatments applied in the fall (F) or in the spring (S) at Bloomfield.

Herbicide and formulation	Rate, a.i. lb/A	Timing	Fall weeds 6/2	Crabgrass 6/2	Crabgrass 7/13	Crabgrass 8/26	Broadleaves 6/2	Broadleaves 7/13	Broadleaves 8/26
controls	0	-	0	12	0	0	0	0	0
simazine, G	1.5	F	76	50	71	55	100	93	80
simazine, G	3	F	93	80	45	25	100	95	89
simazine, G	2	S	77	50	77	20	100	96	88
trifluralin, G	2	F	18	95	81	81	90	73	50
trifluralin, G	4	F	31	98	94	92	98	74	70
trifluralin, G	2	S	16	30	85	47	30	82	50
trifluralin, G	4	S	20	100	99	91	100	95	87
simazine +	1.5+2	F	89	96	89	83	100	91	83
trifluralin,G	1.5+2	S	63	100	87	57	100	93	88
nitralin, G	2	F	8	91	90	89	96	91	80
nitralin, G	4	F	5	100	92	97	100	90	84
nitralin, G	2	S	13	87	93	96	63	82	80
nitralin, G	4	S	27	95	98	99	87	93	92
simazine + nitralin, G	1.5+2	S	70	93	98	88	97	91	88
dichlobenil, G	4	F	98	100	91	73	100	89	58
dichlobenil, G	8	F	99	100	98	76	100	95	86
dichlobenil, G	4	S	57	73	47	53	97	50	30
bensulide, G	8	F	49	89	90	94	81	69	53
bensulide, G	16	F	35	92	98	97	75	28	35
bensulide, G	8	S	0	90	93	99	20	57	10
simazine + bensulide, G	1.5+8	S	67	67	95	77	97	96	83
diphenamid, G	5	F	30	35	32	24	61	53	0
diphenamid, G	10	F	7	35	18	28	90	53	30
diphenamid, G	5	S	13	97	83	50	83	82	47
simazine + diphenamid, G	1.5+5	S	57	100	95	80	98	98	90
norea, wp	4	F	12	35	69	75	60	62	66
norea, wp	8	F	45	42	65	50	94	70	68
norea, wp	4	S	53	97	92	70	100	96	98
norea, wp	8	S	93	100	99	93	100	99	99
fluometuron, G	4	F	83	89	73	65	100	79	91
fluometuron, G	8	F	98	95	91	86	100	95	99
fluometuron, G	4	S	87	98	98	97	100	96	98
fluometuron, G	8	S	98	100	99	95	100	99	100
chlorobromuron,G	4	F	40	42	56	45	92	70	50
chlorobromuron,G	8	F	48	95	90	90	100	92	93
chlorobromuron,G	4	S	43	93	72	40	100	90	90
chlorobromuron,G	8	S	37	93	82	57	100	95	92

Table 3. Injury to azalea hybrids and *Kalmia* with treatments applied in the fall (F) or in the spring (S) at Bloomfield.

Herbicide and formulation	Rate a.i. lb/A	Timing	Injury ratings (0-10) in July								
			A[1/]	B	C	D	E	F	G	H	I
controls	-	-	0	0	0	0	0	0	0	0	0
simazine, G	1.5	F	0	0	0	1	0	-	-	-	-
simazine, G	3	F	3	2	-	0	3	-	-	-	-
simazine, G	2	S	-	-	-	-	-	-	0	-	0
trifluralin, G	2	F	0	0	0	0	-	-	-	-	-
trifluralin, G	4	F	1	0	-	0	-	-	-	-	-
trifluralin, G	2	S	-	-	-	-	-	-	0	-	0
trifluralin, G	4	S	-	-	-	-	-	-	0	-	1
simazine +	1.5+2	F	0	1	0	0	-	-	-	-	-
trifluralin, G	1.5+2	S	-	-	-	-	-	-	0	-	0
nitralin, G	2	F	1	0	0	-	-	-	-	-	-
nitralin, G	4	F	3	2	-	1	-	-	-	-	-
nitralin, G	2	S	-	-	-	-	-	-	0	0	0
nitralin, G	4	S	-	-	-	-	-	-	0	-	0
simazine + nitralin, G	1.5+2	S	-	-	-	-	-	-	1	-	0
dichlobenil, G	4	F	4	0	-	2	-	-	-	-	-
dichlobenil, G	8	F	5	2	-	4	7	-	-	-	-
dichlobenil, G	4	S	-	-	-	-	0	0	1	0	0
bensulide, G	8	F	0	0	-	0	-	-	-	-	-
bensulide, G	16	F	0	3	0	-	-	-	-	-	-
bensulide, G	8	S	-	-	-	-	-	-	0	-	0
simazine + bensulide, G	1.5+8	S	-	-	-	-	-	-	0	0	0
diphenamid, G	5	F	1	0	-	0	0	-	-	-	-
diphenamid, G	10	F	2	0	-	0	-	-	-	-	-
diphenamid, G	5	S	-	-	-	-	-	-	0	-	0
simazine + diphenamid, G	1.5+5	S	-	-	-	-	-	-	1	0	0
norea, wp	4	F	1	1	-	0	-	-	-	-	-
norea, wp	8	F	3	3	5	4	-	-	-	-	-
norea, wp	4	S	-	-	-	-	0	0	-	-	0
norea, wp	8	S	-	-	-	-	1	1	-	-	2
fluometuron, G	4	F	8	8	-	-	5	-	-	-	-
fluometuron, G	8	F	9	9	9	-	-	-	-	-	-
fluometuron, G	4	S	-	-	-	-	-	2	2	3	3
fluometuron, G	8	S	-	-	-	-	4	-	-	-	6
chlorobromuron, G	4	F	0	0	-	0	-	-	-	-	-
chlorobromuron, G	8	F	1	3	-	0	0	-	-	-	-
chlorobromuron, G	4	S	-	-	-	-	0	1	-	-	0
chlorobromuron, G	8	S	-	-	-	-	-	0	-	-	0

[1/] A=*Azalea pontica* hyb. coccinea speciosa; B=*A.* Knaphill-Exbury hyb. Harvest Moon; C=*A. pontica* hyb. Sange de Gentbrugge; D=*A. mollis*; E=*A.* Knaphill-Exbury hyb. Persil; F=*A. pontica* hyb. Nancy Waterer; G=*A.* Knaphill-Exbury hyb. Satan; H=*A.* Knaphill-Exbury hyb. Fireglow; I=*Kalmia latifolia*

ACTIVITIES OF SEVERAL HERBICIDES AND HERBICIDE COMBINATIONS IN SNAP BEANS[1/]

H. P. Wilson, H. J. Davis and J. Belote[2/]

Snap beans are grown in eastern Virginia for both the fresh market and for processing. Notwithstanding that the available supply of labor for harvesting has been diminishing, the increased use of mechanical harvesters is resulting in an increase in the acreage grown for processing (1). Furthermore, the long growing season permits production of both spring and fall crops. Regardless of when the crop is to be grown or how it is to be harvested, a weed-free field is essential for production of high yielding snap beans of good quality. Several herbicides are currently being used extensively in production of snap beans in eastern Virginia but none is entirely satisfactory for reasons related to characteristics of the individual chemicals.

The objectives of research reported in this paper were to further characterize the responses to be expected from some of the commercially available herbicides as well as to evaluate certain newer herbicides or herbicide combinations in snap beans.

Materials and Methods

Research was performed at the Virginia Truck and Ornamentals Research Station near Painter, Va. Soil type was a Sassafras sandy loam with an organic matter content of approximately 1%. Plots measuring 5 ft x 20 ft (2 rows wide) were prepared to receive herbicidal treatments by plowing and tilling twice with a tandem disc-harrow. Selected herbicides were applied prior to planting and incorporated immediately (preplant incorporated) with a power-driven rotary tiller. Snap beans (var. Harvester) were then planted in all plots and herbicides being researched for preemergence activity were applied. All applications were made using a hand-operated plot sprayer; the source of pressure was propane. All treatments were replicated three or four times. Herbicides were not necessarily researched each of the three years. Where herbicides were studied more than one year, rates were frequently varied between years. Dates of planting and herbicide application, soil moisture conditions and initial rainfall or irrigation are presented in Table 1. Chemical descriptions of the herbicides investigated are presented in the Appendix.

Efficacy data consisted of weed control and crop injury ratings using the scale 0 to 10 where 0 represents no effect and 10 complete reduction of plant stand or vigor. Weed species predominant were lambsquarters (*Chenopodium album*, L.), pepperweed (*Lepidium virginicum* L.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.) and fall panicum (*Panicum dichotomiflorum* Michx.). To determine

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effects on crop yields, snap beans were harvested twice in 1968 and 1970 and data were analyzed statistically. In 1969, snap beans were not harvested because an infestation of yellow nutsedge was estimated to be so severe as to mask any yield differences which might otherwise have been present.

Table 1. Planting and treatment dates, soil moisture conditions and dates of initial precipitation in snap bean studies conducted from 1968 to 1970.

Year	Treatments	Date Planted	Date Treated	Soil Moisture	Date and amount of initial rainfall or irrigation
1968	All	May 7	May 7	Dry	May 12 - 0.26 in
1969	Preplant Inc	May 2	May 2	Dry	May 7 - 1.00 in
1969	Preemergence	May 2	May 6	Dry	May 7 - 1.00 in
1970	All	April 28	April 28	Wet	April 29 - 0.17 in

Results and Discussion

For ease of discussion, each experiment will be presented separately.

Preplant incorporated: Results obtained during the three years of the experiment with herbicides applied prior to planting and incorporated are presented in Table 2. Outstanding broad-spectrum control was effected by 2 and 3 lb/A of EPTC. Notwithstanding that initial injury occurred, manifesting itself as an early malformation of leaf growth, snap beans produced good yields. The three herbicides trifluralin, nitralin and ER-5461 gave excellent control of grasses but failed to provide satisfactory control of pepperweed. Results further indicate that with ER-5461 a rate of approximately 3/4 lb/A was needed to provide acceptable control of lambsquarters. It is evident that neither ER-5461 nor nitralin controlled lambsquarters as effectively as did trifluralin.

Table 2. Weed control and crop yields from herbicides applied preplant incorporated to snap beans from 1968 to 1970.

		Weed Control 1/				Yields, T/A	
		Lambs-quarters		Pepper-weed	Grasses 2/		
Herbicide	Rate, lb/A ai	1969	1970	1970	1968-1970	1968	1970
EPTC	2		9.6	9.9	9.9		1.5
	3	9.2	9.7	10.0	9.9	1.8	1.9
Trifluralin	1/2	9.0	9.8	1.3	9.8	2.2	1.1
Nitralin	3/4	8.7	8.9	2.7	9.4		1.2
ER-5461	1/2	8.0	8.2	5.2	9.1		0.6
	1	9.3			9.8		

Table 2 (continued)

Herbicide	Rate, lb/A ai	Weed Control 1/ Lambs-quarters 1969	Lambs-quarters 1970	Pepper-weed 1970	Grasses 2/ 1968-1970	Yields, T/A 1968	Yields, T/A 1970
Check (cultivated) 3/			4.0	4.7	4.0 4/	2.0	1.3
Check (weedy)		0.0	0.0	0.0	0.0		0.4
LSD 0.05						N.S.	0.8

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

2/ Crabgrass and fall panicum.

3/ Cultivation consisted of one hoeing in 1970.

4/ Datum refers to 1970 only. In 1968, cultivation occurred after ratings were made.

Preemergence applications of alachlor, dinoseb and nitrofen: Results with alachlor (Table 3) are consistent with those reported elsewhere (2); that is, grass control is usually excellent but control of lambsquarters may not be satisfactory. The addition of dinoseb to alachlor resulted in outstanding control of broadleaf weeds and grasses while apparently maintaining an adequate margin of crop safety. Although initial control by combinations of dinoseb with nitrofe was better than by either herbicide alone, it was evident at harvest time that control was not long lasting. It is believed that one or two cultivations would be necessary to maximize control with the latter combination.

Table 3. Weed control and crop yields from alachlor, dinoseb and nitrofen applied preemergence to snap beans in 1969 and 1970.

Herbicide	Rate, lb/A ai	Weed Control 1/ Lambs-quarters	Pepper-weed	Grasses 2/	Yield, 3/ T/A
1969					
Alachlor	1	0.0		9.2	
	1 1/2	3.5		9.8	
	2	1.7		10.0	
Dinoseb	3	9.3		4.5	
1970					
Alachlor	1 1/2	8.7	9.9	9.9	1.5
Dinoseb	3	10.0	10.0	7.9	2.0
Alachlor +	1 + 2	9.9	10.0	10.0	1.9
Dinoseb	1 1/2 + 2	10.0	10.0	10.0	2.7

(continued)

Table 3 (continued)

Herbicide	Rate, lb/A ai	Weed Control 1/ Lambs-quarters	Pepper-weed	Grasses 2/	Yield, 3/ T/A
1970					
Nitrofen	2	6.7	8.0	4.3	1.2
Nitrofen +	1 1/2 + 3/4	8.4	9.7	8.7	1.3
Dinoseb	3 + 1 1/2	9.2	9.9	9.3	1.5
Check (weedy)		0.0	0.0	0.0	0.3
LSD 0.05					0.8

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

2/ Crabgrass and fall panicum.

3/ Not harvested in 1969.

Preemergence applications of C-6989: Although C-6989 generally provided effective control of grasses, control of lambsquarters was somewhat variable (Table 4). Notwithstanding that rates as high as 6 lb/A in 1968 (not shown) were safe to snap beans, C-6989 caused some stand and vigor reductions to the crop in 1969 at a rate of 4 1/2 lb/A. For this reason, the margin of safety of this herbicide to snap beans may not be adequate.

Table 4. Weed control and crop response to C-6989 applied preemergence to snap beans in 1968 and 1969.

Herbicide	Rate, lb/A ai	Snap beans 1969 1/	Weed Control Lambsquarters 1968	Lambsquarters 1969	Grasses 1968 and 1969
C-6989	3	3.0		8.0	9.0
	4 1/2	5.0	8.5	7.0	9.4
Check		3.3	0.0	0.0	0.0

1/ Scale: 0 = no effect and 10 = complete reduction in plant stand.

Preemergence applications of chloramben and diphenamid: It is noteworthy that combinations of chloramben with diphenamid effected control that was only slightly better than either herbicide alone and that differences between combinations were small (Table 5). Based on the species of weeds which can be expected to infest snap bean fields in eastern Virginia and the relatively short period of time that control is needed, the merit of this combination is questionable.

Table 5. Weed control with chloramben and diphenamid applied preemergence to snap beans in 1970.

Herbicide	Rate, lb/A ai	Weed Control 1/ Lambs-quarters	Pepper-weed	Grasses 2/	Yield, T/A
Chloramben	2	7.1	8.5	8.5	1.2
Diphenamid	2	7.5	9.2	9.2	1.2
Chloramben + Diphenamid	1 1/2 + 1 1/2	8.4	9.1	8.3	1.6
	2 + 2	8.3	8.8	9.5	1.5
	2 + 1	8.0	8.5	9.0	1.2
Check (weedy)		0.0	0.0	0.0	0.3
LSD 0.05					N.S.

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

2/ Crabgrass and fall panicum.

Summary

Research was conducted for three years to further evaluate commercially available as well as certain experimental herbicides, alone and in selected combinations, for use in snap beans. Of the herbicides applied prior to planting and incorporated, EPTC effected the broadest spectrum of control; initial injury from this herbicide did not result in any lasting crop response. Neither trifluralin, nitralin nor ER-5461 controlled pepperweed while nitralin and ER-5461 were less effective than trifluralin for control of lambsquarters.

With reference to preemergence applications, combinations of alachlor with dinoseb provided outstanding control of broadleaf weeds and grasses and treated snap beans produced high yields. The combination of nitrofen with dinoseb produced better initial control than either of the component herbicides alone, but control was short-lived. The apparent advantages of combinations of chloramben with diphenamid over single applications of the component herbicides were small. Control with C-6989 was variable and the margin of safety to snap beans is questionable.

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Appendix

Chemical descriptions of herbicides evaluated in snap beans from 1968 to 1970.

Alachlor	2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide
C-6989	2,4'-dinitro-4-trifluoromethyl-diphenyl= ether
Chloramben	2-amino-2,5-dichlorobenzoic acid
Dinoseb	4,6-dinitro-o-sec-butylphenol
Diphenamid	N,N-dimethyl-2,2-diphenylacetamide
EPTC	ethyl N,N-dipropylthiocarbamate
ER-5461	Chemistry not disclosed
Nitralin	4-2(2-methylsulfonyl)-2,6-dinitro-N, N-dipropylaniline
Nitrofen	2,4-dichlorophenyl-4-nitrophenyl ether

FIELD INVESTIGATIONS OF THE ACTIVITIES OF SEVERAL HERBICIDES FOR CONTROL OF YELLOW NUTSEDGE [1/]

H. P. Wilson, R. L. Waterfield, Jr. and C. P. Savage, Jr. [2/]

Yellow nutsedge (*Cyperus esculentus* L.) infests large areas of the United States (5). In eastern Virginia, it is a troublesome weed species in many vegetable crops, corn, soybeans and nurseries. Widespread use of herbicides effective on predominating annual weeds and a decrease in hand hoeing are two of the factors listed by Hauser (6) which have been responsible for changes in weed ecology. These changes have favored the succession and intensification of yellow nutsedge.

Research aimed at control of yellow nutsedge in various cropping situations has included many herbicides. Several of the thiocarbamate compounds have effec ed good control when incorporated or injected into the soil (5,7,9). However, Rud (8) has reported good control of several species of annual weeds with surfac applications of S-propyl dipropylthiocarbamate (vernolate). The addition of (2,4 dichlorophenoxy) acetic acid (2,4-D) to incorporated applications of S-ethy diisobutylthiocarbamate (butylate) has also looked promising (4). Control with 2-chloro-4-ethylamino-6-isopropylamino-s-triazine (atrazine) applied preemergenc has varied from good (10) to poor (3). Applications of atrazine preemergence followed by a subsequent postemergence application of the same herbicide was effective for Cole et al. (3). Recently, Behrens (1,2) has reported that 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) provided good control when incorporated but was variable when applied preemergence.

The studies reported herein were conducted to determine the capacity of several herbicides and herbicide combinations to control yellow nutsedge in eastern Virginia. The effects of soil incorporation on herbicide activity were considered of primary importance.

Materials and Methods

Research was conducted from 1968 through 1970 near Accomac, Va. A sandy loam soil with approximately 1.5 per cent organic matter and known to be heavily infested with yellow nutsedge was chosen as the research site. Land was prepared to receive herbicide treatments by plowing and then tilling once with a tandem disc-harrow 2 to 3 weeks prior to herbicide application. On the day herbicides were applied, soil was again tilled with either a disc-harrow or power-driven rotary tiller. Stage of growth of nutsedge was determined prior to the final tillage operation. In 1968, applications were made on April 26; at this time some tubers had germinated and a few leaves were emerging. Although the date herbicides were applied in 1969 was only 3 days

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later than in 1968, a uniform stand of nutsedge had emerged to a height of approximately 1 to 2 in. It was estimated in 1970 that less than 1 per cent of the tubers had germinated and that maximum bud length was 0.5 in on April 17 when herbicides were applied. Where succeeding postemergence applications were made, nutsedge height was approximately 4 to 6 in in 1968 and averaged 1.5 in in 1970.

Herbicides listed in the Appendix were applied with small-plot sprayers using propane as the source of pressure. Plot size varied with years; in 1968 preemergence and incorporated studies were maintained separately in plots measuring 5 ft x 10 ft. Studies in 1969 were designed to determine the influence of different amounts of incorporation on herbicide performance. Plots measuring 5 ft x 20 ft and spaced 1 ft apart were sprayed. Successive 5 ft increments were then incorporated perpendicular to the long axis of the plots 0, 1, 2 or 3 times in the same direction of travel. Plots were further enlarged in 1970 to measure 6.7 ft x 22.5 ft with the back half of each plot being incorporated twice in opposite directions of travel. Incorporation was performed in all studies with a power-driven rotary tiller.

Estimates of yellow nutsedge control were made using the scale 0 to 10 where 0 represents no effect and 10 represents complete stand elimination. Data were analyzed statistically.

Results and Discussion

Results obtained with the thiocarbamate herbicides are presented in Tables 1, 2 and 3. It is evident that all possessed good activity against yellow nutsedge when incorporated but had little or no activity when left on the soil surface. Although molinate provided excellent control initially, effects of this herbicide were short-lived. Due to the variability in control which existed between years, no relative order of activity could be determined between thiocarbamates. With reference to incorporation, control generally increased with increasing amounts of incorporation, especially at the lower herbicide rates. It seems likely that these increases in control resulted at least partially from the increased tillage rather than entirely from increased herbicide activity. Also noteworthy was the fact that additions of atrazine to vernolate, pebulate or butylate failed to increase control over that obtained with either herbicide alone. Similarly, no advantage was observed from the additions of 2,4-D to butylate or a hydrocarbon emulsion[1] to EPTC.

Results obtained with atrazine (Table 4) are in agreement with the conclusion drawn by Hauser (6) that atrazine activity on yellow nutsedge is erratic. Notwithstanding that successive applications provided excellent control in 1968, a single preemergence application of 2 lb/A atrazine also provided good control. In 1970, neither single nor successive applications were satisfactory. Soil moisture conditions at the time of and following herbicide application did not differ appreciably between the two years. Soils were moist at the time of herbicide application and approximately 0.5 in rain was received within 10 days. If soil moisture were limiting and moisture were the most important factor influencing atrazine activity, as suggested by Vengris (10), the incorporated treatments should have been superior to surface

[1] The hydrocarbon emulsion was FOLICOTE from the Sun Oil Co., Marcus Hook, Pa.

applications. Since low rates were as effective as high, the suggestion by Cole et al. (3) that atrazine rate is more important than application time may not apply here. Furthermore, if timing were of primary importance, it would seem that results in 1970 should have been superior since timing of both soil and foliage applications should have been nearly ideal.

Incorporation was necessary for acceptable control with alachlor (Tables 5 and 6). With the low rate of only 1 1/2 lb/A, nutsedge control was increased by each additional incorporation; effects of additional incorporations were small with higher rates of alachlor. Notwithstanding that initial activity with alachlor incorporated was good, control was short-lived. The addition of atrazine to alachlor failed to either increase or extend the period of nutsedge control.

Control with R-7465 was effective only when the herbicide was incorporated and then only at rates of at least 4 lb/A. (Table 7). It was interesting to note, however, that raising the rate to 8 lb/A resulted in only a slight increase in control.

Summary

Research conducted for three years indicated that EPTC, vernolate, pebulate, butylate and molinate were highly effective for controlling yellow nutsedge. Relative differences in activity between the thiocarbamates existed during the 3-year period as well as differences in length of control; for these reasons no consistent order of expected activity could be predicted. Atrazine activity was highly erratic. No single factor was considered to be the primary cause for atrazine behavior. Notwithstanding that alachlor effected control of yellow nutsedge, activity was pronounced only when the herbicide was incorporated and even then the period of control was short-lived. Control with R-7465 was satisfactory only at rates of 4 lb/A or above when incorporated.

Acknowledgments

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Appendix

Chemical descriptions of herbicides researched for activity against yellow nutsedge from 1968 to 1970.

Alachlor	2-chloro-2',6'-diethyl-N-(methoxy=methyl) acetanilide
Atrazine	2-chloro-4-(ethylamino)-6-(isopropyl=amino)-s-triazine
Butylate	S-ethyl diisobutylthiocarbamate
EPTC	S-ethyl dipropylthiocarbamate
Molinate	S-ethyl hexahydro-1 H-azepine-1-carbothioate
Pebulate	S-propyl butylethylthiocarbamate
R-7465	2-(a-naphthoxy)-N,N-diethylpropionamide
Vernolate	S-propyl dipropythiocarbamate

Table 1. Control of yellow nutsedge with EPTC, butylate, atrazine and 2,4-D incorporated in 1968.

Herbicide	Rate, lb/A ai	Control 1/
EPTC	4 1/2	8.9
Butylate	2	7.6
	4	9.5
Atrazine	2	8.7
Butylate + Atrazine	2 + 1	9.0
	3 + 1	7.6
	4 + 1	8.0
	3 + 2	7.8
Butylate + 2,4-D	2 + 1	5.2
	2 + 2	7.3
	4 + 2	7.3
Check		0.0
LSD 0.05		2.8
0.01		3.8

1/ Scale: 0 = no control and 10 = complete control.

Table 2. Effects of incorporation on control of yellow nutsedge with four thiocarbamate herbicides in 1969.

Herbicide	Rate, lb/A ai	Nutsedge Control 1/ Number of Incorporations 0	1	2	3
EPTC	3	0.9	7.3	8.9	9.8
	6	2.4	9.7	10.0	10.0
Vernolate	3	2.1	7.6	8.4	8.7
	6	1.5	9.1	9.8	9.9
Pebulate	3	2.1	5.3	6.1	7.4
	6	1.3	8.3	9.4	9.7
Butylate	3	1.3	5.4	6.4	6.8
	6	2.4	6.5	7.8	8.1
EPTC + FOLICOTE (1 pt/A) 2/	3	1.8	8.3	8.7	9.3
	6	3.0	9.7	10.0	9.9

(continued)

Table 2 (continued)

Herbicide	Rate, lb/A ai	Nutsedge Control 1/ Number of Incorporations 0	1	2	3
Butylate +	3 + 1	3.1	6.4	6.3	6.9
Atrazine	3 + 2	4.0	6.6	7.1	7.4
	4 + 1	2.0	6.2	6.9	7.1
Check		1.0	1.3	3.3	2.1
LSD 0.05		N.S.	2.1	1.6	1.4
0.01		N.S.	2.8	2.1	1.8

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

2/ A hydrocarbon emulsion from Sun Oil Co. used primarily to retard moisture loss from plant foliage.

Table 3. Effects of incorporation on control of yellow nutsedge with several thiocarbamate herbicides and atrazine in 1970.

Herbicide	Rate, lb/A ai	Control 1/ 4 wks. after appl. No. of incorp. 0	2	8 wks. after appl. No. of incorp. 0	2
EPTC	3	1.0	9.9	0.0	9.0
	6	2.7	10.0	0.0	9.8
Vernolate	3	1.3	9.9	0.0	8.0
Vernolate + Atrazine	3 + 1	3.3	10.0	0.0	6.5
Pebulate	3	2.3	9.5	0.0	4.2
Pebulate + Atrazine	3 + 1	1.3	9.7	0.0	5.0
Butylate	3	0.0	9.7	0.0	9.6
Butylate + Atrazine	3 + 1	1.7	9.9	0.0	9.7
Molinate	6	4.0	10.0	0.0	6.0
Atrazine	1	0.0	3.3	0.0	4.8
Check		0.0	0.0	0.0	0.0
LSD 0.05		2.5	1.3	N.S.	2.0
0.01		N.S.	1.8	N.S.	2.7

1/ Scale: 0 = no control and 10 = complete control.

Table 4. Effects of atrazine applied preemergence or incorporated followed by subsequent applications of atrazine postemergence to yellow nutsedge in 1968 and 1970.

Atrazine Rate, lb/A		Control 1/		
Soil		1968 2/	1970 2/	
Applied	Postemergence	Inc.	Preem.	Inc.
1	1		0.0	2.0
1	2		0.0	2.3
2	1	9.5	0.0	3.0
2	2	9.7	0.3	1.0
4	1	9.7		
4	2	9.7		
1			0.0	2.3
2		8.7	0.3	0.3
Check	Check	0.0	0.0	2.3
LSD 0.05		0.9	N.S.	N.S.
0.01		1.3	N.S.	N.S.

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

2/ In 1968 soil applications of atrazine were incorporated. In 1970 atrazine was researched both preemergence and incorporated prior to postemergence applications.

Table 5. Effects of incorporation on control of yellow nutsedge with alachlor in 1969.

Alachlor rate, lb/A ai	Control 1/ No. of incorporations			
	0	1	2	3
1 1/2	2.3	6.9	8.9	9.5
3	5.8	8.5	9.7	9.9
4 1/2	5.4	8.9	9.7	9.9
Check	1.0	1.3	3.3	2.1
LSD 0.05	2.5	1.9	2.0	2.0
0.01	3.5	2.7	2.9	3.2

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

Table 6. Effects of incorporation on control of yellow nutsedge with alachlor and atrazine 4 and 8 weeks after applications in 1970.

Herbicide	Rate, lb/A ai	Control 1/ Number of incorporations 0 4 wks	0 8 wks	2 4 wks	2 8 wks
Alachlor	2	2.0	0.0	9.1	1.0
	4	3.7	0.7	9.9	5.0
Atrazine	1	0.0	0.0	2.3	1.3
	2	0.3	0.7	0.3	2.0
Alachlor + Atrazine	2 + 1	2.7	0.7	8.3	1.3
	4 + 1	5.3	1.7	9.7	5.3
Check		0.0	0.0	2.3	0.0
LSD 0.05		3.2	N.S.	3.3	3.5
0.01		N.S.	N.S.	4.7	4.9

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

Table 7. Effects of incorporation on control of yellow nutsedge with R-7465 in 1968 and 1970.

R-7465 Rate, lb/A ai	Control 1/ 1968 No. of incorp. 0	1968 No. of incorp. 1	1970 No. of incorp. 0	1970 No. of incorp. 2
1			2.3	4.5
2			1.0	4.5
4	3.0	8.2		
6	3.5	8.2		
8	4.9	8.9		
Check	0.0	0.0	0.0	0.0
LSD 0.05	3.1	1.9	N.S.	N.S.
0.01	N.S	2.9	N.S.	N.S.

1/ Scale: 0 to 10; 0 = no effect and 10 = complete control.

Time of Application of Alachlor and Atrazine for Weed Control in Corn

William B. Duke and V. S. Rao[1/]

Introduction

The combination of alachlor (2-chloro-2,6-dimethyl-N-methoxymethylacetanilide) and atrazine (2-chloro-4-ethylamino-6-isopropylamino-S-triazine) at 2 lb plus 1 lb rate per acre applied preemergence has proven effective for corn and is widely used by the corn growers of New York State. However, many times due to rainfall after planting, the grower is unable to apply the herbicide combination before the corn emerges. Little information is available regarding postemergence activity of the combination. The studies reported herein were designed to determine the effects of early to late postemergence applications of alachlor and atrazine on corn tolerance and weed susceptibility. The effect of application of liquid nitrogen along with these two herbicides has also been studied to find out whether this practice can be adopted.

Materials and Methods

These studies were conducted in 1970 at the Aurora Research Farm near Aurora, New York on a Honeoye silt loam (O.M.= 3.8%). The experiment was a randomized complete block with four replications. The plot size was 10 x 23 ft.

The experimental field was fall-plowed and planted with Funk G-4110 on May 20 at a rate to give a population of 25,000 plants per acre. A 13-13-13 analysis fertilizer was placed in a 2 x 2 inch band beside the row at planting time to give 300 lb. per acre.

Herbicides applied with the Mater plot sprayer included alachlor alone (2 lb/A), atrazine alone (1 lb/A), alachlor plus atrazine (2 lb + 1 lb/A) and alachlor plus atrazine (2 + 1 lb/A) plus liquid nitrogen in the form of NH_4NO_3 (90 lb/A) as the herbicide carrier. Booster + E was used as a surfactant for all the applications excluding liquid N treatments.

Herbicides were applied at five different times as shown below:

Size of corn and weeds at time of spraying.

Date	Days after Planting	Corn	Broadleaf weeds	Grasses
May 21	1	--	--	--
May 26	6	Spike	Cotyledon	one leaf
May 30	10	1-2"	1/2 - 1 1/2"	1/2 - 1 1/2"
June 5	15	2-3"	1-2"	1-2"
June 10	20	3-4"	2-4"	2-3"

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Weed control ratings were taken on July 21 - two months after planting - and October 5 - two weeks before harvest. Crop injury ratings were taken on July 21. The scale used was 0 to 10 where 0 represents no weed control or crop injury and 10 represents complete reduction of plant stand. Corn yield was measured as bushels of grain at 15% moisture.

Results and Discussion

Barnyardgrass [*Echinochloa crusgalli* (L.) Beauv.], yellow foxtail [*Setaria glauca* (L.) Beauv.], redroot pigweed (*Amaranthus retroflexus* L.), lambsquarters (*Chenopodium album* L.), were the predominant species in the experiment. Witchgrass (*Panicum capillare* L.), ragweed (*Ambrosia artemisiifolia* L.), and ground cherry (*Physalis subglabrata* Mack. and Bush.) were also found but not uniformly.

Control of annual grasses was significantly better in alachlor-atrazine and alachlor-atrazine-liquid nitrogen combination treatments (Table 1). Alachlor was significantly superior to atrazine in annual grass control.

Data on control of pigweed and lambsquarters recorded two months after planting are presented in Table 2. Alachlor was found to be weak on these broadleaf weeds. There is little difference between atrazine alone and the alachlor-atrazine combination treatments. Application after 10 days following planting seemed to be less effective, particularly with the alachlor plus atrazine treatment.

Application of herbicides before 10 days after planting gave significantly better annual grass control than latter applications. There was also a tendency towards reduced acrivity of alachlor either alone or in combination with atrazine when applied later than 10 days after planting.

Weed control ratings taken prior to harvest (Table 3 and 4) reveal that atrazine and alachlor are more active on broadleaf weeds and annual grasses respectively. While the time of application had no significant effect on broadleaf weeds, it does have on annual grasses. Applications later than 10 days caused reduced activity on both species. Though the interaction between herbicide treatments and time of application was not significant, the data suggests a marked reduction in activity in the alachlor plus atrazine combination treatments. This trend was seen with both barnyardgrass and foxtail.

Application of liquid nitrogen along with alachlor and atrazine was less effective than when it was not used. The difference being significant in the case of barnyardgrass.

Alachlor applied either alone or in combination with atrazine later than 10 days after planting was more toxic to corn (Table 5). Alachlor plus atrazine combination treatments were significantly superior with regard to total weed control. There was a marked reduction in activity of both the combination treatments when applied later than 10 days.

Alachlor-atrazine treatments gave maximum grain yield. Application of liquid nitrogen had a negative effect on yield, although it was not significant. Alachlor alone gave significantly lower yield than atrazine alone. This indicates that the broadleaf weeds on which alachlor was ineffective, competed with corn more than annual grasses.

Table 1. Weed control ratings on annual grasses as affected by alachlor and atrazine alone and in combination at different times of application.

Herbicide Treatment	Rate lbs/A	Weed Control Rating Annual grasses 1/ 2/ Time of Application 1	6	10	15	20	Mean
Alachlor + Booster +E	1+1/2 gpa	8.1	6.5	7.1	3.8	3.3	5.8 b
Atrazine + Booster +E	1+1/2 gpa	4.5	5.3	4.8	5.9	3.0	4.7 c
Alachlor + atrazine + Booster +E	2+1 + 1/2 gpa	9.5	8.9	9.5	8.8	7.4	8.8 a
Alachlor + atrazine + Liquid NH_4NO_3	2+1 + 90	9.0	8.1	8.6	7.9	7.8	8.3 a
Check	-	0.0	-	-	-	-	
Mean (excluding check)		7.8a	7.2ab	7.5a	6.6b	5.4c	

1/ Annual grasses include barnyardgrass and yellow foxtail predominantly.

2/ Rating scale used was 0 to 10 where 0 equals no control and 10 represents a complete reduction in plant stand.

Application just after planting and 5 days after planting did not influence grain yield. Applications at 10 days after planting resulted in 5 bu/A yield reduction, which was not statistically significant. Although the interaction was not significant there was a marked difference of 14 bu/A between applications up to 10 days and application later than 10 days. It is also to be noted that application at 15 days after planting resulted in a yield reduction of 15 bu/A when compared to yield resulting from the 10 day application. Application of liquid nitrogen later than 5 days seemed to have reduced the yields markedly.

Summary

Time of application of alachlor alone and atrazine alone and in combination was studied in field corn. The results indicated that application of alachlor (2 lb/A) and atrazine (1 lb/A) before 10 days of planting gave better weed control and grain yield. The later applications resulted in reduced herbicide activity and injured corn thus affecting the grain yield. Application of liquid nitrogen along with this combination was comparable to that without it. The herbicide application period for this treatment was limited up to 5 days after planting, beyond which there is a marked reduction in yield level. Further work in this regard needs to be done. Alachlor was more effective on annual grasses and atrazine on broadleaf weeds. Time of application had no effect on atrazine while it had some on alachlor.

Table 2. Broadleaf weed control ratings 2 months after planting as affected by alachlor and atrazine alone and in combination at different times of application.

Herbicide Treatment	Rate lbs/A	Weed Control Ratings - July 21											
		Redroot pigweed						Lambsquarters					
		Time of application						Time of application					
		1	6	10	15	20	Mean	1	6	10	15	20	Mean
Alachlor + Booster $^{+}$E	2+1/2 gpa	5.2	4.6	3.1	3.6	4.1	4.1	2.1	3.2	0.2	0.8	1.3	1.5
Atrazine + Booster $^{+}$E	1+1/2 gpa	9.0	9.8	9.8	9.6	9.0	9.4	8.6	9.0	9.4	8.4	8.4	8.8
Alachlor + Atrazine + Booster $^{+}$E	2+1 +1/2 gpa	9.8	9.9	9.3	7.9	7.4	8.9	9.9	9.9	9.6	7.8	7.9	9.0
Alachlor + Atrazine + Liquid NH_4NO_3	2+1 + 90	9.8	9.4	10.0	9.5	8.2	9.4	9.4	9.4	9.4	9.5	9.6	9.5
Check	--	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	-
Mean (excluding Check)		8.4	8.4	8.0	7.6	7.2	-	7.5	7.9	7.2	6.6	6.8	-

1/ Rating scale used was 0 to 10 where 0 equals no control and 10 equals a complete reduction in plant stand.

Table 3. Weed control ratings at 2 weeks before harvest on barnyardgrass and yellow foxtail affected by alachlor and atrazine alone and in combination at different times of application.

Herbicide Treatment	Rate lbs/A	Weed Control Ratings - October 5, 1970											
		Barnyardgrass						Yellow foxtail					
		Time of application						Time of application					
		1	6	10	15	20	Mean	1	6	10	15	20	Mean
Alachlor + Booster $^{+}$E	2+1/2 gpa	7.7	6.0	7.0	6.7	7.0	6.9 b	7.7	6.3	7.0	6.7	7.3	7.0 b
Atrazine + Booster $^{+}$E	1+1/2 gpa	3.0	3.7	4.7	4.0	2.7	3.6 c	4.3	4.3	4.7	4.0	3.7	4.2 c
Alachlor + atrazine + Booster $^{+}$E	2+1+1/2 gpa	9.7	9.0	9.3	8.3	6.7	8.6 a	9.0	8.0	8.7	7.0	5.7	7.7 a
Alachlor + atrazine + Liquid NH_4NO_3	2+1+90	7.0	8.3	9.3	6.3	6.7	7.5 b	8.0	7.7	7.3	6.0	6.7	7.1 ab
Check	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean (exclusing check)		6.8ab	6.7b	7.6a	6.3bc	5.8c		7.8a	6.6ab	6.9a	5.9bc	5.8c	

Table 4. Weed control rateings two weeks before harvest on pigweed and lambsquarters as affected by alachlor and atrazine alone and in combination at different times of application.

Herbicide Treatment	Rate lbs/A	Weed Control Ratings - Oct. 5, 1970											
		Redroot pigweed						Lambsquarters					
		Time of application						Time of application					
		1	6	10	15	20	Mean	1	6	10	15	20	Mean
Alachlor + Booster +E	2+1/2 gpa	4.3	4.0	4.0	3.7	5.7	4.3 b	2.3	1.7	1.0	1.0	3.3	1.9 c
Atrazine + Booster +E	1+1/2 gpa	9.7	9.3	9.0	9.7	9.3	9.4 a	9.3	8.3	9.7	9.3	9.0	9.1 b
Alachlor + atrazine + Booster +E	2+1 +1/2 gpa	10.0	10.0	10.0	10.0	10.0	10.0 a	10.0	10.0	10.0	10.0	10.0	10.0 a
Alachlor + atrazine + Liquid NH_4NO_3	2+1 + 90	10.0	10.0	10.0	10.0	10.0	10.0 a	10.0	9.3	9.3	9.0	9.3	9.5 ab
Check	--	0.0	-	-	-	-	-	0.0	-	-	-	-	-
Mean (excluding check)	--	8.5	8.4	8.3	8.4	8.8	-	7.9	7.4	7.5	7.4	7.9	-
'F' test		Not significant						Not significant					

le 5. Corn response, total weed control and grain yield as affected by alachlor and atrazine alone and in combination at different times.

rbicide eatment	Rate lbs/A	Corn response[1/] Time of application 1	6	10	15	20	Mean	Total weed control[2/] Time of application 1	6	10	15	20	Mean	Grain yield bu/A Time of application 1	6	10	15	20	Mean
chlor + ster +E	1 + 1/2 gpa	0.0	0.3	0.8	0.8	0.8	0.5	3.9	4.4	4.1	4.1	5.3	4.6 c	108	112	107	96	95	104c
azine ooster +E	1 + 1/2 gpa	0.1	0.0	0.0	0.1	0.5	0.1	7.1	6.9	7.5	7.4	6.7	7.1 b	115	121	119	123	109	117b
chlor + azine ooster +E	2+1 + 1/2 gpa	0.1	0.0	0.1	1.1	1.8	0.6	9.7	9.4	9.6	9.1	8.4	9.2 a	144	141	139	114	120	132a
chlor trazine ooster +E	2+1 + 90	0.0	0.0	0.1	0.9	0.3	0.3	9.2	8.8	8.9	8.0	8.5	8.7 a	138	131	118	114	118	124ab
ck	-	0.9	-	-	-	-	0.9	0.0	-	-	-	-	-	-	82	-	-	-	-
n cluding heck)		0.1	0.1	0.3	0.7	0.9	-	7.7	7.4	7.5	7.1	7.2	-	126a	126a	121ab	112b	111b	-

FIELD EVALUATION OF CONTROL OF YELLOW NUTSEDGE

O. E. Rud[1/]

Abstract

Two tests were conducted at the Tidewater Research Station to evaluate the effectiveness of herbicide treatments for the control of yellow nutsedge (Cyperus esculentus L.). Test 1, established on June 24, included the following treatments: 2,6-diethyl-N-(methoxymethyl) acetanilide (alachor) emusifiable concentrate formulation (EC) at 2½, 3, and 4 lb/A soil incorporated and surface applied, and granular formulation (10G) 3 lb/A soil incorporated and surface applied; ethyl N,N-dipropylthiocarbamate (EPTC) 3 lb/A soil incorporated; S-propyl dipropyl-thiocarbamate (Vernolate) 2 lb/A soil incorporated; and S-ethyl diisobutylthiocarbamate (butylate) 4 lb/A soil incorporated. Test 2, established on July 1, included: potassium azide, technical, 10, 20, 40 lb/A, potassium azide granular formulation 10, 20, 40 lb ai/A, EPTC 3 lb/A, butylate 3 lb/A applied in volumes of 38 and 5 gpa (LV), vernolate 3 lb/A applied in 38 gpa and 5 gpa (LV), N-(beta-0,0-diisopropyl= dithiophosphenylethyl) benzene (bensulide) 6 lb/A, 2-chloro-4-ethylamino-6-isopropylamino-s-triazine (atrazine) 4 lb/A, 2-chloro-N-isopropyl= acetanilide (propachlor) 4 lb/A, alachlor 3 lb/A, and a combination of butylate 3 lb + EPTC 1 lb/A. All treatments in test 2 and soil-incorporated treatments in test 1 were incorporated immediately after application with a tractor mounted P.T.O. rotary tiller (McClenney).

Nutsedge control was not equal in the two tests. EPTC and vernolate resulted in 100 percent elimination of nutsedge in test 2 at the time evaluations were made 21 days after treatment, while vernolate was relatively ineffective and EPTC was only moderately effective in test 1. Soil water relations and air temperatures could have contributed to the differences in efficacy of these treatments.

In test 1 only the butylate and EPTC treatments were effective on nutsedge. In test 2 EPTC, butylate (both regular volume and low volume application), vernolate at regular volume application and the combination of butylate and EPTC had checked nutsedge plant initiation at the time evaluations were made 21 days after treatment. Vernolate (applied in low volume) and atrazine were highly effective and alachlor was moderately effective. The other treatments were ineffective. Observations will be made on the nutsedge response during the next year as influenced by treatments applied in 1970.

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A COMPARISON OF THE ACTIVITY OF NITRALIN, TRIFLURALIN AND ER-5461 ON TRANSPLANTED TOMATO AND EGGPLANT

D. A. Braden and J. C. Cialone[1]

Abstract. The comparison of the activity of three substituted dinitroaniline herbicides, 4-(methylsulfonyl)-2,6-dinitro-N,-N-dipropylaniline (nitralin), alpha, alpha, alpha,-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin), and ER-5461, was made on transplanted tomato (Lycopersicon esculentum Mill.) and eggplant (Solanum Melongena L.) when applied preplant incorporated at rates of 0, 0.5, 1.0, 2.0, and 4.0 lbs/A into a sandy loam soil. Weed control was evaluated, tomato and eggplant vigor and root development was visually rated at different times by different observers, and fresh weights of plants were determined. The higher dosages (2.0 and 4.0 lbs/A) of trifluralin and nitralin caused greater reductions in vigor, root growth, and fresh weights of tomato and eggplant, than did the same rates of ER-5461. The tolerance of tomato to the lower rates (0.5 and 1.0 lbs/A) of herbicide was in the order ER-5461 > nitralin > trifluralin. The tolerance of eggplant to these herbicides was greater than tomato but this could have been due to the presence of peat on the roots of eggplant at transplanting.

Introduction

The phytotoxicity of the selective substituted dinitroaniline herbicides is demonstrated by the inhibition of the growth and development of roots and shoots (6). Talbert (7) found that in nutrient solution, alpha, alpha, alpha,-trifluoro-2,6-dinitro-N, N-dipropyl-p-toluidine (trifluralin) inhibited cell division in meristimatic regions of intact soybean (Glycine max. (L.) Merr.) roots. Gentner and Burk (4) found that preemergence applications of 4-(methylsulfonyl)-2,6-dinitro-N, N-dipropylaniline (nitralin) affected root growth of corn (Zea mays L.). Studies by Anderson et al. (1) showed that trifluralin stunted growth of cotton (Gossypium hirsutum L.) and prevented lateral root growth without affecting the growth of the tap root. Feeny (2) applied trifluralin to oats (Avena sativa L.), a susceptible species, and found a reduction of root length, root dry weight and coleoptile length.

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Tomato (Lycopersicon esculentum Mill.) is intermediate in tolerance to trifluralin and nitralin, and commercial use of these compounds is limited to transplants. Feulner (3) subjected tomato and pepper (Capsicum annuum L.) transplants to trifluralin under various temperature conditions. Weights of roots and shoots and fruit yield were depressed when high rates of the herbicide were used regardless of temperature.

The objective of the study reported here was to evaluate the activity of trifluralin, nitralin, and ER-5461 on broadleaf and grass weed species and on tomato and eggplant (Solanum Melongena L.) vigor, root growth, and fresh weight.

Materials and Methods

This experiment was conducted at the Soils and Crops Department Research Center at Adelphia, New Jersey on a Freehold sandy loam soil containing one percent organic matter. The land was spring plowed and disced just prior to herbicide application. Herbicides were applied pre-plant with a CO_2-powered, portable sprayer and were incorporated with a Ferguson Tilrovator[R] which was set at a depth of two and one-half inches. Beds were formed in the incorporation operation. Individual plots were 6 x 20 feet and the experimental design was a randomized complete block with four replicates.

ER-5461, nitralin, and trifluralin were applied to the soil surface at rates of 0, 0.5, 1.0, 2.0 and 4.0 lbs/A on June 19, 1970 and immediately incorporated. The volume of spray mixture used was equivalent to 45.5 gallons per acre. Immediately following herbicide application and incorporation, ten, five-week-old, field grown, tomato plants, variety Heinz 1409, were transplanted into each plot. Ten, eight-week-old eggplants, variety Harris Special, grown in a peat mix in the greenhouse were transplanted into each plot. Pepper (Capsicum annuum L.) plants were also transplanted into each plot but pepper responses will not be reported here. Immediately following transplanting one-half acre inch of water was applied to the experimental area by overhead irrigation.

Visual ratings were made on July 1, 1970 to evaluate weed control and vigor of tomato and eggplant. The rating system used was based on a scale of one to nine where one equals no weed control or no reduction of vigor and nine equals perfect weed control or death of the crop.

On July 3, five tomato plants and five eggplants were carefully dug from each plot in replicates I and II. On July 17, this procedure was repeated for plants in replicates III and IV. Soil was rinsed from the

plant roots and visual observations were made on roots and tops and whole plant fresh weights were determined. The rating system used to evaluate root development was based on a scale of one to nine; one being equal to no reduction in root development and nine equal to severe root reduction.

Tomato and eggplant vigor was evaluated on July 10, 1970. These ratings are expressed as percent of the untreated plants.

All data were subjected to analysis of variance and Duncan's new multiple-range test of mean comparison was used to compare differences between treatment means.

Results

Weed Control

Excellent control of grasses, fall panicum (*Panicum dichotomiflorum* Michx.) and large crabgrass (*Digitaria sanguinalis* (L.) Scop.), and broadleaves common lambsquarters (*Chenopodium album* L.) and redroot pigweed (*Amaranthus retroflexus* L.), was obtained at all rates of herbicide application (table 1).

Table 1. Weed control by three substituted dinitroaniline herbicides in transplanted tomato and eggplant, evaluated on July 1, 1970 at Adelphia, New Jersey[a].

	Grasses					Broadleaves				
lbs/A	0	0.5	1.0	2.0	4.0	0	0.5	1.0	2.0	4.0
ER-5461		9a[b]	9a	9a	9a		9a[b]	9a	9a	9a
nitralin		9a	9a	8.3a	9a		9a	8.3a	9a	9a
trifluralin		9a	9a	9a	9a		9a	9a	9a	9a
control	3.5b	(5.8 weeded)				3.3b	(5.3 weeded)			

[a] Ratings are means of four replicates.

[b] Means within each species followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

Tomato

Ratings taken on July 1, indicate that tomato vigor was significantly reduced by the higher dosages (2.0 and 4.0 lbs/A) of all herbicides (table 2). Data in figure 1 indicate that at both the 1.0 and 2.0 lbs/A dosages trifluralin caused more injury to tomato than did nitralin. Tomato vigor ratings (table 3) on replicates I and II made on July 3, by a second observer indicate the same trends as noted above. Ratings made two weeks later on July 17, show no significant differences in tomato vigor between herbicide treatments and untreated controls in replicates III and IV.

Table 2. The effect of three pre-plant incorporated, substituted dinitroaniline herbicides on the vigor of tomato transplants on July 1, 1970[a].

lbs/A	0	0.5	1.0	2.0	4.0
ER-5461		1.8 e[b]	3.5 bcde	4.0 abcd	5.5 ab
nitralin		2.5 de	3.5 bcde	3.3 cde	6.0 a
trifluralin		2.8 de	5.0 abc	5.3 abc	6.3 a
control	2.1 e				

[a] Means of four replicates.

[b] Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

Table 3. The effect of three preplant incorporated, substituted dinitroaniline herbicides on the vigor of tomato transplants on July 13, 1970[a].

lbs/A	0	0.5	1.0	2.0	4.0
ER-5461		1.5 f[b]	1.0 e	4.5 bcd	6.0 ab
nitralin		2.5 de	2.0 ef	4.5 bcd	5.0 abc
trifluralin		2.0 ef	3.5 cde	7.0 a	6.0 ab
control	1.6 ef				

[a] Means of replicates I and II.

[b] Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

Root development ratings made on July 3, for plants dug in replicates I and II indicate a significant reduction in fibrous roots on plants treated with 1.0, 2.0 and 4.0 lbs/A of trifluralin and nitralin (table 5). ER-5461, however, showed significant root inhibition only at the 2.0 and 4.0 lbs/A levels. Data taken two weeks later on July 17, show significant root reduction from trifluralin and ER-5461 at the same dosages as indicated above. Nitralin, however, showed significant injury only at the 4.0 lbs/A dosage at this time (table 5).

Fresh weight data (table 4) from replicates I and II indicate significant reduction in tomato treated with 1.0, 2.0 or 4.0 lbs/A of nitralin and trifluralin and 1.0 or 2.0 lbs/A of ER-5461. Two weeks later on July 17 no significant fresh weight reductions were noted with any chemical treatment. The lack of significant differences in tomato fresh weights and foliar vigor ratings at the later date could indicate that fresh weight is determined primarily by foliar growth, since root reduction is significant for some herbicide treatments.

Table 4. Total fresh weight, in pounds, of five tomato transplants on July 3, 1970 two weeks after the preplant incorporation of three substituted dinitroaniline herbicides[a].

lbs/A	0	0.5	1.0	2.0	4.0
ER-5461		0.18 abcd[b]	0.11 def	0.16 bcde	0.05 f
nitralin		0.19 abc	0.15 bcde	0.09 ef	0.09 ef
trifluralin		0.17 de	0.11 def	0.10 def	0.06 f
control	0.24 a				

[a]Means of replicates I and II.

[b]Means followed by a common letter do not differ significantly at the 5% level using Duncan's multiple range test.

Eggplant

Vigor ratings made on July 3, for replicates I and II indicate significant injury from 2.0 or 4.0 lbs/A rates of trifluralin and nitralin and from the 4.0 lbs/A rate of ER-5461; this was also evident in vigor ratings made on July 10, (Fig. 1). Vigor ratings made on July 17, were not significantly different.

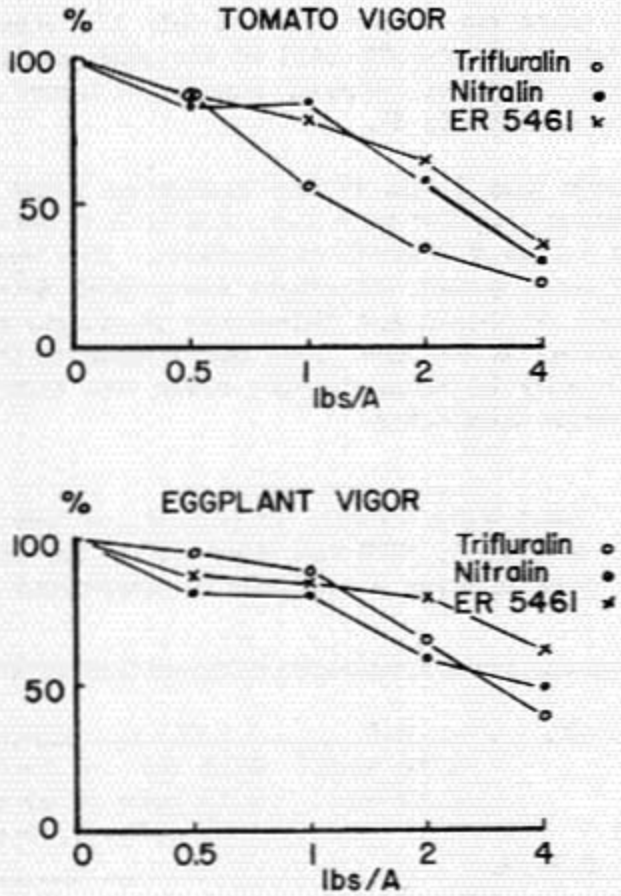

Figure 1. Tomato and eggplant transplant vigor response to three substituted dinitroaniline herbicides on July 10, 1970[a].

[a]Vigor rating, the mean of four replicates, is expressed as percent of untreated controls.

Table 5. Root development ratings of tomato and eggplant transplants taken on two dates after the preplant incorporated application of three substituted dinitroaniline herbicides.

	Tomato									
	July 3, 1970[a]					July 17, 1970[b]				
lbs/A	0	0.5	1.0	2.0	4.0	0	0.5	1.0	2.0	4.0
ER-5461		3.0 cde[c]	3.0 cde	5.0 bc	8.0 a		1.5 d[c]	3.0 bcd	6.0 ab	5.5 abc
nitralin		3.5 bcd	4.5 bcd	8.0 a	8.5 a		2.5 cd	3.0 bcd	3.0 bcd	7.5 a
trifluralin		1.5 de	5.0 bc	6.5 ab	8.5 a		2.5 cd	5.5 abc	8.0 a	8.0 a
control	1.4 e					1.7 d				

	Eggplant									
	July 3, 1970[a]					July 17, 1970[b]				
lbs/A	0	0.5	1.0	2.0	4.0	0	0.5	1.0	2.0	4.0
ER-5461		3.5 cde[c]	3.0 cde	4.0 abc	5.0 abc		2.0 cd[c]	3.0 abcd	3.0 abcd	2.0 cd
nitralin		2.6 cde	3.5 cde	7.5 a	4.5 bcd		2.0 cd	5.5 a	2.5 bcd	5.0 ab
trifluralin		3.0 cde	3.5 cde	5.0 abc	6.5 ab		2.5 bcd	1.5 d	3.0 abcd	4.5 abc
control	1.4 e					1.6 d				

[a] Means of replicates I and II.

[b] Means of replicates III and IV.

[c] Means within each rating date for each crop, followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

Root development ratings (table 5) made on July 3, for replicates I and II indicate that the 2.0 or 4.0 lbs/A rates of all herbicides inhibited root growth. On July 17, only the 4.0 lbs/A rate of trifluralin and nitralin exhibited root inhibition.

Fresh weights of eggplant harvested on July 3, from replicates I and II show no significant reductions due to chemical treatment. Fresh weights of eggplants in replicates III and IV on July 17 were significantly reduced in all treatments except by the 0.5 lb/A rate of ER-5461 and trifluralin and the 2.0 lbs/A rate of nitralin (table 6).

Table 6. The effect of three substituted dinitroaniline herbicides on total fresh weight, in pounds, of five eggplant transplants on July 17, 1970[a].

lbs/A	0	0.5	1.0	2.0	4.0
ER-5461		1.54 a[b]	0.83 abcde	0.60 bcde	0.61 bcde
nitralin		1.01 abcde	0.63 bcde	1.35 abc	0.24 e
trifluralin		1.13 abcd	0.49 cde	0.23 e	0.31 e
control	1.20 abc				

[a] Means of replicates III and IV.

[b] Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

Discussion

Tomato vigor reduction was greater from trifluralin than from treatments of ER-5461 and nitralin, and injury from all herbicides was less obvious with time. Initial tomato root reduction was more evident with nitralin and trifluralin treatments than with treatments of ER-5461 and root reduction by trifluralin treatments was still evident after two weeks. Greater reduction in fresh weights of younger tomato plants resulted from treatments with trifluralin than from nitralin and ER-5461, and the effect of herbicides on fresh weight diminished with time.

Initially, the tolerance of eggplant was greater to all herbicides. Greater vigor reduction, root reduction, and fresh weight reduction resulted from nitralin and trifluralin than from ER-5461, and nitralin caused greater reductions with eggplants than did trifluralin. Tolerance to these herbici-

des was found to be greater with eggplant than with tomato; this unexpected result could have been due to the presence of peat on eggplant roots at transplanting.

Acknowledgement

We wish to thank Dr. R. J. Marrese for his aid and advice.

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OBSERVATIONS ON TWO SPECIES OF GALINSOGA R. & P. TRANSPLANTED FROM THE GLASSHOUSE TO THE FIELD

D. A. Braden, J. C. Cialone, and Ruth M. Fritsch[1/]

Abstract.

One week-old seedlings of Galinsoga ciliata (Raf.) Blake and Galinsoga parviflora Cav. were transferred from artificial germination media to a peat mix and placed in the glasshouse on May 20, 1970. One week later ten plants of each species were removed from the glasshouse and transplanted into the field at the Soils and Crops Research Center at Adelphia, New Jersey.

Observations on the growth habit of the two species were made and recorded photographically, and seed was harvested on three dates. The length and widths of mature achenes were measured and a length versus width ratio was calculated. The L/W ratio for G. parviflora was greater than that for G. ciliata. This was due to the fact that G. parviflora was longer and G. ciliata had greater width.

Germination of the harvested seeds provided seedlings for counting marginal cotyledonary hairs. Cotyledons of G. parviflora possessed an average of 58 marginal hairs while those for G. ciliata had only 2.7.

Plants in the field were allowed to mature and observations were made on the emergence of seedlings under field conditions. In early October, G. parviflora seedlings were present in greater numbers than those of G. ciliata.

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HERBICIDE COMBINATIONS AND CARRIERS FOR NO-TILLAGE CORN

C. T. Dickerson, Jr. and H. E. Mengel 1/

Abstract

In three experiments with no-tillage corn (*Zea mays* L.) conducted on a sod, 1,1'-dimethyl-4,4'-bipyridinium dichloride (paraquat) was required for initial control of orchardgrass (*Dactylis glomerata* L.). Several mixtures of 2'-chloro-2,6-diethyl-N-methoxymethylacetanilide (alachlor), 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine (atrazine), 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron) and (2,4-dichlorophenoxy) acetic acid (2,4-D) did not give sufficient control of orchardgrass. Non-phytotoxic oil was an unacceptable substitute for the non-ionic surfactant which is normally used with paraquat; in other treatments, oil did not enhance the activity of residual herbicides enough to eliminate the use of paraquat. When liquid nitrogen was used as a carrier in place of water, herbicidal activity was increased approximately 20 percent. In large strip tests with established herbicide mixtures, six perennial broadleaf species were found resistant. In these same tests, a mixture of alachlor, atrazine and paraquat produced the best control of fall panicum (*Panicum dichotomiflorum* Michx.) and large crabgrass (*Digitaria sanguinalis* (L.) Scop.).

Introduction

The utility of no-tillage corn production is now well established in the Northeastern United States (2,5). A grower may wish to utilize no-tillage production because, (a) less time is required, since none of the standard tillage operations are employed; or (b) planting may be accomplished on soils that are not suited for conventional tillage, either because they are too shallow or have steep slopes that may be prone to erosion; or (c) seeding may be done when the soil is too wet to allow planting on a conventional seed bed. Several workers have outlined effective herbicide programs for weed control in no-tillage corn production (1,3,4).

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The objective of the experiments reported below was to evaluate in both small and large plots several herbicide combinations, adjuvants, and carriers for compatibility, herbicidal activity, and crop selectivity in no-tillage corn.

Materials and Methods

Three small plot experiments were initiated in 1970 near Westminster, Maryland on a sod classified as a Manor slate loam with approximately 4 percent organic matter. All three experiments were randomized complete block designs with two replicates; each plot was two rows wide and 30 feet long. Treatments were applied in a final volume of 50 gpa using a carbon dioxide powered small plot sprayer. The predominant weed species in the ten year old sod was orchardgrass with an approximate height of 12 inches. Agway 724 corn was planted on May 28, herbicide treatments were applied June 2, initial observations of orchardgrass control were made June 19, with final evaluations made October 30.

A fourth experiment consisted of one-half acre plots which were four rows wide by 530 yards long arranged in a randomized complete block with two replicates. Treatments were applied with a large plot sprayer using 37 gal of 30 percent liquid nitrogen and sufficient water to make the final spray volume 50 gpa. Applications were made on May 8, 1970 to a Manor slate loam which had bare soil, 3-foot tall barley, (*Hordeum vulgare* L.) 1969 corn stubble, 4-foot rye, (*Secale cereale* L.) and 3-foot timothy (*Phleum pratense* L.) at intervals along the length of each plot, four days after treatment DeKalb X-85 corn was planted. Initial observations of control or desiccation to the weed and cover crop species were made on June 1, twenty-four days after treatment. On September 29, after the silage corn was removed, ratings of fall panicum and large crabgrass control and final observations were obtained.

Results and Discussion

The first small plot experiment was designed specifically to evaluate the herbicidal activity of all combinations of alachlor at 2.0 lb/A, atrazine 1.5 lb/A, 2,4-D isooctyl ester 1.0 lb/A, linuron 0.75 lb/A and paraquat 0.5 lb/A

Table 1. Comparison of alachlor, atrazine, 2,4-D, linuron and paraquat combinations for orchardgrass control in no-tillage corn

Treatment*	Orchardgrass Control** June 19	Orchardgrass Control** October 30	Corn**
AL+AT+P	7.0a	6.0ab	6.0ab
AL+P	6.0ab	5.0abcd	5.5abc
AT+L+P	6.0ab	5.5abc	5.5abc
D+L+P	6.0ab	3.5 bcdef	3.5 bcdef
AT+P	5.5ab	6.5a	7.5a
AL+D+P	5.5ab	3.0 cdefg	5.5abc
AL+L+P	5.5ab	4.5abcde	4.0 bcde
AT+D+P	5.5ab	5.0abcd	7.0a
AL+AT+D+P	5.5ab	7.5a	7.5a
AL+AT+L+P	5.5ab	6.5a	7.0a
AL+AT+D+L+P	5.5ab	6.5a	6.0ab
D+P	5.0ab	3.0 cdefg	3.0 bcdefg
P	4.5 b	4.5abcde	5.0abcd
L+P	4.5 b	4.5abcde	3.5 bcdef
AL+D+L+P	4.5 b	5.0abcd	6.0ab
AT+D+L+P	4.0 bc	6.0ab	7.0a
AT+D+L	2.0 cd	3.0 cdefg	3.5 bcdef
AL+L	1.5 d	0.0 h	1.5 efg
AT+D	1.5 d	1.0 fgh	2.0 defg
D+L	1.5 d	2.5 defgh	4.0 bcde
AL+AT+D	1.5 d	3.5 bcdef	4.0 bcde
AL+AT+L	1.5 d	3.5 bcdef	4.0 bcde
AT	1.0 d	1.5 fgh	2.0 defg
L	1.0 d	0.5 gh	1.5 efg
AL+AT	1.0 d	3.0 cdefg	4.0 bcde
AL+D	1.0 d	1.5 fgh	2.5 cdefg
AT+L	1.0 d	2.0 efgh	2.0 defg
AL+AT+D+L	1.0 d	3.0 cdefg	4.0 bcde
AL+D+L	0.5 d	0.0 h	0.5 fg
Control	0.2 d	0.5 gh	0.3 fg
AL	0.0 d	0.5 gh	1.5 efg
D	0.0 d	1.0 fgh	2.0 defg

* Rate of each herbicide was identical in specified treatments, rates in lb/A were ALachlor 2.0, ATrazine 1.5, 2,4-D isooctyl-ester 1.0, Linuron 0.75 and Paraquat 0.5 plus Ortho X-77 surfactant at 4 oz/50 gal of water which was also final spray volume per acre. ** Rating of 10 equals complete weed control or perfect crop, 0 equals no weed control or crop. Means having the same letter in common are not significantly different at the 0.05 level.

plus non-ionic surfactant (i) at 4 oz/A. With these relatively low rates, none of the herbicide treatments (Table 1) gave acceptable early or final control of the ten year orchardgrass sod. In the initial evaluation, treatments containing paraquat produced significantly better control than other combinations which did not contain it.

At the end of the season three conclusions could be made from this test. Combinations of the four materials without paraquat were not effective for initial control. The best treatments were those which produced good initial control of orchardgrass and contained soil active herbicides, alone or in combination, to maintain the initial activity. Corn vigor was closely related to control of the orchardgrass sod at the end of the season, with better sod control resulting in better corn vigor.

The second experiment was initiated with three objectives; (a) to study the effect of substituting 30 percent liquid nitrogen fertilizer for water as the carrier; (b) to evaluate the utility of a non-phytotoxic crop oil (ii) as a substitute for the non-ionic surfactant used with paraquat, and (c) to observe the effect of a soil active herbicide or combinations of these plus oil without paraquat.

Several treatments produced acceptable early and full season control of orchardgrass. Early control was significantly better when alachlor and/or atrazine were mixed with paraquat (Table 2). This trend was also observable at the end of the season.

In addition to better control of orchardgrass with higher rates of herbicide, a 20 percent increase in activity was noted when liquid nitrogen was used in place of water as the herbicide carrier. In contrast, an increase in the rate of paraquat from 0.5 to 1.0 lb/A improved control by approximately ten percent. Increased activity of treatments using liquid nitrogen as a carrier will be of value to growers who prefer to apply nitrogen fertilizer in liquid form for no-tillage corn. One application can be used for both the fertilizer and herbicide with increased herbicide activity as a result.

(i) Non-ionic surfactant was formulated as Ortho X-77 spreader; available from Chevron Chem. Co., Cherry Hill, N.J.

(ii) Non-phytotoxic crop oil formulated as Agway Booster Plus E Oil, available from Agway, Inc., Syracuse, N.Y.

Table 2. Comparison of water versus liquid nitrogen carriers and surfactant versus oil adjuvants with various rates of alachlor, atrazine, and paraquat for orchardgrass control in no-tillage corn.

	Orchardgrass Control**		Corn**
Treatment and lb/A*	June 19	October 30	
AL4.0+AT3.0+P1.0+S+N	10.0a	9.5a	9.0ab
AL4.0+P1.0+S+N	10.0a	8.0abc	9.5a
AL2.0+AT1.5+P0.5+S+N	9.5a	9.5a	9.0ab
AL4.0+AT3.0+P1.0+S	8.5ab	8.0abc	8.0abcd
AT3.0+P1.0+S	8.0ab	8.5ab	8.5abc
AT1.5+P0.5+S+N	8.0ab	8.0abc	7.0abcdef
AL1.5+AT2.0+P0.5+0	8.0ab	8.0abc	8.0abcd
AL2.0+AT1.5+P0.5+S	7.0 bc	6.0 cdef	6.0 cdefg
AT2.0+P0.5+S	7.0 bc	8.5ab	8.0abcd
AT1.5+P0.5+S	5.5 cd	6.5 bcde	7.5abcde
P1.0+S	5.5 cd	7.0abcd	8.0abcd
AL2.0+AT1.5+0+N	5.0 de	2.5 gh	4.5 fgh
P0.5+S	4.5 de	4.5 ef	2.0 i
AT3.0+P0.5+0	4.5 de	6.5 bcde	7.5abcde
AT2.0+P0.5+0	4.5 de	5.0 def	6.5 bcdef
AT3.0+0	4.0 de	5.0 def	5.5 defg
AL2.0+AT1.5+P0.5+S+0	4.0 de	6.0 cdef	6.5 bcdef
AL4.0+0+N	2.0 f	4.0 efg	5.0 efg
AT3.0	1.5 fg	5.5 def	5.5 defg
AT1.5	1.0 fg	1.5 h	2.0 i
N	1.0 fg	2.0 h	3.0 hi
AL4.0	0.5 fg	0.5 h	1.0 i
0	0.5 fg	1.0 h	1.5 i
Control	0.3 fg	0.5 h	0.3 i
AL2.0	0.0 g	0.5 h	1.5 i

* Herbicide and rate in lb/A vary above as noted: ALachlor 1.5-4.0, ATrazine 1.5-3.0, Paraquat 0.5-1.0. Ortho X-77 surfactant (S) and/or Agway Booster plus E Oil (O) were added at 4 oz or 3 qt to the final spray volume of 50 gal/A. The 30% liquid nitrogen carrier (N) in some treatments was mixed with the herbicide and adjuvants to make the final spray volume 50 gpa.

** Rating of 10 equals complete weed control or perfect crop, 8 equals acceptable weed control and crop, 0 equals no weed control or crop. Means having the same letter in common are not significantly different at the 0.05 level as determined by Duncan's Multiple Range Test.

The substitution of oil for either the surfactant or paraquat plus surfactant significantly reduced both initial and final control of orchardgrass. Comparisons of atrazine at 3 lb/A alone, with oil, or with paraquat at 1 lb/A plus surfactant demonstrated that addition of oil in proved but acceptable control was obtained only with the use of paraquat plus surfactant. When oil was used as a substitute for the surfactant in combination with 2.0 lb/A atrazine plus 0.5 lb/A paraquat significantly poorer control of orchardgrass was observed.

The third small plot experiment was established to evaluate compatability and herbicidal activity of the eighty percent wettable powder and four pound per gallon flowable formulations of atrazine, when they were mixed with paraquat alone or alachlor and paraquat. In addition to the atrazine formulation evaluations, further comparisons were made with non-phytotoxic crop oil and surfactant.

Early control of orchardgrass tended to be better with the wettable powder than the flowable formulation of atrazine. At the end of the season, however, the opposite was observed. It was therefore concluded that the two formulations produced similar herbicidal activity and were equally compatible with the paraquat alone and alachlor plus paraquat.

As observed in experiment two, significantly poorer orchardgrass control was observed when oil was used as a substitute for surfactant in 2 lb/A atrazine wettable powder plus 0.5 lb/A paraquat mixtures. In contrast, no differences were observed with the flowable formulation of atrazine plus paraquat. It would therefore appear that the flowable formulation of atrazine has ingredients that may substitute for the surfactant normally used with paraquat.

The final experiment was initiated on one-half acre plots to simulate application methods and herbicide combinations that could be used by growers. In addition to the normal records of herbicidal activity, frequent observations were made during application to evaluate compatability of all of the herbicides in the liquid nitrogen-water carrier.

Twenty-three days after treatment, no differences in the herbicide treatments could be attributed to alachlor, atrazine, or linuron. Since no differences were observed between soil active herbicides, Table 4 lists the relative susceptibility of several species to 0.5 lb/A of paraquat

Table 3. Comparison of two formulations of atrazine and two adjuvants in various combinations of alachlor and paraquat for orchardgrass control in no-tillage corn.

Treatment and lb/A*	Orchardgrass Control** June 19	Orchardgrass Control** October 30	Corn**
ATW3.0+P1.0+S	8.0a	8.5a	8.5a
ATW3.0+P0.5	7.5ab	6.0 bc	5.5 bcde
ATW2.0+P0.5+S	7.0abc	8.5a	8.0ab
AL1.5+ATW2.0+P0.5+S	6.0abcd	4.5 c	5.0 cde
AL2.0+ATW1.25+P0.5+S	6.0abcd	4.5 c	4.5 de
AL1.5+ATF1.25+P0.5+S	6.0abcd	4.0 c	5.0 cde
ATF3.0+P0.5+S	5.5 bcd	7.0ab	7.5abc
ATF2.0+P0.5	5.5 bcd	7.0ab	7.5abc
ATF2.0+P0.5+0	5.0 cd	7.0ab	7.5abc
AL1.5+ATF2.0+P0.5+S	5.0 cd	7.5ab	7.0abc
P0.5+S	4.5 d	4.5 c	5.0 cde
ATW2.0+P0.5+0	4.5 d	5.0 bc	6.5abcd
ATF2.0+P0.5+S	4.5 d	6.5abc	6.5abcd
AL2.0+ATF1.25+P0.5+S	4.5 d	7.0ab	8.5a
ATW3.0	1.5 e	5.5 bc	5.5 bcde
0	0.5 e	1.0 d	1.5 fg
Control	0.3 e	0.5 d	0.2 g
AL2.0	0.0 e	0.5 d	1.5 fg

* Herbicide and rate in lb/A vary above as noted: ALachlor 1.5-2.0, ATrazine 80% Wettable powder or 4 lb/gal Flowable 1.25-3.0, Paraquat 0.5-1.0. Ortho X-77 Surfactant (S) or Agway Booster Plus E Oil (O) were added to certain treatments at 4 oz or 3 qt to the final spray volume of 50 gpa.

** Rating of 10 equals complete weed control or perfect crop, 8 equals acceptable weed control and crop, 0 equals no weed control or crop. Means having the same letter in common are not significantly different at the 0.05 level as determined by Duncan's Multiple Range Test.

plus surfactant. All annual and many of the perennial species which were present in the experimental area were controlled by paraquat. Six perennial species were not controlled, however. Although the perennials which were not controlled occupied a small area, the infestation could become a serious economic problem if no-tillage corn were continued and control measures were not used. Similar problems were observed in several near-by areas; we believe that resistant perennials will undoubtedly become one of the serious weed problems in a monoculture of no-tillage corn.

Of the three cover crops used in this test, rye was the most easily controlled, timothy intermediate, and barley the most difficult to control. Observations indicate that 0.25 lb/A of paraquat plus surfactant in a liquid nitrogen-water carrier will give excellent control of a rye cover crop while 0.5 lb/A in combination with the other materials will be required for barley.

During the first eight weeks after the corn was planted no difference in crop growth could be observed. At the end of the season, however, crop growth was better and silage easier to harvest where weed competition was the least. The only treatment which produced acceptable control of both fall panicum and large crabgrass contained alachlor at 2.0 lb/A, atrazine 1.6 lb/A, paraquat at 0.5 lb/A plus surfactant, or at two times those rates (Table 5). The treatment containing alachlor, linuron, and paraquat produced significantly poorer control of redroot pigweed (Amaranthus retroflexus L.) than those treatments containing atrazine alone or in combination with alachlor. With the exception of the two annual grasses and redroot pigweed discussed above, all herbicidal treatments produced full season control of the species that were initially controlled by paraquat (Table 4).

Table 4. Relative susceptibility of weed and cover crop species 24 days after treatment with paraquat plus surfactant at 0.5 lb plus 4 oz/A.

CONTROL		INTERMED. CONTROL
perennial spp.	seedling annuals	perennial spp.
blackseed plantain	barnyardgrass	Canada thistle
buckhorn plantain	com. lambsquarter	
European woodsurrel	common ragweed	NO CONTROL
oxeye daisy	giant foxtail	perennial spp.
yellow nutsedge	green foxtail	common milkweed
	large crabgrass	common pokeweed
biennial spp.	Penna. smartweed	curly dock
white cockle	yellow foxtail	clam. groundcherry
		hedge bindweed
cover crops		horsenettle
barley		
rye		
timothy		

Table 5. Annual grass control with herbicicide combinations in no-tillage corn using liquid nitrogen plus water as a carrier.

		Control 9/29/70**	
Treatment	Rate/A*	Fall Panicum	Large Crab.
Alachlor + Atrazine + Paraquat + Surf.	4.0+2.4+ 1.0+8	9.0a	9.0a
Alachlor + Atrazine + Paraquat + Surf.	2.0+1.6+ 0.5+4	8.0ab	8.0ab
Alachlor + Atrazine + Paraquat + Surf.	2.0+1.2+ 0.5+4	7.5 cd	7.5ab
Alachlor + Linuron Paraquat + Surf.	2.0+1.0+ 0.5+4	7.5 cd	6.5 b
Atrazine + Paraquat + Surf.	2.0+ 0.5+4	6.5 cd	6.5 b
Atrazine + Paraquat + Surf.	2.4+ 0.5+4	6.0 d	7.0 b
Control	--	2.0 e	2.0 c

* Ortho X-77 Surfactant rates expressed in ounces/50 gal of carrier, all other rates in lb/A.

** Rating of 10 equals complete weed control, 8 equals acceptable weed control and 0 equals no weed control. Means having the same letter in common are not significantly different at the 0.05 level.

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FALL PANICUM CONTROL IN NO-TILLAGE CORN[1/]

J. V. Parochetti[2/]

ABSTRACT

No-tillage corn (*Zea mays* L.) was planted in a site heavily infested with fall panicum (*Panicum dichotomiflorum* Michx.). Excellent fall panicum control resulted from applications of 2-chloro-4,6-bis(ethylamino)-*s*-triazine (simazine) alone or in combinations with 2-chloro-4-(ethylamino-6-(isopropylamino)-*s*-triazine (atrazine).

The following herbicides provided over 80% control at the end of the season: atrazine, atrazine + 2'-chloro-2,6-diethyl-*N*-=methoxymethylacetanilide (alachlor) and 2-(4-chloro-6-ethylamino-*s*-triazin-2-ylamino)-2-methylpropionitrile (SD 15418). Atrazine applied to bare ground resulted in poor fall panicum control.

1/ Scientific Article No. A 1661, and Contribution No. 4402 of the Maryland Agricultural Experiment Station, Department of Agronomy, College Park.

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INTRODUCTION

There are a number of herbicides which are used for weed control in conventional tillage of corn (Zea mays L.). Only the combination 1,1'-dimethyl-4,4'-bipyridinium (paraquat) plus 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine (atrazine) is registered as a tank-mix for use in no-tillage corn. However, there are other residual herbicides which might perform satisfactorily in no-tillage corn as previously reported (1, 2). The objective of this experiment was to evaluate 10 herbicides or combinations in a 2 year study.

MATERIALS AND METHODS

Corn was established in 1969 and 1970 on a Chillum silt loam site heavily infested with fall panicum (Panicum dichotomiflorum Michx.). Conventional and no-tillage seeding methods were used with a cover crop of rye (Secale cereale L.). A randomized complete block design with four replications was used. Treatments are listed in Table 1. In treatment 1 the rye was plowed under. Treatment 2 was plowed and treated with atrazine, 2 lb/A. In treatment 3 the rye was mechanically removed and corn planted in the stubble, and in treatments 4 through 13, the rye was killed with ½ lb/A paraquat plus 0.05% of wetting agent. Weed control was rated on a scale of 0 to 100 with 100 equalling 100% weed destruction. Oil, when used, was Sun oil IIE at 1 gal/A. Plots were 10 x 30 feet with a row width of 2.5 feet. Spray volume was 30 gpa.

1969. Pioneer 3304 corn was planted May 26. Paraquat was applied May 20. Residual herbicides were applied May 26.

1970. Pioneer 3306 corn was planted May 11. Paraquat was applied May 5. Residual herbicides were applied May 11.

RESULTS AND DISCUSSION

Excellent fall panicum control resulted from applications of 2-chloro-4,6-bis(ethylamino)-s-triazine (simazine) alone or in combinations with atrazine (Table 1). In both years, simazine alone or in combinations with atrazine resulted in 95% or better fall panicum control. Most other herbicides, except 3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea (chlorbromuron), 2-chloro-N-isopropylacetanilide (propachlor) and atrazine plus oil effected fair to excellent fall panicum control. Rye, which was seeded for the cover crop in the fall of 1969, was not effected by any of the chemicals applied at planting time.

Early control of fall panicum was good to excellent for many combinations on June 10, 1970, but this control decreased as the season progressed (Table 1). For excellent season-long fall panicum control, simazine or combinations with

simazine appear superior. Where residues may be a problem, the following herbicides provided good season-long control: 2-(4-chloro-6-ethylamino-s-triazin-2-ylamino-2-methylpropionitrile (SD 15418), atrazine and atrazine plus 2-chloro-2,6-diethyl-N-=(methoxymethyl)acetanilide (alachlor).

In 1969, crabgrass (Digitaria sanguinalis L.) was present and poor crabgrass control was noted with propachlor, chlorbromuron, atrazine on bare ground and alachlor plus atrazine. Redroot pigweed (Amaranthus retroflexus L.) was a problem weed in 1970 and was controlled by all chemicals except propachlor.

It was interesting to note that atrazine resulted in over 80% fall panicum control under the no-tillage rye mulch. Where the land had been conventionally tilled and treated with atrazine, fall panicum control was poor being about 50% at the end of the season. When the rye was removed from the field and the stubble sprayed with paraquat and atrazine, fall panicum control was intermediate between conventional tillage and no-tillage practices. Observations on farmers' fields using a corn stubble as a cover clearly indicates that atrazine does not provide adequate fall panicum control. A vigorous rye cover crop and a dense mulch probably shades the ground preventing favorable conditions for early fall panicum germination. This situation might account for the differential response of fall panicum control under no-tillage mulch and conventional production. Other mulch covers may, indeed, act differently than the rye mulch cover reported here.

ACKNOWLEDGEMENTS

The author wishes to express his acknowledgement for the computer time for this project which was made available through the facilities of the Computer Science Center of the University of Maryland.

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Table 1. Fall panicum control in no-tillage corn; a two year study conducted at the Plant Research Farm.

	Treatment[1/]	Rate lb/A	Paraquat ½ lb/A	% Fall Panicum Control[2/] 9/10/69	6/10/70	9/24/70	2 year average September
1.	Plow and disk	-	-	0a[3/]	10	0a	0
2.	Atrazine (plowed)	2	-	45b	78	50b	47
3.	Atrazine (cover removed)	2	+	80bcd	90	60bc	70
4.	Atrazine	2	+	81bcd	93	80cd	80
5.	Atrazine + prometryne	1 + 1	+	86d	98	70bcd	78
6.	Alachlor + atrazine	1.5 + 1	+	85cd	95	75cd	80
7.	Linuron	1	+	75bcd	95	73bcd	74
8.	Simazine	2	+	96d	100	100f	97
9.	Atrazine + simazine	1 1	+	95d	100	98ef	96
10.	Atrazine + propachlor	1 3	+	78b	83	10a	44
11.	Propachlor	5	+	48bc	33	0a	24
12.	SD 15418	2	+	85d	100	88de	87
13.	Chlorbromuron	1.5	+	63bcd	93	68bcd	65

1/ Treatments 4 through 13 planted in a rye mulch.

2/ Weed control was rated on a scale of 0 to 100 with 100 equalling 100% weed control or crop destruction.

3/ Values followed by the same letter are not statistically different at the 5% level of probability using Duncan's Multiple Range Test.

ESTABLISHING CROWNVETCH (CORONILLA VARIA L.) FOR SEED PRODUCTION (1970)[1/]

D. L. Linscott and R. D. Hagin[2/]

In 1969 we demonstrated the potential for establishing Crownvetch (Coronilla varia L.) for seed production by the use of row seeding techniques and herbicides for weed control. The herbicides S-ethyl dipropythiocarbamate (EPTC) or N-butyl-N-ethyl-a,a,a,-trifluoro-2,6-dinitro-p-toluidine (benefin) applied preemergence followed by a postemergence application of 2-sec-butyl-4,6-dinitrophenol (dinoseb) resulted in excellent early season weed control and subsequent establishment of Crownvetch. When EPTC or benefin was applied to the entire plot area and, in addition, either 2-chloro-4,6-bis(ethylamino)-s-triazine (simazine) or 5-bromo-3-sec-butyl-6-methyluracil (bromacil) was applied between the seeded rows at planting, excellent season-long weed control resulted. In this paper, we report results of 3 field experiments conducted in 1970 involving weed control in seedling Crownvetch.

Methods and Materials

Study I: EPTC at 3 lb/A or benefin at 1 1/2 lb/A in 30 gpa of water was applied to a dry Honeoye silt loam at the Agronomy farm, Aurora, New York on May 1, 1970. The herbicides were incorporated by 2 tandem diskings, the second at right angles to the first. The plot size was 7 by 24 feet. On May 5, 1970 two rows of Chemung Crownvetch were seeded in bands 28 inches apart 2.5 lb/A with a drill equipped with a band seeder, band fertilizer attachments and packing wheels. At drilling, simazine or bromacil both at 1 or 2 lb/A in 30 gpa water was applied in a 20 inch band between the seeded rows. For the simazine and bromacil treatments a boom was attached behind the drill and adjusted so that the herbicide spray came no closer than 4 inches to the seeded Crownvetch row. Fertilizer (6-24-24) was drilled in bands at the time of seeding at the rate of 250 lb/A. Study II and III: These two experiments were located in the same field as Study I and the seeding methods and rates, fertilization and preplanting herbicide dilutions and incorporation means were the same as for Study I. In Study II, benefin was applied at 0, 1, or 2 lb/A on April 30, 1970. In Study III EPTC was applied at 0, 2, and 4 lb/A. On June 2, dinoseb was applied at 0, 1/4, and 1/2 lb/A to previously treated plots to give all combinations of EPTC or benefin alone or with dinoseb.

For all these studies visual determinations of damage and counts of weeds

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1/ Contribution from the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture in cooperation with the New York State Agricultural Experiment Station at Cornell University.

2/ Research Agronomist and Biological Technician, Agricultural Research Service, U. S. Department of Agriculture and the Department of Agronomy, Cornell University, Ithaca, New York.

and Crownvetch were made in mid-June. The stand of Crownvetch was also determined in October. In each case, vegetation counts were made from two 1-meter lengths of row (7 by 39 in.) selected at random within the seeded row. In Study I, two similar counts were made between the seeded rows. The experimental design was a randomized complete block with 5 replications. Two plots per entry per replication were used in Study I whereas Studies II and III had one plot.

The Crownvetch seed was treated to partially remove growth inhibitors by rinsing the seed twice for one minute in a 10 percent sodium carbonate solution and once for two-minutes with clear water. The seed was dried rapidly after spreading it on a plastic sheet and exposing it to wind and sun. Inoculation was accomplished by standard methods.

All plots were trimmed just above the developing Crownvetch seedlings with a rotary mower once a month June through September. Foliage was removed to within 3 inches of the soil in late September.

Annual weeds typical of the region infested the plots. Primary species were wild mustard [Brassica kaber (D.C.) L. C. Wheeler], (var. pinnatifidia Stokes.), lambsquarter (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), annual foxtails (Setaria sp.) and annual Panicum sp. Numerous other annuals were present but in limited quantities. Perennials such as quackgrass (Agropyron repens L.) and yellow nutsedge (Cyperous esculentus L.) were present but not to a significant extent.

Results

Study I

Weed control resulting from the application of EPTC or benefin and followed by between-row applications of simazine or bromacil was outstanding during the entire season. Damage to Crownvetch from chemical action was minimal except in those plots receiving 2 lb/A of bromacil and even these equaled or exceeded control plots in plant numbers in October (Table 1). The most satisfactory plots from the standpoint of weed control and Crownvetch stand were those which received either EPTC or benefin and simazine or the 1 lb/A rate of bromacil (Table 1). Plants from these plots were considerably more vigorous than control plants and were at least 1.6 times more numerous. Crownvetch stem numbers increased between June and October in most plots. These increases probably were due to development from rhizomes and not from late germinating seeds. By early September, Crownvetch had covered plots with the better weed control and in some cases flowering was initiated.

Early in the season some control of weeds within the seeded row was obtained from between-row applications of simazine or bromacil alone. This effect probably was caused by uptake of the herbicide from lateral roots of weeds growing close to the surface and to limited surface movements of chemical into the seeded row. The condition was temporary and weeds developed in the row late in the season sufficiently to compete with Crownvetch. In these cases season-long weed control was maintained between the rows.

This study demonstrated that simazine and bromacil could be placed as close as 4 inches to the seeded row with minimal damaging effect to Crownvetch. Careful adjustment of the spray apparatus was necessary to keep herbicide spray out of the seeded row. For commercial practice, we suggest that the simazine or bromacil band be no closer than 6 to 8 inches to the seeded row. Drilling with the slope will be helpful in preventing surface movement of the herbicide into the row.

Study II and III

Little damage to Crownvetch was noted from benefin applications alone or when followed by dinoseb (Table 2). However, early in the season, Crownvetch was stunted considerably when dinoseb followed EPTC (Table 3). The stunted plants recovered for the most part. By seasons end, the most satisfactory plots in both Studies II and III were those which received treatments with benefin or EPTC followed by dinoseb postemergence. Dinoseb alone was unsatisfactory for broadleaf weed control. Similarly, benefin or EPTC alone were unsatisfactory for late season broadleaf weed control although considerable benefits were realized early. Both preemergence chemicals controlled annual grasses satisfactorily for the season.

Summary

In summary, Crownvetch was established successfully by row culture using herbicides for control of competing weeds. The most outstanding treatments were EPTC at 3 lb/A or benefin at 1.5 lb/A, each incorporated prior to planting, followed by simazine at 1 or 2 lb/A or bromacil at 1 lb/A applied at planting between the rows. EPTC at 2 or 4 lb/A or benefin at 1 or 2 lb/A applied preplanting and followed by dinoseb at 1/4 or 1/2 lb/A postemergence, resulted in highly satisfactory stands of Crownvetch. For two consecutive years, as the result of the above described methods, weed control and subsequent Crownvetch establishment has been excellent.

able 1. Effect of EPTC or benefin applied to the entire plot prior to planting (incorporated) and simazine or bromacil applied at planting between seeded rows of Crownvetch on early damage and subsequent stand of Crownvetch and weeds.c/

Treatment, lb/A				Weeds								Crownvetch		
				Damage a/ June 10				Plants b/ June 16				Damage a/	Plants b/	
verall		Between Rows		In row		Between row		In row		Between row		June 10	June 16	October 19
				Br	Gr	Br	Gr	Br	Gr	Br	Gr		no.	no.
ontrol				0	0	0	0	32 a	13 a	33 a	9 a	0	26 ef	28 d
		Simazine	1	17	19	94	94	25 ab	10 ab	>1 d	<1	4	33 de	32 d
		"	2	27	20	95	96	15 cd	8 b	<1 d	<1	6	38 bcd	41 bc
		Bromacil	1	16	7	95	99	26 ab	8 b	<1 d	<1	6	33 d	31 d
		"	2	12	1	99	99	18 bc	8 b	<1 d	<1	7	25 f	28 d
PTC	3		0	73	99	79	98	5 de	<1 c	6 c	<1	0	46 a	39 c
"	3	Simazine	1	98	99	99	99	2 e	<1 c	<1 d	<1	3	43 ab	50 a
"	3	"	2	99	99	99	99	2 e	<1 c	<1 d	<1	11	42 abc	49 a
"	3	Bromacil	1	96	99	99	99	7 de	<1 c	<1 d	<1	11	38 bcd	46 ab
	3	"	2	93	99	99	99	3 e	<1 c	<1 d	<1	22	33 d	38 c
enefin	1.5		0	52	99	51	96	13 cd	<1 c	14 b	<1	0	38 bcd	41 bc
"	1.5	Simazine	1	46	93	97	96	14 cd	>1 c	<1 d	<1	2	42 abc	47 ab
"	1.5	"	2	46	99	95	99	13 cd	<1 c	<1 d	<1	10	43 ab	48 a
"	1.5	Bromacil	1	36	98	93	98	16 cd	<1 c	<1 d	<1	2	35 cd	53 a
"	1.5	"	2	79	99	99	99	9 cde	<1 c	1 d	<1	25	32 def	38 c

/ Scale 0-99 in increasing order of damage to plants based on visual estimates. Br = broadleaved weeds, Gr = weed grasses.

/ Plant numbers are based on counts from 2-meter lengths of row (7" x 39"). Rows seeded 28 inches apart.

/ Duncan's Multiple Range Test for significance at 0.05 level was used. Entries with no letter or identical letters are not significantly different. Visual rating data was not analyzed statistically.

Table 2. Effect of preplanting (incorporated) applications of benefin followed by postemergence treatments with dinoseb on early damage and subsequent stand of weeds and Crownvetch. c/

Treatment, lb/A				Weeds				Crownvetch		
PPI		Post E		Damage a/ June 18		Plants b/ June 17		Damage a/ June 18	Plants b/ June 18	Plants b/ October 19
				Br	Gr	Br	Gr		no.	no.
Control				0	0	29 a	6 c	0	19 d	17 e
Benefin	1	Dinoseb	0	42	98	28 ab	2 d	0	28 bcd	26 bcd
"	2	"	0	60	94	19 bc	4 c	0	27 bcd	28 ab
"	0	"	1/4	36	0	31 a	15 a	0	26 cd	20 cde
"	1	"	1/4	78	92	10 c	<1 d	0	35 abc	34 ab
"	2	"	1/4	84	99	12 c	<1 d	4	37 ab	36 a
"	0	"	1/2	44	0	27 ab	10 ab	0	27 bcd	19 de
"	1	"	1/2	78	92	10 c	<1 d	0	46 a	35 ab
"	2	"	1/2	86	99	10 c	<1 d	6	38 ab	35 ab
Cultivation				54	54	19 bc	5 c	0	18 d	16 e

a/, b/, and c/ - See Table 1.

Table 3. Effect of preplanting (incorporated) applications of EPTC followed by postemergence treatments with dinoseb on early damage and subsequent stand of weeds and Crownvetch. c/

Treatment, lb/A				Weeds				Crownvetch		
PPI		Post E		Damage a/ June 18		Plants b/ June 17		Damage a/ June 18	Plants b/ June 18	Plants b/ October 19
				Br	Gr	Br	Gr		no.	no.
Control				0	0	59a	11 b	0	20 c	20 c
EPTC	2	DNBP	0	70	99	35 bc	<1 c	4	31 ab	25 cde
"	4	"	0	82	96	23 cd	2 c	4	35 ab	27 bcd
"	0	"	1/4	44	0	43 b	19 a	4	21 c	21 ef
"	2	"	1/4	90	96	16 de	4 bc	28	32 ab	29 abc
"	4	"	1/4	99	99	13 de	1 c	44	36 a	32 a
"	0	"	1/2	68	0	36 bc	22 a	8	27 bc	24 def
"	2	"	1/2	98	96	10 de	2 c	52	32 ab	26 bcd
"	4	"	1/2	96	99	6 e	9 c	52	36 a	30 ab

a/, b/, and c/ - See Table 1.

EVALUATION OF HERBICIDES ON SOYBEANS, 1970

O. E. Rud[1/]

Abstract

Field experiments were conducted at two locations (subsequently referred to as 1 and 2) to evaluate the response of soybeans and annual weeds to the following herbicides: 2,6-diethyl-N-(methoxymethyl) acetanilide (alachlor), 2,chloro-N-isopropylacetanilide (propachlor) dimethyl 2,3,5,6-tetrachloroterephthalate (DCPA), 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron), 2-(4-bromo-3-chlorophenyl)-1-methoxy-1-methoxy-1-methylurea (C6313), 4-amino-6-t-butyl-3-(methylthio)-as-triazin-5 (4H)-one (BAY 94337), 2-(4-chloro-6 ethylamino-s-triazine-2-ylamino)-2-methylproionitrile (SD 15418), 3-amino-2,5-dichlorobenzoic acid (chloramben), [3 p-(p-chlorophenoxy) phenyl] - 1, 1-dimethyl urea (chloroxuron). N,N-dimethyl-2,2-diphenylacetamide (diphenamid), 4,6-dinitro-o-sec-butylphenol (dinoseb), N-(beta-0,0-diisopropyldithiophosphenylethyl) benzine sulfonamide (bensulide), ER-5461, EL 119, R 7465 (structures not released), N-1-naphthylphthalamic acid (naptalam), 4-2 (2-methylsulfonyl)-2,6-dinitro-N, N-dipropylaniline (nitralin), a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin), S-propyl dipropylthiocarbamate (vernolate 6E and 7E formulations), and including several combinations of these herbicides.

Low seed viability and unfavorable field conditions at location 2 resulted in stand failure. Herbicide applications had been made as scheduled, assuming normal crop establishment. Soybeans were replanted 22 days after the preemergence treatments had been applied. A planter designed for minimum tillage planting was used. An additional variable was thereby introduced - that of time between herbicide treatment and planting. Observations as to what effect this concept had on crop tolerance with certain compounds were made, as compared to that observed on conventionally planted soybeans.

Primary weeds at both locations included crabgrass (*Digitaria sanguinalis* (L.) scop.), pigweed (*Amaranthus retroflexus* L.) annual morningglory (*Ipomea purpurea* L. Roth). In addition at location 1, fall panicum (*Panicum dichotomiflorum* Michx.) carpetweed (*Mollugo verticillata* L.) and at location 2, cocklebur (*xanthium spinosum* L.) goosegrass (*Elusive indica* L. Gaertn.) ragweed (*Ambrosia artemisiifolia* L.) and cutleaf primrose *Oenothera biennis* L. were present. Soils were similar in surface testure but that at location 1 was somewhat higher in organic matter.

Efficacy differences between treatments were greater at location 2 than at location 1 due primarily to the more favorable moisture relationships following herbicide applications. Chloramben, naptalam, linuron, chloropropham + naptalam, C6313 at lower rates, ER 5461 alone and with linuron, as preemergence treatments exhibited a low degree of efficacy at both locations on annual grasses. BAY 94337 and SD 15418 were very effective on broadleaf weeds, but the period of time between application of herbicide and the replanting of soybeans at location 2 did not entirely reduce the phytotoxicity observed with these two materials. Chloroxuron was effective on broadleaf weeds.

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Effect of RH 315 on Quackgrass and Alfalfa
II. Soil Residual Activity in Relation to Quackgrass Regrowth Potential[1/]

William B. Duke and Julian F. Hunt[2/]

Introduction

The herbicide N-(1,1-dimethylpropynyl)-3,5-dichlorobenzamide (RH 315) has proven to be effective for control of quackgrass [Agropyron repens (L) Beauv.] in established alfalfa (Medicago sativa L.) (1). Applications of this herbicide to established alfalfa have resulted in almost complete removal of quackgrass from the first forage harvest after treatment (1). Duke (1) has reported significant re-infestation of the perennial grass by time of second forage harvest while others have observed continued grass control throughout the season.[3/] It has been postulated that quackgrass re-infestation of RH 315-treated areas is because of a loss of RH 315 activity in the soil before all of the quackgrass rhizome buds have broken late spring dormancy. When buds on the rhizome become active after the dormant period the levels of RH 315 present in the soil would be insufficient to control them (1). Reduction of herbicidal activity of RH 315 in the soil has been shown to occur with increasing soil temperatures (3). The studies reported herein were designed to: 1) gather more information on the effects of RH 315 on alfalfa and quackgrass yield; 2) to determine levels of the chemical remaining in the soil for periods after treatment; and 3) to determine the effects of RH 315 on quackgrass rhizome production and regenerative potential.

Materials and Methods

Field Studies

During 1969 and 1970, studies were conducted at the Leonard Farm (private farm near Sidney, New York) on Tioga silt loam (OM = 1.9%). The experiment was a randomized complete block with four replications and was analyzed as a complete factorial. Plots 6 x 24 ft. were established in a two year old Saranac alfalfa sta predominately infested with quackgrass. All herbicide applications were made with a Mater plot sprayer calibrated to deliver 30 gpa using air as the pressure source.

Applications of RH 315 at 0, 3/4, 1 1/2 and 3 lb/A were made to the establish alfalfa in November, 1969 and April, 1970. Treatments in November were made soon after the melting of a heavy snow fall. At that time, the alfalfa was semi-dormant and quackgrass was green and 4 to 8 in. tall. Treatments in April were applied pri to visible initiation of spring growth of alfalfa, however, quackgrass sprouts were visible.

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3/ Unger, V. H. 1970. Personal Communication.

Total forage yields were taken at three different cutting times during the growing season. At each time, a swath 3.25 x 21 feet was taken through the center of each plot for yield determinations. Botanical composition was determined from hand separations of a random subsample composited from five locations within each plot. Samples were separated, weighed and oven-dried. All yield data are expresses as lb/A on an oven-dry basis (75°C to a constant weight).

Soil Residue and Quackgrass Regrowth Studies

Soil samples were taken June 6 and 23, July 7 and 21, August 20 and October 27, 1970, from plots treated with 0, 1 1/2 and 3 lb/A RH 315 in November, 1969 and April, 1970. Soil was removed with a soil-corer designed to give 1/2 sq. ft. of surface area/sample to a depth of 6 in. Two random samples were taken from each plot for each replicate. Samples were composited and transported to Ithaca, New York for further study.

Soil samples were sieved to remove all quackgrass rhizomes. Rhizome material was washed in running tap water to remove adhering soil particles. The underground organs were then transplanted into flats containing untreated Honeoye silt loam soil. Four to five weeks after planting, numbers of plants emerging were recorded. Plants were cut at the soil surface for green weight determinations.

The soil from which rhizomes were removed was used to bioassay for RH 315 residual activity. At each sampling date, untreated soil from the control (0 lb/A) area was used for the bioassay standard curve. Three-in. pots replicated four times were sprayed with each of the following levels of RH 315: 0, 0.1, 0.2, 0.4, 0.8 and 1.6 lbs/A. At the same time the standards were being prepared, soil from the plots treated with RH 315 were placed in 3-in. pots. Fifteen annual ryegrass (*Lolium multiflorum* Lam.) seeds were planted 1/4 inch deep in all soils. Pots were placed in the greenhouse and were watered initially from the surface and then by subirrigation every day. Four weeks after planting, numbers of ryegrass plants emerged were noted. Plants were clipped and fresh weights recorded.

Results and Discussion

Field Studies

All levels of RH 315 gave outstanding quackgrass control at the time of first forage harvest (CT I) as evidenced by significant reductions in quackgrass dry matter (Table 1). The most significant perennial grass yield reduction occurred from 3 lb/A of the herbicide applied in the fall or spring. While quackgrass yield data showed no significant differences with regard to time of RH 315 applications, it was obvious that fall treatments were more effective. Removal of quackgrass from the forage caused a significant increase in alfalfa dry matter at CT I. Highest yields were obtained following treatments of 1 1/2 and 3 lb/A RH 315. As observed with quackgrass data, no significant differences in alfalfa yield were noted as a result of varying times of application.

In the second forage harvest (CT II), quackgrass levels were significantly reduced only by 3 lb/A RH 315. Even though the amounts of quackgrass were reduced by 1 1/2 lb/A, the reductions were not significant. No significant differences in timing of application could be detected. In relation to the control, relative percentages of quackgrass in all treatments at CT II were higher than in CT I. This would indicate that quackgrass re-infestation of plots was beginning to occur. This phenomenon was reported in 1970 by Duke (1). Alfalfa yields were slightly higher in RH 315 treated areas but were not significant.

Table 1. Dry matter yield of alfalfa and quackgrass in first, second, and third cuttings as affected by RH 315 applied in the fall and spring to establish alfalfa, Sidney, New York, 1969-1970.

Time of Application	RH 315 Rate lb/A	Alfalfa Yield 1/ 2/ Dry Matter, lb/A				Quackgrass Yield 1/ Dry Matter, lb/A			
		CT I 3/	CT II	CT III	Total	CT I	CT II	CT III	T
November 1969	0	2212	1560	340	4113	2377	1125	663	4
	3/4	3017	2003	294	5314	1335	1093	691	3
	1 1/2	4210	1963	686	6859	172	775	355	1
	3	3707	2239	662	6608	54	436	397	
April, 1970	0	2307	1966	452	4725	3045	1126	664	4
	3/4	3096	1779	450	5325	1207	960	630	2
	1 1/2	2932	2410	577	5919	751	465	472	1
	3	3272	2358	404	6034	297	424	703	1
RH 315 Mean	0	2260 b	1763	396 b		2711 a	1125 a	663 a	
	3/4	3056 ab	1891	372 b		1271 b	1026 ab	660 a	
	1 1/2	3571 a	2186	631 a		461 bc	620 ab	413 b	
	3	3489 a	2298	533 ab		175 c	430 b	550 ab	

1/ Yield values were obtained from botanical separations of five random subsample from each plot.

2/ Treatment means followed by identical letters are not significant at the 0.05 level.

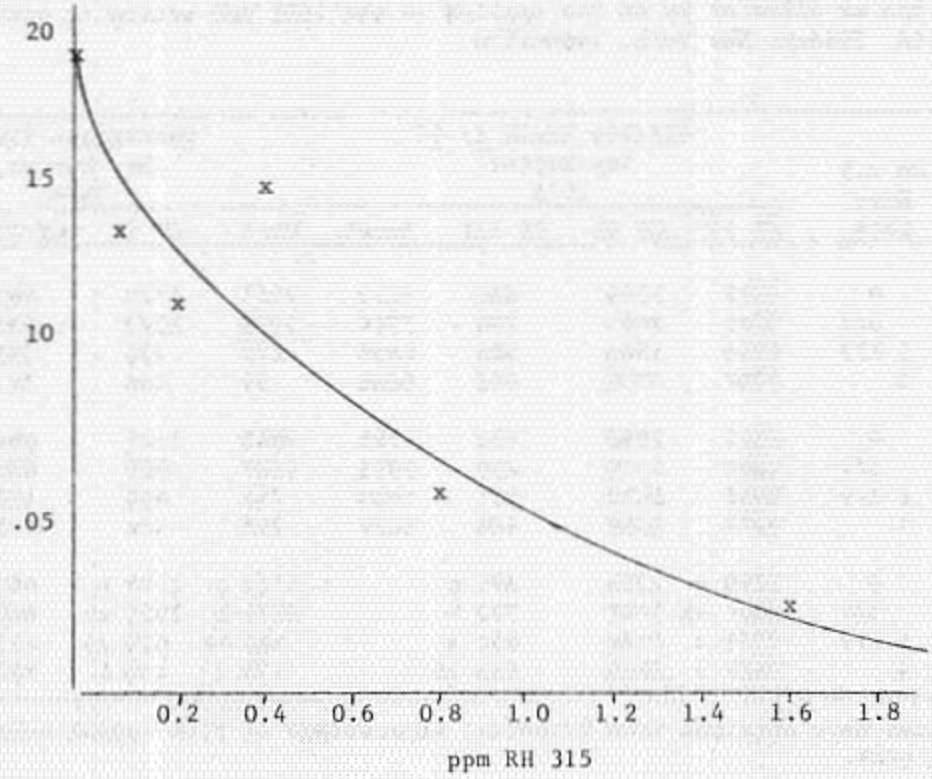
3/ CT I, CT II, and CT III refer to forage harvests taken on June 8, July 22 and October 27, 1970, respectively.

No significant differences in quackgrass yields were observed at third forage harvest (CT III). It appeared, however, that the 1 1/2 lb/A and 3 lb/A RH 315 rates applied in November, 1969 were still having some effect, although slight. Quackgras re-infestation of all rates applied in April was obvious. For both times of application, the amount of re-infestation by the perennial grass was sufficient to lead one to postulate complete takeover by April, 1971. It appeared that retreatment of F plots would be required to remove the encroaching quackgrass.

Residue and Quackgrass Regrowth Studies

Soil residual activity of RH 315 as measured by annual ryegrass bioassay (Figure 1) decreases rapidly in the late spring and early summer regardless of time of application (Table 2). The observed activity decline agrees with the recent pape by Yih et. al. (3) who have reported that in the soil, RH 315 transforms by cyclizat and hydrolysis to two metabolites which are much less active than the parent compoun The transformation to the metabolites occurred more rapidly as soil temperatures increased. From their data, it can be assumed that RH 315 applied in the fall would not undergo transformation until the soil began to warm up. Since from the time the fall treatments were applied to the time the April treatments were sprayed, the soil

Figure 1. Annual Ryegrass Bioassay.[1/]



1) Figures represent average of all bioassays conducted for each sampling date.

temperature only decreased, it would seem that in April, only slight, if any, differences in lb/A should exist between November and April treatments. Both spring and fall levels should undergo transformations as the temperatures increase in the spring. This is indeed what is shown in Table 2. Since in the early spring all plots receiving RH 315 have approximately equal amounts of herbicide and since the chemical dissipates from the soil in the late spring at the same rate regardless of time of application, any observed differences in degree of quackgrass control would indicate that the herbicide has its primary effect on the perennial grass in the time period between applications.

Rhizome samples taken at the same dates of soil bioassays revealed that throughout 1970 total rhizome weight was significantly reduced by November, 1969, applications of RH 315 (Table 3). Applications of 1 1/2 lb/A in November, 1969 significantly reduced weight of rhizome through July 7, 1970 while 3 lb/A significantly affected production all year. Applications of the herbicide in April slightly reduced rhizome weights at each sampling, although the reductions were not significant except for the final date, October, 1970. The apparent increased effectiveness of November applications would appear to be due to an effect which occurs between late fall and the time it takes the April treatments to penetrate the soil and quackgrass plants, particularly since the levels of chemical residue remaining in the soil in late spring are similar as shown in Table 2.

Table 2. Soil residual activity of RH 315 as measured by annual ryegrass bioassay.

Time of Application	RH 315 Rate/A	PPM Remaining (1970)1/				
		June 9	June 23	July 7	July 21	August 20
November 1969	1 1/2	0.00	0.00	0.00	0.00	0.00
	3	0.10	0.00	0.00	0.00	0.00
April, 1970	1 1/2	0.04	0.00	0.00	0.00	0.00
	3	0.14	0.00	0.00	0.00	0.00
Control	0	0.10	0.00	0.00	0.00	0.00

1/ Based on bioassay curve developed for each sampling date.

Rhizomes taken from soil treated with RH 315 and transplanted to untreat soil are not as productive as those from untreated soil (Table 4). At all sampling dates in 1970, a significant decrease was noted in total number of plants emerging from rhizomes treated in November, 1969. A reduction in plant production was also noted for rhizomes treated in April, 1970 although the observed decreases were not as great. By October, 1970 total plants emerging from rhizomes treated in April were not significant from the control. Since rhizome weight was significantly reduced (Table 3), it was expected that total plant numbers would be reduced accordingly. Hence, plant numbers emerging were expressed on a unit basis (Table 4, bottom). On this basis, plant numbers were also significantly reduced by RH 315 treatments (Table 4, bottom). By early June, applications of RH 315 in both November and April reduced numbers of plants/gram of rhizome (bud activity) but November treatments were more effective. This trend was constant through July after which time only the November applications caused a significant reduction in numbers of plants/gram of rhizome. The rhizomes treated in November are apparently not quite as capable of producing plants as those treated in April. The total number of plants produced is much less because the number of rhizomes is reduced (Table 3), and possibly because of the regrowth ability of these rhizomes.

Total green weight produced from transplanted rhizomes followed the same trend as numbers of plants produced (Table 5). Green weight of plants per gram of rhizome was significantly reduced through early July. In August, plant weight production in treated plots was significantly reduced only by the 3 lb/A rate applied in November, 1969. It would appear obvious that if the numbers of plants produced per rhizome is reduced (Table 4) then green weight produced per rhizome would also be reduced. It is important, however, to note that on a unit basis, the plants which are emerging are not significantly different. This would mean that even though RH 315 can reduce the number of plants produced, it does not affect vigor of emerged plants in the absence of chemical. These emerging plants then could re-infest treated areas if levels of RH 315 were decreasing rapidly or diminished completely.

The bioassay and rhizome data taken from soil samples from plots treated with RH 315 may help explain why quackgrass re-infests treated plots and also why late fall treatments are more effective in the prevention of this occurrance. Re-infestation occurs because the herbicide breaks down before it can inhibit activity of all buds on the quackgrass rhizomes. That it is capable of preventing bud

Table 3. Quackgrass rhizome green weight at various sampling dates in 1970 as affected by RH 315 applied in the fall or spring, Sidney, New York, 1969-1970.

Time of Application	RH 315 Rate/A	Sampling Dates (1970) June 9	June 23	July 7	July 21	Aug. 20	Oct. 27
		Rhizome Wt. (gms)/sq. ft.[1/] [2/]					
November, 1969	1 1/2	6.4 ab	6.9 a	3.1 a	6.9 ab	7.1 ab	4.9 a
	3	5.8 a	1.7 a	6.6 ab	2.9 a	3.2 a	3.9 a
Totals		12.2	8.6	9.7	9.8	10.3	9.8
April, 1970	1 1/2	7.4 b	11.2 b	8.3 bc	8.9 b	12.0 ab	13.4 b
	3	13.0 c	10.4 b	10.6 bc	9.9 b	10.1 ab	5.6 a
Totals		20.4	21.6	18.9	18.8	22.1	19.0
Control	0	9.3 bc	11.9 b	11.4 c	12.5 b	18.1 b	15.7 b

1/ Rhizome weight is a composite sample from two soil cores taken at random at each sampling date.

2/ Treatment means in each column followed by identical letters are not significant at the 0.05 level.

activity is obvious from data in Table 4. Re-infestation in areas treated in the fall is less than from areas treated in the spring because of the effects of the chemical on rhizome production between late fall and early to mid-spring. Late fall treatments apparantly prevent new rhizome production during this late fall and winter period which obviously means plots which received treatments in April had proportionally more rhizomes. During the late spring prior to dissipation of the chemical, all new rhizome production would be prevented by both times of application. Hence, the plots treated in April would have fewer rhizomes than the control and plots treated in November would have fewer than those of April. This reduced rhizome and bud activity caused significant quackgrass plant production and, hence, yield in June. However, with chemical dissipation, the quackgrass began to regrow and produce new rhizomes thereby giving re-infestation. After the loss in herbicide activity, regrowth was less in areas treated in November because: 1) total number of rhizomes present was much less; and 2) because of those rhizomes present, most had been produced prior to November or December, 1969 and according to Johnson and Buchholtz (2) they would have less bud activity than rhizomes present into April, 1970. It is important to note, however, that those plants which were produced from rhizomes taken from plots treated in November were as vigorous as untreated plants and would therefore be capable of causing the degree of re-infestation seen by the third forage harvest.

If the above theory is accepted, it provides a workable explanation for re-infestation of land by quackgrass following treatment with RH 315. More important, however, is the fact that there is a reduction in rhizome activity in late summer the year following fall treatment which leads to speculation that retreatment with identical or lower rates may completely remove this perennial pest.

Table 4. Number of quackgrass plants which emerged from RH 315-treated rhizomes following transfer of rhizomes to untreated soil at various times following herbicide applications, Sidney, New York, 1969-1970.

Time of Application	Rate lb/A	Sampling Dates (1970) June 9	June 23	July 7	July 21	Aug. 20	Oct. 27 1/ 2/
		Total No. of Plants Emerged/Rhizome Sample					
November, 1969	1 1/2	11 b	9 bc	2 c	11 bc	5 c	6 b
	3	3 c	3 c	3 c	0 c	1 c	4 c
April, 1970	1 1/2	13 b	17 b	16 b	17 b	24 b	16 a
	3	13 b	11 b	17 b	12 b	14 bc	11 ab
Control	0	24 a	24 a	39 a	42 a	54 a	24 a
		No. of Plants Emerged/Gram Rhizome Planted					
November, 1969	1 1/2	8.8 c	1.0	2.2 c	1.9 b	1.2	1.2
	3	0.6 a	0.9 a	1.5 c	0 c	0.2 a	1.1
April, 1970	1 1/2	5.8 b	1.4	6.2 b	1.6 b	1.9	1.2
	3	3.8 b	1.4	5.2 b	1.2 b	1.4	1.0
Control	0	12.1 d	3.2	11.2 a	3.8 a	2.0	2.3

1/ Numbers of plants emerged were counted four weeks after planting except for the October sampling for which numbers were taken at two weeks.

2/ Treatment means in each column followed by identical letters are not significant at the 0.05 level.

Summary

Quackgrass control obtained with treatments of RH 315 in the fall was excellent in June and marginal by October the following year. Rhizome production in treated areas was reduced, more so following fall treatments. Soil residual activity of RH 315 had diminished to very low levels by late spring regardless of whether chemical was applied in fall or spring. Rhizome bud activity of treated rhizomes transplanted to untreated soil was decreased by all treatments. Difference in reduction of bud activity between rhizomes treated in the fall compared to spring seems to be due to inherent vigor of the quackgrass. No differences in vigor were observed between plants produced from treated and untreated rhizomes.

These studies have further explained the phenomenon of quackgrass regrowth in RH 315 treated soil and provide a framework for chemical treatments to remove this perennial pest from alfalfa.

Table 5. Green weight of quackgrass plants emerged from RH 315-treated rhizomes following transfer of rhizomes to untreated soil at various times after application, Sidney, New York 1969-1970.

Time of Application	RH 315 Rate/A	Sampling Dates (1970) June 9	June 23	July 7	July 21	August 20
		Green Weight (gr)/Gram Rhizome Planted[1/]				
November, 1969	1 1/2	1.80 a	1.28	0.23 a	3.00 ab	6.2 ab
	3	0.36 a	0.89	0.27 a	0.00 b	0.6 a
April, 1970	1 1/2	1.11 a	1.30	0.75 a	3.36 a	11.5 b
	3	1.18 a	1.08	2.09 b	2.53 a	8.5 b
Control	0	3.10 b	1.54	3.48 b	4.36 a	10.1 b
		Green Weight (gr) Plant Emerged				
November, 1969	1 1/2	0.8	1.4	1.0	5.9 b	4.8 ab
	3	0.5	0.5	0.7	0.0 c	1.0 a
April, 1970	1 1/2	0.8	0.6	2.3	8.0 a	6.1 b
	3	1.2	0.7	4.7	5.8 b	6.7 b
Control	0	1.0	0.7	4.7	4.9 b	4.6 ab

1/ Treatment means in each column followed by identical letters are not significant at the 0.05 level.

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HERBICIDES FOR WEED CONTROL IN SEEDLING RED CLOVER AND BIRDSFOOT TREFOIL[1/]

(Progress Report)

D. L. Linscott and R. D. Hagin[2/]

Outbreaks of alfalfa weevil (Hypera postica Gyll.) during the past few years have generated increased interest in red clover (Trifolium pratense L.) and birdsfoot trefoil (Lotus corniculatus L.) as forage legumes. These legumes are grown widely in the Northeast but have been surplanted on much of the acreage by alfalfa (Medicago sativa L.) because of alfalfa's greater yield potential.

Although many studies on weed control in legumes have been conducted, the information available on preplanting treatments followed by postemergence treatments is limited for red clover and birdsfoot trefoil. This paper is a progress report of 1970 field work on weed control in seedling red clover and birdsfoot trefoil.

Methods and Materials

A Honeoye silt loam at Aurora, New York was plowed in the fall of 1969 and prepared for seeding on April 29, 1970. In both the red clover and birdsfoot trefoil studies S-ethyl dipropylthiocarbamate (EPTC) was applied at 0, 2 or 4 lb/A in 30 gpa of water and was incorporated by cross disking. Pennscott red clover was seeded at 10 lb/A by band-seeding techniques on April 30. Similarly, Viking birdsfoot trefoil was seeded at 8 lb/A. Fertilizer (6-24-24, N-P_2O_5-K_2O) was applied with a drill approximately 2 inches beneath the legume seeds. On June 2, 2-sec-butyl-4,6-dinitrophenol (dinoseb) was applied to the red clover and birdsfoot trefoil plots at 0, 1/4 and 1/2 lb/A in 30 gpa water to give all possible combinations with the previous EPTC treatment. Similarly, 4-(2,4-dichlorophenoxy)-butyric acid (2,4-DB) was applied to red clover at 0, 3/4 and 1 1/2 lb/A to give all possible combinations with EPTC. The temperature at time of postemergence applications was 88°F.

Plot size was 7 by 24 feet. The experimental design was a randomized complete block with 5 replications. Estimates of early plant damage were made June 8. Numbers of surviving plants were determined June 16 by counting the species in

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2 one-meter lengths of row (7 by 39 inches) selected at random. Two harvests were made for yields on July 23 and September 17. Yields were taken by a flail-plot harvester that cut to within 2 inches of the soil line. Yields are reported on a 15 percent moisture basis.

The major annual weed species were common lambsquarters (Chenopodium album L.); redroot pigweed (Amaranthus retroflexus L.); ragweed (Ambrosia artemisiifolia L.); barnyardgrass [Echinochloa crusgalli (L.) Beau.]; wild mustard [Brassica kaber (D.C.) L. C. Wheeler]; yellow foxtail [Setaria glauca (L.) Beauv.]; green foxtail [Setaria viridis (L.) Beauv.]; ladysthumb [Polygonum persicaria (L.)Beauv.] and smartweed (Polygonum pensylvanicum L.). Perennial species were not present in significant numbers in these plots.

Results

Red clover and birdsfoot trefoil in all plots including controls established successfully. However, tonnage of clover from plots receiving herbicides was as much as 1500 lbs/A greater based on two cuttings (Table 1). Similarly, birdsfoot trefoil plots treated with herbicides yielded as much as 2250 lb/A more than controls (Table 2). Red clover was stunted early by the 4 lb/A EPTC treatment and was further damaged by dinoseb or 2,4-DB applications. However, these effects were not noticeable when yields were taken.

Dinoseb at 1/4 lb/A or EPTC at 2 lb/A alone at rates used were unsatisfactory for controlling broadleaf weeds. However, the combination treatment resulted in excellent control of both broadleaf weeds and grasses. EPTC alone controlled annual grasses during the season whereas when dinoseb or 2,4-DB was used, as a result decreased broadleaf weed competition, the grass population increased significantly. Considering the weed population in this study, and the relative cost of chemicals, the most satisfactory treatments were dinoseb applied at 1/4 or 1/2 lb/A after the 2 lb/A EPTC treatment. Similarly 2,4-DB at 3/4 lb/A following EPTC was highly satisfactory.

The stand of red clover was not significantly affected by chemical treatment. Conversely, 6 weeks after planting, plots receiving EPTC alone or followed by dinoseb had double the numbers of birdsfoot trefoil plants. Birdsfoot trefoil is quite sensitive to competition the first few weeks after planting. Thus, the numbers of birdsfoot trefoil on June 16 were inversely proportional to the numbers of weeds in the plot at that time.

The significant point in this paper is that adequate weed control was obtained by lower than normal rates of EPTC when followed by lower than normal rates of dinoseb or 2,4-DB. If perennial grasses and sedges are a problem (in these plots they were not) at least 4 lb/A of EPTC should be used. A reduced rate of dinoseb or 2,4-DB following the higher rate of EPTC could be used successfully for weed control and at the same time not seriously affect legume stand. For the post-emergence treatments to be most effective in this system, the weeds escaping EPTC treatments must be sprayed when 3 inches or less in height.

Table 1. Effect of preplanting (incorporated) applications of EPTC and postemergence application of dinoseb or 2,4-DB on population of weeds and red clover and the yield of red clover. a/

Treatment, lb/A Preplant Inc.		Post-Emerg.		Damage Red Clover June 8	Stand b/ Red Clover June 16	Weeds June 16	Grass June 16	Yield Red Clover, lb/A July 23	Sept. 17	Total
EPTC	0	DNBP	0	0 e	61	84 a	9 b	1516 c	3868 abcd	5374 d
"	2	"	0	10 cd	73	35 b	1 c	2348 b	3906 abcd	6250 bc
"	4	"	0	22 bc	76	23 bcd	0 c	2512 ab	3834 abcd	6348 abc
"	0	"	1/4	2 d	56	69 a	14 ab	2404 b	4032 ab	6440 abc
"	2	"	1/4	10 cd	82	9 bcd	2 c	2948 a	3576 cd	6526 ab
"	4	"	1/4	40 a	74	3 d	0 c	2558 ab	3924 abc	6482 ab
"	0	"	1/2	0 b	62	32 bc	19 a	2924 a	3198 abcd	6844 a
"	2	"	1/2	14 cd	80	14 bcd	1 c	2912 a	3634 cd	6546 ab
"	4	"	1/2	38 a	76	2 d	0 c	2526 ab	3910 abc	6430 abc
"	0	2,4-DB	3/4	11 cd	60	4 d	12 b	2592 ab	4064 a	6658 ab
"	2	"	3/4	10 cd	80	5 cd	1 c	2606 ab	3628 cd	6230 bc
"	4	"	3/4	36 ab	79	2 d	0 c	2268 b	3644 cd	5992 bc
"	0	"	1 1/2	2 d	70	9 bcd	13 b	2514 ab	3830 abcd	6344 abc
"	2	"	1 1/2	14 cd	90	4 d	0 c	2570 ab	3174 d	6282 bc
"	4	"	1 1/2	34 ab	90	1 d	0 c	2538 b	3746 abcd	6504 ab

a/ Means within columns with no letter or the same letter designation are not significantly different at the 0.05 level according to Duncan's Multiple Range Test.

b/ Damage rating 0 - 99 in increasing order of intensity. Stand taken from 2 meters of row.

Table 2. Effect of EPTC (preplanting, incorporated) and DNBP (postemergence) on early damage, plant numbers and birdsfoot trefoil and weeds and yield of birdsfoot trefoil. a/

Treatment, lb/A				Damage b/ (June 8)			Stand (June 16)			Birdsfoot Trefoil Yield, lb/A		
PPI		Post E		Bft.	BLW	GW	Bft.	BLW	GW	July 23	Sept. 17	Total
EPTC	0	DNBP	0	0 f	0 c	0 c	32 d	80 a	7 b	1754 d	2699 b	4454 d
	2		0	4 c	50 bc	99 a	38 cd	49 ab	3 b	1748 d	3126 a	4874 cd
	4		0	6 bc	79 bc	99 a	57 abc	9 ad	0 b	2286 c	3227 a	5510 bc
	0		1/4	2 cd	58 bc	0 c	33 d	42 bc	17 a	2948 ab	2950 ab	5898 ab
	2		1/4	8 bc	80 bc	50 b	48 bcd	27 bcd	6 b	3134 ab	3320 a	6454 a
	4		1/4	12 ab	98 ab	99 a	65 ab	2 d	0 b	2778 bc	3383 a	6160 ab
	0		1/2	2 cd	70 bc	0 c	45 bcd	22 bcd	19 a	3402 a	3305 a	6708 a
	2		1/2	12 ab	90 ab	99 a	61 abc	7 cd	0 b	3274 ab	3555 a	6628 a
	4		1/2	20 a	99 a	99 a	72 a	3 d	0 b	2848 b	3364 a	6212 ab

a/ Means within columns with no letter or the same letter designation are not significantly at the 0.05 level of significance according to Duncan's Range Test. Bft = birdsfoot trefoil; BLW = broadleaved weeds; GW = grass weeds.

b/ Damage rating 0 - 99 in increasing order of intensity. Stand taken from 2 meters of row.

TANK MIXTURES OF DALAPON-DINOSEB VERSUS SPLIT APPLICATIONS[1/]

(Progress Report)

Sherry Chen and D. L. Linscott[2/]

Alfalfa (Medicago sativa L.) in the seedling stage grows slowly and competes poorly with weeds during the early phases of growth. When not controlled weeds are detrimental to alfalfa establishment. Many investigators have controlled weeds in seedling legumes with EPTC (S-ethyl N,N-dipropylthiocarbamate), dalapon (2,2-dichloropropionic acid), dinoseb (2-sec-butyl-4,6-dinitrophenol) and 2,4-DB [4-(2,4-dichlorophenoxy)butyric acid]. To obtain a satisfactory control of both annual grasses and broadleaf weeds some times it is necessary to use a mixture of herbicides such as 2,4-DB and dalapon or dinoseb and dalapon. Often a pre-emergence chemical such as EPTC or N-butyl-N-ethyl-a,a,a,-trifluoro-2,6-dinitro-p-toluidine (benefin) can be followed by a postemergence treatment to control escaping species.

Dalapon is an effective grass killer. However, increasing susceptibility of peas (Pisum sativum L.) and several weeds to subsequent foliage treatment with dinoseb has been reported (1). Our previous research showed that dalapon-dinoseb is an excellent combination at proper rates for weed control in seedling legumes. The practice is used by some growers who have problems with both broadleaved weeds and grasses.

Preliminary laboratory experiments indicated that a dalapon-dinoseb mixture induces greater damage on alfalfa seedlings than does separated applications of the same compounds. This paper is a progress report of 1969 and 1970 field research designed to compare effectiveness of mixtures with split applications.

Materials and Methods

The trials were carried out at Cornell Agronomy Farm, Aurora, New York on a Honeoye silt loam. Saranac alfalfa was planted at 8 lb/A in 7 inch rows with a grain drill equipped with band seeding attachments and packer wheels. All plots received 250 lb/A of N-P_2O_5-K_2O fertilizer (0-25-25) applied in a band approximately 2 inches beneath the legume seed. Plot size was 7 by 24 feet. The experimental design was randomized complete block. Eight replications were used in 1969 while 10 replications were used in 1970.

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The major annual weed species were common lambsquarters (Chenopodium album L.); redroot pigweed (Amaranthus retroflexus L.); ragweed (Ambrosia artemisiifolia L.); barnyardgrass [Echinochloa crusgalli (L.) Beau.]; wild mustard [Brassica kaber (D.C.) L.C. Wheeler]; yellow foxtail [Setaria glauca (L.) Beauv]; green foxtail [Setaria viridis (L.) Beauv.]; ladysthumb [Polygonum persicaria (L.) Beauv.] and smartweed (Polygonum pensylvanicum L.). The primary perennial species present were quackgrass [Agropyron repens (L.) Beauv.] and ground cherry (Physalis heterophylla Nees.).

Dalapon was applied in 30 gpa water at 2 lb/A and was followed with dinoseb in 30 gpa water at 1 lb/A, 2, 4, and 24 hours later. Similarly dinoseb was applied and followed by dalapon at the same time interval. Each plot received a total of 1 lb/A of dinoseb and 2 lb/A dalapon. For the mixture the two chemicals were mixed together in water and applied at 30 gpa. The alfalfa seedlings were at the four to five-true-leaf stage at the time of spraying. In 1969 the date and time of initial spraying was 10 AM, June 10 and in 1970, 9:45 AM, June 1. Maximum air temperature during the 2-day treatment period was 80°F and 84°F in 1970.

Plant populations (legumes, grass, and broadleaved weeds) were recorded two times during the season, once before the chemical treatments and the other 16 days after spraying. In 1969, plant populations were counted from a square meter area selected at random from each plot. In 1970 plant populations were determined from two 1-meter (7 by 39 inches) lengths of row selected at random. Weed control and crop injury were rated within a week after treatment using the scale 0 to 99; 0 represented no weed control or crop injury and 99 nearly complete control of weeds or reduction in crop stand or vigor. The first cutting of forage yield was made by a flail plot harvester 5 weeks after seeding. Second cutting yields were not significantly different and are not reported. All yield data are expressed on an oven-dry basis (175°F to constant weight). Significance of treatment means at the 0.05 level was determined by Duncan's Multiple Range Test.

Results

Tank mixtures of dinoseb-dalapon damaged alfalfa more extensively than did split applications 2, 4, or 24 hours apart in the 1969 and 1970 field trials (Table 1). Leaves of alfalfa were burned more severely by the mixtures. The population of alfalfa was significantly decreased by the tank mixture in 1970 and a similar trend was detected in 1969. These observations on early damage to the plants and a significant reduction in plant numbers have been confirmed by studies in controlled environments.

The weed population in the two field studies was quite variable and therefore interpretation of the data is difficult. The damage estimates indicate a pattern for weeds similar to that for alfalfa. However, the plant population data indicates the reverse. More refined experiments will determine whether these observations are consistent.

Differences in alfalfa yield between the treatments have not been demonstrated conclusively. Therefore it would be premature to suggest an economic advantage for split applications of dinoseb-dalapon over tank mixtures. Nevertheless, the tank mixture does increase early damage to alfalfa and we intend to determine the reason for it. First indications are that the spray droplet contact angle is less for the tank mixtures thus promoting increased retention and more absorption and penetration.

This premise is being studied further in controlled environmental systems.

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Table 1. Effect of dalapon-DNBP mixtures and split applications on damage and numbers of alfalfa and weeds and first cutting yield. a/

1st herbicide	Interval hours	2nd herbicide	Damage rating c/ Alfalfa	BLW	Grass W.	Population b/ Alfalfa	BLW	Grass W.	1st cutting forage dry matter, lb/A
						1969			
Dalapon 2 lb/A	24	DNBP 1 lb/A	22 b	98		142	73		2621
"	4	"	8 cd	96		151	53		2641
"	2	"	11 c	98		156	54		2742
"	0 (mix)	"	44 a	99		132	63		2461
DNBP 1 lb/A	2	Dalapon 2 lb/A	9 cd	98		161	59		2673
"	4	"	4 d	96		139	69		3100
"	24	"	4 d	99		152	96		3010
						1970			
Dalapon 2 lb/A	24	DNBP 1 lb/A	20 c	96	23 ab	61 a	12 abc	23 b	1844 b
"	4	"	18 c	99	14 d	62 a	11 bc	21 b	2114 ab
"	2	"	19 c	99	20 bc	58 a	6 c	63 ab	1985 ab
"	0 (mix)	"	55 a	99	26 a	42 b	20 a	80 a	1986 ab
DNBP 1 lb/A	2	Dalapon 2 lb/A	24 bc	98	16 cd	55 a	16 ab	34 b	2391 a
"	4	"	18 c	96	13 d	62 a	11 bc	33 b	1821 b
"	24	"	29 b	99	27 a	61 a	13 abc	36 c	2293 a

a/ Means within columns with identical or no letters are not different at the 0.05 level according to the Duncan's Multiple Range Test of Significance.

b/ In 1969 plant population was taken on June 26 from a meter square. The 1969 plots were essentially grass free. Population in 1970 was determined June 16 from 2-one meter lengths of row (7 by 39 in.).

c/ 0 to 99 scale: 0 = no effect and 99 - very serious damage. Ratings recorded on June 15, 1969; June 4, 1970.

THE EFFECT OF VERNOLATE, ROW WIDTH AND CULTIVATION ON SOYBEAN PRODUCTION AND FOXTAIL CONTROL[1/]

J. V. Parochetti[2/]

ABSTRACT

A three year field study was conducted on the effect of 7 inch row spacing with S-propyldipropyl thiocarbamate (vernolate) and a maximum of 3 cultivations on soybeans (*Glycine max* L.) in 30 inch row spacing. Vernolate caused soybean height and vigor reduction of 7.5 to 20% of the control; however yields were not reduced. Best giant foxtail (Setaria faberii L.) control resulted from 7 inch row spacing. Soybean yields for the 7 inch row spacing were not significantly different from the 30 inch rows. Soybean yields were similar in 30 inch rows with vernolate alone or vernolate plus cultivation. Vernolate with no cultivation gave better foxtail control than 3 cultivations without vernolate. Number of cultivations did not significantly change yields except for one year when soybean yields with 1 cultivation were less than 2 or 3 cultivations.

1/ Scientific Article No. A 1662, and Contribution No. 4403 of the Maryland Agricultural Experiment Station, Department of Agronomy, College Park.

2/ Assistant Professor, Department of Agronomy, University of Maryland, College Park, Maryland 20742.

INTRODUCTION

Until recently soybeans have been planted most successfully so that they could be cultivated for weed control. Chemical weed control has opened the possibility of soybean (Glycine max L.) production without cultivation. Yield increases have been reported for many varieties of soybeans where row spacings have been decreased (1, 3) in these experiments. Weeds were controlled by hand removal. The purpose of this study was to evaluate soybean yields at row spacings of 30 and 7 inches using S-propyldipropyl thiocarbamate (vernolate) to control weeds. A comparison of vernolate with 1, 2 and 3 cultivations was also studied at the 30 inch row spacing.

MATERIALS AND METHODS

Studies were conducted in 1967, 1969 and 1970 at the Wye Institute, Queenstown, Maryland, on a Mattapex silt loam. A randomized complete block with four replications was used. Plots were 10 x 20 feet; 30 gpa was the spray volume. Treatments are listed in Table 1. Vernolate, 3 lb/A, was preplant incorporated with a rototiller to a depth of 3 inches.

The cultivation schedule following planting was: treatment 4 at 3, 5 and 7 weeks; treatment 5 at 3 and 5 weeks; and treatment 6 at 3 weeks.

In 1968 Kent variety soybeans were planted June 7. Vernolate was applied June 7.

In 1969 York variety soybeans were planted June 12. Vernolate was preplant incorporated June 10.

In 1970 Cutler variety soybeans were planted June 3. Vernolate was preplant incorporated June 3.

RESULTS

Vernolate caused soybean vigor reduction in all years studied (Table 1). Height reduction and crinkling of the first two to three leaves decreased with soybean growth and did not reduce soybean yields (Table 2); similar results have been previously reported (2, 4).

Best giant foxtail (Setaria faberii L.) control occured in the 7 inch row spacings with vernolate (Table 2). This was attributed to the more rapid canopy development in the 7 inch rows in comparison to 30 inch rows. In general, soybean yields for the 7 inch row spacing plus herbicide were not significantly different from 30 inch row spacings.

In 1969 very few weeds were present during soybean growth because the land was tilled at 4 different time intervals which effectively controlled many weeds which had sprouted. Soybean yields in 7 inch rows in 1969 were similar whether a herbicide was used or not because of the sparse weed population. In 1967 and 1970 where weeds were present, soybean yields were significantly higher for 7 inch rows with vernolate compared to no herbicide in 7 inch rows.

There were other weeds present in these studies but the infestations were unevenly distributed and weed control information was difficult to assess. This might have contributed to variability in yield data.

Soybean yields in 30 inch rows with 2 cultivations and no herbicide were significantly greater than one cultivation and no herbicide only in 1970.

There was no significant increase of soybean yields in 30 inch rows with vernolate alone or vernolate plus one cultivation.

DISCUSSION

Before the advent of chemical weed control, cultivation was the only method of weed control. In soybean culture it was the common practice to prepare the field several weeks before planting and the land was tilled at intervals following germination of annual weeds. This was the situation in 1969; because of inclement weather, it was necessary to rework the field 4 times prior to establishing the test. During this time, several flushes of annual weeds germinated and were killed, and the weed population for the remainder of the season was very sparse. As a result, yields from no cultivated plots in 30 inch rows were similar to all treatments except two cultivations and vernolate plus cultivation. It would appear that this method of control for giant foxtail is effective. However, had the population of weeds consisted of morningglory (Ipomea spp.) or other large seeded and broadleaved weeds such as jimsonweed (Datura stramonium L.), then the fallow tillage preparation of the land might have been less effective.

The addition of one cultivation with vernolate did not increase soybean yields when compared to vernolate alone. The major advantage that can be attributed to the use of vernolate over only cultivation certainly can not be attributed to an increase in soybean yields; however, chemical weed control can substitute for the necessity of the early time consuming, critical cultivation. Indeed, the necessity of a herbicide in drill beans is imperative because mechanical cultivation is restricted to only proper land preparation and early rotary hoeing.

These data should not be extrapolated to other weed competition situations. Where ragweed (Ambrosia artemisilifolia L.), morningglory, jimsonweed and perennial weeds are a problem, it will be necessary to use different chemical and mechanical weed control practices. At present, no one herbicide can control a complete spectrum of weeds in soybeans.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation for the computer time made available through the facilities of the Computer Science Center of the University of Maryland.

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Table 1. The effect of vernolate on soybean vigor reduction.

	Treatment	Row Width	Herbicide	% Soybean Vigor Reduction[1/] 6/28/67	7/30/67	7/2/69	7/14/70
1.	Control	---	no	0	0	0	0.0
2.	No cultivation	30"	yes	12.5	17.5	20	12.5
3.	1 cultivation	30"	yes	17.5	10.0	18	12.5
4.	1 cultivation	30"	no	0	0	0	0
5.	2 cultivations	30"	no	0	5	0	0
6.	3 cultivations	30"	no	0	0	0	0
7.	No cultivation	7"	no	0	0	0	0
8.	No cultivation	7"	yes	11.3	7.5	18	12.5

1/ Soybean vigor reduction was rated on a scale of 0 to 100 with 0 equalling no effect and 100 equalling 100% death. A rating of 30 or more is considered unacceptable injury.

Table 2. The effect of row width, vernolate, and cultivation on soybean production. A three year study conducted at the Wye Institute, Queenstown, Maryland.

	Treatment	Row Width	Herbicide	% Foxtail Control[1/] 7/18/67	7/14/70	Bu/A 1967	1969	1970
1.	Control	---	-	0	0	8.4a[2/]	46.1a	15.0a
2.	No cultivation	30"	+	98	89	25.7bc	48.6ab	22.9bc
3.	1 cultivation	30"	+	100	88	27.8bc	52.7b	24.6cd
4.	1 cultivation	30"	-	63	45	20.0bc	50.8ab	22.1bc
5.	2 cultivations	30"	-	78	73	25.9bc	53.0b	30.5d
6.	3 cultivations	30"	-	90	76	27.9bc	49.8ab	26.7de
7.	No cultivation	7"	-	45	29	17.0ab	47.4ab	19.5ab
8.	No cultivation	7"	+	100	99	30.0c	45.5a	26.2cde

1/ Weed control was rated on a scale of 0 to 100 with 100 equalling 100% weed destruction.

2/ Numbers having the same letter are not significant at the 0.05 level of probability.

YELLOW NUTSEDGE CONTROL IN CORN WITH BUTYLATE, ATRAZINE, ALACHLOR AND COMBINATIONS

J. V. Parochetti[1/]

ABSTRACT

A three year study was conducted on the control of yellow nutsedge (*Cyperus esculentus* L.) in corn (*Zea mays* L.). Data discussed are an average over three years and three replications. *S*-ethyl diisobutylthiocarbamate (butylate), 3 lb/A, 2-chloro-4-(ethylamino)-6-(isopropylamino)-*s*-triazine (atrazine), 4 lb/A, 2'-chloro-2,6-diethyl-*N*-methoxymethylacetanilide (alachlor), 4 lb/A, preplant incorporated (ppi), resulted in 68, 75 and 87% nutsedge control, respectively. Combinations of atrazine plus butylate, ppi, at 1 + 3 lb/A and 1 + 4 lb/A, resulted in 75 and 82% control. Post-emergent (post) treatments were made when nutsedge was one inch high. Atrazine post at 2 lb/A with Sun oil IIE (1 gal/A) resulted in 67% control which was 10% better than the same treatment without oil. Combinations of butylate ppi and atrazine post with oil resulted in 84% control for a 3 + 1 lb/A combination; and the same combination without oil resulted in a 73% control. Atrazine, 2 lb/A, ppi plus atrazine, 1 lb/A, post, resulted in 70% control. This similar combination with atrazine post plus oil resulted in 88% control.

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FALL PANICUM CONTROL IN FIELD CORN

N. L. Hartwig and F. S. Serdy 1/

Abstract

Fall panicum (Panicum dichotomiflorum Mich.) was controlled best with 2-chloro-2'6'-diethyl-N-(methoxymethyl)acetanilide (alachlor), S-ethyl diisobutylthiocarbamate (butylate) and 2-chloro-N-(1-methyl-2-propynyl) acetanilide (BAS 2903-H) in a test conducted at State College, Pennsylvania in 1970. Due to known weaknesses in butylate and alachlor for control of some weeds, butylate was used in combination with 2-chloro-4-(ethylamino)-6-(isopropylamino) s-triazine (atrazine) and alachlor was used in combination with a number of herbicides. A fall panicum stand reduction of 97% was required in the spring to prevent dry matter accumulation from exceeding 500 hg/ha by late summer.

Introduction

Fall panicum has infested large acreages of corn in Pennsylvania since 1965. As a result of this large build up, fall panicum has been a growing problem in alfalfa established on some of this corn acreage in recent years. The most consistent control of fall panicum in corn has been obtained with alachlor, butylate and in some areas with the combination of atrazine and 2-chloro-4,6-bis(ethylamino)-s-triazine (simazine) applied preemergence. To date, only herbicides having a relatively high contact activity on both fall panicum and corn have effectively controlled fall panicum when applied postemergence, and these herbicides can be applied only as directed sprays.

Materials and Methods

Fall panicum control trials were established in 1969 and 1970 in a field that had a long history of corn treated with a band application of atrazine. Over 95% of the weed stand was fall panicum. The soil type is a Hagerstown silt loam (OM - 2.0%) with a few clay knolls within the trial area. All herbicide treatments were applied with a compresed air pressure sprayer mounted on an International Cub tractor. These rates were obtained by varying the speed of the tractor so that the low rate was applied in 10 gpa, the medium rate in 20 gpa and the high rate in 30 or 40 gpa except for the postemergence treatments which were all applied in 20 gpa. Preplant incorporated treatments were disked once with a double tandem disk.

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In 1969, of 32 herbicides and combinations of herbicides tested, only alachlor, butylate and 2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methylpropionitrile (SD 15418) controlled fall panicum satisfactorily without injury to the corn. The results of this trial will not be presented in this paper.

In 1970, alachlor and butylate were tested at three rates alone and in combination with herbicides known to be strong for control of common weeds not controlled by alachlor or butylate. BAS 2903-H and a combination of atrazine and simazine and were included in the 1970 trial.

A randomized complete block design was used with 4 row plots (38 inch spacing) 20 ft. in length. Pa 507 hybrid corn was planted May 21 with both the preplant incorporated and preemergence treatments applied the same day. Soil conditions were dry on the surface with good moisture available at one inch and below. Rainfall was .63 inch the first week after planting and equalled 1.5 inches after two weeks. Postemergence treatments were applied June 9 when the corn had 5 leaves and the fall panicum was 1 to 5 inches tall.

Weed stand reduction ratings were made July 1 (Table 1). All weed growth from two .5 m^2 quadrats was harvested in each plot on August 24 and oven dried to a constant weight. Corn yields were obtained from the two middle rows of each plot.

Results and Discussion

Butylate did not provide satisfactory control of fall panicum but poor incorporation was apparently the real reason for the high weed dry weight yields. The double tandem disk used for incorporation left a one foot strip down the middle of each plot which became heavily infested with fall panicum. Excellent weed control was obtained on the rest of the plot but corn yields were undoubtedly reduced by this strip of fall panicum.

Alachlor at 1.5lb/A was needed to control fall panicum satisfactorily when used alone but 1 lb./A in combination with 1.5 lb/A of 3-(4-Bromo-3-chlorophenyl)-1-methoxy-1-methylurea (C 6313), or 1 lb/A of 2-chloro-4-cyclopropylamino-6-isopropylamino-s-triazine (S 6115), or 1 lb/A of 2-(4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methylpropionitrile (SD 15418), or 0.5 lb/A of atrazine plus 0.5 lb/A of 2,4-bis(isopropylamino)-6-(methylthio)-s-triazine (prometryne), or 1 lb/A of atrazine plus 1 lb/A of 3-(3,4-dichloropheny)-1-methoxy-1-methylurea (linuron), or 1.5 lb/A of atrazine applied preemergence gave equal control of fall panicum with maximum corn yields.

Fall panicum was not effectively controlled with 4 lb/A of atrazine nor with a combination of 1.5 lb/A of atrazine plus 1.5 lb/A of simazine.

Table 1. Fall panicum stand reduction and dry weight yields, corn yields following treatment with various herbicides

Treatment	Rate ai lb/A	Weed Stand Reduction[1/] July 1	Weed Dry Wt Yields kg/ha Aug. 24	Corn Yields bu/A 15.5% Moisture	Corn Yields kg/ha 15.5% Moisture
Preplant incorporated					
	1.5	7.0	4270	39.2	2461
butylate	3	9.0	4690	80.7	5066
	6	9.0	1613	75.5	4740
butylate	1.5+ .5	8.7	4377	61.7	3873
+	3 +1	9.0	4170	78.4	4922
atrazine	6 +2	9.0	4220	76.4	4796
Preemergence					
	.5	9.3	2627	67.4	4231
alachlor	1	9.3	1060	70.9	4451
	1.5	9.7	550	92.2	5788
C6313	.75+.5	9.3	1163	84.3	5292
+	1.5 +1	9.7	687	90.1	5656
alachlor	2.25+1.5	10.0	63	97.1	6096
S6115	.5 + .5	9.0	2620	80.5	5053
+	1 +1	9.7	877	94.9	5957
alachlor	1.5 +1.5	10.0	50	76.3	4790
SD 15418	.5 + .5	9.0	3170	88.9	5581
+	1 +1	9.7	383	105.6	6629
alachlor	1.5 +1.5	10.0	47	98.0	6152
	L.S.D. (0.05)		1134	26.5	1664
atrazine +	.25+.25+.5	9.0	2233	79.6	4997
prometryne +	.5 +.5 +1	9.3	63	93.0	5838
alachlor	.75+.75+1.5	10.0	67	95.4	5989
atrazine +	1/3 ea.	9.0	4207	60.7	3810
linuron +	2/3 ea.	9.3	1237	90.8	5700
alachlor	1 ea.	9.7	287	77.6	4871
atrazine	.5+1/3	8.7	2370	79.6	4997
+	1+2/3	9.3	1237	91.3	5731
alachlor	1.5+1	9.7	107	104.7	6573
atrazine +	.5+1/3	9.0	3687	62.8	3942
alachlor +	1+2/3	9.3	1370	102.1	6409
slurry	1.5+1	10.0	470	101.3	6359
	2	9.0	1923	76.1	4777
BAS 2903-H	4	9.3	1110	93.4	5863
	6	10.0	113	95.3	5982

Table 1. (Continued)

Treatment	Rate ai lb/A	Weed Stand Reduction July 1	Weed Dry Wt Yields kg/ha Aug. 24	Corn Yields bu/A 15.5% Moisture	Corn Yields kg/ha 15.5% Moisture
	1	0.3	5513	37.0	2323
atrazine	2	1.3	4267	37.6	2360
	4	1.7	3600	63.2	3967
atrazine	.5 + .5	0.0	4773	46.0	2888
+	1 +1	4.0	3740	73.4	4601
simazine	1.5 +1.5	9.0	3843	80.7	5066
Postemergence					
atrazine	.5 +1/3	0.0	4560	47.4	2976
+	1+2/3	1.0	4517	26.5	1664
alachlor	1.5+1	4.7	5727	27.8	1745
atrazine +	.5+1/3	0.7	6503	26.0	1632
alachlor +	1+2/3	0.0	6373	29.9	1877
1 qt. Booster E oil	1.5+1	2.3	5243	40.0	2511
Weedy Check		0.0	5647	24.0	1507
Weedy Check		0.3	5507	26.6	1670
Hoed Check		9.7	0	96.3	6045
	L.S.D. (0.05)		1134	26.5	1664

1/ Weed stand reduction ratings: 0 = no reduction; 10 = 100% reduction

The postemergence treatments of atrazine and alachlor were completely ineffective and corn yields were reduced approximately 70% on these plots.

BAS 2903 at 4 lb/A did not give the desired fall panicum control; however, corn yields were not reduced. At 6 lb/A excellent fall panicum control was obtained.

Most treatment combinations containing alachlor reduced the stand of fall panicum 90% even at the low rate according to visual observations made on July 1. The 10% fall panicum stand remaining produced from 2000 to 4000 kg/ha dry matter by August 24 as compared to 5507 and 5647 kg/ha dry matter produced in the weedy checks with a 100% stand. Fall panicum growth exceeding 500 kg/ha could cause problems at harvest time before a hard frost has killed the plant tissue or on damp days when there is a greater tendency for the stems to wrap on the snapping rollers of the corn picker. In order to prevent an accumulation of not over 500 kg/ha by late summer a stand reduction of over 97% is probably required in the spring when heavy infestations of fall panicum are present.

APPENDIX

Common Name		Chemical Company
alachlor	2-chloro-2'6'-diethyl-N-(methoxymethyl) acetanilide	Monsanto
atrazine	2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine	Geigy
BAS 2903-H	2-chloro-N-(1-methyl-2-propynyl)acetanilide	BASF
butylate	S-ethyl diisobutylthiocarbamate	Stauffer
C 6313	3-(4-Bromo-3-chlorophenyl)-1-methoxy-1-methylurea	CIBA
linuron	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	DuPont
prometryne	2,4-bis(isopropylamino)-6-(methylthio)-s-triazine	Geigy
S6115	2-chloro-4-cyclopropylamino-6-isopropylamino-s-triazine	Gulf
SD 15418	2-4-chloro-6-ethylamino-s-triazin-2-ylamino)-2-methylpropionitrile	Shell
Simazine	2-chloro-4,6-bis(ethylamino)-s-triazine	Geigy

A PROGRESS REPORT UPON THE UTILIZATION OF KARBUTILATE[1/] AS A SOIL STERILANT IN FORESTRY PRACTICES IN NEW JERSEY

P. M. GREHLINGER[2/]

Introduction - Forest fire prevention programs necessitate the cutting and clearing of certain forest lands for firebreaks, backfire areas and roadside maintenance. These programs are usually carried out by cutting, bulldozing or controlled burning.

A cooperative program between the New Jersey Fire Service and the Niagara Chemical Division, FMC Corporation, was developed. Karbutilate, m-(3,3-Dimethylureido)phenyl tert-butylcarbamare, was selected as the soil sterilant. Five years of data, as reported by Edward S. Hagood (Proc. NEWCC 23:303-319,1969 and Proc. NEWCC 23:87-101,1970) were employed as a basis for this selection. These data indicated that an effective, economical and practical program for the control of herbaceous species is 8 to 10, 3, 3, and 2 lb/A during a four-year period. For the control of brush and trees, the first year's application should be increased from 8-10 to 17.5-20 lb/A.

Rates for specific controls along fire lanes were applied and compared. Since several years of applications and evaluations will be required to support a practice, this first year's discussion is considered to be a progress report.

Materials and Methods

1. Elimination of Understory - In the management of forests it is sometimes desirable to eliminate the understory of brush, small trees and herbaceous species. The remaining overstory, in the event of a fire, would tend to trap airborne sparks and embers, minimizing their spread. Rates in the range of 3.2 to 6.4 lb/A active of Tandex 80 WP were suggested for the experimental control of this understory.

11. Establishment of a Firebreak or a Backfire Area- Higher rates, than those indicated to be required, were employed to determine (1) controls,

1/ Tandex is a registered trademark of FMC Corporation for Karbutilate.

2/ Industrial Chemicals Dept. Niagara Chemical Division Middleport, New York.

(1) controls, (2) persistence of controls, (3) safety and (4) chemical movement on or within the soil. Rates of 32.0 and 64.0 lb/A active of Tandex 80 WP were experimentally applied. When proven as a practice, the effectiveness of lower rater will be determined.

III. Control of Roadside Vegetation - Forest roads serve as access routes, as firebreaks, and as backfire areas. Maintained roads have from small to moderate size brush and young trees along their rights-of-way. A rate of 12.8 lb/A active of Tandex was suggested as the first year's experimental maintenance rate for the control of roadside vegetation.

IV. Reforestation - Cutting, replacement of access roads, and changes in land use might result in the former chemically treated sites being reforested and new sites being treated. The tolerance of transplants of forest species to these residues over a period of time should and is being established.

A standard forest fire-fighting engine, mounted upon a four-wheel drive Dodge Power Wagon, was employed to apply sprays of Tandex 80 WP. An adjustable fog-type of nozzle was employed to treat plots, which were 1/10 of an acre in size. The roadside maintenance plots were 0.25 mile long and 12 ft. wide. These were located on both sides of the road. The treatments, directed to wet both the vegetation and the sandy type of soil, were applied on July 17, 1970.

Results - The first visible effects were observed on August 13, 1970. Weeds, grasses, brush and small trees exhibited a 70 to 80% brownout. At that time the leaves of the larged woody species were partially chlorotic, partially necrotic, and partially defoliated. The extent of defoliation varied with the species. Smaller and partially necrotic leaves appeared upon the treated trees during late August and early September. The controls, as observed on September 28, 1970 are shown in the table.

Additional evaluations during 1971 will be required to (1) confirm the kill of each species and (2) to associate the method of application with a practical rate and a promising pattern of use. Lesser rates of Tandex in maintenance types of applications should be applied and evaluated.

These promising patterns of use of soil sterilants for the control of vegetation along roads and fire lanes should be proven under the soil and weather conditions of other regions.

Species Treated: See table
Experimenter: P. M. Grehlinger, Niagara Chemical Division
Treated: July 17, 1970, using fog type sprays of Tandex 80 WP upon 1/10 acre or 1320 by 24 ft plots
Evaluations: First of several planned evaluations upon September 28, 1970

Species	Botanical Name	Percent Controls				
		Understory Firebreaks		Firebreaks		Road Maintenance
		3.2 lb/A	6.4 lb/A	32.0 lb/A	64.0 lb/A	12.8 lb/A
Scrub oak	Quercus ilicifolia	100	100	100	100	100
Scarlet oak	Quercus coccinea	100	100	100	100	100
Blackjack oak	Quercus marilandica	100	100	100	100	100
Chestnut oak	Quercus prinus					100
Quaking aspen	Populus tremuloides					100
Pitch pine	Pinus rigida	100	100	100	100	100
Sasafrass	Sasafrass albidum					20
Gray birch	Betula populifera					100
Red cedar	Juniperis virginiana	0				
Red maple	Acer rubrum				100	100
Blueberry, wild	Vaccinium pennsylvanicum	100	100	100	100	100
Cranberry, wild	Vaccinium oxycoccos	100	100	100	100	100
Smilax		100	100	100	100	100
Bracken fern	Pteridium aquilinum	100	100	100	100	100
Sweet fern						100
Partridge pea	Cassia fasiculata					100

Species	Botanical Name	Percent Controls				
		Understory Firebreaks		Firebreaks		Road Maintenance
		3.2 lb/A	6.4 lb/A	32.0 lb/A	64.0 lb/A	12.8 lb/A
Hemp dogbane	Apocynum cannabinum					100
Heather		100	100	100	100	100
Narrowleaf vetch	Vicia angustifolia					100
Fall panicum	Panicum dichotomiflorum	100	100	100	100	100
Broom sedge	Andropogon virginicus	100	100	100	100	100
Nimblewill	Muhlenbergia schreberi					100

GROWTH CONTROL IN TREES

A comparative study of four growth retardents applied as foliar sprays.

M.R. Gardner1/

Abstract: A new philosophy is developing amongst Utility Companies toward new improved appearance rights-of-way. One of the methods utilized, to reduce the impact of rights-of-way is the increasing retention of existing plants and the planting of woody species on the power corridor. These plants will require extensive maintenance if their growth is uncontrolled. Three species of forest trees, White Ash, (Fraxinus americana L.), Silver maple, (Acer saccharinum L.) and Carolina poplar, (Populus canadensis Moench) were sprayed with four growth inhibitors each at three rates. MH30T (Diethanolamine salt of 1,2-dihydro-3,6-pyridazinedione) gave the most complete control with least foliar damage. NIA10637 (Ethyl hydrogen 1-propylphosphonate) gave adequate control at one rate. Increased bud formation was noted. CF125 (Methyl 2-chloro-9-hydroxyfluorene -9-carboxylate) did not indicate good control at the rates used. A new material DP1108, the structure of which is not known, gave promising results.

INTRODUCTION

The sustained increase in electrical power demand and concomitant generation facilities is exerting a substantial pressure on the electrical utilities to purchase more property for generating plants and transmission rights-of-way. This latter demand is demonstrated graphically in Table I.

It is the view of many conservationists that electric power lines are one of the more significant despoilers of natural beauty wrought by the industrial revolution. Whether this view is right or wrong, much of the general public shares it, and the electric utilities are now under constant pressure to reduce the impact of transmission lines on the surrounding landscape.

Such attitudes are now reflected in reports sponsored by government authorities (29),(30),(31),(32). It is fully recognised that it is not technologically or economically feasible to place high voltage electric transmission lines underground for long distances.

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Hydro Electric Power Commission of Ontario

In view of this, the Electric Utility Industry Task Force has stated that "a special burden is justifiably placed on the Industry to do whatever is possible to alleviate the environmental problems caused by transmission lines." (30).

The problem, then, is how best to meet the mounting demand for electricity and to build the necessary additional transmission facilities while at the same time protecting environmental values.

The trend in many utilities by design or pressure has been away from a purely engineering approach to such environmental problem solving. Utility personnel with backgrounds in the biological sciences have published a number of papers on ways of moderating the impact of rights-of-way. A number of papers have been presented on this subject (9),(12),(14),(18),(20),(27).

The principal theme of such papers has involved the improvement of line location, the retention of woody shrubs and trees on new rights-of-way, screening, planting and the selective use of herbicides. Much of the plant material mentioned for planting does, or is assumed to have, inherently fastigiate growth characteristics. Such material is costly if purchased from commercial nurseries. In fact, the estimated cost by one utility for the creation of one 100 foot wide screen comprised of small growing trees and shrubs is some $550. (33).

Forest trees are perhaps significantly not mentioned although they offer a much less expensive method of obtaining the same, or in some cases, a substantially more natural and silviculturally more suitable effect. One author has noted that some trees will be planted that may eventually require trimming for maximum safety clearances but that such maintenance would not be extravagant (12).

With an interconnected grid system, all coupled systems require a high degree of security. Maintenance Departments must be extremely alert to system failure from whatever cause or potential cause. Such a potential is inherent in the current trend toward leaving woody growth in relatively close proximity to high tension conductors. Maintenance costs and methods for beautility plantings are an unknown. Such must not be the case.

The biological sciences are on the threshold of offering a possible key to reduced maintenance costs on growing plant material. If the plant physiologist can reliably contain the growth of plants by chemical, by genetic or by environmental factors, we will have transcended the era of the herbicides.

A number of papers have referred to the utility application of MH30 and MH30T, (1,2 dihydro-3,6-pyridazinedione) and the Diethanolamine salt to control the growth of woody plants (1),(2),(6),(10),(15),(19),(25),(28). Much of this information has been developed in conjunction with trimming practice on distribution lines. Such information has culminated in a commercial use of the material in California (7),(23) and in an experimental station publication (26).

Recently, the group of morphactin materials has been demonstrated as effective foliar growth retardents for woody plants (13),(16),(17). The most active of these materials is CF125, (Methyl 2 chloro-9-hydroxyfluorene-9-carboxylate). NIA10637, (Ethyl hydrogen 1-propylphosphonate) is a growth regulating material which Nethery has shown to have activity on a number of woody species (21),(22). A new growth regulating material has been developed by DuPont (3). It has been given the designation DP1108; however, the chemical structure has not been released.

These four growth control chemicals have been compared in an experiment designed to evaluate the control of apical and lateral growth on three species of forest trees.

MATERIAL AND METHODS

An experimental nursery for growth retardation experiments was established by Ontario Hydro in 1969. This nursery is situated on flat ground with a predominantly heavy clay soil, poor drainage and open exposure to easterly winds. The prevailing winds are however from the west. Average rainfall in this area is some 75 cm per year, the maximum and minimum temperatures +35C and -25C respectively. Micro-climate at this point is effected by a 0.8 kilometer proximity to Lake Ontario just below the 44th parallel.

White ash (Fraxinus americana L.) and silver maple (Acer saccharinum L.) were established in the spring of 1969. Carolina poplar (Populus canadensis, eugenei Moench) were planted in the early spring of 1970.

The stock originated from the Ontario Department of Lands and Forests nursery at Orno, Ontario. The ash and maple were grown from seed collected in zone 6E while the poplar were grown from 15 cm cuttings having Ontario clone origin.

The trees were planted in rows 3 meters apart with the individual trees 2.5 meters apart, seventy trees in each row. At time of treatment (June 10, 1970) the ash and maple had attained a height of 2 to 2.5 meters and the poplar 1.5 to 2 meters.

Trees were picked randomly for treatment, but trees exhibiting dieback or poor crown development were not included in the block used for random choice.

Each tree was numbered with a plastic tag attached to a major lateral. These self-tie tags were also attached with a plastic/wire tie which would fall into the crotch of that lateral if the tag were to break. A map of each row and specific placing of each proposed treatment was compiled.

The time of bud break was relatively uniform between species. The time of treatment was determined by the degree of leaf expansion of each species, however, some

individuals had greater growth at time of treatment than did others. No treatment was attempted until all buds had produced leaves and these leaves had completed initial chlorophyl production.

One day prior to treatment each tree was measured at three points; the leader, the lateral with the tag and the immediate opposite lateral in the case of ash and maple and the next lateral down in the case of the poplar. The actual measurements were made from the seasonal growth collar to the end of the growing point of each branch. One hundred and five trees of each species were tagged to provide for four chemicals at three rates plus three controls, all replicated seven times. The large number of controls (21) and replications (7) were required for statistical analysis of the results of each treatment. Any dead laterals or small laterals with dead buds on the tree were removed with secateurs. The species treatment date, evaluation dates and weather conditions are given in Table II.

A hand operated Cooper Pegler CP3 pressure gauge backpack sprayer with a nozzle producing a broad flat spray pattern was used to apply the chemicals. These rates are given in Table III. Each was applied in an aqueous solution of nine liters which was sufficient to spray the leaf surfaces and stem of the seven replications of each of the three species. Specific care was taken to ensure complete coverage without contaminating a neighbouring treatment. No more than 1 kg per sq cm pressure was used. This gave good penetration into the crown with minimum drift. The controls were sprayed with the water (pH6.5) used in making up the treatment solution.

The median rate used was that suggested in the manufacturers literature (3), (34),(35),(36). The other two rates used above and below that rate are at a level which would control growth without severe foliage damage. A second experiment with greater spread of rates has been repeated with three replications to determine the toxic threshold of each species to the materials; however, the results in that experiment differ little from those reported here.

The use of surfactant combinations was considered, however a previous paper by Sachs (25), has noted little enhanced efficacy with a number of these agents and they were not incorporated in this experiment.

Measurements and observations were made approximately 40 and 140 days after treatment. Each evaluation remeasured the growth of the leader and laterals, the first lateral being identified by the previous attachment of the tag and wire tie. Measurement of growth alone was found to provide an inadequate picture of results. Therefore data sheets were compiled for each individual tree. Where at the first evaluation leaf necrosis, dieback, chlorosis, epinasty, bud damage, or bark damage were evident these were recorded. A subjective evaluation of leaf loss as a percentage of the total crown was made. At the second evaluation made after senescence, bud set, tissue dieback, bark damage and death were recorded.

The statistical analysis of the numerical data was undertaken by Punhani (24) using an Incomplete Latin (Youden) square design as described by Cox (5). This numerical data, given in Table IV, applies only to the evaluation made in August of 1970. There is little difference between these data and those collected in October of 1970. The growth on all species between these two periods was comparatively small.

The correlation of the subjective evaluation of visible effects was undertaken by the author. Evaluation number one and two data sheets were compiled to give a composite picture of growth and or damage during 1970.

RESULTS

The statistical analysis of the growth data for the White ash did not detect any significant difference among the treatments. Treatments 1, 4 and 7 appeared to have exerted some effect relative to the controls. All other treatments grew more than the controls. Sachs, Phillips and Corkins have noted fair to poor control of ash with MH30 (26),(23),(4). Further, ash is notably resistant to a number of herbicides. A combination of reasons may explain this resistance. Poor leaf absorption may be a characteristic of ash species. Each of the treatments mentioned above are the low rates of each material. Possibly high auxin levels in ash may cause auxin antagonism with synthetic growth regulators resulting in a diffusion blockage of the sprayed material.

The subjective analysis indicated severe and very severe leaf necrosis respectively for the two higher rates of MH30T at 40 days after treatment. This damage was not evident at the 140 day evaluations. The DP1108 did not cause noticeable formative effects. Some bark damage was evident at the 4 lb rate. NIA10637 at the 1 lb and 4 lb rates produced no foliage damage, however, the 8 lb rate produced severe necrosis at the 40 day evaluation on 40 per cent of the replicates. This did not affect bud set although slight bark damage was evident on some individuals. The CF125 produced slight necrosis at all rates at 40 days, however no effect carried through to fall. No disturbance of the controls was evident.

Growth of all the maples tested was relatively small despite favourable growing weather. This may be a reflection of the site quality which is not ideal for maple species. Lane has indicated that silver maple is not an ideal choice for experimental work if grown from commercial seed rather than one clone. Silver maple will cross-pollinate freely with other maple species thus producing variability in collected seed. Since genetic similarity of stock is required for reliable results of growth retardent response, silver maple will not be used in future experiments.

Treatments 1, 2, 3, 4, 5 and 12 controlled the growth of the leader and laterals uniformly. Treatments 8 and 9 promoted growth in comparison with the controls.

The subjective evaluation indicates that the 2 and 3 gal rates of MH30T caused no disturbance of the foliage during the growing season or of bud set in the fall. The 5 gal rate caused severe leaf necrosis and severe dieback of all 1970 tissue. The DuPont research material caused no evident damage other than slight lateral defoliation at the 40 day assessment with the 2-5 lb rate. NIA10637 caused little damage at the 1 and 4 lb rates however, 8 lb caused severe leaf necrosis noted at the 40 day assessment. This damage did not affect bud set at the 140 day evaluation.

CF125 produced small cupped leaves on growth produced after spraying. This epinasty was still noticeable 40 days after treatment at all rates. Some tissue dieback of 1970 growth was produced by the 300 ppm rate. No other adverse effects were evident. No undue disturbance of the controls was detected.

The poplar, although established in the year of treatment, produced greater growth than ash and maple. The statistical analysis of the numerical data provides more meaningful results. Further, the degree of damage was greater with high rates of the chemicals used, indicating a threshold of tolerance. Treatments 3, 4, 5, and 6 were significantly better in their control of both apical and lateral growth with the exception of treatment 4 on lateral #2. Treatments 8, 9, 10, 11 and 12 grew more than the controls. Treatments 10, 11 and 12 were significant in this respect.

The subjective analysis produced uniform results with respect to defoliation, necrosis, chlorostic effects, and bud damage. The 2 gallon rate of MH30T did not produce adverse effects either at the 40 day evaluation or after senescence. The 3 gal rate caused some defoliation of laterals when first evaluated. This effect resulted in incomplete fall bud formation on 60 per cent of the replicates. The 5 gal rate produced noticeable defoliation initially. This resulted in severe bud damage and tissue dieback by the time of the second assessment.

The 1 lb rate of DP1108 produced some initial defoliation, however, this did not result in incomplete bud set. The 2.5 lb rate caused severe defoliation at 40 days, causing 50 per cent of the replicates to die by fall. Those remaining alive had up to 80 per cent bud damage. The 4 lb rate produced even more severe defoliation resulting eventually in 70 per cent death.

NIA10637 at the 1 lb rate produced slight defoliation after treatment. This did not effect hardening off. Increased bud formation from auxiliary buds was noted on 30 per cent of the treatments. The 4 lb rate produced essentially the same results although increased bud formation was noted on 70 per cent of the trees. The 8 lb rate did not cause this effect, but severe bark lesions were noted at the base of the leader on 30 per cent of the specimens.

The low rate of CF125 caused slight defoliation and chlorosis was noted on 20 per cent of the treatments. No effect was evident on bud formation at the 140 day assessment. Similarly, the 200 ppm rate caused little effect other than chlorosis on 40 per cent of the treatments. The 300 ppm rate produced noticeable epinasty on new growth 40 days after treatment. This did not effect fall bud set. One control died; the balance had produced a high degree of bud set at the time of the 140 day evaluation.

DISCUSSION

The experiment was intended to screen the four growth retardents to establish efficacy, optimum rates of application and degree of undesirable side effects. Ash and maple did not show statistically significant results for linear growth control however, the order of these results is similar to the data collected on poplar. The subjective data are of value in comparing treatments even though growth differences in some treatments are not significant. Different species would appear to require separate rates to provide equal control. MH30T gave the most complete growth control with fewest side effects at the 2 and 3 gal rates. The low rate produced no adverse side effects but the 3 gal rate produced some defoliation especially in the ash 40 days after treatment. The only long term effect was on poplar where fall bud set was affected. The 5 gal rate produced severe defoliation after treatment, eventually resulting in severe tissue dieback and bud damage.

The DP 1108 gave good growth control at all rates. The 1 lb rate provided the most uniform control and produced no ill effects on any species. The 2.5 and 5 lb rates however, produced this control of growth on the poplar through very severe dieback resulting at the high rate in 70 per cent death. Maple and Ash did not exhibit this effect although some bark damage was caused by the high rate on Ash.

The NIA 10637 at the low rate produced better control than at higher rates. Increased bud formation was noted at this rate and at the 4 lb rate. Such was not the case at the 8 lb rate which caused some leaf damage after treatment and bark lesions on poplar. These two higher rates appeared to stimulate growth on ash and maple in comparison with the controls.

The three rates of CF125 used did not control growth except at 300 ppm on maple and in the case of poplar all rates appeared to stimulate growth. The material produces epinasty on new growth especially on maple. This effect does not persist as bud damage, however some leaf malformation in the second year has been observed by the author in other experiments. It would appear that the rates used were too low and that control may be effected at a 500 ppm concentration.

These experiments will be evaluated in June and October of 1971 to establish if the materials exert any carryover effect. In an effort to apply the information gained here toward field use of the more successful growth retardents, further trials will be undertaken in 1971. It is hoped that aerial application with a helicopter and Micro Foil spray equipment will be investigated on a new right-of-way which has been selectively cut.

All growth regulation experiments require more definite parameters to enable results to be translated from one species to another. Application techniques should be standardized. Specific species should be recognized for screening and experimental field trials. Stock used should only originate from one clone. Sachs has noted that terminal dieback is characteristic of MN30 (25). Such damage may be tolerated or produce longer term control on larger trees. The acceptable degree of damage caused by growth retardents should be established. The effect of either pruning or not pruning prior to application of growth controling chemicals should be further investigated.

Auxin control of plant growth mechanism is fraught with difficulties. The mode of action in many plants is little understood. Much of the research is less than scientific, substances that effect growth being tested in biological and numerical permutations that are staggering in number, in the hopes of hitting a usable combination. Many of the chemicals so far developed and now used in woody growth research were first developed for horticultural or agricultural purposes. The short-term financial gains in these two fields are of course considerable and much of the research money in this field is devoted to this end.

The formation of a group whose prime interest would be the various aspects of growth regulation would appear to be indicated. This combination of people in basic research, chemical company development, extension and commercial fields would enable a definition and perhaps answer to be given to some of the puzzles presently evident in growth regulation.

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Table I.

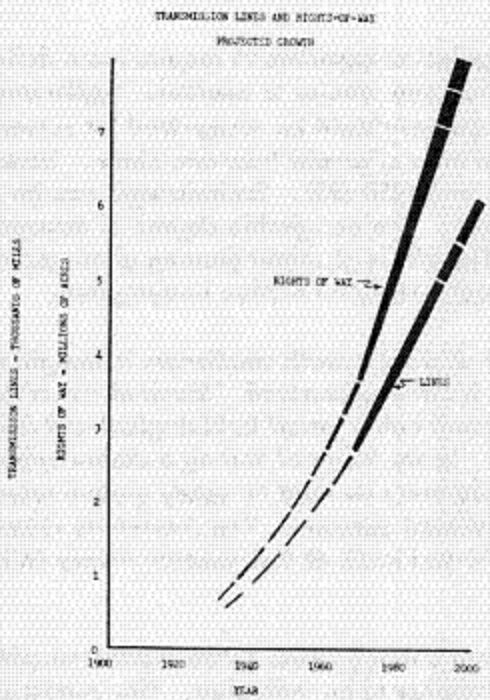

Table II.

Species	Date of Treatment	Wind 12:00 pm	Temp. 12:00 pm	Humidity 12:00 pm	Date of Eval #1	Date of Eval #2
Ash W.	June 10	W.S.W.	27°C	43%	July 21	Oct. 27
Maple S.	"	at	"	"	Aug. 8	Oct. 28
Poplar C.	"	11 mph	"	"	July 22	Oct. 29

Table III.

Research Designation	Trade Name	Chemical Name	Rate
1	MH30T	Diethanolamine salt of 1,2- dihydro	2 gal p
2	(Royal Slo-Gro)	-3,6-pyridazinedione plus	3 in 80
3		adjuvant	5 imp gal
4	DP1108	Not known	1 lb p
5			2.5 in 100
6			4 US gal
7	NIA10637	Ethyl hydrogen 1-propyl-	1 lb ai
8		phosphonate	4 in 100
9			8 US gal
10	CF125	Methyl 2-chloro-9-hydroxy-	100
11		fluorene-9-carboxylate	200 ppm

Table IV.

ASH: Mean Linear Growth in cm for each Treatment

Leader

9	12	10	11	3	6	2	8	5	C*	4	7	1
1.27	0.70	0.62	0.59	0.58	0.56	0.55	0.43	0.42	0.40	0.34	0.32	0.23

Lateral #1

8	12	5	6	9	2	11	3	10	C*	7	1	4
1.04	0.78	0.56	0.56	0.46	0.40	0.39	0.37	0.34	0.33	0.32	0.24	0.23

Lateral #2

8	11	12	9	3	6	5	4	2	7	1	10	C*
1.14	0.76	0.63	0.54	0.50	0.49	0.44	0.41	0.34	0.26	0.23	0.21	0.14

MAPLE: Mean Linear Growth in cm for each Treatment

Leader

8	C*	7	6	10	9	11	5	12	1	3	4	2
0.54	0.45	0.43	0.36	0.36	0.34	0.31	0.30	0.30	0.30	0.19	0.10	0.07

Lateral #1

8	9	C*	10	11	7	5	6	4	3	12	1	2
0.54	0.54	0.35	0.34	0.34	0.33	0.26	0.23	0.21	0.19	0.19	0.14	0.10

Lateral #2

9	6	C*	11	8	4	7	10	12	5	1	2	3
0.49	0.44	0.43	0.34	0.33	0.33	0.31	0.31	0.26	0.23	0.21	0.19	0.06

POPLAR: Mean Linear Growth in cm for each Treatment

Leader

11	10	12	1	8	C*	2	9	7	4	3	5	6
8.20	7.82	7.17	5.90	4.50	4.44	4.17	3.94	3.59	2.20	2.11	1.59	0.79

Lateral #1

11	12	10	8	1	9	2	C*	7	6	5	3	4
4.61	4.13	3.86	3.83	3.63	3.30	2.84	2.82	2.36	1.79	1.51	1.16	0.90

Lateral #2

11	12	10	8	7	9	1	4	C*	2	3	5	6
4.87	3.93	3.91	3.37	2.69	2.59	2.52	1.91	1.79	1.11	1.10	1.03	0.51

Treatments which do not differ significantly have been underlined by a bar, the significance level being 5%.

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BASAL STEM SOIL APPLICATIONS OF BROMACIL FOR WOODY PLANT CONTROL

By

C. B. Harris, Jr.1/

INTRODUCTION

"Hyvar" X (80% wettable powder), "Hyvar" X-WS (50% soluble powder), and "Hyvar" X-P (10% pellet) formulations of bromacil have been labeled for control of woody plants on rights-of-ways of utilities and railroads, on ditch banks and on other industrial sites for several years. Woody plant species such as cottonwood, hackberry, maple, oak, poplar, red bud, sweet gum, wild cherry, willow, and winged elm are controlled at rates of 1.5-3 grams per 2-4 inch diameter stems or 7.5 to 15 lb s. active ingredient per acre. The material is directed to the soil at the base of the plants to cover an area 1/2 to 1 square foot in size.

"Hyvar" X-WS is being discontinued and a new 3 lb. per gallon formulation of bromacil, "Hyvar" X-L, has been introduced to replace it.

Work on the application of bromacil applied to the soil was started in the Midwest in 1965 in cooperation with several utilities in Indiana, Kentucky and Michigan. Today, "Hyvar" X, "Hyvar" X-WS, and "Hyvar" X-P are all being used commercially as soil applications.

MATERIALS AND METHODS

Most of you are familiar with the basal-stem treatment using 2,4,5-T or 2,4-D-2,4,5-T in diesel oil. This brush control technique has been highly effective.

It was decided to test "Hyvar" X and "Hyvar" X-L applied in the same manner, but substituting water for the oil. Application personnel object to the use of oils.

These tests were set out beginning in April, 1968 near Lansing, Mancelona and Niles, Michigan; Columbus and Galion, Ohio; Shively, Louisville and Bowling Green, Kentucky; and near Indianapolis, Indiana. Species involved in these tests were wild cherry; common and red maple; sassafras; winged

1/ E. I. DuPont DeNemours and Company, Inc.

and American elm; hackberry; poison ivy; hickory; sumac; white, green and blue ash; mulberry; pear; box elder; pin, white, red and water oak; privet; dogwood; willow; apple; cottonwood; poplar; walnut and red bud.

The "Hyvar" X-L was mixed in water at the rate of 2 gallons (6lbs. active bromacil) per 100 gallons and applied by spraying the basal part of stems of the plants up to 15 inches from the ground with 7 to 14 ounces of solution per stem 2 to 4 inches in diameter. Applications were made on a monthly basis throughout the calendar year.

RESULTS

Seven ounces of solution per stem was effective on plants up to 2 inches in size and the more susceptible species. In fact, at all locations, results on maple, sweet gum, box elder, wild cherry, oak, sumac, white ash, elm, sassafras, hackberry, red bud, dogwood, poison ivy, winged elm, willow an d cottonwood showed 100 per cent foot kill at that rate. But, control on pear, apple, green ash, and mulberry at 7 ozs. per stem ranged between 75 and 90%. Results on persimmon averaged 50 to 60%. The higher rates were required to kill these species.

We found that no species is completely resistant to bromacil. In o ther areas of the U. S. persimmon, sycamore, and Chinese tallow have required the higher rates.

After two years of work with this new formulation of bromacil, no differences in performance on brush have been noted when "Hyvar" X-L and "Hyvar" X-WS were used at equal rates.

Soil type has had little effect on the results obtained with bromacil when applications are made in the spring, summer and fall. An exception is fall applications in sandy soils where slightly inferior results were obtained. Applications were also made during the months of November through March when temperatures are below 32°. Six gallons of methanol were added to the water to make up 100 gallons of spray material. The results from these applications were excellent.

CONCLUSIONS

"Hyvar" X-L is non-volatile, easy and clean to apply. It may be applied with hand sprayers or conventional spray

equipment. As a basal-stem treatment, "Hyvar" X-L at 2 gallons per 100 and applied at 7-14 ounces per stem, 2-4 inches in diameter was at least as effective as "Hyvar" X and "Hyvar" X-WS at equal rates of active ingredient.

Now let's look at some of the slides which show the results with bromacil as a basal-stem treatment.

REGULATIONS GOVERNING INDUSTRIAL WEED AND BRUSH CONTROL IN THE NORTHEAST

J. E. Dewey and R. F. Pendleton[1/]

Increasingly restrictive regulations for pesticide control and usage are presently being established at both state and federal levels. Federal laws apply universally, but state laws are often more restrictive as to specific uses. Laws vary from state to state. The authors have compiled existing regulations which pertain to industrial weed and brush control in the Northeast. These are believed to be correct at the present time, but since it is anticipated that considerable legislative activity will continue, it is imperative that the user keep abreast of new developments.

Table I lists current state regulations as known to the authors at the date of writing. Registration and licensing laws pertaining to applicators are not included.

Table II compiles uses and limitations of several of the more commonly used industrial herbicides.

Table I. State Laws Relating To Application Of Herbicides[2/]

There are no laws governing application of herbicides in Delaware, Rhode Island, Virginia, and West Virginia, excepting those requiring licensing of applicators.

Connecticut

1. Landowners desiring aerial application must have permits from the Commissioner of Agriculture and Natural Resources.

2. Permits are required from the State Pesticide Control Board to chemically treat waters of the State, after approval from the State Board of Fisheries and Game. Approval is required also from the Shellfish Commission if marine or tidal waters are involved, and from the State Health Department if public water supplies are involved.

Maine

1. No pesticide may be applied to any municipal water supply or body of water used for public purposes without permission of State Board of Pesticide Control.

1/ Program Leader and Situation Survey respectively, Chemicals-Pesticides Program, Cornell University

2/ Chemical names are listed in Table II.

Table I (Cont'd.)

Maine (Cont'd.)

2. The Highway Department may not apply herbicides within right-of-way to control deciduous trees or brush over 6' tall or evergreens over 3' unless annual regrowth exceeds these limits.

3. The inland Game and Fish Department advises permission to apply registered chemicals to body of water greater than 10 acres. No action can be taken unless intent is to stupefy or poison fish. This does not apply to privately owned waters.

Maryland

1. Sodium arsenite requires a "restricted use permit" and is prohibited for home and garden.

2. Phenoxy herbicides and other growth regulators require "restricted use permit" from the State Board of Agriculture if applied aerially.

Massachusetts

1. The State Pesticide Control Board must approve each use of any pesticide on watersheds and public water supplies, on the advice of the Department of Public Health, and following practices approved by the U. S. Public Health Service.

New Hampshire

1. Sodium arsenite is allowable by permit only. The specific use is for tree killing where debarking is necessary.

New Jersey

1. Permits to treat water with chemicals may be issued by the local conservation officer.

2. Upstream sources of potable water may be treated by permit from the local potable water purveyor.

New York

1. 2,4-D; 2,4,5-T; MCP may be prohibited by petition of 10 or more grape growers in area where grapes are main source of income.

2. No pesticides may be applied to surface waters other than private with no outlet except by permit from Department of Environmental Conservation.

3. No pesticide may be applied to state lands under jurisdiction of the Department of Environmental Conservation without written permission.

Table I (Cont'd.)

New York (Cont'd.)

4. 2,4,5-T, DNBP - sale and use by permit only.

5. Paraquat - all concentrations above 0.2% cation, sale and use by permit only.

6. Pentachlorophenol - all concentrations above 5%, sale and use by permit only.

7. Sodium arsenite - all concentrations above 2%, sale and use by permit only.

8. Pesticides may be used only by permits from the Department of Water Supply, Gas and Electricity of New York City on watersheds surrounding their reservoirs.

Pennsylvania

1. 2,4-D and 2,4,5-T may not be used within two miles of commercial grape vineyards.

2. No chemical may be applied to ponds, lakes, streams, and other potable waters without written permit from Pennsylvania Fish Commission.

Vermont

1. All regulations pertaining to pesticides published in the Federal Register will apply in Vermont.

2. Pesticides may be applied by air only by permit issued by the Aeronautics Board.

3. Pesticides may be applied to water only by permit from Water Resources.

4. The use of dinitros, pentachlorophenol and its salts, endothall, acrolein, paraquat, sodium chlorate and picloram is restricted to commercial users only who must sign for purchase.

5. Sodium arsenite, diquat and the mercuries may be used by permit only.

Table II. Uses and Limitations

amitrole 3-amino-s-triazole

Federal Registration and Labeled Uses: Non-selective weed control on non-crop areas, spot treatment on alfalfa, clover, grains, legumes, peas, soybeans, dormant grape vineyards, pastures, chemical fallow in grain fields, preplant in corn, non-bearing apple orchards, cattails, some woody plants and vines. Weed control in nursery stock, forest plantations.

Federal Limitations: Crops label under review. Use prohibited on areas under jurisdiction of USDI.

State Limitations: See Table I - Connecticut 2, Maine 1 and 3, Massachusetts 1, New Jersey 1 and 2, New York 2, 3, and 8, Pennsylvania 2, Vermont 3.

Notes: Acute oral LD_{50} 15,000 mg/kg (rats).

AMS ammonium sulfamate

Federal Registration and Labeled Uses: Non-selective brush and weed control on non-crop areas, rangelands, and pastures. Apples, pears for spot treatment of poison ivy. Use around lakes, ponds, streams, and reservoirs for public water supply.

State Limitations: See Table I - Maine 2, Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 1,600 mg/kg (rats). Useful in areas where drift of phenoxy type herbicides would damage sensitive crops such as grapes. Formulation Ammate X-NI registered for weed and brush control along shoreline of public water reservoirs.

atrazine 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine

Federal Registration and Labeled Uses: Non-selective weed control in non-crop areas, soil sterilant, chemical fallow of grain fields, weed control in forest and Christmas tree plantations, weed control in corn, sorghum, pineapples, macadamia orchards, sugarcane, and wheat.

State Limitations: See Table I - Connecticut 1, Massachusetts 1, New York 3 and 8, Vermont 2.

Notes: Acute oral LD_{50} 3,080 mg/kg (rats). Even at low rates may affect sensitive crops the following year.

Table II. Uses and Limitations (Cont'd.)

bromacil 5-bromo-3-sec-butyl-6-methyluracil

Federal Registration and Labeled Uses: Non-selective weed control on non-crop areas, soil sterilant, pineapple, spot treatment in citrus.

State Limitations: See Table I - Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 5,200 mg/kg (rats).

cacodylic acid hydroxydimethylarsine oxide

Federal Registration and Labeled Uses: Non-selective contact herbicide in non-crop areas and turf, silvicide.

Federal Limitations: Use restricted to small scale applications on areas under jurisdiction of USDI.

State Limitations: See Table I - Maine 2, Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 830 mg/kg (rats).

dalapon 2,2-dichloropropionic acid

Federal Registration and Labeled Uses: Control of grasses on non-crop areas, ditchbanks, aquatic weeds, grassy weed control in alfalfa, apples, apricots, asparagus, bananas, beans, birdsfoot trefoil, citrus, coffee, corn, cotton, cranberries, flax, grapes, grass, macadamia nuts, pastures, peaches, pears, peas, pineapples, plums, potatoes, sorghum, soybeans, sugar beets, sugarcane, sweet clover.

State Limitations: See Table I - Connecticut 2, Maine 1 and 3, Massachusetts 1, New Jersey 1 and 2, New York 2, 3, and 8, Pennsylvania 2, Vermont 3.

Notes: Acute oral LD_{50} 3,860 mg/kg (rats).

dicamba 3,6-dichloro-o-anisic acid

Federal Registration and Labeled Uses: Selective weed and brush control on non-crop areas, aquatic weed control, silvicide by injection, weed control on turf, barley, corn, pasture, rangeland, oats, sorghum, wheat grass seed production.

Table II. Uses and Limitations (Cont'd.)

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dicamba (Cont'd.)

State Limitations: See Table I - Connecticut 2, Maine 1, 2, and 3, Massachusetts 1, New Jersey 1 and 2, New York 2, 3, and 8, Pennsylvania 2, Vermont 3.

Notes: Acute oral LD_{50} 1,040 mg/kg (rats). Use in fertilizer mixtures prohibited in New York and Vermont.

dichlobenil 2,6-dichlorobenzonitrile

Federal Registration and Labeled Uses: Selective weed control in fruit, woody ornamentals, temporary soil sterilant for shallow rooted plants, shelterbelt, and forest trees, fruit, and nut tree nurseries, alfalfa and ladino clover seed crop, cranberries, ponds, reservoirs, lakes.

State Limitations: See Table I - Connecticut 1 and 2, Maine 1 and 3, Massachusetts 1, New Jersey 1 and 2, New York 2, 3, and 8, Pennsylvania 2, Vermont 2 and 3.

Notes: Acute oral LD_{50} 2,710 mg/kg (rats).

dinoseb 2-sec-butyl-4,6-dinitrophenol

Federal Registration and Labeled Uses: Contact weed and brush control in non-crop areas, weed control on orchard floors, vineyards and bush fruits, vinekiller on potatoes, weed control in alfalfa, cereal grains, beans, birdsfoot trefoil, clover, corn, cucumbers, mint, peanuts, peas, pumpkins, soybeans, squash, strawberries, sweetclover (usually as pre-emergence or pre-harvest spray on crops grown for seed).

Federal Limitations: Use restricted to small scale applications on areas under jurisdiction of USDI.

State Limitations: See Table I - Connecticut 1, Maine 2, Massachusetts 1, New York 3, 4, and 8, Vermont 2 and 4.

Notes: Acute oral LD_{50} 40 mg/kg (rats). Absorbed through skin.

diquat 6,7-dihydrodipyrido[1,2-a:2',1'-c] pyrazinediium ion

Federal Registration and Labeled Uses: Non-selective top killer in non-crop areas, preharvest dessicant for certain crops, aquatic weeds on ponds, ditches, lakes, laterals, canals.

Table II. Uses and Limitations (Cont'd.)

diquat (Cont'd.)

Federal Limitations: Use restricted to small scale applications on areas under jurisdiction of USDI.

State Limitations: See Table I - Connecticut 2, Maine 1 and 3, Massachusetts 1, New Jersey 1 and 2, New York 2, 3, and 8, Pennsylvania 2, Vermont 2, 3, and 5.

Notes: Acute oral LD_{50} 400 mg/kg (rats).

diuron 3-(3,4-dichlorophenyl)-1,1-dimethylurea

Federal Registration and Labeled Uses: Non-selective weed control in non-crop areas, soil sterilant, irrigation ditches, weed control in alfalfa, apples, asparagus, artichokes, banana, barley, bermudagrass, birdsfoot trefoil, blueberries, caneberries, citrus, corn, cotton, gooseberries, grapes, grass (seed), macadamia nuts, oats, olives, pears, peas, peppermint, pineapple, potatoes, red clover, sorghum, sugarcane, vetch, walnuts, winter wheat.

State Limitations: See Table I - Connecticut 2, Maine 1, Massachusetts 1, New Jersey 1 and 2, New York 2, 3, and 8, Pennsylvania 2, Vermont 3.

Notes: Acute oral LD_{50} 3,400 mg/kg (rats).

fenac (2,3,6-trichlorophenyl)acetic acid

Federal Registration and Labeled Uses: Weed control in non-crop areas. Soil sterilant. Aquatic weeds. Sugarcane.

State Limitations: See Table 1 - Connecticut 2, Maine 1 and 3, Massachusetts 1, New Jersey 1 and 2, New York 2, 3, and 8, Pennsylvania 2, Vermont 3.

Notes: Acute oral LD_{50} 2,500 - 3000 mg/kg (rats).

fenuron 1,1-dimethyl-3-phenylurea

Federal Registration and Labeled Uses: Non-selective weed and brush control, soil sterilant, spot treatment of brush on rangelands.

Table II. Uses and Limitations (Cont'd.)

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fenuron (Cont'd.)

State Limitations: See Table I - Maine 2, Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 6,400 mg/kg (rats).

MH 1,2-dihydro-3,6-pyridazinedione

Federal Registration and Labeled Uses: Growth inhibitor on grasses, trees, shrubs on non-crop areas, to control some annual weeds, to induce dormancy in citrus, to prevent sucker growth of tobacco, to inhibit sprouting of potatoes and onions.

State Limitations: See Table I - Maryland 2, Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 2,350 mg/kg (rats, diethanolamine salt).

monuron 3-(p-chlorophenyl)-1,1-dimethylurea

Federal Registration and Labeled Uses: Non-selective weed control on non-crop areas, drained irrigation and drainage ditches, soil sterilant, weed control on asparagus, avocadoes, oranges, lemons, cotton, grapes, onions, pineapples, spinach, sugarcane.

State Limitations: See Table I - Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 3,600 mg/kg (rats).

paraquat 1,1'-dimethyl-4,4'-bypyridinium ion

Federal Registration and Labeled Uses: Non-selective top killer on weeds and brush in non-crop areas, seedbed preparation for grasses for seed production, cotton and potato vine dessicant, as a directed spray for weed control in orchards, vineyards, and as a preplant weed killer on asparagus, corn, cotton, lettuce, melons, peppers, sorghum, soybeans, sugarbeets, tomatoes.

Federal Limitations: Use restricted to small scale applications on areas under jurisdiction of USDI.

State Limitations: See Table I - Connecticut 1, Maine 2, Massachusetts 1, New York 3, 5, and 8, Vermont 2 and 4.

Notes: Acute oral LD_{50} 157 mg/kg (rats).

Table II. Uses and Limitations (Cont'd.)

PCP pentachlorophenol

Federal Registration and Labeled Uses: Non-selective contact weed killer, preharvest dessicant on alfalfa, clover, lespedeza, and vetch seed crops.

State Limitations: See Table I - Massachusetts 1, New York 3, 6, and 8, Vermont 4.

Notes: Acute oral LD_{50} 27-80 mg/kg (rats). Absorbed through skin.

picloram 4-amino-3,5,6-trichloro-picolinic acid

Federal Registration and Labeled Uses: Non-selective brush and weed control on non-crop areas.

Federal Limitations: Use restricted to small scale applications on areas under jurisdiction of USDI.

State Limitations: See Table I - Connecticut 1, Maine 2, Massachusetts 1, New York 3 and 8, Vermont 2 and 4.

Notes: Acute oral LD_{50} 8,200 mg/kg (rats). Persistent up to three years.

prometone 2,4-bis(isopropylamino)-6-methoxy-s-triazine

Federal Registration and Labeled Uses: Non-selective brush and weed killer in non-crop areas. Soil sterilant.

State Limitations: See Table I - Maine 2, Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 2,980 mg/kg (rats). Residual not as long as simazine or atrazine.

simazine 2-chloro-4,6-bis(ethylamino)-s-triazine

Federal Registration and Labeled Uses: Non-selective weed control in non-crop areas, selective weed control in alfalfa, almonds, apples, artichokes, asparagus, avocados, bermudagrass, blackberries, blueberries, boysenberries, cherries, corn, cranberries, currants, dewberries, filberts, grapefruit, grapes, grasses, lemons, loganberries, macadamia orchards, olives, oranges, peaches, pears, pineapples, plums, raspberries, strawberries, sugarcane, walnut, grasses grown for seed, nurseries, Christmas tree plantings and shelter belts, some turf grasses for sod.

Table II. Uses and Limitations (Cont'd.)

simazine (Cont'd.)

State Limitations: See Table I - Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 5,000 mg/kg (rats). May be used for shelter belts around base of many woody ornamentals to control surface weeds.

sodium arsenite

Federal Registration and Labeled Uses: Non-selective weed and brush killer, silvicide, soil sterilant, aquatic weeds.

State Limitations: See Table I - Connecticut 2, Maine 1, 2, and 3, Maryland 1, Massachusetts 1, New Hampshire 1, New Jersey 1 and 2, New York 2, 3, 7 and 8, Vermont 3 and 5.

Notes: Acute oral LD_{50} 10 mg/kg (small rodents). Concentrations above 2% may not be used or stored around homes.

sodium chlorate

Federal Registration and Labeled Uses: Non-selective soil sterilant on non-crop areas. Registered also as dessicant on beans, cotton, potatoes, rice, sorghum, tomato.

State Limitations: See Table I - Massachusetts 1, New York 3 and 8, Vermont 4.

Notes: Acute oral LD_{50} 5,000 mg/kg (rats). Sodium chlorate is a strong oxidizing agent and is frequently mixed with borates to reduce fire hazard. Is also frequently formulated with other herbicides.

Tandex[1/] m-(3,3-dimethylureido)phenyl *tert*-butyl carbamate

Federal Registration and Labeled Uses: Non-selective weed control in non-crop areas, soil sterilant.

State Limitations: See Table I - Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 3,000 mg/kg rats.

1/ Proprietary name.

Table II. Uses and Limitations (Cont'd.)

TCA (sodium salt) trichloroacetic acid (sodium salt)

Federal Registration and Labeled Uses: Grassy weed control on non-crop areas, beets, cabbage, cauliflower, flax, sugar beets, sugar cane, plant cane, stubble cane, tomatoes.

State Limitations: See Table I - Massachusetts 1, New York 3 and 8.

Notes: Acute oral LD_{50} 5,000 mg/kg (rats). Effects last from 60-90 days. At lower rates can be used to suppress grass growth rather than kill.

2,4-D (2,4-dichlorophenoxy)acetic acid

Federal Registration and Labeled Uses: Selective weed control on turf and other non-crop areas, apples, asparagus, barley, blueberries, corn, cranberries, fallow land, flax, grapes, grapefruit, grass, lemons, oats, oranges, pasture, pears, potatoes, rangeland, raspberries, rice, rye, sorghum, soybeans, strawberries, sugarcane, wheat, aquatic sites, non-selective brush control.

State Limitations: See Table I - Connecticut 1 and 2, Maine 1, 2, and 3, Maryland 2, Massachusetts 1, New Jersey 1 and 2, New York 1, 2, 3, and 8, Vermont 2 and 3.

Notes: Acute oral LD_{50} 500 mg/kg (rats).

2,4,5-T (2,4,5-trichlorophenoxy)acetic acid

Federal Registration and Labeled Uses: Broadleaved weed and brush control on non-crop areas. Pastures and rangeland brush clearance. Registration has recently been cancelled for all uses in lakes, ponds, or ditchbanks; all uses around the home, recreation areas, and similar sites; all uses on food crops.

Federal Limitations: Use prohibited on areas under jurisdiction of USDI.

State Limitations: See Table I - Connecticut 1, Maine 2, Maryland 2, Massachusetts 1, New York 1,3,4, and 8, Pennsylvania 1, Vermont 2.

Notes: Acute oral LD_{50} 300 mg/kg (rats).

LONG RANGE MAINTENANCE CONTRACTS FOR BRUSH CONTROL

Howard B. White[1]

Until the middle 1950s, our System enjoyed the enviable position of having many competent local brushcutters interested in competition bidding for mechanical reclearing of our transmission line rights-of-way. These individuals bid for work, assembled their crews, and were awarded work based on the amount of brush they could clear. Contracts were awarded on a line-mileage basis; and as these individuals possessed little working capital, crews were paid periodically as the work progressed. Due to competition, our brush control maintenance cost was approximately $17.00 per acre, per 3-year cutting cycle.

As we moved toward the end of the 50s the economy was rapidly improving, wages in industry were spiraling, and the younger cutters began drifting off to industry. Brushcutting labor became scarce, thus causing rising costs at a time when our System was experiencing rapid expansion. The "day-of-reckoning" was fast approaching--We either sought new methods or accepted a radical increase in maintenance costs.

Not having sufficient personnel with the expertise in chemical control to properly supervise and evaluate results, we sought a realistic and controlled evaluation of chemical control in order to intelligently justify a conversion to chemical clearing with its initial higher costs.

In 1960, we selected our Palmer-to-Millbury 115 kV line right-of-way as typical of System rights-of-way in terrain, growth, species, and access. Also, since one-half its 34-mile length had been stump treated when initially cleared, plus the fact agreements with landowners prohibited chemical use on three separate parcels aggregating about 3/4 of a mile, we were afforded comparison of at least three different programs of chemical treatment, versus mechanical clearing.

Costwise, from the viewpoint of moneys spent, this job would not be a bargain compared to our past contract prices for reclearing. However, since two chemical applications were supposed to convert the right-of-way from tree species to grass and shrub species, and we would be allowed to capitalize these two treatments, our maintenance charges would not greatly exceed those of previous methods. Also, costs would decline as brush density decreased.

It was agreed that this right-of-way, initially cleared in 1959, would be acceptable for chemical treatment in 1961. Several knowledgeable, reputable contractors were invited to submit proposals for a planned ten-year control program. A contract was consummated in late 1960, with the understanding the first treatment was to be made in 1961.

Our contract was not uniquely different from usual contracts regarding liability, wages, supervision, contractor performance, etc., but did include the following specifics:

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[1]Supervisor, Right-of-Way Maintenance Department, New England Power Company, Worcester, Massachusetts.

1. Ammate-X be used on approximately 5 miles of right-of-way for the term of the contract--No substitution;
2. Type and amount of chemical on remaining 29 miles at discretion of the contractor;
3. Eighty-five percent of all tree species eliminated at completion of contract;
4. Evaluation test plots to be established along various sections of the right-of-way;
5. Time of year and type of application left to the contractor's discretion;
6. Evaluation inspections to be conducted yearly, by representatives of the Company and contractor.

A payment schedule was submitted and agreed upon, whereby the contractor would be paid a sum of money upon completion of each treatment, with the balance of the total sum paid yearly, during the term of the contract.

The first foliar application, including the Ammate-X section, was made in 1961. Our inspection in 1962, noted a 98% "stem kill" of tree species.

The second application was a dormant-cane treatment in 1964. The Ammate-X section was not treated.

In 1966, or 5 years from the date of first foliar application, the Ammate-X section was again foliar treated.

The third and final treatment, foliar type, excepting the Ammate-X, was applied in 1968.

The Ammate-X section was given a final treatment in 1970.

Our evaluation inspections were conducted faithfully, with close scrutiny given each year. We believe this right-of-way will not require treatment again until 1972, or possibly 1973. While we term this a ten-year program, in reality it thus becomes 12 or 13 years; so if we divide the total cost of the contract by 12, rather than 10, we find our maintenance costs comparable to our mechanical-clearing costs. Based on 13-year control, we are ahead of present mechanical-clearing costs.

Chemicals utilized during the term of this program were 2,4,5-T and Ammate. The 2,4,5-T was applied at the rate of 6-pounds acid equivalent per 100 gallons of water in the foliar treatment; and at a rate of 4-pounds acid equivalent per 100 gallons of oil in the dormant-cane treatment. Ammate was applied at the rate of 60 pounds per 100 gallons of water.

Our inspection showed no significant difference between the section that was stump treated and the section where the stumps were not treated.

We believe that it is more advantageous to allow the stumps to sprout after initial clearing and then apply a foliar spray, than to treat the stumps when many of the smaller ones become hidden or buried, due to the disturbance of the earth during clearing and construction.

While we agree the contractor fulfilled his obligations and our right-of-way is converted to grass and shrub species, there are still "pros and cons" to be considered under a program of this type.

Pros:
1. Predetermined maintenance costs;
2. Minimum number of Company personnel required;

Cons:
1. Loss of control of program by Company;
2. Inability to determine methods or materials;
3. Inability to defer or step-up treatment for specific areas.

CONCLUSION

Our decision to utilize such a program was predicated on the fact we did not have the personnel or the expertise to properly supervise or instruct people in the correct method or type of control, in order to guarantee a program of brush control most advantageous to us.

Based on the information obtained from this ten-year program, we have been able to train personnel, establish a control program, project approximate maintenance costs, and convert our rights-of-way to chemical control.

Due to the present awareness of and consideration for environmental and ecological aspects of our maintenance programs, the Company must exercise complete control in order to have the flexibility needed to alter, revise, defer or otherwise modify procedures or materials as conditions may warrant.

POTOMAC ELECTRIC POWER COMPANY'S EXPERIENCE WITH HERBICIDES ON FEDERAL WILDLIFE LANDS

J. H. PARSONS

Abstract

Potomac Electric Power Company owns most of its high voltage transmission rights-of-way. A small portion is of the easement type, and the U. S. Department of Interior, Fish and Wildlife Service controls some of this on which their Patuxent Wildlife Research Center is located.

The agreement with them states that "brush or small trees below a height of 18 feet, six inches may not be cut without permission". In 1967 the brush which came on after the initial clearing of 1960 was approaching this height.

After much deliberation and consulation with the wildlife people, we received permission to proceed with a selective basal spray. The results were satisfactory to everyone concerned. Several unexpected benefits were derived by Pepco from doing the treatment at the time of year insisted on by the Fish and Wildlife Service.

Introduction

Being located in the Nation's Capital my company, Potomac Electric Power Company, has long been conscience of its responsibility to its neighbors. In the past, this did not mean any more in the way of conservation than any other utility was doing but took the form of attractive substations. It is almost impossible to tell many of the substations from the adjacent buildings.

Prior to 1955 Pepco had only nine miles of cross country 230 KV rights-of-way. This has now been expanded to 220 miles of which most is fee simple. I realize this is not much in comparison to what many of you manage, but due to the location, I feel we have more than the usual number of problems.

One of these problems was a small portion of our rights-of-way on which we have only an easement. This area is controlled by the Federal Government through the Departments of Agriculture and Interior and their subdivisions, the Forest Service and Wildlife Service.

When I first saw the area I could see why my predecessor had advised me to look at it as soon as possible. The easement contract with the Wildlife Service reads, "brush or small trees below a height of 18 feet, six inches may not be cut without permission" and this brush, which had not been treated since the original clearing, was approaching 20 feet in height.

After several meetings the Federal Personnel agreed that something needed to be done and asked what we would propose. Everyone had a good laugh when I said I would like to brush hog the area. I then suggested, as had other people, a selective basal treatment and from there, it was just a matter of agreeing on specifications. I would like to mention a couple of points at this stage which were in our favor. The Forest Service agreed to let the Wildlife Service oversee the work on

their land and so we had only the one agency to deal with. Perhaps deal isn't the right word, because one of the first things the wildlife representative advised me of was that the work should represent a typical job as near as possible. In other words, his agency wanted to see if it were economically feasible to preserve the wildlife plants while doing a regular spray job.

Method of Treatment

What we did was certainly nothing new and was not a scientific experiment as such, but it was a good job of application of the things many of you have prescribed.

In 1968 there were 73 acres of brush involved of which approximately 40 were in almost solid pine. We agreed to have this pine cut and chipped to eliminate any fire hazard. This was quite an undertaking since the Wildlife Service insisted the spraying be done in the growing season. Due to getting a late start, we had to do the cutting and chipping in June and July when it was extremely hot. Then we proceeded with the spraying on the hardwoods.

The wildlife people employed a botanist to work right along with the crew and this, in my estimation, made a success of the job. I have found that no matter who is doing the work on selective basal spraying, unless one man is especially assigned to plant identification, the desired results cannot be obtained.

On the first treatment in 1968 we used 27 gal./a. of 2,4-D and 2,4,5-T solution. On the respray in 1970, due to the restrictions placed on 2,4,5-T, we used 2,4-D and 2,4-DP solution at the rate of 65 gal./a.

In 1968 we had an excellent kill on everything except Yellow Poplar and Black Gum. However, the 2,4-D, 2-4-DP took care of these this year and everyone concerned is well satisfied with the total results.

Benefits

Several unexpected benefits were realized from this work. In the past, when a basal treatment was used on pines in the dormant season, the results were not too satisfactory. This thinking tended to carry over into growing season. However, we missed some pines when we were cutting and treated them when we did the hardwoods. I could hardly believe they were all dead from basal spraying so I supervised the treating of an acre of pines on another right-of-way. The 99% kill was so good that I did not hesitate to do a 700 acre job, of mostly pine, in the growing season of 1969. The results were very good. After checking the wildlife area I believe we could obtain the same results from treating Black Locust in the growing season.

The state of Maryland Forestery Division likes our spray program so well they are letting us treat the stumps as we clear out weed trees in public space under distribution lines - something we had not been able to do before working on the Wildlife Lands.

During the past summer we had the same experience with the U. S. Park Service. You can imagine, with all the pesticide furor going on, what I thought the answer would be when I asked to spray on their land in the District of Columbia. The okay came through so fast that I double checked to make sure everyone understood what we wanted to do.

Conclusion

In other words, I feel that to be able to continue using chemicals, we, the final users, will have to do this type of contact work ourselves. We cannot sit back and ask chemical manufactures and contractors to promote all the publicity for us. We will have to prove to the Federal and State personnel, and this certainly includes public officials at all levels of government, that we can be trusted to use these chemicals in a safe and sane manner.

HERBICIDES AND WATER QUALITY IN AMERICAN FORESTRY

James H. Patric[1]

ABSTRACT

Scientific literature was reviewed to evaluate effects of forest herbicide use on water quality. No report suggested that proper herbicide use has limited the usefulness of water in forest streams. The long-term effects of herbicide use on water quality are unknown. Some rules are suggested for minimizing water pollution by herbicides applied in forests.

INTRODUCTION

Twenty years ago, pesticides were touted as man's best hope for survival in a hostile biota; today it is widely held that man cannot survive unless use of pesticides ceases. Usually, people who test and otherwise deal objectively with pesticides hold that blanket condemnation is nonsense. Nevertheless, social pressure against pesticide use is real and potent. Sometimes, though not always, social pressure without valid evidence of environmental damage has brought about unwarranted restriction against useful pesticides.

This is far too broad a problem to deal with in detail and briefly. My report is limited to herbicide use for controlling unwanted forest vegetation and effects of this use on water quality. The report is drawn almost entirely from scientific literature reporting evidence of herbicide effects on water quality, especially in forest applications.

Foresters are faced increasingly with problems of producing more goods and services in greater variety from a fixed or even shrinking land-resource base. Water, for example, is produced on forest land that is important also to timber, grazing, and recreation interests. Years ago, it was noted that defoliation by fire (19) and insects (14) increased streamflow. Now it is generally accepted that forest cutting increases water yield (16), but a host of social and economic considerations preclude wholesale burning or cutting solely to increase streamflow.

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[1]Forest hydrologist, Timber and Watershed Laboratory, Northeastern Forest Experiment Station, Forest Service, U.S. Department of Agriculture, Parsons, West Virginia.

The economy, efficacy, and controllability of herbicides as forest defoliators suggest that they be used to help satisfy man's ever-increasing needs for water. However, there is a very real risk that water so produced could be unfit for domestic, recreational, or even manufacturing use. In this respect, any material injurious to plant life is potentially harmful to animal life. But toxicity is not the only concern, because objectionable odor or taste also pose water-quality problems.

VALUES IN FORESTRY

Selective herbicides were developed after World War II, and their use has increased phenomenally in agriculture, more slowly in forestry. Hydrologists (2, 20) soon speculated about using 2,4-D to eliminate water-wasteful phreatophytic plants bordering many western rivers. Apparently no one was concerned at the time about pollution problems arising from such use. Thereafter, several reports (47, 9, 24, 44) clearly established that considerable saving of soil-moisture accompanied destruction of uneconomic woody plants with herbicides. In due course these reports were followed by other reports of herbicides used alone (4, 35), in conjunction with forest cutting (41, 36, 18), or with fire (21, 17) to achieve substantially increased streamflow.

Forest Service research on herbicides and water quality centers in the Pacific Northwest, origin of several excellent reviews (48, 49, 27, 50). The authors of these reviews concluded that herbicide use in forests is safe; and that water pollution can be held far below toxic levels simply by avoiding application into or close to streams. McKee and Wolfe (23) provided a lengthy review of herbicide toxicity to many forms of animal life.

EFFECTS ON WATER QUALITY

Foresters are proud that high-quality water almost always flows from woodland, and they quickly tested these increased streamflows for herbicide contamination. Because 2,4,5-T is especially useful in forestry, its effects on water quality are of widespread interest. Rowe (41) reported no trace of 2,4,5-T used to suppress riparian vegetation, but 2 to 30 ppm of the oil used as a carrier was detected. Re-treatment of the same watershed showed no trace of oil in stream samples, while 2,4,5-T never exceeded 0.09 ppm (21). Reinhart (40) never found 2,4,5-T in excess of 0.5 ppm after heavy applications to prevent regrowth on a deforested watershed. Pierce (37) reported concentrations of less than 0.001 ppm after similar use on another deforested watershed. Reigner et. al. (38), in widely published results, reported concentrations of 2,4,5-T up to 0.4 ppm immediately after spraying riparian vegetation. Lesser contamination (0.1 to 0.2 ppm) occurred 4 hours after spraying and during the first hard rain. Norris (29) found no

stream contamination after spraying 2,4-D and 2,4,5-T on several tracts within large forested watersheds.

In light of these and similar results, Montgomery and Norris (25) concluded that aerial application of 2,4,5-T to forest land causes an initial low-level, short-term stream contamination, which does not constitute a significant hazard to fish or animals. It nevertheless should be noted that even these low-level contaminations exceed the 0.001-ppm concentration of phenols recommended for drinking water by the U. S. Public Health Service (51). Although not toxic, low-level contamination by phenoxy herbicides and oil carriers causes objectionable taste and odor in drinking water. Reigner et. al. (39) suggested that phenol odor caused by minor pollution with 2,4,5-T may be masked or even eliminated by chlorination, a process reported by McKee and Wolfe (23) to magnify this problem.

Other herbicides caused somewhat higher pollution levels in forest streams. An exception was ammate; no sulfamate residues were detected after large-scale brush killing with ammate along lake borders (3). Bromacil concentration, on the other hand, was about 1 ppm 2 weeks after application, and 1 1/2 years later remained about 0.25 ppm. At these rates, about 20 percent of the bromacil applied to an experimental watershed drained into the stream (37). Picloram persisted in flow for almost a year; but concentrations, maximum at 0.37 ppm 1 week after application, only once exceeded 0.045 ppm thereafter (6). Atrazine up to 0.034 ppm drained from a grass watershed; but 3 weeks after application, concentrations did not exceed 0.01 ppm (8). Smaller amounts of paraquat in streamflow, but none of 2,4-D, were measured during the same study. After re-treatment, no contamination occurred when a 10-foot unsprayed strip of grass was left along the stream channel. Traces of fenuron remained in streamflow from a chaparral watershed 27 months after application, but concentrations never exceeded 0.43 ppm (5). Marston (22) concluded that helicopter-applied amitrole never was concentrated in streams at levels to impair water for irrigation use or to render it toxic to warm-blooded animals.

A number of investigators sought to explain why the losses of herbicides applied to forest land were slight, a major factor in lack of significant water pollution. Adsorption and desorption kinetics in forest-floor materials were similar for 2,4-D and 2,4,5-T; amitrole had a slower rate of desorption than adsorption; but picloram attained equilibrium more quickly by desorption (33, 34). Degradation of 2,4-D, 2,4,5-T, picloram, and amitrole are independent of application rate; and these materials do not interact (30, 31). Amitrole and 2,4-D are least persistent in forest soil, 2,4,5-T is intermediate, and picloram persists longest. Stream pollution potential of these herbicides probably is related to their persistence in forest soil and litter (28, 31). Shipman (43) concluded that soil conditions favoring microbiological activity (moisture, pH,

organic matter, fertility, and temperature) favor disappearance of urea herbicides from forest soil. Krammes and Willets (21) added texture to Shipman's list when accounting for phenoxy herbicide disappearance. Norris (32) found that herbicide runoff from forest land is proportional to amount of watershed treated, amount of rain, and time-lapse between herbicide application and rainfall. The latter finding was noted in several previously cited studies.

NON-FORESTRY STUDIES

White-Stevens (52) has reviewed effects of farm chemical use on water quality, and Mullison (26) has reviewed the significance of herbicides to non-target organisms. Both concluded that fears of herbicides accumulating to chronically injurious levels are unfounded, provided these materials are used with wisdom and restraint. Their conclusions, supported by many studies in agriculture, public health, and engineering, closely parallel previously cited forestry experience. A few of these non-forestry studies will be reviewed here to illustrate this striking similarity of results.

Herbicides play as important a water-conserving role in agriculture as in forestry. For example, herbicides in conjunction with tillage provided extra soil-moisture for winter wheat on the semi-arid Great Plains (46). Properly applied, little herbicide reaches streams even after use on non-forest soil relatively low in organic matter. Clays and organic matter adsorb large amounts of soil-applied herbicide (42). At least eight species of soil bacteria are known to feed on phenoxy herbicides, converting them to the same harmless end products reported in forests (54). Thus little atrazine and bromacil, and no triaflurin, drained from industrial and agricultural land 2 weeks after application (7).

Inevitably, some herbicide does drain from agricultural land to pollute the water supply, persisting longest in standing water. Paraquat and diquat in ponds persisted 23 and 27 days, respectively, while fenac and amitrole were detectable 200 days after application (15). While several herbicides disappeared from pond water 36 days after application, all but 2,4-D were found 160 days later in hydrosoils (11). Half of the taste and smell of 2,4-D disappeared from lake water 6 days after application, but some persisted at objectionable levels up to 80 days (10). Very small amounts (0.4 ppm) of 2,4,5-T cause odor and taste in water, but oil in the common ester formulation is far more odorous. Oil-free amine formulations cause fewer odor problems and break down in water to carbon dioxide, chlorine, ammonia, and water (54). Also, less of the amine form drains from bare soil (13). Although 8 ppm of fenac and dichlorobenyl in water were measured initially after weed treatment in irrigation ditches, concentrations decreased to less than 0.1 ppm in 1 hour, to 0.004 ppm in 1

week, and disappeared in 2 weeks (12). Flowing water has a considerable capability for ridding itself of pollution; for example, an amine derivative of 2,4-D is used routinely to control water hyacinth in the City of Tampa's water supply. Treatments of 2 pounds per acre are continued until herbicide residuals up to 0.1 ppm reach the raw-water intake 3 miles downstream (53).

DISCUSSION

At present, the question whether herbicides ultimately enter water supplies in such concentrations as to constitute health hazards and otherwise cause damage has not been fully evaluated (45). No one involved with herbicide use on forest land will want the finger of guilt pointed in his direction if wrong answers to that question are forthcoming. High levels of water quality will be maintained on all water-producing land when the following rules govern herbicide use:

1. Select the least toxic and persistent herbicide that will do the job.
2. Follow the manufacturer's instructions or other responsible directions.
3. Avoid direct application into streams or on streamside vegetation.
4. Store or dispose of herbicides where they are least likely to damage water supplies.
5. Re-treat vegetation only as needed to maintain treatment objectives.

There are several sources from which herbicides applied to forest land may reach and pollute streams:

1. Application directly into streams.
2. Drip from trees overhanging streams.
3. Contaminated leaves or soil getting into streams.
4. Volitalized herbicides drifting into streams or falling in with rain.
5. Subsurface stormflow.
6. Overland flow.

Pollution from all these sources is minimized simply by not applying herbicides close to streams. Indeed, pollution from the first three sources probably is not possible when herbicides are so applied. Volitalization always is possible, but significant pollution by this means is unlikely; tremendous dilution accompanies the volitalization process and reoccurs when air-borne herbicides are deposited in streams. Most long-continued stream pollution by herbicides probably results from subsurface stormflow that has moved through contaminated foliage, litter, and soil--a process described in detail by

Nutter and Ike.[2] Overland flow can be dismissed as a significant source of forest stream pollution when the almost ubiquitous organic soil layers have not been removed or severely compacted.[3]

Granting that the preceding pollution sources are correctly evaluated, have forest streams in fact been polluted with herbicides? Actually, no report was found in the literature of such pollution constituting a health hazard. Probably herbicide pollution at toxic levels has not occurred in forest streams, although gross herbicide pollution has been observed in urban-area rivers; e. g., McKee and Wolfe (23), page 366. Nevertheless, none of us should become complacent about using herbicides in forests on water-producing lands. Any sudden change in taste, odor, or color of tapwater is regarded as an emergency by the average consumer. Herbicide applicators, like Caesar's wife, will want to be above reproach when such emergencies inevitably arise. Another warning--the demonstrated efficacy of forest soils at filtering out herbicides should not invite their use as the "garbage can par excellence", a mistake that will lead to grave consequences and must be avoided.

In conclusion, it seems to me that people concerned with problems of pollution and environment can be grouped into three categories:

1. Those who do not care--the lazy, ignorant, or selfish.

2. The prophets of doom--who say we are using up the oxygen, raising the earth's temperature, or bringing on a new ice age.

3. Those with a viewpoint blended of social and economic realities:

> "'The right amount of pollution' is perhaps a disturbing phrase. It does not mean that we--or anybody else--are going to plan to injure the environment in which we live. It does mean that

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[2]Nutter, W. L. and A. F. Ike. 1970. Evaluating effects of forest fertilization on water quality. Presented before Div. S-7, Soil Sci. Soc. Amer., Tuscon, Ariz., 12 pp.

[3]Lull, H. W. and K. G. Reinhart. Forests and floods in the eastern United States--a reconsideration. In preparation for publication, USDA Forest Serv. Northeastern Forest Exp. Sta.

we shall continue honestly and intensively to identify and analyze benefits and costs. We shall try to minimize hazard or offense; but we shall also try to maintain the living levels and the productivity and the strength of the American economy" (1).

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PESTICIDE PRECAUTIONARY STATEMENT

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife--if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

PROTECT

Use Pesticides Safely

FOLLOW THE LABEL

DEFOLIATION OF OAK, MAPLE, AND OTHER WOODY PLANTS WITH 2-CHLOROETHYLPHOSPHONIC ACID AND POTASSIUM IODIDE

J. P. Sterrett, J. A. Baden III, and J. T. Davis[1/]

ABSTRACT

The purpose of this investigation was to determine the defoliation response of red maple (Acer rubrum L.), pin oak (Quercus palustris Muenchh.), and several other actively growing deciduous woody plants to 2-chloroethylphosphonic acid (68-240) and potassium iodide (KI). The study was divided into three experiments on woody plants planted in a clipped grass field near Frederick, Maryland. The chemicals were foliar-applied in water to run-off with an air pressure sprayer at 12 psi.

In the first experiment 68-240 was applied alone at 2500, 5000, and 10,000 mg/L and each concentration in combination with 2.0% KI to six-year-old red maple and pin oak. Treatments were made in July and included one, two or three sprays at one-week intervals. Observations of defoliation and desiccation over a 55-day period showed that the best treatment was with three sprays of 68-240 alone at 10,000 mg/L which caused complete defoliation of red maple and 60% defoliation of pin oak. When 2.0% KI was added to 68-240, complete desiccation occurred before abscission could take place on red maple and pin oak and 2.0% KI alone caused complete desiccation followed by considerable refoliation.

In the second experiment KI was applied the first of August at 0.5, 1.0, and 2.0% with each level at a pH of 2.5 or 5.0 to six-year-old red maple and pin oak. On red maple all of the concentrations of KI, regardless of pH caused 100% desiccation and from 40 to 60% defoliation over a 25-day period. With pin oak, 1.0% KI was needed to obtain 100% desiccation, and no difference was observed due to pH.

In the third experiment ten different woody plants from 5 to 10 ft tall were sprayed in early July with 5000 mg/L of 68-240. During a period of three weeks black locust (Robinia pseudoacacia L.), tree-of-heaven (Ailanthus altissima (Mill.) Swingle), sycamore (Platanus occidentalis L.), and sweet gum (Liquidambar styraciflua L.) were almost completely defoliated (80 to 100%). California privet (Ligustrum ovalifolium Hassk.), flowering dogwood (Cornus florida L.), Chinese elm (Ulmus parvifolia Jacq.), yellow poplar (Liriodendron tulipifera L.), Lombardy poplar (Populus nigra L. var. italica Muenchh.), and green ash (Fraxinus pennsylvanica Marsh.) were defoliated to a lesser extent in descending order from 60 to 20%.

It appears that if actively growing woody plants are exposed to enough ethylene gas from 68-240, senescence can be maintained long enough to induce defoliation with minimum plant damage. If desiccation is not a deterrent, KI, at 2.0% will probably cause eventual defoliation of most species of deciduous woody plants.

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PUBLIC RELATIONS
AND
THE INDUSTRIAL VEGETATION CONTROL WORKER

Lyle R. McCutchen [1/]

Public Relations and the Industrial Vegetation Control Worker, whether the "worker" be a maintenance supervisor, a forestor, or the man on the end of the spray hose, is certainly not a new subject. It has been discussed many times and in fact much has been written - therefore, what I am speaking on or about today may be nothing more than a re-hash of material already given or available. However - today - with "instant ecology", worried environmentalists and the many well intentioned do-gooders we need to not passively read or listen to the subject of Public Relations but we must actively participate in telling the other side of the coin. That side which is based upon scientific fact as well as common sense.

When a spray unit passes by, be it a highway crew, utility right-of-way, county road district or a rancher/farmer and be the unit a helicopter, bombadier or truck mounted equipment, the uninformed or partially informed public sees further contamination of our atmosphere. May I digress and tell you what I see. To do this properly I feel one must start in the Toxicology Laboratory. I realize that product efficacy is also a vital part of any product, however, let us assume that its performance, as per label recommendations, is not in question.

In the material being used I see a product that has met all the needed requirements placed upon it by the U.S.D.A., F.D.A. and Fish and Wildlife Department. Of necessity this product has been subjected to rigorous testing as per:

1. Blood chemistry
   (slide and explanation)

2. Feeding studies
   (slide and explanation)

3. Acute oral toxicity
   (slide and explanation)

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4. Vapor/inhalation studies
   (slide and explanation)

5. The sacrificing and posting of
   test animals
   (slide and explanation)

6. The microscopic study and analysis
   of the vital organs/tissues of the
   test animal
   (slide and explanation)

Therefore, the first item I see is a product that has been backed by years of research and that when used as directed on the label is also a safe product. Although the cost figure of bringing a new product to market includes much more than the above it is none-the-less a considerable amount and could well be upwards of $6,000,000. This does not mean, as it is sometimes implied, that we as an industry will set up helter-skelter sales programs with no thought given to how such a material is to be used. Instead it means that we must, to the best of our ability, make sure that the chemical and/or product is used as directed so as to insure us of its continual use until such time that better practices become available.

Further, and I believe this to be opportune to relate to at this time, is that should you be questioned by a passing motorist, a farmer whose field you border, a woman garden club member, or by your own children who may be doing a paper on our environment, about the chemical you are using that you should be knowledgeable enough to answer or explain a considerable part of said questions. Explanations may be such that one must know that following an application of say a phenoxy herbicide or TORDON® 101 Mixture herbicide on a utility right-of-way that grass becomes more plentiful, that low browse type plants become more numerous, that the spray is not toxic to animals and yes, it is more economical to spray than it is to do mechanical cutting. Because of the grass cover one builds better soil and protects against erosion, it conserves more water as there is less chance of run off on a grassy right-of-way than one choked with brush. If one is spraying noxious weeds along a highway and one is engaged in conversation about such an application it is a good place to point out that one is eliminating pollutants by getting rid of ragweed, thistle, leafy spurge, goldenrod or the like - all of which can cause misery to the allergic or hayfever sufferer.

It also may be well to point out that many well intentioned individuals feel that once a herbicide is applied to a brushy/weedy

area that the chemical will persist in the soil - or actually build up to a point where no vegetation will grow. Yes, there are differences in breakdown of the various formulations, however, there is no evidence that these chemicals are permanent nor do they accumulate. In fact evidence has been established that organic herbicides are degraded, by microbiological processes, in a short time following application.

Public relations may take other forms - having been on the working end of a hose as well as pulling hose for the applicator I'm well aware that everyone on a spray crew cannot look like he just stepped out of the shower, however, there is generally one "chief" involved and I believe it be important that he be clean and neat. I am not suggesting his attire be a suit or shirt and tie - just a clean shirt and work pants is fine. The public judge's the company by the man who represents them and this same public likes to speak to someone who is polite, knowledgeable, neat and honest. It also would be wise to have freshly painted or washed vehicles - it looks professional.

Honesty - its a great policy to follow. One has to admit that whenever you are spraying that the possibility of spray drift exists - yet if you are explaining this to an interested or worried public, it again leaves one an excellent opportunity. Yes sir, I realize that there are susceptible crops near by and I share your concern and it is for this reason that we spray only at time of wind velocity less than 2 mph and it must be in a direction away from said crop area, or, we are using invert emulsions or TORDON 101 Mixture with NORBAK® particulating agent thus insuring us of eliminating the "fines" associated with spray application and thus reducing the likelihood of drift. Perhaps the public is concerned over "brownout" and again one must agree that a spring or summer foliar application will leave an area very brown. In some areas, where a utility line takes off across country this is perhaps of little importance - if it be in a more populated area, it perhaps would be wise to do a little public relations work in advance of application and explain to the people, who may be your boundary neighbors, what your intentions are and that the brownout is but temporary. And if you have done your homework properly and know of a chronic problem area, then you should change application method and use a dormant basal spray program, or pellets with proper timing, or in some areas you may wish to do some mechanical cutting. Using dormant application, as an example, one also may be selective in that you have the opportunity to leave low growing or small shrubs that will be of no harm. Man must manage his environment and/or change the ecology - without doing so would be just as disasterous as wanton use of chemicals that had never been tested or approved. Clean corn fields would

turn to weed infested fields. Rangeland would not be able to support the cattle they presently do as weeds not only take needed moisture from the grass but they also take space, use soil nutrients, and also of great importance is that many weeds are poisonous to animals. Herbicides have been successfully used to gain more available food for wildlife as well as improve their habitat. All this can be stored in your warehouse of knowledge and used when needed or when appropriate.

Please remember there are many people to assist you should their help be needed. The local county agent, university personnel, The National Agricultural Chemical Association, the distributor or contract/applicator and companies such as Dow, will all lend a hand where needed. And now as a part of my public relations to you, I'll thank you for your kind attention and leave the podium with a little time to spare.

Thank you.

BRUSH CONTROL COMPLAINTS AND POSSIBLE SOLUTIONS

Kenneth L. Grimm[1/]

I have been attending this Weed Control Conference for about twelve to fourteen years and have heard all the various formulations and types of applications discussed in great detail at these meetings. Imagine what condition the thousands of miles of right of ways would be in today if we could not use chemicals as a means of controlling the brush.

Our company has been in the brush control business for about twenty years and during that time have used various methods of control measures to achieve our goal. When we started, everything was foliage spraying which limited our spraying time to about three months in our area. On account of the time factor crops were often damaged because of the close proximity of the spray work being done.

Dormant spraying was the next development which gave us a choice of applications when there was danger of crop damage. Mixtures of 2,4,5-T and kerosene or fuel oil gave excellent results. In addition more selectivity was possible which permitted leaving desirable plants that would not interfere with distribution on the right of way. Today there are many chemicals available for use mixed with fuel oil as a carrier which is one of the objects of my remarks today.

Fuel oil has a very strong and persistent odor. Men spraying with these mixtures work under most unpleasant conditions. Home owners complain of the odor when spraying is carried on near their homes. Quite often sparks from equipment have set fire to the oil and burned several acres of right of way and valuable woodland. Vandals are also a threat to equipment left overnight. Animals have lost considerable patches of hair as a result of walking through brush that has been treated with fuel oil. More could be added to this list.

We have had good results in overcoming the objectionable odor in our dormant sprays by the addition of an industrial grade pine scented deodorant. At least the men doing the work do not complain as much, and we have received no complaints from home owners.

1/ Walgren Tree Experts, Inc., W. Hartford, Conn.

However, this is not the whole answer and what I am asking is why someone can't either develop a chemical that has a built-in carrier that is odorless, non-flammable, will not freeze at low temperatures and will adhere to the plant as well as oil; or develop a carrier with the above qualifications that the applicator can add to the present chemicals in use.

I am sure that where mist blower applications or any other low gallonage method is used the possible additional cost would be welcomed by any Utility Company as a continued effort to maintain good public relations.

PRELIMINARY EVALUATION OF EXPERIMENTAL CHEMICALS FOR RETARDING THE GROWTH OF WOODY PLANTS

William A. Jeffers[1]

Abstract

To facilitate the preliminary evaluation of a growth retardant for woody plants, a stand-by supply of trees and a planned test program are needed. Applications to achieve clear-cut results would be limited to the period of time preceding the maximum period of growth unless the chemical has residual growth retardant capabilities. The response to a test chemical has to be determined for each species of tree. The results from limited preliminary tests with foliage sprays of chlorflurenol and NIA 10637 point out the variation in response that can occur with different species of woody plants.

The Davey Tree Expert Company's first extensive tree growth retardant tests with an experimental chemical were in 1957. Several polychlorinated benzoic acid formulations supplied by Amchem Products, Inc., Ambler, Pennsylvania, were evaluated both on brush and trees. It was no problem to locate brush plots which could be treated. Utility rights of way which would be scheduled for chemical brush control in the future were used.

Trees which could be used for the benzoic test series were more difficult to locate. Besides the possibility of injuring the trees with the chemical treatments, part of the test plan included trimming back the tops of some of the trees.

One source of test trees was a nursery area where the trees had about outgrown the limits of their planting sites. Such trees, however, can only be used on a short-term basis since they are eventually dug out to provide space for new plantings.

Another source of trees for testing the benzoic formulations as growth retardants were wooded areas where the property owners would allow the trees to be cut back and treated with a chemical. Usually, the trees in such areas were not easy to get to and the selection of a number of comparable trees of the same species was poor.

The polychlorinated benzoic acid formulations applied to the trees in the 1957 tests were put down in bands on the trunks. When high concentrations were used, injury or death resulted to the treated bark area on some trees. Foliage sprays would have been difficult to apply in many of the wooded sites.

The difficulty experienced with locating test trees for the benzoic retardant tests pointed up the need for having a stand-by supply of trees for initial evaluation of growth retardant chemicals. These trees should be easy to get to and expendable if serious injury results from excessive dosages.

1/ Vice President, The Davey Tree Expert Company, Kent, Ohio

Future Source of Trees for Experimental Purposes

Beginning in 1963, The Davey Tree Expert Company began to plant at a research farm in Shalersville, Ohio, trees which could be used at a future date for testing various fertilizers, insecticides, fungicides and growth retardants.

Fast-growing species, such as silver maple (Acer saccharinum), honeylocust (Gleditsia triacanthos), London planetree (Platanus acerifolia) and Chinese elms (Ulmus parvifolia) were planted for the initial preliminary evaluation of tree growth retardants. The trees were planted in rows on 10-foot centers. They are to be kept within this spacing by periodic trimming. The heights of the trees are to be maintained between 8 - 13 feet so that treatments and measurements of the upper terminal shoot growth can be conveniently made from a stepladder.

In addition to the species mentioned above, there are other species available on the farm which could be used to spot-check the effect of a growth retardant chemical.

Since a considerable expense is involved in purchasing land, planting trees and maintaining them for the time when experimental new growth control chemicals may be available, only a limited supply of trees can be maintained on a stand-by basis. Under these conditions, the preliminary test work with a chemical would be restricted when a number of them were to be evaluated at the same time.

Purpose of the Initial Evaluation of Experimental Growth Retardant Chemicals

The main object of the initial evaluation of any experimental growth retardant chemical is to determine whether there is any concentration at which it will be safe and effective to use on individual species of plants. When a chemical of this type is first available for test work, little may be known except that it has potential growth retardant possibilities.

Characteristics to be Considered in Evaluating Growth Retardants

To have promise as a growth retardant which could be used commercially, a chemical should be able to achieve at least 50% growth inhibition without any immediate or accumulative long-term undesirable side-effects which would impair the appearance or the survival of the treated plants.

With a foliar-applied material, there is also a need for some carry-over or residual growth inhibition in the next growing season. If there is no carry-over, application of foliage sprays of chemical growth retardants would generally be limited to about a five-week period following full leaf development. By that time, most of the shoot growth for many species of trees would have already occurred for the current year.

For chemical growth retardants that are active only in over-all spray applications, any harmful effect on other plants from possible drip or drift of

the chemical would be an initial consideration in any evaluation program. Some indication of adverse effects on surrounding vegetation would show up first under and around test trees.

Test Program in Evaluating an Experimental Chemical as a Growth Retardant on Trees Planted in a Research Area

The first step will be to treat the various species of trees available using a range of concentrations of the experimental chemical based on the recommendations of the company supplying the chemical. When possible, the initial tests will be applied before much of the growth for the current season has taken place.

Applying a chemical growth retardant after most of the growth for the current season has already occurred would not permit much chance for growth inhibition to take place unless there is some carry-over or residual effects in the next growing season. The carry-over of growth inhibition into following years would have to be checked out for each chemical on each species of tree.

A three-gallon compressed air pack sprayer is used to apply the foliage sprays of experimental growth retardant chemicals at the Davey Tree Research Farm. The foliage and stems in the top half of the tree are thoroughly sprayed and in the process just about all the foliage on the tree may be treated.

If the results of the initial tests indicate some effective growth inhibition without serious side-effects on a given species, then additional trees would be treated at other possible periods in the year. The rates of application would be in the range where optimum results were obtained in the initial tests.

There are situations where some slight foliage or stem tip injury might be tolerated. Therefore, this would be taken into consideration when a decision had to be made whether to continue tests with a chemical or reject it on the basis of the side-effects.

Repeat applications will be made to the same tree to determine the long range accumulative effects of a chemical. The timing of the retreatments will be based on the frequency necessary to maintain effective growth control. No treatment will be repeated more than once a year.

Several methods of taking measurements will be used in determining the amount of growth inhibition. If a treatment is made after the new stem growth for the current year is more than 6 inches, the length of the new growth present at the time of treatment will be measured on a number of dominant terminal shoots selected over the top of the tree. The length of the new growth will be marked on an aluminum tag and tied to the proper shoot. The same procedure will be followed in measuring and tagging the terminal shoots in the untreated trees. At the end of the growing season, the final length of the tagged shoots will be measured to determine the amount of growth which occurred after treatment. Then the average increase in growth after treatment of the tagged shoots on the treated trees will be compared with the average of those on the untreated or control trees.

If the treatment is made the previous growing season or before the growth of the current year is over 6 inches, the measurements of a number of the longest terminal shoots in the top of the treated and untreated trees will be taken at the end of the current season's growth. Then the difference between the average length of the measured shoots on the treated and untreated trees will be compared.

The number of terminal shoots measured and tagged or measured only will vary with the size of the test trees. Presently about five terminal shoot measurements are taken.

Experimental Chemicals in the Process of Being Evaluated

In 1968, two experimental growth retardant chemical formulations were initially applied as foliage sprays to several species of trees at the Davey Research Farm in Shalersville, Ohio. Additional applications were made in 1969 and 1970.

One of the growth retardants was methyl 2-chloro-9-hydroxy-fluorene-9-carboxylate (chlorflurenol). Chlorflurenol was furnished for experimental work by U.S. Borax Research Corporation, Anaheim, California, under the trade name of Maintain CF 125.

The other experimental growth retardant chemical was ethyl hydrogen 1-propylphosphonate (NIA 10637). It is available in a water miscible concentrate containing 8 pounds of the above chemical in a gallon. NIA 10637 is supplied by the Research and Development Department of the Niagara Chemical Division, FMC Corporation, Middleport, New York.

Some preliminary results with chlorflurenol and NIA 10637 will be reported to indicate the variation in response on different species of woody plants. These results will be confirmed by additional tests.

Chlorflurenol Foliage Applications on Silver Maples

On July 11, 1968, foliage sprays of chlorflurenol were applied to the top half of silver maples (*Acer saccharinum*) at the rates of 50 ppm, 125 ppm, 250 ppm and 375 ppm. These silver maples had been planted as 4 - 5 foot, two-year transplants in 1963. The trees were cut back to a height of about 8 feet just before they were sprayed. This removed the most vigorously growing terminal shoots. Four terminal shoots were measured and tagged just after the trees were trimmed and sprayed.

From July 11, 1968, to September 13, 1968, the average increase in length of the tagged stems on the untreated trees was 11.6 inches. In comparison, the average increases in the length of the tagged stems for the various rates of treatments during the same period of time were 1.25 inches for the 50 ppm rate, 10.6 inches for the 125 ppm rate, 2.2 inches for the 250 ppm rate and 3.8 inches for the 375 ppm rate.

The lack of any growth inhibition at the 125 ppm rate points up the variation that might occur with tests of growth retardants.

The treated silver maples were inspected for side-effects that would be objectionable. Chlorflurenol at the highest rate, 375 ppm, did not affect any of the mature leaves present at the time of treatment. The last few leaves near the stem tips at the time of treatment showed a typical response from the chlorflurenol applications. They were slightly stunted, curled, puckered and dark green in color. Several sets of leaves may show these responses.

Variation in the rate of growth of the stems on the treated trees seem to have a decided effect on their growth after treatment. On the slow-growing stems, the stem tip stops growing after a given chlorflurenol treatment. On the more rapidly-growing stems of the same tree, the tips may continue to grow. Severely stunted leaves develop along the new stem growth. These usually fall off.

Under one tree treated with chlorflurenol at 375 ppm, there were a number of fast-growing weeds. The new growth of these weeds was distorted by the spray drip or drift from the treated tree.

Since the pattern of the results on the trimmed silver maples treated in 1968 indicated a satisfactory growth retardant response at rates of chlorflurenol as low as 50 ppm, additional silver maples were treated in 1969 with a foliage spray of this chemical at 100 ppm. This rate of application did not satisfactorily inhibit the growth of rapidly-growing stems. The stems continued to grow after treatment. Sometimes the foliage on the new stem growth was stunted. Other times it regained its normal size. When the foliage remained stunted, there occasionally was some curvature in the stem.

On two silver maples initially treated with chlorflurenol on July 11, 1968, and retreated with the same chemical on May 24, 1969, at 100 ppm, there was as much or more growth than on the untreated control silver maples by the end of the 1969 growing season.

On June 17, 1970, chlorflurenol was applied to four silver maples at the rate of 500 ppm and four silver maples at the rate of 1200 ppm as a foliage spray. Two of these silver maples had been treated two previous years with this chemical. The other six trees had been trimmed late in July 1969. One of these had been treated with chlorflurenol at 500 ppm just after it had been cut back. Before treatment on June 17, 1970, there was no indication of any effect on the new growth from previous treatments.

The concentration of the chlorflurenol in the 1970 foliage sprays was increased to 1200 ppm to attempt to stop the growth on vigorously growing shoots more rapidly so as to decrease the amount of distorted foliage and defoliated stem tips.

On September 24, 1970, the increase in the length of the tagged stems, after treatment, averaged 3 inches or less for both the 500 ppm and the 1200 ppm rates of application, compared to an average of 20.25 inches for the untreated trees.

There was no injury to the older foliage when the concentration of the chlorflurenol spray was increased to 1200 ppm. However, the undesirable ap-

pearance of the terminal stem tips due to the formative effect on the last few sets of leaves and the defoliation and/or the dieback of the stem tip still occurred when vigorously growing terminal shoots were treated.

The results to date indicate that chlorflurenol applied to silver maples at the rate of 500 ppm should result in satisfactory growth control. A certain amount of formative effects should be expected on the terminal leaves present at the time of application. There could be some defoliation and dieback of the stem tips of vigorously growing terminal shoots.

On silver maples, there is no indication of residual growth inhibition in the next growing season from foliage sprays of chlorflurenol applied at rates up to 500 ppm.

Spray drift could cause distortion to rapidly growing plants other than grasses.

Chlorflurenol Foliage Applications on Norway Maples

The initial tests with chlorflurenol at 100 ppm on Norway maples (*Acer platanoides*) indicates the differences in species responses that could be obtained with this chemical. Three Norway maples planted in 1963 as 5 - 6 foot transplants were treated on May 24, 1969. The untreated control tree had an average of 10.7 inches of new stem growth on the tagged stems at this time. The new stem growth on the tagged stems on the treated trees averaged 11.8 inches at the time of treatment.

When the tagged stems of the treated and untreated control trees were measured at the end of the 1969 growing season, the average increase in the length of the tagged growth after May 24 on all of the trees was less than 1 inch. As indicated here by the lack of growth on the control tree, Norway maples usually complete their growth early in the growing season.

When the treated Norway maples leafed out in 1970, most of the leaves were drastically different in shape from the typical leaves of this species. The new leaf form appeared to be two opposite terminal leaves joined together entirely along the petioles and the base of the leaves. The combined petioles were attached at the middle of the lower surface of the circular-shaped leaf blade. There were other variations in the leaf development on the treated trees. Some of the leaf petioles from the terminal leaves had grown together for varying distances. The stem growth was obviously reduced.

On September 14, 1970, the five longest terminal shoots for the 1970 season were measured on the Norway maples treated with chlorflurenol on May 24, 1969. The average length of the five longest terminal shoots on the treated trees was 3.4 inches, compared to an average length of 10.6 inches for the untreated trees.

This is the first indication of any residual growth inhibition or growth modifications in the next growing season from a chlorflurenol foliage application.

NIA 10637 Foliage Applications on Silver Maples

On July 11, 1963, foliage sprays of NIA 10637 were applied to the top half of silver maples (Acer saccharinum) at the rates of 1.5, 3, 4 and 6.5 lb/100 gal. These silver maples had been planted as 4 - 5 foot two-year transplants in 1963. The trees were cut back to a height of 8 feet just before they were sprayed. Four terminal shoots were measured and tagged just after the trees were trimmed and sprayed.

From July 11, 1968, to September 13, 1968, the average increase in the length of the tagged stems on the untreated trees was 11.6 inches. In comparison, the average increases in the length of the tagged stems for the various rates of treatment during the same period of time were 4.4 inches for the 1.5 lb, 2.2 inches for the 3 lb, 3.8 inches for the 4 lb and 3.5 inches for the 6.5 lb/100 gal rate.

The differences in the amount of growth after treatment at the various rates of NIA 10637 did not clearly indicate the optimum one to use for future tests with silver maples.

There was some injury to the foliage present at the time of application from treatments below the 4 lb/100 gal rate. Above this rate, it became more severe and would be objectionable.

Examination of the tagged stems showed the changes in the growth of the stem and leaves which occurred after treatment with foliage sprays of NIA 10637. There was a shortening of the internodes (distances between the sets of leaves), and the leaves themselves were slightly stunted, misshapen and had areas missing from the leaf blades.

After single or double annual applications of foliage sprays of NIA 10637 at rates as high as 8 lb/100 gal, there was no residual growth retardation the next growing season on silver maples.

Remaining is the determination of whether it is possible to secure satisfactory growth control over a full growing season without objectional side-effects. To minimize the possibility of serious foliage burn and still obtain effective growth control on silver maples for one season, previous results indicate rates about 3 - 4 lb/100 gal should be tried early in the growing season when the new growth is about 6 inches in length.

NIA 10637 Foliage Applications on Pin Oak and Weeping Willow

On July 30, 1969, a pin oak (Quercus palustris) and a Wisconsin weeping willow (Salix blanda) were treated with a foliage spray of NIA 10637 at the rates of 4 lb and 8 lb/100 gal. Four stems on each tree were measured and tagged at the time of treatment.

By October 30, 1969, there was an average increase of stem growth after treatment of from 3 inches to 9 inches on the untreated pin oaks. In comparison, there was an average increase of 1 inch or less of new stem growth after treatment on the treated pin oaks.

At the end of the 1970 growing season, the average length of the five longest terminal shoots was 10.5 inches for the 8 lb/100 gal rate of NIA 10637 compared to 24.5 inches for the untreated control pin oaks, and 21.6 inches for the 4 lb/100 gal rate of NIA 10637.

In addition to the more than 50% residual growth inhibition carried over into the 1970 growing season, the pin oak treated with NIA 10637 at 8 lb/100 gal on July 30, 1969, had a drastic change in the foliage which developed in 1970. The leaves were very narrow and ragged, with no resemblance to those of a pin oak. The narrow leaves and shortening of the internodes were more pronounced near the tip than at the base of the 1970 stem growth.

The aluminum tags were missing from the Wisconsin weeping willows by the end of the 1969 growing season. When the treated willows were inspected in 1970, it was evident that there was some residual growth inhibition in the weeping willow treated with NIA 10637 at 8 lb/100 gal. On September 25, 1970, the average length of the five longest terminal shoot was 15.6 inches on that willow compared to 36.9 inches for that of the untreated control willow, and 33.2 inches for the willow treated with NIA 10637 at 4 lb/100 gal.

There were some narrowed leaves on the willow showing the more than 50% residual growth inhibition, but since this species has narrow leaves it wasn't noticeable.

NIA 10637 Foliage Applications on Amur Privet

On May 14, 1969, 15-foot sections of Amur privet (*Ligustrum amurense*) hedge in Kent, Ohio, were treated with a foliage spray of NIA 10637 at 4 lb/100 gal and 8 lb/100 gal. The hedge had been trimmed 9 days earlier.

By the end of the 1969 growing season, there were about 27 inches of growth on the untreated sections of hedge compared to 3 - 5 inches for the treated sections. The stem tips were defoliated back 1 - 2 inches with both rates of application. Many of these stem tips had withered up and sloughed off. There was a little more spotting and distortion of the last set of leaves near the stem tips at the higher rate of application. Axillary shoots died in the initial stages of development.

The growth inhibiting effect on the privet hedge from both rates of NIA 10637 applied on May 14, 1969, lasted through the 1970 growing season. Inspection of the new growth as of May 11, 1970, revealed that several sets of normal privet leaves developed, followed by several sets of leaves that were slightly off-color and puckered. Then the shoot growth stopped. By the end of the 1970 growing season, there were 3 - 5 inches of shoot growth in the sections of privet hedge treated at both rates of NIA 10637, compared to about 32 inches of growth on the untreated sections. The appearance of the treated sections of the hedge would not be objectional when viewed from a distance.

THIRTY-FIVE YEARS BEHIND THE GUN

ONE YEAR ON THE FIRING LINE!

by

Francis E. Klitsch 1/

I don't really believe people in our business -- pesticides -- really care to listen to the experiences of others. It tends to be a bit boorish or to smack of bragadoo. However, much may be learned and passed on to others. Many questions and situations arise every day and need to be answered.

Thirty-five years ago, I graduated from The Institute of Applied Agriculture, Farmingdale, Long Island, New York, and have been actively engaged in the field of horticulture, arborculture, and pesticides ever since. However, my experience goes back even farther -- to a kid growing up on a farm in New York State where I picked potato bugs and squashed them with two blocks of wood; then graduated to thumb and forefinger -- also painting chicken roosts with creosote to kill mites.

For 15 years, I managed a cemetery where I first became acquainted with 2,4-D for broadleaf weeds as a wettable powder. My first shipment arrived at the post office where the postmistress dumped the mail sack out on the floor, resulting in broken packages and 2,4-D powder all over the office. After she finished gagging, she swept the mess out the door. A few days later, she had a dead rose bush outside and dead potted plants on the window sills inside.

In those days, we controlled crabgrass by the height we cut our grass. Now we use chemicals and cut our lawns closer. But we have other problems to deal with. My first experience with high-pressure hydraulic spray equipment and dormant oil resulted in a neat hole burned through a spruce tree resulting from a solid stream from the gun instead of fog. I haven't burned one since! Another time, I shot the mealy bugs off the yews - bark included - as I tried to do it with a long tom gun.

What I learned in those early days was to become thoroughly familiar with my equipment. This is most essential even today with our many kinds of exotic new equipment.

1/ President Alpine Acres, Inc. Wellesley Hills, Massachusetts

I have had further herbicide experience using ammonium sulfamate ("Ammate" X weed and brush killer) 2,4-D -- 2,4,5-T for brush and poison ivy and many products for lawns. I have sprayed rights-of-way for miles with knapsack mist blower and hydraulic equipment with no complaints from abutters. This was mainly because I have always been with the crew, and have talked to people - even helped them with their own vegetation problems.

Creating goodwill ahead of time is the only way to keep out of trouble. I have seen people shake their heads over what a terrible thing we were doing, but, on the other hand, have had hunters delight in having an opening cleared for a good shot at deer. I have also observed Audubonners finding rare flowers after their release to light brought about by brush spraying, although they did not realize how it came about. I told them how - but doubt if they appreciated what I had done!

Enough about the past! Let's get on to the present - ONE YEAR ON THE FIRING LINE! This year, I have had more discussions, not only with my clients, but with the man next door or with someone passing by.

> What are you doing?
>
> What are you using?
>
> You can't use DDT; it's outlawed, you know.
>
> Don't you know you are poisoning the air I breathe and killing birds?
>
> Don't get any of that stuff in my yard or else you will have a law suit, AND SO ON!

This year I have found pesticide puddles in the streets after someone sprayed large trees. The work was done by a large and well recognized so-called responsible company. I have seen empty pesticide containers left by streams - bags blow off spray trucks. This is unpardonable. It only leads to incidents that do none of us any good. I have seen evergreen shrub material inadvertently sprayed with brush killer thought to be a dormant spray.

What does this teach us?

1. We need well educated people in the field who know how to check materials before they use them - by smell, consist-

ency, and general appearance. We need people in the field who have an understanding of the nature of the person they might meet next door or in the street. To do this, you have to size them up quickly. After all, these people have become a concerned authority as of yesterday from something they read about a pesticide puddle or an empty container.

2. We need knowledgeable people to man spray equipment.

3. We need people with a good working knowledge of chemicals and plants so that their knowledge can be used on their pest problems. This knowledge should be tested in the examination for a pesticide license.

4. We should not spray EVERYTHING in sight simply because the client wants it done, or because the client feels that otherwise he may not get his money's worth!

5. We need an EARLY warning system directed to companies applying pesticides and to all licensed applicators from our Experimental Stations and Agricultural Colleges.

6. We need a better disposal system for EMPTY containers - from bags to drums. Perhaps they should go back to the manufacturer for disposal or to a central-wide area disposal set up.

7. Last but not least, we need adequate insurance protection for the pesticide a pplicators from company to EMPLOYEE to protect them from the public. For instance - what would you do in the case of a backyard boundary ELM tree? Or in the case of a housewife who, when requested, took in the fancy clipped dog, but let out her two toddlers? We had such a case. The housewife did take the youngsters in after a second trip over the fence by the concerned spray man; but then she opened the window and let the children lean out to watch the apray job. What would be her reaction if the kids got a stomach ache from the green apples off a nearby tree? Well, you can bet your bottom dollar that her first thought would be PESTICIDE POISONING! Where do we stand in cases like these? The smartest thing to do would be to drop the clients unless we can gain more on-the-spot understanding.

We had better smarten up and cooperate to the Nth degree - join a conservation group, educate the environmentalists, show them what is being done by our industry in the interest of ecology, etc. -- or we may be legislated out of business. It has already been suggested that the spraying of orna-

mentals, lawns, and rights-of-way is not necessary to our way of life, while the spraying of food crops is recognized as essential to feed the world. Any lessening of so-called non-essential spraying would seem to mean fewer environmental problems. Think it over! Pressure from the public and politicians can work against us.

If you believe, as I do, that our industry is vital, then now is the time for all of us to tell the positive side of the use of pesticides. And I don't mean by talking to each other either. We must get the true story to the questioning public and I've outlined some of the ways to do this. Only then will we have their support and only then can we leave the firing line and return to our spray guns.

HOW THE 2,4,5-T CONTROVERSY HAS AFFECTED APPALACHIAN POWER COMPANY'S R/W VEGETATION MANAGEMENT PROGRAM

H. E. Colwell

U.S. CURBS USE OF WEED KILLER THAT PRODUCES RAT DEFORMITIES . . . U.S. DEFOLIANT RATED BIRTH DEFECT CAUSE . . . HOME WEED KILLER IS LINKED TO BIRTH DEFECTS; GOVERNMENT BANS ITS INTERSTATE SALE.

This type of newspaper caption plus TV specials and articles in most of the popular monthly magazines on the newsstand since late 1969 pointing a finger at 2,4,5-T (2,4,5-Trichlorophenoxyacetic acid), caused us in Appalachian Power to sit down and take a serious look at our proposed 1970 Right-of-Way Vegetation Management Program. While we believed that statements of this type were either wholly unjustified or highly exaggerated, we felt that we should modify our spraying program to take public opinion into account.

I previously mentioned our 1970 Right-of-Way Vegetation Management Program; let's take a look at the acreage proposed for treatment. We in Appalachian Power Company have delineated our lines into three categories: namely, System Transmission, Sub-Transmission, and Distribution. Overall acreage, we are talking about an estimated 100,000 acres. Of this 100,000 acres we had programmed an estimated 15,500 acres for treatment by application of U.S.D.A. registered herbicides, namely 2,4-D (2,4-Dichlorophenoxyacetic acid), 2,4,5-T and Tordon®. Of this proposed acreage approximately 95% was programmed for treatment by helicopter aerial application using Amchem's® Spra-disc and microfoil boom.

The big decision we were posed with, as all users, was "Were we willing to contract for application of a herbicidal formulation containing 2,4,5-T manufactured under specifications requiring less than 1 p.p.m. of the contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin." Actually it boiled down to, "could we afford to revert to mechanical and hand tool methods of reclearing rights-of-way." This, in reality, would be impossible due to economics and the non-availability of man-power.

Our main concern was what the public reaction would be to our spraying after being exposed to statements relative to pesticides from uninformed sources which were regarding all pesticides as lethal poisons. Knowing the past complaint history due to our spraying, we felt that an all out effort would be required to combat an expected avalanche of complaints from the aroused public. The decision to continue with our proposed R/W Vegetation Management Program with a few refinements was rendered.

We initiated four refinements or changes in our spray program and attempted to enjoy the calm before the expected storm:

1. The first change or refinement was to use all odor inhibited herbicides in our program. We had applied a commercial application

of this material in 1969 for evaluation purposes and liked what we smelled. Being aware that a considerable number of complaints in past years were initiated because of the somewhat offensive odor, we felt that the small additional cost would be money well invested and hopefully a reduction in complaints.

2. Secondly, we pin-pointed pasture lands as being another area to become concerned about. After deliberating and with mixed feelings, we decided that all discernible pastures would be put in the no spray category. Granted, a well managed pastured land does not support woody stems capable of interferring with conductors, but in some areas the maintenance is lax and pasture lands are tending to revert back to a forest type. This is the category that in the past was sprayed during our spray program.

3. Lakes, ponds, and ditch banks were restricted from spraying by the U.S. Government; consequently, we became concerned about all open water. Feeling that enough alarm had been generated by the various news media concerning pesticides, we decided to avoid spraying all open water regardless of its purity state or location. In areas where water was prevalent, we substituted a formulation of 2,4,-DP (2,4-Dichlorophenoxpropionic acid) for 2,4,5-T in the envert.

4. Past spraying practice on our system was to spray as close to rural residences as possible without actually physically spraying the home or other improvements. Also in most areas, the right-of-way was sprayed up to the edge of highways. We felt here were two areas we could improve on and decided to leave buffer zones or screens at all residences and on the majority of highways.

The four refinements were inserted in our program and performed to the best of the contractors ability. The questions in our minds were, "What effect will the changes have on the public?" . . ."Will this drawback and deodorizing be sufficient to keep complaints within the realm of reality?" . . . "What acreage will not be sprayed and consequently requiring added expenditures for required treatment by other methods?" These are just a few of the questions that were to be answered only after the aerial spray program was completed.

Let's take a look at what did transpire and what the overall results were. We became aware as the program progressed that the number of complaints were less than in past years. The final tabulation of the data revealed that we had sprayed approximately 30 per cent additional acreage than in 1969, with the number of complaints approximately 33 per cent less. This we feel was accomplished by the instituted refinements, high quality performance by the contractor, and constant surveilance of the operation by our field personnel.

We did not fare as well though in the category of acreage that was not sprayed due to the refinements. This is a hard one to attach an exact mathematical value to, but all indications according to our records are that approximately 30 per cent of the proposed acreage was not sprayed. As stated

previously, this will require additional expenditures for treatment. At the present time we have attached a 40 per cent per acre mark up for those areas requiring treatment that would have normally been aerially sprayed. This poses a problem, but we are willing to accept it with the knowledge that herbicides will be available to manage the bulk of Rights-of-Way vegetation.

In conclusion, we feel that the so-called refinements initiated this year in our Rights-of-Way Vegetation Management Program possibly were long overdue. At the present time our projections are to continue the use of herbicides in our program with the necessary refinements to maintain a healthy image throughout our service area. We know that we are not alone in the struggle; in fact, a newsclipping I saw recently revealed the U.S.S.R. is having the same problems. A Latvian expert complaining about the 25 cubic kilometers of dirty water being introduced into open reservoirs annually, insists on the need to develop non-poisonous detergents, pesticides and herbicides and to ban the use of the herbicides near rivers, lakes, and reservoirs.

AN INVESTIGATION OF LATERAL SURFACE MOVEMENT: PICLORAM

B. C. Byrd, C. S. Williams, E. L. Bjerke

Picloram (4-amino-3,5,6-trichloropicolinic acid) the primary active ingredient in TORDON® herbicide formulations, is used widely for vegetation control. Picloram is low in toxicity to mammals, fish and birds, aquatic organisms and soil microorganisms. The compound is degraded in plants, soils, microorganism cultures and water. Bioassay of preliminary soil and water samples suggested that small quantities of Picloram might move short distances in response to water movement. More complete studies at three locations confirmed slight lateral movement for short distances in response to the first rainfall following application. Such movement is of questionable practical significance.

ROLE OF ENDOTHALL IN THE CONTROL OF ANNUAL BLUEGRASS

(Abstract)

A. J. Turgeon and W. F. Meggitt.[1/]

Endothall (7-oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid) has shown selective toxicity toward annual bluegrass (Poa annua) in Kentucky bluegrass (Poa pratensis) and creeping bentgrass (Agrostis palustris) turf. At relatively low application rates, (0.25 to 0.5 lbs/A ae) the growth rate of annual bluegrass plants may be substantially suppressed with little or no suppression of the perennial grasses. At higher rates (2 to 4 lb/A ae), an overall browning of the turf may occur followed by a selective vegetative recovery of Kentucky bluegrass. Annual bluegrass is frequently killed and bentgrass injured from these higher application rates. Annual bluegrass generally recovers from seed in bare areas where the perennial grass has not filled in. Hence, a follow up treatment by a pre-emergence herbicide may be necessary to preclude reinfestation.

The actual toxic effects exhibited by annual bluegrass, following endothall treatment, are highly variable and depend not only upon the application rate, but the temperature, moisture condition and the physiological state of the plant.

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Combinations of Naptalam and Bensulide for Weed Control in Cucumbers

J. C. Cialone and D. A. Braden[1/]

Abstract

Naptalam and bensulide were applied alone and in combination to cucumbers grown on sandy loam soils at Adelphia and Centerton, New Jersey.

Preplant incorporated and preemergence treatments of naptalam at 2, 3 or 4 lbs/A and bensulide at 4, 6 or 8 lbs/A were applied. Four types of combination treatments of naptalam plus bensulide were made at rates of 2 + 4, 3 + 4, 2 + 6 and 3 + 6 lbs/A respectively as follows:

1. Tank mix; preplant incorporated
2. Tank mix; preemergence
3. Sequential application; naptalam, preplant incorporated plus bensulide preemergence
4. Sequential application; bensulide, preplant incorporated plus naptalam preemergence

Incorporation at Adelphia was accomplished with a power-driven tiller, while a double-disc was used at Centerton. Stand counts and visual ratings were made for cucumbers and weed species.

No crop injury was noted at either location from any of the treatments tested. In general, greater herbicidal activity occurred at Centerton than at Adelphia. Differences in preplant incorporated treatments were minimal between locations in spite of the fact that different methods of incorporation were employed. Preemergence applications of bensulide, alone and in combination, were more effective on grass species at Centerton than at Adelphia. Significant increases in weed control were observed where chemicals were applied in combination. In most cases the particular application method which was best for a combination treatment reflected that method which was best for either or both chemicals alone.

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Evaluation of Herbicides for Weed Control in Transplanted and Seeded Tomatoes

J. C. Cialone and D. A. Braden[1/]

Abstract

Studies were conducted with both field-seeded and transplanted tomatoes on a Freehold sandy loam soil at Adelphia, New Jersey. Promising compounds for both field-seeded and transplanted tomatoes included the following:

Chemical		lbs/A
EL-179	- 4-isopropyl-2,6-dinitro-N,N-dipropylaniline	1-2
R-7465	- 2-(α napthoxy)-N, N-diethylpropionamide	2-6
U-27267	- Chemical name is not available	1.5-3
NIA-20439	- 3-(2-methylphenoxy) pyridazine	2-4
BAY-94337	- 4-amino-6-t-butyl-3-(methylthio)-as-triazin-5-(4H)one	.75-2

Performance of these chemicals applied at several different dates was evaluated. EL-179, R7465, and U-27267 were found to be safe on both field seeded and transplanted tomatoes at the rates tested. NIA-20439 injured tomatoes in both crop cultures; dwarfed plants, malformed leaves and dark green color were characteristic of the higher application rates of NIA-20439.

All of the above compounds except BAY-94337 were generally more effective on annual grass species than on broadleaf species. In addition, soil incorporation enhanced the activity of EL-179, R-7465, U-27267 and NIA-20439. Higher activity was found with applications made in late May and June than with those made in early May. This was true in spite of the fact that greater weed pressure, especially with crabgrass, was noted in late May and June.

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BAY-94337 was applied to field seeded tomatoes at 0.75 lb/A when the crop was 4-5" tall. Only slight injury was noted on some individual tomato plants. At time of treating the following weeds were 3-4" tall, lambsquarter (Chenopodium album L.), commom pigweed (Amarathus retroflexus L.), fall panicum (Panicum dichotomiflorium (L.) Michx.) and lovegrass Erogrostis spp.). Postemergence control of these weed species was excellent.

All five compounds show promise as selective herbicides in tomatoes. BAY-94337 is especially interesting since it is more active on broadleaf weeds than the present commercial tomato herbicides.

EFFECT OF HERBICIDE TREATMENTS ON WEED CONTROL AND YIELD OF MIDWAY STRAWBERRIES[1]

Oscar E. Schubert and C. E. Hickman[2]

Abstract. Nineteen different herbicide treatments involving ten different herbicides were made to well-established Midway strawberry (Fragaria grandiflora Ehrh.) plants. Best weed control was obtained by the combination of S-ethyl dipropylthiocarbamate (EPTC) plus 2-chloro-4,6-bis(ethylamino)-s-triazine (simazine) at 5 + 1 lb/A and by EPTC plus 2-chloro-4-cyclopropylamino-6-isopropylamino-1,3,5-triazine (hereafter referred to as Outfox) at 5 + 1 lb/A. Six other treatments which gave good weed control were: 3-[p-(p-chlorophenoxy)phenyl]-1,1-dimethyl-urea (chloroxuron) plus 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) at 4 + 2 lb/A; chloroxuron plus dimethyl tetrachloroterephthalate (DCPA) at 4 + 9 lb/A; DCPA plus 2-(2,4-dichlorophenoxy)ethyl sodium sulfate (sesone) at 9 + 4 lb/A; N,N-dimethyl-2,2-diphenylacetamide (diphenamid) plus Outfox at 6 + 1 lb/A; diphenamid plus simazine at 6 + 1 lb/A; and diphenamid plus chloroxuron plus DCPA at 6 + 4 + 9 lb/A. Yield of strawberries was not significantly different for any treatments and check except the two treatments involving Outfox (EPTC plus Outfox and diphenamid plus Outfox).

INTRODUCTION

The posttransplant application of S-ethyl dipropylthiocarbamate (EPTC) plus 2-chloro-4,6-bis(ethylamino)-s-triazine (simazine) has been more consistent in overall weed control than N,N-dimethyl-2,2-diphenylacetamide (diphenamid) in many West Virginia strawberry (Fragaria grandiflora Ehrh.) plantings. Diphenamid often has not controlled common ragweed (Ambrosia artemisiifolia L.), black nightshade (Solanum nigrum L.) and ladysthumb (Polygonum persicaria L.) as well as EPTC plus simazine. In greenhouse experiments (2,5,6,7) 3-[p-(p-chlorophenoxy)phenyl]-1,1-dimethyl-urea (chloroxuron), chloroxuron plus dimethyl tetrachloroterephthalate (DCPA), DCPA plus diphenamid, DCPA plus 2-(2,4-dichlorophenoxy)ethyl sodium sulfate (sesone), diphenamid, diphenamid plus EPTC, 4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline (nitralin), diphenamid plus nitralin, diphenamid plus simazine, and EPTC + simazine generally have not reduced growth and development of strawberry mother and daughter plants at rates considered sufficient for weed control. Nitralin 0.75 lb/A reduced growth of runner plants of the Surecrop variety (4). In another greenhouse experiment (3) strawberry mother plants treated with 2,4-dichlorophenyl p-nitrophenyl ether (nitrofen) and daughter plants grown in nitrofen-treated soil grew as well as untreated plants. The primary objective of the present study was to evaluate most of the above herbicides either alone or in combination in the field. The secondary objective was to evaluate 2,4'-dinitro-

[1]Published with the approval of the Director of the West Virginia University Agricultural Experiment Station as Scientific Paper No.

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4-trifluoromethyl-diphenylether (hereafter referred to as Preforan[3]), a herbicide similar to nitrofen, and 2-chloro-4-cyclopropylamino-6-isopropylamino-1,3,5-triazine (hereafter referred to as Outfox[4]), a triazine herbicide which may control a similar spectrum of weeds as simazine. Preforan and Outfox have some postemergent weed control activity and may provide better weed control than preemergent herbicides alone, especially if small weeds are missed in weeding prior to herbicide application. The tertiary objective was to evaluate 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) alone and in combination since alachlor controls several troublesome weeds in strawberries, e.g., barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.) large crabgrass (*Digitaria sanguinalis* (L.) Scop.) foxtails (*Setaria* spp.) and common ragweed.

MATERIALS AND METHODS

Virus-free Midway strawberry plants were set 2 feet apart in rows 4 feet apart on April 30, 1969, at the Ohio Valley Experiment Station, Point Pleasant, West Virginia. The soil was a Monongahela sandy loam. The planting was cultivated and hoed on June 12-13, 1969 prior to herbicide treatments on June 13 and 14.

The field was marked into plots 4 feet wide and 20 feet long. The herbicide treatments were applied in a single pass with a 4-foot boom mounted on the rear of a 4-wheel garden tractor. Three TeeJet 8004 tips[5] on the boom were adjusted to apply the herbicides in 100 gpa. Tank mixes were used where two herbicides were included in a treatment, except EPTC, which was applied separately first, then incorporated by hand-raking before the second herbicide was applied to the freshly-raked surface. A carbon dioxide cylinder with regulator was used to supply a constant pressure of 33 psi. The CO_2 for spraying was introduced into the bottom of the stainless steel tank with a jet agitator to provide agitation and to prevent settling of herbicides. A small amount of CO_2 was bled-off continuously to provide agitation between spraying of individual plots.

Two experiments were conducted side by side with Experiment 1 designed to assess a greater variety of treatments while Experiment 2 was to evaluate various herbicides in combination with diphenamid (Table 1). Diphenamid was included in each experiment to serve as a standard herbicide treatment and EPTC plus simazine was included in Experiment 1 to have a standard with the most reliable treatment in West Virginia. Both experiments were set up as randomized complete blocks with 8 replications.

Data: Per cent weed control was recorded on July 17 (5 weeks after treatment) and August 20-21, 1969 (10 weeks after treatment). Plant stand was recorded on July 17. Weeds were harvested from 6 of the 8 replications between August 21 and September 8, 1969. Yield of No. 1 and cull strawberries was

[3]Registered trade name of CIBA Agrochemical Company, Vero Beach, Florida.
[4]Registered trade name of Gulf Research and Development Company, Merriam, Kansas.
[5]Manufactured by Spraying Systems Company, Bellwood, Illinois.

recorded for the 1970 growing season. The data were analyzed by Duncan's Multiple Range Test (1) at the 5 per cent level of significance.

Table 1. Posttransplant herbicide treatments[a] applied to well-established Midway strawberries.

Herbicides and formulation	Rate lb/A ai	Application made Time	Day
Experiment 1			
None	--	--	--
Alachlor, 4 ec	2	6:15 pm	June 13
Chloroxuron, 50 wp	4	11:23 am	June 13
Diphenamid, 4 wd	6	1:10 pm	June 13
Preforan, 3 ec	4	6:40 pm	June 13
Chloroxuron + alachlor, 50 wp + 4 ec	4 + 2	5:45 pm	June 13
Chloroxuron + DCPA, 50 wp + 75 wp	4 + 9	12:30 pm	June 13
Chloroxuron + Preforan, 50 wp + 3 ec	4 + 4	7:10 pm	June 13
DCPA + sesone, 75 wp + 90 ws	9 + 4	1:45 pm	June 13
EPTC[b] + Outfox, 6 ec + 1 ec	5 + 1	3:30 pm and 5:10 pm	June 13
EPTC[b] + simazine, 6 ec + 80 wp	5 + 1	3:30 pm and 4:20 pm	June 13
Experiment 2			
None	--	--	--
Diphenamid, 4 wd	6	7:35 pm	June 13
Diphenamid + alachlor, 4 wd + 4 ec	6 + 2	9:20 pm	June 13
Diphenamid + chloroxuron, 4 wd + 50 wp	6 + 4	8:05 pm	June 13
Diphenamid + DCPA, 4 wd + 75 wp	6 + 9	8:35 pm	June 13
Diphenamid + EPTC[b], 4 wd + 6 ec	6 + 5	9:00 pm and 3:50 pm	June 13
Diphenamid + nitralin, 4 wd + 75 wp	6 + 0.75	9:45 pm	June 13
Diphenamid + Outfox, 4 wd + 1 ec	6 + 1	9:30 am	June 14
Diphenamid + Preforan, 4 wd + 3 ec	6 + 4	8:50 am	June 14
Diphenamid + simazine, 4 wd + 80 wp	6 + 1	9:10 am	June 14
Diphenamid + chloroxuron + DCPA, 4 wd + 50 wp + 75 wp	6 + 4 + 9	10:00 am	June 14

[a] Planting was cultivated and hoed free of weeds on June 12 and 13, 1969. Maximum temperature was 90° F on June 13 and 14.

[b] Incorporated within 3 minutes after application to a depth of 2-5 cm by hand raking.

RESULTS AND DISCUSSION

Weed control: All herbicide treatments in both experiments provided (Table 2) excellent weed control through the July 17 observation period. Near the end of August, two treatments (EPTC + Outfox, 5 + 1 lb/A and EPTC + simazine 5 + 1 lb/A) were outstanding with 92% weed control. Unfortunately, Outfox at 1 lb/A reduced the stand of strawberries too much when used with either EPTC (average of 1 alive out of 10) or diphenamid (3 alive out of 10). Simazine, the other triazine included in the experiments, did not reduce stand of strawberries. Other herbicides in Experiment 1 that gave satisfactory weed control were choloroxuron + alachlor (76%), chloroxuron + DCPA (80%) and DCPA + sesone (81%). Alachlor alone, Preforan alone, and chloroxuron + Preforan gave marginal weed control (ca 70%). Chloroxuron alone and diphenamid alone were un-

Table 2. Strawberry herbicide treatments, weed control and fresh weed weights during first season.[a]

Treatment	Rate lb/A	Weed control[b] (0=none; 100=complete) July 17 1969	August 20-21, 1969	Fresh weed weight per plot[c] Aug. 21-Sept. 9, 1969 (lb.)
Experiment 1				
Check	0	63 b[d]	48 d	11.2 cd
Alachlor	2	97 a	70 bc	5.9 a
Chloroxuron	4	94 a	58 cd	14.9 d
Diphenamid	6	95 a	48 d	13.6 d
Preforan	4	97 a	71 bc	10.2 bcd
Chloroxuron + alachlor	4 + 2	96 a	76 abc	7.7 abc
Chloroxuron + DCPA	4 + 9	96 a	80 ab	4.5 a
Chloroxuron + Preforan	4 + 4	98 a	71 bc	6.5 ab
DCPA + sesone	9 + 4	98 a	81 ab	4.9 a
EPTC[e] + Outfox	5 + 1	99 a	92 a	2.9 a
EPTC[e] + simazine	5 + 1	99 a	92 a	2.5 a
Experiment 2				
Check	0	81 c[d]	59 bcd	7.4 ab
Diphenamid	6	92 b	38 d	13.6 c
Diphenamid + alachlor	6 + 2	95 ab	53 cd	7.8 ab
Diphenamid + chloroxuron	6 + 4	95+ ab	59 bcd	8.5 abc
Diphenamid + DCPA	6 + 9	94 b	69 abc	6.6 ab
Diphenamid + EPTC[e]	6 + 5	97 a	55 cd	10.5 bc
Diphenamid + nitralin	6 + 0.75	92 a	64 abc	7.1 ab
Diphenamid + Outfox	6 + 1	98 a	82 a	5.6 ab
Diphenamid + Preforan	6 + 4	96 a	71 abc	6.7 ab
Diphenamid + simazine	6 + 1	97 a	80 ab	4.1 a
Diphenamid + chloroxuron + DCPA	6 + 4 + 9	97 a	78 ab	3.9 a

[a]Treatments applied June 13, 1969 following cultivation and hoeing on June 12 and 13, 1969. Treatments applied at random within each of 8 replications.

[b]Average of 8 replications for weed control.

[c]Average of 6 replications for weed weights.

[d]Averages in the same column and in the same experiment followed by a common letter are not significantly different from each other according to Duncan's Multiple Range Test at the 5 per cent level.

[e]EPTC was incorporated to a depth of 2-5 cm within 3 minutes after application.

satisfactory (58 and 48% weed control, respectively). In Experiment 2, diphenamid + Outfox, diphenamid + simazine and diphenamid + chloroxuron + DCPA gave good weed control (80, 80, and 78% control, respectively). Diphenamid + DCPA and diphenamid + Preforan gave marginal weed control (ca 70%). Diphenamid alone and the remaining combinations with diphenamid were unsatisfactory in weed control. Weeds harvested and weighed fresh from 6 of the 8 replications indicated a good comparison (r=0.9) between visual weed ratings in August and

Table 3. Weed species and intensities in posttransplant treatments in strawberry Experiment 1.

Weed Species	Herbicide Rate lb/A										
	None	Alachlor, 2	Chloroxuron, 4	Diphenamid, 6	Preforan, 4	Chloroxuron + alachlor, 4 + 2	Chloroxuron + DCPA, 4 + 9	Chloroxuron + Preforan, 4 + 4	DCPA + sesone, 9 + 4	EPTC + Outfox, 5 + 1	EPTC + simazine, 5 + 1
BROADLEAF WEEDS:	(Intensity of weeds[a])										
Bindweed, hedge (Convolvulus sepium L.)	2	1	2	3	1	1	1	T	T	T	T
Carpetweed, (Mollugo verticillata L.)	4	2	2	4	2	2	1	2	1	T	T
Copperleaf, Virginia (Acalypha virginica L.)	3	2	3	4	2	1	1	T	1	T	T
Groundcherry, clammy (Physalis heterophylla Nees)	3	1	2	2	2	T	1	1	1	T	T
Horsenettle (Solanum carolinense L.)	2	2	2	3	2	2	2	2	2	T	T
Ladysthumb (Polygonum persicaria L.)	1	0	0	1	0	0	0	0	T	0	0
Lambsquarters, common (Chenopodium album L.)	2	1	2	1	1	T	T	0	T	0	0
Milkweed, honeyvine (Ampelamus albidus (Nutt.) Britt.)	2	1	2	1	2	2	1	2	2	1	T
Morningglory, bigroot (Ipomea pandurata (L.) G.F.W.Mey)	1	0	1	1	0	0	0	1	0	0	1
Morningglory, ivyleaf (Ipomea hederacea (L.) Jacq.)	1	1	1	2	1	1	1	1	T	T	T
Nightshade, black (Solanum nigrum L.)	2	0	1	3	T	T	T	T	1	0	T
Pigweed, redroot (Amaranthus retroflexus L.)	1	0	1	1	1	T	1	T	0	0	T
Purslane, common (Portulaca oleracea L.)	1	1	1	2	T	T	1	0	1	T	T
Sida, prickly (Sida spinosa L.)	3	2	2	4	2	1	1	2	1	T	T
Woodsorrel, yellow (Oxalis stricta L.)	4	2	2	4	2	2	1	1	T	0	T
GRASSY WEEDS:											
Crabgrass, large (Digitaria sanguinalis (L.) Scop.)	4	2	3	4	2	1	1	2	2	T	T
Goosegrass (Eleusine indica (L.) Gaertn.)	2	0	1	0	T	T	T	T	T	0	T
Johnsongrass (Sorghum halepense (L.) Pers.)	1	T	T	T	T	T	T	T	T	0	T
Panicum, fall (Panicum dichotomiflorum Michx.)	1	0	1	0	T	0	0	T	0	T	0
SEDGES:											
Nutsedge, yellow (Cyperus esculentus L.)	3	T	1	1	T	1	1	T	1	T	T

[a]Intensity of weeds was recorded for each plot with 0 = none observed; T = occasional weed in plots; 1 = few weeds or small weeds; 2 = several weeds or medium size weeds; 3 = many weeds or several medium size weeds; 4 = very many small to medium weeds; 5 = very many medium to large weeds; and 6 = very many large weeds.

Table 4. Weed species and intensities in posttransplant treatments in strawberry Experiment 2.

Weed Species	Herbicide Rate lb/A									
	None	Diphenamid, 6	Diphenamid + alachlor, 6 + 2	Diphenamid + chloroxuron, 6 + 2	Diphenamid + DCPA, 6 + 9	Diphenamid + EPTC, 6 + 5	Diphenamid + nitralin, 6 + 0.75	Diphenamid + Outfox, 6 + 1	Diphenamid + Preforan, 6 + 4	Diphenamid + simazine, 6 + 1	Diphenamid + chloroxuron + DCPA, 6 + 4 + 9
BROADLEAF WEEDS:	(Intensity of weeds[a])										
Bindweed, hedge (Convolvulus sepium L.)	1	1	T	1	T	1	1	1	1	1	T
Carpetweed, (Mollugo verticillata L.)	3	3	4	3	2	3	2	1	2	1	2
Copperleaf, Virginia (Acalypha virginica L.)	2	3	3	2	2	2	2	T	1	T	1
Groundcherry, clammy (Physalis heterophylla Nees)	1	1	2	2	1	1	1	T	T	T	0
Horsenettle (Solanum carolinense L.)	2	2	2	2	1	1	2	T	1	1	1
Ladysthumb (Polygonum persicaria L.)	T	1	0	0	0	0	0	0	0	0	0
Lambsquarters, common (Chenopodium album L.)	2	1	T	T	T	2	T	T	1	T	T
Milkweed, honeyvine (Ampelamus albidus (Nutt.) Britt.)	2	1	T	2	T	1	T	T	2	1	T
Morningglory, bigroot (Ipomea pandurata (L.) G.F.W.Mey)	1	1	1	1	1	1	1	1	1	1	1
Morningglory, ivyleaf (Ipomea hederacea (L.) Jacq.)	1	2	2	0	1	0	1	1	1	T	T
Nightshade, black (Solanum nigrum L.)	1	1	0	1	1	T	1	T	0	0	1
Pigweed, redroot (Amaranthus retroflexus L.)	2	2	2	1	1	1	T	T	0	0	T
Purslane, common (Portulaca oleracea L.)	4	2	2	1	1	2	T	T	0	T	T
Sida, prickly (Sida spinosa L.)	3	4	4	3	2	2	3	1	2	1	1
Woodsorrel, yellow (Oxalis stricta L.)	2	3	2	3	1	1	2	0	2	1	1
GRASSY WEEDS:											
Crabgrass, large (Digitaria sanguinalis (L.) Scop.)	3	4	3	2	2	3	1	2	2	1	2
Goosegrass (Eleusine indica (L.) Gaertn.)	1	1	0	T	T	T	0	T	T	T	0
Johnsongrass (Sorghum halepense (L.) Pers.)	1	1	0	0	1	1	T	T	0	T	0
Panicum, fall (Panicum dichotomiflorum Michx.)	1	1	0	0	0	0	0	T	0	0	T
SEDGES:											
Nutsedge, yellow (Cyperus esculentus L.)	2	3	1	1	2	1	1	1	T	1	1

[a]Intensity of weeds was recorded for each plot with 0 = none observed; T = occasional weed in plots; 1 = few weeds or small weeds; 2 = several weeds or medium size weeds; 3 = many weeds or several medium size weeds; 4 = very many small to medium weeds; 5 = very many medium to large weeds; and 6 = very many large weeds.

Table 5. Strawberry herbicide treatments[a] and yield.

Treatment	Rate lb/A	Yield of berries[b] No. 1 (qt/A)	Culls (qt/A)	Total (qt/A)
Experiment 1				
Check	0	10,019 ab[c]	1,198 a	11,217 a
Alachlor	2	8,766 ab	1,307 a	10,073 a
Chloroxuron	4	9,855 ab	1,307 a	11,162 a
Diphenamid	6	9,801 ab	1,035 ab	10,836 a
Preforan	4	11,380 ab	1,634 a	13,014 a
Chloroxuron + alachlor	4 + 2	9,583 ab	1,416 a	10,999 a
Chloroxuron + DCPA	4 + 9	12,033 a	1,143 a	13,176 a
Chloroxuron + Preforan	4 + 4	10,291 ab	1,416 a	11,707 a
DCPA + sesone	9 + 4	10,346 ab	1,525 a	11,871 a
EPTC[d] + Outfox	5 + 1	1,797 c	381 b	2,178 b
EPTC[d] + simazine	5 + 1	10,346 ab	1,252 a	11,598 a
Experiment 2				
Check	0	9,474 a[c]	1,688 a	11,162 a
Diphenamid	6	9,964 a	1,252 a	11,216 a
Diphenamid + alachlor	6 + 2	10,999 a	1,361 a	12,360 a
Diphenamid + chloroxuron	6 + 4	9,638 a	1,035 a	10,673 a
Diphenamid + DCPA	6 + 9	10,727 a	1,415 a	12,142 a
Diphenamid + EPTC[d]	6 + 5	10,182 a	1,307 a	11,489 a
Diphenamid + nitralin	6 + 0.75	9,256 a	1,579 a	10,835 a
Diphenamid + Outfox	6 + 1	3,811 b	599 b	4,410 b
Diphenamid + Preforan	6 + 4	11,325 a	1,742 a	13,068 a
Diphenamid + simazine	6 + 1	10,019 a	1,307 a	11,326 a
Diphenamid + chloroxuron + DCPA	6 + 4 + 9	9,420 a	1,797 a	11,217 a

[a]Treatments applied June 13, 1969 following cultivation and hoeing on June 12 and 13, 1969. Treatments applied at random within each of 8 replications.

[b]Yield converted to average quarts per acre from mean of 8 plots each 4 x 20 foot.

[c]Averages in the same column followed by a common letter are not significantly different from each other according to Duncan's Multiple Range Test at the 5 per cent level.

[d]EPTC was incorporated to a depth of 2-5 cm within 3 minutes after application.

actual weed weights per plot (Table 2). Diphenamid did not control weeds as well as expected and lack of control may have resulted from one or more of the following: 1) some weeds were not killed by the cultivation and hoeing 1 to 2 days before application; 2) moisture was inadequate for activation of diphenamid and 3) some weeds grew vigorously when partially released from competition. In other adjacent experiments with tomatoes where the soil was thoroughly disked prior to diphenamid application and then irrigated the same day or one day after treatment weed control was excellent (ca 90%) at the end of August and October (8).

Twenty-seven weed species were identified in the experimental plots. Nineteen of the more abundant weeds in check and treated plots are given in Tables 3 and 4. The presence of eight perennial weeds may have accounted for the lack of control of many of the treatments. The four most common perennial weeds (clammy groundcherry, horsenettle, yellow woodsorrel and yellow nutsedge) and the four most common annuals (carpetweed, Virginia copperleaf, prickly sida and large crabgrass) were controlled by two treatments--EPTC plus Outfox and EPTC plus simazine.

Prior to and during the 1970 harvest season, the weeds were not a problem in any plots except the checks.

Yield: All treatments, except the combination of Outfox with either EPTC or diphenamid, were not significantly different in yield of No. 1 or total berries from the check (Table 5).

ACKNOWLEDGMENTS

The author gratefully acknowledges the cooperation of the CIBA Corporation, Diamond Shamrock Corporation, Eli Lilly and Company, Geigy Chemical Corporation, Gulf Research and Development Company, Monsanto Company, Shell Chemical Company, Stauffer Chemical Company and Union Carbide Corporation in supplying the herbicides used in these experiments. The assistance of Dr. W. H. Childs in reviewing the manuscript is gratefully acknowledged and deeply appreciated.

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CHEMICAL WEED CONTROL FOR POTATOES IN NORTHWESTERN EUROPE

Arthur Hawkins 1/

A survey of weed problems and methods of chemical weed control in potatoes in northwestern Europe was made in 1970.

The extent of chemical weed control in potatoes in 1970 varied from a rather small percentage of the potato acreage in Scandinavian countries to about 50% of the potato acreage in the United Kingdom and 70% in Switzerland. Usage has increased rapidly in the United Kingdom since herbicides were not used on any scale prior to 1963.

Perennial grasses:

The control of quackgrass (*Agropyron repens*) is of considerable concern throughout the area, especially in those fields which tend to be wet, and also in a few fields in drier areas. TCA has been recommended for control of quackgrass in much of northwestern Europe, especially as an autumn treatment. More recently recommendations include EPTC for control of all infestations, and paraquat applied preemergence to potatoes as a suppressant for light infestations.

Annual grasses:

In contrast to northeastern United States, annual grass weeds are generally of no problem in potatoes in northwestern Europe. Barnyardgrass (*Echinochloa crusgalli*) and crabgrass (*Digitaria* spp.) either are unknown to parts of the area or are of no concern in potato production.

Annual bluegrass (*Poa annua*) is common in potato fields in this area but it is usually easily controlled. Of some concern is wild oat grass (*Avena fatua*), especially in United Kingdom. They do not usually constitute a problem since they are quite easily killed by chemicals.

Broadleaf weeds:

Control of annual broadleaf weeds in potatoes is of primary concern in this area. The most important annual broadleaf weed in potatoes in northwestern Europe is lambsquarters (*Chenopodium album*).

As herbicides are used, wild buckwheat (*Polygonum convolvulus*) and knotweed (*Polygonum aviculare*) are becoming increasingly important. It is reported in England that *P. aviculare* and *Chenopodium album* cause a problem because they tend to survive herbicide applications.

Other important broadleaf weeds in potato fields are: chickweed (*Stellaria media*), catchweed (*Gallium aparine*), *Fumaria officinalis*, ladysthumb (*Polygonum persicaria*), spreading orach (*Atriplex patula*), pineapple weed (*Matricaria* spp.) and *Tripleurospermum*.

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Chemicals used for control of annual grasses and broadleaf weeds in potatoes.

Chemical control of annual grass weeds and annual broadleaf weeds has been primarily by application preemergence to potatoes of contact or residual chemicals or mixtures of the two.

Contact treatments used are DNOC and dinoseb. In U. K. the use of dinoseb has been replaced by paraquat or paraquat plus diquat.

Residual chemicals used have been primarily substituted urea compounds. Linuron, especially, or monolinuron, or a mixture of the two are widely used. Monolinuron is reported to be more effective for grass control. Recently metabromuron has been included in the lists of chemicals that may be used. More recently chlorbromuron has been added to herbicide treatments recommended for potatoes in some countries.

A mixture of a contact material and a residual material is being recommended such as paraquat plus monolinuron in Great Britain; or DNOC plus linuron or dinoseb plus monolinuron in Holland. Other materials listed for contact and residual preemergence treatment include Ametryne, prometryne, and a mixture of simazine and prometryne.

Preplant treatment with EPTC is being recognized for control of annual grasses and some annual broadleaf weeds as well as for quackgrass.

Chemical weed control and changes in cultural practices.

Early deep covering or final ridging or hilling of potatoes before emergence has become possible by chemical weed control. Deep early covering has been found desirable in certain soils, particularly on heavy cloddy soils. Only whole seed is planted in these countries and only carefully sprouted seed or warmed-up seed is planted to promote rapid growth. Also, cup-type potato planters are used to minimize loss of sprouts.

Final ridging before emergence is now being practiced in some of the countries, especially U. K. and Holland. Either a contact treatment or a residual treatment or a mixture of contact and residual materials is applied just prior to emergence of the potatoes. Some growers may follow with an additional ridging.

In some instances growers are going so far as to make the final ridge at planting, followed somewhat later by an application of a chemical or chemicals preemergence to potatoes.

Chemical weed control problems.

It was noted that under the dry soil conditions in 1970 in Holland and England that in some instances lambsquarters and Polygonum spp. were not adequately controlled with urea compounds.

WEEDS TODAY - THE MAGAZINE FOR A BETTER TOMORROW

Robert P. Upchurch*

In order to appraise Weeds Today it is necessary to review the basis for its existence and the manner in which it is being produced. Having done this it should be possible to evaluate its current status and the prospects for the future.

In February 1969, the WSSA Executive Committee received a suggestion that a popular publication on weeds would be meritorious. Discussions on this subject led to the appointment of a special WSSA committee entitled the Popular Publication Committee. This group was to evaluate the potential need, possible contents, and purposes of such a publication. In the event that the committee was in favor of a popular publication, they were to have the responsibility for outlining the ways and means of instigating the project. The committee consisted of G. A. Buchanan, J. W. Koehler, G. E. O'Brien, J. T. Holstun, Jr., J. K. Leasure and R. P. Upchurch, Chairman.

After soliciting opinions from many individuals and intensively exchanging views on the subject, the committee agreed to recommend that WSSA initiate a popular publication on weeds and related subjects during 1971. The recommended purposes of the publication were to be as follows:

1. Generate grassroots support for the discipline of Weed Science.
2. Provide a rational interpretation of technology dealing with Weed Science.
3. Convey useful information from Weed Science to interested parties.
4. Generate income for WSSA.

The matter of support of all types for the discipline of Weed Science has been a major concern for weed scientists for many years. The discipline has not received its fair share of administrative and financial resources and projections for the future do not look favorable. A popular publication could help to generate grassroots support for our discipline by showing farmers, agribusinessmen, legislators, and administrators the contribution we have made and the magnitude of the contributions which we can make to society in the future.

Each branch of science has an obligation to see that the technology which it generates is used wisely by society. Today the public and our elected representatives are expressing a keen interest in how mankind is influenced by technology. Unfortunately, we are in an era in which alarmist's viewpoints by self-proclaimed experts are often accepted readily while inadequate attention is given to the true state of affairs as revealed by our knowledge of technology. Through a popular publication we can attempt to acquaint some of the public with a rational interpretation of facts associated with weeds and their control. In the new vernacular we want to "tell it like it is" and in the old vernacular "let the chips fall where they may".

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Although we do have an excellent farm press today and we do have a great many dedicated Extension Weed Specialists and hard working industrial technologists, one can make the claim that more effort is needed to bring the fruits of weed science to the user level. Prior to the introduction of Weeds Today there was no single national popular periodical devoted exclusively to weeds. There has been an inadequate mechanism for spreading the knowledge generated by Weed Scientists. Weeds Today certainly has a role in transmitting useful information.

The objective of generating income for WSSA is of minor importance. It is of importance that the publication be self-supporting since the coffers of WSSA cannot provide substantial financial support. More important is the fact that the potential of generating income encourages us to plan for the time when we can acquire a full time paid professional staff to help us publish a product of which we can all be proud.

In February 1970, the WSSA Executive Committee approved the recommendation to initiate a popular publication during 1970 and they approved the four objectives outlined above. To continue this project the special Popular Publication Committee was reappointed and expanded to include E. G. Rodgers, Richard Behrens and F. W. Slife.

The question of how to finance and publish the popular publication was a major concern. After a survey of the possibilities, the committee concluded that the only logical route was to send the publication free-of-charge to a selected audience with the idea that advertising revenue would bear the financial burden. Our hopes were to locate a publishing house which would undertake the project as a joint venture in which the publishing house would secure advertising, publish and circulate the publication and advance financial support until profits would occur, while WSSA would provide technical content and retain editorial control, policy control, and ownership of the venture. Such an arrangement was eventually achieved with the New Science Publishing Company of Memphis, Tennessee. We have agreed to circulate the publication to the WSSA membership, to major agricultural producers, Extension personnel, pest control operators, rights-of-way agencies, and to selected influence groups. We started at 50,000 copies per issue and have a goal of 200,000 copies per issue.

On an interim basis Dr. Earl G. Rodgers, WSSA Editor, agreed to serve as Editor for the new publication, Dr. Fred W. Slife, WSSA Business Manager, agreed to serve as Business Manager, and Dr. Richard Behrens agreed to serve as Circulation Manager. The 1970 trial schedule resulted in the publication of issues in June, July and August. During 1971 six issues are planned.

In order to select a name for the new venture a panel of 18 members assembled several hundred names. From the five most favored names - Weeds and Man, Weed News, Weed Technology, Weed World, and Weeds Today, the latter was selected.

In the publication world the successful introduction of a new magazine is recognized as a difficult and risky undertaking. As matters stand now we are close to accomplishing this difficult feat. From a financial standpoint we

must reserve judgment until the revenues for the 1971 issues begin to accrue. We had anticipated that the 1970 issues would show an operations deficit and in this respect we were not disappointed.

From a circulation standpoint we have been disappointed in our capacity to foresee every pitfall. The pitfalls seem to come from every corner including the Post Office and computers. Some WSSA members have failed to get their copies. These circulation problems will be corrected in time but as long as we need to mail 200,000 copies and publish only 50,000 copies, misunderstandings will occur. There is the option that any individual who wishes to be guaranteed a regular mailing can subscribe for $4.00/year ($6.00/year ex-U.S.).

From an editorial content standpoint we have been well pleased. The Weed Scientists in the U.S. and Canada have shown themselves ready and willing to supply articles. It would be relatively easy to generate enough editorial volume for a several fold increase in the size of the magazine. The big problem comes in getting the right balance of articles in a given issue and in getting certain specialized types of information such as current thoughts about action in the Congress. In due course several well recognized Departments should become established in Weeds Today. An example is the "World Weed Notes" Department which appeared for the first time in the August, 1970 issue. Considerable attention will be given in the future to having attractive layouts, simplified presentations and skillful use of color. The articles must be written for the layman. So far we have been especially pleased by the color covers which have done a great deal to project a favorable image for us.

There is the distinct possibility that regional editions of Weeds Today can be produced. With such a procedure each reader would find interest in a higher percentage of the editorial content. As this possibility unfolds, there will be an increased opportunity for WSSA and the regional weed conferences or societies to collaborate. If we are successful with the magazine over the next 12 to 24 months, there is the possibility that a special edition for the homeowner may be justified. As long as we exclude the homeowner from our clientele we are limited to a circulation of several hundred thousand. With a homeowner edition we might reach several million readers.

The uniqueness of Weeds Today is that it involves an attempt of a professional group to bring the fruits of its efforts to society-at-large. The merit of this venture rests entirely on the capacity of the WSSA membership to let its unimpeachable integrity be reflected in the editorial content of the magazine. I know of no other professional group which has undertaken such a worthy challenge. Having achieved a modicum of success and having been given the support of weed scientists far and wide, you may be assured that we will continue to maintain and expand this venture which has so much potential for weed scientists as individuals and for mankind everywhere.

EFFECT OF POSTTRANSPLANT HERBICIDE TREATMENTS ON NEWLY-SET ORNAMENTALS[1]

Oscar E. Schubert and Karel R. Schubert[2]

Abstract. Newly-set 'Bigleaf' wintercreeper (Euonymus fortunei 'Vegetus') 'Purpleleaf' wintercreeper (E. f. 'Coloratus'), 'Hetzi' Japanese holly (Ilex crenata 'Hetzi'), 'Blue Rug' juniper (Juniperus horizontalis 'Wiltonii'), and 'Weeping' forsythia (Forsythia suspensa) were treated with herbicides within one day of setting. The herbicide treatments were: 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) at 4 and 8 lb/A; 2,6-dichlorobenzonitrile (dichlobenil) at 5 lb/A; N,N-dimethyl-2,2-diphenylacetamide (diphenamid) at 6 lb/A; S-ethyl dipropylthiocarbamate (EPTC) at 5 lb/A; 2-chloro-4-cyclopropylamino-6-isopropylamino-1,3,5-triazine (hereafter referred to as Outfox) at 0.75 lb/A; 2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione (hereafter referred to as Tunic) at 4.8 lb/A; alachlor plus 2-chloro-4,6-bis (ethylamino)-s-triazine (simazine) at 4 + 1 and 4 + 2 lb/A; 3-amino-2,5-dichlorobenzoic acid (as the methyl ester of chloramben) plus diphenamid at 4 + 6 lb/A; and 2-(p-(p-chlorophenoxy)phenyl)-1,1-dimethyl-urea (chloroxuron) plus diphenamid at 4 + 6 lb/A. All herbicide treatments gave satisfactory weed control of annual grassy and broadleaf weeds from July 8 through October 8, 1970. Field bindweed (Convolvulus arvensis L.) was the most common perennial broadleaf weed not generally controlled. New shoot growth of 'Purpleleaf' wintercreeper 'Hetzi' Japanese holly, and 'Weeping' forsythia was decreased over check by Tunic. New shoot growth of 'Hetzi' Japanese holly also was reduced over check by dichlobenil and Outfox. Shoot growth of 'Weeping' forsythia was decreased by Outfox. All other treatments did not significantly decrease shoot growth of ornamentals compared with check.

INTRODUCTION

Weed control in newly-planted ornamentals, particularly those easily injured by herbicides, is one of the most perplexing problems confronting nurserymen. At the time plants are lined-out suitable weather and soil conditions often limit the amount of time available for weeding new plantings; consequently many plantings are neglected. The proper use of safe herbicides would be a worthwhile production tool in growing larger ornamentals at less cost and with minimum effort.

The objective was to evaluate several herbicides on young plants of 'Bigleaf' wintercreeper (Euonymus fortunei 'Vegetus'), 'Purpleleaf' wintercreeper (E. f. 'Coloratus'), 'Hetzi' Japanese holly (Ilex crenata 'Hetzi'), 'Blue Rug' juniper (Juniperus horizontalis 'Wiltonii') and 'Weeping' forsythia (Forsythia suspensa).

[1]Published with the approval of the Director of the West Virginia University Agricultural Experiment Station as Scientific Paper No. .

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MATERIALS AND METHODS

The soil (Horton silty clay loam) to be planted was plowed and disked about 2 weeks before a final cultivation with a small rototiller on July 3, 1970 at the Horticulture Farm, Morgantown, West Virginia. Soil samples taken for analysis[3] in September showed: pH 4.4-4.8; available phosphorus 29-60 lb/A; and exchangeable potassium 256 to 309 lb/A.

'Bigleaf' and 'Purpleleaf' wintercreeper (2-year, bare root); 'Hetzi' Japanese holly and 'Blue Rug' juniper (2 1/4-inch peat pots) were planted in the afternoon and evening of July 6, 1970. Overhead sprinklers were turned on about 9:30 p.m. and off at 7:00 a.m. the next morning (rate varied from 0.05 to 1.20 inches). The 'Weeping' forsythia (1-year, bare root) were set between 10 a.m. and 11 a.m. on July 8. The plants, one of each species, were set about 2 feet apart in 2 rows near the center of each plot (10 x 10 feet). The herbicide treatments were: 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) at 4 and 8 lb/A; 2,6-dichlorobenzonitrile (dichlobenil) at 5 lb/A; N,N-dimethyl-2,2-diphenylacetamide (diphenamid) at 6 lb/A; S-ethyl dipropylthiocarbamate (EPTC) at 5 lb/A; 2-chloro-4-cyclopropylamino-6-isopropylamino-1,3,5-triazine (hereafter referred to as Outfox)[4] at 0.75 lb/A; 2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione (hereafter referred to as Tunic)[5] at 4.8 lb/A; alachlor plus 2-chloro-4,6-bis(ethylamino)-s-triazine (simazine) at 4 + 1 and 4 + 2 lb/A; 3-amino-2,5-dichlobenzoic acid (as the methyl ester of chloramben) plus diphenamid at 4 + 6 lb/A; and 2-(p-(p-chlorophenoxy)phenyl)-1,1-dimethyl-urea (chloroxuron) plus diphenamid at 4 + 6 lb/A. Three treatments (alachlor, 4 lb/A; dichlobenil, 5 lb/A; and EPTC, 5 lb/A) and half of another (chloramben, 4 lb/A of the chloramben + diphenamid treatment) were applied during the evening of July 8 in a light rain which amounted to 0.75 inch within 6 hours of application. In addition the irrigation system was turned on at midnight providing a variable application of 0.03 to 0.80-inch. All other treatments were applied between 9:15 a.m. and 1:10 p.m. on July 9.

All herbicides, except Outfox (1 ec) and Tunic (75 wp) which were unavailable on granules, were applied as granular formulations to minimize phytotoxicity to ornamentals. A small jar with a perforated lid was used to apply granular formulations as uniformly as possible. The granular formulations of alachlor and diphenamid were, perhaps, a little light and were moved more than desirable by a moderate wind which made application more difficult. The ec and wp formulations were applied as separate aliquots to each plot with a hand-carried boom (pressurized with CO_2 at 33 psi) at 208 gpa. The experiment was set up as a randomized complete block with 8 replications.

Data: Per cent weed control and appearance of ornamentals were recorded on July 29-31 and again on October 8-10, 1970. Weeds from all plots were harvested October 11-29, 1970. The data were analyzed by Duncan's Multiple Range Test (1) at the 5 per cent level of significance.

[3]The authors are grateful to Edwin Colburn and his staff in Agronomy for the soil analysis.

[4]Registered trade name of Gulf Research and Development Company, Merriam, Kansas.

[5]Registered trade mark of Velsicol Chemical Corporation, Chicago, Illinois.

RESULTS AND DISCUSSION

Weed control: Per cent weed control by the end of July was almost complete in all treatments (98 and 99%) compared to 66 and 79% 'control' for grassy and broadleaf weeds in untreated plots, respectively (Table 1). All treatments still controlled grassy and broadleaf weeds satisfactory by October 8-9, 1970; however, grassy weeds were becoming rather abundant in plots treated with Outfox at 0.75 lb/A and broadleaf weeds were somewhat abundant in plots treated with diphenamid at 6 lb/A (Table 3). Overall weed control was acceptable in all treated plots. Weed control in plots treated with diphenamid (6 lb/A), Outfox (0.75 lb/A) and chloramben plus diphenamid (4 + 6 lb/A) was poorer than in plots treated with alachlor (4 and 8 lb/A), Tunic (4.8 lb/A) and alachlor plus simazine (4 + 2 lb/A).

Weed weights: As weeds were harvested in each plot they were separated into perennial grassy weeds, perennial broadleaf weeds, annual grassy weeds, annual broadleaf weeds and yellow nutsedge (*Cyperus esculentus* L.), as given in Table 2. Perennial grassy and broadleaf weeds were not uniformly distributed in all plots.

Table 1. Ornamental herbicide treatments[a] and weed control--1970

Treatment	Rate lb/A	Weed control (0=None; 100=complete) Grassy weeds July	Grassy weeds Oct.	Broadleaf weeds July	Broadleaf weeds Oct.
Check	0	66 b[c]	36 c	79 b	84 b
Alachlor[d]	4	99 a	96 a	99 a	98 a
Alachlor	8	99 a	96 a	99 a	99 a
Dichlobenil[e]	5	99 a	87 ab	99 a	96 a
Diphenamid	6	98 a	91 ab	99 a	84 b
EPTC[e]	5	99 a	88 ab	99 a	93 a
Outfox	0.75	99 a	75 b	99 a	93 a
Tunic	4.8	99 a	99 a	99 a	98 a
Alachlor + simazine	4 + 1	98 a	95 a	99 a	94 a
Alachlor + simazine	4 + 2	99 a	98 a	99 a	98 a
Chloramben + diphenamid	4 + 6	98 a	84 ab	99 a	92 a
Chloroxuron + diphenamid	4 + 6	99 a	95 a	99 a	96 a

[a]Treatments applied July 8-9 to ornamentals set July 7-8, 1970. Treatments applied at random to each of 8 replications.

[b]Observations made July 29-31 and October 8-10, 1970.

[c]Averages in the same column followed by a common letter are not significantly different from each other according to Duncan's Multiple Range Test at the 5 per cent level.

[d]All herbicides, except Outfox (1 ec) and Tunic (75 wp), applied as granular formulations.

[e]Dichlobenil and EPTC were incorporated only by light rain and irrigation.

Table 2. Ornamental herbicide treatments[a] and average weight of weeds per plot--October 11-29, 1970.

		Weight of weeds[b]				
	Rate lb/A	Perennial grassy weeds (g)	Annual grassy weeds (g)	Perennial broadleaf weeds (g)	Annual broadleaf weeds (g)	Yellow nutsedge (g)
Check	0	0 a[c]	7174 e	329 b	889 d	72 bc
Alachlor[d]	4	0 a	422 abc	47 a	68 ab	1 a
Alachlor	8	1 a	235 abc	66 a	75 ab	T a
Dichlobenil[e]	5	T[f] a	1079 bc	T a	222 ab	32 ab
Diphenamid	6	1 a	622 bc	47 a	783 cd	87 cd
EPTC[e]	5	0 a	295 abc	77 a	340 bc	6 a
Outfox	0.75	0 a	1684 d	118 a	247 ab	21 ab
Tunic	4.8	0 a	8 a	48 a	1 a	1 a
Alachlor + simazine	4 + 1	58 ab	140 abc	150 ab	32 a	6 a
Alachlor + simazine	4 + 2	7 a	80 ab	49 a	20 a	1 a
Chloramben + diphenamid	4 + 6	T a	833 bc	38 a	396 bc	95 d
Chloroxuron + diphenamid	4 + 6	80 b	178 abc	6 a	82 ab	23 ab

[a]Treatments applied July 8-9 to ornamentals set July 7-8, 1970.

[b]Most of the weeds were nearly dry at time of weighing.

[c]Averages in the same column followed by a common letter are not significantly different from each other according to Duncan's Multiple Range Test at the 5 per cent level.

[d]All herbicides, except Outfox (1 ec) and Tunic (75 wp), applied as granular formulations.

[e]Dichlobenil and EPTC incorporated only by light rain and irrigation.

[f]T = less than 1 g per plot.

Quackgrass (Agropyron repens (L.) Beauv.) was the only perennial grassy weed found. The most common perennial weeds were field bindweed (Convolvulus arvensis L.) and hedge bindweed (C. sepium L.) with the latter being less frequently found. Two treatments (dichlobenil and chloroxuron plus diphenamid) may have retarded field and hedge bindweeds. Although all herbicides reduced weights of annual grassy and broadleaf weeds, Tunic at 4.8 lb/A was outstanding. Dichlobenil (5 lb/A), Outfox (0.75 lb/A), diphenamid (6 lb/A) and chloramben plus diphenamid (4 + 6 lb/A) were poorer than Tunic for control of annual grassy weeds. Diphenamid (6 lb/A), EPTC (5 lb/A) and chloramben plus diphenamid (4 + 6 lb/A) were less effective than Tunic at 4.8 lb/A. Although yellow nutsedge perhaps was not uniformly dispersed throughout all plots, alachlor (4 and 8 lb/A), EPTC (5 lb/A) and alachlor plus simazine (4 + 1 and 4 + 2 lb/A) seemed to have reduced the amount present. The amount of nutsedge may have been greater than normal in plots treated with diphenamid (6 lb/A) and chloramben plus diphenamid (4 + 6 lb/A).

Weed species: Twenty-five different species of weeds were found in check plots. Sixteen of the more commonly found weeds are given in Table 3. The more troublesome grassy weeds were large crabgrass, barnyardgrass and fall panicum, while field bindweed, redroot pigweed, common ragweed and common purslane were the most common broadleaf weeds.

Table 3. Most common weed species and intensities in postharvest treatments[a], October 8-10, 1970.

Weed species	Intensity[b] of weeds											
	Check	Alachlor[c], 4	Alachlor, 8	Dichlobenil[d], 5	Diphenamid, 6	EPTC[d], 5	Outfox, 0.75	Tunic, 4.8	Alachlor + simazine (4 + 1)	Alachlor + simazine (4 + 2)	Chloramben + diphenamid (4 + 6)	Chloroxuron + diphenamid (4 + 6)
PERENNIAL GRASSY WEEDS												
Quackgrass (*Agropyron repens* (L.) Beauv.)	0	0	T	T	T	0	0	0	2	T	T	3
ANNUAL GRASSY WEEDS												
Barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.)	9	2	T	3	2	1	2	0	T	T	1	T
Crabgrass, large (*Digitaria sanguinalis* (L.) Scop.)	10	2	T	5	1	T	8	0	T	T	2	T
Foxtail, yellow (*Setaria glauca* (L.) Beauv.)	4	T	T	0	1	T	1	0	0	0	1	T
Panicum, fall (*Panicum dichotomiflorum* Michx.)	8	3	2	2	3	2	5	T	2	1	2	2
PERENNIAL BROADLEAF WEEDS												
Bindweed, field (*Convolvulus arvensis* L.)	7	1	1	T	1	2	5	1	2	1	1	T
Bindweed, hedge (*C. sepium* L.)	2	T	1	T	T	T	T	T	T	T	T	T
ANNUAL BROADLEAF WEEDS												
Copperleaf, Virginia (*Acalypha virginica* L.)	4	T	0	T	2	1	1	0	0	0	1	T
Lambsthumb (*Polygonum persicaria* L.)	4	0	0	0	4	T	T	0	0	0	T	0
Lambsquarters, common (*Chenopodium album* L.)	3	0	0	0	0	0	0	0	0	0	T	0
Mustard, birdsrape (*Brassica rapa* L.)	4	1	T	T	4	2	2	0	0	0	4	T
Pigweed, redroot (*Amaranthus retroflexus* L.)	8	T	T	1	0	2	2	0	0	0	1	0
Purslane, common (*Portulaca oleracea* L.)	5	T	T	3	3	3	4	T	T	T	5	1
Ragweed, common (*Ambrosia artemisiifolia* L.)	6	T	0	0	4	T	0	0	0	0	0	0
Woodsorrel, yellow (*Oxalis stricta* L.)	3	0	T	0	2	0	T	0	0	0	T	0
SEDGES												
Nutsedge, yellow (*Cyperus esculentus* L.)	7	T	T	3	9	T	2	T	T	T	10	2

[a]Treatments applied July 8-9 to ornamentals set July 7-8, 1970. Treatments applied at random to each of 8 replications.

[b]Intensity of weeds are recorded for each plot with 0=none observed to 10=very many and/or large weeds present, T=occasional weeds found.

[c]All herbicides, except Outfox (1 ec) and Tunic (75 wp), applied as granular formulations.

[d]Dichlobenil and EPTC incorporated only by light rain and irrigation.

New shoot growth: New shoot growth of 'Purpleleaf' wintercreeper was larger than check in the EPTC-treated plots (Table 4). Only Tunic reduced shoot growth significantly over check. All other treatments were not significantly different from check. Fitzgerald and Havis (3) reported no injury to 3-year-

Table 4. Ornamental herbicide treatments[a] and average new shoot growth--November 9-10, 1970.

Treatment	Rate lb/A	Average new shoot growth: 'Purpleleaf' wintercreeper (cm)	'Bigleaf' wintercreeper (cm)	'Hetzi' Japanese holly (cm)	'Weeping' forsythia (cm)
Check	0	140 b[b]	86 ab	36 abc	76 bc
Alachlor[c]	4	141 b	92 ab	38 abc	112 ab
Alachlor	8	136 bc	112 a	41 ab	115 ab
Dichlobenil[d]	5	151 ab	84 ab	5 d	33 cd
Diphenamid	6	145 ab	78 ab	34 bc	127 ab
EPTC[d]	5	185 a	112 a	38 abc	142 a
Outfox	0.75	144 ab	70 b	26 c	15 e
Tunic	4.8	95 c	89 ab	0 d	19 e
Alachlor + simazine	4 + 1	141 b	110 a	43 ab	88 ab
Alachlor + simazine	4 + 2	150 ab	86 ab	28 bc	101 ab
Chloramben + diphenamid	4 + 6	134 bc	73 b	49 a	133 a
Chloroxuron + diphenamid	4 + 6	116 bc	92 ab	34 bc	78 bc

[a]Treatments applied July 8-9 to ornamentals set July 7-8, 1970. Treatments applied at random to each of 8 replications.

[b]Averages in the same column followed by a common letter are not significantly different from each other according to Duncan's Multiple Range Test at the 5 per cent level.

[c]All herbicides, except Outfox (1 ec) and Tunic (75 wp), applied as granular formulations.

[d]Dichlobenil and EPTC incorporated only by light rain and irrigation.

old transplants of Euonymus fortunei 'Emerald Cushion' from applications of dichlobenil (3 lb/A) or simazine (1 1/2 lb/A) made the day of setting.

No plants of 'Bigleaf' wintercreeper grown in treated soil had significantly more new shoot growth than check; however, Outfox and chloramben plus diphenamid resulted in less shoot growth than three other treatments (alachlor, 8 lb/A; EPTC, 5 lb/A and alachlor plus simazine, 4 + 1 lb/A). Ahrens[6] reported no injury to Euonymus from postplant application of dichlobenil at 5 lb/A.

No treated plants of 'Hetzi' Japanese holly had significantly more shoot growth than check but Outfox and Tunic caused a significant reduction in shoot growth compared to check.

[6]Ahrens, J. F. 1966. Persistence in soil of dichlobenil and EPTC applied for quackgrass control in ornamentals (Abstract). Proc. No. East. Weed Contr. Conf. 20:630-631.

Table 5. Phytotoxic symptoms[a] on leaves of newly-set ornamentals treated with various herbicides in 1970.

Herbicide	lb/A	Time[b]	'Purpleleaf' Wintercreeper	'Bigleaf' Wintercreeper	'Hetzi' Japanese Holly	'Weeping' Forsythia
Alachlor[c]	4	July	None observed	Sl[d] IC	None observed	None observed
		Oct.	None observed	Sl IVC;Few CC	Few MC	Few CC; Few Sl MN
Alachlor	8	July	None observed	Sl IVC	None observed	None observed
		Oct.	None observed	Few CC(Y); Few L Drop	Few IVC; Sl MC	Few Mod MC & GC
Dichlobenil	5	July	None observed	Many Sl FCM	Few Mod MC; F MN (spots); Few L Drop	Many MC & IVC
		Oct.	None observed	Few Mod to Hvy MC; Few L Drop	Hvy MC; Few plants dead	Many BC; Few MN and at tip
Diphenamid	6	July	None observed	Few SL MC	None observed	None observed
		Oct.	None observed	Few Mod MC	Few Sl MC	Few BC
EPTC	5	July	None observed	None observed	None observed	None observed
		Oct.	None observed	Many Sl MC & IVC	Many Hvy MC; Few L Drop	None observed
Outfox	0.75	July	Many Mod MC & IVC	Many Mod MC; Few L Drop	Many Sl MC & MN	Many CC; Few MN; Few CN
		Oct.	Few Mod MC & BC	Many Hvy MC; Few CC(Y); Hvy L Drop	Many Hvy MC; Few CC(Y)	Many BC; Few Sl MC Hvy L Drop; Few plants dead
Tunic	4.8	July	Many GC & IVC	Many Sl MC & GC; Few L Drop	Many GC & Hvy N (50%); Hvy L Drop	Many Hvy GC; Few MN to CN
		Oct.	Many Hvy VC; Few CC	Variable; Few VC; Few IVC; Few BC; Hvy L Drop	All plants dead	All hvy MN or at tip; Many plants dead.
Alachlor + simazine	4+1	July	None observed	Few Sl IC	Many Sl FCM; Few Sl IC	Few Sl MC
		Oct.	None observed	Few Mod MC; Few Sl IVC	Few Mod MC; Few PTC	Few Mod MC; Few plants dead
Alachlor + simazine	4+2	July	Few Sl MC	Few Sl MC & IVC	Many FCM; Few Sl IVC	Few Sl MC
		Oct.	Few Mod MC; Few PTC	Sl to Mod MC; Few Mod IVC	Many Mod MC; Many PTC	Many Mod MC & IVC; Few MN (spots)
Chloramben + diphenamid	4+6	July	None observed	None observed	Few Sl MC	Few Sl C(spots)
		Oct.	None observed	Many Sl MC	Many Mod MC; Few CC(Y)	Few Mod BC
Chloroxuron + diphenamid	4+6	July	Few Sl C	Few Sl MC	Many FCM	Few Mod BC
		Oct.	Few Sl MC (spots)	Few Hvy MC; Few Sl IVC	Many PTC; Few CC(Y)	Many Mod BC; Few MN (spots)

[a]Key to phytotoxic symptoms:

C = chlorosis
BC = 'Blotchy' chlorosis not restricted to veins or between veins
CC = Leaf completely chlorotic
CC(Y) = Leaf completely chlorotic (yellow)
GC = General (overall) loss of color (yellowish-green)
MC = Chlorosis at margin
FCM = Fading (indistinct) chlorosis at margin
IVC = Interveinal chlorosis
VC = Veinal chlorosis
IC = Islet chlorosis (chlorosis between tiny veins)
PTC = 'Pine tree' chlorosis (yellowish chlorosis along margin that extends inwardly between secondary veins giving appareance of a pine tree on a yellow background)
N = Necrosis
MN = Necrosis at margin
CN = Leaf completely necrotic

[b]July = Observations made July 29-31, 1970
Oct. = Observations made October 8-10, 1970

[c]All herbicides, except Outfox (1 ec) and Tunic (75 wp), applied as granular formulations.

[d]Modifying terms:

Sl = Slight amount
Mod = Moderate amount
Hvy = Considerable or severe amount
Few = Few leaves affected
All = All leaves affected
L Drop = Leaves dropped

'Weeping' forsythia plants in EPTC and in chloramben plus diphenamid-treated soil had more shoot growth than check. Forsythia plants grown in Outfox- and Tunic-treated plots had less growth than checks. The present work generally agrees with Ahrens[6] who found no injury to Forsythia from post-planting applications of dichlobenil at 5 lb/A. In the present experiment, differences in growth were not significant at the 5 per cent level but were at the 10 per cent level (not given in Table 6). In addition leaves of 'Weeping' forsythia exhibited slight marginal and interveinal chlorosis at Morgantown. Haramaki et al. (4) reported no injury to potted liners of Forsythia 'Spring Glory' which were treated with dichlobenil (4 lb/A), diphenamid (4 lb/A) or simazine (2 lb/A) 3-8 days after setting.

New shoot growth on 'Blue Rug' junipers was difficult to distinguish from previous growth and was not measured.

Phytotoxic symptoms: Brief descriptions of symptoms observed on leaves of newly set ornamentals are presented in Table 5. Observations were made July 29-31 and October 8-10, 1970. Notes for 'Blue Rug' juniper were not included in Table 5 since phytotoxic symptoms were not found except perhaps a general loss of color in plots treated with Outfox or Tunic. Bennett et al. (2) reported injury (yellowing and chlorosis of leaf margins) to newly-planted

Euonymus alatus 'Compactus' and Forsythia treated with simazine at 1 and 2 lb/A. 'Purpleleaf' wintercreeper appeared to be more tolerant of herbicides used in this experiment than the cultivar 'Bigleaf' wintercreeper. 'Hetzi' Japanese holly and 'Weeping' forsythia exhibited phytotoxic symptoms from several herbicides. It is of interest, however, that many plants having phytotoxic symptoms of herbicide injury were not retarded appreciably in growth (Tables 4 and 5).

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