SOYBEAN WEED CONTROL SYSTEMS UTILIZING ACIFLUORFEN

W. H. Mitchell and R. Uniatowski [1/]

ABSTRACT

About 60% of Delaware's 280,000 acres of soybeans are produced as a full season crop as compared to a smaller acreage grown in a double cropping sequence with winter grains. Full season soybeans, planted in May, develop more slowly and are less competitive with many weed species than soybeans planted in June and July. It is estimated that 75- to 100,000 acres are produced on loamy sands which have a low water holding capacity and, frequently, insufficient moisture to activate preemergence herbicides. Combined, these factors lead to a high frequency of weed control failure which is the basis of a continuing search for improved weed control systems.

Acifluorfen has been evaluated as a component of pre-plant incorporated, preemergence, and post-emergence weed control systems. In all cases acifluorfen has been used as an early post-emergence treatment to supplement one or more earlier applied or companion herbicides. The experimental design consisted of three replications of nine-row plots with 1/3 of the rows treated with herbicides, 1/3 cultivated once, and 1/3 receiving both herbicides and cultivation. The most effective weed control systems were those which involved a combination of acifluorfen and cultivation. Herbicides alone controlled different species than cultivation alone but the effect on soybean yield was essentially the same. There were no significant interactions between herbicides and cultivation in terms of soybean yields although several herbicides, notably the dinitroanilines, appeared to predispose grass species to improved control by cultivation. The very striking yield increases associated with herbicide-cultivation treatments shows the need for caution when considering soybean production systems that eliminate the cultivation option.

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APPLICATIONS OF ACIFLUROFEN IN SOYBEANS

H. P. Wilson and T. E. Hines[1/]

ABSTRACT

Many species of annual broadleaf weeds and grasses escape mechanical and chemical control in soybeans grown in the Northeast. Herbicides which would provide control of a broad-spectrum of species as well as those with activity only against certain individual species are needed to permit economic production of high yielding soybeans of good quality. For these reasons, field studies have been conducted since 1976 to evaluate the preemergence and postemergence activity of acifluorofen. In 1976, acifluorofen was evaluated as a 4 lb/gal emulsifiable concentrate (EC) coded RH-6201. Preemergence applications were safe to soybeans at rates up to 2 lb/A but even that rate failed to provide season-long control of common lambsquarters and redroot pigweed although control of jimsonweed was good. Applications of 1/4 lb/A to 1/2 lb/A "at cracking" injured soybeans and lacked sufficient residual control. Postemergence applications of 1/2 lb/A to 1 lb/A 4 weeks after planting to soybeans treated preemergence with alachlor resulted in good control of small lambsquarters, jimsonweed, and redroot pigweed and soybeans outgrew slight initial injury to produce high yields. In 1977, activity of a 2 lb/gal EC formulation of RH-6201 in both soybeans and weeds increased with rate from 1/4 lb/A to 1 lb/A and with the addition of surfactant or the grass herbicides diclofop and HOE-29152. Studies in 1978 compared post-emergence activity of two formulations of RH-6201 which differed on the basis that one contained surfactant and was designated as 2 LCS while the other was designated as 2 LC. The 2 LCS formulation of RH-6201 was more effective than the 2 LC as weed size increased but caused more soybean injury. Neither formulation provided satisfactory control of fall panicum. Postemergence studies with the 2 LC formulation in 1979 found that surfactant improved control of annual morningglories and common lambsquarters but was not needed for jimsonweed in the one to four leaf stage. It was also confirmed that control of small-flowered white morningglory was more effective than control of ivy-leaf morningglory. During 1978 and 1979 a formulation of acifluorofen coded MC 10978 performed in a manner similar to the 2 LC formulation of RH-6201 with reference to soybean response and spectrum of weeds controlled.

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CONTROL OF IVYLEAF MORNINGGLORY IN SOYBEANS WITH ACIFLUORFEN

J. V. Parochetti and T. C. Harris[1/]

ABSTRACT

This experiment, conducted in 1979 at the Wye Institute, Queenstown, MD, was designed to evaluate the phytotoxicity of acifluorfen on ivyleaf morningglory (Ipomoea hederacea (L.) Jacq.). Variables in this study included herbicide rate, time of application, and addition of a surfactant. No surfactant (2L) and surfactant (2S) formulations of acifluorfen at 0.25 and 0.50 lb/A were applied to 2-leaf morningglory, 4 to 8-leaf morningglory, and just prior to soybean canopy when the morningglory were about 3 feet long. For comparison purposes, several standard herbicides were also included. Alachlor was applied preemergence at 2.5 lb/A in all plots except control plots.

'Miles' soybeans were planted in 30 inch rows on June 15 in a Matapeake silt loam soil (pH 6.2, OM 1.5%). The field had been sown with ivyleaf morningglory in the spring. Plots were four rows wide and 20 feet long. The experiment was established as a randomized complete block design with four replications. Herbicides were applied with a CO_2 pressurized bicycle sprayer that delivered 30 gal/acre at 30 psi. Flat fan nozzles (SS-8004) were used except for the treatments sprayed at canopy which were applied with high pressure (50 psi) and low volume (15 gal/acre through SS-8002 flat fan nozzles). Visual ratings of ivyleaf morningglory control and crop injury were taken through late August.

The 0.25 lb/A rate of acifluorfen 2L applied to ivyleaf morningglory with up to 8 leaves resulted in 95% control through August. Doubling the rate or adding a surfactant had no significant effect on increasing weed control. When applied to large (3 ft.) ivyleaf morningglory, however, the 0.5 lb/A rate was necessary to obtain satisfactory (85%) results. Again, the addition of a surfactant had no significant effect on increasing weed control. A standard treatment of 4.5 lb/A of dinoseb + naptalam, applied preemergence, did not result in satisfactory control. Bentazon at 1.0 lb/A was effective on ivyleaf morningglory up to the 2-leaf stage.

Acifluorfen injured the soybeans only slightly (3%) when applied early (2 to 4-leaf morningglory, first trifoliate soybeans). Injury increased to 10% when acifluorfen was applied 11 days later (4 to 8-leaf morningglory, fourth trifoliate soybeans). At this stage, injury was greater when using the 2S formulation. A treatment using 4.0 lb/A of ammonium sulfate as a surfactant with 0.25 lb/A acifluorfen sprayed on 4 to 8-leaf morningglory also caused moderate (10%) injury. Acifluorfen applied at crop canopy caused some injury (5%) which was proportional to the herbicide rate and not to the presence of a surfactant. Bentazon and dinoseb + naptalam did not injure the crop at any application time.

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INFLUENCE OF TEMPERATURE AND RELATIVE HUMIDITY ON THE HERBICIDAL ACTIVITY OF ACIFLUORFEN

R. L. Ritter[1/]

ABSTRACT

The influence of temperature and relative humidity on the herbicidal activity of acifluorfen on common cocklebur (*Xanthium pensylvanicum* Wallr.) and common ragweed (*Ambrosia artemisiifolia* L.) was studied in growth chambers. Acifluorfen applications made under high relative humidity (85 ± 5%) resulted in significant increases in phytotoxicity and decreases in dry weight as compared to plants treated under low relative humidity (50 ± 5%). The influence of high temperature (32 C day, 22 C night) or low temperature (26 C day, 16 C night) were not as critical as relative humidity in the phytoxicity expressed. Addition of a nonionic surfactant to the herbicide resulted in greater phytotoxicity regardless of temperature or relative humidity. Recovery of ^{14}C-acifluorfen applied to plants and autoradiographs of plants treated with ^{14}C-acifluorfen indicated increased penetration and translocation in common cocklebur when applications were made under high relative humidity.

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CONTROL OF VOLUNTEER CORN IN SOYBEANS

R. Uniatowski and W. H. Mitchell [1/]

ABSTRACT

The increasing cost of energy and the need to increase worker efficiency has caused many Delaware corn and soybean growers to substitute the chisel plow for the moldboard plow. This substitution results in energy savings and makes it possible for the farmer to till many additional acres.

The chisel plow, however, fails to cover the kernals and ears that are lost at harvest and these show up in soybeans as volunteer corn the following year. This results in a soybean quality that is unacceptable for the export market and especially for certified seed. With these thoughts in mind, field tests were conducted to evaluate herbicides for the selective removal of corn from soybeans. These tests involved time and rates of application of diclofop and mefluidide on mixed plantings of corn and soybeans at 2 locations. Data were collected on corn control, barren corn plants, amount of corn in harvested soybeans and the yield of soybeans. Corn plants were best controlled when treatment was made at the 20 to 30 cm growth stage. Ear control was improved when treatment was delayed until the 38 to 46 cm growth stage.

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POSTEMERGENCE CONTROL OF ANNUAL GRASSES IN SOYBEANS[1/]

H. P. Wilson and T. E. Hines[2/]

ABSTRACT

Six herbicides were evaluated in soybeans for postemergence control of barnyardgrass, large crabgrass, bullgrass and lovegrass. Most rapid control was obtained with BAS 9052 OH but KK-80 and AXF-1080 also provided complete control of grasses in the 8-leaf stage. BAS 9021 OH and diclofop provided good control of grasses in the 4-leaf stage although diclofop was weak against large crabgrass. Mefluidide failed to provide control and caused limited soybean injury.

INTRODUCTION

Notwithstanding that herbicides have been used for postemergence control of many species of broadleaf weeds in soybeans (*Glycine max* (L.) Merr.) for years, no herbicide has been commercially available for broadcast postemergence control of annual grasses. Previously it was reported that diclofop (2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid) provided good postemergence control of small lovegrass (*Eragrostis pilosa* L.), bullgrass (*Paspalum Boscianum* Fluegge), and fall panicum (*Panicum dicotomiflorum* Michx.) and partial control of large crabgrass (*Digitaria sanguinalis* L.) (3). Research from 1976 to 1978 indicates that the experimental herbicide BAS 9021 OH (chemistry not disclosed) was active postemergence against fall panicum and large crabgrass and did not injure soybeans (4). In 1979, Sciarrapa (2) reported that postemergence applications of BAS 9052 OH (chemistry not disclosed) controlled several species of annual and perennial grasses without causing injury to soybeans. In other studies, melfluidide (N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl] amino] phenyl] acetamide) provided partial control of johnsongrass (*Sorghum halepense* (L.) Pers.) but has not controlled fall panicum (1,5).

The studies reported herein were conducted to compare the activities of the above-mentioned herbicides as well as those of two other experimental herbicides for postemergence control of annual grasses in soybeans.

MATERIALS AND METHODS

Soybeans ('York') were planted July 11, 1979 in 36-inch rows; no herbicides were applied and a high, natural population of annual grasses emerged. On July 25 or August 3 the herbicides were applied to grasses in the 4-leaf or 6 to 7-leaf stage respectively as indicated in Table 1. Herbicides were applied with small plot equipment using propane to provide pressure of 50 psi. The delivery rate

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was 25 gpa using TeeJet[1/]8003 tips on 20-inch spacings; tip height averaged 18 to 20 inches above the soybeans. A second study was established on August 7 in which selected herbicides were applied as above to grasses in the 8-leaf stage averaging 16 inches in height. All applications of BAS 9052 OH contained 1 qt/A of an oil concentrate. The effects of surfactants on the activity of KK-80 (chemistry not disclosed) and AXF-1080 (chemistry not disclosed) were also investigated. Percent control of barnyardgrass (Echinocloa crusgalli (L.) Beauv.), large crabgrass, lovegrass and bullgrass was visually rated.

The 1979 growing season was characterized as one of high temperatures and relative humidity and frequent showers. Rainfall for the months of July and August totaled 13.28 inches compared with a 39-year average of 8.44 inches. Under these conditions both soybeans and annual grasses grew very rapidly. No rainfall was recorded for 3 days following the applications of July 25; however, 1.5 inches were received within 2.5 hours following the August 3 applications of BAS 9052 OH and 0.12 inch was received 1 day following the August 7 applications.

RESULTS AND DISCUSSION

Soybean injury and percent control of small annual grasses 9 days after application are presented in Table 1. Differences existed between herbicides with BAS 9052 OH being the most rapid in effecting a response and eventually providing complete control of all species. Two to three weeks after application, the lower leaves of soybeans treated with BAS 9052 OH were chlorotic but this response was subsequently outgrown. Applications of BAS 9052 OH to grasses in the 6 to 7-leaf stage also provided complete control of grasses but the time required was longer than with the smaller grasses; this may be due in part to the heavy rain 2.5 hours following application. The addition of bentazon (3-isopropyl-1H-2,1,3-benzothiadiazin-(4) 3H-one 2,2-dioxide) to BAS 9052 OH resulted in control of the few scattered common lambsquarters (Chenopodium album L.) plants which were present in the plots while apparently not interferring with control of annual grasses but had little effect on carpetweed (Mollugo verticillata L.) and ivy leaf morningglory (Ipomoea hederacea (L.) Jacq.).

BAS 9021 OH was also very effective eventually providing complete control of annual grasses. However, comparisons with results obtained in previous years (4) show that this chemical has been highly effective only on small grasses and when soil moisture is adequate to promote a rapid rate of growth of annual grasses.

Both KK-80 and AXF-1080 were slower to cause visual response symptoms by grasses than were the two previous herbicides although this may be partially related to the low rates of these latter two herbicides. Although 1/4 lb/A KK-80 eventually provided good control (not shown in table) rates of 1/2 and 1 lb/A caused a more rapid response and little if any soybean injury. However, in other studies early in the season under lower temperatures, several annual broadleaf species exhibited temporary chlorosis to KK-80 applications. Although surfactant may have increased initial grass response to KK-80, final observations showed

1/Manufactured by Spraying Systems Co., Bellwood, IL.

complete control with and without the surfactant. AXF-1080 did not provide complete control at 1/8 lb/A but 1/4 lb/A slowly killed all grass species in the test.

Diclofop continued to be weak against large crabgrass but provided good control of barnyardgrass and bullgrass even though both species had reached the 4-leaf stage of growth at the time of treatment. Mefluidide produced an epinastic response by soybeans but did not control annual grasses.

The effects of BAS 9052 OH, KK-80 and AXF-1080 against annual grasses in the 8-leaf stage and averaging 16 inches in height are presented in Table 2. In general, grasses were slower to show response to any of the three herbicides when applications were made at this late stage of growth; this was noted consistently with bullgrass and to a lesser extent with large crabgrass. There appeared to be a slight reduction in control with the addition of a surfactant to KK-80 and AXF-1080; this may be due to increased runoff from the plants which were already wet from heavy dew at application.

In summary, other than mefluidide, all herbicides exhibited good postemergence activity against several annual grasses. Diclofop was characteristically weak against large crabgrass while BAS 9052 OH, KK-80 and AXF-1080 provided complete control of barnyardgrass, large crabgrass, bullgrass and lovegrass in the 8-leaf stage of growth and BAS 9021 OH was very effective against 4-leaf grasses.

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Table 1. Soybean response and percent control of small annual grasses 9 days after application of several postemergence herbicides in 1979.

Herbicide[1]	Rate, (lb/A)	Grass leaf stage	Soybean injury (%)	Weed Control (%) Barnyard-grass	Bull-grass	Crab-grass
BAS 9052 OH	1/2	4	3	100	97	95
BAS 9052 OH	1	4	7	100	100	98
BAS 9052 OH[2]	1/2	6-7	5	100	100	100
BAS 9052 OH[2]	1	6-7	5	100	100	100
BAS 9021 OH	1	4	0	100	90	90
BAS 9021 OH	1 1/2	4	7	100	98	93
Bentazon +	3/4 + 1/2	4	11	100	99	95
BAS 9052 OH	3/4 + 1	4	20	100	99	100
KK-80	1/4	4	0	100	77	63
KK-80	1/2	4	3	100	99	94
KK-80	1	4	7	100	100	97
KK-80 + 0.25% surfactant[3]	1/4	4	0	100	98	85
AXF-1080	1/8	4	0	100	73	75
AXF-1080	1/4	4	0	100	93	88
Diclofop	3/4	4	0	97	100	73
Diclofop	1	4	0	100	98	78
Mefluidide	1/8	4	10	0	0	0
Mefluidide	1/4	4	20	0	0	0
Check			0	0	0	0

1/All applications of BAS 9052 OH included 1 qt/A of an oil concentrate from BASF Wyandotte Corp., Parsippany, NJ.
2/Rated August 31, 1979.
3/X-77 spreader, Chevron Chemical Co., San Francisco, CA.

Table 2. Percent control of large annual grasses 20 days after application of three postemergence herbicides in 1979.[1]

		Weed Control (%)			
Herbicide[2]	Rate, (lb/A)	Barnyard-grass	Crab-grass	Bull-grass	Love-grass
BAS 9052 OH	1/2	100	98	78	100
BAS 9052 OH	1	100	100	83	100
KK-80	1/2	100	98	88	100
KK-80	1	100	100	96	100
KK-80 + 0.25% surfactant[3]	1/2	100	93	80	100
AXF-1080	1/2	100	85	87	100
AXF-1080	1	100	94	75	100
AXF-1080 + 0.25% surfactant[4]	1/2	100	75	79	100
Check		0	0	0	0

1/Grasses averaged 16 inches in height and were in the 8-leaf stage.
2/All applications of BAS 9052 OH included 1 qt/A of an oil concentrate from BASF Wyandotte Corp., Parsippany, NJ.
3/X-77 Spreader, Chevron Chemical Co., San Francisco, CA.
4/Surfactant not chemically identified, Union Carbide Corp., Ambler, PA.

SUMMARY OF RECENT EUROPEAN STUDIES OF ETHEPHON AS AN ANTI-LODGING TREATMENT IN WINTER BARLEY

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ABSTRACT

A vigorous healthy barley crop grown under fertile soil conditions is most likely to suffer extensive and expensive damage through lodging. Ethephon applied at the optimum rate and at the optimum time will reduce crop height by shortening the final internodes, giving greater resistance to lodging. Application rates and timings and the effects on yield, lodging control, internode length reduction, straw strength, ear length, 1,000 grain weight, ear loss and cost/benefits are discussed.

INTRODUCTION

The area planted to winter barley in Europe has increased rapidly over the last several years and since it is grown primarily on the better soils and in crop rotation which produce high fertility conditions, lodging has become an increasingly serious problem. The higher the potential yield the greater is the risk of lodging. Economic losses occur due to uneven ripening and maturity, higher moisture content of the grain requiring expensive drying, loss of quality due to mouldiness and sprouting, loss of malting quality and from a higher incidence of bird damage. In addition, a lodged crop increases harvesting costs because of delays in the morning, or after rain, the necessity to lower the cutter-bar height, with greater risks of mechanical damage, a slower cutting speed, less efficient pick-up and greater grain loss and poorer grain threshing and cleaning.

Initially released for field trials in 1966, ethephon was first tested on cereals to prevent lodging in 1976. Early trials were contemplated on winter wheat, spring wheat and spring barley in comparision with chlormequat, at growth stages 4-6. Comparable or better control of lodging was obtained, but at higher rates (0.96 - 3.84 kg/ha), which proved uneconomic. Subsequently it was discovered that good height and lodging reduction could be achieved with lower rates of ethephon when applied at later stages of growth. Ethephon was commercially introduced in the UK in 1979 under the trademark CERONE, and in France under the trademark ETHEVERSE.

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Rate and time of application

During 1977 and 1978, in Europe, 31 trials on 17 cultivars gave the following results:

Table 1

Lodging - influence of time and rate on area lodged (%)

Growth Stage Feekes-Large	Ethephon Rates (l/ha)					
	0.5	0.75	1	1.25	1	Control
5 - 10.1	34	30	28	24	6	52
5 - 8	56	43	43	35	-	
8 - 10	-	31	25	28	7	
10 - 10.1	29	25	24	21	5	

It can be seen, that under the greatly varying growing conditions of these trials, a satisfactory anti-lodging effect was achieved with the rates of 0.75 - 1.25 l ethephon/ha.

It is apparent, that treatment before growth stage 8 (G.S. 8) was not satisfactory, but there was little difference between G.S. 8-10 and G.S. 10 - 10.1.

It has been observed that with a luxuriant crop and unfavorable weather conditions, lodging can occur before G.S. 10. Application of ethephon must be made before general lodging has started.

The identification of G. S. 8 (when the last leaf is just visible) is very difficult for most farmers and even the specialist. Consequently, it is better to delay treatment until some of the plants in the field are in the easily identifiable G.S. 9 (ligule of last leaf just visible).

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Yields

The trials referred to in Table 1 above, gave the following results:

Table 2

Yield - Influence of time and rate of application on yield (% of control)

Growth Stage Feekes-Large	Ethephon Rates (1/ha)					
	0.50	0.75	1	1.25	2	Control
6 - 10.1	101	105	104	106	104	100
6 - 8	101	101	103	109	99	
8 - 10	102	108	105	108	104	
10 - 10.1	100	103	102	102	103	

All cultivars, on which trials have been made so far, have shown a good tolerance to ethephon, up to 2 1/ha., (i.e. double recommended rate) even in the absence of lodging.

The reduction of lodging is of most interest to the farmer when the incidence of lodging is severe. Ethephon has been particularly beneficial under such conditions, as shown by the following results from trials with heavy lodging.

Table 3

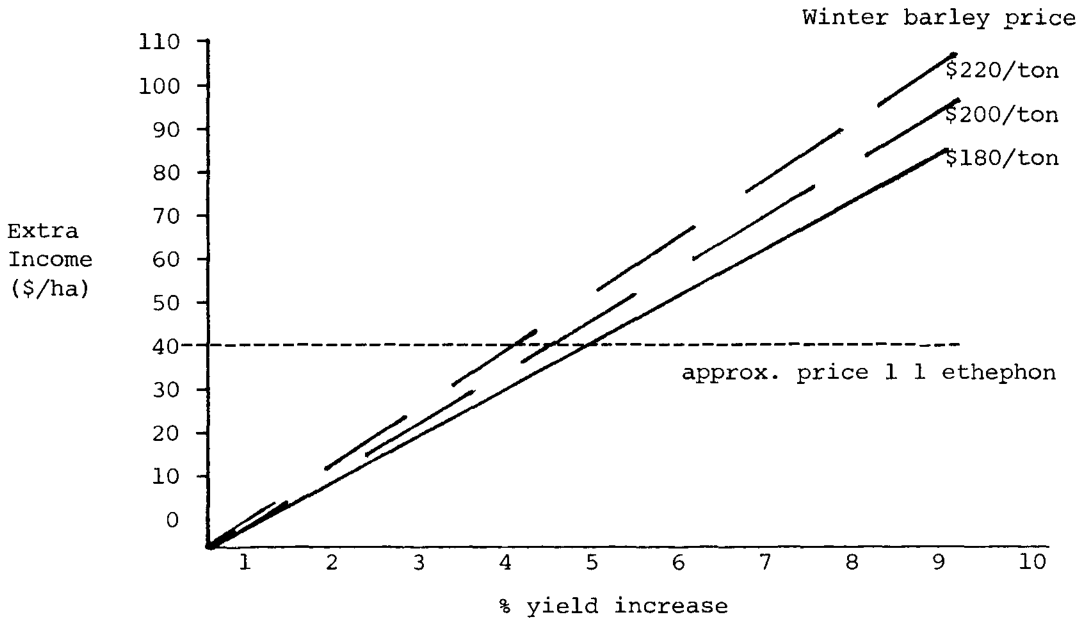
Lodging/yield - under heavy lodging conditions (ethephon 1 l/ha)

Country	Cultivar	Stage	Lodging %		Yield %
			Control	Treated	
U. K.	Athene	8 - 10	94	8	151
U. K.	Maris Otter	10 - 10.1	87	38	100
U. K.	Hoppel	10 - 10.1	88	20	114
France	Hop	8	68	10	102
France	Hop	9	85	2	100
France	Hop	9 - 10	53	0	100
France	Hop	10.1	85	8	111
France	Robur	10 - 10.1	46	1	100
France	Robur	10. 1 - 10.5	71	7	111
France	Robur	10.1	53	15	108
Belgium	Ager	8	82	55	106
Belgium	Capri	8	90	70	103
Belgium	Capri	9 - 10	90	0	99
Belgium	Ager	9	80	10	115
Belgium	Bessy	9	80	15	104
Average			77	17	108

The reduction of heavy lodging gives an interesting economic benefit, as can be seen from the following graph:

Figure 1

Income benefit from yield increase based on winter barley yielding 5 ton/ha.



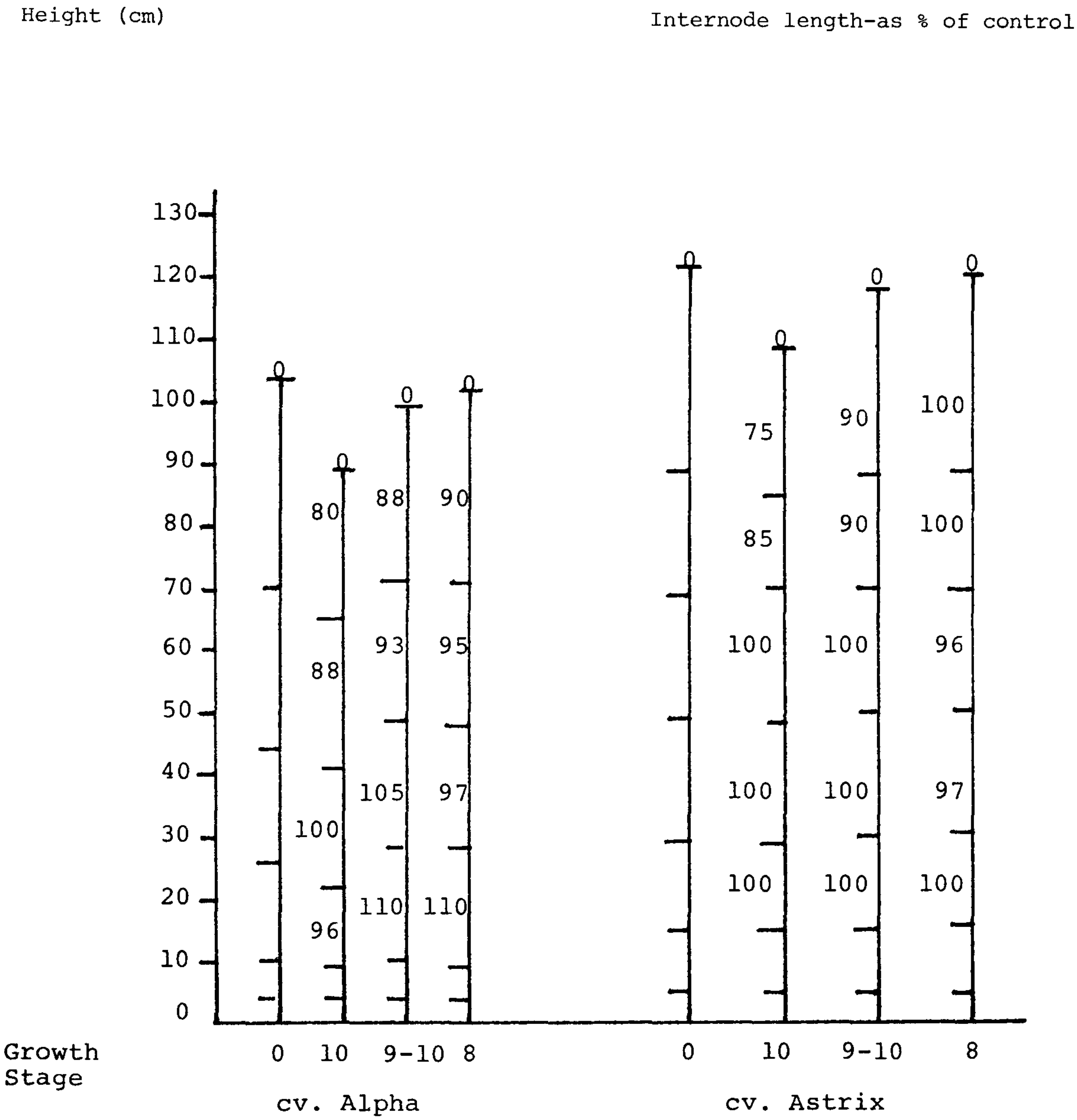
This shows that, at the lowest barley price quoted - $180/ton, a 4% yield saving on a 5 ton/ha crop will already cover the cost of ethephon at 1 l/ha. Apart from the question of preventing yield loss due to lodging, there are many other benefits which will be outlined later.

Height reduction

The effect of ethephon is to reduce the length of the internodes which are still growing during the period following treatment. With the recommended application time being G.S. 8 - 10.1, the greatest shortening effect is seen on the last 2 or 3 internodes, especially the final one, which is the longest. This is shown by:

Figure 2

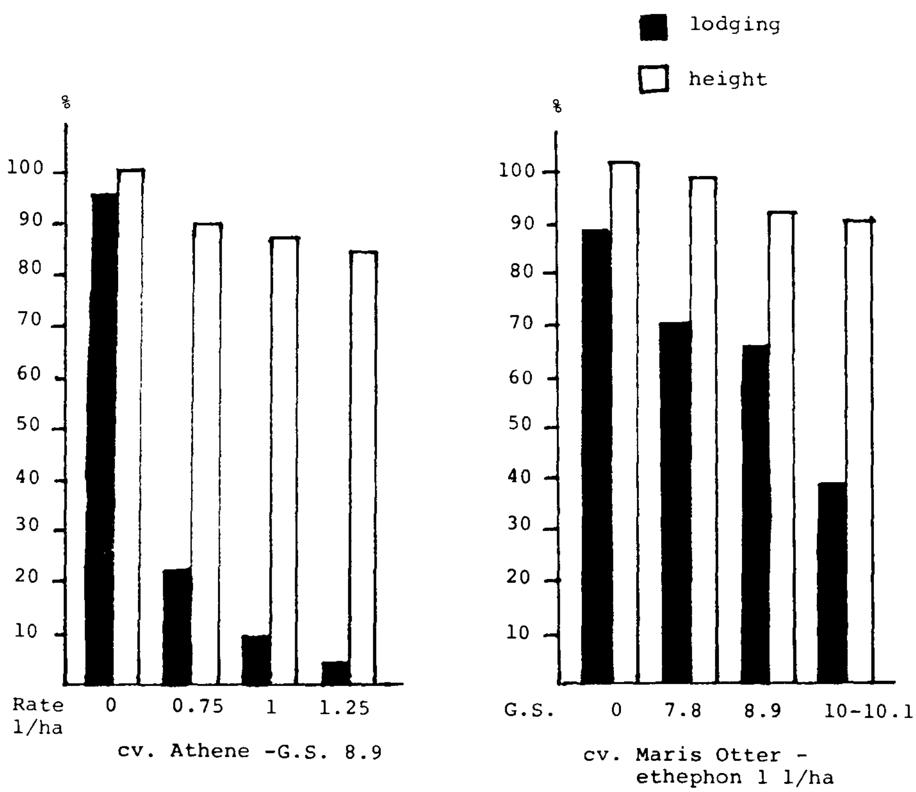
Plant height and internode length compared to time of treatment. Ethephon 1 l/ha, winter barley.



Relationship between height and lodging

By shortening the last internode(s) of the plant, the tendency to lodge is reduced as a result of the reduction in total plant height. The later the time of treatment, the greater length reduction of the last internode and the total height of the plant. In practice, the latest stage of application will be G.S. 10.1.

Figure 3



Stem breaking

Apart from the height, the tendency to lodge also depends on the strength of the straw. Ethephon can increase straw strength, as shown by the following results from France.

Table 4

Influence of rate on height and strength of straw

Cultivar		0	ethephon l/ha			
			0.75	1	1.5	2
Hop	Height %	100	100	95	93	-
	Breaking strain %	100 (675g)	104	137	121	-
Malta	Height %	100	93	93	94	90
	Breaking Strain %	100 (368g)	115	100	120	130
Alpha	Height %	100	90	93	92	91
	Breaking strain %	100 (480g)	122	117	123	119

Ear length

As shown by the following table, ethephon does not significantly influence the length of ear:

Table 5

Influence of ethephon rate and timing on ear length (%) of winter barley.

Growth stage	8 - 9				10 - 10.1		
Ethephon l/ha	0	0.75	1	1.25	0.75	1	1.25
Cultivar							
Athene (U.K.)	100 (86.8 mm)	104	102	102	102	102	102
Maris Otter (U.K.)	100 (79.6 mm)	97	99	95	103	101	101

Table 5

(Cont)

Growth Stage	9 - 10			
Ethephon l/ha	0	0.75	1	1.25
Cultivar				
Pella (NL)	100 (72.1 mm)		108	101
Banteng (NL)	100		103	

Grain size

The weight of one thousand grains has not been affected by ethephon treatments, on most cultivars, as shown by the table below. However, some question remains regarding the cv "Malta", and this needs further evaluation.

Table 6

Influence of ethephon on weight of 1,000 grains winter barley (untreated control - 100%)

Country	Cultivar	Growth Stage	Ethephon l/ha.	1000 grain wt. %
Germany	Sonja	8-10	1	100
	Dura	8-10	1	103
	Doris	9	1	96
France	Alpha	8	1	103
	Alpha	10.5	1	102
	Antares	9	1	101
	Antares	10	1	97
	Astrix	9-10	1	102

Ear loss

The breaking off of ears, prior to harvest, especially when this is delayed due to bad weather, can be a serious matter with some cultivars. In trials, ethephon has reduced the tendency to "neck" and for ears to drop off, as shown below. As a result, ethephon has sometimes given yield increases in the absence of lodging.

Table 7

Influence of ethephon on ear loss of winter barley.

Cultivar	Ethephon l/ha.	Ears on ground per m^2	Ears on ground %
Astrix	0	176	100
	1	64	36
Igri	0	202	100
	1	144	71

Seed germination

Limited tests on grain from ethephon treated crops, have shown no effects at rates up to 2 l/ha.

Discussion

Under Northern and Central European conditions ethephon applied to winter barley from the time the flag leaf is just visible until the stage when the first spikelet is visible (Feekes-Large Stages 8 - 10.1) has given acceptable control of lodging at rates between 360 - 600 g/ha. The anti-lodging effects and yield increases observed appear to be the result of shortening the last 2-3 internodes, increasing the straw breaking strain, reducing "necking" and ear breakage, reducing bird damage and increasing the effeciency of the combining operation.

COMPETITIVE CONTROL OF COMMON LAMBSQUARTERS IN A CORN-SOYBEAN INTERCROP

P. A. Moss and N. L. Hartwig[1]

ABSTRACT

A competition study was conducted to investigate whether a corn-soybean intercrop would decrease a stand of common lambsquarters (*Chenopodium album* L.) to a greater extent than a corn monoculture. Three intercrop treatments were used in which different populations of corn were planted in the same row as soybeans. Weed dry weight in these plots was compared with corn monoculture plots and a weedy check. Plots were harvested eight times during the season and dry weights of corn, soybeans, lambsquarters, and other weeds were obtained.

One intercrop treatment consisting of 23,000 corn plants per acre with soybeans was found to have only 61% of the weeds of the corn monoculture (24,000 corn plants per acre). This was significantly different at the 5% level.

Nearly identical soybean dry weights were observed at high, medium and low corn populations. This indicated that weeds tended to fill in for a low corn stand instead of soybeans. Interplanting corn and soybeans in the same row can have a significant effect on lowering a stand of common lambsquarters.

INTRODUCTION

Crops have varying degrees of success in their ability to compete with weeds for light, water, and nutrients. The success of the crop (indirectly measured by its yield) depends both on its resistance to weed competition and on its ability to inhibit weed growth.

Many factors determine the outcome of crop-weed competition. These include: crop species and variety, soil fertility, climatic conditions, the nature of the weed population, and the weed control practices applied (including site preparation).

Common lambsquarters is a particularly harmful weed in corn in our region. Common lambsquarters can cause corn yield reductions by its ability

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to take up nutrients at the expense of the corn (11), by its ability to take up water at the expense of the crop (6), by its ability to trap light efficiently in mixed stands (12), and from possible allelopathic effects (3).

Although corn does compete against common lambsquarters, it is desirable to encourage it to be more competitive. One such way is to use higher fertility levels (10). Intercropping corn with a legume is another way of making corn a more competitive crop.

In the Philippines, corn-mungbean intercrops have been observed to greatly decrease weed dry weight (1) and weed population (7, 8). This may be caused by greater light interception due to the presence of the legume in the intercrop (7).

While mungbeans are not typically grown with corn in the United States, there has been a long history of corn-soybean intercropping in this country (9). Some recent literature indicates an economic advantage in this intercrop (2, 4, 5). This experiment was an attempt to determine whether a corn-soybean intercrop can provide more competition against common lambsquarters than a corn monoculture.

MATERIALS AND METHODS

This trial was conducted in 1979 at the Pennsylvania State University Agronomy Research Farm in plots located on Hagerstown silt loam soil. Five tons per acre of dolomitic lime were applied to the experimental area in early May. Seedbed preparation consisted of plowing, disking, harrowing, and using a cultipacker. Six pounds of common lambsquarters seed were spread over the experimental area with a hand-held centrifugal seeder on May 14 (between plowing and disking). Corn (*Zea mays* L. 'Pioneer 3382') and soybeans (*Glycine max* L. 'Perry') were planted on May 17. The soybeans were planted at 70,000 seeds per acre (half of the recommended rate for a monoculture) in 30 inch rows one inch deep. Corn was hand planted at varying rates in the same rows on the same day.

'Pioneer 3382' was chosen because it is a vertical-leaved variety that would let more light through the crop canopy for the soybeans. 'Perry' was chosen as a result of a preliminary growth chamber investigation conducted by the authors. When compared to seven other soybean varieties with respect to dry weight, leaf area, and plant height under cool conditions, typical of weather at corn planting time, 'Perry' appeared to be superior.

The field trial was conducted using a randomized complete block design with four replications. Plots were 15 feet wide and 30 feet long with a five foot alleyway between each block of five treatments. There were six 30 inch rows in each plot. The five treatments were: corn at 11000 plants/A (13000 planted) plus soybeans, corn at 17000 plants/A (19000 planted) plus soybeans, corn at 23000 plants/A (26000 planted) plus soybeans, corn at 24000 plants/A (26000 planted) with no soybeans, and weeds alone.

Alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] at 1 lb ai/A was applied in 20 gal/A of water to all plots on May 18 using a boom sprayer. Nitan (3.54 lbs N/gal) was applied at 20 gal/A using a boom with drop nozzles on July 13 to all plots. The plots were irrigated using sprinklers after the nitrogen application.

Corn, soybeans, common lambsquarters, and other weeds were harvested by hand using clippers from successive 10 feet by 20 inch areas (a 20 inch wide section including the inner four rows) eight times during the season. A one foot border was left between each harvested area. Samples were placed in paper bags and dried for at least a week at 170°F in forced air dryers and then weighed.

No weeds were harvested in the first harvest because there was not a measurable amount at that time. Corn weights per plant in each harvested sample were multiplied by treatment mean number of plants per 16.7 square feet to obtain corn weights reported. This was felt to be more representative of the corn stand than the total weights of the observed number of corn plants in each sample.

RESULTS AND DISCUSSION

When the results for the whole season were combined and analyzed as a split plot in time, the total weed dry weight was significantly less in the 23000 corn plants/A intercrop than in the 24000 corn plants/A monoculture. This intercrop contained only 61% of the weeds found in the monoculture corn (Table 1). The ratio of crop to weed dry weights was significantly greater in the 23000 corn plants/A intercropped treatment when compared with the monoculture corn. The crop/weed ratio could be considered to be an index of the competitive ability of a crop. A high crop/weed dry weight ratio indicates high crop competitive ability.

The amount of total weed weight (common lambsquarters plus other weeds) in the five treatments over the growing season is displayed in Figure 1. The inhibition of weed growth by each of the crop treatments is indicated here.

The weed population over the entire growing season was composed of 75% common lambsquarters and 25% other weed species by dry weight. These other weeds consisted mainly of shepherdspurse [Capsella bursa-pastoris (L.) Medic.], chickweed [Stellaria media (L.) Cyrillo], redroot pigweed (Amaranthus retroflexus L.), yellow foxtail [Setaria lutescens (Weigel) Hubb.], and large crabgrass [Digitaria sanguinalis (L.) Scop.]. The grasses were only observed later in the season when the effect of the alachlor was no longer apparent.

Table 1. Dry weight yields of crop and weed components for combined harvests.

Treatment	Lambsquarters	Other Weeds	Total Weeds	Soybeans	Corn	Total Crop	Crop/Weed Ratio
	--------------------------	----	----	(lb/A)	----	--------------------------	
11000 corn + soy	1974 b[a]	336 b	2310 b	591 a	1517 b	2107 b	0.94 c
17000 corn + soy	1024 bc	406 b	1430 cd	628 a	2791 a	3419 a	2.40 ab
23000 corn + soy	679 c	494 b	1173 d	616 a	2645 a	3261 a	2.72 a
24000 corn only	1418 bc	520 b	1936 bc	---	3267 a	3267 a	1.62 bc
weeds only	3010 a	942 a	3951 a	---	----	----	----

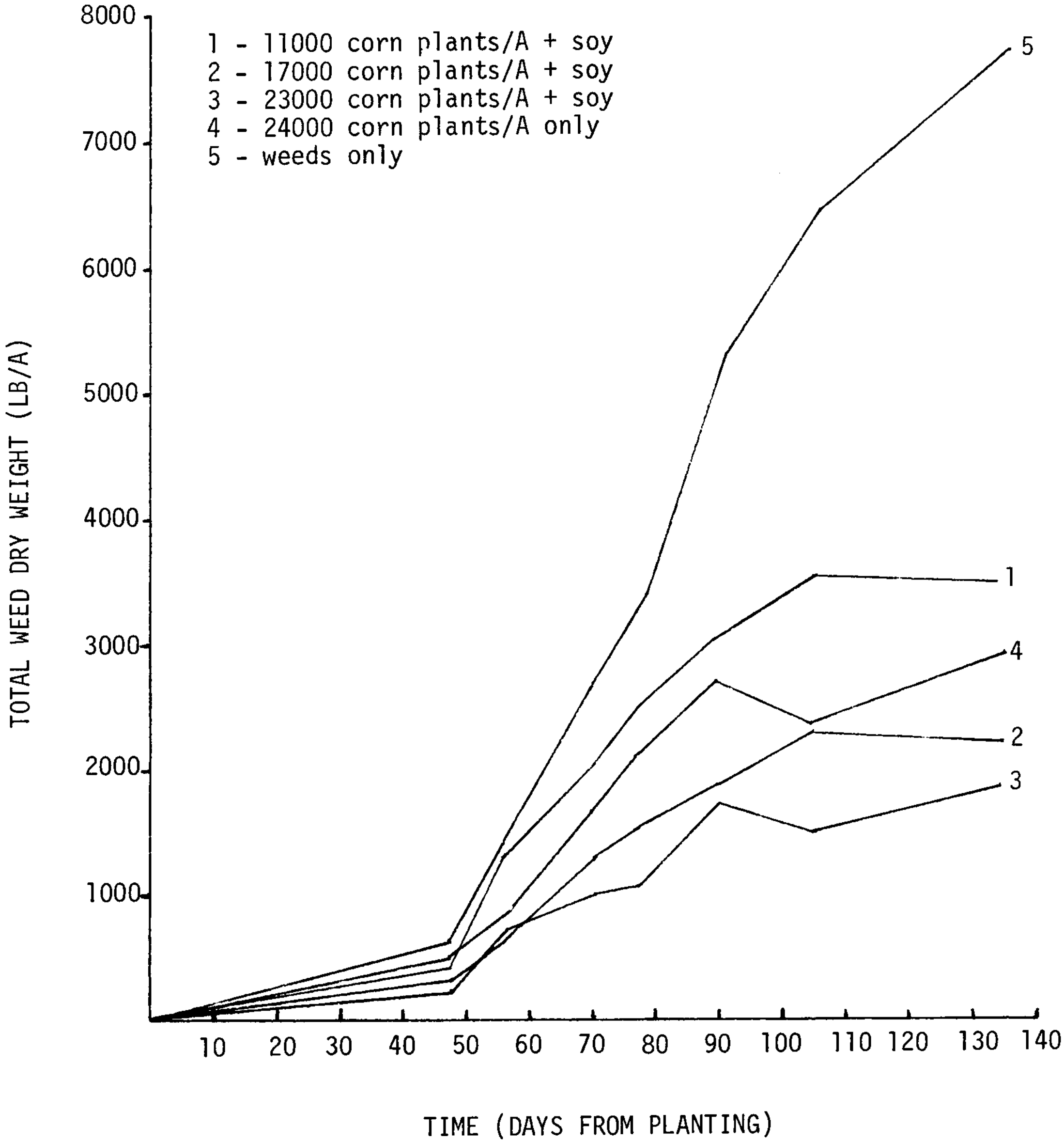
[a] Numbers in each column followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Table 2. Dry weight yields of crop and weed components for final harvest (9/27/79).

Treatment	Lambsquarters	Other Weeds	Total Weeds	Soybeans	Corn	Total Crop	Crop/Weed Ratio
	--------------------------	----	----	(lb/A)	----	--------------------------	
11000 corn + soy	3079 b[a]	356 b	3434 b	1391 a	5321 b	6712 b	2.04 b
17000 corn + soy	1801 bc	415 b	2216 c	1374 a	9000 a	10374 a	5.56 a
23000 corn + soy	1544 c	314 b	1858 c	1349 a	8238 a	9588 a	5.39 a
24000 corn only	2173 bc	739 ab	2912 bc	----	10846 a	10846 a	3.99 ab
weeds only	6454 a	1306 a	7760 a	----	----	----	----

[a] Numbers in each column followed by the same letter are not significantly different at the 5% level as determined by Duncan's multiple range test.

Figure 1. Total weed dry weight in lb/A in intercropped treatments, monoculture, and check over the growing season.



When the last harvest is considered alone, significant differences are also observed between the treatments (Table 2). The 23000 corn plants/A intercrop still has only 64% of the weeds of the monoculture, but this difference is not statistically significant. Corn dry weight yields are highest for the monoculture corn. The lower corn yields in the intercrops may be explained both by the lower corn populations and the competitive effect of the soybeans. Total crop yields (corn plus soybean dry weights) are not statistically different from the corn monoculture until the corn stand is reduced to 11000 plants/A. The 11000 plants/A corn stand was least competitive in terms of weed weight and crop/weed ratio and also produced the least yield.

Soybean yields were nearly identical for all three corn populations. This indicates that weeds filled in for the lower corn stand instead of soybeans.

Crop and weed dry weights in the 23000 corn plants/A intercrop were not significantly different from the 17000 corn plants/A intercrop. The rate of nitrogen applied was probably too low to allow the high corn population treatments to make optimum growth. Corn plants in various plots showed signs of nitrogen deficiency. A higher rate of nitrogen fertilization should have been used.

The proportion of total plot dry weight occupied by each of the plant components changed a great deal over the season (Table 3). Soybeans made considerably more early growth than corn. As much of crop-weed competition occurs in the critical period of early crop growth, the soybeans probably make their contribution to weed control at this point. The percentage of soybeans in the crop dropped from 75% of total crop dry weight after 28 days to only 9% of total crop dry weight 133 days after planting.

The percentage of common lambsquarters compared with that of other weeds rose through the season. This indicates that common lambsquarters is more competitive than the other weeds found in the plots.

We observed a decrease in corn stand resulting from the weed and the soybean competition. Both the 24000 corn plants/A monoculture and the 23000 corn plants/A intercrop had been planted at 26000/A. The decreased corn stand in the intercrop may have been due to the soybeans.

In summary, it appears that planting corn and soybeans in the same row is an effective method of reducing common lambsquarters yield. Had a higher fertility level (with respect to nitrogen) been used, the competitive effect of the crop might have been more pronounced. Of the three intercropping treatments studied, the 23000 corn plants/A plus soybeans appeared to be the most effective in terms of control of common lambsquarters.

Table 3. Percentage of total plot dry matter contributed by each crop and weed component throughout the season.

Treatments	Yield Components	Days after planting 28	46	56	70	77	90	105	133
		%							
11000 corn + soy	corn	13	10	10	21	23	34	40	52
	soy	87	25	18	16	14	12	14	14
	lambsquarters	--	33	47	51	54	48	42	30
	other weeds	--	32	25	12	8	6	4	4
17000 corn + soy	corn	25	29	29	41	45	62	62	71
	soy	75	18	21	20	19	12	11	11
	lambsquarters	--	8	17	23	23	20	24	15
	other weeds	--	45	33	16	13	6	3	3
23000 corn + soy	corn	39	33	34	48	50	58	66	72
	soy	61	19	13	18	20	14	14	12
	lambsquarters	--	4	10	18	14	15	14	13
	other weeds	--	44	43	16	16	13	6	3
24000 corn only	corn	100	30	32	47	48	64	71	79
	soy	--	--	--	--	--	--	--	--
	lambsquarters	--	22	29	38	40	29	24	16
	other weeds	--	48	39	15	12	7	5	5
weeds only	corn	--	--	--	--	--	--	--	--
	soy	--	--	--	--	--	--	--	--
	lambsquarters	--	27	37	69	71	80	83	83
	other weeds	--	73	63	31	29	20	17	17

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VELVETLEAF CONTROL IN CORN

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ABSTRACT

A field experiment was conducted in 1979 to evaluate velvetleaf (Abutilon Theophrosti Medic.) control on an Ontario loam soil near Waterloo, N.Y. Excellent control was obtained with the following chemicals: butylate plus safener, atrazine, pendimethalin plus atrazine, and bentazon plus atrazine. Velvetleaf control was higher than expected. This was perhaps due to the fact that there was only one major flush of seed germination early in the spring, followed by a 50 day dry period in which very little velvetleaf germinated. Flushes in velvetleaf germination were also found not to be due to a narrow temperature range, but rather more likely to be due to rainfall pattern. Greenhouse postemergence herbicide studies show that cyanazine, cyanazine plus pendimethalin, and dicamba give good velvetleaf control up to the sixth leaf stage.

INTRODUCTION

Velvetleaf (Abutilon theophrasti Medic.) has been a problem annual weed in the midwest for many years, but has only recently become a problem in New York State (5,7). Velvetleaf is considered to be one of the most difficult annual weeds to control (7). Velvetleaf control has further been complicated by variability in herbicide control from year to year (2,5,7). Studies were initiated to examine selected aspects of velvetleaf seed germination and the effectiveness of selected herbicides for velvetleaf control.

MATERIALS AND METHODS

Experiment 1: Corn 'Doebler 600' was planted on May 26, 1979 into an Ontario loam soil at Beltevarian Farms near Waterloo, N.Y. The experiment was established as a factorial design with four replications and plot sizes 3.05 m x 7.62 m. Herbicides were applied at 280.6 l/ha. with a bicycle sprayer on the following dates: ppi- May 16, 1979; pre- May 29, 1979; post- June 13, 1979. Ratings of the treatments were made on June 20, 1979 and August 13, 1979.

Experiment 2: Velvetleaf seeds were evenly spread across the top 5 cm of filter paper sheets. Sheets were tightly rolled and placed in gorwth chambers set at the following temperatures: 10, 15.6, 21.1, 32.2, 37.8 C, 2.5 C night and 10 C day, 10 C night and 21.1 C day, and 21.1 C night and 26.7 C day. Each treatment was replicated 3 times. Germination data was taken when the primary radical was 3 mm in length.

Experiment 3: Velvetleaf seeds were planted 2.5 cm deep into Elmwood sandy loam contained in 10 cm styrofoam pots. Plants were grown in a glasshouse under

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23.9 day and 15.6 C night temperatures with natural lighting conditions supplemented with 1000 watt metal-halide lamps (16 hour daylength) at an approximate light intensity of 37.8 to 43.2 klux (3). Several herbicides including: dicamba (3,6-dichloro-o-anisic acid), atrazine [2-chloro-4 (ethylamino)-6-(isopropylamino)-5-triazine], bentazon [3-isopropyl-1H-2,1,3-benzothiadiazin-4-(3H)-one 2,2-dioxide], cyanazine [2[[4-chloro-6(ethylamino)-5-triazin-2-yl]amino]-2-methylpropionitrile [2-chloro-4-(1-Cyano-1methylethylamino)-S-triazine]]and pendimethalin [N-(1-ethylpropyl)-3,4 dimethyl-2,6 dinitrobenzeneamine] were sprayed at the following stages of development: preemergences, cotyledon, two leaf stage, four leaf stage, and six leaf stage. All applications were made with a laboratory belt sprayer delivering 280.6 l/ha. Plants were harvested three weeks after treatment. Fresh weight and plants per pot data were taken.

RESULTS AND DISCUSSIONS

A field study near Waterloo, NY during 1979 showed that most velvetleaf treatments gave adequate control (Table 1). The best treatments were: Butylate (S-ethyl diisobutylthiocarbamate) plus safener ppi 4.48 kg/ha, atrazine preemergence 1.12 or 2.24 kg/ha, atrazine preemergence 1.12 2.24 ka/ha plus bentazon postemergence at 1.12 kg/ha, pendimethalin and atrazine preemergence 1.48 plus 1.12 2.24 kg/ha, and pendimethalin and cyanazine postemergence 1.48 plus 2.24 kg/ha. Velvetleaf control with selected treatments was higher than normally expected. This increased control could perhaps be attributed to several related points: 1) only one major germination flush occurred soon after the corn was planted, 2) there was sufficient rainfall to leach most herbicides into the upper soil profile, 3) most velvetleaf seedlings emerged from upper soil profile (Figure 1). As a consequence herbicides were present near the soil surface when most of the velvetleaf germinated. Since good control only required killing the velvetleaf seedlings of the first and only significant flush of germination, even non-residual postemergence herbicides gave excellent control. During a different type of growing season, where several later flushes of germination may occur, one application of a non-residual early postemergence herbicide might not give adequate control. Also, herbicides with a short residual life may not give good control in a season with late flushes of germination.

Experiment 2 was set up to find if late flushes of velvetleaf seed germination are caused by warming trends in the soil. Since germination of selected weed seeds depends upon the soil reaching a certain temperature (1), it was hypothesized that late velvetleaf germination and subsequent flushes of germination may be directly related to warming trends in the soil. A temperature requirement would then explain why velvetleaf germinates in flushes throughout the season: seeds in the top 2 cm of soil would germinate earlier and seeds at deeper soil levels would germinate later in the season as the soil warmed at deeper levels. Data from experiment 1 indicate that there is only a slight increase in percent germination at higher temperatures (Table 1). Furthermore, field tests made to record the depth from which seedlings emerged throughout the growing season showed that the average depth of germination from planting until August 1 was less than 2.5 cm (Figure 1). Therefore, we can conclude that velvetleaf germination does not hinge upon a specified temperature or narrow temperature range, flushes in germination do not occur from deeper soil levels throughout the growing season, and something other than changes in soil temperature causes flushes of velvetleaf germination.

Table 1: The effectiveness of selected herbicides for velvetleaf control on an Ontario loam soil near Waterloo, NY

Treatment	Formulation	Rate kg/ha	How Applied	Velvetleaf Rating 6/20/79	Velvetleaf Rating 8/13/79
1) Butylate + safener	6.7 EC	4.48	ppi	7.50	7.75
2) Atrazine	4 FL	1.12	ppi	7.00	7.25
3) Butylate + safener	6.7 EC	4.48	ppi	7.75	7.25
Atrazine	4 FL	1.12	ppi		
4) Pendimethalin	4 EC	1.48	pre	8.00	7.50
5) Atrazine	4 FL	1.12	pre	8.50	8.75
6) Atrazine	4 FL	2.24	pre	9.75	9.75
7) Cyanazine	80 W	2.24	pre	7.00	6.50
8) Pendimethalin	4 EC	1.48	pre	8.25	7.75
Cyanazine	80 W	2.24			
9) Pendimethalin	4 EC	1.48	pre	8.25	7.75
Atrazine	4 FL	1.12			
10) Pendimethalin	4 EC	1.48	pre	9.50	9.00
Atrazine	4 FL	2.24			
11) Atrazine	4 FL	1.12	pre	10.00	9.75
Bentazon	4 EC	1.12	post		
12) Pendimethalin	4 EC	1.48	post	7.25	7.25
13) Cyanazine	80 W	2.24	post	6.75	7.00
14) Atrazine	4 FL	2.24	post	7.50	6.00
15) Pendimethalin	4 EC	1.48	post	9.00	6.75
Atrazine	4 FL	2.24	post		
16) Pendimethalin	4 EC	1.48	post	8.75	7.25
Cyanazine	80 W	2.24			
17) Untreated	--	--	--	0.00	0.00
18) Untreated	--	--	--	0.00	0.00
19) Atrazine	4 FL	2.24	pre	9.25	9.25
Bentazon	4 EC	1.12	post		

1/ Rating Scale: 0=no control, 10=complete control, 7 or above=commercially acceptable.
Each value is the mean of 4 replications.

Table 2: Velvetleaf germination at different temperatures.

	Temperature C							
Seed	2.5-10	10	15.6	10-21.1	21.1	21.1-26.7	32.2	37.8
	(% Germination)							
Velvetleaf	51	57	57	62	59	66	69	52

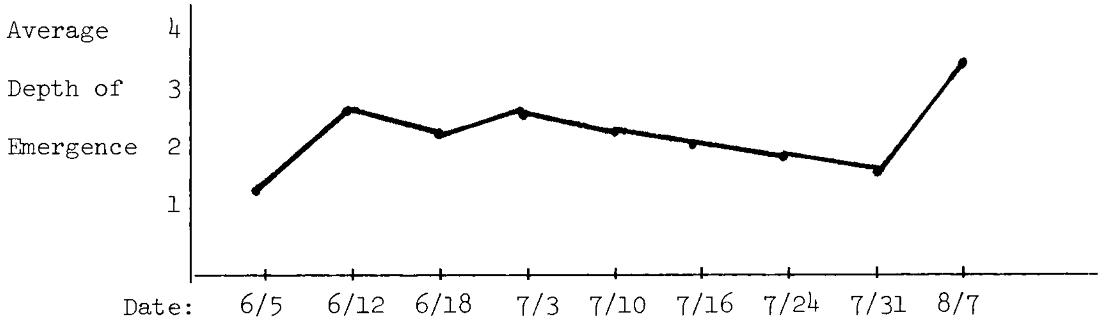

Figure 1: Average depth of velvetleaf emergence over 1979 growing season.

Stoller and Wax noted in 1967 that two flushes of velvetleaf germination occurred in May and June following rainfall greater than 2 cm (6). La Croix and Staniforth found that velvetleaf dormancy is primarily due to its hard impermeable seed coat, which when cracked allows moisture to enter and germinates. Cracking was found to occur from drying conditions (5). Stoller and Wax's data indicates "that this mechanism operates in the field for this species, because the germination stimulated by rainfall was preceeded by dry conditions which could have fractured the seed coat (6)." Our data, from a field study near Waterloo, NY agrees with their conclusion. Over 90% of the velvet leaf germinated in late May and early June when adequate moisture was present. This was followed by a 50 day dry period from June 12 through August 1. After this dry period, no major flush of germination was noted and seedlings which did emerge had no competitive effect.

From these observations we can conclude that when a wet spring is followed by an extensive dry period, only one major flush of velvetleaf seed germination will occur and good velvetleaf control could be obtained by a relatively short residual herbicide. Conversely, a dry planting period followed by heavy rainfalls separated by approximately 2 week dry periods will cause staggered flushes of velvetleaf seed germination and over a long period of time good velvetleaf control would require a long residual herbicide.

Experiment 3 was designed to provide information as to how late a grower can apply a postemergence treatment and still obtain good control. This information is especially important in a growing season where initial herbicide treatments fails or poor weather conditions stop a grower from applying his preemergence or early postemergence treatment, and as a result needs an effective late postemergence treatment to save his crop.

Table 3: Postemergence velvetleaf control by selected herbicides at various growth stages expressed in % reduction from untreated plants.

Treatment	Rate kg/ha	Treated Leaf Stage[1]				
		pre	Cotyledon	2nd leaf	4th leaf	6th leaf
		(% Reduced from Untreated)[2]				
1) Dicamba	1.06	100.0	100.0	100.0	61.0	7.5
2) Atrazine	1.12	100.0	99.5	98.9	82.6	53.2
3) Pendimethalin	1.68	87.4	89.9	77.1	49.6	-5.9
4) Bentazon	1.12	--	98.9	100.0	72.7	63.7
5) Cyanazine	2.24	100.0	100.0	100.0	100.0	100.0
6) Atrazine plus Pendimethalin	1.12 1.68	100.0	100.0	95.5	79.8	58.2
7) Cyanazine plus Pendimethalin	2.24 1.68	100.0	100.0	100.0	100.0	59.8

1/ Plant shoots harvested three weeks after treatment.
2/ Each value is the mean of three replications.

The following results were obtained: 1) pendimethalin and bentazon control broke after the second leaf stage; 2) dicamba, atrazine, atrazine plus pendimethalin, and cyanazine plus pendiemthalin control broke after the fourth leaf stage, 3) cyanazine gave excellent control through the sixth leaf stage (Table 3). It should be noted, however, that while the figures show poor control for dicamba at the sixth leaf stage, severe injury symptoms were evident at harvest.

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SMOOTH CRABGRASS CONTROL IN FIELD CORN

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ABSTRACT

In 1977 through 1979 herbicide treatments applied to five field corn experiments were evaluated for their control of smooth crabgrass. These experiments were conducted at Fabius, New York on a Halsey gravelly loam, with a pH of 7.4, organic matter of 6.0% and a CEC of 7.0. In each of the years the corn was planted between May 15 and May 19. Preplant incorporated treatments were applied the day prior to, or the day of planting. Preemergence applications were sprayed the day or the day after planting. Early postemergence treatments were applied when the corn was in the 2 to 4 leaf stage and the smooth crabgrass was in the 1 to 3 leaf stage. Rainfall, during the 2 week period following planting, totaled: 0.74 inches in 1977, 0.22 inches in 1978 and 3.19 inches in 1979.

The preplant incorporated thiocarbamate treatments (see Table 1) gave the best control regardless of rainfall. The acetanilides were the most effective preemergence herbicides. However the dry weather following planting in 1978 lessened the effectiveness of many of the preemergence treatments. Early postemergence applications of cyanazine and pendimethalin also gave effective control of this species.

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Table 1. Control of smooth crabgrass in field corn, 1977-1979

Trt. No.	Treatment	Timing	Rate ai/A	Smcg. Control 1/				
				1977	#1 1978	#2 1978	#1 1979	#2 1979
1.	atrazine	Pre 3/	2.0	--	--	0.0	0.5	0.0
2.	alachlor	Pre	2.0-2.5	8.8	8.0	8.7	10.0	--
3.	alachlor	EPo	2.5	--	--		5.8	--
4.	atrazine + alachlor	Pre	1.0+2.0	10.0	1.8	--	9.0	--
5.	atrazine + alachlor	EPo	1.0+2.0	1.0	0.0	--	7.3	--
6.	atrazine + alachlor + o.c. 2/	EPo	1.0+2.0	--	0.5	--	6.3	--
7.	atrazine + metolachlor	Pre	1.0+2.0	9.5	2.8	--	8.7	--
8.	atrazine + metolachlor	EPo	1.0+2.0	9.3	6.0	--	7.3	--
9.	atrazine + metolachlor + o.c.	EPo			8.5		9.0	--
10.	cyanazine	EPo	2.0	8.0	--	--	--	--
11.	atrazine + cyanazine	Pre	1.0+2.0	5.0	0.5	--	8.0	9.8
12.	atrazine + cyanazine	EPo	1.0+2.0	1.0	10.0	--	6.5	3.5
13.	atrazine + cyanazine	LPo	1.0+2.0	4.7	--	--	--	--
14.	atrazine + simazine	Pre	1.0+1.0	5.3	1.5	--	--	--
15.	cyanazine + alachlor	Pre	2.0+2.0	--	--	--	9.8	10.0
16.	cyanazine + alachlor	EPo	2.0+2.0	--	--	--	10.0	--
17.	cyanazine + metolachlor	Pre	1.5+1.5	10.0	5.0	--	10.0	--
18.	cyanazine + metolachlor	EPo	2.0+2.0	--	7.0	--	9.0	--
19.	pendimethalin	Pre	2.0	--	--	--	9.5	--
20.	pendimethalin	EPo	2.0	--	--	--	6.0	--
21.	pendimethalin + atrazine	Pre	1.5+1.0	9.0	1.8	--	--	--
22.	pendimethalin + atrazine	EPo	1.5+1.0	1.5	8.8	9.8	8.3	--
23.	pendimethalin+atrazine+o.c.	EPo	1.5+1.0	9.0	9.3	9.8	9.0	--
24.	pendimethalin + cyanazine	Pre	2.0+1.5	9.8	8.0	--	--	--
25.	pendimethalin + cyanazine	EPo	1.5+2.0	--	10.0	9.8	--	--
26.	pendimethalin+cyanazine+o.c.	EPo	1.5+2.0	8.5	--	--	--	--
27.	EPTC+antidote+atrazine	PPI	3.0+4.0+1.0	9.0	9.3	9.8	9.5	8.8
28.	EPTC+antidote+atrazine	PPI	6.0+1.0	--	--	9.3	--	9.5
29.	EPTC+antidote+cyanazine	PPI	3.0+2.0	--	--	--	9.8	--
30.	butylate+antidote+atrazine	PPI	3.0+1.0	--	--	7.8	--	9.8
31.	butylate+antidote+atrazine	PPI	4.0+1.0	--	8.5	9.8	9.3	9.8
32.	butylate+antidote+cyanazine	PPI	4.0+2.0	--	--	9.5	9.5	--
33.	butylate+antidote+cyanazine	PPI	6.0+2.0	--	--	9.0	--	--
34.	CP55097	Pre	2.0	--	5.8	--	--	--
35.	CP55097 + atrazine	Pre	2.0+1.0	--	5.8	--	8.8	--
36.	CP55097 + atrazine	EPo	2.0+1.0	--	8.3	--	7.5	--
37.	CP55097 + atrazine + o.c.	EPo	2.0+1.0	--	--	--	8.5	--
38.	CP55097 + cyanazine	Pre	2.0+2.0	--	--	--	10.0	--
39.	CP55097 + cyanazine	EPo	2.0+2.0	--	--	--	9.8	--
40.	Check			0	0	0	0	0

1/ Rating scale: 0= no effect, 10= complete kill

2/ o.c. = the oil concentrate, Booster Plus E applied at 1.7% v/v

3/ PPI - preplant incorporated, Pre = preemergence, EPo = Early postemergence

POSTEMERGENCE ACTIVITY OF REGISTERED PREEMERGENCE HERBICIDES FOR CORN

T. C. Harris and J. V. Parochetti[1/]

ABSTRACT

Weather, equipment and time limitations can sometimes alter the best planned farming schedules. In 1979, a field study was conducted at the Wye Institute, Queenstown, MD, to determine the effectiveness of various standard preemergence herbicides for conventional corn when application was delayed until the crop and weeds had emerged.

Treatments included 1.0 lb/A pendimethalin, 2.0 lb/A alachlor, and 2.0 lb/A metolachlor which were applied alone and with 1.25 lb/A atrazine both preemergence and early postemergence. Atrazine (1.25 lb/A) alone was also applied at both times.

'Pioneer 3184' corn was planted in 30 inch rows on May 17 in a Matapeake silt loam soil (pH 6.2, OM 1.5%). Plots were four rows wide and 20 feet long. The experiment was established as a randomized complete block design with four replications. Herbicides were applied with a CO_2 pressurized bicycle sprayer that delivered 30 gal/acre at 30 psi. Flat fan nozzles were used (SS-8004).

When preemergence treatments were applied on May 17 the soil was dry to a depth of 1 inch but 0.70 inches of rain fell within 72 hours. The postemergence treatments were sprayed on May 29. The soil was moist and 1 inch of rain fell within 48 hours. At the time of postemergence application the corn was 2 inches tall with 2-3 leaves. Giant green foxtail (*Setaria viridis* var. *major* (Gaud.) Posp.) and fall panicum (*Panicum dichotomiflorum* Michx.) had 1-2 leaves, common lambsquarters (*Chenopodium album* L.) and jimsonweed (*Datura stramonium* L.) were both in the cotyledon stage, and yellow nutsedge (*Cyperus esculentus* L.) had not yet emerged. Visual ratings of weed control and crop injury were taken through early August. Plots were harvested by hand on October 22.

Results indicate that, under ideal conditions, application of preemergence herbicides can be delayed until after corn and weed emergence with no loss in efficiency. No decrease in weed control, no increase in crop injury (no injury observed from any treatment), and no decrease in yield was observed from the postemergence application of any herbicide tested. An exception was atrazine used alone when applied preemergence resulted in fair (85%) control of fall panicum but when applied postemergence resulted in poor (60%) control of fall panicum. Statistically, yield was not affected by choice of herbicides, but there was a tendency for corn treated with a two-way combination (either pendimethalin, alachlor, or metolachlor plus atrazine) to yield higher than corn treated with any one chemical alone.

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COMPETITIVE CONTROL OF FALL PANICUM AND GIANT FOXTAIL BY FIELD CORN

L. A. Perera and N. L. Hartwig[1/]

ABSTRACT

Control of the annual grasses, fall panicum, giant foxtail and johnsongrass seedlings by corn competition was 75%. With increasing rates of alachlor the grass control was increased to 92%. Alachlor in this trial did not provide more than 17% of the grass control. These results were obtained with a well adapted corn variety planted at 24,400 plants/A, with adequate fertility and moisture.

INTRODUCTION

Most herbicides used for weed control in corn do not have an effective residue of more than 6 to 8 weeks (1). Since weed seeds can germinate after the herbicides are no longer effective, albeit in reduced numbers, weed control during the last half of the growing season must be provided by competition from the corn.

The objective of this trial was to determine the amount of annual grass control provided by the corn competition when treated with different rates of the common grass herbicide alachlor.

MATERIALS AND METHODS

This trial was conducted in 1979, on a Hagerstown loam soil containing 10% sand, 67% silt, 20% clay and 2.5% organic matter at the Pennsylvania State University research fields. The soil pH was 6.7 and no liming was done. Trial area was allowed to grow up to fall panicum for 2 to 3 years before this experiment. 'Pioneer 3780' (100 day) corn was planted conventionally to a stand of about 27,000 plants/A on May 9. Three hundred lb/A of urea was broadcast before planting and one hundred and fifty lb/A of 10-20-10 fertilizer was row applied at planting time. Atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-S-triazine] was applied early postemergence as a blanket treatment at 2 lb ai/A on May 16 and Alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] was applied at variable rates 0 to 1 2/3 lb ai/A at the same time with an 8001 LP nozzle at 25 psi when corn was in the spike stage and fall panicum in the 2 leaf stage.

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Corn was hoed out of the no corn plots and was thinned to approximately 24,400 plants/A in plus corn plots at 3-4 leaf stage in early June.

Corn yields were determined by hand harvesting 2 samples of 2 rows each leaving the border row on each edge of 6 row plots. Weeds yields were determined by harvesting 0.5 m^2 areas at 2 points selected at random in each plot in late August. Weed weights were divided by species into fall panicum (*Panicum dichotomiflorum* Michx.), giant foxtail (*Seteria faberii* Herrm.) and johnsongrass (*Sorghum helapense* (L.) Pers.). Wet weight determinations were done in the field and 1 to 2 lb. samples of each were used for dry matter determinations.

The experiment was arranged in a split plot design with the herbicide treatments as main plots and corn treatments as sub plots replicated 4 times. Plot size was 15 x 20 feet with 6 (30 inch) corn rows per plot. Replication 4 was discarded due to heavy johnsongrass infestation and final analysis was carried out with data from other three replications.

RESULTS AND DISCUSSIONS

In the absence of corn, fall panicum and giant foxtail control was not significantly reduced with increasing rates of alachlor up to 1 2/3 lb ai/A (Table 1). Johnsongrass was found only in a few plots and statistical analysis could not be run of this species. To better express the actual control by alachlor, the grass dry weights were totalled and plotted in (Figure 1).

In the presence of corn fall panicum control was not significantly decreased with increasing rates of alachlor up to 1 2/3 lb ai/A. Giant foxtail control was significantly increased by greater than 2/3 lb ai/A of alachlor compared to the untreated check but there was no significant difference in giant foxtail control among any of the alachlor treatments. Again since species dry weights fluctuate among plots, total dry weight yields were calculated to determine the true control provided by alachlor and corn competition. These total dry weight yields indicate a significant decrease as alachlor increased up to 2/3 lb ai/A.

Corn provided 75% control of fall panicum and giant foxtail in the untreated check (Table 2). Grass control was further increased to 92% with increasing rates of alachlor up to 1 2/3 lb ai/A. Even though grass control contributed by alachlor was never more than 17%, even this may not be all due to alachlor, but partially due to increased growth and greater competition provided by corn that has been treated with alachlor.

In summary grass control provided by corn competition can be as high as 75% when a corn variety adapted to the area is planted at 24,400 plants/A, with adequate soil fertility and moisture. Alachlor undoubtably contributes to seedling grass control early in the season which allows corn to get off to a better start and produce more competition against weeds later in the season.

References

1. Herbicide handbook. Weed Science Society of America.

Table 1. Dry weight yields of fall panicum, giant foxtail, johnsongrass and total weed weight with and without corn competition.

Treatment	Rate	Fall Panicum		Giant Foxtail		Johnsongrass		Total Weed		Corn Yield
		-Corn	+Corn	-Corn	+Corn	-Corn	+Corn	-Corn	+Corn	
	lb ai/A	-----	-----	-----	-----	lb/A	-----	-----	-----	bu/A[2]
Atrazine + Alachlor	2 + 0	1325 a[1]	250 a	5500 a	1475 a	0	0	6825 a	1725 a	109 ab
	2 + 1/3	225 a	25 a	4925 a	1150 ab	3000	75	7250 a	1250 ab	104 b
	2 + 2/3	1100 a	175 a	3275 a	450 b	1575	0	5950 a	625 bc	133 ab
	2 + 1	1075 a	7 a	2950 a	450 b	1950	125	5975 a	575 bc	125 ab
	2 + 1 1/3	1950 a	25 a	4350 a	525 b	0	25	6300 a	575 bc	123 ab
	2 + 1 2/3	2250 a	50 a	3375 a	375 b	0	0	5625 a	425 c	136 a

1/ Means followed by the same letter do not differ at the 5% level of significance according to Waller-Duncan K-ratio T test.

2/ Corn yields in bushels of shelled corn/A at 15.5% moisture.

Figure 1. Dry weight yields of fall panicum, giant foxtail and total weed weight with and without corn competition.

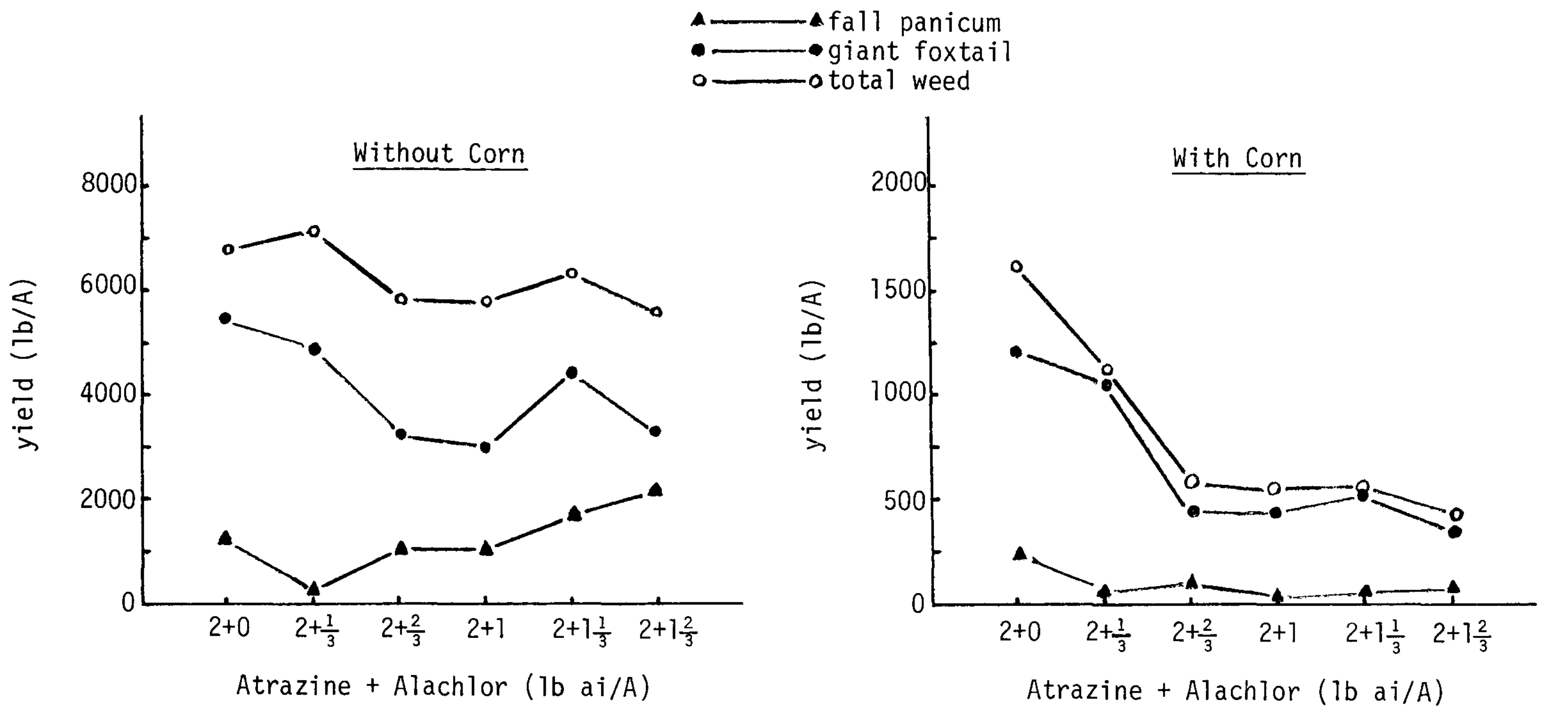


Table 2. Total dry weight yields of grasses with and without corn and percentage grass control by corn + alachlor and alachlor alone.

		Total weed weights		Weed Control by	
Treatment	Rate	-Corn	+Corn	Corn + Alachlor	Alachlor
	lb ai/A	-------lb/A--------		-------------%-------------	
	2 + 0	6825 a[1/]	1725 a	75	0
Atrazine + Alachlor	2 + 1/3	7250 a	1250 ab	83	7
	2 + 2/3	5950 a	625 bc	90	15
	2 + 1	5975 a	575 bc	90	15
	2 + 1 1/3	6300 a	575 bc	91	16
	2 + 1 2/3	5625 a	425 c	92	17

[1/]Means followed by the same letter do not differ at the 5% level of significance according to Waller-Duncan K-ratio test.

PERFORMANCE OF ACETOCHLOR IN CORN AND POTATOES IN THE NORTHEASTERN UNITED STATES

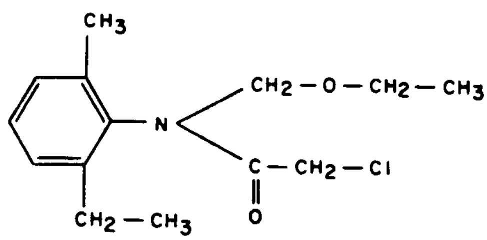
L. B. Lynn 1/

ABSTRACT

Results of trials with acetochlor, an acetanilide herbicide, have shown promise in both corn and potatoes. Preemergence treatments provided good to excellent control of foxtails, fall panicum, redroot pigweed, common lambsquarter, common ragweed, galinsoga, and yellow nutsedge. Preplant incorporated treatments were slightly less effacious than preemergence treatments. Acetochlor shows promise in high organic soils and for specific weed problems such as yellow nutsedge or galinsoga.

INTRODUCTION

Acetochlor, [2-chloro-N-(ethoxymethyl)-6'-ethyl-O-acetotoluidide], has been evaluated for several years under the code MON-097. It is a member of the acetanilide herbicide family. Acetochlor has a molecular weight of 269.78, its empirical formula is $C_{14}H_{20}ClNO_2$, and its structural formula is:



The herbicidal efficacy and crop tolerance of acetochlor has been evaluated at rates of 1 to 4 lb/A mostly in corn (*Zea mays*), but recently in potatoes (*Solanum tuberasum*) too. Scientists at northeastern institutions have compared acetochlor with other acetanilides such as alachlor [2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide] and metoachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide]. Vengris (10) and Dest et al (3) demonstrated excellent control of fall panicum (*Panicum dichotomiflorum* Michx), crabgrass (*Digitaria* spp) and barnyardgrass (*Echinochloa crusgalli* L.) in field corn with preemergence applications of acetochlor. Ashley

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(1) demonstrated superior control of galinsoga (Galinsoga ciliata (Ref.) Blake) with as low rates as 0.75 lb/A acetochlor. Researchers in New York and Maryland have also evaluated acetochlor in corn (2, 4, 5, 7) and potatoes (8, 9) for control of weeds such as crabgrass (Digitaria sanguinalis (L.) Scop.), redroot pigweed (Amaranthus retroflexus L.), yellow foxtail (Setaria lutescens (Weigel) Hubb.), green foxtail (Setaria viridis var. major), yellow nutsedge (Cyperus esculentus L.), barnyardgrass and fall panicum. Good to excellent crop tolerance for both corn and potatoes was exhibited in these trials.

Based on the promising results obtained with acetochlor in numerous academic locations, Monsanto researchers have conducted several trials throughout the northeast on corn and potatoes. The overall objectives of these trials were to determine the technical and practical fit of acetochlor into the existing herbicide arsenal. This paper compiles the results and interpretations of these trials with acetochlor.

MATERIALS AND METHODS

In 1978-79, acetochlor (MON-097) formulated as a 5 lb/Gal emulsifiable concentrate was applied to corn and potatoes in New York, Pennsylvania and Maine. Corn trials in New York and Pennsylvania on medium textured soils (clay loam 3% OM; silt loam 1.5% OM; silt loam 2.5% OM and sandy loam 1% OM) included both preemergence and preplant incorporated treatments. Potato plots in New York and Maine (sandy loam 1% OM; loam 2% OM and muck soils) included preplant incorporated, preemergence and early postemergence treatments. Data from twelve experiments from nine locations are reported.

All experiments were established with CO_2 small plot sprayers using 20 to 40 GPA water. Preplant incorporation was completed within four hours of application using a spring-toothed or spike toothed harrow to insure shallow incorporation. Preemergence treatments were applied immediately after planting in corn and just before emergence in potatoes. The early-postemergence treatment was made to potatoes only in the 4 to 6 true leaf stage of growth. Acetochlor rates of 1.5 to 4.0 lb/A were evaluated. In several cases, constant rates of residual broadleaf herbicides such as metribuzin [4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5[4H]-one], linuron [3-(3, 4-dichlorophenyl)-1-methoxy-1-methylurea] and atrazine [2-chloro-4 (ethylamino)-6-(isopropylamino)-s-triazine] were included. Also in two no-till corn trials, glyphosate [N-(phosphonomethyl) glycine][2/] was also included in the tank-mixes.

2/ Roundup®, isopropylamine salt of glyphosate

Due to the wide geographic distribution of experiments, dates of application varied from early May until the end of June. Weed control and crop tolerances evaluations were reported as percent of control 0-100 for days after treatments (DAT). Experiments were replicated at least three times except in one site where statistical subsampling techniques were used to accommodate large plot evaluations. ANOVA statistical procedures were employed to determine differences within experiments.

RESULTS AND DISCUSSION

Corn

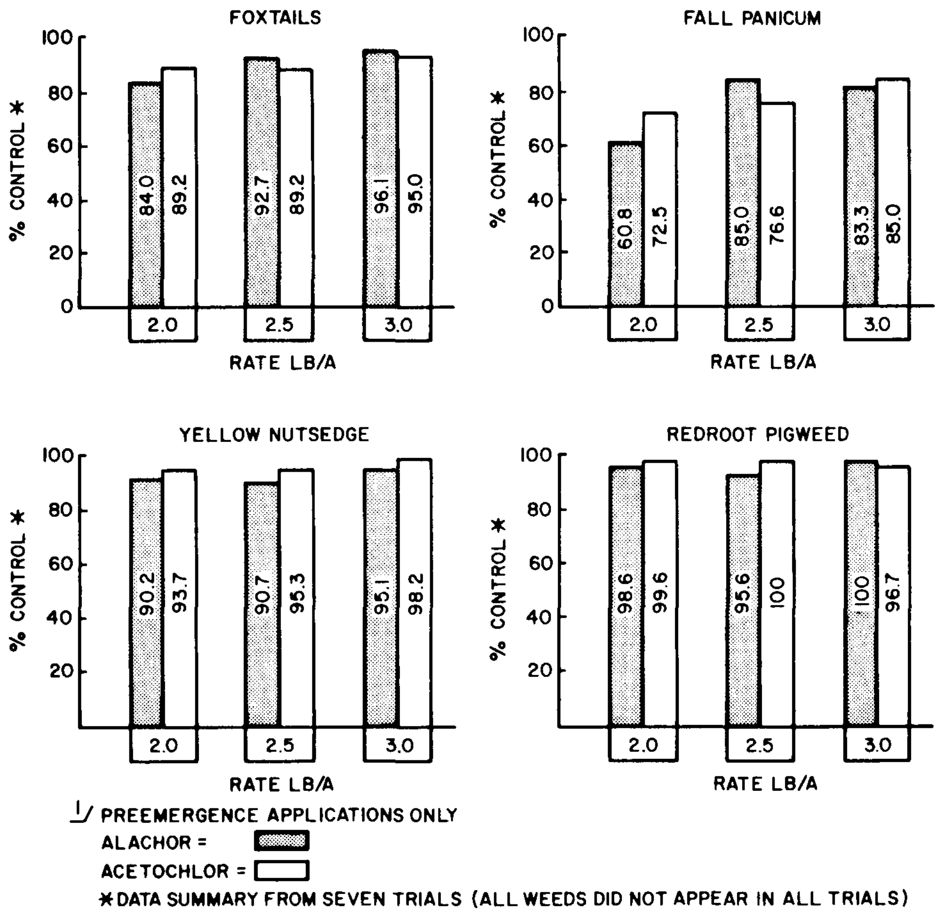
The performance of acetochlor compared to alachlor is illustrated in Figure 1. At 2.0 lb/A, acetochlor was generally more efficacous than alachlor for control of foxtails, fall panicum, redroot pigweed and yellow nutsedge. At 2.5 and 3.0 lb/A, alachlor performed as well as and often better than acetochlor for control of the grasses (foxtails and fall panicum). Overall control of foxtails was better than fall panicum, but with both species there was a rate responsive increase in weed control with rate increases. As expected with a small seeded broadleaf weed - redroot pigweed - both of these acetanilide herbicides provided excellent control (97-100%). In all cases, control of yellow nutsedge was better with acetochlor than with alachlor. The improved yellow nutsedge efficacy can be attributed to the higher biological activity per unit of acetochlor as compared to alachlor. This higher unit activity of acetochlor is translated into reduced crop tolerance as compared to alachlor (Table 1).

Table 1. Tolerance of Corn to Preemergence Applications of Acetochlor and Alachlor

Rate	% Corn Injury (Early to Mid Season)	
Lb/A	Acetochlor	Alachlor
1.5	5.0	-
2.0	11.0	5.4
2.5	16.0	1.6
3.0	8.0	6.0
4.0	-	6.3

Acetochlor provided good to excellent weed control in corn trials. Crop safety is, however, a matter of concern. Indications from these experiments as well as academic trials suggest adequate crop safety to corn. Considering overall crop safety, the technical advantages of acetochlor verses alachlor seem to be with higher organic matter soils and specific weed problems, i.e., yellow nutsedge.

FIGURE I. COMPARISON OF ALACHLOR VS. ACETOCHLOR FOR CONTROL OF CERTAIN WEEDS IN CORN IN SEVERAL NORTHEASTERN LOCATIONS 1/



Potatoes

Acetochlor was more efficacious than alachlor or metoachlor at 1.5 to 2.0 lb/A for control of redroot pigweed, common lambsquarter (Chenopodium album L.), common ragweed (Ambrosia artemisiifolia L.) and quackgrass (Agropyron repens (L.) Beauv). This trend was generally true for both preplant incorporated and delayed preemergence treatments (Table 2).

Table 2. Weed Control in Potatoes with Preplant Incorporated vs Preemergence Applications of Acetochlor, Alachlor and Metoachlor

		% Control 8 Weeks After Treatment							
	Rate	Redroot Pigweed		C. Lambsquarter		C. Ragweed		Quackgrass	
Herbicide	Lb/A	PPI	PRE	PPI	PRE	PPI	PRE	PPI	PRE
Acetochlor	1.5	100	100	92.7	95.0	92.7	91.3	86.7	65.0
Acetochlor	2.0	100	100	81.7	98.0	81.7	97.0	81.0	72.5
Acetochlor	3.0	100	100	94.3	99.3	90.0	96.0	75.0	86.7
Alachlor	1.5	95.0	100	76.7	76.0	36.7	67.7	33.0	43.3
Alachlor	2.0	96.7	100	88.3	86.7	23.3	73.0	13.0	40.0
Metoachlor	1.5	93.3	96.7	60.0	90.0	18.3	16.7	15.0	10.0
Metochlor	2.0	93.3	93.3	73.3	65.0	25.0	23.3	26.7	13.3

Preemergence applications of all herbicides were generally more efficacious than the preplant incorporated applications, except for quackgrass. These trials show inconsistent quackgrass activity with acetanilide herbicides as experienced by several academic researchers (5, 6). Acetochlor does, however, show promise for controlling quackgrass, especially with preplant incorporated treatments.

As with corn, the increased biological activity of acetochlor is also reflected in crop safety. The effects of acetochlor are mostly displayed as delayed maturity, however, by bloom these effects were mostly overcome (Table 3).

Table 3. Potato Response to Acetochlor, Alachlor and Metoachlor

		% Crop Injury			
		PPI		PRE	
Herbicide	Rate Lb/A	4 Wk	8 Wk	4 Wk	8 Wk
Acetochlor	1.5	25	5	20	0
Acetochlor	2.0	20	5	33	0
Acetochlor	3.0	25	12	38	5
Alachlor	1.5	-	5	3	0
Alachlor	2.0	0	0	10	0
Metoachlor	1.5	0	0	0	2
Metoachlor	2.0	3	0	3	0

The technical acceptability of the crop injury with acetochlor as compared to currently labelled herbicides, i.e., metribuzin, linuron, alachlor, etc., needs further evaluations.

Becuase of the specific weed problems on muck soils and the desirability to reduce residual herbicide activity, researchers have had interest in acetanilide herbicides. Preemergence applications of acetochlor, alachlor and metoachlor provided good to excellent control of redroot pigweed, common lambsquarter, ryegrass (Lolium perenne L.) and galinsoga (Table 4).

Table 4. Efficacy of Preemergence Applications of Acetochlor, Alachlor and Metoachlor on Potatoes in a Muck Soil

Herbicide	Rate Lb/A	% Control 4 Weeks After Treatment: Redroot Pigweed	Common Ragweed	Common Lambsquarter	Ryegrass	Galinsoga	% Injury
Acetochlor	2.0	100	98.3	99.0	90.6	100	1
Acetochlor	3.0	100	98.3	99.3	98.3	100	0
Acetochlor	4.0	100	99.0	100	99.0	100	0
Alachlor	4.0	97	95.6	98.0	95.6	100	0
Alachlor	6.0	99.3	95.0	100	94.6	100	0
Metoachlor	4.0	95.7	97.7	99	76.6	100	0
Metoachlor	6.0	98.7	98.6	99.7	96.3	100	0

Because of the buffering effects of the high organic matter in the muck soil, the acetanilide herbicides provided excellent crop safety. Acetochlor, alachlor and metoachlor all showed promise for weed control in potatoes. However, due to the increased biological activity of acetochlor as compared to alachlor and metoachlor, the effective rate of acetochlor is lower.

Postemergence applications of acetochlor, alachlor and metoachlor were weak for controlling redroot pigweed, common lambsquarter, common ragweed and quackgrass (Table 5).

Table 5. Efficacy of Postemergence Applications of Acetochlor, Alachlor and Metoachlor in Potatoes

		% Control								Potato Response % Crop Injury	
		Redroot Pigweed		C. Lambsquarter		C. Ragweed		Quackgrass			
Herbicide	Rate Lb/A	1 Wk	4 Wk	1 Wk	4 Wk	1 Wk	4 Wk	1 Wk	4 Wk	1 Wk	4 Wk
Acetochlor	1.5	6.7	53.3	6.7	33.3	10.0	40.0	0	13.0	0	0
Acetochlor	2.0	13.3	43.3	11.7	26.7	13.3	40.0	2	13.0	0	0
Acetochlor	3.0	10.0	45.0	10.0	33.0	10.0	38.3	0	15.0	0	3
Alachlor	1.5	63.3	70.0	66.7	60.0	66.7	48.3	3	26.7	0	0
Alachlor	2.0	23.3	26.7	20.0	58.3	30.0	28.3	0	23.3	0	0
Metoachlor	1.5	3.3	46.7	0	20.0	0	28.3	0	21.7	0	0
Metoachlor	2.0	3.3	40.0	8	25.0	6.7	31.7	0	26.7	0	0
Acetochlor + Metribuzin	1.5+ 0.5	100	100	100	100	100	100	38.3	66.7	15.7	3
Acetochlor + Metribuzin	2.0+ 0.5	100	100	100	100	100	100	41.7	51.7	16.7	7

The apparent improvement in weed control from postemergence applications 4 weeks after treatment was due to preemergence activity on subsequent germination of the species involved. There was no crop injury from either of the acetanilides applied alone. A postemergence application of acetochlor plus metribuzin provided excellent weed control with acceptable crop safety.

In another experiment in Maine, preemergence applications of acetochlor provided excellent control of redroot pigweed, common lambsquarter and common mustard. There was no crop injury to potatoes in this experiment.

Overview

Acetochlor applied preemergence to corn and potatoes provided good to excellent control of foxtails, fall panicum, redroot pigweed, yellow nutsedge, common lambsquarter, common ragweed, ryegrass, and galinsoga. Preplant incorporated treatments were generally less efficacious probably due to distribution within the soil profile which also attributed to a reduction in crop safety. Postemergence applications of acetochlor provided inadequate weed control. Results in both corn and potatoes indicate a technical fit for acetochlor for high organic soils and specific weeds (yellow nutsedge, galinsoga, etc.). Questions on crop safety are closely related to soil type and organic matter and need further definition. Acetochlor can fill a void currently not filled by other acetanilide herbicides.

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ANNUAL GRASS CONTROL IN MINIMUM TILLAGE CORN

R. R. Hahn[1/]

ABSTRACT

Preemergence herbicides were evaluated for the control of fall panicum (Panicum dichotomiflorum Michx.) and green foxtail [Setaria viridis (L.) Beauv.] in minimum tillage corn at Valatie, New York in 1979. The soil type was a Hoosic gravelly loam with 3.0% organic matter. The plot area had been planted to continuous no-tillage corn from 1971 through 1977 and a severe annual grass problem had developed. In 1978 and again in 1979, the area was chisel-plowed, disked and planted to corn. Herbicide treatments were applied to 10 by 25 ft plots using a compressed air plot sprayer calibrated to deliver 25 gpa of spray solution and were replicated four times. Corn was planted May 7, 1979 and the herbicides applied on May 10. The first rainfall following application was 0.34 inches on May 14 and the total for the two weeks after spraying was 1.27 inches. An additional 2.45 inches fell on May 25.

No corn injury was observed on May 28 so injury ratings were not made. Both fall panicum and green foxtail were controlled with the 4.0 lb/A rate of cyanazine and with the 2.0 lb/A rate of cyanazine in combination with CP 55097, metolachlor or pendimethalin. In addition, the combination of pendimethalin and atrazine provided good control of these annual grasses.

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Table 1. Annual grass control ratings and corn yields for preemergence herbicide treatments in minimum tillage corn in 1979.

Treatment		Control Ratings[a]		Corn Yield
Herbicide(s)	lb/A	Green Foxtail	Fall Panicum	Bu/A
1. AC-206784	4.0	5.3	4.0	34.0
2. Alachlor	2.0	5.7	5.7	45.1
3. Atrazine	1.0	2.7	0.0	11.4
4. CP 55097	1.5	7.3	5.5	53.5
5. Cyanazine	2.0	4.7	4.5	66.2
6. Cyanazine	4.0	7.3	7.3	61.9
7. Metolachlor	2.0	7.3	5.5	55.4
8. Pendimethalin	1.5	6.5	6.5	63.7
9. Propachlor	4.0	6.5	3.7	35.7
10. Simazine	2.0	6.0	1.7	51.3
11. AC-206784	4.0	7.5	2.7	71.3
Atrazine	1.0			
12. AC-206784	4.0	6.7	5.5	67.8
Cyanazine	2.0			
13. Alachlor	2.0	7.0	6.5	71.1
Atrazine	1.0			
14. Alachlor	2.0	6.0	6.0	72.5
Cyanazine	2.0			
15. CP 55097	1.5	6.7	4.5	70.8
Atrazine	1.0			
16. CP 55097	1.5	7.0	7.0	70.5
Cyanazine	2.0			
17. Cyanazine	2.0	6.0	4.7	63.3
Atrazine	1.0			
18. Cyanazine	2.0	8.7	7.3	73.4
Metolachlor	2.0			
19. Cyanazine	2.0	7.7	7.5	67.8
Pendimethalin	1.5			
20. Metolachlor	2.0	7.3	6.3	67.6
Atrazine	1.0			
21. Pendimethalin	1.5	7.7	7.7	68.6
Atrazine	1.0			
22. Propachlor	4.0	4.7	3.5	42.9
Atrazine	1.0			
23. Simazine	2.0	5.7	3.0	49.4
Atrazine	1.0			
24. Control	0.0	0.0	0.0	3.1
l.s.d. @ 5% level		2.2	2.3	17.2
l.s.d. @ 1% level		2.9	3.1	22.9

[a]Control ratings (0 = no control, 10 = complete control) were made September 14, 1979.

SUPPRESSION OF CROWNVETCH FOR NO-TILLAGE CORN

J. Cardina and N. L. Hartwig[1/]

ABSTRACT

Preplant and preemergence herbicide treatments were applied in 1976 and 1978 to reduce competition by a crownvetch cover crop in no-tillage corn. The same rates of atrazine + simazine and atrazine + pendimethalin suppressed crownvetch less in 1978 than in 1976, while suppression by atrazine + cyanazine was similar both years. Preemergence applications of atrazine + simazine and atrazine + cyanazine gave better crownvetch suppression and higher corn yields than early spring preplant incorporated treatments in 1978. Crownvetch suppression by atrazine + simazine + dicamba was too severe to permit crownvetch recovery. Addition of paraquat did not increase effectiveness of herbicide mixtures. Corn yields were similar with and without crownvetch for treatments that controlled crownvetch well, though the presence of crownvetch decreased corn yields an average of 10% both years.

INTRODUCTION

Crownvetch (*Coronilla varia* L.) cover crops in no-till corn (*Zea mays* L.) have been shown to aid in control of yellow nutsedge (*Cyperus esculentus* L.) (2) and some annual weeds (3). In addition, the perennial crownvetch cover reduced soil erosion, improved water infiltration, and provided a double crop of haylage from spring regrowth (1). Linscott and Hagin (4) found that a 50% cover of crownvetch (1320 lb/A) could be maintained without reducing no-till corn yield, although increased cover decreased corn yield (2, 3). The objective of this study was to evaluate preplant and preemergence treatments that suppress crownvetch sufficiently minimize its competition with corn, yet allow the crownvetch to survive and regrow in the fall and spring.

MATERIALS AND METHODS

A crownvetch cover crop was established in 1973 on a Hagerstown silt loam (Typic Hapludult) with about 10% sand, 67% silt, 20% clay, and 2.5%

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organic matter. The field has been in no-till corn for grain or silage since 1975. The soil was limed to a pH of 7.0 in April 1976, and a pH of 6.8 was measured in 1978. Fertilizer was broadcast according to soil test recommendations and was equivalent in 1976 to 170, 154, and 75 lb/A N, P_2O_5, and K_2O, respectively. An additional 200 lb/A of 10-30-10 was applied in the row at planting. Nitrogen was applied as ammonia, side-dressed in late June at 150 lb/A of N. In 1978 a broadcast application of 800 lb $MgSO_4$ and 400 lb urea preceded 150 lb/A 10-30-10 in the row at planting.

'Pioneer 3780' (100 day) corn was sown May 6, 1976, and a mixture of 'Funks 5198' and '4141' (95 day) was planted May 23, 1978 with a six-row no-tillage corn planter to obtain stands of about 24,000 plants per acre.

Atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine] + simazine [2-chloro-4,6-bis(ethylamino)-s-triazine], atrazine + cyanazine [2-((4-chloro-6-(ethylamino)-s-triazin-2-yl)amino)-2-methylpropianitrile], and atrazine + pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine] were applied to the same plots each year since 1975. The rest of the treatments were changed between 1976 and 1978. Preemergence treatments in 1976 were applied May 14 and postemergence treatments on June 16 when corn was 6-8 inches tall and the cover crop and weeds 2-4 inches tall. In 1978 preplant incorporated treatments were applied and disked in on April 10, except granular sutan (S-ethyl diisobutylthiocarbamate) + atrazine 18:6 G which was applied May 4. Preemergence treatments were applied May 26, three days after planting. Herbicide applications were made with a small plot sprayer at 28 psi in 20 gal water/A with an 80015 LP nozzle in 1976 and an 8001 LP nozzle in 1978 except granular sutan + atrazine which was applied with a Gandy Spreader. The soil was firm but appeared sufficiently moist for herbicide activation and crop growth for all treatments. Furadan insecticide at 1 lb/A was banded in the row at planting both years.

The experiments were arranged in a split plot design with crownvetch as main plots, herbicide treatments as sub-plots and with three replications. Plots were 20 ft long with five 30-inch corn rows per plot. Stand counts and corn grain yields were taken from the three center rows. Crownvetch yields were measured in September by harvesting a 20 ft strip to one side of the center row with an 18 in rotary mower. Differences among treatment means were measured by analysis of variance using the Duncan-Waller K-ratio test.

RESULTS AND DISCUSSION

Crownvetch yields were generally higher in 1978 than in 1976. For treatments that were the same from 1975 through 1978, crownvetch growth and yield increased between 1976 and 1978 for all treatments except atrazine + cyanazine (Table 1). Crownvetch recovery growth was good for all treatments except for atrazine + simazine + dicamba (3,6-dichloro-o-anisic acid) which in 1976 suppressed crownvetch too severely to permit recovery growth. In 1976 there was no consistent relationship between corn yield and crownvetch yield (Table 2). The corn stand and corn yield were not significantly lower where crownvetch was present compared to plots without crownvetch. The inclusion of paraquat (1, 1'-dimethyl-4, 4'-bipyridinium ion) in mixtures did not aid in suppressing crownvetch or benefit corn yield.

In 1978 preemergence applications of atrazine + simazine or atrazine + cyanazine gave best crownvetch suppression and resulted in the highest corn yields (Table 3). The crownvetch did not significantly decrease corn yield in these treatments compared to plots without crownvetch although yields tended to be lower in the presence of crownvetch for the other treatments. Crownvetch suppression and corn yields were generally better for preemergence than for preplant incorporated applications 6 weeks before planting. This was probably due to binding of herbicides to soil particles and some dissipation before the crownvetch began spring growth. Simazine + pendimethalin gave the least suppression of crownvetch whether applied preemergence or preplant incorporated. There was no significant difference in cornstand among herbicide treatments either year, though herbicides that gave best suppression and highest corn yields generally had highest corn populations.

In summary, the same treatments that suppressed crownvetch well in 1976 were less effective in 1978. This suggests that as the stand grew older and better established it became more vigorous and was less susceptible to the herbicide treatments. Application rates may have to be increased or a little dicamba might be included on older stands to get the same degree of suppression that was obtained with low rates of herbicides on a young stand. Preemergence applications were more effective in crownvetch suppression than preplant incorporated applications of the same herbicides applied 6 weeks before planting. Atrazine + simazine and atrazine + cyanazine applied preemergence gave best crownvetch suppression and similar corn yields with and without crownvetch.

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Table 1. Crownvetch cover crop and corn grain yields with and without a crownvetch cover crop following herbicide applications in 1976 and 1978.

Treatment			Yields			
			Crownvetch		Corn	
Herbicide		Cover	1976	1978	1976	1978
			---lb/A---		------bu/A[a]------	
atrazine + simazine	Pre	+	540	960	127 abc[b]	112 a
		-	0	0	157 a	104 ab
atrazine + cyanazine	Pre	+	800	700	114 bcde	102 ab
		-	0	0	141 ab	107 a
atrazine + pendimethalin	Pre	+	690	1320	105 cde	96 ab
		-	0	0	127 abc	89 abc

a/ Corn yields are bushels of shelled corn at 15.5% moisture.

b/ Means followed by the same letter do not differ at the 5% level of significance according to the Duncan-Waller K-ratio test.

Table 2. Crownvetch yield, corn stand, and corn grain yield with and without a crownvetch cover crop following herbicide treatments in 1976.

Treatment			Crownvetch	Corn	
Herbicide	Application	Cover	Yield	Stand	Yield
			lb/A	plants/A	bu/A[a]
atrazine + simazine	Pre	+	540	23800 ab[b]	127 abc
		-	0	25400 a	157 a
atrazine + simazine + paraquat	Pre	+	780	23500 ab	130 abc
		-	0	25400 a	144 ab
atrazine + simazine + dicamba	Post	+	140	24600 ab	118 bcd
		-	0	24700 ab	108 cde
atrazine + cyanazine	Pre	+	800	24400 ab	114 bcde
		-	0	24900 ab	141 ab
atrazine + cyanazine + paraquat	Pre	+	530	25600 a	122 bc
		-	0	23400 ab	113 bcde
atrazine + pendimethalin	Pre	+	690	22400 b	105 cde
		-	0	22400 b	127 abc
atrazine + pendimethalin + paraquat	Pre	+	850	19400 c	90 de
		-	0	17700 c	85 e
mean		+	620	23400	115
		-	0	23400	125

a/ Corn yields are bushels of shelled corn at 15.5% moisture.

b/ Means followed by the same letter do not differ at the 5% level of significance according to the Duncan-Waller K-ratio test.

Table 3. Crownvetch yield, corn stand, and corn grain yield with and without a crownvetch cover crop following herbicide treatments in 1978.

Treatment			Crownvetch	Corn	
Herbicide	Application	Cover	Yield	Stand	Yield
			lb/A	plants/A	bu/A[a]
atrazine + simazine	PPI	+	1490	23400 abc[b]	54 cd
		-	0	25600 a	93 ab
atrazine + pendimethalin	PPI	+	1360	22600 abc	102 ab
		-	0	25400 ab	102 ab
simazine + pendimethalin	PPI	+	1570	22700 abc	49 cd
		-	0	25200 abc	67 bcd
sutan + atrazine	PPI	+	1400	23200 abc	45 cd
		-	0	22800 abc	67 bcd
atrazine + simazine	Pre	+	960	24500 abc	112 a
		-	0	24200 abc	104 ab
atrazine + cyanazine	Pre	+	770	24400 abc	102 ab
		-	0	24100 abc	107 ab
atrazine + pendimethalin	Pre	+	1320	22600 abc	96 ab
		-	0	23900 abc	89 abc
simazine + pendimethalin	Pre	+	2250	22600 bc	28 d
		-	0	21500 c	79 abc
mean		+	1390	23400	78
		-	0	24100	88

[a] Corn yields are bushels of shelled corn at 15.5% moisture.

[b] Means followed by the same letter do not differ at the 5% level of significance according to the Duncan-Weller K-ratio test.

MULTIPLE HERBICIDE COMBINATIONS FOR FALL PANICUM CONTROL IN NO-TILLAGE CORN [1/]

J.V. Parochetti and T.C. Harris [2/]

ABSTRACT

Fall panicum (Panicum dichotomiflorum Michx.) is one of the most serious annual weed problems in no-tillage corn production in the mid-Atlantic states. Field experiments were established in 1978 and 1979 in a heavily infested area of fall panicum at the Wye Institute, Queenstown, MD. The area had been planted to corn the previous year (1977) but abandoned because of the heavy weed infestation. No-tillage corn was planted in May each year in the undisturbed plant residues. In 1978 best fall panicum control (90%) resulted from a four-way herbicide combination (paraquat + atrazine + simazine + metolachlor). In 1979 this four-way combination resulted in 80% control which was statistically equal to the best treatment (paraquat + metolachlor + simazine) at that date. In 1979, treatments containing simazine or simazine + atrazine were significantly better than the treatments containing atrazine without simazine.

INTRODUCTION

No-tillage corn (Zea Mays L.) has become an increasingly popular method of producing corn in Maryland. Parochetti (1,2,3) has reported on the effectiveness of a number of residual herbicides for annual weed control in a rye (Secale cereale L.) cover crop planted to no-till corn. However, a number of farmers are planting no-tillage corn directly in a previous year's crop and associated residual weed cover. Fall panicum is the major annual grassy weed problem that continues to be difficult to control in no-tillage corn.

The purpose of this research was to evaluate multiple combinations of residual herbicides in combination with a foliar active herbicide for fall panicum control in no-tillage corn.

MATERIALS AND METHODS

Experiments were conducted in 1978 and 1979 at the Wye Institute, Queenstown, MD. The experiment was located in the same area each year. The soil was a Matapeake silt loam with a pH of 5.8 with 1.5% organic matter. Corn was planted in the previous year's plant residue. Fall panicum pressure

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was heavy (>100 plants/ft^2) both years. Plots were four rows wide (30 inch spacing) and 30 feet long. Herbicides were applied with a CO_2 pressurized bicycle sprayer using 30 psi to deliver 30 gal/A through flat fan nozzles (SS-8004).

Non-residual herbicides, glyphosate [N-(phosphonomethyl)glycine] and paraquat [1,1'-dimethyl-4,4'-bipyridinium ion], were used with residual herbicides. The following residual herbicides were applied in various combinations: atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine], simazine [2-chloro-4,6-bis(ethylamino)-s-triazine], alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide], metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide], and cyanazine [2-[[4-chloro-6-(ethylamino)-s-triazin-2-yl]amino]-2-methylpropionitrile].

1978. The experimental design was a randomized complete block with three replications. Corn, 'XL64', was planted May 21. Herbicides were applied 3 and 5½ weeks prior to planting. Fall panicum had begun to germinate 3 weeks prior to planting. All herbicide treatments are listed in Table 1. Table 2 contains the effects of application time and herbicide treatment for selected herbicide treatments. The European rating system was used in 1978, with corresponding percentages noted at the bottom of Tables 1 and 2.

1979. The experimental design was a split-plot with three replications. Corn, 'Pioneer 3184', was planted May 7. Herbicides were applied May 8 prior to fall panicum germination. All herbicide treatments are listed in Table 3. Table 4 lists the main plot and sub-plot effects of selected treatments. A rating system of 0 to 10 was used with 0 meaning no control or injury and 10 meaning total weed control or total crop desiccation.

RESULTS AND DISCUSSION

1978. The best treatment (90% fall panicum control on September 18) was a three-way residual herbicide combination containing atrazine (1.25 lb/A) + simazine (1.25 lb/A) + metolachlor (2 lb/A) with paraquat (0.25 lb/A) applied 3 weeks before planting (Table 1). The standard recommended herbicide combination for no-tillage corn of paraquat (0.25 lb/A) + atrazine (1.25 lb/A) + simazine (1.25 lb/A) when applied 3 weeks before planting corn resulted in about 75% control at that date. Similar control resulted from paraquat (0.25 lb/A) + atrazine (1.25 lb/A) + metolachlor (2 lb/A) applied 3 weeks prior to planting corn. In contrast, paraquat (0.25 lb/A) + atrazine (1.25 lb/A) + alachlor (2 lb/A) applied 3 weeks prior to planting resulted in about 33% control of fall panicum.

Statistically, herbicides applied 3 weeks (late April) prior to planting no-tillage corn resulted in better fall panicum control than applications made 5½ weeks prior to corn planting (Table 2).

1979. At the last weed control rating (July 30), the treatments resulting in 80% or better fall panicum control were paraquat + metolachlor + simazine, paraquat + metolachlor + atrazine + simazine, paraquat + cyanazine (2.5 lb/A) + atrazine + simazine, and paraquat + atrazine (2 lb/A) + simazine (2 lb/A) (Table 3).

Initially, fall panicum control in all main plots was statistically equal (95%) (Table 4). However, differences in fall panicum control between main plots were noted at the May 29 observation (21 days after herbicide application) and this differential increased as the season advanced.

At the last rating (July 30), fall panicum control resulting from combinations (sub-plot effects) containing simazine or atrazine + simazine were significantly better than from combinations containing atrazine (Table 4).

Statistical interactions between main plots and sub-plots were noted for fall panicum control (data not shown). The interactions for June 28 and July 30 indicated that cyanazine or alachlor required the addition of atrazine plus simazine for best fall panicum control. With metolachlor or pendimethalin the addition of simazine was sufficient. However, at the last rating fall panicum control from the best combination using alachlor was less than with the best combinations using either metolachlor or cyanazine.

Herbicide combinations containing pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] caused corn injury (Table 3) and corn stand reductions. The best treatment using pendimethalin resulted in 90% fall panicum control through the end of June but results dropped to 67% during July.

Statistically, there were few differences among treatment yields. All three and four-way herbicide combinations resulted in equal yields (Table 3).

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Table 1: Fall panicum control and corn yield in no-tillage corn planted in corn stalk/weed cover, Queenstown, MD, 1978.

No.	Herbicide Treatment[a]	Rate	Time of Application	June 12 Fall Panicum[b]	July 20 Fall Panicum[b]	Sept 18 Fall Panicum[b]	Oct 8 Yield
		(lb ai/A)	(Weeks Before Planting)				(bu/A)
1.	paraquat (Paraquat CL 2L)	0.25	5.5	9.0	9.0	9.0	0.0
2.	paraquat (Paraquat CL 2L)	0.25	3	8.7	9.0	9.0	0.3
3.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + simazine (Princep 4L)	0.25 1.25 1.25	5.5 5.5 5.5	7.7	8.3	8.3	9.7
4.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + simazine (Princep 4L)	0.25 1.25 1.25	3 3 3	2.0	4.0	6.0	36.9
5.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + metolachlor (Dual 6EC)	0.25 1.25 2.0	5.5 5.5 5.5	5.3	7.7	7.3	59.2
6.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + metolachlor (Dual 6EC)	0.25 1.25 2.0	3 3 3	2.3	4.0	5.7	31.2
7.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + alachlor (Lasso 4EC)	0.25 1.25 2.0	5.5 5.5 5.5	7.0	8.0	8.3	10.3
8.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + alachlor (Lasso 4EC)	0.25 1.25 2.0	3 3 3	4.7	6.7	8.0	19.8
9.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + cyanazine (Bladex 80WP)	0.25 1.25 2.5	5.5 5.5 5.5	4.7	7.3	8.0	32.8
10.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + cyanazine (Bladex 80WP)	0.25 1.25 2.5	3 3 3	4.7	7.7	7.7	5.7
11.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + cyanazine (Bladex 80WP)	0.25 2.0 4.0	3 3 3	1.7	5.0	6.0	47.8
12.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + simazine (Princep 4L) + metolachlor (Dual 6EC)	0.25 1.25 1.25 2.0	5.5 5.5 5.5 5.5	1.7	3.3	4.7	71.9
13.	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + simazine (Princep 4L) + metolachlor (Dual 6EC)	0.25 1.25 1.25 2.0	3 3 3 3	1.0	2.3	4.0	71.6

Table 1: Fall panicum control and corn yield in no-tillage corn planted in corn stalk/weed cover, Queenstown, MD, 1978. (con't.)

No.	Herbicide Treatment[a]	Rate	Time of Application	June 12 Fall Panicum[b]	July 20 Fall Panicum[b]	Sept 18 Fall Panicum[b]	Oct 8 Yield
		(lb ai/A)	(Weeks Before Planting)				(bu/A)
14.	glyphosate (Roundup 4L) + atrazine (AAtrex 4L) + simazine (Princep 4L)	1.0 1.25 1.25	5.5 5.5 5.5	8.0	8.0	7.3	41.2
15.	glyphosate (Roundup 4L) + atrazine (AAtrex 80WP) + simazine (Princep 4L)	1.0 1.25 1.25	3 3 3	4.7	6.7	6.7	43.4
16.	glyphosate (Roundup 4L) + atrazine (AAtrex 4L) + alachlor (Lasso 4E)	1.0 1.25 2.0	3 3 3	4.3	6.7	7.0	18.3
17.	glyphosate (Roundup 4L) + atrazine (AAtrex 4L) + alachlor (Lasso 4EC)	1.0 1.25 2.0	5.5 5.5 5.5	6.7	8.0	8.7	12.1
18.	atrazine (AAtrex 4L) + simazine (Princep 4L)	1.25 1.25	5.5 5.5	6.7	7.7	7.7	12.8
19.	atrazine (AAtrex 4L) + simazine (Princep 4L) + metolachlor (Dual 6EC)	1.25 1.25 2.0	5.5 5.5 5.5	1.0	2.0	3.7	56.9
20.	atrazine (AAtrex 4L) + metolachlor (Dual 6EC)	1.25 2.0	5.5 5.5	3.7	6.0	6.3	42.5
21.	atrazine (AAtrex 4L) + alachlor (Lasso 4EC)	1.25 2.0	5.5 5.5	7.0	8.3	8.3	9.7
22.	atrazine (AAtrex 4L) + cyanazine (Bladex 80WP)	1.25 2.5	5.5 5.5	6.0	7.7	7.3	36.9
23.	simazine (Princep 4L) + paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L)	1.25 0.25 1.25	5.5 3 3	6.3	7.7	8.3	10.3
24.	simazine (Princep 4L) + paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L)	1.25 0.25 1.25	5.5 3 3	1.3	2.3	3.3	41.4
	Bayes $LSD_{.05}$			1.58	1.26	1.24	36.55

[a] All paraquat treatments include Ortho X-77 at 8 oz/100 gal.

[b] European rating used: for crop injury 1=0%, 2=2.5%, 3=5%, 4=10%, 5=15%, 6=25%, 7=33%, 8=66%, 9=100%; for weed control 1=100%, 2=97.5%, 3=95%, 4=90%, 5=85%, 6=75%, 7=66%, 8=33%, 9=0%.

Table 2: Fall panicum control and corn yield in no-tillage corn planted in corn stalk / weed cover, comparison of application times and comparison of herbicide treatments, Queenstown, MD, 1978.

Treatment Number	Herbicide[a]	Rate	Time of Application	June 12 Fall Panicum[b]	July 20 Fall Panicum[b]	September 18 Fall Panicum[b]	October 8 Yield
		(lb ai/A)	(Weeks Before Planting)				(bu/A)
COMPARISON OF APPLICATION TIMES							
1,3,5,7,9,12,14,17	-	-	5.5	6.3	7.5	7.7	29.6
2,4,6,8,10,13,15,16	-	-	3	4.0	5.9	6.8	28.4
Bayes $LSD_{.05}$				0.48	0.52	0.29	N.S.
COMPARISON OF HERBICIDE TREATMENT							
1,2	paraquat (Paraquat CL 2L)	0.25	-	8.8	9.0	9.0	0.1
3,4	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + simazine (Princep 4L)	0.25 1.25 1.25	- - -	4.8	6.2	7.2	23.3
5,6	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + metolachlor (Dual 6EC)	0.25 1.25 2.0	- - -	3.8	5.8	6.5	45.2
7,8	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + alachlor (Lasso 4EC)	0.25 1.25 2.0	- - -	5.8	7.3	8.2	15.0
9,10	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + cyanazine (Bladex 80WP)	0.25 1.25 2.5	- - -	4.7	7.5	7.8	19.3
12,13	paraquat (Paraquat CL 2L) + atrazine (AAtrex 4L) + simazine (Princep 4L) + metolachlor (Dual 6EC)	0.25 1.25 1.25 2.0	- - - -	1.3	2.8	4.3	71.7
14,15	glyphosate (Roundup 4L) + atrazine (AAtrex 4L) + simazine (Princep 4L)	1.0 1.25 1.25	- - -	6.3	7.3	7.0	42.3
17,16	glyphosate (Roundup 4L) + atrazine (AAtrex 4L) + alachlor (Lasso 4EC)	1.0 1.25 2.0	- - -	5.5	7.3	7.8	15.2
Bayes $LSD_{.05}$				0.97	1.06	0.57	21.45

[a] All paraquat treatments include Ortho X-77 at 8 oz/100 gal.

[b] European rating used: for crop injury 1=0%, 2=2.5%, 3=5%, 4=10%, 5=15%, 6=25%, 7=33%, 8=66%, 9=100%; for weed control 1=100%, 2=97.5%, 3=95%, 4=90%, 5=85%, 6=75%, 7=66%, 8=33%, 9=0%.

Table 3: Fall panicum control and corn yield in no-tillage corn, Queenstown, MD, 1979.

			May 21		May 29		June 6		June 13	June 28	July 30	Oct. 17
No.	Herbicide Treatment [a]	Rate	Fall Panicum [b]	Injury [b]	Fall Panicum [b]	Injury [b]	Fall Panicum [b]	Injury [b]	Fall Panicum [b]	Fall Panicum [b]	Fall Panicum [b]	Yield
		(lb ai/A)										(bu/A)
1.	paraquat (Paraquat CL 2L)	0.25	0.0	0.0	5.0	0.0	3.0	0.0	3.4	1.3	0.3	6.4
2.	paraquat (Paraquat CL 2L) + atrazine (Aatrex 4L)	0.25 1.25	0.6	0.0	5.4	0.0	5.0	0.0	5.0	1.3	1.0	17.2
3.	paraquat (Paraquat CL 2L) + simazine (Princep 80WP)	0.25 1.25	3.4	0.0	8.6	0.0	4.4	0.0	5.4	6.3	5.3	83.4
4.	paraquat (Paraquat CL 2L) + atrazine (Aatrex 4L) + simazine (Princep 80WP)	0.25 1.25 1.25	4.6	0.0	9.4	0.0	6.6	0.0	6.6	7.0	7.0	90.9
5.	paraquat (Paraquat CL 2L) + metolachlor (Dual 6EC)	0.25 2.0	6.6	0.0	9.0	0.0	6.4	0.0	6.4	5.7	5.0	86.5
6.	paraquat (Paraquat CL 2L) + metolachlor (Dual 6EC) + atrazine (Aatrex 4L)	0.25 2.0 1.25	10.0	0.0	6.6	0.0	9.0	0.0	8.0	6.0	5.3	98.4
7.	paraquat (Paraquat CL 2L) + metolachlor (Dual 6EC) + simazine (Princep 80 WP)	0.25 2.0 1.25	9.4	0.0	6.6	0.0	10.0	0.0	10.0	9.0	8.7	105.5
8.	paraquat (Paraquat CL 2L) + metolachlor (Dual 6EC) + atrazine (Aatrex 4L) + simazine (Princep 80WP)	0.25 2.0 1.25 1.25	10.0	0.0	10.0	0.0	9.4	0.0	9.0	8.7	8.0	94.4
9.	paraquat (Paraquat CL 2L) + alachlor (Lasso 4EC)	0.25 2.0	10.0	0.0	10.0	0.0	6.4	0.0	5.6	5.0	4.3	68.3
10.	paraquat (Paraquat CL 2L) + alachlor (Lasso 4EC) + atrazine (Aatrex 4L)	0.25 2.0 1.25	10.0	0.0	10.0	0.0	7.0	0.0	6.4	5.0	4.7	78.7
11.	paraquat (Paraquat CL 2L) + alachlor (Lasso 4EC) + simazine (Princep 80WP)	0.25 2.0 1.25	10.0	0.0	10.0	0.0	7.6	0.4	7.0	6.3	6.7	107.9
12.	paraquat (Paraquat CL 2L) + alachlor (Lasso 4EC) + atrazine (Aatrex 4L) + simazine (Princep 80WP)	0.25 2.0 1.25 1.25	10.0	0.0	10.0	0.0	8.4	0.0	7.6	7.3	7.3	92.7
13.	paraquat (Paraquat CL 2L) + cyanazine (Bladex 80WP)	0.25 2.5	9.6	0.0	10.0	0.0	3.6	0.4	4.6	3.7	4.7	89.2
14.	paraquat (Paraquat CL 2L) + cyanazine (Bladex 80WP) + atrazine (Aatrex 4L)	0.25 2.5 1.25	10.0	0.0	9.6	0.0	5.6	0.0	6.0	6.0	5.0	71.4

Table 3: Fall panicum control and corn yield in no-tillage corn, Queenstown, MD, 1979. (con't.)

No.	Herbicide Treatment [a]	Rate	May 21 Fall Panicum [b]	May 21 Injury [b]	May 29 Fall Panicum [b]	May 29 Injury [b]	June 6 Fall Panicum [b]	June 6 Injury [b]	June 13 Fall Panicum [b]	June 28 Fall Panicum [b]	July 30 Fall Panicum [b]	Oct. 17 Yield
		(lb ai/A)										(bu/A)
15.	paraquat (Paraquat CL 2L) + cyanazine (Bladex 80WP) + simazine (Princep 80WP)	0.25 2.5 1.25	10.0	0.0	10.0	0.0	6.0	0.4	8.4	7.7	7.3	79.9
16.	paraquat (Paraquat CL 2L) + cyanazine (Bladex 80WP) + atrazine (Aatrex 4L) + simazine (Princep 80WP)	0.25 2.5 1.25 1.25	10.0	0.0	10.0	0.0	7.6	0.4	8.6	8.7	8.0	98.2
17.	paraquat (Paraquat CL 2L) + pendimethalin (Prowl 4EC)	0.25 1.5	9.0	1.4	9.6	0.6	9.0	0.6	8.4	6.7	4.3	91.6
18.	paraquat (Paraquat CL 2L) + pendimethalin (Prowl 4EC) + atrazine (Aatrex 4L)	0.25 1.5 1.25	9.4	2.0	9.6	2.0	9.6	1.0	9.6	7.7	5.3	88.7
19.	paraquat (Paraquat CL 2L) + pendimethalin (Prowl 4EC) + simazine (Princep 80WP)	0.25 1.5 1.25	10.0	2.4	10.0	2.0	9.6	1.4	10.0	9.0	6.7	96.0
20.	paraquat (Paraquat CL 2L) + pendimethalin (Prowl 4EC) + atrazine (Aatrex 4L) + simazine (Princep 80WP)	0.25 1.5 1.25 1.25	9.6	1.6	10.0	1.4	10.0	1.4	10.0	8.3	6.3	92.5
21.	paraquat (Paraquat CL 2L) + metolachlor (Dual 6EC) + simazine (Princep 80WP)	0.25 2.0 2.0	10.0	0.0	10.0	0.0	9.4	0.0	9.6	9.3	7.7	113.0
22.	paraquat (Paraquat CL 2L) + metolachlor (Dual 6EC) + atrazine (Aatrex 4L)	0.25 2.0 2.0	10.0	0.0	10.0	0.0	9.4	0.0	8.6	7.7	6.3	89.6
23.	paraquat (Paraquat CL 2L) + atrazine (Aatrex 4L) + simazine (Princep 80WP)	0.25 2.0 2.0	10.0	0.0	9.6	0.0	7.4	0.4	8.0	9.0	8.0	91.1
24.	paraquat (Paraquat CL 2L) + metolachlor (Dual 6EC) + atrazine (Aatrex 4L) + simazine (Princep 80WP)	0.25 2.0 1.0 1.0	10.0	0.0	10.0	0.0	8.4	0.0	9.0	8.3	6.7	94.4
	Bayes $LSD_{.05}$		1.38	0.67	3.45	1.01	2.00	0.99	1.87	1.41	1.51	27.33

[a] All paraquat treatments include Ortho X-77 at 8 oz / 100 gal.

[b] Rating scale: 0 = 0% crop injury and weed control; 10 = 100% crop injury and weed control.

Table 4: Fall panicum control and corn yield in no-tillage corn, split plot analysis, Queenstown, MD, 1979.

No.	Herbicide [a]	Rate (lb ai/A)	May 21 Fall Panicum [b]	May 21 Injury [b]	May 29 Fall Panicum [b]	May 29 Injury [b]	June 6 Fall Panicum [b]	June 6 Injury	June 13 Fall Panicum [b]	June 28 Fall Panicum [b]	July 30 Fall Panicum [b]	Oct.17 Yield (bu/A)
Main Plot Effects												
1-4	control	-	2.2	0	7.1	0	4.8	0	5.1	4.0	3.4	49.5
5-8	metolachlor (Dual 6EC)	2.0	9.0	0	8.1	0	8.7	0	8.3	7.3	6.8	96.2
9-12	alachlor (Lasso 4EC)	2.0	10.0	0	10.0	0	7.3	0.1	6.7	5.9	5.8	86.9
13-16	cyanazine (Bladex 80WP)	2.5	9.9	0	9.9	0	5.8	0.2	6.9	6.5	6.2	84.7
17-20	pendimethalin (Prowl 4EC)	1.5	9.5	1.8	9.8	1.5	9.6	1.1	6.5	7.9	5.7	92.2
	Bayes $LSD_{.05}$		0.89	0.49	1.22	0.58	0.85	0.59	0.67	0.82	0.78	13.59
Sub Plot Effects												
1,5,9,13,17	control	-	7.1	0.3	8.7	0.1	5.7	0.2	5.7	4.5	3.7	68.4
2,6,10,14,18	atrazine (Aatrex 4L)	1.25	8.0	0.4	8.3	0.4	7.3	0.2	7.0	5.2	4.3	70.8
3,7,11,15,19	simazine (Princep 80WP)	1.25	8.5	0.5	9.1	0.4	7.5	0.4	8.1	7.7	6.9	94.5
4,8,12,16,20	atrazine (Aatrex 4L) + simazine (Princep 80WP)	1.25 1.25	8.9	0.3	9.9	0.3	8.4	0.3	8.4	8.0	7.3	93.7
	Bayes $LSD_{.05}$		0.66	N.S.	N.S.	N.S.	0.99	N.S.	0.92	0.61	0.64	11.56

[a] All treatments include 0.25 lb a.i./A paraquat (Paraquat CL 2L) plus Ortho X-77 at 8 oz/100 gal.

[b] Rating scale: 0 = 0% crop injury and weed control; 10 = 100% crop injury and weed control.

EFFECT OF PLANTING EQUIPMENT AND TIME OF APPLICATION ON INJURY TO NO-TILLAGE CORN FROM PENDIMETHALIN-TRIAZINE MIXTURES

N. L. Hartwig[1/]

ABSTRACT

Pendimethalin + atrazine at 2 + 1.5 lb ai/A were applied at different times from 33 days before to 17 days after planting at about two week intervals. Grass control was good for all treatments and there were no differences due to timing. This treatment did cause a significant reduction in corn stand when applied just before planting but did not significantly affect corn yields.

Planting depth had no effect on corn stand or yield except for pendimethalin + atrazine applied just before planting with a 2 inch fluted coulter with seed press wheel. Corn stand from corn planted at 1 inch was significantly reduced compared to corn planted at 2 inches for this treatment.

Type of coulter used for planting had no effect on susceptibility of corn to stand or yield reductions. Planting without a seed press wheel did result in significant stand reductions regardless of type of coulter used. There were no significant interactions between herbicide treatments and planting equipment.

Preemergence treatments of atrazine + simazine gave grass control equal to the other herbicide treatments in spite of a lack of rainfall for the month following application.

Post emergence treatments of cyanazine + pendimethalin and cyanazine + atrazine gave good grass control without significant corn injury.

INTRODUCTION

Annual grasses including fall panicum (*Panicum dichotomiflorum* Michx.), giant foxtail (*Setaria faberii* Herrm.) and others continue to be a problem in no-tillage corn (*Zea mays* L.) and especially where crop residues are left on the surface. Pendimethalin [N-(1-ethylpropyl)-3, 4-dimethyl-2, 6-dinitrobenzenamine] has given good long lasting control in such situations but there has been problems of corn injury in the form of stand reductions and reduced yields (1). Past research has indicated that pendimethalin can be safely used three or more weeks before planting with little loss in weed control activity. The question still remains, is it possible to plant no-tillage corn so that it enjoys the safety of conventionally planted corn

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from pendimethalin injury? The purpose of this trial was (1) to determine if less soil disturbance and planting into a narrower slit might reduce the exposure of the germinating corn seed to pendimethalin, (2) varying seeding depth to see if deeper planting and perhaps more seed coverage would increase the safety of pendimethalin and (3) to see if herbicide application at different times in relation to corn planting will reduce injury.

MATERIALS AND METHODS

This trial was conducted in 1977 on a Hagerstown silt loam soil (Typic Hapludult) with about 10% sand, 67% silt, 20% clay, 2.5% organic matter and a pH of 6.6. Pendimethalin + atrazine mixtures were applied to an untilled area that had been allowed to grow up to fall panicum for two years before this trial. These mixtures were applied at approximately two week intervals starting 33 days before planting to 17 days after planting. All treatments were applied with a small plot sprayer mounted on a Cub tractor with 20 gal/A of water and 8001 low pressure nozzles at 32 psi. Fall panicum was just beginning to germinate on May 10. Corn was in the four leaf stage and fall panicum 2 to 3 leaf stage on May 27 (+ 17 day treatments).

'Pioneer 3780' (100 day) corn was planted on May 10 in 30 inch rows with a 6 row Allis Chalmers no-tillage corn planter. Treatments included corn planted at 2 depths, 1 and 2 inches. Different combinations of coulters and seed press wheel were used for 5 of the 6 rows in each plot. We used a ripple coulter with and without a seed press wheel, 1 inch fluted coulter with a seed press wheel, and 2 inch fluted coulter with and without a seed press wheel. A ribbed packer wheel was used for all 6 rows.

Fertilizer was applied in the row at 200 lb/A of 10-30-10 and 400 lb/A of urea was broadcast after planting. The experiment was laid out as a split plot with three replications. Each plot was 6 rows of corn in width and 20 ft. long. All corn stand, height and yield data were recorded for each row separately. Weed yields were determined by harvesting a .5 m^2 area at one place in each plot. The major weed species were fall panicum and giant foxtail.

The weather at planting time was very dry, 0.2 inch of rainfall between May 8 and June 8, which had a big effect on the activity of herbicides.

RESULTS AND DISCUSSION

Annual grass control was not significantly different among any of the herbicide treatments (Table 1). This was probably due to an uneven stand of weeds and generally reduced activity of all the herbicides because of the extremely dry conditions immediately following corn planting.

Seeding depth had no effect on corn stand or yield (Tables 1, 2 and 3) with one notable exception. Corn stand was significantly reduced when planted at 1 inch vs. 2 inches for row 1, 2 inch fluted coulter with press wheel, when treated with pendimethalin + atrazine immediately before planting (-0 day treatment). Treatment at this time was the most injurious to corn and pendimethalin generally reduced corn stands regardless of depth of planting

(Table 2). The herbicide is probably being incorporated by the fluted or ripple coulter and when applied immediately prior to planting, the herbicide has not had a chance to be adsorbed to clay and organic matter in the soil, making it more toxic than treatments applied several weeks in advance of planting. In a more normal year with more rainfall, depth of planting and corn seed coverage should be more important and the benefits to safety from pendemethalin injury would have been more obvious.

Even in this spring of low rainfall, there was a second 2 inch fluted and a 1 inch fluted coulter with seed press wheel (rows 2 and 4) that did not show any significant stand reduction from atrazine + pendimethalin applied just before planting. I feel this was due to chance and lack of rainfall rather than a real advantage in using these coulters to protect the corn seedling from pendimethalin.

The absolute necessity for a seed press wheel is shown by the row means in Table 2. The 2 inch fluted and ripple coulter without the seed press wheel (rows 3 and 6) resulted in an 19 to 22% corn stand reduction compared to the same coulters with a seed press wheel when averaged over all 18 herbicide treatments.

There were no significant differences in corn yields between any of the herbicide treatments or any of the methods of planting (rows 1 to 6) in spite of some significant differences in corn stand (Table 3). Lack of rainfall following planting reduced the chances of significant herbicide injury and corn was able to compensate for differences in stand.

Atrazine and simazine applied preemergence gave grass control equal to other treatments in spite of the lack of rainfall. Post treatments of cyanazine + Pendimethalin and cyanazine + atrazine when grasses were in the 2 to 4 leaf stage gave good control with no lasting injury to corn.

The addition of paraquat to pendimethalin + atrazine applied preemergence contributed nothing to the overall grass control and had no effect on corn stand or yield.

ACKNOWLEDGMENTS

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Table 1. Fall panicum yield, corn stand and yield following various herbicide treatments applied to corn planted at 1 and 2 inch depths.

Herbicide Treatment	Rate	Appl. Time to Planting	Seeding Depth	F. Pan. Yield	Corn Stand	Corn Yield
	lb ai/A	Days	in	lb/A[a/]	plants/A	bu/A[b/]
pendimethalin + atrazine	2 + 1.5	- 33	1	1200 a[c/]	26600 ab	141 a
		- 33	2	600 a	28200 a	149 a
pendimethalin + atrazine	2 + 1.5	- 19	1	1600 a	24700 abc	149 a
		- 19	2	1300 a	24000 abc	149 a
pendimethalin + atrazine	2 + 1.5	- 11	1	1100 a	27000 ab	152 a
		- 11	2	2100 a	22500 bc	127 a
pendimethalin + atrazine	2 + 1.5	- 0	1	2400 a	20100 c	128 a
		- 0	2	2700 a	20700 c	134 a
pendimethalin + atrazine	2 + 1.5	+ 1	1	600 a	27400 ab	142 a
		+ 1	2	600 a	25400 abc	143 a
pendimethalin + atrazine	2 + 1.5	+ 17	1	1300 a	25400 abc	136 a
		+ 17	2	500 a	26800 ab	144 a
pendimethalin + cyanazine	2 + 2	+ 17	1	400 a	27700 ab	150 a
		+ 17	2	200 a	24100 abc	141 a
atr + cyanazine	1.5 + 2	+ 17	1	900 a	25500 abc	141 a
pendimethalin + atrazine + paraquat + X-77	2 + 1.5 + .25	+ 1	1	800 a	24200 abc	141 a
		+ 1	2	400 a	25000 abc	141 a
atr + simazine	1 + 1.5	+ 1	1	1300 a	29500 a	142 a

[a/]Dry matter yields

[b/]Corn yields include 15.5% moisture

[c/]Means followed by the same letter are not significantly different according to Duncans Multiple Range test.

Table 2. Corn stand with different coulters, with and without a seed press wheel following various herbicide treatments applied to corn planted at 1 and 2 inch depths.

Herbicide Treatment	Rate	Appl. Time to Planting	Seeding Depth	Corn Stand by Row[a]					
				1	2	3	4	5	6
	lb ai/a	Days	in	plants/A					
pendimethalin + atrazine	2 + 1.5	- 33	1	28200 abcd[b]	33600 a	14800 ab	30400 a	31000 a	32200 a
		- 33	2	31000 abc	23300 a	23900 ab	30100 a	31100 a	26400 abc
pendimethalin + atrazine	2 + 1.5	- 18	1	30200 abcd	23400 a	22800 ab	30500 a	24400 abc	19600 abc
		- 18	2	30800 abc	21500 a	14500 ab	28700 a	25300 abc	23600 abc
pendimethalin + atrazine	2 + 1.5	- 11	1	28100 abcd	27000 a	17700 ab	28400 a	31100 a	28500 ab
		- 11	2	29800 abcd	20700 a	17700 ab	26300 a	27600 abc	17500 c
pendimethalin + atrazine	2 + 1.5	- 0	1	23400 d	22600 a	16600 ab	24800 a	19700 c	20800 abc
		- 0	2	30300 abc	23700 a	12100 b	27000 a	20700 bc	19100 c
pendimethalin + atrazine	2 + 1.5	+ 1	1	28600 abcd	27900 a	26200 a	31600 a	28200 abc	18200 bc
		+ 1	2	27200 abcd	24100 a	23600 ab	29300 a	27000 abc	17300 bc
pendimethalin + atrazine	2 + 1.5	+ 17	1	27900 abcd	23700 a	19500 ab	31400 a	27700 abc	22700 abc
		+ 17	2	32400 ab	21700 a	17800 ab	30100 a	29500 abc	25100 abc
pendimethalin + cyanazine	2 + 2	+ 17	1	30300 abc	24700 a	21800 ab	31200 a	27900 abc	25600 abc
		+ 17	2	24100 cd	24000 a	16500 ab	30200 a	25100 abc	18900 abc
atr + cyanazine	1.5 + 2	+ 17	1	25300 bcd	24900 a	16400 ab	26800 a	30600 ab	26600 abc
pendimethalin + atrazine + paraquat + X-77	2 + 1.5 + .25	+ 1	1	29400 abcd	20700 a	16400 ab	27300 a	27000 abc	21600 abc
		+ 1	2	28800 abcd	23700 a	20100 ab	28800 a	28800 abc	15100 c
atr + simazine	1 + 1.5	+ 1	1	34300 a	30300 a	27900 a	28500 a	30000 abc	26500 abc
			Row Mean	28900	24500	19250	29000	27400	22500

[a]

Row	Coulter	7 in. Seed Press Wheel	Mean Corn Std.
1	2 in. fluted	Yes	28900 a
2	2 in. fluted	Yes	24900 bc
3	2 in fluted	No	19250 d
4	1 in fluted	Yes	29000 a
5	ripple	Yes	27400 ab
6	ripple	No	22500 c

[b] Means followed by the same letter are not significantly different at the 5% level according to Duncans Multiple Range test.

Table 3. Corn yields with different coulters with and without a seed press wheel following various herbicide treatments applied to corn planted at 1 and 2 inch depths.

Herbicide Treatment		Appl. Time to Planting	Seeding Depth	Corn Yield for Row [a/]					
				1	2	3	4	5	6
	lb ai/a	Days	in	bu/A[b/]					
pendimethalin + atrazine	2 + 1.5	- 33	1	147 a[c/]	184 a	87 a	156 a	170 a	166 a
		- 33	2	175 a	138 a	127 a	147 a	150 a	135 a
pendimethalin + atrazine	2 + 1.5	- 19	1	164 a	150 a	134 a	152 a	170 a	136 a
		- 19	2	178 a	128 a	102 a	178 a	149 a	160 a
pendimethalin + atrazine	2 + 1.5	- 11	1	156 a	152 a	118 a	154 a	162 a	165 a
		- 11	2	161 a	134 a	106 a	144 a	142 a	104 a
pendimethalin + atrazine	2 + 1.5	- 0	1	138 a	145 a	118 a	147 a	127 a	137 a
		- 0	2	177 a	170 a	102 a	158 a	140 a	107 a
pendimethalin + atrazine	2 + 1.5	+ 1	1	149 a	143 a	136 a	146 a	153 a	104 a
		+ 1	2	152 a	144 a	134 a	149 a	156 a	100 a
pendimethalin + atrazine	2 + 1.5	+ 17	1	147 a	135 a	120 a	139 a	144 a	132 a
		+ 17	2	165 a	131 a	104 a	154 a	151 a	134 a
pendimethalin + cyanazine	2 + 2	+ 17	1	156 a	153 a	126 a	161 a	158 a	118 a
		+ 17	2	126 a	147 a	120 a	154 a	150 a	112 a
atr + cyanazine	1.5 + 2	+ 17	1	138 a	146 a	83 a	147 a	160 a	157 a
pendimethalin + atrazine + paraquat + X-77	2 + 1.5 + .25	+ 1	1	162 a	133 a	104 a	143 a	157 a	133 a
		+ 1	2	153 a	141 a	123 a	146 a	153 a	102 a
atr + simazine	1 + 1.5	+ 1	1	150 a	153 a	136 a	132 a	148 a	138 a
			Row Mean	155	146	116	150	152	130

[a/]

Row		7 in. Seed Press Wheel	Mean Corn Yield
1	2 in. fluted	Yes	155 a
2	2 in. fluted	Yes	146 a
3	2 in. fluted	No	116 b
4	1 in. fluted	Yes	150 a
5	ripple	Yes	152 a
6	ripple	No	130 b

[b/]Corn yields are an average of 3 replications and include 15.5% moisture.

[c/]Means followed by the same letter are not significantly different at the 5% level according to Duncans Multiple Range test.

INTERACTION BETWEEN TRIAZINE AND PENDIMETHALIN ACTIVITY ON VELVETLEAF

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ABSTRACT

Greenhouse studies showed that atrazine, cyanazine, and pendimethalin gave excellent preemergence control of velvetleaf when used alone or when pendimethalin was combined with either atrazine or cyanazine. Postemergence control with these materials varied dependent on timing. Atrazine gave good control up until the fourth leaf stage; cyanazine gave good control through the sixth leaf stage. Pendimethalin combined with atrazine caused a reduction in activity against velvetleaf at the fourth leaf stage and the combination did not produce the same control as atrazine alone at the fourth leaf stage. Pendimethalin combined with cyanazine also caused a reduction in activity from cyanazine used alone at the sixth leaf stage.

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ALFALFA AND DANDELION CONTROL FOR NO-TILLAGE CORN IN AN OLD ALFALFA SOD

N. L. Hartwig[1/]

ABSTRACT

Both fall (November 14, 1977) and spring (May 3, 1978) treatments were applied to a nine year old alfalfa (*Medicago sativa* L.) stand infested with dandelion (*Taraxacum officinale* Weber), yellow nutsedge (*Cyperus esculentus* L.) and bluegrass (*Poa pratensis* L.). Various annual grasses became a problem in some treatments during the growing season, including yellow foxtail (*Setaria glauca* (L.) Beauv.), witchgrass (*Panicum capillare* L.) and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv.). 'Pioneer 3780' corn (*Zea mays* L.) was planted by no-tillage on May 10, 1978.

Fall applications of atrazine + pendimethalin at 2 + 2 lb ai/A alone or with 2,4-D + dicamba never gave more than 42% alfalfa control which severely reduced corn yields. Atrazine + simazine at 2 + 2 lb ai/A alone or with 2,4-D + dicamba increased alfalfa control to about 75% but annual grasses were a severe problem later in the season and corn yields were significantly reduced. In both cases, if the 2,4-D + dicamba in the tank mix was applied in the spring, alfalfa and dandelion control reached 96 to 98% and corn yields were not reduced in spite of marginal yellow nutsedge and annual grass control.

Spring applications of atrazine + simazine at 1.5 + 1.5 lb ai/A with 2,4-D + dicamba at 1/3 to 1/6 lb ai/A greatly improved alfalfa and other broadleaved weed control and gave better yellow nutsedge and annual grass control than the fall treatments. The addition of a surfactant such as Wex or X-77 improved the control slightly but not significantly. The addition of paraquat to the mixture didn't contribute anything to weed control and corn yields were all about the same for these treatments, 100 to 130 bu/A.

Spring applications of atrazine + alachlor at 1.5 + 2.5 lb ai/A with 2,4-D + dicamba at 1/3 + 1/6 lb ai/A were a little weaker on alfalfa and dandelion than the atrazine + simazine treatments. When glyphosate at 1 lb ai/A was added to this mixture early spring weed control was improved and corn yields for this treatment was the highest at 143 bu/A.

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ENERGY CONSERVATION THROUGH REDUCED TILLAGE

W. H. Mitchell and T. H. Williams [1/]

ABSTRACT

Horsepower, fuel and labor requirements for corn production, using moldboard plow, chisel plow, and no-tillage, were studied on an Evesboro loamy sand at Georgetown, Delaware. Related field studies involved a 3-year comparison of several no-tillage cover crops and rates of broadcast nitrogen. Results of these tests were combined for a systems analysis of the role of various tillage programs in energy conservation.

Substituting the chisel plow for the moldboard plow resulted in a 20% reduction in fuel consumption for tillage operations through the planting of corn. In contrast, the no-tillage system consumed only 18% as much fuel as conventional tillage using the moldboard plow. When considering a broader spectrum of energy in-puts the dominant energy role was played by nitrogen fertilizer. The combined pesticides used in no-tillage contributed only 15% to the energy in-puts. Combining no-tillage with a leguminous cover crop raised the energy in-put out-put ratio nearly 300% when compared to conventional tillage using the moldboard plow.

INTRODUCTION

The productivity of U. S. agriculture is unquestioned although it seems to some that it has been achieved through excessive use of energy from fossil fuels. This position is held even though only 2.5% of the nation's energy consumption is by agriculture (1). This is a modest share considering how it has been used to ease the burden of field work for farmers and provide an abundant supply of high quality food for everyone.

It would be short sighted to limit agricultural production by placing restraints on fuel supplies and there is no evidence that farmers need additional incentives to conserve. They will respond to the profit motive and conserve because it is good business to do so. The extent to which energy conservation can be achieved by modifying tillage systems is of considerable interest to farmers and has been the focus of recent Delaware studies.

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MATERIALS AND METHODS

The research plots were located on Evesboro loamy sand in Southern Delaware. This is a droughty soil subject to severe wind erosion. In terms of power requirements for tillage operations it would be considered a low draft soil. Separate agronomic and engineering studies were conducted and the results combined for a systems analysis of the role of various tillage systems in energy conservation. Energy values for herbicides, fertilizers, cultivation, and cover crops were obtained from published sources (5, 6).

Horsepower and fuel consumption measurements were made by calibrating a vacuum gage connected to the tractor intake manifold with a PTO dynamometer (2). Field measurements of hosepower and fuel use for a particular operation were then determined by noting the average inches of vacuum under load and referring to the calibration curve obtained. Speed was determined by timing the machines over measured distances. A drawbar dynamometer was used to measure draft on pull type implements. Since the experimental plots were small in relation to actual fields, field efficiencies were estimated.

Following is a description of some of the machines used.

Tractor: IH 656 gas, gear drive

Plows: 3 - 14" trail type moldboard plow
7 chisels on 12" spacing chisel plow

Planter: 3 row Allis Chalmers 600 planter on 30" row spacing with dry fertilizer and insecticide attachments and no-til fluted coulters.

Since the implements were not selected to match the tractors for maximum efficiency, the data reported are conservative. This is particularly true for the planter because it is smaller than those in general use. This causes the energy, fuel and labor requirement figures to be higher than what might normally be expected. The most important consideration, however, is the relationship of energy, fuel and labor use between the different production systems.

Eight cover crop treatments for production of field corn were compared over a 3-year period (3) but only spring oats (Avena sativa L.), hairy vetch (Vicia villosa Roth) and the control, or no cover treatment, will be discussed in this report. The cover crops were planted on a prepared seedbed following the yearly corn harvest. They were topdressed annually in May with ammonium nitrate to deliver 0, 50, and 100 pounds of nitrogen per acre. Immediately following the nitrogen topdressing, cover crops were killed and subsequent weed control achieved by use of Paraquat (1, 1'-dimethyl-4, 4'-bipyridinium ion) simazine [2-chloro-4, 6-bis (ethylamino)-S-(triazine)], atrazine (2-chloro-4-(ethylamino)-6-(isopropylamino)-S-(triazine), and 2,4-D (2,4-dichlorophenoxy) acetic acid at 0.5, 1.25, 1.25, and 0.5 Lbs. a.i./a, respectively. Toxaphene was added to the tank mixture for insect control and application was made with a boom type sprayer delivering 50 gpa at 30 psi. The corn was machine harvested and yields expressed as shelled corn at 15½ moisture. Statistical design involved a split plot with 3 replications.

RESULTS AND DISCUSSION

The moldboard plow tillage system was the most energy intensive of the systems tested (Table 1). Substituting the chisel plow for the moldboard plow reduced the hp hrs/a by 24%, gasoline by 20% and man hrs. of labor by 15%. The most striking reduction in energy, however, was achieved by the no-tillage system. It consumed only 18% as much fuel as did the moldboard plow system.

The equivalent of 6.1 gallons of gas per acre for tillage was saved by changing to no-tillage but the change involved the use of about 1.8 gallons of gas equivalent for pesticides (Table 2). This is based on the assumption (5) that 1 pound a.i. of herbicides including production and processing involves 11,000 kcal (0.30 gal. gas). There was a net gain of 4.3 gallons but when considering the total of the major energy inputs it represented an energy savings of only 13.4%. The modest reduction in energy resulting from the change to no-tillage was not the result of substituting pesticides for tillage, since pesticides contributed only 15% to the energy total, but to the dominant energy role played by nitrogen fertilizer.

The addition of biological nitrogen through the use of a vetch cover crop made it possible to greatly reduce the largest energy input-synthetic nitrogen. By substituting vetch and reducing the synthetic nitrogen input from 100 to 20 pounds per acre the total energy requirement for no-tillage was dropped to the equivalent of 12.9 gallons of gas or about 40% of that needed for the conventional moldboard plow system. Energy savings through the use of leguminous cover crops such as vetch are not limited to no-tillage systems although the reduction in tillage operations usually results in more growing time for the cover crop. Since 80 to 90% of the nitrogen contained in a vetch cover crop is located in the top growth, nitrogen recovery is directly related to the amount of growth produced before the vegetation is killed with herbicides. Substitution of biological nitrogen for fertilizer nitrogen will sharply reduce the fossil energy input but if the cover crop biomass is small it is conceivable that grain yields will be reduced unless supplemental nitrogen is applied.

The results of a 3-year cover crop-nitrogen study at Georgetown showed that cover crops can be an important aspect of a no-tillage system (Table 3). Spring oats increased corn yields above the control at all levels of applied nitrogen. This cover is normally killed by winter temperatures. Therefore, it must be planted early in order to develop a good ground cover during the fall months. Even more striking was the spring oats-vetch mixture. It produced an average of 18.9 bushels more corn than the control which received 100 pounds of nitrogen.

The energy efficiency of no-tillage was clearly higher than that of conventional tillage (Table 4). The energy input-output ratio of 7.7 with conventional tillage was raised to 22.6 for the no-tillage-vetch system. Additional nitrogen did not increase grain yields but raised the energy input by 800,000 kcal. This reduced the efficiency ratio to 8.1 or essentially the same as for conventional tillage. It is obvious that energy savings can be achieved by substitutions in energy inputs but care must be taken to avoid yield losses in the interest of energy conservation. Fortunately, those practices which are most likely to increase net profit are also most likely to save energy.

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TABLE 1. Energy, fuel, and labor requirements for corn production with tillage systems on Evesboro loamy sand.

Tillage System	Energy hp hrs/a	Fuel gal. gas/a	Labor man hrs/a
Moldboard plow + disk + springtooth + plant	67.8	5.6	1.42
Chisel plow + disk + springtooth + plant	51.6	4.5	1.21
No-tillage plant	9.6	1.0	0.41

TABLE 2. A comparison of selected energy inputs for conventional-and no-tillage corn production on Evesboro loamy sand.

Input	Conventional Tillage		No-Tillage	
	kcal/a (gal.gas/a)			
Moldboard plow	108,675	(3.0)	------	-----
Disk	36,225	(1.0)	------	-----
Springtooth	21,735	(0.6)	------	-----
Plant	36,225	(1.0)	36,325	(1.0)
Cultivation (1)	54,337	(1.5)	------	-----
Nitrogen	800,000	(22.1)	160,000	(4.4)
Phosphorous	23,200	(0.6)	23,200	(0.6)
Potassium	64,000	(1.8)	64,000	(1.8)
Atrazine	16,500	(0.4)	16,500	(0.4)
Simazine	16,500	(0.4)	16,500	(0.4)
2,4-D	-------------		5,500	(0.1)
Paraquat	-------------		2,750	(0.07)
X-77	-------------		11,000	(0.3)
Toxaphene	-------------		33,000	(0.9)
Furadan	-------------		16,500	(0.4)
Vetch cover crop	-------------		90,000	(2.5)
TOTAL	1,177,397	(32.4)	475,275	(12.9)

TABLE 3. Influence of cover crops and nitrogen fertilizer on grain yield of no-tillage corn. (3yr. avg., 1974-1976, Evesboro loamy sand).

Cover Crop 1/	Broadcast Nitrogen, Lbs./A		
	0	50	100
	Bu/A		
No Cover Crop (Chickweed)	57.9	93.8	100.8
Spring oats	73.5	108.3	120.7
Spring oats + hairy vetch	119.7	115.7	116.0

1/ Fall plowed prior to cover crop seeding followed by no-tillage planting of field corn in May.

TABLE 4. Energy efficiency of three corn production systems.

Corn Production System	Input	Output(yield) 1/	Input-Output Ratio
	kcal/a		
Conventional Tillage, 100 Lbs. N.	1,177,397	9,031,680	7.7
No-tillage, Vetch Cover Crop, 100 Lbs. N.	1,275,275	10,393,600	8.15
No-tillage, Vetch Cover Crop	475,275	10,725,120	22.6

1/ Assumes 1 Lb. of corn contains 1600 kcal.

INCORPORATION EFFECTIVENESS OF VARIOUS TILLAGE TOOLS

N. L. Hartwig and L. D. Hoffman 1/

ABSTRACT

The improvement of annual grass control as a result of effectiveness of incorporation of butylate was generally better in plowed ground than on unplowed ground, regardless of the incorporation tool used. Those incorporation tools which worked best on plowed ground were a cultimulcher with the herbicide applied after a single tandem discing. Incorporation with a tandem disc or spring tooth harrow following a tandem disc were also very good.

The use of a roterra to incorporate herbicides appears to do an excellent job whether it is used following a moldboard plow, chisel plow or heavy disc.

Other than the roterra, the only effective method of incorporating butylate following a chisel plow was with a tandem disc.

The use of a heavy disc to incorporate butylate resulted in uneven incorporation and erratic weed control. This seems to be the worst of all methods used to incorporate herbicides for annual weed control.

The corn yields were related to the effectiveness of the weed control. When weeds were controlled, there was little difference in corn yield among any of the methods of tillage used.

INTRODUCTION

Control of some weeds can sometimes be accomplished only with incorporated herbicides. The type of incorporation equipment used for this job is usually what the farmer happens to have on his farm for secondary seedbed preparation. These pieces of equipment can be anything under the sun. Since no two incorporation tools are alike and incorporation effectiveness varies with each (1), it is little wonder that weed control has been often times erratic. Research to measure the efficiency of incorporation has been done by Bode et al. (1) with the use of a fluorescent dye coating on clay granules developed by Kaufman and Butler (2). The clay granules work well as a carrier because they have properties similar to soil. Results of UV light pictures indicated fairly uniform incorporation with two passes at proper speed and depth with a tandem disc or field cultivator. The Do-All and Roterra gave a uniform shallow mixing which Bode et al. considered to be adequate. Large tandem discs may not give good soil mixing when operated at shallow depths. These trials were not

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followed throughout the season to determine what kind of weed control was obtained. The objective of this trial was to try and correlate the incorporation effectiveness according to UV light pictures to the actual weed control obtained during the course of the season.

METHODS AND MATERIALS

This trial was conducted in 1978 and 1979 on a Hagerstown silt loam soil, (Typic Hapludult) with about 10% sand, 67% silt, 20% clay, 2.5% organic matter and a pH of 7.0. Primary tillage tools included the moldboard plow, chisel plow and heavy disk. Secondary tillage tools included the spring tooth harrow, cultimulcher, tandem disk, heavy disk and roterra. These tools were used in various combinations and butylate (S-ethyl diisobutylthiocarbamate) at 3 lb/A was incorporated with the last tillage tool in each treatment combination. Butylate was applied with a small plot sprayer mounted on a Cub tractor with 20 gal/A of water and 8001 low pressure nozzles at 29 psi. The soil surface was moist at the time of application and soil surface temperature was 20°C with a 4 to 15 mph wind. Within a week after application we had 3.8 inches of rainfall. The trial was laid out as a split block with 4 replications and with treatments both with and without butylate so that all treatment comparisons could be made between butylate and the same tillage treatment without butylate to eliminate weed control and corn yield differences due to tillage.

The following tillage combinations were used on May 12, 1978.

1. Plow:(H) 1/:Tandem disk
2. Plow:Tandem disk:(H):Tandem disk
3. Plow:Tandem disk:(H):Spring tooth harrow
4. Plow:Tandem disk:(H):Cultimulcher
5. Plow:(H) 2/:Roterra
6. Chisel plow:(H):Heavy disk
7. Chisel plow:(H):Tandem disk
8. Chisel plow:(H) 2/:Roterra
9. Heavy disk
10. Heavy disk:(H):Heavy disk
11. Heavy disk:(H) 2/:Roterra
12. (H):No Incorporation

In order to photograph the type of incorporation obtained with each tillage treatment, a fluorescent dye was incorporated at the same time as the butylate. The fluorescent dye (Day-Glo) 3/ was applied to atta-clay granules at a rate of 150 gm per 50 lb. The granule was applied with a 6 foot Gandy granular applicator across all tillage treatments in one replication. After the soil had settled about 6 weeks after incorporation, a trench was made across the fluorescent dye area at right angles to the direction of incorporation. An ultraviolet fluorescent light powered by a field generator was used to light the soil profile. The soil profile was photographed with a 35 mm

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1/ Indicates point at which butylate or dye was applied to soil surface
2/ Butylate applied with boom mounted on roterra, dye applied to soil in front of roterra
3/ Day-Glo Color Corp., Cleveland, OH

camera set in a trench under the UV light so the camera was at right angles to the surface photographed. A 64 ASA color film was used with a setting of f2.8 and an exposure of 30 to 45 sec.

In 1978, 150 lb/A of 10-30-10 fertilizer was applied in the row at planting time and 350 lb/A of urea was applied broadcast after planting. Doeblers 50 X (90 day) corn was planted on May 31 in 30 inch rows with a 6 row Allis Chalmers no-tillage corn planter. All plots were 9 rows of corn in width and 20 ft. long. All corn stand and yield data were taken from rows 2, 3, 4 and 6, 7, 8 of each plot. Weed yields were determend by harvesting a .5 m^2 area at 2 places in each plot. The major weed species were the annual grasses, yellow foxtail (Setaria glauca) and witchgrass (Panicum capillare).

The whole trial area was treated with a mixture of dicamba + 2, 4-D at 1/8 + 3/8 lb ai/A on June 12, 1978 to eliminate broadleaf weeds.

RESULTS AND DISCUSSION

The improvement in annual grass control was highly significant as a result of effectiveness of incorporation of butylate by all of the secondary tillage tools except the heavy disc (Table 1). The heavy disc was very uneven in terms of mixing the butylate in the soil according to the UV light picture and the resulting grass control was poor and erratic regardless of whether the primary tillage was a chisel plow or heavy disk.

If we look at trends, the improvement in annual grass control was generally better in plowed ground than chisel plowed or heavy disced ground regardless of incorporation tool used. The cultimulcher was the best method of incorporation followed closely by the spring tooth harrow with the herbicide applied after a single tandem discing of plowed ground. Incorporation with a tandem disc also resulted in good improvement in annual grass control.

The roterra did an excellent job of even, though relatively shallow (2 to 4 inches), incorporation according to the UV light picture. The depth of incorporation was related to the roughness of the soil to which the dye was applied. The rougher the soil surface, the deeper the incorporation. Improvement in annual grass control from butylate ranked 2, 3 and 4 when incorporated with the roterra following a heavy disc, chisel plow and moldboard plow respectively.

The incorporation with a tandem disc was about 3 to 5 inches, depending on the roughness of the soil surface to which the dye was applied. Although incorporation was not as even as with the roterra or cultimulcher, it was much better than the heavy disc. Improvement in annual grass control was slightly less than for the roterra or cultimulcher but better than the heavy disc.

With no incorporation in the no-tillage treatment, butylate contributed nothing toward weed control as would be expected.

Improvement in corn yields appeard to be related to the improvement in weed control, the better the weed control the greater the yield increase (Table 2).

Table 1. Annual grass dry weight yield comparisons with and without butylate after incorporation with various tillage tools.

Treatment	Annual Grass Yield - Butylate	Annual Grass Yield + Butylate	Improvement Yield		Improvement Rank
	-----------------lb/A[a/]	-----------------	-----------------		
1. Plow:(H):Tandem disk	1313[b/] b	568 de	745***[c/]	abc[d/]	9
2. Plow:Tandem disk: (H):Tandem disk	1737 ab	651 cde	1086***	abc	7
3. Plow:Tandem disk: (H):Spring tooth harrow	2354 ab	1133 bcd	1221***	ab	5
4. Plow:Tandem disk: (H):Cultimulcher	2261 ab	758 bcde	1503***	a	1
5. Plow:(H):Roterra	1787 ab	557 de	1230***	ab	4
6. Chisel plow:(H): Heavy disk	1698 ab	1346 b	352 N.S.	cd	11
7. Chisel plow:(H): Tandem disk	1893 ab	784 bcde	1109***	abc	6
8. Chisel plow:(H): Roterra	2005 ab	766 bcde	1239***	ab	3
9. (H):Heavy disk	1414 b	872 bcde	542*	bc	10
10. Heavy disk:(H): Heavy disk	2138 ab	1250 bc	888***	abc	8
11. Heavy disk:(H): Roterra	1672 ab	424 e	1248***	ab	2
12. (H):No Incorporation	3003 a	3302 a	-299 N.S.	d	12

a/ Dry weight.

b/ All means are averages over 2 blocks, 2 reps. and 2 samples (8 observations).

c/ Comparisons for + and - butylate for each treatment; significant at * = 10%, ** = 5%, *** = 1% level of probability.

d/ Treatment comparisons, means followed by the same letter are not significantly different according to Scheffe's test for comparison of means.

Table 2. Corn yield comparisons with and without butylate after incorporation with various tillage tools.

Treatment	Corn Yields		Improvement	
	+ Butylate	- Butylate	Yield	Rank
	bu/A[a]			
1. Plow:(H):Tandem disk	88.0[b] a	55.3 abc	32.7***[c] abc[d]	3
2. Plow:Tandem disk: (H):Tandem disk	80.3 ab	51.6 abc	28.7*** abc	4
3. Plow:Tandem disk: (H):Spring tooth harrow	72.9 ab	39.7 bc	33.2*** ab	2
4. Plow:Tandem disk: (H):Cultimulcher	82.8 ab	47.2 bc	35.6*** a	1
5. Plow:(H):Roterra	91.4 a	64.8 ab	26.6*** abc	5
6. Chisel plow:(H): Heavy disk	70.5 ab	66.6 ab	3.9 N.S.d	11
7. Chisel plow:(H): Tandem disk	67.4 ab	51.7 abc	15.7** abcd	7
8. Chisel plow:(H): Roterra	68.2 ab	53.7 abc	14.5** bcd	8
9. (H):Heavy disk	78.2 ab	73.8 a	4.4 N.S.d	10
10. Heavy disk:(H): Heavy disk	72.7 ab	60.0 abc	12.7* cd	9
11. Heavy disk:(H): Roterra	75.6 ab	57.0 abc	18.6*** abcd	6
12. (H):No Incorporation	42.7 b	39.0 bc	3.7 N.S.d	12

a/ Bushel per acre at 15.5% moisture.
b/ All means are averages over 2 blocks, 2 reps. and 2 samples (8 observations).
c/ Comparisons for + and - butylate for each treatment; significant at * = 10%, ** = 5%, *** = 1% level of probability.
d/ Treatment comparisons, means followed by the same letters are not significantly different according to Scheffe's test for comparison of means.

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TIMING OF HERBICIDE APPLICATION FOR ANNUAL GRASS CONTROL IN CORN

James M. Hutchinson and R. A. Peters[1]

ABSTRACT

Research work was conducted at the University of Connecticut Agronomy Research Farm to determine the effectiveness of alachlor, cyanazine and pendimethalin applied postemergence to field corn in controlling large crabgrass. A randomized complete block design with three replications was used. Fertilization was 1,124 kg/ha applied on May 16, 1979. Corn was planted on May 16, 1979. Alachlor-atrazine at 1.12 + 1.12 kg/ha, pendimethalin-atrazine and cyanazine at 1.12 + 1.12 kg/ha were applied when the corn was in the spike (5.1 cm), three leaf (11.4 cm) and five leaf stage (19.1 cm), respectively. The dates of treatment were June 7, 1979, June 9, 1979 and June 15, 1979. At time of spraying the crabgrass was 1.3, 2.5 and 11.4 cm in height, respectively. Cyanazine-atrazine at 1.12 + 1.12 kg/ha was applied at the three leaf stage only. Corn yield samples were taken on October 12, 1979 and crabgrass yield samples on October 26, 1979.

As indicated by the grass control ratings in Table 1, none of the herbicide treatments applied at the five leaf stage completely controlled the crabgrass. Pendimethalin did give more early control than did the other herbicides. By the time of yield sampling in October, however, the yields for all herbicides applied at the five leaf stage were comparable. All were significantly less than the control but significantly more than applications made in the spike or three leaf stage.

All herbicide treatments increased corn silage and grain corn yields over the control. In plots treated with cyanazine at the five leaf stage there was a reduction in silage corn compared to other herbicide treatments while with alachlor-atrazine there was a significant reduction in grain corn yields.

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Table 1. Influence of timing of herbicide application on annual grass control and corn yields.

Herbicide	Stage of Corn Growth	Rate kg ai/ha	Grass Injury Rating[1] 6/15/79	7/25/79	Annual Grass dry matter	Corn Silage 30% dry matter	Ear Corn 15% dry matter
					T/ha	T/ha	T/ha
1. Alachlor + atrazine	Spike	1.12 + 1.12	10.0	10.0	Trace ^{c}	47.4^{ab}	10.1^{ab}
2. Alachlor + atrazine	3-leaf	1.12 + 1.12	9.0	10.0	Trace ^{c}	46.1^{ab}	9.8^{ab}
3. Alachlor + atrazine	5-leaf	1.12 + 1.12	--	6.3	2.2^{b}	41.4^{ab}	8.4^{b}
4. Cyanazine	Spike	2.24	10.0	10.0	Trace ^{c}	44.7^{ab}	9.8^{ab}
5. Cyanazine	3-leaf	2.24	10.0	9.0	Trace ^{c}	46.3^{ab}	9.8^{ab}
6. Cyanazine	5-leaf	2.24	--	4.7	2.0^{b}	39.7^{b}	8.5^{ab}
7. Cyanazine + atrazine	3-leaf	1.12 + 1.12	9.7	10.0	Trace ^{c}	49.7^{a}	10.4^{a}
8. Pendimethalin + atrazine	Spike	1.12 + 1.12	10.0	10.0	Trace ^{c}	47.6^{ab}	10.1^{ab}
9. Pendimethalin + atrazine	3-leaf	1.12 + 1.12	--	9.7	Trace ^{c}	42.6^{ab}	9.3^{ab}
10. Pendimethalin + atrazine	5-leaf	1.12 + 1.12	--	8.3	2.2^{b}	46.0^{ab}	9.7^{ab}
11. Untreated	----	----	0.0	0.0	4.4^{a}	24.9^{c}	5.9^{c}

1/ 0 - no injury; 10 - complete kill

WEED CONTROL FOR NOTILL RENOVATION OF RUNOUT ALFALFA

G.W. Mueller-Warrant and D.W.Koch[1/]

Runout alfalfa stands (6 to 10 yrs. old) at three sites were renovated in 1979. A Tye Pasture Pleaser notill seeder was used to seed 13 kg/ha of 'Saranac' alfalfa on April 25, May 3,4 and 21. One location (Epsom) was a Hinckley loamy sand rated in October 1978 as 20 percent alfalfa and 80 percent grasses, primarily brome (Bromus inermis L.) and quackgrass (Agropyron repens L.). This field was pastured from mid-September until early October in 1978. A second site, Durham, was a Charlton loam rated as 50 percent alfalfa and 50 percent grasses, mainly quackgrass with some brome and bluegrass (Poa pratensis L.). The third, Pembroke, was a Merrimac sandy loam rated as 70 percent alfalfa, 15 percent dandlelion (Taraxacum officinale Weber), and 15 percent grasses, quackgrass and bluegrass. Several rates of glyphosate and pronamide were applied in the fall of 1978 using a hand held boom, CO_2 pressurized backpack sprayer system. Paraquat and several rates of glyphosate were applied at several dates in the spring, alone or in combination with fall treatments. In Pembroke, 2,4-D was applied to some plots on November 1 for suppression of alfalfa and dandlelion. Treatments reported in Table 1 are those which achieved good control of grass, but resulted in varying degrees of suppression of the old alfalfa. The Epsom site received 4 t/ha of dolomite (initial pH 6.1) and 0-168-168 + 2.2 kg/ha B, Durham received 0-252-168 + 2.2 kg/ha B, and Pembroke received 0-140-0. After seedling emergence, carbofuran was applied at 1.1 kg/ha as Furadan 10G to all plots. At Epsom only, 1.4 kg/ha of 2,4-DB was applied. Plots with substantial growth of old alfalfa were harvested in early summer at Durham and Epsom. Yields of this harvest (if taken) are combined with those of the July harvest in Table 1. Percent old as opposed to new alfalfa of the July harvest was visually estimated on the basis of the advanced maturity of the old plants. No attempts were made to separate old versus newly seeded alfalfa in the final harvest of 1979 or the subsequent stand rating of alfalfa regrowth.

The data indicates that old alfalfa can seriously interfere with notill reseeding of alfalfa. In addition to competing for light, water, and nutrients, old stands of alfalfa are likely to harbor insects and diseases specific to alfalfa. Improvement in the stand of alfalfa as measured by final harvest alfalfa yield or stand rating was more easily obtained in the more runout stands. At the least runout site, treatment on November 1 with 2,4-D failed to control the established alfalfa adequately, while treatment with glyphosate succeeded. November 16 treatment with glyphosate provided little suppression of alfalfa. In Epsom, fall grazing reduced grass growth to such a degree that October applied glyphosate failed to control brome or quackgrass at any rate, and November 13 applied glyphosate succeeded only at 2.6 kg/ha or more. In general, grass and old alfalfa control was considerably better with May than with fall glyphosate treatment. In Durham, May 21 seeding performed better with May 2 than May 16 glyphosate treatment, and also better than May 4 seeding with May 2 glyphosate treatment, showing the value of a delay between glyphosate treatment and alfalfa seeding.

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Table 1. Alfalfa seedling density, yields, and stand ratings.

Date of Seeding	Location and Treatment (kg a.i./ha)	June 20 Alfalfa Seedling Density --#/m^2--	#Alfalfa Component Yields Accumulated thru July Harvest* Old Alf. --% of Unseeded Pronamide---	New Alf.	Of the Final Harvest**	Stand Rating of Alfalfa Regrowth*** 0 to 10
	Epsom (20% alf.,80% grass)		(100=1.371 t/ha)		(100=0.412 t/ha)	
Unseeded	3.7 pronamide Nov. 13	---	100	0	100	X
Unseeded	No herbicide	---	74	0	30	X
May 3	3.7 pronamide Nov. 13	102	43	42	290	X
Apr. 25	2.6 glyphosate Nov. 13	145	10	40	378	X
May 3	Ave. 1.5,2.2,3.0 glyphosate May 1	102	3	32	406	X
	Durham (50% alf.,50% grass)		(100=3.877 t/ha)		(100=1.935 t/ha)	
Unseeded	3.4 pronamide Nov. 17	---	100	0	100	5.8
Unseeded	No herbicide	---	79	0	50	4.8
May 4	3.4 pronamide Nov. 17	41	89	6	105	6.9
May 21	3.4 pronamide Nov. 17 + 0.3 paraquat May 23	117	48	9	106	8.0
May 4	0.7 glyphosate Oct. 28	66	73	4	91	7.1
May 4	3.0 glyphosate Oct. 28	55	60	12	88	7.4
May 4	1.5 glyphosate Oct. 28 + 0.7 glyphosate May 2	96	33	22	117	7.9
May 21	1.5 glyphosate May 2	160	1	24	91	9.3
May 21	1.5 glyphosate Oct. 28 + 0.7 glyphosate May 16	185	1	26	109	9.8
May 21	Ave. 1.5,2.2,3.0 glyphosate May 16	89	0	12	64	7.6
	Pembroke (70% alf.,15% dandlelion,15% grass)		(100=4.910 t/ha)			
Unseeded	Ave. 2.2,3.4 pronamide Nov. 16	---	100	0	X	6.8
Unseeded	1.4 2,4-D Nov. 1 + ave. 2.2,3.4 pronamide Nov. 16	---	50	0	X	3.7
Apr. 25	Ave. 2.2,3.4 pronamide Nov. 16	11	117	1	X	7.1
Apr. 25	1.4 2,4-D Nov. 1 + ave. 2.2,3.4 pronamide Nov. 16	81	45	8	X	6.9
Apr. 25	2.2 glyphosate Nov. 1	137	8	39	X	8.4
Apr. 25	2.2 glyphosate Nov. 16	51	60	14	X	7.1
Apr. 25	1.4 2,4-D Nov. 1 + 2.2 glyphosate Nov. 16	39	54	18	X	8.2

*Treatments harvested in Epsom June 14 (except glyphosate) and July 27, in Durham May 31 (except paraquat or May glyphosate) and July 20, and in Pembroke July 12.

**Final harvests of 1979 taken Oct. 19 in Epsom, Aug. 31 in Durham, and Sept. 3 in Pembroke (data lost).

***Visual stand rating (0=no alfalfa to 10=optimum) on Sept. 21 in Durham and Oct. 22 in Pembroke.

#Alfalfa yields based on measured forage yields X mean of three visual estimates of alfalfa composition.

EFFECT OF TIMING AND HERBICIDES ON THE NO-TILLAGE ESTABLISHMENT OF RED CLOVER, ALFALFA, AND BIRDSFOOT TREFOIL

R. L. Nichols and R. A. Peters[1/]

ABSTRACT

Nine field experiments were conducted between October 1976 and August 1978 to investigate the effects of fall, spring, or midsummer applied herbicides on the no-tillage establishment of three forage legumes. The site was an orchardgrass-quackgrass sward on a Paxton soil of pH 4.8 and low overall fertility.

'Pennscott' red clover, 'Iroquois' alfalfa, and 'Viking' birdsfoot trefoil were each seeded on 3 June or on 19 July 1977 following four herbicide treatments. Paraquat at 1 kg/ha and glyphosate at 2 kg/ha were applied at all three dates. Pronamide at 2 kg/ha and dalapon at 17 kg/ha were applied on 30 October 1976. Dalapon at the same rate and amitrole at 4.5 kg/ha were applied on 12 May 1977. Amitrole at the same rate and paraquat as a split application of 1/2 + 1/2 kg/ha were applied on 11 (and 18) July 1977.

June seedings were harvested in August 1977 and June and August 1978. July seedings were harvested in June and August 1978. At all harvests dry matter yields of the weed-free legumes were determined.

Glyphosate effectively subjugated the sward when applied in spring or midsummer. An infestation of annual weeds followed the spring glyphosate application. Contrary to previous finding, glyphosate did not control the sward when fall applied. Sward control with paraquat at 1 kg/ha was most effective following midsummer, marginally effective following spring, and ineffective following late fall applications. Control with the split application of paraquat was superior to the single application.

Fall applied pronamide or dalapon substantially reduced the perennial grasses, but released the perennial broadleaf weeds which competed with the seeded legumes. Amitrole controlled all sward species, but was phytotoxic to alfalfa, birdsfoot trefoil, and red clover in that order. Fall applied dalapon stimulated volunteer red clover.

Total dry matter yields of alfalfa or birdsfoot trefoil obtained from the June seeding with spring applied glyphosate were superior to those obtained with any other spring herbicides (P .05). Total dry matter yields of alfalfa or birdsfoot trefoil obtained with midsummer applications of glyphosate or the split application of paraquat did not differ significantly and were higher than those obtained with the other midsummer herbicides (P .05). Red clover yields were relatively insensitive to herbicides. No significant differences were observed in the total yields of any of the three legumes when seeded following the fall herbicides (P .05).

Red clover, birdsfoot trefoil, and alfalfa were established with that order of facility. June seedings of red clover following fall or spring herbicides were superior to the July seedings. June seedings of alfalfa or birdsfoot trefoil with spring applied herbicides were superior to those made following fall or midsummer applied herbicides.

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QUACKGRASS CONTROL FOR MINIMUM TILLAGE ESTABLISHMENT OF BIRDSFOOT TREFOIL

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ABSTRACT

Ten treatments (Table 1) including cultural and chemical control of quackgrass (Agropyron repens (L.) Beauv.) were initiated in the fall of 1978. The site was a somewhat droughty Hollis fine sandy loam with a sward dominated by quackgrass. Since initial pH was 5.9, 3.4 t/ha of dolomite was applied in Aug. 1978. Mowing was at the height of 2 cm; clippings were not removed. Herbicides were applied with a hand-held CO_2 pressurized sprayer delivering 185 l/ha at a pressure of 2.1 kg/cm^2. Prior to seeding 250 and 56 kg/ha, respectively, of P_2O_5 and K_2O was applied.

'Viking' birdsfoot trefoil (BFT) and 'Climax' timothy were seeded at 9.4 and 4.7 kg/ha, respectively, with a Tye Pasture Pleaser minimum tillage seeder on April 20 and May 10, 1979. Rows were spaced 23 cm. A split-plot design with seeding dates as main plots, quackgrass control treatments as subplots, and four replications were used.

Seedling density of BFT was determined on June 19 by averaging random counts on three 46-cm sections of row in each plot. On Aug. 3 all plots were rated by 3 observers for estimated % dry matter contribution of BFT, all grasses (timothy and annual grasses, in addition to quackgrass), and broadleaf weeds. Only treatments with glyphosate had sufficient growth for harvesting. On Oct. 3 all plots were again rated in a similar manner and on Oct. 15 all plots were harvested.

In general, highest densities of BFT seedlings resulted in highest seasonal yields of BFT (Table 1). Even though BFT seedling numbers were adequate with most treatments, regrowth of quackgrass limited seasonal BFT yields of the least effective treatments. Fall nitrogen with subsequent slipping decreased the density of BFT seedling numbers with the May 10 seeding. BFT seedling density varied considerably within plots and among plots of similar treatment.

In terms of BFT yield, glyphosate was most effective when applied immediately preceding the May 10 seeding and with the combination of fall application and Apr. 20 seeding. At the May 10 seeding 1.12 and 2.25 kg/ha lf glyphosate were equally effective. Treatments with no-till rye resulted in lower yields of BFT than in similar treatments without rye. Four spring clippings were as effective as paraquat with Apr. 20 seeding, but with the May 10 seeding the addition of fall clippings or paraquat to the spring clipping treatment improved BFT yields. Paraquat as a substitute for fall clippings resulted in similar BFT yields.

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Table 1. Effect of fall and spring cultural and chemical methods of quackgrass control on establishment of birdsfoot trefoil seeded by minimum tillage in 1979.

			April 20 Seeding			May 10 Seeding		
				Seasonal Yield of			Seasonal Yield of	
Treatment	Number or Rate	Timing	BFT Seedlings	Forage	BFT	BFT Seedlings	Forage	BFT
			per m^2	t/ha		per m^2	t/ha	
Mowing	8	Fall[1/] & spring	183	2.09	0.94	145	1.93	1.03
Mowing	4	Spring only	167	2.00	1.01	167	1.77	0.54
Mowing	8	Fall & spring						
& Nitrogen	45 kg	Sept. 17	51	1.19	0.13	143	2.07	0.85
Mowing	7	Fall & spring						
& Paraquat[2/]	.28 kg	Spring	170	2.11	1.06	175	2.27	0.94
Mowing	3	Spring only						
& Paraquat	.28 kg	Sept. 20						
	+.28 kg	Spring	268	2.51	1.01	226	2.18	1.06
Mowing	3	Spring only						
& Paraquat	.28 kg	Sept. 20						
	+.28 kg	Spring						
+No-till rye	40 kg	Sept. 13	245	2.20	0.61	65	1.98	0.31
Mowing	3	Spring only						
& Paraquat	.56 kg	Spring	261	2.33	0.79	143	2.25	0.88
Glyphosate[3/]	1.12 kg	Spring	148	3.41	0.79	242	4.38	3.17
Glyphosate	2.24 kg	Spring	194	3.70	1.21	385	3.73	2.58
Glyphosate	2.24 kg	Oct. 17	347	4.31	2.51	269	3.91	1.44
	Treatment LSD .05		139	0.57	0.66	139	0.57	0.77

[1/] Fall mowing dates were Sept. 13 and 29, Oct. 13 and Nov. 3, 1978; spring mowing dates were May 2 and 17 and June 4 and 21, 1979, except that the earliest date was eliminated on plots receiving paraquat.

[2/] Spring-applied paraquat was on Apr. 24 and May 15 for the Apr. 20 and May 10 seedings, respectively, and expressed as kg cation/ha.

[3/] Spring-applied glyphosate was on Apr. 24 and May 9 for Apr. 20 and May 10 seedings, respectively, and on the basis of kg/ha of the isopropylamine salt.

DIRECT-PLANTING OF LEGUMES - AN UPDATE

D. L. Linscott, E. B. Rayburn, J. F. Hunt and R. H. Vaughan

ABSTRACT

In a continuing effort to improve the probability for successful forage establishment by direct-planting or no-tillage means, we conducted numerous field experiments at research stations and on commercial farms throughout New York State in 1979. The weed and vegetation control experiments focused on two situations: (a) direct-planting in stubbles of corn or small grains in rotations and (b) direct planting in grass hay or pasture sods. In most cases, the conventional tillage-planting practices were compared with the direct-planting or limited-tillage practices. Forage included alfalfa, birdsfoot trefoil and red clover. Herbicides for use depended on the site and the particular problem to be addressed. Herbicides used alone or in combination included glyphosate, paraquat, dalapon, 2,4-D, 2,4-DB, pronamide, dicamba and EPTC.

All forages planted by no-tillage means with herbicides for weed control established successfully in 1979 with the exception of two cases. The first involved a site where atrazine carried over from a previous corn crop and destroyed the seedling legumes. The second involved an alfalfa planting into a quackgrass (Agropyron repens L. Beauv.) sod soon after treatment with glyphosate. All other establishments were successful and compared favorably with conventional plantings or were better.

In the past 5 years, the incidence of successful no-tillage establishment of legumes into corn or small grain stubbles has been over 95%. Incidence of successful plantings in sods in the same time frame is not as great, but is increasing as skills improve in selecting and utilizing herbicides properly according to species involved and the best time for application. Best successes in sods have been experienced with birdsfoot trefoil and red clover. However, alfalfa establishment probability in sod is on an upward trend.

Although many of the weed control problems associated with direct planting of legumes have been solved, there is still a need for new herbicides to selectively control annual grasses and broadleaf weeds emerging after planting.

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CHLOROPROPHAM WITH SIMAZINE OR PARAQUAT ON ESTABLISHED ALFALFA

R. H. Vaughan and D. L. Linscott[1/]

Abstract

Established stands of alfalfa in the Northeastern United States often become infested with annual and perennial weeds and grasses. The purpose of this study in 1979 was to evaluate combinations of herbicides for effectiveness when applied in the Spring at the time when alfalfa was breaking dormancy.

Combinations of chloropropham, simazine and paraquat were applied on April 12, 1979, to established 'Iroquois' alfalfa in three replications at rates indicated in Table 1. Wind conditions were calm and air temperature at the time was 7C. The evening following treatment there was a 10 cm snowfall. Plots were located on a Niagara silt loam at the Caldwell Field Research Farm, Ithaca, New York. Weeds included Kentucky bluegrass (*Poa pratensis* L.) annual bluegrass (*Poa annua* L.),witchgrass (*Panicum capillare* L.), fall panicum (*Panicum dichotomiflorum* Michx.). There were minor infestations of other annual grasses as well as some orchard grass (*Dactylis glomerata* L.) and quackgrass [*Agropyron repens* (L.) Beauv.]. Perennial broadleaf species included several Plantago species, dandelion (*Taraxacum officianale* Weber.), Hieracium species, fleabane (*Erigeron canadensis* L.), rough cinquefoil (*Potentilla norvegica* L.), and others. The broadleaf weed population was not as serious a problem as the grasses, but it was significant.

Yields for two harvests were taken. Because of drouth conditions in early summer this was one harvest less than normal. Control of the grasses by chloropropham alone and in combination with simazine or paraquat was excellent. The combinations gave better broadleaf weed control in general than the single herbicide treatments. The three best combination for overall weed control and an increased alfalfa component were: No. (8) chloropropham 2.24 kg/ha + simazine 0.9 kg/ha, No. (6) chloropropham 2.24 kg/ha + simazine 0.45 kg/ha and No. (10) chloropropham 1.12 kg/ha + paraquat 0.28 kg/ha (Table 1). Total yields of these three combinations were less than the controls but the legume component was considerably greater. It is suggested that the time of application in relation to alfalfa and weed stages of growth and good moisture conditions following treatments had much to do with the overall effectiveness.

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Table 1. Effect of chlorophopham in combination with simazine or paraquat on weed and grass control in established alfalfa.[1]

	Herbicide				Forage Production						
					Hay	Alfalfa		Grass		BL Weeds	
		kg/ha		kg/ha	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha
					1st Harvest May 31, 1979						
1	Chloropropham	1.12			3635	68	2527	13	489	18	618
2	"	2.24			3015	70	2113	13	404	16	497
3	Simazine	0.45			4025	58	2302	32	1340	10	383
4	"	0.90			2968	78	2323	12	363	10	284
5	Chloropropham	1.12	Simazine	0.45	3040	67	2026	23	712	10	303
6	"	2.24	"	0.45	3224	78	2504	15	502	7	220
7	"	1.12	"	0.90	3056	75	2312	13	413	11	330
8	"	2.24	"	0.90	3006	87	2607	7	205	7	193
9	Paraquat	0.28			2906	68	1965	25	744	7	198
10	Chloropropham	1.12	Paraquat	0.28	2721	85	2326	5	137	10	258
11	"	2.0	"	0.28	2795	67	1840	13	390	20	559
12	Control				4014	35	1415	47	1858	18	741
				C.V.%	14	15	21	53	57	44	44
				LSD^{05}	341	9.1	356	8.2	272	4.5	128
					2nd Harvest 1979						
1	Chloropropham	1.12			2200	88	1940	5	110	7	149
2	"	2.24			2935	89	2617	5	153	6	165
3	Simazine	0.45			2343	82	1943	13	279	5	121
4	"	0.90			2135	89	1830	7	146	4	93
5	Chloropropham	1.12	Simazine	0.45	2664	88	2352	8	174	4	118
6	"	2.24	"	0.45	2749	93	2578	5	110	2	60
7	"	1.12	"	0.90	2637	92	2421	4	119	4	97
8	"	2.24	"	0.90	3269	95	3095	3	113	2	63
9	Paraquat	0.28			2755	84	2312	12	325	4	118
10	Chloropropham	1.12	Paraquat	0.28	2876	95	2733	2	69	3	73
11	"	2.0	"	0.28	2386	89	2112	6	159	5	115
12	Control				2736	75	2049	16	448	9	244
				C.V.%	15	4	17	36	31	38	41
				LSD^{05}	302	2.8	308	2.2	44	1.5	37
					Total Harvest '79						
1	Chloropropham	1.12			5836	75	4469	10	599	14	767
2	"	2.24			5950	79	4731	9	558	12	662
3	Simazine	0.45			6389	67	4245	25	1619	8	504
4	"	0.90			5104	83	4217	10	508	6	377
5	Chloropropham	1.12	Simazine	0.45	5705	76	4378	16	908	7	421
6	"	2.24	"	0.45	5935	85	5082	11	612	5	280
7	"	1.12	"	0.90	5694	87	4734	9	531	8	428
8	"	2.24	"	0.90	5604	91	5780	5	318	4	256
9	Paraquat	0.28			6276	75	4276	19	1065	6	317
10	Chloropropham	1.12	Paraquat	0.28	5598	90	5060	4	206	6	333
11	"	2.0	"	0.28	5183	77	3960	10	548	13	574
12	Control				6751	51	3464	34	2300	15	986
				C.V.%	11	10	18	13	47	41	39
				LSD^{05}	473	6.6	608	5.9	292	3.1	147

[1]Herbicides applied April 12, 1979 in 262 l/ha H_2O. Rates are listed in ai/ha. Plots located at the Caldwell Field Research Farm, Cornell University, Ithaca, N.Y. BL indicates broadleaf weeds.

INFLUENCE OF MANAGEMENT PRIOR TO DIRECT-PLANTING ON THE ESTABLISHMENT OF LEGUMES

E. B. Rayburn, D. L. Linscott, and J. F. Hunt[1/]

ABSTRACT

The development of better and alternative means of weed control and means for reducing tillage are important concerns in maintaining agricultural productivity in a society bound by the need to conserve energy and maintain environmental quality. Using livestock for grazing weeds prior to no-till renovation of pastures has been recommended as a weed control method in such systems. A compilation of direct planting research has also shown that direct planting after grazing is generally more successful than where grazing is not used. In 1978 an experiment was initiated to compare the effects of grazing and mechanical harvest in conjunction with herbicides for perennial forage grass control during establishment of legumes by direct sod seeding.

A timothy-bluegrass-quackgrass pasture at Miner Research Institute (18 km north of Plattsburgh, N.Y.) was cross fenced into four paddock pairs to evaluate the influence of grazing vs. haying in combination with several herbicide treatments on the no-till establishment of 'Empire' birdsfoot trefoil and 'Pennscott' red clover. First growth forage was removed by means of the management treatments in early June. Herbicides treatments were sprayed on 22 June and were paraquat at 1/2 kg/ha, glyphosate at 1 kg/ha and 2 kg/ha and a no herbicide check. Seed was planted with a John Deere Power-Till drill on 22 June. The weather was typified by good early summer rainfall followed by a late summer dry spell. Soil moisture was excellent at the time of spraying and planting with clear warm weather at the time of spraying. The sandy soil at this site was derived from an old esker bed mined for gravel which had been reclaimed by manure application and grazing.

Stand ratings at 25 days past planting found a significantly greater seedling growth and percent weed kill (forage grasses) on the area grazed prior to herbicide application and planting (Table 1). These differences were still measurable in October. Total dry matter yields the year following establishment were not affected by management or herbicide. However, the yield of the planted legume was significantly increased by grazing prior to planting. Of the herbicides, glyphosate at 1 or 2 kg/ha increased the planted legume yield but paraquat at 1/2 kg/ha did not. A significant management by herbicide interaction showed that all herbicide treatments gave increased legume yields when applied under grazing management as compared to no herbicide under haying management and that only the glyphosate treatments increased legume yields as compared to no herbicide under grazing management.

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Table 1. Influence of management and herbicide treatment prior to direct planting of 'Empire' birdsfoot trefoil and 'Pennscott' red clover on seedling establishment 25 days past planting and on dry matter yield in the year following planting (average of the two species).

	Stand Ratings 25 days past planting			
	No Seedlings /.2m^2	Seedling Height (cm)	Weed Height (cm)	Percent Weed Kill
Management Prior to Planting				
Grazed	11	5	15	58
Hayed	5	2	18	44
$LSD_{.05}$	N.S.	1	N.S.	10
Herbicide Prior to Planting				
Paraquat 1/2 kg/ha	8	3	19	43
Glyphosate 1 kg/ha	11	3	14	79
Glyphosate 2 kg/ha	10	4	14	82
Check	3	2	20	0
$LSD_{.05}$	4	N.S.	2	8

	Dry Matter Yield Year Following Planting			
	Total	Planted Legume	Grass	Broadleaf Weed
	t/ha			
Management Prior to Planting				
Grazed	4.9	1.7	2.8	0.5
Hayed	3.9	0.2	3.0	0.7
$LSD_{.05}$	N.S.	1.1	N.S.	N.S.
Herbicide Prior to Planting				
Paraquat 1/2 kg/ha	4.1	0.6	3.0	0.5
Glyphosate 1 kg/ha	4.4	1.5	2.3	0.6
Glyphosate 2 kg/ha	4.8	1.4	2.8	0.6
Check	4.2	0.4	3.3	0.5
$LSD_{.05}$	N.S.	0.5	0.4	N.S.

HERBICIDE COMBINATIONS FOR OILSEED SUNFLOWERS

R. R. Hahn[1]

ABSTRACT

Herbicides and herbicide combinations were evaluated for crop safety and for the control of common ragweed (Ambrosia artemisiifolia L.) and giant foxtail (Setaria faberi Herrm.) in oilseed sunflowers in Seneca County, New York during the 1979 growing season. The soil type was a Honeoye silt loam with 3.5% organic matter and a pH of 6.2. The field was chisel-plowed in the fall of 1978. A field cultivator was used prior to the application of the preplant-incorporated treatments and incorporation was accomplished with a double cultimulching. Herbicide treatments were applied to 10 by 25 ft plots using a compressed air plot sprayer calibrated to deliver 25 gpa of spray solution and were replicated four times. Preplant-incorporated treatments were applied May 5; the sunflowers were planted May 7; preemergence and postemergence applications were made on May 9 and June 1, respectively. On June 1 the sunflowers had four to six leaves and the common ragweed was in the two to four leaf stage.

Sunflower injury ratings and control ratings of common ragweed and giant foxtail are shown in Table 1. Rainfall was limited to 0.36 inches during the two weeks following preemergence applications; however, 1.65 inches fell during the third week. As a result, preemergence treatments were not as effective as might have been expected. Several herbicide combinations of preplant-incorporated and preemergence herbicides were effective in controlling the common ragweed and giant foxtail with combinations of trifluralin and RH-2512 providing the best weed control. Both preemergence and postemergence applications of RH-2512 caused some sunflower injury; however, the postemergence application of 0.25 lb/A was more injurious than the preemergence applications of 1.0 or 1.5 lb/A.

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Table 1. Sunflower injury ratings and control ratings of common ragweed and giant foxtail with various herbicide treatments in 1979.

Treatment			Injury and control ratings[a]		
Herbicide(s)	lbs/A	Appl.	Sunflower	Common Ragweed	Giant Foxtail
1. Alachlor	2.00	PRE	0.3	3.3	3.5
2. Chloramben	3.00	PRE	0.5	5.7	1.3
3. EPTC	3.00	PPI	0.3	6.0	5.3
4. Metolachlor	2.00	PRE	0.0	2.5	4.7
5. Pendimethalin	2.00	PRE	1.3	2.3	5.3
6. Profluralin	1.00	PPI	0.7	3.0	5.3
7. RH-2512	1.00	PRE	1.7	5.5	5.5
8. RH-2512	1.50	PRE	2.0	6.7	8.0
9. RH-2512	0.25	PO	3.3	5.7	1.3
10. Trifluralin	0.75	PPI	0.0	3.5	5.3
11. Chloramben	2.00	PRE	0.3	6.0	3.0
Alachlor	2.00	PRE			
12. Chloramben	2.00	PRE	0.3	5.3	5.0
Metolachlor	2.00	PRE			
13. Chloramben	2.00	PRE	0.7	4.3	5.3
Pendimethalin	1.50	PRE			
14. Profluralin	1.00	PPI	0.0	6.0	6.5
Chloramben	2.00	PRE			
15. Trifluralin	0.75	PPI	0.3	2.3	7.0
Chloramben	2.00	PRE			
16. EPTC	3.00	PPI	0.0	6.3	6.5
Trifluralin	0.75	PPI			
17. Trifluralin	0.75	PPI	1.5	7.3	9.0
RH-2512	1.00	PRE			
18. Trifluralin	0.75	PPI	2.3	7.5	10.0
RH-2512	1.50	PRE			
19. Trifluralin	0.75	PPI	3.0	4.7	4.7
RH-2512	0.25	PO			
20. Control	0.00	-	0.0	0.0	0.0
l.s.d. @ 5% level			0.8	2.7	1.7
l.s.d. @ 1% level			1.1	3.6	2.3

[a]Injury ratings (0 = no injury) made June 12, 1979; weed control ratings (0 = no control, 10 = complete control) made September 8, 1979.

POSTEMERGENCE CONTROL OF CRABGRASS WITH BAS 9052 OH IN NEW ALFALFA AND RED CLOVER SEEDINGS

R. A. Peters[1]

ABSTRACT

Applications of BAS 9052 OH (2-(N-ethoxybutyrimidoyl)-5-(2-ethylthiopropyl) -3-hydroxy-2-cyclohexen-1-one) at .28 and .56 kg ai/ha with and without oil and BAS 9021 OH at .84 and 1.68 kg ai/ha were made as an early postemergence treatment on July 6. The experimental area was an alfalfa seeding made June 13, 1979 with a heavy infestation of volunteer large crabgrass. On this date both alfalfa and large crabgrass were in the two-three leaf stage. Late postemergence applications of BAS 9052 at .56 kg and 1.12 kg ai/ha and BAS 9021 at 1.12 and 2.24 kg ai/ha with and without oil were made on July 27 on both alfalfa and red clover. On this date the crabgrass was 15-20 cm in height and overgrowing the legumes which averaged 25 cm in height.

All of the early postemergence applications of BAS 9021 and 9052 gave complete crabgrass control. Stunting followed by a purpling of the leaves was followed by slow death. At the late postemergence stage of growth the BAS 9052 was distinctly more effective in crabgrass control than BAS 9021 with all treatments of the former giving total kill. Only the 2.2 kg/ha rate with oil of BAS 9021 controlled the crabgrass at this relatively advanced stage of growth (25 cm in height). Kill was quite slow but the treatments were effective in releasing the legumes.

No injury to the alfalfa was observed from either the early or late postemergence treatments from either herbicide. Yields of alfalfa were significantly increased over the control. When the BAS 9052 was applied to the red clover in the postemergence treatments there was some initial injury as shown by crinkled and strap-like leaflets. These symptoms were outgrown by the time of harvest in October.

BAS 9052 shows considerable promise as a grass herbicide for postemergence applications on red clover and especially on alfalfa. A postemergence grass killer for legumes is very much needed for grass control in no-tillage seedings since currently registered herbicides active on grasses are all preplant incorporated materials which cannot be used for no-tillage.

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CONTROL OF MULTIFLORA ROSE IN PASTURES

B.M. Barbour and J.A. Meade 1/

ABSTRACT

Five herbicides in nine formulations were evaluated in Sussex County, New Jersey on a Hero loam soil for control of multiflora rose. Glyphosate, at 1% and 2%, picloram, at 2,4, and 6 lbs/A, and triclopyr, at 3 lbs/A, all gave acceptable control. However glyphosate at .5% and triclopyr at 1.5 lb/A appeared to be inadequate to kill the plants and regrowth occurred.

Dicamba was evaluated in four formulations alone, and one formulation that included 2,4,-D. None of the formulations that contained dicamba alone gave adequate control but the dicamba spray did exhibit a marked activity compared to the granular forms of dicamba. The dicamba - 2,4-D combination was the only other material in this trial that gave lasting control.

INTRODUCTION

Multiflora rose was introduced to the country in 1886 for use as an understock for ornamental roses (1). In the late 1930's it began to be used commonly as a "living fence" through recommendation of the Soil Conservation Service. Its inherent vigor combined with its ability to propagate itself, both sexually and vegetatively, have led to its spread well beyond the boundaries of its intended uses. Many counties in New Jersey have declared it a noxious weed and forbade its intentional importation or propagation within their boundaries. In some areas large acreages of pasture land have been completely covered by multiflora rose and taken out of production.

The spread of multiflora rose is aided in nature by birds such as the cedar waxwing (*Bombycilla cedrorum*) and robin (*Merula migratoria*) (2). Because of this, the already large established populations of the plant, it is likely to be a major invading species of unmowed pastures from hence forward.

In New Jersey the available means of cultural controls are repeated mowing and excavation of the entire plant, roots and all. The fact that both of these procedures are labor intensive and sometimes impossible in rough terrain, led to the identification of a clearcut need for effective chemical control.

This series of experiments tested five herbicides and nine formulations at varying rates in an attempt to determine relative effectiveness on multiflora rose and the lowest effective rates. Observations spanned a period of three years with up to two full years of post-treatment observation of some materials.

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MATERIALS AND METHODS

The site of this study was a moderately infested pasture in Sussex County, New Jersey near Frankford Plains. The topography was generally level and the soil Hero loam.

The bushes selected ranged from four to ten feet in height and three to twelve feet in diameter. Each bush comprised a single treatment. Applications of the various herbicides took place on three dates, July 15, 1977, May 30, 1978, and September 25, 1978.

For the 1977 trials, hand pumped knapsack sprayers were used for the liquid formulations which included glyphosate [N-(phosphonomethyl) glycine] and triclopyr [(3,5,6-tricloro- 2 - pyridinyl) oxy) acetic acid]. Separate sprayers were used for the glyphosate and triclorpyr and again when applying glyphosate and Krenite. Foliage was sprayed to the point of runoff. Granular materials were hand applied evenly over a 100 square foot area marked off with stakes that usually completely contained the bush and its boundaries. The granular materials included dicamba [3,6-dichloro-o-anisic acid] 10% pellets and 5 and 10G formulations and picloram [4-amino3,5,6-trichloropicolinic acid].

Observations were made on the dates indicated in Table I and control was estimated by percent defoliation. Untreated bushes in the field served as controls and were rated on all dates as zero percent defoliation.

On May 30, 1978 dicamba 5 and 10G formulations were applied for a second trial along with a 4 WS dicamba formulation and a dicamba plus 2,4-D [(2,4-dichlorophenoxy) acetic acid] formulation 2/. Rates, number of replicates, and observations are shown in Table II.

The last application date was September 25, 1978. Glyphosate at .5 and 1% [v/v] and Krenite [ammonium ethyl carbamoylphosphonate] 1% [v/v] were applied with separate knapsack sprayers up to the point just before runoff. Total coverage was striven for but some of the Krenite bushes originally treated were thought not to have received total coverage. In sofar as these could be identified, those bushes were dropped from the experiment when the data was tallied.

The number of replicates ranged throughout the tests from one in the earliest applications to four in the last application. The single replicates of dicamba on the first application date were augmented the second year with additional treatments of dicamba having three replicates.

Anecdotally, it may be noted that the first year's work was hampered by cows which ate the yellow plastic tape used to mark the bushes. Eventually a double marker system was devised using blue tape, which seemed less enticing to the bovine eye, and wooden stakes placed as far as possible under the bush's dripline seemed to be a more durable marking system.

RESULTS AND DISCUSSION

Observations of the 1977 plots indicated that glyphosate at 1% (v/v) and 2% concentrations and picloram at 2, 4 and 6 lb. rates were generally effective in controlling multiflora rose (see Table I). It was also observed that

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2/ Banvel Weedmaster 4WM

glyphosate had the unique side effect of making the canes very brittle so that machinery or cattle coming in contact with the dead bushes could easily shatter and pulvarize the remains of the multiflora rose bush. No other material used in these tests had the same effect. Triclopyr was also effective at the 3 lb rate. At 1.5 lbs the plants recovered almost completely after two years.

TABLE I
PERCENT DEFOLIATION 1/

Herbicide & Formulation	Rate	Number of Reps.	OBS 1 7/21/78	OBS 2 5/26/78	OBS 3 7/5/79
Dicamba 10 G	2 ai/a	1	15	0	0
	4	1	0	0	0
	6	1	0	0	0
	8	1	15	0	0
Dicamba 5 G	2 ai/a	1	15	0	0
	4	1	20	0	0
Dicamba 10%	2 ai/a	1	30	0	0
	4	1	25	0	0
	6	1	15	0	0
	8	1	10	0	0
			PERCENT DEFOLIATION 2/		
Picloram/OK	2 ai/a	2	20*	83	90
	4	2	65*	100	97
	6	2	73	100	100
Triclopyr	1.5 ai/a	2	100	100	100
	3	2	100	100	100
Glyphosate	1% solution	2	100	100	100
	2%	2	95	100	100

Application Date: June 15, 1977

Dicamba at all rates and formulations was apparantly ineffective but since the treatments were not replicated in this initial test, no conclusions could be drawn.

On May 30, 1978, replicated treatments of four dicamba formulations were applied. The bushes were in early bud, humidity was high, and the temperature was warm at 30°C. Four months later, in September, all treatments looked promising but the dicamba 2-4D formulation was the only treatment that achieved total defoliation. One year later, the 4 WS dicamba treatments were recovering and only the dicamba 2-4D was effective. The granular dicamba formulations had not killed the multiflora rose bushes at any of the tested rates.

1/ Because of lack of repetitions, no statistical significance is attributed

2/ All data significant at the .05 level unless marked with asterisk

TABLE II
PERCENT DEFOLIATION 3/

Herbicide & Formulation	Rate	Number of Reps.	OBS 1 9/25/78	OBS 2 7/5/79
Dicamba 5G	4 ai/a	3	83	25*
	10	3	60	27*
Dicamba 10G	4 ai/a	3	45	2*
	10	3	85	47*
Dicamba 4 WS	4 ai/a	3	95	83
Dicamba 4 WM	4 ai/a	3	100	100

Application Date: May 30, 1978
Air Temp: 30°C., sunny, high humidity
Rose in early bud

On September 25, 1978, a third set of applications were made using glyphosate and Krenite. This was a fall application of glyphosate as opposed to the initial trial which was put on in June. As before, the glyphosate was effective at the 1% concentration. The .5% treatment looked good the following spring (100% defoliation) but those same plants were well on their way to recovery by July.

TABLE III
PERCENT DEFOLIATION

Herbicide & Formulation	Rate	Number of Reps.	OBS 1 4/17/79	OBS 2 7/5/79
Glyphosate	.5% v/v	3	100	48*
	1 % v/v	3	100	100
Krenite 4/	1 % v/v	4	100	76

Application Date: September 25, 1978
Air Temp: 18°C., sunny
Rose bearing mature fruit

The Krenite treatment at 1% v/v concentration showed no refoliation the following April but it turned out that budbreak had only been delayed. In July the Krenite treated bushes had partially refoliated and appeared to be recovering. Further trials with Krenite are necessary before any conclusions can be drawn.

3/ All data significant at the .05 level unless marked with asterisk

4/ X-77 added to Krenite treatments, 5 ml per half gallon

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2. Wyman, D. 1969. Shrubs and Vines for American Gardens. MacMillan Co. New York. 613 pp.

COMPUTERIZED COLLECTION AND PROCESSING OF FIELD PLOT DATA

Lee Torgerson 1/

ABSTRACT

The Datamyte 900 and Datamyte 1000 portable, battery powered data collectors are described for use in gathering field plot or greenhouse data. The Datamyte is used to replace the field book and pencil method of collecting data. The advantages of using the Datamyte is that the data are stored in computer format ready for immediate transmission to your computer system. This eliminates manual transcription and keypunching of the data. Results can be obtained immediately and errors can be minimized by using the Datamyte. Details of the system will be presented along with examples of data collection techniques.

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SOYBEAN/ANNUAL GRASS COMPETITION AS MODIFIED BY DICLOFOP; PRELIMINARY INFORMATION

G. P. Albaugh and D. L. Regehr[1/]

ABSTRACT

Williams soybeans were planted conventionally on 21 June in a field of predominately Portsmouth sandy loam soil with a known heavy infestation of giant foxtail. The field was divided into randomly assigned plots 4 rows wide by 10.7 meters long. The chemical treatments were 0, 0.56, 0.84, and 1.12 kg•ha^{-1} a.i. diclofop applied when the grasses were pre-emergent, at the 2 - 3 leaf stage and at the 4 - 5 leaf stage. Cultural treatments were with or without cultivation, imposed two weeks after the application of the 4 - 5 leaf stage chemical treatments. Plots were visually rated (range: 0 = no control, 10 = complete control) on 23 July, sampled for weed and crop above ground biomass in mid-September and sampled for grain yield on 22 October.

Visual ratings suggest a strong relationship between cultivation and chemical treatment. The plots that received either 0.84 of 1.12 kg•ha^{-1} diclofop at the 4 -5 leaf stage, followed by cultivation were visually the best in terms of grass control. Plots that received only cultivation invariably had weeds growing in the row, while those receiving only chemical treatment were not completely weed free. Chemically treated plots were easier to cultivate due to root pruning of the weeds. Cultivation thus caused less crop damage than in plots without diclofop. Biomass and grain yield data will be discussed at the meeting.

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EFFECT OF SNAP BEAN ROW SPACING ON WEED COMPETITION

J.R. Teasdale and J.R. Frank[1/]

ABSTRACT

The objective of this study was to determine the effect of row spacing on competition between snap beans and weeds. The same experiment was conducted at Beltsville, MD and Frederick, MD during 1979. 'Checkmate' snap beans were planted at the same plant density in all plots; only the plant arrangement differed. Treatments consisted of five row spacings (by within row spacings): 6" by 6", 10" by 3.6", 14" by 2.6", 18" by 2", and 36" by 1".

For most variables measured, the 6" to 18" row spacings gave a similar response. Therefore, an 18" row spacing was sufficient to provide most of the benefits of narrow row spacing and the term "narrow row" will refer to row spacings up to 18".

At Beltsville, total weed growth (as measured by fresh weight) was significantly reduced by narrow rows compared to 36" rows. Of the two dominant species in the Beltsville study, common purslane (*Portulaca oleracea* L.) growth was reduced more by narrow row spacings than was yellow nutsedge (*Cyperus esculentus* L.) growth. Weed growth reduction by narrow row spacings could be explained by leaf canopy closure and light penetration data. Rate and extent of leaf canopy closure increased with decreasing row spacing and light measurements showed a corresponding decrease in light penetration through the leaf canopy. Light penetration was reduced by at least 93% for the 6" to 18" rows, but only by 46% for the 36" rows. At Frederick, row spacing had no effect on growth of the varied population of perennial weeds at that site. This may be explained by incomplete canopy closure (no row spacing reduced light penetration by more than 63%) which allowed equivalent weed growth at all row spacings.

All row spacings were included in both hoed and weedy plots. In hoed plots, narrow row spacings yielded an average of 11% and 15% more than the 36" row spacing at Beltsville and Frederick, respectively. This yield increase probably reflects the reduction of intraspecific competition as a result of more uniform plant distribution within narrow rows. In weedy plots, bean yield results were different at each location. At Frederick, weed pressure was not sufficient to affect yield and weedy plot yields did not differ significantly from hoed plot yields. At Beltsville, weed suppression by narrow rows resulted in significantly greater bean plant weight and bean yield in narrow row plots compared to 36" row plots. Weed competition reduced narrow row yields by an average of 11% but reduced 36" row yields by 60% compared to the corresponding row spacings in hoed plots.

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EFFECT OF TRIFLURALIN ON METRIBUZIN TREATED TOMATOES

B. B. Messier and R. A. Ashley [1]

ABSTRACT

Metribuzin injury to soybeans has been shown to be reduced by trifluralin in combined preplant incorporated applications. Field experiments were conducted to determine the effect of trifluralin preplant incorporated 1.1 kg/ha on injury resulting from foliar application of metribuzin 0.56 kg/ha to 'Heinz 1350' tomato transplants in hoed plots. Since several studies have indicated that low light before metribuzin treatment, high light after treatment and low photosynthate reserves predispose plants to metribuzin injury the effects of hardening trifluralin and shade after metribuzin postemergence were assessed. In a second experiment, the effects of hardening, trifluralin and shade before metribuzin late postemergence were evaluated.

Metribuzin injury seven days after treatment was determined by differences in mean dry weight of leaves between treatments with no metribuzin and treatments including metribuzin. In both the postemergence and late postemergence experiment, the mean dry weights of the metribuzin treatments were less than any of the means from treatments not including metribuzin. Injury levels were considered acceptable when rated visually during the two weeks following metribuzin treatment.

Plants treated with trifluralin did not show significant differences in dry weight attributable to metribuzin under light conditions which predispose plants to metribuzin injury. Metribuzin postemergence on otherwise untreated plants produced a significant difference in dry weight (g) (1.173 vs. 0.876) but differences caused by metribuzin were not significant when plants were treated with trifluralin (1.168 vs. 0.915) or shade for four days after metribuzin (1.297 vs. 1.059). Plants that were shaded for four days before metribuzin late postemergence suffered significant dry weight loss (2.336 vs. 1.770) but significant loss was prevented by trifluralin in the same circumstances (2.237 vs. 1.801). Hardening failed to prevent significant differences due to metribuzin postemergence (1.2444 vs. 0.863) or late postemergence on preshaded plants (2.508 vs. 1.731). Pretreatment does not appear to be necessary for trifluralin to increase tomato tolerance to metribuzin.

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INFLUENCE OF WIND EROSION ON SURFACE APPLICATIONS OF ATRAZINE

A. E. M. Chirnside and D. L. Regehr[1/]

ABSTRACT

Approximately 90% of the corn grown in Delaware is produced under conventional tillage practices. These cultural practices leave the fields very susceptible to wind erosion. Subsequently, surface applied agricultural chemicals may be carried from the field with the eroded soil resulting in erratic weed control and reduced crop yields. A wind tunnel apparatus was used to study the movement of atrazine with the wind eroded soil. Soil to be eroded was placed in trays (62 cm x 31 cm) even with the floor of the leeward end of the tunnel. A collection basin was positioned to the rear of the soil tray and was enclosed through the use of Typar(R) (spunbonded polypropylene) in order to trap soil particles without interrupting air flow. Atrazine was applied to the soil trays at the rate of 2.8 kg/ha. The effect of soil moisture on the amount of soil and concentration of atrazine moved was assessed. Evesboro loamy sand was used for all studies. Moisture levels included 0%, 1.25%, 3.75%, 5% and 10%. Soil treatment was exposed to 40 km/h winds for a period of 20 minutes. As soil moisture increased, the amount of soil eroded decreased. The eroded soils are being analyzed for atrazine concentration through gas chromatography.

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FURTHER STUDIES ON AZIDE-STIMULATED WEED EMERGENCE

W. Hurtt and R. B. Taylorson[1/]

ABSTRACT

Field studies concerned with the chemical promotion of weed emergence were continued at Frederick, MD in 1979. The test area was fallow land that had been undisturbed for 2 years and the soil was a silt loam containing 1.7% organic matter. Site preparation consisted of rotary tilling the area twice to a final depth of ca 20 cm. Plots, 1.3 by 8.5 m, were arranged in a randomized complete block design with six blocks. Sodium or potassium azide, ammonium nitrate, and butylate were applied to the soil surface with a bicycle sprayer in 244 L/ha of water and immediately incorporated with the rotary tiller to an average depth of 8 cm.

Weed counts 13 days after application of the chemicals revealed that sodium azide at 4.5 kg/ha significantly increased the number of grass plants by 97% over that of the control. No treatments significantly increased numbers of broadleaf weeds. Butylate at 0.4 kg/ha inhibited emergence of grass and broadleaf weeds by 33 and 32%, respectively.

At the 20-day weed count, the 4.5 kg/ha sodium azide plots contained 168% more grass and 186% more broadleaf weeds than the controls. The 9.0 kg/ha sodium azide treatment, although not significant at the 5% level, appeared to stimulate the emergence of both grasses and broadleaf weeds with enhancements of 120 and 126%, respectively.

Evaluation of the plots 27 days after treatment indicated essentially the same trends in stimulation of weed emergence as were found at 20 days. Sodium azide at 4.5 kg/ha enhanced both grass and broadleaf populations by 130 to 150%, and the 9.0 kg/ha treatment caused nonsignificant 67 to 100% increases in emergence.

Counts were made of the redroot pigweed (*Amaranthus retroflexus* L.) and tumble pigweed (*Amaranthus albus* L.) populations 50 days after treatment. Analysis of the data showed that the 9.0 kg/ha sodium azide plots contained more pigweeds than the control plots. When the data were segregated into the redroot and tumble pigweed components, the results were significantly changed. Sodium azide at 9.0 kg/ha had no real effect upon the population of redroot pigweed but increased the population of tumble pigweed by a factor of three to four.

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THE USE OF $K^+/^{86}Rb^+$ FLUX AS A MEASURE OF HERBICIDE EFFECT

G. P. Albaugh, D. L. Regehr, and H. Frick[1/]

ABSTRACT

It has been observed in the field that diclofop has the ability to to chemically "prune" the root system of many annual grasses. This observation led to the speculation that ion flux into diclofop treated roots may be altered.

Work conducted with the primary roots of etiolated maize seedlings demonstrates that an exposure to 1×10^{-4} M diclofop for 15 minutes is required in vitro to cause a 50% reduction in apparent influx of $^{86}Rb^+$ in root segments assayed via liquid scintillation spectrometry.

The use of liquid scintillation counting as a tool for herbicide investigation offers certain advantages. Among these is the ability to ascertain whether a compound's activity is an external or internal phenomenon by noting the presence or absence of a lag time before effect is observed. If external (if no lag time is required), a variety of efflux experiments may be designed to distinguish between compounds which alter membrane permeability or cause the membrane to be "leaky", as opposed to those that inhibit initial uptake of $K^+/^{86}Rb^+$. These techniques are being used to compare diclofop with other phenoxy-phenoxy compounds.

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THE WEEDS OF LONG ISLAND III. SAURURACEAE TO PLATANACEAE

Richard Stalter [1]

ABSTRACT

The present study is a continuation of work dealing with the weeds of Long Island. The investigation included a survey of herbarium specimens in the Brooklyn and Bronx Botanical Gardens and field work by the investigator and his students in various habitats on Long Island from 1971 to the fall of 1979. This section is represented by thirty-eight families, one hundred thirty genera, and three hundred twelve species.

INTRODUCTION

A brief description of Long Island, its geology, soils and study sites has been previously described by the author (#3, #4). The objective of the present study was to identify the families, genera, and species of dicotyledonous plants native to Long Island. A second objective was to identify the troublesome weeds.

METHODS

The study was initiated in the summer of 1971 and continued until the fall of 1979, and involved an intensive investigation of a large variety of sites on Long Island previously described by the author (#3). These sites were visited by the author and his students and the taxa there were collected and identified. The author gratefully acknowledges the help provided by the taxonomists on Long Island and New York City. Taxa in Long Island collections and the Brooklyn and Bronx Botanical Gardens were examined in compiling the present list.

RESULTS AND DISCUSSION

Thirty-eight families, one hundred thirty genera, and three hundred twelve species have been identified in this section. Many of the species are our most common weeds including smartweed (*Polygonum* spp.), dock (*Rumex* spp.), lambs quarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), spiny pigweed (*Amaranthus spinosus*), carpet weed (*Mollugo verticillata*), common purslane (*Portulacca oleracea*), mouseear chickweed (*Cerastium vulgatum*), chickweed (*Stellaria*

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media), and pepper grass (Lepidium virginicum). While the aforementioned species pose a problem to the farmer, arborescent species deserve special consideration, especially to those who manage and maintain our rights-of-way. Woody members of the Juglandaceae, Corylaceae, Fagaceae, Moraceae, and Magnoliaceae can be considered troublesome "weeds" since their stature is not compatible to proper care and maintenance of power line, roadside, railroad, and pipeline rights-of-way. Control of undesirable woody vegetation, plant succession, and right-of-way management has been previously discussed (#2).

A list of the Saururaceae to Platanaceae follows. Classification follows that of Fernald (#1). Important weeds are preceded by an asterisk (*).

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Table 1. The flora of Long Island, Saururaceae - Platanaceae. An asterisk (*) preceeds troublesome weeds.

SAURURACEAE

Saururus cernuus L.

SALICACEAE

Populus alba L.
Populus balsamifera L.
Populus deltoides Marsh.
Populus grandidentata Michx.
Populus heterophylla L.
Populus tremuloides Michx.
Salix alba L.
Salix babylonica L.
Salix caprea L.
Salix cordata Michx.
Salix discolor Muhl.
Salix fragilis L.
Salix humilis Marsh.
Salix humilis Marsh.
var. microphylla (Anderss.) Fern.
Salix interior Rowler
Salix lucida Muhl.
Salix nigra Marsh.
Salix pentandra L.
Salix sericea Marsh.

MYRICACEAE

Comptonia Peregrina (L.) Coult.
var. asplenifolia (L.) Fern.
Myrica cerifera L.
Myrica gale L.
Myrica pensylvanica Loisel.

JUGLANDACEAE

Carya cordiformis (Wang.) K. Koch
*Carya glabra (Mill.) Sweet
Carya laciniosa (Michx.) Loud.
Carya ovalis (Wang.) Sarg.
*Carya ovata (Mill.) K. Koch
*Carya tomentosa Nutt.
Juglans cinerea L.
*Juglans nigra L.

CORYLACEAE

Alnus glutinosa (L.) Gaertn.
Alnus incana (L.) Moench
Alnus rugosa (DuRoi) Spreng.
Betula alba L.
*Betula lenta L.
*Betula lutea Michx. f.
*Betula populifolia Marsh.
Carpinus caroliniana Walt.
Corylus americana Walt.
Ostrya virginiana (Mill.) K. Koch

FAGACEAE

Castanea dentata (Marsh.) Borkh.
Fagus grandifolia Ehrh.
*Quercus alba L.
Quercus bicolor Willd.
Quercus coccinea Muenchh.
*Quercus ilicifolia Wang.
Quercus marilandica Muenchh.
*Quercus palustris Muenchh.
Quercus phellos L.
Quercus prinoides Willd.
Quercus prinus L.
*Quercus rubra L.
Quercus stellata Wang.
*Quercus velutina Lam.

ULMACEAE

Celtis occidentalis L.
Ulmus americana L.
Ulmus procera Salisb.
Ulmus rubra Muhl.

MORACEAE

Broussonetia papyrifera (L.) Vent.
Maclura pomifera Raf. Schneid.
*Morus alba L.
*Morus rubra L.

CANNABINACEAE

Cannabis sativa L.
Humulus japonicus Sieb. + Zucc.
Humulus lupulus L.

URTICACEAE

Boehmeria cylindrica (L.) Sw.
Laportea canadensis (L.) Wedd.
Pilea pumila (L.) Gray
Urtica dioica L.
Urtica gracilis Ait.
Urtica urens L.

SANTALACEAE

Comandra umbellata (L.) Nutt.

ARISTOLOCHIACEAE

Asarum canadense L.
var. reflexum (Bickn.) Robins.
Aristolochia clematitis L.
Aristolochia durior Hill
Aristolochia serpentaria L.

POLYGONACEAE

Fagopyrum sagittatum Gilib.
Polygonella articulata (L.) Meisn.
Polygonum arifolium L.
* Polygonum aviculare L.
Polygonum careyi Olney
Polygonum cilinode Michx.
Polygonum coccineum Muhl.
* Polygonum convolvulus L.
Polygonum erectum L.
Polygonum exsertum Small
Polygonum glaucum Nutt.
Polygonum hydropiper L.
Polygonum hydropiperoides Michx.
Polygonum lapathifolium L.
Polygonum opelousanum Riddell
Polygonum orientale L.
* Polygonum pensylvanicum L.
* Polygonum persicaria L.
Polygonum prolificum (Small) Robins.
Polygonum punctatum Ell.
Polygonum ramosissimum Michx.
Polygonum ramosissimum Michx.
forma atlanticum Robins
Polygonum sagittatum L.
Polygonum setaceum Baldw.
Polygonum tenue Michx.
* Rumex acetosella L.
Rumex conglomeratus Murr.
* Rumex crispus L.
Rumex hastatulus Baldw.
Rumex obtusifolius L.
Rumex orbiculatus Gray
Rumex patientia L.
Rumex persicarioides L.
Tovaria virginiana (L.) Raf.

CHENOPODIACEAE

Atriplex arenaria Nutt.
Atriplex patula L.
var. hastata (L.) Gray
Atriplex rosea L.
Bassia hirsuta (L.) Aschers.
Bassia hyssopifolia (Pall.) Ktze.
* Chenopodium album L.
Chenopodium ambrosioides L.
Chenopodium Bonus-Henricus L.
Chenopodium botrys L.
Chenopodium glaucum L.
Chenopodium hybridum L.
Chenopodium leptophyllum Nutt.
Chenopodium murale L.
Chenopodium polyspermum L.
Chenopodium rubrum L.
Chenopodium urbicum L.
Cycloloma atriplicifolium (Spreng.) Coult.
Kochia scoparia (L.) Roth
Roubieva multifida (L.) Moq.
Salicornia bigelovii Torr.
Salicornia euopaea L.
Salicornia virginica L.
Salsola kali L.
Salsola kali L.
var. tenuifolia Tausch
Suaeda americana (Pers.) Fern.
Suaeda linearis (Ell.) Moq.
Suaeda maritima (L.) Dumort.

AMARANTHACEAE

Acnida cannabina L.
Amaranthus crispus (Lesp. & Thev.) A. Br.
Amaranthus cruentus L.
Amaranthus deflexus L.
Amaranthus graecizans L.
Amaranthus hybridus L.
Amaranthus pumilus Raf.
* Amaranthus retroflexus L.
* Amaranthus spinosus L.
Amaranthus viridis L.

NYCTAGINACEAE

Mirabilis hirsuta (Pursh) MacM.
Mirabilis nyctaginea (Michx.) MacM.

PHYTOLACCACEAE

Phytolacca americana L.

AIZOACEAE

* Mollugo verticillata L.
Sesuvium maritimum (Walt.) BSP.
Tetragonia tetragonioides (Pall.) Ktze.

PORTULACACEAE

Claytonia virginica L.
Portulaca grandiflora Hook.
* Portulaca oleracea L.

CARYOPHYLLACEAE

Arenaria carolinana Walt.
Arenaria lateriflora L.
Arenaria peploides L.
* Arenaria serpyllifolia L.
Arenaria stricta Michx.
Cerastium arvense L.
Cerastium nutans Raf.
Cerastium semidecandrum L.
Cerastium viscosum L.
* Cerastium vulgatum L.
Dianthus armeria L.

Dianthus barbatus L.
Dianthus prolifer L.
*Lychnis alba Mill.
Lychnis coronaria (L.) Desr.
Lychnis dioica L.
Paronychia canadensis (L.) Wood
Sagina decumbens (Ell.) T. + G.
Sagina procumbens L.
Saponaria officinalis L.
Saponaria vaccaria L.
Scleranthus annuus L.
Silene armeria L.
Silene antirrhina L.
Silene caroliniana Walt.
Silene cserei Baumg.
Silene cucubalus Wibel
Silene nivea (Nutt.) Otth.
Silene noctiflora L.
Silene nutans L.
Silene stellata (L.) Ait. f.
*Spergula arvensis L.
Spergularia marina (L.) Griseb.
Spergularia marina (L.) Griseb. var. leiosperma (Kindb.) Gurke
Spergularia media (L.) C. Presl.
Spergularia rubra (L.) J. + C. Presl.
*Stellaria graminea L.
Stellaria holostea L.
Stellaria humifusa Rottb.
Stellaria longifolia Muhl.
*Stellaria media (L.) Cyrillo

CERATOPHYLLACEAE

*Ceratophyllum demersum L.

NYMPHAEACEAE

Brasenia schreberi Gmel.
Nuphar advena (Ait.) Ait. f.
*Nymphaea ordorata Ait.

RANUNCULACEAE

Actaea pachypoda Ell.
Actaea quinquefolia L.
Actaea virginiana L.
Anemonella thalictroides (L.) Spach.
Aquilegia vulgaris L.
Aquilegia palustris L.
Cimicifuga racemasa (L.) Nutt.
Clematis ochroleuca Ait.
Clematis viorna L.
Clematis virginiana L.
Delphinium ajacis L.
Hepatica americana (D.C.) Ker
Ranunculus abortivus L.
Ranunculus acris L.
Ranunculus bulbosus L.
Ranunculus fascicularis Muhl.
Ranunculus ficaria L.
Ranunculus flabellaris Raf.
Ranunculus hispidus Michx.
Ranunculus laxicaulis (T. & G.) Darby
Ranunculus recurvatus Poir.
Ranunculus repens L.
Ranunculus sceleratus L.
Ranunculus trichophyllus Chaix
Thalictrum dioicum L.
Thalictrum polygamum Muhl.
Thalictrum revolutum DC.
Trollius laxus Salisb.

BERBERIDACEAE

Berberis vulgaris L.

MENISPERMACEAE

Menispermum canadense L.

MAGNOLIACEAE

*Liriodendron tulipifera L.
Magnolia acuminata L.
Magnolia macrophylla Michx.
Magnolia tripetala L.
Magnolia virginiana L.

LAURACEAE

Lindera benzoin (L.) Blume
*Sassafras albidum (Nutt.) Nees

PAPAVERACEAE

Argemone mexicana L.
Chelidonium majus L.
Glaucium flavum Crantz
Sanguinaria canadensis L.

FUMARIACEAE

Dicentra cucullaria (L.) Bernh.
Fumaria officinalis L.

CAPPARIDACEAE

Cleome spinosa Jacq.

CRUCIFERAE

Alliaria officinalis Andrz.
Alyssum spp.

Arabis canadensis L.
Arabis glabra (L.) Bernh.
Arabis lyrata L.
Armoracia lapathifolia Gilib.
Barbarea verna (Mill.) Aschers.
Barbarea vulgaris R. Br.
Brassica juncea (L.) Coss.
Brassica kaber (DC.) L. C. Wheeler
var. pinnatifida (Stokes) L. C. Wheeler
*Brassica nigra (L.) Koch
*Brassica rapa L.
Cakile edentula (Bigel.) Hook.
Cakile maritima Scop.
Camelina sativa (L.) Crantz
*Capsella bursa-pastoris (L.) Medic.
Cardamine bulbosa (Schreb.) BSP.
Cardamine hirsuta L.
Cardamine parviflora L.
Cardamine pratensis L.
Cardamine pensylvanica Muhl.
Cardamine rotundifolia Michx.
Cardaria draba (L.) Desv.
Coronopus didymus (L.) Sm.
Dentaria laciniata Muhl.
Diplotaxis tenuifolia (L.) DC.
Draba reptans (Lam.) Fern.
Draba verna L.
Hesperis matronalis L.
Iberis amara L.
Lepidium campestre (L.) R. Br.
Lepidium densiflorum Schrad.
Lepidium ruderale L.
*Lepidium virginicum L.
Lobularia maritima (L.) Desv.
Lunaria rediviva L.
Nasturtium officinale R. Br.
Raphanus raphanistrum L.
Raphanus sativus L.
Rorippa islandica (Oeder) Borbas
Rorippa sinuata (Nutt.) Hitchc.
Sisymbrium altissimum L.
Sisymbrium officinale (L.) Scop.
Thlaspi arvense L.

RESEDACEAE

Reseda lutea L.

SARRACENIACEAE

Sarracenia purpurea L.

DROSERACEAE

Drosera filiformis Raf.
Drosera intermedia Hayne
Drosera rotundifolia L.

CRASSULACEAE

Sedum acre L.
Sedum purpureum (L.) Link

SAXIFRAGACEAE

Chrysosplenium americanum Schwein.
Heuchera americana L.
Heuchera villosa Michx.
Parnassia glauca Raf.
Penthorium sedoides L.
Philadelphus coronarius L.
Philadelphus inodorus L.
Ribes americanum Mill.
Ribes cynosbati L.
Ribes hirtellum Michx.
Ribes nigrum L.
Ribes odoratum Wendland f.
Ribes sativum Syme
Ribes triste Pall.
Saxifraga pensylvanica L.
Saxifraga virginiensis Michx.

HAMAMELIDACEAE

Hamamelis virginiana L.
*Liquidambar styraciflua L.

PLATANACEAE

Platanus occidentalis L.

THE WEEDS OF LONG ISLAND IV. ROSACEAE TO ARALIACEAE

Richard Stalter [1/]

ABSTRACT

This research is a continuation of work dealing with the weeds of Long Island. The study included a survey of herbarium specimens in the Brooklyn and Bronx Botanical Gardens and field work by the investigator and his students in various habitats on Long Island from 1971 to the fall of 1979. This section is represented by thirty-seven families, one hundred four genera, and three hundred fourteen species.

INTRODUCTION

Many taxonomists and plant systematists have contributed to the flora of Long Island including Jelliffe and the late Norman Taylor. The present study is a continuation and compilation of the flora indigenous to Long Island. The objective of the present study was to identify the dicotyledonous plants, Rosaceae to Araliaceae. A second objective was to identify troublesome weeds.

METHODS

Research was initiated in the summer of 1971 and continued until the fall of 1979, and involved an intensive investigation of a large variety of sites on Long Island previously described by the author (#2). These sites were visited by the author and his students and the taxa there were collected and identified. The author gratefully acknowledges the help provided by the taxonomists on Long Island and New York City. Taxa in Long Island collections and the Brooklyn and Bronx Botanical Gardens were examined in compiling the present list.

RESULTS AND DISCUSSION

Thirty-seven families, one hundred four genera, and three hundred fourteen species have been identified. The most troublesome weeds can be found in the Rosaceae: common cinquefoil (*Potentilla canadensis*), Virginia rose (*Rosa virginiana*), blackberry (*Rubus* spp.); the Legumimosae: beggarweed (*Desmodium* spp.), red clover (*Trifolium pratense*), white clover (*Trifolium repens*); and Anacardiaceae: poison ivy (*Rhus radicans*), poison oak (*Rhus toxicodendron*), and poison sumac (*Rhus vernix*). Other species pose special problems in specific habitats. In

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ponds and lakes, members of the Haloragaceae: watermilfoil (*Myriophyllum* spp.) and in bogs water willow (*Decodon verticillatus*) grow rapidly and may over-run their respective habitats. In farmer's fields, woodsorrel (*Oxalis* spp.), copperleaf (*Acalypha* spp.), spurge (*Euphorbia* spp.), velvet-leaf (*Abutilon theophrasti*), and common evening primrose (*Oenothera biennis*) may outcompete and suppress the growth of certain vegetable crops. Prickly pear cactus (*Opuntia humifusa*) is rare on Long Island and while a weed, might actually be encouraged because of its scarcity.

A list of the Rosaceae to Araliaceae follows. Classification follows that of Fernald (#1). Weeds are preceded by an asterisk (*).

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2. Stalter, R. 1979. The Monocotyledonous Weeds of Long Island. Proceedings of the Northeastern Weed Science Society 33: 83-89.

Table 1. The flora of Long Island. Rosaceae - Araliaceae. An asterisk (*) preceeds troublesome weeds.

ROSACEAE

Agrimonia gryposepala Wallr.
Agrimonia parviflora Ait.
Agrimonia pubescens Wallr.
Agrimonia rostellata Wallr.
Amelanchier canadensis (L.) Medic.
Amelanchier intermedia Spach
Amelanchier nantucketensis Bickn.
Crataegus arnoldiana Sarg.
Crataegus crus-galli L.
Crataegus intricata Lange
var. straminea (Beadle) Palmer
Crataegus pedicellata Sarg.
Crataegus pedicellata Sarg.
var. albicans (Ashe) Palmer
Crataegus pruinosa (Wendl.) K. Koch
Crataegus uniflora Muenchh.
Duchesnea indica (Andr.) Focke
Fragaria vesca L.
Geum aleppicum Jacq.
var. strictum (Ait.) Fern.
Geum canadense Jacq.
Geum canadense Jacq.
var. camporum (Rydb.) Fern.
Geum laciniatum Murr.
var. trichocarpum Fern.
Geum vernum (Raf.) T. &. G.
Geum virginianum L.
Keria japonica (L.) DC.
Potentilla anserina L.
Potentilla argentea L.
Potentilla arguta Pursh.
*Potentilla canadensis L.
Potentilla canadensis L.
forma ochroleuca (Weath.) Fern.
Potentilla intermedia L.
*Potentilla norvegica L.
Potentilla recta L.
Potentilla simplex Michx.
Prunus americana Marsh.
*Prunus avium L.
*Prunus cerasus L.
Prunus maritima Marsh.
Prunus pensylvanica L. f.
*Prunus serotina Ehrh.
Prunus susquehanae Willd.
Prunus virginiana L.
Pyrus arbutifolia (L.) L.f.
Pyrus communis L.
Pyrus malus L.
Pyrus melanocarpa (Michx.) Willd.
Rosa carolina L.
Rosa carolina L.
var. grandiflora (Baker) Rehd.
Rosa carolina L.
var. villosa (Best) Rehd.
Rosa eglanteria L.
Rosa multiflora Thunb.
Rosa palustris Marsh.
*Rosa virginiana Mill.
Rosa virginiana Mill.
forma nanella (Rydb.) Fern.
*Rubus allegheniensis Porter
Rubus argutus Link
Rubus canadensis L.
Rubus chamaemorus L.
Rubus cuneifolius Pursh
Rubus facetus Bailey
Rubus flagellaris Willd.
Rubus frondosus Bizel.
Rubus hispidus L.
Rubus idaeus L.
var. aculeatissimus Regel & Tiling
Rubus occidentalis L.
Rubus pensilvanicus Poir.
forma phyllophorus Fern.
Rubus phoenicolasius Maxim.
Rubus setosus Bigel.
Sanguisorba canadensis L.
Sorbaria sorbifolia (L.) A. Br.
Spiraea alba Du Roi
Spiraea latifolia (Ait.) Borkh.
Spiraea tomentosa L.

LEGUMINOSAE

Amorpha fruiticosa L.
Amphicarpa bracteata (L.) Fern.
Apios americana Medic.
Baptisia tinctoria (L.) R. Br.
Cassia fasciculata Michx.
Cassia hebecarpa Fern.
Cassia nictitans L.
Cercis canadensis L.
Cladrastis lutea (Michx. f.) K. Koch
Colutea arborecens L.
Coronilla varia L.
Crotolaria sagittalis L.
Cytisus scoparius (L.) Link
*Desmodium canadense (L.) DC.
*Desmodium ciliare (Muhl.) DC.
Desmodium cuspidatum (Muhl.) Loud.
Desmodium glabellum (Michx.) DC.
Desmodium laevigatum (Nult.) DC.
Desmodium marilandicum (L.) DC.
Desmodium nudiflorum (L.) DC.
Desmodium paniculatum (L.) DC.
Desmodium rigidum (Ell.) DC.
*Desmodium rotundifolium DC.
Desmodium virdiflorum (L.) DC.
Dolichos lablab L.
Galactia volubilis (L.) Britt.
*Gleditsia triacanthos L.
Gymnocladus dioica (L.) K. Koch
Lathyrus japonicus Willd.
var. glaber (Ser.) Fern.
Lathyrus palustris L.
Lathyrus palustris L.
var. myrtifolius (Muhl.) Gray
Lathyrus palustris L.
var. pilosus (Cham.) Ledeb.
Lathyrus latifolius L.
Lespedeza angustifolia (Pursh) Ell.
Lespedeza Brittonii Bickn.
Lespedeza capitata Michx.
Lespedeza capitata Michx.
var. velutina (Bickn.) Fern.
Lespedeza hirta (L.) Hornem.
Lespedeza intermedia (S.Wats.) Britt.
Lespedeza Nuttallii Darl.
Lespedeza procumbens Michx.
Lespedeza repens (L.) Bart.
Lespedeza Stuevei Nutt.
Lespedeza violacea (L.) Pers.
Lespedeza virginica (L.) Britt.
Lotus corniculatus L.
Lupinus perennis L.

Medicago lupulina L.
*Medicago sativa L.
Melilotus alba Desr.
Melilotus officinalis (L.) Lam.
* Phaseolus vulgaris L.
* Robinia hispida L.
Robinia pseudo-acacia L.
Strophostyles helvola (L.) Ell.
Strophostyles umbellata (Muhl.) Britt.
Tephrosia virginiana (L.) Pers.
Trifolium agrarium L.
Trifolium arvense L.
Trifolium dubium Sibth.
Trifolium hybridum L.
Trifolium incarnatum L.
Trifolium medium L.
* Trifolium pratense L.
Trifolium procumbens L.
* Trifolium repens L.
Vicia angustifolia Reichard
Vicia cracca L.
Vicia hirsuta (L.) S.F. Gray
Vicia sativa L.
Vicia tetrasperma (L.) Moench
* Wisteria frutescens (L.) Poir.
* Wisteria sinensis Sweet

LINACEAE

Linum intercursum Bickn.
Linum medium (Planch.) Britt.
Linum striatum Walt.
Linum sulcatum Riddell
Linum usitatissum L.
Linum virginianum L.

OXALIDACEAE

Oxalis corniculata L.
* Oxalis dillenni Jacq.
* Oxalis stricta L.
Oxalis violacea L.

GERANIACEAE

Erodium cicutarium (L.) L'Her.
Geranium carolinanum L.
var. confertiflorum Fern.
Geranium maculatum L.
Geranium molle L.
Geranium pusillum L.
Geranium Robertianum L.
Geranium sibiricum L.

RUTACEAE

Ptelea trifoliata L.
Ruta graveolens L.
Xanthoxylum americanum Mill.

SIMARUBACEAE

*Ailanthus altissima (Mill.) Swingle

POLYGALACEAE

Polygala brevifolia Nutt.
Polygala cruciata L.
Polygala Curtissii Gray
Polygala lutea L.
Polygala Nuttallii T. & G.
Polygala paucifolia Willd.
Polygala polygama Walt.
Polygala sanguinea L.
Polygala senega L.
Polygala verticillata L.
Polygala verticillata L.
var. ambigua (Nutt.) Wood

EUPHORBIACEAE

*Acalypha gracilens Gray
*Acalypha virginica L.
Euphorbia corolatta L.
Euphorbia cyparissias L.
Euphorbia humistrata Engelm.
Euphorbia ipecacuanhae L.
*Euphorbia maculata L.
Euphorbia marginata Pursh
Euphorbia peplus L.
Euphorbia polygonifolia L.
Mercurialis annua L.
Ricinus communis L.

CALLITRICHACEAE

Callitriche heterophylla Pursh
Callitriche palustris L.
Callitriche stagnalis Scop.

BUXACEAE

Pachysandra procumbens Michx.

EMPETRACEAE

Empetrum nigrum L.

ANACARDIACEAE

*Rhus copallina L.
*Rhus glabra L.
*Rhus typhina L.
*Rhus radicans L.

*Rhus vernix L.

AQUIFOLIACEAE

*Ilex glabra (L.) Gray
*Ilex laevigata (Pursh) Gray
Ilex opaca Ait.
Ilex verticillata (L.) Gray
Nemopanthus mucronata (L.) Trel.

CELASTRACEAE

Celastrus scandens L.
*Celastrus orbiculatus Thunb.
Euonymus americanus L.
Euonymus atropurpureus Jacq.
Euonymus europaeus L.

STAPHYLEACEAE

Staphylea trifolia L.

ACERACEAE

Acer campestre L.
Acer negundo L.
Acer platanoides L.
*Acer rubrum L.
Acer pseudo-platanus L.
Acer saccharum Marsh.
Acer saccharinum L.

HIPPOCASTANACEAE

Aesculus hippocastanum L.

SAPINDACEAE

Cardiospermum halicacabum L.

BALSAMINACEAE

Impatiens capensis Meerb.
Impatiens pallida Nutt.

RHAMNACEAE

Ceanothus americanus L.
Rhamnus cathartica L.

VITACEAE

*Parthenocissus quinquefolia (L.)
Parthenocissus tricuspidata (Sieb. & Zucc.) Planch.
*Vitis aestivalis Michx.
Vitis aestivalis Michx. var. argentifolia (Munson) Fern.
*Vitis labrusca L.
Vitis vulpina L.

TILIACEAE

Tilia americana L.

MALVACEAE

*Abutilon theophrasti Medic.
Althaea officinalis L.
Hibiscus moscheutos L.
Hibiscus syriacus L.
Hibiscus trionum L.
Kosteletzkya virginica (L.) Presl
Malva moschata L.
Malva rotundifolia L.
Malva sylvestris L.

GUTTIFERAE

Hypericum adpressum Bart.
Hypericum boreale (Britt.) Bickn.
Hypericum canadense L.
Hypericum denticulatum Walt. var. acutifolium (Ell.) Blake
Hypericum dissimulatum Bickn.
Hypericum ellipticum Hook.
Hypericum gentianoides (L.) BSP.
Hypericum majus (Gray) Britt.
Hypericum mutilum L.
Hypericum perforatum L.
Hypericum punctatum Lam.
Hypericum pyramidatum Ait.
Hypericum spathulatum (Spach) Steud.
Hypericum virginicum L.

ELATINACEAE

Elatine americana (Pursh) Arn.
Elatine minima (Nutt.) Fisch. & Mey.

CISTACEAE

Helianthemum canadense (L.) Michx.
Helianthemum Bicknellii Fern.
Hudsonia ericoides L.
Hudsonia tomentosa Nutt.
Lechea intermedia Leggett var. juniperina (Bickn.) Robins.
Lechea leggettii Britt. & Hollick

Lechea minor L.
Lechea maritima Leggett
Lechea racemulosa Michx.
Lechea tenuifolia Michx.
Lechea villosa Ell.

VIOLACEAE

Viola Brittoniana Pollard
Viola conspersa Reichenb.
Viola cucullata Ait.
Viola emarginata (Nutt.) Le Conte
Viola fimbriatula Sm.
Viola lanceolata L.
Viola mulfordae Pollard
Viola notabilis Bickn.
Viola odorata L.
Viola pallens (Banks) Brainerd
Viola palmata L.
Viola papilionacea Pursh
Viola pedata L.
Viola pedata L.
var. lineariloba DC.
Viola pensylanica Michx.
Viola primulifolia Michx.
Viola pubescens Ait.
Viola rotundifolia Michx.
Viola sagittata Ait.
Viola sororia Willd.
Viola triloba Schwein.

CACTACEAE

*Opuntia humifusa Raf.

THYMELACEAE

Dirca palustris L.

ELAEAGNACEAE

Elaeagnus angustifolia L.
Elaeagnus commutata Bernh.

LYTHRACEAE

Cuphea petiolata (L.) Koehne
*Decodon verticillatus (L.) Ell.
Lythrum salicaria L.
Rotala ramosior (L.) Koehne

NYSSACEAE

Nyssa aquatica L.
*Nyssa sylvatica Marsh.
Nyssa sylvatica Marsh.
var. biflora (Walt.) Sarg.

MELASTOMATACEAE

Rhexia virginica L.

ONAGRACEAE

Circaea quadrisulcata (Maxim.) Franch. & Sav.
Epilobium angustifolium L.
Epilobium coloratum Biehler
Epilobium glandulosum Lehm.
var. adenocaulon (Haussk.) Fern.
Epilobium hirsutum L.
Epilobium palustre L.
Epilobium palustre L.
var. oligantum (Michx.) Fern.
Epilobium latifolium L.
Epilobium strictum Muhl.
Gaura biennis L.
Ludwigia alternifolia L.
Ludwigia palustris (L.) Ell.
Ludwigia sphaerocarpa Ell.
*Oenothera biennis L.
Oenothera fruticosa L.
Oenothera fruticosa L.
var. humifusa Allen
Oenothera laciniata Hill
Oenothera parviflora L.
Oenothera parviflora L.
var. oakesiana (Robbins) Fern.
Oenothera perennis L.
Oenothera tetragona Roth
Oenothera tetragona Roth
var. velutina (Pennell) Munz

HALORAGACEAE

*Myriophyllum farwellii Morong
*Myriophyllum humile (Raf.) Morong
*Myriophyllum pinnatum (Walt.) BSP.
*Myriophyllum tenellum Bigel.
Proserpinaca palustris L.
Proserpinaca pectinata Lam.

ARALIACEAE

Aralia hispida Vent.
Aralia nudicaulis L.
Aralia racemosa L.
Aralia spinosa L.
Panax trifolius L.

THE WEEDS OF LONG ISLAND V. UMBELLIFERAE TO CAMPANULACEAE

Richard Stalter [1]

ABSTRACT

The present investigation is a continuation of work dealing with the weeds of Long Island. The study included a survey of herbarium specimens in the Brooklyn and Bronx Botanical Gardens and field work by the investigator and his students in various habitats on Long Island from 1971 to the fall of 1979. This section is represented by thirty-two families, one hundred fifty genera, and three hundred thirty-three species.

INTRODUCTION

The present work on the flora of Long Island is the last of five sections. One objective of the present study was to record and identify the families, genera, and species from the Umbelliferae to the Campanulaceae. A second objective was to identify the troublesome weeds.

METHODS

The study was initiated in the summer of 1971 and continued until the fall of 1979, and involved an intensive investigation of a large variety of sites on Long Island previously described by the author (#2). These sites were visited by the author and his students and the taxa were collected and identified. The author gratefully acknowledges the help provided by the taxonomists on Long Island and New York City. Taxa in Long Island collections and the Brooklyn and Bronx Botanical Gardens were examined in compiling the present list.

RESULTS AND DISCUSSION

Thirty-two families, one hundred fifty genera and three hundred thirty-three species have been identified in this section. One family, the Convolvulaceae, contains three genera: *Convolvulus*, *Cuscuta*, and *Ipomoea* that are a problem for the farmer. *Convolvulus* competes directly while *Cuscuta* may parasitize crops and desirable plants. Problem plants in this section include Queen Anne's lace (*Daucus carota*), wild parsnip (*Pastinaca sativa*), hemp dogbane (*Apocynum cannabinum*),

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periwinkle (Vinca minor), and common milkweed (Asclepias syriaca).

Two important crop plants in the Solanaceae, the potato (Solanum tuberosum) and tomato (Solanum esculentum) may persist for a year (or rarely two) on fields where they have been grown previously, do not compete well with native vegetation, and are not part of the "indigenous" flora of Long Island.

A list of the Umbelliferae to Campanulaceae follows. Classification follows that of Fernald (#1). Troublesome weeds are preceded by an asterisk (*).

LITERATURE CITED

1. Fernald, M. L. 1950. Gray's Manual of Botany. American Book Company, N. Y. 8th Edition. 1632 pp.

2. Stalter, R. 1979. The Monocotyledonous Weeds of Long Island. Proceedings of the Northeastern Weed Science Society 33: 83-89.

Table 1. The flora of Long Island, Umbelliferae - Campanulaceae. An asterisk (*) preceeds troublesome weeds.

UMBELLIFERAE

Aegopodium podagraria L.
Aethusa cynapium L.
Anethum graveolens L.
Angelica atropurpurea L.
Angelica venenosa (Greenway) Fern.
Carum carvi L.
Cicuta bulbifera L.
Cicuta maculata L.
Coelopleurum lucidum (L.) Fern.
Coriandrum sativum L.
Cryptotaenia candensis (L.) DC.
* Daucus carota L.
Foeniculum vulgare Mill.
Heracleum maximum Bartr.
Hydrocotyle americana L.
Hydrocotyle umbellata L.
Ligusticum scothicum L.
Lilaeopsis chinensis (L.) Ktze.
Osmorhiza claytoni (Michx.) C.B. Clarke
Osmorhiza longistylis (Torr.) DC.
Oxypolis rigidior (L.) C. + R.
* Pastinaca sativa L.
Petroselinum crispum (Mill.) Mansf.
Ptilimnium capillaceum (Michx.) Raf.
Sanicula canadensis L.
Sanicula gregaria Bickn.
Sanicula marilandica L.
Sium suave Walt.
Taenidia integerrima (L.) Drude
Thaspium trifoliatum (L.) Gray
Zizia aptera (Gray) Fern.
Zizia aurea (L.) W.D.J. Koch

CORNACEAE

Cornus alternifolia L. f.
Cornus amomum Mill.
Cornus florida L.
Cornus racemosa Lam.
Cornus stolonifera Michx.

CLETHRACEAE

Clethra alnifolia L.

PYROLACEAE

Chimaphila maculata (L.) Pursh
Chimaphila umbellata (L.) Bart.
Monotropa hypopithys L.
Monotropa uniflora L.
Pyrola elliptica Nutt.
Pyrola rotundifolia L.
var. americana (Sweet) Fern.
Pyrola virens Schweigger

ERICACEAE

Arctostaphylos uva-ursi (L.) Spreng.
Chamaedaphne calyculata (L.) Moench
Epigaea repens L.
Gaultheria hispidula (L.) Bigel.
Gaultheria procumbens L.
Gaylussacia baccata (Wang.) K. Koch
Gaylussacia dumosa (Andr.) T. + G.
Gaylussacia dumosa (Andr.) T. + G.
var. Bigeloviana Fern.
Gaylussacia frondosa (L.) T. + G.
* Kalmia angustifolia L.
* Kalmia latifolia L.
Leucothoe racemosa (L.) Gray
Lyonia ligustrina (L.) DC.
Lyonia mariana (L.) D. Don
Rhododendron calendulaceum (Michx.) Torr.
Rhododendron nudiflorum (L.) Torr.
Rhododendron viscosum (L.) Torr.
Vaccinium angustifolium Ait.
var. laevifolium House
Vaccinium atrococcum (Gray) Heller
Vaccinium caesariense Mackenz.
Vaccinium corymbosum L.
Vaccinium macrocarpon Ait.
Vaccinium oxycoccos L.
Vaccinium stamineum L.
Vaccinium vacillans Torr.

PRIMULACEAE

Anagallis arvensis L.
Hottonia inflata Ell.
Lysimachia ciliata L.
Lysimachia lanceolata Walt.
Lysimachia nummularia L.
Lysimachia quadrifolia L.
Lysimachia terrestris (L.) BSP.
Lysimachia thyrsiflora L.
Lysimachia vulgaris L.
Samolus parviflorus Raf.
Trientalis borealis Raf.

PLUMBAGINACEAE

Limonium carolinianum (Walt.) Britt.
Limonium carolinianum (Walt.) Britt.
var. angustatum Blake
Limonium nashii Small
Limonium nashii Small
var. trichogonum Blake

EBENACEAE

Diospyros virginana L.

STYRACACEAE

Halesia carolina L.

OLEACEAE

Chionanthus virginicus L.
* Fraxinus americana L.
Fraxinus pennsylvanica Marsh.
Ligustrum vulgare L.
Syringa vulgaris L.

LOGANIACEAE

Gelsemium sempervirens (L.) Ait. f.

GENTIANACEAE

Bartonia paniculata (Michx.) Muhl.
Bartonia virginica (L.) BSP.
Gentiana Andrewsii Griseb.
Gentiana clausa Raf.
Gentiana crinita Froel.
Gentiana saponaria L.
Menyanthes trifoliata L.
Nymphoides cordata (Ell.) Fern.
Sabatia angularis (L.) Pursh.
Sabatia campanulata (L.) Torr.
var. gracilis (Michx.) Fern.
Sabatia dodecandra (L.) BSP.
Sabatia stellaris Pursh.
Sabatia stellaris Pursh.
forma albiflora Britt.

APOCYNACEAE

Amsonia tabernaemontana Walt.
Apocynum androsaemifolium L.
* Apocynum cannabinum L.
* Vinca minor L.

ASCLEPIADACEAE

Asclepias amplexicaulis Sm.
Asclepias exaltata L.
Asclepias incarnata L.
Asclepias incarnata L.
var. pulchra (Ehrh.) Pers.
Asclepias purpurascens L.
Asclepias quadrifolia Jacq.
* Asclepias syriaca L.
Asclepias tuberosa L.
Asclepias variegata L.
Asclepias verticillata L.
Asclepias viridiflora Raf.
Cynanchum nigrum (L.) Pers.
Cynanchum vincetoxicum (L.) Pers.

CONVOLVULACEAE

*Convolvulus arvensis L.
*Convolvulus sepium L.
*Convolvulus sepium L.
forma malachophyllus Fern.
Convolvulus spithamaeus L.
*Cuscuta cephalanthi Engelm.
*Cuscuta compacta Juss.
*Cuscuta epilinum Weihe
*Cuscuta gronovii Willd.
*Cuscuta gronovii Willd.
var. latiflora Engelm.
*Cuscuta pentagona Engelm.
*Cuscuta polygonorum Engelm.
*Ipomoea purpurea (L.) Roth.

POLEMONIACEAE

Phlox drummondii Hook
Phlox paniculata L.
Phlox subulata L.

HYDROPHYLLACEAE

Hydrophyllum virginianum L.

BORAGINACEAE

Cynoglossum officinale L.
Echium vulgare L.
Hackelia virginiana (L.) I.M. Johnston
Heliotropium europaeum L.
Lappula echinata Gilib.
Lithospermum arvense L.
Lithospermum officinale L.
Myosotis laxa Lehm.
Myosotis scorpioides L.
Myosotis verna Nutt.
Onosmodium virginianum (L.) A. DC.
Symphytum asperum Lepechin
Symphytum officinale L.

VERBENACEAE

Verbena hastata L.
Verbena officinalis L.
Verbena simplex Lehm.
Verbena urticifolia L.

LABIATAE

Agastache nepetoides (L.) Ktze.
Ajuga reptans L.
Collinsonia canadensis L.
Cunila origanoides (L.) Britt.
Galeopsis tetrahit L.
Glechoma hederacea L.
Hedeoma hispida Pursh
Hedeoma pulegioides (L.) Pers.
Hyssopus officinalis L.
*Lamium amplexicaule L.
Lamium maculatum L.
Leonurus cardiaca L.
Lycopus americanus Muhl.
Lycopus amplectens Raf.
Lycopus europaeus L.
Lycopus rubellus Moench.
Lycopus uniflorus Michx.
Lycopus virginicus L.
Marrubium vulgare L.
Melissa officinalis L.
Mentha aquatica L.
Mentha arvensis L.
Mentha arvensis L.
var. villosa (Benth.) S.R. Stewart
Mentha cardiaca Baker
Mentha citrata Ehrh.
Mentha gentilis L.
Mentha longifolia (L.) Huds.

Mentha piperita L.
Mentha rotundifolia (L.) Huds.
Mentha spicata L.
Monarda didyma L.
Monarda fistulosa L.
Nepeta cataria L.
Origanum vulgare L.
Physostegia virginiana (L.) Benth.
Prunella vulgaris (L.) Fritsch
Pycnanthemum flexuosum (Walt.) BSP.
Pycnanthemum incanum (L.) Michx.
Pycnanthemum muticum (Michx.) Pers.
Pycnanthemum virginianum (L.)
Durand & Jackson
Satureja hortensis L.
Satureja vulgaris (L.) Fritsch
Scutellaria epilobiifolia A. Hamilton
forma albiflora (Millsp.) Fern.
Scutellaria integrifolia L.
Scutellaria lateriflora L.
Scutellaria parvula Michx.
Stachys hyssopifolia Michx.
Stachys palustris L.
Stachys tenuifolia Willd.
var. hispida (Pursh) Fern.
Teucrium canadense L.
Trichostema dichotomum L.

SOLANACEAE

*Datura stramonium L.
*Datura stramonium L.
var. tatula (L.) Torr.
Petunia axillaris (Lam.) BSP.
Petunia parviflora Juss.
Physalis heterophylla Nees.
Physalis maritima M.A. Curtis
Physalis pruinosa L.
Physalis pubescens L.
Physalis virginiana Mill.
*Solanum carolinense L.
*Solanum dulcamara L.
*Solanum nigrum L.
Solanum rostratum Dunal
*Solanum tuberosum L.

SCHROPHULARIACEAE

Chelone glabra L.
Digitalis purpurea L.
Gerardia acuta Pennell
Gerardia flava L.
Gerardia maritima Raf.
Gerardia pedicularia L.
Gerardia purpurea L.
Gerardia racemulosa Pennell
Gerardia setacea (Walt.) J.F. Gmel.
Gerardia tenuifolia Vahl.
Gerardia virginica (L.) BSP.
Gratiola aurea Muhl.
forma leucantha Bartlett
Gratiola virginiana L.
Limosella aquatica L.
Limosella subulata Ives
*Linaria canadensis (L.) Dumont
*Linaria vulgaris Hill
Lindernia anagallidea (Michx.) Pennell
Lindernia dubia (L.) Pennell
Melampyrum lineare Desr.
Melampyrum lineare Desr.
var. latifolium Bart.
Mimulus moschatus Dougl.
Mimulus ringens L.
Paulownia tomentosa (Thunb.) Steud.
Pedicularis canadensis L.
Pedicularis lanceolata Michx.
Penstemon digitalis Nutt.
Penstemon hirsutus (L.) Willd.
Penstemon pallidus Small
Scrophularia lanceolata Pursh
Verbascum blattaria L.
Verbascum thapsus L.
Veronica americana (Raf.) Schwein.
Veronica arvensis L.
Veronica anagallis-aquatica L.
Veronica chamaedrys L.
Veronica officinalis L.
* Veronica peregrina L.
Veronica persica Poir.
Veronica scutellata L.
Veronica serpyllifolia L.
Veronicastrum virginicum (L.) Farw.

BIGNONIACEAE

Catalpa bignonioides Walt.
Catalpa speciosa Warder

OROBANCHACEAE

Epifagus virginiana (L.) Bart.
Orobanche uniflora L.

LENTIBULARIACEAE

Utricularia cornuta Michx.
Utricularia fibrosa Walt.
Utricularia geminiscapa Benj.
Utricularia gibba L.
Utricularia inflata Walt.
Utricularia intermedia Hayne
Utricularia juncea Vahl
Utricularia minor L.
Utricularia purpurea Walt.
Utricularia resupinata B.D. Greene

Utricularia sublata L.
Utricularia sublata L.
forma cleistogama (Gray) Fern.
Utricularia vulgaris L.

PHRYMACEAE

Phyrma leptostachya L.

PLANTAGINACEAE

Plantago aristata Michx.
Plantago juncoides Lam.
*Plantago lanceolata L.
*Plantago major L.
Plantago media L.
Plantago pusilla Nutt.
Plantago rugelii Dcne.
Plantago virginica L.

RUBIACEAE

Cephalanthus occidentalis L.
Diodia teres Walt.
Galium aparine L.
Galium asprellum Michx.
Galium circaezans Michx.
Galium concinnum T. + G.
Galium erectum Huds.
Galium lanceolatum Torr.
Galium mollugo L.
Galium obstusum Bigel.
Galium pilosum Ait.
Galium tinctorium L.
Galium triflorum Michx.
Galium verum L.
Hedyotis uniflora (L.) Lam.
Houstonia caerulea L.
Houstonia longifolia Gaertn.
Mitchella repens L.

CAPRIFOLIACEAE

Diervilla sessilifolia Buckl.
Linnaea borealis L.
Lonicera dioica L.
* Lonicera japonica Thunb.
Lonicera morrowi Gray
Lonicera sempervirens L.
Lonicera tatarica L.
Sambucus canadensis L.
Symphoricarpos albus (L.) Blake
Triosteum angustifolium L.
Triosteum aurantiacum Bickn.
Triosteum perfoliatum L.
Viburnum acerifolium L.
Viburnum cassinoides L.
Viburnum dentatum L.
Viburnum lentago L.
Viburnum nudum L.
*Virburnum opulus L.
Viburnum prunifolium L.

VALERIANACEAE

Valeriana officinalis L.
Valeriana septentrionalis Rydb.
Valerianella olitoria (L.) Poll.

CUCURBITACEAE

Melothria pendula L.
Sicyos angulatus L.

CAMPANULACEAE

Campanula aparinoides Pursh.
Campanula glomerata L.
Campanula rapunculoides L.
Campanula rotundifolia L.
Jasione montana L.
Lobelia canbyi Gray
Lobelia cardinalis L.
Lobelia dortmanna L.
Lobelia inflata L.
Lobelia nuttallii R. + S.
Lobelia siphilitica L.
Lobelia spicata Lam.
Specularia perfoliata (L.) A. DC.

WEEDS OF THE WORLD. IIf., THE WEEDS OF INDIA AND ADJACENT REGIONS; IIg., THE WEEDS OF CHINA AND JAPAN. A SUMMARY.

Lawrence J. King[1/]

ABSTRACT. IIf., INDIA AND ADJACENT REGIONS

This is a summary of one section of a long-term project on the "Weeds of the World." In its original format this section comprises an introduction, and an alphabetical check-list of 429 species and varieties providing the Latin species and family names, life span and other biological data. Crop associations, distribution for certain regions, bibliographies and illustrations are also included.

INTRODUCTION

The "Weeds of the World" project has been in progress for about twenty-five years, and the present report comprises one of the final two sections of Vol. II, covering the regions of the Old World. This checklist of the weed flora of "India and Adjacent Regions" (16) has been prepared from the studies of a number of investigators noted below, and is the basis for the present summary. The recent work of Holm et al. (6) and of Reed (25) with their excellent coverage and bibliographies also should be consulted.

The subcontinent of India occupies a vast area of more than 1,269,420 square miles of Southern Asia. India and Burma have about 20,000 species of flowering plants; while in the peninsula south of the Indus and Ganges plains, there are perhaps not more than 4,000 native species (2).

The checklist of the weeds of India and Sri Lanka (Ceylon) has been compiled almost entirely from four very useful publications. "A Handbook of Some South Indian Weeds," by C. Tadulingam and G. Venkatanarayana (28) has been particularly useful since it covers principally the plains regions of the Madras Presidency. The small manual, "Weeds," by C. Thakur (29) has summarized the important characteristics of 106 weeds commonly found in the plains of northern India - in the area of Bihar. "A Weed Manual of Gwalior State" by L. A. Kenoyer (12) has summarized the data on some weeds of this area

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together with illustrations. An article by Vas Rao (16) has provided a list of weeds from Poona. "A Manual of the Weeds of the Major Crops of Ceylon," by J. C. Haigh (3) has provided data for 50 of the more common weeds of this area. A few records from Afghanistan are also included (30).

DISCUSSION AND SUMMARY

Two grass species, *Imperata cylindrica* ("Lalang Grass, Thatch Grass") and *Saccharum spontaneum* ("Kans Grass"), especially the former, are widespread and occupy vast areas that have been abandoned to agriculture. Species of *Loranthus* (*Dendrophthoe*), the genus of flowering parasites attached to the stems of woody plants, are extensive and are discussed in detail in Vol. 1. (See also, Kuijt (18), Singh (27), Hawksworth (5).) Species of witchweed, *Striga* (Scrophulariaceae), are widespread and quite damaging to tobacco and cereal crops including rice.

The total number of species and varieties listed as weeds or ruderals in the present checklist totals 429. From data in the checklist (16) the following genera were generally represented by 5 or more species of weeds (as indicated by the appended number):

Corchorus (5) (Tiliaceae)	*Ipomoea* (7) (Convolvulaceae)
Crotalaria (5) (Leguminosae)	*Justicia* (4) (Acanthaceae)
Cyperus (10) (Cyperaceae)	*Leucas* (6) (Labiatae)
Datura (4) (Solanaceae)	*Oldenlandia* (5) (Rubiaceae)
Euphorbia (6) (Euphorbiaceae)	*Phyllanthus* (4) (Euphorbiaceae)
Heliotropium (4) (Boraginaceae)	*Sida* (5) (Malvaceae)
Indigofera (6) (Leguminosae)	*Solanum* (4) (Solanaceae)

The weed flora of North Gujerat cotton fields in India have been studied (26). A total of 91 species are tabulated. Five principal weed communities were noted (mainly based on the soil moisture condition): (1.), dominant is *Echinochloa colonum*; (2), *Cynodon dactylon* with higher moisture; (3), *Chloria barbata* in drier patches; (4), *Cyperus rotundus* or *Eclipta alba* replaces the *Echinochloa* community when moisture becomes less. Species of *Alysicarpus*, *Epaltes*, *Vicoa*, *Merremia*, *Striga* and *Sporobolis* were abundant and received special study. The authors note that the weeds of the long-cultivated fields of India have come to a degree of equilibrium with the environment. They have a broad ecological amplitude and once adapted are not easily destroyed; while crops have a narrow ecological amplitude.

Additional comments on Indian weeds and recent references are included in the original checklist section (16).

ABSTRACT. IIg., CHINA AND JAPAN

This is a summary of one section of a long-term project on the "Weeds of the World." In its original format this section comprises an introduction, and an alphabetical checklist of 953 species and varieties for China, Taiwan, and Japan. The checklist provides the Latin species and family names, life span and other biological data. Crop associations, distribution for certain regions, bibliographies and illustrations are also included.

INTRODUCTION

The present study is a summary of one section of a long-term project on "Weeds of the World" (13, 14, 15). The checklist of the weed flora of "China and Japan" (16) has been prepared from the studies of a number of investigators noted below, and is the basis for the present summary. The studies of Holm et al. (6) and of Reed (25) with their excellent coverage and bibliographies also should be consulted.

Mainland China is three times the size of India, and the population is nearly one-quarter of the world's population. The most recent information reveals that Mainland China comprises nearly 3.7 million square miles and has a population of 960 million (1978 est.). Unofficial population estimates range upward to about 1.0039 billion in 1978. Taiwan has an area of 13,880 square miles and a population of 16.7 million.

The majority of the weed records included here for China has been taken from the study of Dr. Shiu-ying Hu (9) which included about 366 species. This work provides notes on food and medicinal uses and draws on the author's earlier publication (8), and from her extensive knowledge of the flora of China. A few additional records have been added from the publications of Porterfield (24) and Tutcher (see, 16).

Dr. Hu's study of the medicinal plants of Chengtu herb shops (8) provides the Latin, as well as the Chinese names for these plants - the majority being common weeds. A map of the city of Chengtu included in that study reveals the large number of these shops throughout the city. One can readily understand that the handling aspects (processing, shipping, dispersal, discarding of refuse, etc.) all could provide widespread dissemination of seeds. Thus some of these species may well have become weeds by virtue of these handling processes.

The Chinese and Japanese ideographs for "weed" have been discussed in Volume I (13). It is interesting that the literal translation here is "miscellaneous herb." There is no implication of harm or trouble here which is implied in the words "malerba," "malezea," of other languages.

The island of Taiwan (Formosa) with an area of 13,880 sq. miles lies off the coast of China between the Philippines on the south and Japan to the north. Taiwan has largely a tropical climate since the country lies within the Tropic of Cancer. Two studies of Taiwanese weeds, available in the earlier phase of this study, were those of Hu and Kang (7) and Huang and Chen (10). The former records the weeds of pineapple fields, and the latter examined the upland or dryland weeds on the grounds of the experiment station at Taiwan National University. These studies provided about 150 taxa for Taiwan and are included in the checklist. The more recent study of Lin et al. (19) should be noted.

Japan occupies an archipelago off the eastern coast of Asia, and comprises four main islands within the temperate zone. The land area covers 140,681 sq. miles with a population of 113.9 million according to the 1977 census (in 1950 the population was 83.2 million). Ohwi (23) states that the vascular flora of Japan comprises approximately 4,500 species and varieties.

The older work on the weeds of Japan is that of Hanzawa (4) listing about 635 taxa. The original source for the Japanese weeds of the present checklist was the study of Kasahara, which included some 519 taxa. Of this flora 302 species were upland weeds, 191 were from rice fields (paddies), and 76 were common to both habitats. Kasahara examined the origins of this weed flora and made some comparisons of the weed flora of other countries (see, 16). He cites a study of Yano on introduced plants: 90 originated from Europe, 60 from North America, 20 from South America, 42 from Asia, etc. Some 32 species were introduced from Europe through China. An additional 82 species were introduced from southeastern Asia and southern China some 2,000 years ago by an ancient group of people who brought rice culture to Japan. Kasahara (11) discusses the world dispersal of weeds and cites data from a number of authors (17, 21; see, 13).

In 1969 Dr. M. Numata, Professor of Botany at Chiba University in Japan, reviewed the checklist and revised some of the nomenclature, contributed valuable notes, and supplied a supplementary list of weeds. He is not only the author of a major work on weeds (see, 16) but has also co-authored (with N. Yoshizawa) a striking book, "Weed Flora of Japan Illustrated by Colour," (1975). It is in the Japanese language, but Latin names are used and the distribution, phenological data, and life-form are in English. Some 563 taxa are included. For the species of vascular flora included this comprises some 12.4 percent of the total vascular flora of Japan.

Additional comments on Japanese weeds and recent references are included in the original checklist section (16).

DISCUSSION AND SUMMARY

The total number of species and varieties listed as weeds or ruderals in the present checklist for China and Japan totals 953. The original checklist includes 904 species and varieties with some of these considered by Numata to be cultivated plants or not considered as weeds. His supplementary list of 58 species and varieties (not duplicated in the original checklist) brings the grand total to 953. A survey of the genera represented by nine or ten (or more) species and varieties (indicated by the number in parentheses) includes the following:

Amaranthus (9) (Amaranthaceae)	_Lindernia_ (9) (Scrophulariaceae)
Carex (9) (Cyperaceae)	_Polygonum_ (32) (Polygonaceae)
Eleocharis (9) (Cyperaceae)	_Ranunculus_ (9) (Ranunculaceae)
Eragrostis (12) (Gramineae)	_Rumex_ (9) (Polygonaceae)
Eriocaulon (10) (Eriocaulaceae)	_Scirpus_ (10) (Juncaceae)
Euphorbia (9) (Euphorbiaceae)	_Solanum_ (9) (Solanaceae)
Fimbrystylis (13) (Cyperaceae)	_Viola_ (9) (Violaceae)
Lactuca (9) (Compositae)	

The above tabulation reflects the taxonomic nature of weeds associated with the aquatic culture of rice (paddies). Weeds in the grass, sedge, rush, and knotweed families are relatively high. The plant associations of the rice fields of Japan and of Europe have been studied by Miyawaki (20), and he provides a map of the principal rice-field plant associations of the world.

The rice farmers of Szechuan certainly appreciate the menace of weeds. "The roily water makes the hoeing of his rice field impossible; so he does not hoe it; he toes it. With bare foot he feels about the plant with his toes, and if he finds a weed, he toes it out; then presses the dirt firmly in place again. With his right foot he toes two rows, with his left foot he toes two rows, and thus he toes four rows as he goes. That's the way he hoes." (_See_, 1). Modern advances in weed control probably have reduced this practice to an oddity. _Scirpus mucronatus_ var. _robustus_ is a "mimic" weed of rice, as the vegetative stages are difficult to distinguish from young rice plants.

SUMMARY OF VOLUME II

The brief account presented here summarizes the final two regional reports of Volume II. This entire volume with seven sections comprises a survey of the weed flora of some representative areas of "The Old World." In 1959 the sections were submitted in typed manuscript form to the original editor, Dr. Nicholas Polunin. A 25-year effort has been involved in writing and revising the three volumes - Volume I (published in 1966); Volume II (1976, 1979); and Volume III, "The New World" (1979, 1980).

Thus the total number of weed species and variety entries listed in all of Volume II is 5,317 (without correction for the duplication of the same names among the seven regional checklists).

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WEEDS OF THE WORLD. IIIa-e, THE WEEDS OF THE AMERICAS AND AUSTRALIA - A STATUS REPORT

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ABSTRACT

This abstracts the five sections of Volume III (North America North of Mexico; Mexico, Central America and the Islands of the Caribbean; South America; Australia and New Zealand; and Selected Islands of the Pacific). Surveys of weeds from published accounts for representative areas of the regions listed were, in the original format, presented in alphabetical checklists. These also provide introductions, Latin species and family names, life span and other biological data. Crop associations, distribution for certain areas, and bibliographies are also included. Short accounts for each of the above sections are based on these checklists, and they appear in this report. The number of weed species entries in Volume III, "The New World," totals 3,599. This number together with the 5,317 entries in Volume II, "The Old World," total 9,014 entries for the world survey (without correction for name duplication or possible errors in synonomy).

IIIa., THE WEEDS OF NORTH AMERICA NORTH OF MEXICO

North America north of Mexico comprises the United States (3.02 million square miles) and the state of Alaska (0.59 million square miles), as well as Canada (3.6 million square miles). This total area of the larger portion of the New World occupies some 14 percent of the total land area of the world. The total number of vascular species given in 1900 by A. Heller was listed at 16,673, and W. MaCoun (1883-1890) listed 3,209 species for Canada. Recent estimates indicate these values may be close to 20,000 species for North America. One very early account of American weeds is that of John Josselyn in 1672 (see, 6) who listed 40 European weeds for New England and associated their appearance generally with the introduction of cattle by the English settlers. William Darlington's "Weeds and Useful Plants" (1847) provided an early work, as did the weed book of E. Michener (1872). D. Halsted's "Checklist of American

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Weeds" (1894) provides a list of 817 names of vascular weeds arranged by families. Among the early state publications is that of F.L. Scribner of Maine (1870). An early Canadian publication is Prof. Thomas Shaw's "Weeds and How to Control Them" (Toronto, 1893). The well known manual of C. Frankton (1955) provides an excellent coverage for Canada. See also other references (11, 13, 14).

The weed checklist for North America north of Mexico has been prepared from a card file in which the majority of the weeds reported for this area were listed (10, IIIa). These data for the card file were taken from such original sources as state or provincial weed manuals, bulletins, etc. Thus the inclusion of a weed is based generally upon the fact that some state or other publication so classed it. Emil Korsmo (1930) has stated that in the north temperate zone the weed flora may constitute 8 to 10 percent of the entire vegetation. When using a value of 10 percent for the weed species of the entire vascular flora for this vast region (some 16,673 species) the number of weeds estimated for this area might then be about 1,667 species for North America. This may be compared to the actual figure of about 856 species included in the checklist. Some comparisons have been made (L. King, 1956): the 571 species listed in W.C. Muenscher's "Weeds" (2nd Edition, 1955) comprise about 10 percent of the 5,523 species covered in the area of Gray's Manual (8th Edition, 1950); and the 413 weeds listed for New York State by W.C. Muenscher constitute about 14 percent of the 2,876 vascular species included in the flora of New York State. The number of weed species and varieties provided in this regional checklist totals 856 (10, IIIa).

IIIb., THE WEEDS OF MEXICO, CENTRAL AMERICA, AND THE ISLANDS OF THE CARIBBEAN

Mexico is the southernmost country in North America, occupying some 758,000 square miles to the immediate south of the United States. Central America forms a land bridge from Mexico to South America and is about one-third the area of Mexico. The standard work on the trees and shrubs of Mexico (P. Standley, 1920-1926) includes about 5,700 species; while the catalog of M. Martinez (1937) includes a list of over 13,000 vernacular plant names. Weed lists utilized in the checklist were from several studies (M.A. Batalla, 1940; and I. Rivera and R. Breton, 1940) of the weeds of the Valley of Mexico and from C. Reiche's (1923) survey of the weeds of Mexico City. Some 13,422 species of vascular plants have been reported for both Central America and Mexico

(Honduras has 2,125). The weed records for Central America are taken from P. Standley's "Flora of the Panama Canal Zone" (1928), and from a few lists provided in his "Flora of the Lancetilla Valley, Honduras" (1931).

Older studies on the flora of the British West Indies (not including Cuba, Dominican Republic, and Puerto Rico) indicate some 4,400 species for this area. The weed list for this Caribbean area is taken principally from the work of I. Velez and J. Overbeek (1950) for Puerto Rico and of J. Roig (1933) for Cuba. A small list of Jamaican weeds is included from the work of G. Proctor (1957). Both L. Kasasian's "Weed Control in the Tropics" (5) and C.D. Adams et al., "Common Weeds of the West Indies" (1) have been helpful. A regional bibliography is available (3).

J. Roig (1933) observed that species in the families Malvaceae, Leguminosae, Gramineae, Rubiaceae and Compositae formed more than 50 percent of the spontaneous herbaceous flora of Cuba. Particularly noticeable in the present checklist are the species of weeds in the Rubiaceae (e.g. the genera Borreria, Coccocypselum, Chiococca, Gonzalagunia, Hemidiodia, Hillia and Randia). Particularly troublesome in sugar cane are "cohitri" or day flower (Commelina longicaulis and C. elegans) the strangling vine (Ipomoea liliacea, the stinging and irritable plant, "pica pica" (Mucuma pruriens), as well as the ubiguitous "coqui" (Cyperus rotundus). In Cuba "marabu" (Dichrostachys glomerata), introduced as an ornamental from Senegal, has escaped and spread rapidly into many areas, closing off roadways, and invading abandoned sugar cane fields. The number of weed species and varieties provided in this regional checklist totals 539 (10, IIIb).

IIIc., THE WEEDS OF SOUTH AMERICA

The South American continent occupies a total land area of some 6.86 million square miles - nearly eight percent of the total land surface of the world. The forested areas are estimated to cover about 43 percent of the continental area. Only some 2.8 percent of the total land area is considered suitable for agriculture - about one-half that of North and Middle America. The monumental "Brazilian Flora" of C. von Martius et al. (40 vols., 1840-1906) described 22,767 species - less than one-half of the estimated 50,000 species to be found there. Brazil is the largest country in South America and coffee production accounts for about 6 to 7 million acres - some 15 percent of the country's arable lands. The weeds of Brazil have been enumerated in a list of 229 species which excludes the Gramineae, Cyperaceae and noxious woody plants (Filho, 1956). The importance of the tank species of the largely epiphytic Bromeliaceae in relation to malaria has been presented in Volume I. One of the most serious pasture pests is "leiteiro (Tabernaemontana fuchsiaefolia). Others are "amendoim (Pterogyne nitens) and two members of the "cat's claw" family "monjoleiro" (Acacia polyphylla) and "unha de gato" (Acacia paniculata). A list of over a hundred noxious brush and other species identified in Brazilian pastures is provided by L. Quinn et al. (1956). An extensive bibliography is available (3).

Argentina lies almost wholly within the temperate zone, and except in the western areas it is a vast plain which has been easily colonized. The weeds of the flax and wheat crops have been studied by A. Gareiso and M. Sanguinetti (1944), F. Ibarra (1937), and L. Paroidi (1926). The Argentina weed record has been prepared from the latter publication and from that of R. Martinez Crovetto (1948). One of the principal weeds of concern is "sorgo de alepo" (Sorghum halepense). Others receiving considerable attention are Convolvulus repens, Avena fatua, Wedelia glauca, Artemisia spp., Oryza ruffipogon, Centaurea repens, Cyperus rotundus, Prosopis ruscifolia and species of Xanthium ("abrojo"), Cuscuta and the razor sedge, Scleria. The weeds of Chile are from a manuscript list of Munoz (1956). Those included for Bolivia are from a manuscript list of R. alcala (1956); while those of Uruguay and the LaPlata zone are from A. Boerger (1943). The study of F. Blackburn et al. (1952) has provided a list of the weeds of the sugar cane fields of Trinidad. The useful work of J. Cardenas et al., "Tropical Weeds" (2), with color plates and text in English and Spanish, should be noted. The number of weed species and varieties provided in this regional checklist totals 1,082 (10, IIIc).

VOLUMEIIId. THE WEEDS OF AUSTRALIA AND NEW ZEALAND

The Commonwealth of Australia encompasses some 2.97 million square miles and is located entirely within the southern hemisphere. This area is almost as great as the United States, or nearly two-thirds that of Europe. Over one-half of Australia is arid. It is the land where the members of the Myrtaceae are extensive - with more than 800 species. Of the 45 genera the most important one is Eucalyptus. The total flora of the continent includes some 12,000 species. Most of the serious Australian weed pests are introduced. Bassia birchii is an exception, since it is a native species. The introduced prickly pear cacti (Opuntia inermis and O. stricta) escaping from hedges and invading vast areas have been controlled by the Argentine moth-borer, Cactoblastis cactorum.

The weeds of wheat land include skeleton weed (*Chondrilla juncea*), introduced into Australia about 1914, the hoary cress (*Cardaria draba*), of world-wide distribution, is a deep rooted perennial spread by seeds and root pieces, Morning glory (*Convolvulus arvensis*) is a serious weed in wheat (especially in New South Wales) and of cotton, and in orchards. Wild oats (*Avena fatua*) ripen their seed just before the wheat, and the harvester machines help to spread this pest. The annual wild turnip (*Brassica tournifortii*) was introduced about 1914 and is mainly a pest of western Australian wheat fields. Other important weeds of arable land include nutgrass (*Cyperus rotundus*) and mint weed (*Salvia reflexa*) - an aggressive annual in Queensland poisonous to hungry stock unaccustomed to it.

Serious weeds of grazing lands include Noogoora burr (*Xanthium pungens*), and the Bathurst burr (*Xanthium spinosum*) - both causing heavy losses to the wool industry because of the ripe burrs in the fleece. St. John's wort (*Hypericum perforatum*) in New South Wales has invaded large areas of low-grade grazing country as well as areas of fairly good natural pasture. Galvanized burr (*Bassia birchii*) of drier inland areas of Australia has spread in bare areas of natural pastures. Lantana (*Lantana camera*) is a shrub pest of grazing lands and young forest plantations. Additional pests of pastures in the winter rainfall districts include blackberry (*Rubus fruticosus*), sweet briar (*Rosa rubiginosa*) and bracken (*Pteridium aquilinum*).

New Zealand comprises some 103,736 square miles, of which most is contained within four principal islands. It extends from the tropics to Antarctica, and two-thirds of the land area is suitable for farming. There were in 1940 at least one million acres of land occupied by bracken (*Pteridium* sp.). The burrs of *Acaena* reduce the market value of wool. Cows grazing on ragwort (*Senecio jacobaea*) will have the butterfat production reduced. Other serious weed pests include the blackberry (*Rubus fruticosus* etc.). The piri-piri (*Acaena* spp.) already mentioned for the burr damage to wool has been more successfully controlled by a species of sawfly. Some success has been achieved in the control of gorse (*Ulex europaeus*) by the use of a seed-weevil. L.J. Mathews (1956) has produced a handbook illustrating many of the important weed problems of New Zealand. The number of weed species and varieties provided in this regional checklist totals 567 (10, IIId).

IIIe., THE WEEDS OF SOME SELECTED ISLANDS OF THE PACIFIC

Since there are approximately 17,000 islands in the Pacific area, some limitation on coverage is most essential. For earlier periods this was largely regulated by the relatively few weed studies available for this vast region. It perhaps is the ultimate in simplification to attempt to prepare such a catalog. Even so, it has been attempted for some representative areas. The Hawaiian Islands, now the 50th State, are of special interest. H. St. John (1973) provides a list of Hawaiian flowering plants which totals 7,612 species and varieties - of which 2,744 are native (2,678 endemic), and 4,944 are cultivated or introduced. One early study was W.T. Pope's "Wayside Plants of Hawaii" (1929) listing some 160 species. An extensive study of field weeds was H. St. John and E. Hosaka's, "Weeds of the Pineapple Fields" (1932). The junior author, E. Hosaka, continued to study this group of plants, and his several studies (1945, 1954, 1957) form the basis for the checklist of Hawaiian weeds.

Indonesia comprises some 3,000 islands stretching for a distance of 3,000 miles. This region has an exceedingly rich and diversified flora. The extensive ecological study of the weed flora of Java by W.J.C. Koopers (1926) lists some 240 weeds and is included. Other well-known studies include the multi-volume work of C.A. Backer (1934, 1973) describing, with full illustrations some weeds of the sugar cane fields of Java, and his one volume work on weeds of the tea plantations (1924). These records are not included here. A few records from the Fiji Islands have been included. The Republic of the Philippines, largest island group in the Malay Archipelago (land area 115,000 square miles), comprises eleven islands. E. Merrill (1912) in a survey of the flora about the city of Manila found a total of 1,007 species. Of these 457 were purposely or inadvertently introduced by man, of which 232 grew spontaneously. Of this entire flora 812 extended to the Malay Archipelago, 789 to tropical Asia, 425 to tropical Australia, 355 to Polynesia, and 402 to tropical Africa.

E. Merrill (1932) notes that the American element is of particular interest as showing the effect of commerce on the vegetation of the country. From the time of the Spanish conquest, up to the year 1815, a period of nearly 300 years, the government galleons sailed annually for Manila, first from Navidad and later Acapulco, on the western coast of Mexico. He notes that <u>Elephantopus</u> (Compositae) comprises some 16 species, of which three are widely distributed in the Philippines: *E. scaber* (in most other tropical countries too), *E. spicatus*, and *E. mollis* all no doubt introduced from tropical America through the medium of the Acapulco-Manila galleons. Philippine weeds, principally from rice fields, were included in the checklist from B.C. Cabaillo (1925). In Volume I a chapter is devoted to parasitic plants and some attention was given to *Loranthus* spp., to *Aeginetia indica* on sugarcane, and to other flowering parasites of these islands. The later weed study of J. Pancho et al. (1969, see, 4) was not utilized here. The number of weed species and varieties provided in this regional checklist totals 653 (10, IIIe).

SUMMARY OF VOLUMES II AND III

This brief account presents a status report on the five regional sections of the final Volume III. This entire volume (10) comprises a catalog of the weed flora of some representative areas of "The New World." In 1959 the regional reports were first submitted in typed manuscript form to the original editor, Dr. Nicholas Polunin. A 25-year effort has been involved in issuing the three volumes - Volume I, published in 1966; Volume II, 1976, 1979 (revised); and Volume III, 1980 (largely unrevised). The nomenclature for the latter volume has yet to be checked by regional authorities. The world surveys of Holm et al. (4) and Reed (13) should be noted. The references cited throughout this paper can be found in the bibliography of the appropriate regional report (10); acknowledgments are also in these reports.

The total number of weed species and variety entries listed in Volume II, "The Old World," is 5,317 (without correction for the duplication of the same names among the seven regional checklists or possible errors in synonomy). The total number of weed species and variety entries listed in Volume III, "The New World," is 3,697. The latter number is subject to the same provisions as that stated for Volume II. The number of entries for the entire world survey (7-10) totals 9,014.

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RATE OF DISAPPEARANCE OF ATRAZINE AND ALACHLOR IN CORNFIELD SOILS

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ABSTRACT

The herbicides atrazine and alachlor are frequently sprayed as a mixture to control cornfield weeds. Kinetics of atrazine and alachlor disappearance from the upper elevation of a cornfield were studied during the growing season of 1976. The disappearance rate was first tested with a first order rate law and then with a power rate equation. Disappearance of alachlor from cornfield soils followed the first order rate law. The first order rate constants of alachlor disappearance (at initial application rate of 2.2 kg/ha) in field soils were 0.48-0.51 day^{-1}. The disappearance rate of atrazine is more complex. Disappearance rate of atrazine in the top 1 cm of soil followed the first order rate kinetics, but atrazine disappearance in 0-2.5 cm and 0-30 cm soil columns were tested with a non-linear regression analysis. For the top 30 cm plowed zone when the atrazine application rate was 0.8 kg/ha, regression analysis indicated that the disappearance rate was best described by the equation: Rate = $-dc/dt = kc^n$, with $n = 2.89 \pm 1.78$ and $k = 0.024 \pm 0.060$. The 90% loss time from the plowed zone (top 30 cm) was 45 days for alachlor and 298 days for atrazine. Application of an "Initial Rate" method to the kinetic study of herbicide disappearance in field soil is discussed.

INTRODUCTION

Persistence of herbicides is often desirable for control of weeds; non-persistence is desirable in order to avoid accumulation in the environment. If the natural disappearance rate is slower than the rate of introduction, herbicides will accumulate and contribute to the contamination of the soil environment. In order to reduce the quantity needed to effectively control many varieties of weeds, the use of a mixture of different herbicides is often desirable. In the cornfields of the Atlantic coastal plain of the U.S., mixtures of atrazine (2-chloro-4-ethylamino-6-isopropyl amino-1, 3, 5-triazine) and alachlor (2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide) are commonly used as pre-emergence herbicides for most broadleaf weeds and grasses.

The disappearance rates of atrazine and alachlor were studied for 148 days on a one acre cornfield. The field is situated at an elevation of 30 m and is at the highest topographic elevation of the local terrain. Thus, the herbicide concentration of field soils in this field received only one initial annual input during the spraying operation and was not subjected to continuous input from runoff or percolation of herbicides from higher elevations.

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$$\text{Rate of Disappearance} = -\frac{dc}{dt} = kc^n \qquad \text{Equation I}$$

where c is the residual herbicide concentration, n is the order of reaction, k is the rate constant, and t is the time after initial application. Integrating Equation I, if

$$n = 1 \qquad \ln C = \ln Co - kt \qquad \text{Equation II}$$

$$n = 1 \qquad C = [Co^{1-n} + (n-1)\,kt]^{1/1-n} \qquad \text{Equation III}$$

The first order kinetic rate (Equation II) is tested with the concentrations of atrazine and alachlor reported in Tables 1 and 2. A simple summation method is used to derive "total" residual concentration from herbicide concentrations at various depths within the soil columns. Table 3 summarizes the results of the first order correlation. The disappearance rate of alachlor from corn field soils at all depths (0-1, 0-2.5, and 0-30 cm) followed the first order kinetic rate law during the 1976 growing season. The disappearance rate of atrazine seems to be more complicated, although the rate of atrazine disappearance from the top 1 cm of the soil column followed the laws of first order kinetics. Atrazine in both 0-2.5 and 0-30 cm soil columns did not give a very strong correlation with the first order rate expression.

Table 1. Atrazine Concentration in the Soil Profile (ug/g)*

Day	Depth (cm) 0-1	1-2.5	2.5-5	5-8	8-12	12-18	18-24	24-30
1	4.74	3.26	.72					
2	1.44	1.92	.55					
3	1.32	3.74	1.32					
4	5.55	3.50	.53					
5	1.94	.36	.89					
6	2.13	.40	.58					
7	1.21	2.00	2.13	.47	.27			
10	2.53		.67	.67	1.91	.53		
15	1.34	1.04			.41			
37	.05			.15	1.03		.72	
64	.16	1.13						
109	0	.28	.43		.78			1.03
148	0	0	0	0	0	0	.83	

*Samples that showed concentrations below detection limit (< .01 ug/g) are left blank in this table.

EXPERIMENT

Sampling

In the spring of 1976, the soil was plowed to about 30 cm and planted with corn (Zea mays L). It was then sprayed with the herbicides atrazine and alachlor on May 18, 1976. Spraying rates were 830 g/ha for atrazine and 2214 g/ha for alachlor. At least three cores were taken on each of 13 sampling dates. Core segments at like depths were composited and kept frozen until chemical analysis for atrazine and alachlor. Soil moisture was measured with Delmhorst gypsum block moisture sensors and a Delmhorst model KS-1 moisture tester. Soil temperature was measured with Fenwall precision unicurve thermistors. Soil pH was measured with a hydrogen electrode system after suspension of an aliquot of soil core in one ml of distilled water per gram of soil and centrifugation. Percentage of organic matter, soil particle size distribution, and soil minerology were determined as previously described (6).

Chemical Analysis

Each sample of frozen soil was thawed and homogenized in a blender. Soil water content was determined by a weight loss method at 60° C (7). Fifteen grams of soil were extracted with 200 ml of 15:4:1 dichloromethane, hexane, and toluene (all pesticide grade). The organic extract was then concentrated and cleaned on a grade V alumina column. A Tracor 560 gas chromatograph equipped with a Nickel 63 electron capture was used for quantitation. An all glass column 1.8 m x 4 mm coiled and packed with 10% DC-200 on 80/100 GCQ was used. The percentage recovery of fortified soil on triplicate analysis was better than 86% for atrazine and better than 88% for alachlor.

RESULTS

Major soil minerals are montmorillonite, illite, kaolinite, and quartz (2-60 um); quartz generally accounted for more than 80% of particles larger than 60 um. The top one cm of soil had 3% organic matter, 26% clay, 28% silt, and 46% sand; pH was 5.1-5.5. The remaining lower soil segments showed 6-15% organic, 4-11% clay, 35-61% silt, and 35-45% sand; pH was between 5.2 and 7.1.

About 1.7 cm of rainfall occurred on the first day of herbicide application. During the period of the study (148 days), there was a total of 51 cm rainfall. During the growing season, major rainfall events (> 4 cm) occurred on June 16, July 10, August 14, August 27, September 16, and October 4, 11, and 20. Soil moisture of 200-300 mg H_2O/cc was generally found in all soil depth segments.

Atrazine concentrations in the soil are reported in Table 1. Alachlor concentrations are reported in Table 2. Due to the variability of the herbicide application rate to the field soils, herbicide concentrations detected were somewhat scattered. However, this has been the case for the majority of field application studies.

The disappearance rate of a herbicide from field soil can be tested with a power model method. In the power model method, the disappearance rate is expressed with a power function (Equation I).

Table 2. Alachlor Concentration in the Soil Profile (ug/g)*

				Depth (cm)				
Day	0-1	1-2.5	2.5-5	5-8	8-12	12-18	18-24	24-30
1	2.63	1.52	.26			.04		
2	.80	.95	.20					
3	5.02	1.47	.36	.03				
4	1.31	.40	.15	.07	.05			
5	.78	.41	.18	.03	.03			
6	3.53	.55	.17	.05		.04		
7	3.47	.84	.49	.14	.07	.05		
10	1.64	.81			.04	.11		.05
15	.50	.35	.11	.05				
37	.18	.04		.01				.03
64	.05							
109	.05					.02		
148	0	0	0	0	0	0	0	0

*Samples that showed concentrations below the detection limit (< .005 ug/g) are left blank in this table.

Table 3. Results of Disappearance Rates Tested with a First Order Kinetic Law

Herbicide	Depth	Initial Conc. Calculated (ug/g)	Rate Constant (1/Day)	Coefficient of Determination
Alachlor	0- 1 cm	2.1	0.048	0.89
	0- 2.5 cm	3.1	0.051	0.91
	0-30 cm	3.5	0.051	0.91
Atrazine	0- 1 cm	2.9	0.061	0.90
	0- 2.5 cm	4.6	0.046	0.74
	0-30 cm	5.1	0.012	0.60

For a complex system such as the field soil, it is somewhat unreasonable to expect that each herbicide would follow a simple first order rate law. It could be argued that since there are many competitive concurrent reactions in the soil environment, non-integers are often more representative of the "apparent" reaction orders of real field soils. A computer program (2) was employed to calculate non-linear regressions to describe changes of atrazine concentrations over periods of time in the 0-2.5 cm and 0-30 cm soil columns. Using Equation III and by making calculated curve - observed curve = minimum, the order of the disappearance rate can be determined. The order of the reaction and rate constants are obtained and are reported in Table 4. The disappearance curve of atrazine of the top 30 cm plowed zone obtained this way to best fit the data is illustrated in Figure 1.

Table 4. Best fit of data for the disappearance of atrazine from 0-2.5 cm and 0-30 cm cornfield soils during the 1976 growing season.*

	Initial Concentration	Rate Order	Rate Constant
0-2.5 cm	8.73 ± 3.85	1.95 ± 1.30	0.029 ± 0.056
0-30 cm	8.47 ± 3.40	2.89 ± 1.78	0.024 ± 0.060

*Rate law follows Equation III, concentration units are ug/g, time units are days. Predicted values and their asymptotic standard deviations are reported.

One of the primary needs in agricultural practice is to estimate the field loss time. Times required for the herbicides to disappear from the target soil are commonly expressed as 50% and 90% loss times from the original herbicide concentrations. Loss time is calculated with the obtained k, n, and Co values. For the top 30 cm plowed zone, 50% loss time is 14 days for either atrazine or alachlor; 90% loss time is 45 days for alachlor, but 298 days for atrazine.

DISCUSSION

Published values of disappearance rates of atrazine and alachlor from field soils are not plentiful, although data from laboratory studies are available. For example, first order kinetics were reported for atrazine hydrolysis in an aqueous solution (1) and recently in an aqueous fulvic solution (5). Zindahl et al (8) believed that the first order kinetics of some herbicides in soil are due to the fact that soil, moisture, and microorganisms were already in abundance and capable of becoming non-limiting. Hamaker (4) pointed out that, often, a soil-herbicide complex is largely responsible for herbicide degradation and that in many cases, the "apparent" first order kinetics may actually follow a hyperbolic type of rate law.

The majority of herbicide concentrations in field soils have been studied and reported only descriptively in the literature. Few studies have endeavored to analyze the kinetics of disappearance rates. Disappearance of herbicides in field soils is due to various concurrent processes such as degradation by microorganisms, decomposition due to chemical reactions, loss to the atmosphere due to volatilization, transport out of the zone of application through leaching and runoff processes, and other removal methods such as photodecomposition and plant uptake.

Practical methods to study the kinetics of herbicide disappearance rates in fields include the hyperbolic model and the power model. Hamaker (3) observed that a simple hyperbolic rate model does not usually fit the disappearance curves. A better fit is usually found with the power model. This does not necessarily negate the suggestion that the underlying process may be catalytic and follow the hyperbolic rate law. The overall form of the reaction curve does not necessarily correspond to the basic mechanism of the reaction due to modifying factors.

High sampling variance in field soil is common. A kinetic study which took only a few soil cores would introduce a large sampling error, mainly due to uneven application of herbicides in the fields. This probably explains, in part, the difficulty of obtaining a satisfactory disappearance curve for atrazine. Another difficulty in the disappearance study is that different kinetic equations would be derived from different application rates. In the future, we propose to apply the "initial rate" method as an alternative to the conventional rate model of power or hyperbolic functions.

The "initial rate" method involves choosing a single sampling time (determined from previous study information) for residual soil analysis. Many pairs of initial and residual herbicide concentrations, corresponding to various application rates, will be used as data points for a kinetic equation. If we assume that the disappearance rate follows the form of Equation IV, where k_{ex} is the experimental rate constant, c_{oi} is the initial concentration of component i in the reaction mixture, and x_i is the order of the reaction in component i.

$$\text{Rate}_{\text{initial}} = k_{ex} \prod_i (c_{oi})^{x_i} \qquad \text{Equation IV}$$

Using the van't Hoff order determination technique of taking the logarithm of both sides,

$$\log(\text{Rate}_{\text{initial}}) = \log k_{ex} + \sum_i x_i \log(c_{oi}) \qquad \text{Equation V}$$

If the concentration of all the reactants except the jth are held constant, then a plot of log ($\text{Rate}_{\text{initial}}$) vs. log ($c_{oj}$) will be a straight line with a slope x_j, the order of the reaction in the jth component, and an intercept, at log (c_{oj}) = 0, of $\log k_{ex} \prod_{i \neq j} (c_{oi})^{x_i}$. $\text{Rate}_{\text{initial}}$ can be estimated by the difference between initial and residual herbicide concentrations and the time span involved. This technique may be applied by measuring the initial rate of several herbicide application rates holding all variables constant except the concentration of c_{oj} (initial herbicide concentration which is directly dependent on application rate).

CONCLUSION

Downward movement of atrazine as reported in Table 1, indicates that year long carry over of atrazine in the top 30 cm plowed zone is possible. The 50% and 90% loss time of alachlor are similar for the top 1 cm and for the entire top 30 cm soil zone. In situ degradation and evaporation, rather than leaching, are apparently the major processes in the disappearance of alachlor from the fields.

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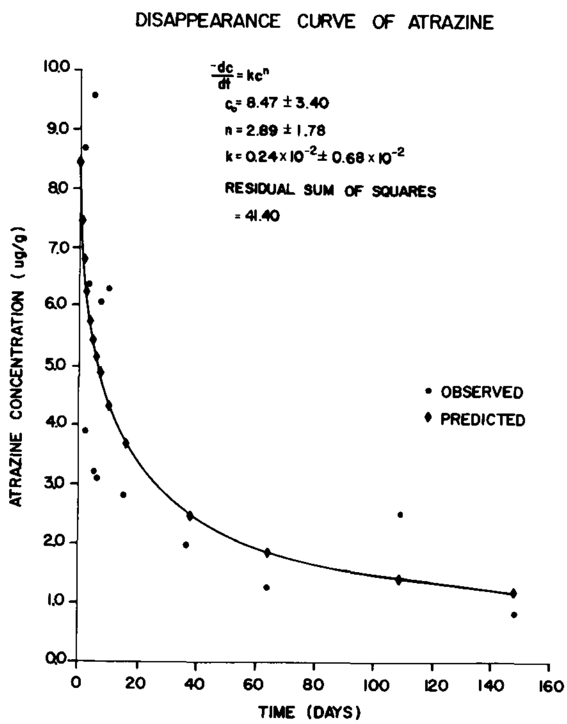
Figure 1. Disappearance curve of atrazine from 0-30 cm soil of a cornfield duing the 1976 growing season. The curve is the result of a non-linear regression analysis with n ≠ 1.



ECONOMIC LOSSES IN VEGETABLES DUE TO WEEDS[1/]

P.L. Minotti[2/]

ABSTRACT

A 1979 survey indicates that weed related economic losses in the northeast for 15 commercially grown vegetables, not including potatoes, was $27,577,955. As high as this figure is, it grossly understates the extent of the total loss for these reasons: 1) several minor vegetables were not included; 2) estimates were based primarily on the operation of successful commercial growers; 3) small acreages not appearing in the USDA Crop Reporting Service, with a few exceptions, were not included; and 4) home gardens were completely ignored. Based on 431,065 acres, an average economic loss of $64 per acre can be calculated for the 15 vegetables as a group. This is rather meaningless since individual crops varied from a low of $20 per acre to a high of $262 per acre. As expected, the percentage of per acreage cost attributable to herbicides and their application varied tremendously with the individual vegetable crop.

INTRODUCTION

This report is a contribution to a wider effort to assess weed-caused economic losses in the United States. It was undertaken in response to a request from G.W. Selleck, the WSSA Weed Losses Representative for the Northeast Region. Other northeast reports have been presented for potatoes (2), soybeans (3) and forage legumes (1).

MATERIALS AND METHODS

Several experiment station workers and extension agents were asked to supply estimates on individual vegetable crops according to the format in Table 1. Precisely how they arrived at the figures is not known, but one should appreciate that these figures come from professionals who have regular contact with growers and spend considerable time in the fields during the growing season. Past reports dealing with only one crop reported separate estimates from each of the states with substantial acreages. It did not make sense to this worker to try and lump vegetables together as a group since onions, vine crops, sweet corn and tomatoes (to mention a few) have very little in common. To avoid excessive bulk, the lesser of two evils seemed to be to report vegetables separately and lump together the information from the separate states. To do this, a rough weighted average was used. Thus, for example, if 90% of the onions are grown on the muck soils of NY state, then the averages will look more like estimates received from the muck areas than from Long Island or New Jersey. The weighted averages for areas reporting were applied in some cases to areas with significant acreage from which no information was received. States listed

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in Tables 1a,b,c are in the order of acreage planted for any particular crop.

RESULTS AND DISCUSSION

The total estimated losses were $27,577,955 (Table 1a,b,c). Of this amount $17,122,658 or 62% was for control measures such as herbicide cost and application, cultivation, handweeding and extra land preparation. The remainder was attributed to crop losses resulting from weed competition, herbicide injury, reduction in quality and extra harvesting expense. This proportion varied tremendously depending on the individual vegetable. The same can be said for per acre comparisons. For example, sweet corn and cauliflower showed very modest per acre weed-caused losses of $27 and $20 respectively. On the other hand, onion, melons (watermelons and cantaloupes) and peppers showed very high per acre costs of $194, $200 and $262 respectively. The proportion of the onion cost spent for control measures was 91% and most of that went for herbicides. The proportion of the pepper cost spent for control measures was about 60% but very little of that went for herbicides. In contrast, only 24% of the melon cost went for control measures; losses were due primarily to weed competition, reduced quality and herbicide injury.

The total loss figure of $27.6 million presents only a part of the story. Many minor vegetables were not included, such as asparagus, squash, pumpkins, parsnips, celery, spinach, endive, escarcole, eggplant, broccoli, Brussels sprouts, dry beans other than red kidney, rhubarb, Chinese cabbage, sweet potatoes, Swiss chard and various pot herbs and greens, just to name a few. In addition, minor acreages of many of the reported crops escaped the totals. Moreover, losses realized from commercial growers who are in the same business year after year are likely to be less than those realized by the less experienced. Finally, home gardens have been completely ignored. If the average gardener spent only three hours per year weeding, his labor should be worth $10. Multiply that by the number of home gardens in the northeast and I predict one would arrive at another astronomical figure.

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Appreciation is expressed to the following individuals who contributed information to the survey: Carol MacNeil, Dan B. Grad, Mike Orzolik, Ted Flanagan, Dale Young, Bill Sanok, Ed Rutkowski, Dick Ashley and Robert Precheur, and cooperating vegetable growers.

FOOTNOTE

I emphasized the fact that the figures in the tables are simply compilations of estimates. Some items such as herbicide costs can be figured accurately, while others are at best educated guesses and vary considerably from source to source. Because they happen to be on paper does not mean they are gospel; they are simply the best we could do with what was available and are probably better than nothing at all. They are offered for what they are worth and nothing more.

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TABLE 1a. Estimated weed-caused expenses in the northeast for sweet corn, snap beans, dry beans, lima beans and tomatoes. Fresh market and processing acreage has been lumped together.

	Sweet Corn	Snap Beans	Dry Beans	Lima Beans	Tomatoes
N.E. ACREAGE	108,875	104,410	32,000	17,000	41,390
STATES	NY,PA,MD,NJ,MA CT,DE,VA,VT	NY,DE,VA,MD,NJ, PA	NY	DE,MD	NJ,VA,MD,PA, NY,MA
HERBICIDES & APPLICATION					
percent treated	95	99	100	100	98
average $ acre	$22	$24	$24	$35	$25
total cost	$2,275,488	$2,480,782	$ 768,000	$ 595,000	$1,014,055
CULTIVATION, HANDWEEDING, EXTRA LAND PREPARATION					
percent involved	45	30	100	10	15
average $ acre	$ 5	$ 8	$ 6	$30	$45
total cost	$ 244,969	$ 250,584	$ 192,000	$ 51,000	$ 279,382
HERBICIDE INJURY					
percent involved	<1	5	2	5	4
average $ acre	$25	$40	$40	$200	$100
total cost	$ 15,000	$ 208,820	$ 25,600	$ 170,000	$ 165,560
COMPETITION YIELD					
percent involved	5	8	5	15	13
average $ acre	$50	$90	$80	$200	$250
total cost	$ 272,186	$ 751,752	$ 128,000	$ 510,000	$1,345,175
REDUCED QUALITY LOSS					
percent involved	2	1	5	5	10
average $ acre	$30	$338	$20	$100	$100
total cost	$ 65,325	$ 352.872	$ 32,000	$ 85,000	$ 413,900
INCREASED HARVESTING COST					
percent involved	7	4	5	5	11
average $ acre	$10	$35	$60	$40	$55
total cost	$ 76,213	$ 146,174	$ 96,000	$ 34,000	$ 250,410
TOTAL WEED EXPENSE	$2,949,181	$4,190,984	$1,241,600	$1,445,000	$3,468,482
AVERAGE PER ACRE LOSS	$27	$40	$39	$85	$84

TABLE 1b. Estimated weed-caused expenses in the northeast for cabbage, onions, cucumbers, melons and peas. Fresh market and processing acreage has been lumped together.

	Cabbage	Onions	Cucumbers	Melons	Peas
N.E. ACREAGE	29,040	15,650	23,400	6,750	22,500
STATES	NY,NJ,PA,VA,MA, MD	NY,NJ	VA,MD,NJ,NY,CT DE	DE,MD,VA,NY	DE,MD,NY,PA
HERBICIDES & APPLICATION					
percent treated	92	100	96	85	75
average $ acre	$18	$160	$36	$36	$38
total cost	$ 480,902	$2,504,000	$ 808,704	$ 206,550	$ 641,250
CULTIVATION, HANDWEEDING, EXTRA LAND PREPARATION					
percent involved	90	50	50	35	20
average $ acre	$25	$35	$50	$50	$30
total cost	$ 653,400	$ 273,000	$ 585,000	$ 118,125	$ 135,000
HERBICIDE INJURY					
percent involved	<1	30	15	22	5
average $ acre	--	$50	$125	$360	$100
total cost	$ --	$ 234,750	$ 440,625	$ 534,600	$ 112,500
COMPETITION YIELD					
percent involved	10	<1	10	25	20
average $ acre	$70	$200	$200	$200	$130
total cost	$ 203,280	$ 15,650	$ 468,000	$ 337,500	$ 585,000
REDUCED QUALITY LOSS					
percent involved	<1	<1	10	15	10
average $ acre	$100	--	$100	$150	$50
total cost	$ 14,520	$ --	$ 234,000	$ 151,875	$ 112,500
INCREASED HARVESTING COST					
percent involved	10	<1	20	--	20
average $ acre	$15	$60	$20	--	$20
total cost	$ 43,560	$ 8,700	$ 93,600	$ --	$ 90,000
TOTAL WEED EXPENSE	$1,395,662	$3,036,100	$2,629,929	$1,348,650	$1,765,750
AVERAGE PER ACRE LOSS	$48	$194	$112	$200	$78

TABLE 1c. Estimated weed-caused expenses in the northeast for peppers, lettuce, red beets, cauliflower and carrots. Fresh market and processing acreage has been lumped together.

	Peppers	Lettuce	Red Beets	Cauliflower	Carrots
N.E. ACREAGE	9,250	7,700	5,300	4,300	3,500
STATES	NJ,NY,CT	NY,NJ	NY	NY	NY,DE
HERBICIDES & APPLICATION					
percent treated	90	99	100	90	100
average $ acre	$14	$19	$27	$14	$45
total cost	$ 116,550	$144,837	$143,100	$54,180	$157,500
CULTIVATION, HANDWEEDING, EXTRA LAND PREPARATION					
percent involved	80	100	100	10	10
average $ acre	$180	$38	$57	$20	$40
total cost	$1,332,000	$292,600	$302,100	$ 8,600	$ 14,000
HERBICIDE INJURY					
percent involved	<1	10	25	--	5
average $ acre	--	$100	$80	--	$80
total cost	$ --	$ 77,000	$106,000	$ --	$ 14,000
COMPETITION YIELD					
percent involved	10	<1	<1	--	15
average $ acre	$800	--	--	--	$600
total cost	$ 740,000	$ --	$ --	$ --	$315,000
REDUCED QUALITY LOSS					
percent involved	10	<1	--	10	5
average $ acre	$100	--	--	$40	$80
total cost	$ 92,500	$ --	$ --	$17,200	$ 14,000
INCREASED HARVESTING COST					
percent involved	20	10	--	10	5
average $ acre	$75	$20	--	$10	$40
total cost	$ 138,750	$ 15,400	$ --	$ 4,300	$ 7,000
TOTAL WEED EXPENSE	$2,419,800	$529,837	$551,200	$34,280	$521,000
AVERAGE PER ACRE LOSS	$262	$69	$104	$20	$149

INTEGRATED WEED CONTROL PROGRAMS FOR CARROTS AND TOMATOES

R. C. Henne and T. L. Poulson [1/]

ABSTRACT

Several weed control systems involving hoeing, cultivation, and herbicides were evaluated using carrot and tomato crops. Hand hoeing was the most expensive method employed. Mechanical cultivation, while the least costly, permitted in-row weed escapes which competed strongly with the crops, reducing tomato yields by 36% and preventing carrot roots from reaching marketable size. A program utilizing only herbicides was relatively economical; however, in the tomato experiment black nightshade escapes, and in the carrot experiment, smartweed escapes prevented these crops from reaching their maximum yield potential and consequently, net dollar returns were compromised. Integrated programs, with mechanical cultivation assisting herbicides for tomatoes, and limited hand hoeing supplementing carrot herbicides, resulted in the most efficient weed control systems for these two crops.

INTRODUCTION

As agriculture faces its responsibilities to maximize the efficiency with which our limited fossil fuel resources are utilized, it is incumbent on weed scientists to develop the lowest cost or most economical weed control programs possible by integrating mechanical, hand labor and chemical means.

Preliminary work with tomatoes (*Lycopersicon esculentum* Mill.) in 1977 and 1978 (1) produced conflicting results in that in 1977, with low weed pressure, a weed control program employing only mechanical cultivation was found to be most efficient and economical; whereas, in 1978, with greater weed pressure, this was the least effective method and herbicides alone were considered most promising. This study was continued with tomatoes in 1979 to verify earlier findings and expanded slightly to help separate the contributions of various components of the programs. A similar experiment was designed using carrots (*Daucus carota* L.) to determine what factors are involved in developing an economical integrated weed control program for this crop.

MATERIALS AND METHODS

Tomatoes. This experiment was located on a sandy loam soil with 2.6% organic matter. Three-row plots 6.1 m long with rows spaced 1.5 m apart were replicated four times in a randomized block design. Land was prepared following preplant herbicide application on May 17 by rototilling the entire experimental area 7.5 cm deep. All herbicide treatments were applied using a bicycle plot sprayer delivering 309 l/ha at 2.1 cm^2 pressure. Variety Campbell '38' was transplanted the following day with in-row spacing averaging 27 cm. Postplanting metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4H)-one) treatments were applied on June 11 after transplants were well established and a few weed seedlings were emerging.

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Mechanical cultivation operations were done on June 12 and weeding and hoeing on June 14. Hand weeding time was recorded for each plot. Additional cultivations and hand weedings were carried out and the date of these operations noted in Table 1. The number and identity of in-row weed escapes in plots receiving only mechanical cultivation were recorded as a measure of weed pressure for this experiment. Weed escapes in this treatment and the one receiving "herbicides alone" were allowed to compete with the crop for the entire growing season. Plots were hand harvested on August 27 and September 12.

Carrots. This experiment was located on the same soil type as the tomatoes. Four-row plots 6.1 m long, spaced 75 cm apart, were replicated four times in a randomized block design. Preplant treatments of trifluralin (a,a,a-trifluoro-2, 6-dinitro-N,N-dipropyl-p-toluidine) were made May 1 using a rototiller to incorporate the material 7 cm deep. Variety Danvers 126 was sown the same day. Initial postemergence treatments of linuron (3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea) were applied June 4 to carrot seedlings in the 2 to 3 leaf stage while weeds were mostly 2 to 5 cm tall. Cultivations also were initiated on June 4 and hand hoeing started on June 5. Additional cultivations and weedings are noted in Table 2. Weed escapes in plots receiving only cultivation or "herbicides only" were allowed to compete with the crop the entire season. The identity and number of weeds in the plots receiving cultivation only treatments were recorded as a measure of weed pressure for this experiment. Carrots were harvested on September 7 and roots graded as marketable, small (less than 2.5 cm in diameter) and culls (forked, rotten, and growth cracked carrots).

RESULTS AND DISCUSSION

In order to conduct an economic cost analysis for the various weed control programs evaluated, a number of monetary values were assigned to the various components and these are noted in the footnotes of Tables 1 and 2. While costs and prices are variable items depending on the year, farm equipment used, and location in the country, they are used here to illustrate relative differences in weed control cost and how this might affect a grower's net return, assuming all other production costs are equal.

Tomato Experiment: The weed density in this study averaged 3.7 broadleaf weeds and 0.5 annual grass plants per meter of row. Common lambsquarters (*Chenopodium album* L.) was the dominant species with smartweed (*Polygonum pensylvanicum* L.), redroot pigweed (*Amaranthus retroflexus* L.) and black nightshade (*Solanum nigrum* L.) as minor species. Giant foxtail (*Setaria faberi* Herm.) represented the annual grasses.

Results of this experiment are summarized in Table 1. Hand hoeing was the most expensive method used employing 240 hrs/ha of labor at a cost of $720. Mechanical cultivation was the least expensive technique and while it eliminated weeds between the rows, the in-row escapes were dense enough to significantly reduce tomato yields by 36% and consequently produce the lowest net return. The herbicide program using trifluralin plus metribuzin preplanting followed by a postplanting application of metribuzin was relatively inexpensive and controlled all weed escapes except black nightshade.

Without competition from other broadleaf weeds, this species became very profuse and significantly reduced tomato yields about 11.2 m tons per ha and resulted in the second lowest net return. Supplementing this herbicide program with either a single cultivation or with hand hoeing or a combination of both resulted in weed-free tomato plantings and similar net returns. The herbicide program with one timely cultivation was considered the overall most effective program because it reduced the black nightshade population by 73% compared to "herbicide alone". Trifluralin without the use of metribuzin required twice as much hand labor to achieve a satisfactory level of weed control. It is estimated that metribuzin contributed to a savings of about $70/ha in 1979. While our 1978 trial (1) indicated that satisfactory weed control could be achieved through the use of herbicides alone, this study reveals the fact that when a tolerant weed species is present in the population, an integrated program using herbicides plus cultivation is required to minimize weed competition and maximize a grower's net return.

Carrot Experiment: Lambsquarters and smartweed were the two dominant species in this trial while redroot pigweed and black nightshade were very minor. These broadleaf weeds, as in-row plants in plots which received only cultivation treatments averaged 5.2 plants/m of row while giant foxtail was present at a relatively low density of 0.25 plants/m.

Results of the weed competition program for carrots are summarized in Table 2. The narrow row spacing involved with carrot culture plus a denser weed population, incurred more hand labor costs for hoeing than did tomato culture. Intensive mechanical cultivation controlled weeds between the rows, but strong competition from in-row weeds prevented the crop from developing any marketable size roots. This demonstrates the fact that carrots are extremely sensitive to weed competition. The use of trifluralin preplanting and two applications of linuron postemergence was fairly effective although some smartweed plants recovered and competed with the crop late in the season resulting in about 25% yield loss. Supplementing the herbicide program with cultivations did not provide a benefit as in-row smartweed escapes remained to compete with the crop. Hand hoeing to remove the smartweeds which survived the single application of linuron resulted in clean carrot plots, produced the greatest yields, and in spite of the labor costs involved, provided the highest net return. The hoeing labor may have been reduced further if two applications of linuron had been made prior to initiating the hand hoeing operations. Plots receiving a second linuron application had 60% fewer smartweed escapes than those receiving a single application followed by cultivation.

A return to more intensive use of hand labor has been advocated as a means of reducing fossil fuel use in food production (2,3). If this philosophy were followed, the results of these two experiments indicate prices of tomatoes and carrots would have to be increased 12% and 43% respectively to provide a net return comparable to programs utilizing herbicides alone. If we assume the price of herbicides truly reflects the value of petroleum products used in their manufacture and distribution, then these tools are playing an important role in keeping down food costs.

In spite of the strides made in developing herbicides for vegetable crops such as carrots and tomatoes, results of this study indicate complete reliance on this tool is not practical when tolerant weed species exist and a maximum return will be accomplished by integrating mechanical cultivation and/or some hand labor.

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Table 1. An economic comparison of several weed control programs for transplanted tomatoes at Napoleon, Ohio, in 1979.

Weed control operation	Date performed	Hand labor hrs/ha	Weed control costs/ha [2/]	Yield m ton/ha 8/27	9/12	Total	Net $[3/] return/ha
Hand hoe	6/14,6/26,8/13	240	$720	32.7	42.3	75.0	$4,652
Cultivation	6/12, 6/28	--	25	25.3	23.1	48.4	3,442
Cultivation + hand hoe	6/12 6/14,6/26,8/13	138	425	31.6	44.4	75.9	5,012
Herbicides alone [1/]	5/17 ppi, 6/11 post	--	57	26.2	38.1	64.3	4,548
Herbicides + cultivation	5/17 ppi, 6/11 post 6/12	--	69	26.4	47.7	74.1	5,238
Herbicides + hand hoe	5/17 ppi, 6/11 post 7/26, 8/13	73	277	27.3	50.2	77.3	5,258
Herbicides + cultivation + hand hoe	5/17 ppi, 6/11 post 6/12 7/26, 8/13	30	161	21.1	52.4	73.5	5,104
Trifluralin (1.12 kg ai/ha) + cultivation + hand hoe	5/17 6/12 6/14, 8/13	61	225	27.5	46.4	73.9	5,068
			Bayes LSD 5%	NSD	7.8	10.9	

1/ "Herbicides alone" - Trifluralin + metribuzin, 1.12 + 0.56 kg ai/ha ppi; plus metribuzin, 0.28 kg ai/ha postplanting.

2/ Labor charged - $3/hr., cultivation - $12.50/ha/operation
Trifluralin - $20/kg ai; Metribuzin - $30/kg ai, $7.50 for application.

3/ Net return based on $71.63/m ton, less cost for weed control program.

Table 2. An economic comparison of several weed control programs for carrots at Napoleon, Ohio, in 1979.

Weed control operation	Date performed	Hand labor hrs/ha	Weed control cost/ha [2/]	Yield m t/ha Total	Yield m t/ha Marketable	Net $ return/ha [3/]
Hand hoe	6/5,6/27,8/13	328	$984	49	42	$1,116
Cultivation	6/4,6/14,6/25	--	38	3.8	0	0
Cultivation + hand hoe	6/4, 6/14 6/5 6/27,8/13	306	943	58	48	1,457
Herbicides alone [1/]	5/1 ppi 6/4,6/26 post	--	75	51	42	2,025
Herbicides + cultivation	5/1 ppi, 6/4 post 6/4, 6/14	--	76	45	39	1,874
Herbicides + hand hoe	5/1, 6/4 6/27,8/13	103	360	61	52	2,240
Herbicides + cultivation + hand hoe	5/1, 6/4 6/4, 6/14 6/27,8/13	83	325	64	55	2,425
			Bayes LSD 5%	8.1	8.5	

1/ "Herbicides" - represent trifluralin at 1.12 kg/ha ai as ppi, plus linuron at 1.12 kg/ha ai postemergence on dates indicated.

2/ Labor charge of $3/hr., cultivation at $12.50/ha.
Trifluralin - $20/kg ai; Linuron - $16/kg ai, $7.50 ha/appl.

3/ Net return based on $50/m ton of marketable carrots, less cost of the weed control program.

WEED CONTROL EXPERIMENTS IN TOMATOES -- A THREE-YEAR SUMMARY

W.J. Sanok, G.W. Selleck, and J.F. Creighton[1/]

ABSTRACT

Experiments were conducted over the past three-year period on a sandy loam soil at the Long Island Horticultural Research Laboratory to evaluate the efficacy and phytotoxicity of several herbicides for weed control in tomatoes (*Lycopersicon esculentum* Mill.).

In 1977 metribuzin was used at 0.56 kg/ha on 24 varieties of tomatoes and phytotoxicity was observed on a number of the varieties. The following year five tomato varieties were used to test for phytotoxicity by metribuzin. Metribuzin at 0.28 and 0.56 kg/ha alone or in combination with napropamide, trifluralin, or diphenamid resulted in some phytotoxicity to several varieties. All of these treatments resulted in effective control of barnyardgrass, (*Echinochloa crus-galli* (L.) Beauv.), and purslane (*Portulaca oleracea* L.). In 1979 metribuzin again was used at 0.28 and 0.56 kg/ha and provided near perfect control of barnyardgrass, purslane, and crabgrass (*Digitaria sanguinalis* (L.) Scop.). The preplant incorporated treatments of metribuzin resulted in slight phytotoxicity to the variety Early Girl. More severe affects were seen in the post-transplant treatments with the varieties Early Girl, Red Pak, and Ramapo.

From the three-year observation in these experiments there appears to be some relationship between varieties and phytotoxic effects using metribuzin, but another factor seems to be the condition of the plant at the time of application. Particularly in 1979, the post-emergence application of metribuzin was applied during the rainy period of May 30.

INTRODUCTION

The herbicide, metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5 4*H*)-one) is proving to be one of the most effective post emergence treatments for weed control in tomatoes. This chemical has proven to be very effective in controlling the broad spectrum of weeds in this crop.

In experiments conducted on Long Island as in other areas some phytotoxic effects have been noticed resulting in severe stunting or even death of tomato plants. Experiments were conducted in 1977, 1978 and 1979 to determine if the effect is related to variety. If growers are to use this herbicide effectively, they must be aware of its phytotoxic effects, particularly if it is related to varieties.

MATERIALS AND METHODS

In 1979 three varieties of tomatoes, Early Girl, Red Pak, and Ramapo, were transplanted on May 23 at the Long Island Horticultural Research Laboratory in the sandy loam soil. Metribuzin at 0.28 and 0.56 kg/ha and a tank mix combination of metribuzin at 0.28, and trifluralin (*a,a,a*-trifluoro-2,6-dinitro-*N,N*-dipropyl-

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p-toluidine) were applied prior to transplanting. Napropamide (2-(α-naphthoxy)-*N,N*-diethylpropionamide) at 1.12 and diphenamid (*N,N*-dimethyl-2,2-diphenylacetamide) at 2.24 kg/ha were applied after transplanting and preemergence to the weeds. Post-emergence application of metribuzin at 0.28 and 0.56 kg/ha were applied on May 30 and repeated on June 7.

All herbicide applications were made on four plants per plot with a spacing of 0.6 m between plants. An 0.9-m untreated strip was adjacent to each plot. All applications were made with a tractor-mounted sprayer delivering 61 l/ha at 2.4 atmospheres.

Frequent rains and cloudy weather occurred between planting May 23 and the post-emergent application on May 30. Treatments of metribuzin, preplant incorporated and diphenamid required cultivation and hand weeding on July 2. Assessments for phytotoxicity were made on June 6 and June 18 and for weed control on June 29.

RESULTS AND DISCUSSION

In 1977 metribuzin was used at 0.56 kg/ha and resulted in a phytotoxity rating of 50% for the variety Early Girl. The varieties Red Pak, Ohio 736 VF, Beef Master, and Spring Set resulted in a 30% phytoxicity. Other varieties that were significantly affected included: NFV 22, Super Fantastic VF, Terrific VFN, Supersonic VF, Big Set and XP 160. From this preliminary study, it was indicated that the effect of metribuzin on tomatoes could be related to variety.

In 1978 experiments conducted on the varieties Jet Star, Red Pak, Ramapo, Early Girl, and Better Boy resulted in the variety Ramapo being the most severely affected. In that experiment Early Girl and Red Pak appeared to be severely affected by the lower rate of metribuzin.

In 1979, again using Early Girl, Red Pak, and Ramapo, these varieties were severely affected by the post-emergent treatment of metribuzin. Results of the comparison of the three-year period are given in Table 2.

Based on these experiments and observations, it appears that in 1979 metribuzin was more toxic to the tomato plants following periods of cloudy weather when the carbohydrate reserves in the plants are low. Timing of application then becomes very important.

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Table 1. Percent weed control, percent phytotoxicity and yield of three tomato varieties treated with herbicides -- 1979.

Chemical	Rate kg/ha	Percent weed control			Percent phytotoxicity						Yield lbs/plot		
		barnyardgrass	crabgrass	purslane	Early Girl		Red Pak		Ramapo		Early Girl	Red Pak	Ramapo
					6/6	6/18	6/6	6/18	6/6	6/18			
diphenamid	2.24 pre	60	90	43	0.0	0.0	0.0	0.0	0.0	0.0	110.5	109.9	80.5
metribuzin	0.28 ppi	37	57	27	8.0	7.0	0.0	0.0	0.0	0.0	91.0	103.5	83.75
metribuzin	0.56 ppi	50	60	77	12.0	3.0	1.5	1.5	6.5	5.0	126.25	95.25	61.75
metribuzin	0.28 post	100	100	100	40.0	20.0	13.0	5.0	17.0	8.0	125.0	110.5	78.25
metribuzin	0.56 post	100	100	100	22.0	23.0	28.0	23.0	35.0	12.0	142.5	150.0	70.0
metribuzin	0.28 pre + post	100	96	100	3.0	22.0	3.0	13.0	-	8.0	129.0	107.25	86.0
metribuzin	0.56 pre + post	100	100	100	3.0	53.0	2.0	50.0	-	50.0	138.75	103.5	84.75
metribuzin	0.28 ppi												
+ trifluralin	0.56	60	66	60	3.0	1.5	7.0	8.0	5.0	0.0	114.0	108.0	73.0
napropamide	1.12 pre	90	100	87	0.0	0.0	0.0	0.0	3.0	3.0	133.0	114.0	70.0
untreated[1/]		12	5	38	0.0	0.0	0.0	0.0	5.0	17.0	59.0	26.0	36.25

[1/]plants per 0.3 m^2

Table 2. Percent phytotoxicity of five tomato varieties treated with metribuzin.

Year	Rate of metribuzin kg/ha	Phytotoxicity Rating				
		Early Girl	Red Pak	Ramapo	Jet Star	Better Boy
1977	0.56	50	30	t	t	t
1978	0.28	27	15	27	5	5
	0.56	5	5	35	12	12
1979	0.28	30	9	12		
	0.56	23	26	24		

t = trace

ALACHLOR FOR TRANSPLANTED VEGETABLES

R.D. Sweet, A. Richard Bonanno, D.T. Warholic, and P.L. Minotti[1]

ABSTRACT

Either DCPA or trifluralin prior to transplanting is standard practice for many vegetables. Annual grassy weeds are usually controlled but certain broadleaved species such as galinsoga spp, lambsquarters, ragweed and redroot pigweed often escape. Thus postemergence sprays or hand hoeing frequently are required. For tomatoes, metribuzin appears to be quite useful, but it is not safe on the cruciferae crops and lettuce and is marginal for peppers. Nitrofen is cleared for crucifers but is only partially satisfactory for galinsoga and ragweed.

Alachlor has been shown by the authors to be effective against galinsoga and safe at rates of 1.0 lb or less on seeded cabbage. The purpose of the several experiments conducted in 1979 was to evaluate alachlor and certain other herbicides on transplanted broccoli, cabbage, cauliflower, Chinese cabbage, peppers, romaine lettuce and tomatoes. Herbicides included alachlor, DCPA, metolachlor, napropamide, nitrofen and trifluralin. Weeds involved were galinsoga, lambsquarters, redroot pigweed, chickweed and annual bluegrass. Ragweed was not present in sufficient numbers to permit reliable observations. Four experiments were completed, but not all crops, chemicals and weeds were included in each, but all except tomatoes and peppers were evaluated at least twice.

Broccoli, cabbage and cauliflower responded similarly to herbicides, and were very tolerant of alachlor, metolachlor, DCPA, nitrofen and trifluralin. Chinese cabbage however was sensitive to nitrofen except when used on well established plants (three to five true leaves). Romaine lettuce was severely damaged by alachlor (metolachlor was not tested), nitrofen and trifluralin except when applied to well established plants with three to five true leaves. Peppers were tolerant of both alachlor and metolachlor, but tomatoes were damaged.

Redroot pigweed and lambsquarters in the cotyledonary stage were readily controlled by alachlor, metolachlor, napropamide and nitrofen. Although alachlor was extremely effective against galinsoga even at 0.5 lb/A, metolachlor and napropamide were only partially satisfactory. On the other hand DCPA and trifluralin were totally ineffective against galinsoga. It appears that with tomatoes, metribuzin is a better choice than alachlor for combating a range of broadleaved weeds; whereas with peppers, broccoli, cabbage and cauliflower, alachlor at about 1.0 lb/A is very effective when weeds are just emerging. With romaine lettuce and Chinese cabbage all the postemergence herbicides tested are very likely to be damaging unless the crop has three to five true leaves.

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SEEDED LEGUMES AS LIVING MULCHES IN SWEET CORN[1/]

T.E. Vrabel, P.L. Minotti and R.D. Sweet[2/]

ABSTRACT

Red clover, ladino clover, white clover, alfalfa and annual bluegrass were investigated as living mulch crops growing in association with sweet corn. Legumes were seeded five weeks prior to, at planting, and five weeks after planting sweet corn. Legume seed was broadcast either over the entire plot or in 0.45 m strips between corn rows.

Sweet corn yields were reduced by planting into previously established covers with yields reduced more by full cover than by strips. When sweet corn and legumes were planted at the same time, strips of legumes caused no yield reductions, but full seeded plots still proved excessively competitive. When legumes were seeded five weeks after the sweet corn none of the treatments reduced corn yields. Results with annual bluegrass were erratic and inconclusive.

Weeds were most effectively suppressed by ladino and white clover and least effectively suppressed by red clover. Dry weight of the earliest planted red clover was more than double that of the latest planting while the other species yielded about the same regardless of planting date. Strip plantings yielded about two thirds as much as full cover plantings.

INTRODUCTION

Loss of soil structure and organic matter content is a serious problem for vegetable growers in New York. The use of sod crops for two to three years to alleviate these problems is not feasible since market and economic considerations force the grower into producing a cultivated crop for many successive years. Animal manures do not offer a solution since they are not readily available on most vegetable farms.

The use of a "living mulch" crop as a source of organic matter has been investigated in agronomic and vegetable production systems and has been shown to be feasible (1,2,3,4). The mulch crop can be returned to the soil in the fall or may be maintained through the following spring for reutilization as a mulch crop. The purpose of this study was to determine the magnitude of the competitive effects of selected legume species on sweet corn when seeded either before, after, or at the same time as the corn, and also to compare broadcast vs strip plantings of these legume species.

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MATERIALS AND METHODS

The study was conducted at the Thompson Vegetable Research Farm near Ithaca, NY. The soil was an Eel silt loam with a pH of 5.8, an organic matter content of 3.6% and a cation exchange capacity of 11 me/100 g. On May 8 fertilizer was broadcast and plowed down at the rate of 930 kg/ha of 13-13-13. The area was harrowed on May 11 and May 17. On May 18 one third of the experimental area was seeded to the legumes (Table 1) either broadcast or in 0.45 m strips. Plots were 3.66 m x 6.1 m. On June 21 another third of the experimental area was also seeded to the four legumes. On the same day the entire experimental area was seeded to Gold Cup sweet corn (*Zea mays saccharata* L.) in rows 0.91 m wide. The final third of the area was seeded to legumes on August 1. Shortly after emergence the sweet corn was thinned to approximately one plant every 25 cm. In the first planting soils were cultipacked before and after seeding legumes. In the second and third seedings the seed was raked by hand. Treatments within each planting were replicated four times.

TABLE 1. Mulch crops and seeding rates

Mulch Crop	Seeding Rate (kg/ha)
white clover (*Trifolium repens* L.)	6.7
ladino clover (*Trifolium repens* L.)	22.4[1/]
red clover (*Trifolium protense* L. cv Penscotti [R])	6.7
alfalfa (*Medicago sativa* L. cv Iroquois [R])	15.7
annual bluegrass (*Poa annua* L.)	13.4

[1/] high rate due to error in seeder calibration.

Dinoseb at 0.56 kg/ha was applied July 15 to control annual broadleaf weeds and grasses. Unfortunately this severely injured the second planting of red clover so it was replaced by annual bluegrass seeded on August 1. The last area to be planted to legumes was hand weeded prior to seeding.

Rainfall was deficient early in the season so 6 cm of overhead irrigation was applied on June 6. Another 18 cm was applied on July 23. During the latter part of the season rainfall was adequate and totalled 34.7 cm.

Visual weed control ratings were recorded on September 14. On September 22 the above ground portion of sweet corn plants was harvested in a 2 m section of the three innermost rows in each plot. Total plant fresh weights and fresh weights of primary ears were obtained. On October 12 a strip 1 m wide and 6 m long of the above ground portion of legume mulch was harvested and dry weight determined. Corn and legume weights were analyzed statistically.

RESULTS AND DISCUSSION

Weed suppression, yield of sweet corn and the dry matter production of legumes was influenced by time of seeding, by strip vs broadcast planting and by species of legume. Weeds present were redroot pigweed (*Amaranthus retroflexus* L.), lambsquarters (*Chenopodium album* L.), common chickweed (*Stellaria media* L.), annual bluegrass (*Poa annua* L.) and (*Galinsoga ciliata* L.). In general weed suppression was excellent in the earliest seedings, acceptable when seeded with the sweet corn, and only partially acceptable when seeding was delayed (Table 3). Red clover, regardless of timing, was least effective in suppressing weeds. Alfalfa was an excellent competitor to weeds in the earliest seeding but was slightly inferior to the other species at the delayed timing.

Planting sweet corn into established legumes severely reduced yield of both corn plants and primary ears, with reductions greater in broadcast than strip seedings (Table 2). Although red clover was least competitive to weeds and reduced sweet corn yields the least, it produced the most dry matter of all legumes in the earliest planting (Table 3). When sweet corn and legumes were seeded at the same time, white clover and alfalfa in strips gave corn yields comparable to that realized in no legume plots. When legumes were seeded after sweet corn emergence, almost every legume plot yielded as much sweet corn as the no legume plots.

Dry matter production by white clover was much greater in broadcast than in strip plantings at all three seeding dates. With ladino clover, however, broadcast plantings out-yielded strip plantings only at the earliest date. Red clover produced equally in strips or broadcast plantings at the early seeding whereas alfalfa produced equally only at the latest seeding.

Ladino appears to be comparable in many ways to white clover but because seeding rates were higher than planned, comparisons to other legumes remain somewhat tenuous.

Seeding legumes prior to planting corn may not be viable unless strips narrower than 0.45 m are utilized. Seeding legumes after corn emergence requires special weed control practices. The results of this test indicate that planting legumes at the same time as sweet corn was the most promising timing.

Follow-up plantings will be made in the various legume seedings to determine their influence on sweet corn.

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TABLE 2. Effects of mulch crop treatments on sweet corn yields[a/]

Treatment	CORN PLANTS yield/6(m) row (kg)	CORN PLANTS yield/ plant (g)	EARS yield/6(m) row (kg)	EARS yield/ plant (g)
MULCH SEEDED 5 WEEKS PRIOR TO CORN PLANTING				
-white clover strip seeded	2.335 ab	67.37 ab	0.466 b	13.48 bc
-white clover full seeded	0.621 c	22.85 c	0.101 c	3.93 d
-red clover strip seeded	2.476 ab	79.33 ab	0.493 ab	15.81 ab
-red clover full seeded	1.133 c	29.26 c	0.193 c	5.50 cd
-ladino clover strip seeded	1.575 bc	48.03 bc	0.242 bc	7.34 bcd
-ladino clover full seeded	----[b/]	----[b/]	----[b/]	----[b/]
-alfalfa strip seeded	2.207 ab	69.67 ab	0.466 b	14.67 ab
-alfalfa full seeded	1.086 c	25.90 c	0.153 c	3.58 d
-clean cultivation-no cover	3.056 a	98.27 a	0.726 a	23.44 a
-Duncan-Waller (.05)	(0.965)	(33.26)	(0.258)	(8.94)
MULCH AND CORN SEEDED SIMULTANEOUSLY				
-white clover strip seeded	3.191 a	105.16 a	0.584 a	19.18 b
-white clover full seeded	2.830 a	100.99 a	0.605 a	21.45 b
-annual bluegrass strip seeded	3.183 a	116.05 a	0.812 a	29.41 ab
-annual bluegrass full seeded	2.987 a	105.56 a	0.716 a	25.33 ab
-ladino clover strip seeded	3.087 a	107.86 a	0.624 a	21.84 b
-ladino clover full seeded	2.677 a	91.00 a	0.590 a	19.98 b
-alfalfa strip seeded	3.034 a	113.26 a	0.674 a	25.18 ab
-alfalfa full seeded	2.880 a	97.21 a	0.593 a	20.00 b
-clean cultivation-no cover	2.996 a	100.44 a	0.716 a	24.45 ab
-Duncan-Waller (.05)	(0)	(27.96)	(0.237)	(7.52)
MULCH SEEDED 5 WEEKS AFTER CORN PLANTING				
-white clover strip seeded	2.336 a	97.43 a	0.645 ab	26.73 a
-white clover full seeded	2.369 a	100.60 a	0.608 ab	25.85 a
-red clover strip seeded	2.687 a	107.35 a	0.723 ab	28.91 a
-red clover full seeded	2.573 a	101.51 a	0.711 ab	28.16 a
-ladino clover strip seeded	2.894 a	117.89 a	0.770 a	31.40 a
-ladino clover full seeded	2.406 a	104.96 a	0.706 ab	30.73 a
-alfalfa strip seeded	2.350 a	102.90 a	0.662 ab	28.88 a
-alfalfa full seeded	2.599 a	104.39 a	0.690 ab	27.73 a
-clean cultivation-no cover	2.540 a	102.77 a	0.642 b	25.94 a
-Duncan-Waller (.05)	(0)	(0)	(0.177)	(6.56)

[a/]harvested September 22, 1979

[b/]corn did not survive clover competition

TABLE 3. Dry weight yield[a,b] for 6 m^2 area of mulch and weed control ratings[c,d]

	Yield of mulch $6m^2$ area (kg)	Weed control rating
MULCH SEEDED 5 WEEKS PRIOR TO CORN PLANTING		
-white clover strip seeded	0.379 d	8
-white clover full seeded	0.598 cd	8
-red clover strip seeded	1.094 a	7
-red clover full seeded	1.062 a	7
-ladino clover strip seeded	0.371 d	8
-ladino clover full seeded	0.729 bc	8
-alfalfa strip seeded	0.470 cd	8
-alfalfa full seeded	0.929 ab	8
-clean cultivation	--	9
-Duncan (.05)		
MULCH AND CORN SEEDED SIMULTANEOUSLY		
-white clover strip seeded	0.254 c	7
-white clover full seeded	0.560 b	8
-annual bluegrass strip seeded	0.308	6
-annual bluegrass full seeded	0.335	7
-ladino clover strip seeded	0.560 b	7
-ladino clover full seeded	0.560 b	8
-alfalfa strip seeded	0.568 b	7
-alfalfa full seeded	0.855 a	7
-clean cultivation-no cover	--	9
-Duncan-Waller (.05)	(0.277)	
MULCH SEEDED 5 WEEKS AFTER CORN PLANTING		
-white clover strip seeded	0.390 a	7
-white clover full seeded	0.456 a	7
-red clover strip seeded	0.277 a	6
-red clover full seeded	0.432 a	6
-ladino clover strip seeded	0.393 a	7
-ladino clover full seeded	0.406 a	7
-alfalfa strip seeded	0.378 a	5
-alfalfa full seeded	0.396 a	6
-clean cultivation-no-cover	--	9
-Duncan-Waller (0.5)	(0)	

a/ harvested October 22, 1979

b/ LSD of 0.05 Duncan and Duncan-Waller

c/ using a scale of 0-9; 0 = no effect, 7 = acceptable control; 9 = complete control

d/ rating taken September 14, 1979

NEW HERBICIDES FOR NARROW-ROW SNAP BEANS[1/]

P. C. Bagley and C. E. Beste[2/]

Abstract. Weed control was evaluated in snap bean rows spaced 18 inches in a Norfolk loamy sand (0.6% O.M.). Postemergence bentazon at 0.75 lb/A was effective on 2 inch tall ragweed and lambsquarters 1 1/2 inch tall when applied at the first trifoliate leaf stage of snap beans. Dinoseb at 0.375 lb/A was an effective postemergence herbicide. BAS 9052 OH postemergence was effective on crabgrass without snap bean injury. EPTC, preplant incorporated 3.0 lb/A plus dinoseb, preemergence 1.5 lb/A did not control ragweed; however, a three inch rain occurred after application. The following order of activity based on late-season lambsquarters control was observed: MON 55097 > metolachlor > alachlor > xylachlor. The extender, R-33865 was not effective with EPTC or vernolate. UBI-S734, preplant incorporated at 0.5 to 1.0 lb/A was acceptable for snap beans and controlled crabgrass, but yellow nutsedge control was erratic and lambsquarters and ragweed were not controlled. Ethalfluralin or trifluralin combined with EPTC preplant incorporated improved lambsquarters control. Cultivation improved the control of 3 to 5 leaf size crabgrass with postemergence diclofop and 1.0 lb/A was more effective than 0.75 lb/A. Snap beans were uninjured by postemergence diclofop and combinations with bentazon.

INTRODUCTION

New herbicides and new labels on existing herbicides have potential for increased weed control in narrow-row snap beans. With the advent of commercially successful snap bean harvestors that do not require rows, growers are changing to narrow-row snap beans which produce a 50% yield increase compared to wide-rows. Narrow-row snap beans are not cultivated.

The objectives of this study was to evaluate various new postemergence herbicides and herbicide combinations on narrow-row snap beans and to evaluate the influence of cultivation on grass control with diclofop.

MATERIALS AND METHODS

'Gallatin Valley 50' snap beans were planted May 22, 1979, 1.5 inches deep, in Norfolk loamy sand (0.6% organic matter). The plots were 6 ft wide by 19 ft long with 3 rows per plot and rows 18 inches appart. The herbicide treatments were applied with a bicycle boom sprayer and CO_2 was utilized as the spray propellant. Spray volume was 45 gal/A. The preplant incorporated (PPI) herbicide treatments were incorporated 3 inches deep with a rototiller plus crow foot cultipacker on May 22. A randomized complete block design with three replicates

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was utilized for the herbicide treatments. Preemergence (Pre) treatments were applied immediately after planting and postemergence sprays were applied on June 12 (Post I), June 20 (Post II), July 5 (Post III), July 14 (Post IV). The following herbicides were evaluated dinoseb (2-sec butyl-4,6-dinitrophenol), EPTC (S-ethyl dipropylthio-carbamate), bentazon (3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide), paraquat (1,1'-dimethyl-4,4'-bipyridinium ion), metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide]xylachlor[2-chlor-N-(2,3-dimethylphenyl)-N-(1-methylethyl) acetamide], DCPA (dimethyl tetrachloroterephthalate), trifluralin (α,α,α- trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), ethalfluralin (N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzenamine), alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide, vernolate (S-propyl dipropylthiocarbamate), cycloate (S-ethyl N-ethylthiocyclohexanecarbamate), acifluorfen (5-[2-chlor-4-(trifluoromethyl)phenoxy]-2-nitrobenzoic acid), napropamide (2-(α-naphthoxy-N,N-diethylpropionamide), R-33865, MON 55097, BAS 9052 OH, BAS 479 OOH, UBI-S734. Rainfall data is summarized in Table 3. Ammonium nitrate was topdressed (40 lb N/A) on June 18. Snap bean vigor ratings were made May 30, June 10, June 17 (Post I treatments only), June 21 and July 13. A plant stand rating was made on June 10 and weed control was rated on June 10, June 17 (Post I treatments only) and July 13 on the following weeds: common ragweed Ambrosia artemisiifolia L.), yellow nutsedge (Cyperus esculentus L.), large crabgrass (Digitaria sanguinalis L.), goosegrass (Eleusine indica L.), common lambsquarters (Chemopodium album L.), carpetweed (Mollugo verticillata L.), and morninglories composed of tall morninggloxy (Ipomoea purpurea L.), entire-leaf morningglory (I. hederacea var. integriuscula) and ivyleaf morningglory (I. hederacea (L.)Jacq.).

The size of weeds at the time of Post I treatment was as follows: Weed size with EPTC, 3.0 lb/A, PPI and dinoseb 1.5 lb/A Pre was ragweed - 1/2 to 1 1/2 in tall, 1 to 3 pair true leaves; yellow nutsedge - 1 to 5 in tall, 2 to 7 leaves. Weed size without any ppi or pre herbicides was ragweed - 1/2 to 2 in tall, 1 to 4 pair true leaves; yellow nutsedge - 2 to 7 in tall, 2 to 7 leaves, crabgrass - 1/2 to 2 in tall, 2 to 4 leaves, none to 2 tillers; lambsquarters - 1/2 to 1 1/2 in tall, 1 to 3 pair true leaves; carpetweed - 1 in whorl, 3 pair true leaves; common purslane - 1/2 in tall, 1 to 2 pair leaves. The snap beans were in the first trifoliate leaf stage. Leaf burn ratings of snap beans were made on June 10 and June 17 (Post I treatments only). A single harvest and plant counts were made on 10 ft of one row per plot July 17.

The diclofop and cultivation study was planted adjacent to the nutsedge study in the same manner except that herbicide plots were 12 ft wide by 19 ft long with 4 rows per plot and 36 inches between row. Two rows in each plot were cultivated on June 29. Herbicide treatments were applied with the same apparatus as the nutsedge study with a spray volume of 45 GPA. A split-block design with three replicates was utilized for the treatments. Dinoseb 1.5 lb/A was applied preemergence for some treatments to suppress broadleaf weeds but not grasses prior to the post treatments. Bentazon was tank mixed with diclofop and applied at Post I or II. Diclofop was applied at Post I or II over the dinoseb pre treatment. Postemergence I treatment was applied June 12 and Post II on June 19. The stage-of-growth at the postemergence treatment was influenced by preemergence dinoseb as follows: June 12 - untreated: snap beans = 1st trifoliate leaf; large crabgrass = 3 to 5 leaves, 1/4 to 1 1/2 in tall, 0 to 2 tillers; goosegrass = 2 to 6 leaves, 1 tiller; ragweed = 2 to 3 pair leaves, 1/2 to 1 inch tall and for dinoseb, 1.5 lb/A pre: snap beans =

1st trifoliate leaf; large crabgrass = 3 to 4 leaves; goosegrass = 1 to 2 tillers per plant; ragweed = 1 to 3 pair true leaves. June 19 - untreated: crabgrass 4 to 5 leaves and dinoseb 1.5 lb/A pre: crabgrass 3 to 5 leaves. The dinoseb pre caused the crabgrass to be one leaf less than in the untreated plots at the time of Post treatments. Ammonium nitrate (40 lb N/A) was topdressed on June 18. Snap bean vigor, leaf burn and weed control ratings were made on July 13. A single harvest and snap bean plant count was made on July 17 on a 10 ft area of one row in each cultivated and uncultivated area.

RESULTS AND DISCUSSION

Three inches of rainfall during the first four days after planting increased the potential for seedling injury from the ppi and pre herbicides (Table 3). The extender, R-33865, with EPTC did not improve weed control; however, although not significant, the yield was greater with the extender which indicated that weeds may have been suppressed more than with EPTC alone (Table 1). R-33865 extender did not appear to influence vernolate activity. Cycloate at 3.0 lb/A, ppi, was safe on snap beans and cycolate, EPTC and vernolate at 3.0 lb/A, ppi, provided excellent nutsedge, crabgrass and lambsquarters control and the same 50% early control of ragweed. Vernolate control of lambsquarter was better than EPTC or cycloate. Dinoseb 3.0 lb/A preemergence, plus EPTC 3.0 lb/A, ppi,only improved ragweed control to 60% compared to 50% control with EPTC alone as shown by the early June 10 ratings prior to postemergence treatments. Dinoseb, 3.0 lb/A pre, alone provided very poor control of ragweed and lambsquarters as shown by the June 10 rating in treatment No. 9; however, rainfall probably leached the dinoseb below the sprouting weeds.

Ethalfluralin, ppi, 0.5 lb/A did not control ragweed and in combination with EPTC did not improve ragweed control. However, ethalfluralin 1.0 lb/A ppi in combination with EPTC appeared to improve late season ragweed control better than the combination of trifluralin 1.0 lb/A, ppi, plus EPTC. Ethalfluralin and trifluralin at 1.0 lb/A each in combination with EPTC caused similar slight vigor reduction of snap beans. Ethalfluralin and trifluralin in combination with EPTC significantly improved lambsquarters control compared to EPTC alone.

DCPA did not control ragweed nor nutsedge and the combination with dinoseb did not appear to improve the control of other broadleaf weeds which may have been due to the large ragweed canopy that suppressed other weeds. DCPA at 12.0 lb/A pre was safe on snap beans. BAS 479 OOH caused unacceptable vigor reduction at 0.5 lb/A pre for snap beans. The snap bean population was not reduced by BAS 479 OOH at 0.5, 0.75 or 1.0 lb/A.

UBI-734 ppi appears to be safe on snap beans at 0.5, 0.75 and 1.0 lb/A; however, ragweed and lambsquarter are not controlled. Yellow nutsedge control appears to be acceptable and crabgrass control was excellent.

Alachlor at 1.5, 2.0 and 3.0 lb/A pre in combination with dinoseb was not injurious to snap beans; however, ragweed control was not acceptable although nutsedge control was excellent at all rates. Late season lambsquarters control was weak with alachlor 1.5 lb/A pre with dinoseb. Metolachlor did not control ragweed and lambsquarter control in late season decreased at 1.25 lb/A with less lambsquarter control from the ppi treatment compared to the pre. Yellow nutsedge control was acceptable with metolachlor pre; however, ppi was erratic which indicated that rainfall may have caused excessive dilution of metolachlor. MON 55097 at 3.0 lb/A, pre, caused unacceptable vigor reduction and although 1.5 and 2.0 lb/A appeared to be acceptable, some vigor reduction occurred at the 1.5 lb/A rate. Yellow nutsedge control was excellent at 1.5 lb/A MON 55097 pre. MON 55097 at 3.0 lb/A provided 97% ragweed control early; however, late season lambsquarters appeared to weaken slightly at 2.0 and 3.0 lb/A. Some variation in lambsquarter control was due to the density of the ragweed canopy which could suppress lambsquarter and might account for the 100% lambsquarter late season control at 1.5 lb/A MON 55097. Xylachlor at 3.0 and 6.0 lb/A pre and ppi was safe on snap beans. Yellow nutsedge control was slightly weaker with ppi; however, ppi and pre xylachlor were both acceptable. Late season lambsquarters control was unacceptable except for 6.0 lb/A xylachlor, pre. Crabgrass control was weak but acceptable with the ppi xylachlor. In this study, the order of activity of the acetanalides, using lambsquarters as the most realiable indicator was as follows: MON 55097 > metolachlor > alachlor >xylachlor.

Postemergence bentazon at 0.75, 1.0 and 1.5 lb/A provided excellent control of ragweed 1/2 to 1 1/2 in tall at Post I and even larger ragweed at Post II. Lambsquarter escapes with EPTC, ppi, plus dinoseb, pre were controlled by bentazon post. Trifluralin, ppi plus dinoseb, pre did not have lambsquarters escapes. The control of ragweed with Post bentazon caused the release of crabgrass by removing the ragweed competition and this is shown by the weak, but acceptable, late season crabgrass control with EPTC, ppi plus dinoseb, pre. The late season release of crabgrass did not occur with bentazon, post over trifluralin, ppi plus dinoseb, pre. Snap bean injury was not observed with temperatures in the 80's for 9 days after the post bentazon on snap beans in the 1st trifoliate leaf stage. BAS 9052 OH, 0.5 lb/A Post I was effective on large crabgrass and goosegrass without snap bean injury; however, yields were suppressed because broadleaf control with dinoseb, pre was unacceptable. The combination of BAS 9052 OH plus 0.75 lb/A bentazon tank mixed and applied postemergence controlled grasses, ragweed 2 in tall and lambsquarters 1.5 in tall but not morningglory without any ppi or pre herbicides, and yields were acceptable. This combination did not control yellow nutsedge and the BAS 9052 OH rate of 1.0 lb/A caused slight snap bean injury in the combination with bentazon 0.75 lb/A. Bentazon applied post over BAS 479 OOH, pre controlled ragweed, but yields were reduced due to the BAS 479 OOH injury.

Postemergence dinoseb 0.375 lb/A applied over EPTC, pre had the highest yield even though 12% of the foliage leaf surface area was necrotic due to the treatment. Ragweed and lambsquarters were controlled by post dinoseb at 0.375 lb/A. A 2X safety factor was shown with normal yields from dinoseb 0.75 lb/A post which caused 25% leaf necrosis. EPTC provided suppression of morningglory and the dinoseb effect could not be evaluated.

Acifluorfen post caused unacceptable snap bean injury at 0.25 lb/A but provided excellent ragweed control.

Directed paraquat of one application provided excellent control of ragweed, goosegrass, lambsquarters, morningglory and carpetweed at 0.25 lb/A; however, crabgrass control was acceptable but weak and nutsedge control was slightly below acceptable. Paraquat at 0.5 lb/A controlled all the weeds. Repeat applications of paraquat 0.25 lb/A were not necessary for full-season control but they were repeated for residue samples and the foliar burn was due to the application of paraquat to full size beans without shields. Yields were not significantly reduced with paraquat at 0.25, 0.5 and 1.0 lb/A although the 1.0 lb/A caused a downward trend.

Napropamide caused serious snap bean injury and stand reduction which indicates that snap beans should not follow napropamide applications in the same season. However, additional studies should be made on the soil dissipation of napropamide in relation to snap bean tolerance.

Cultivation greatly improved the control of crabgrass with postemergence diclofop on snap beans. The difference between cultivated and non-cultivated was greatest with the combination of diclofop and bentazon because the dinoseb, pre reduced the size of the grasses at the time of the post treatments which made the post diclofop more effective on the smaller grasses. However, bentazon also reduced the ragweed and lambsquarters competition and permitted more vigorous crabgrass growth. Diclofop alone or in combination with bentazon did not injure snap beans. Diclofop at 1.0 lb/A in combination with bentazon was required for yields equal to the handweeded-cultivated treatment. Therefore, higher rates appear to be advisable for adequate control of large crabgrass with diclofop and cultivation.

Table 1. Weed control in 18 inch spaced narrow-row 'GV-50' snap beans in a Norfolk loamy sand in 1979.

Treatments			% Emergence[e]	Snap Bean Vigor (% of Control)				Plant Stand[g]	Leaf Burn[h]		Percent Weed Control[i] June 10						
Herbicide	Lb/A	Method[a]	5-30	6-10	6-17[f]	6-21	7-13	6-10	6-17[f]	7-13	RW	NUT	CG	GG	LQ	CW	MG
1.Control	----	----	100	100	100	97	30	100	--	0	0	0	0	0	0	0	0
2.Handweeded	----	----	98	100	100	100	92	100	--	0	100	100	100	100	100	100	100
3.EPTC (7E)	3.0 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon (4E)	0.75	Post I	93	100	100	95	92	100	2	2	52	99	93	100	88	100	90
4.EPTC +	3.0 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon	1.0	Post I	97	100	97	98	100	100	2	3	60	97	95	100	83	100	100
5.EPTC +	3.0 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon	1.5	Post I	95	92	95	95	100	93	3	7	62	97	100	100	92	100	83
6.EPTC +	3.0 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon	0.75	Post II	95	100	--	100	90	100	--	0	70	100	93	93	95	100	100
7.EPTC +	3.0 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon	1.0	Post II	93	97	--	95	93	97	--	5	58	100	100	100	93	100	67
8.EPTC +	3.0 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon	1.5	Post II	85	93	--	98	93	90	--	5	77	99	100	100	87	100	93
9.dinoseb (3E) +	3.0 +	Pre +															
BAS 9052 OH (1.53E)	0.5	Post I[b]	92	100	100	92	78	100	2	0	13	0	0	0	33	27	33
10.BAS 9052 OH +	0.5 +																
bentazon	0.75	Post I[b]	100	100	100	98	90	100	2	0	0	0	0	0	0	0	0
11.BAS 9052 OH +	1.0 +																
bentazon	0.75	Post I[b]	98	97	100	87	90	100	10	5	0	0	0	0	0	0	0
12.BAS 479 00H (1.66E)	0.5	Pre	73	73	---	73	74	90	--	1	50	98	100	100	99	100	67
13.BAS 479 00H	0.75	Pre	37	67	---	63	62	90	--	0	70	100	100	100	100	100	90
14.BAS 479 00H	1.0	Pre	15	67	---	53	83	93	--	0	55	100	100	100	100	100	67
15.BAS 479 00H +	0.5 +	Pre +															
bentazon	0.75	Post I	68	77	82	70	100	88	2	5	52	98	100	100	100	100	33
16.BAS 479 00H +	0.75 +	Pre +															
bentazon	0.75	Post I	25	68	75	52	100	83	3	10	47	97	100	100	95	100	53
17.paraquat (2E)	0.25[c]	Post I +															
		III + IV	98	100	100	95	93	100	5	17	0	0	0	0	0	33	33
18.paraquat	0.50[c]	Post I +															
		III + IV	100	100	100	100	100	100	2	17	0	0	0	0	0	0	0
19.paraquat	1.0[c]	Post I +															
		III + IV	100	100	100	98	95	100	9	22	0	0	0	0	0	0	0
20.metolachlor (8E) +	1.25 +																
dinoseb	3.0	Pre	90	95	---	98	92	100	-	0	58	100	100	100	95	100	100
21.metolachlor +	2.5 +																
dinoseb	3.0	Pre	93	97	---	93	87	100	-	0	45	100	100	100	93	100	83
22.metolachlor +	1.25 +	PPI +															
dinoseb	3.0	Pre	92	100	---	95	93	95	-	0	43	95	100	100	93	100	92
23.metolachlor +	2.5 +	PPI +															
dinoseb	3.0	Pre	93	98	---	98	100	100	-	0	47	67	100	100	100	100	100
24.DCPA (75WP) +	6.0 +																
dinoseb	3.0	Pre	92	100	---	97	95	100	-	0	32	0	100	100	100	100	53
25.DCPA +	12.0 +																
dinoseb	3.0	Pre	97	97	---	98	100	93	-	2	33	33	100	100	100	100	67
26.ethalfluralin (3E)	0.5	PPI	92	100	---	98	88	93	-	0	17	0	100	100	100	100	90
27.ethalfluralin +	0.5 +																
EPTC (7E)	3.0	PPI	92	93	---	98	95	100	-	0	50	97	100	100	100	100	100
28.ethalfluralin +	1.0 +																
EPTC	3.0	PPI	70	82	---	88	100	90	-	3	62	98	99	100	100	100	100
29.trifluralin +	0.5 +																
EPTC	3.0	PPI	95	93	---	93	92	98	-	3	53	100	100	100	100	100	67
30.trilfluralin +	1.0 +																
EPTC	3.0	PPI	78	82	---	88	100	83	-	2	48	100	100	100	100	100	100
31.EPTC	3.0	PPI	97	100	---	92	90	100	-	2	50	98	100	100	88	100	70
32.MON 55097 (5E) +	1.5 +																
dinoseb	3.0	Pre	85	85	---	80	90	92	-	2	83	100	100	100	100	100	83
33.MON 55097 +	2.0 +																
dinoseb	3.0	Pre	88	97	---	93	97	97	-	1	48	100	100	100	100	100	100
34.MON 55097 +	3.0 +																
dinoseb	3.0	Pre	47	68	---	75	83	90	-	0	97	100	100	100	100	100	95

Footnotes at end of Table (Continued)

Continued (Table 1)

Treatments: Herbicide	Lb/A	Method a/	% Emergence e/ 5-30	Snap Bean Vigor (% of Control) 6-10	6-17 f/	6-21	7-13	Plant Stand g/ 6-10	Leaf Burn h/ 6-17 f/	7-13	Percent Weed Control i/ June 10 RW	NUT	CG	GG	LQ	CW	MG
35.Xylachlor +	3.0 +	PPI +															
dinoseb	3.0	Pre	93	93	---	97	80	95	-	0	40	95	95	100	83	100	13
36.Xylachlor +	6.0 +	PPI +															
dinoseb	3.0	Pre	90	97	---	97	93	90	-	0	52	92	95	92	83	100	53
37.Xylachlor (5.5E) +	3.0 +																
dinoseb (3E)	3.0	Pre	88	100	---	100	97	97	-	0	55	98	98	98	95	90	33
38.Xylachlor +	6.0 +																
dinoseb	3.0	Pre	85	97	---	92	92	97	-	0	60	93	100	100	88	100	100
39.alachlor (4E) +	1.5 +																
dinoseb	3.0	Pre	90	97	---	85	83	85	-	0	53	100	100	100	93	100	100
40.alachlor +	2.0 +																
dinoseb	3.0	Pre	88	95	---	93	90	100	-	0	47	99	100	100	98	100	83
41.alachlor +	3.0 +																
dinoseb	3.0	Pre	95	93	---	92	100	90	-	1	65	100	100	100	100	100	100
42.vernolate (7E)	3.0	PPI	98	100	---	95	87	93	-	2	53	95	100	100	98	100	100
43.vernolate (6E) +	3.0 +																
R-33865	0.5	PPI	97	100	---	97	88	100	-	0	63	100	100	100	100	100	53
44.EPTC (6E) +	3.0 +																
R-33865	0.5	PPI	100	97	---	100	90	97	-	0	40	93	100	100	90	100	100
45.cycloate	3.0	PPI	93	90	---	95	83	92	-	2	40	97	100	100	92	100	50
46.UBI-S734 (75W)	0.5	PPI	95	100	---	87	73	100	-	0	45	83	88	100	85	67	33
47.UBI-S734	0.75	PPI	95	93	---	85	83	95	-	0	18	62	97	100	73	100	67
48.UBI-S734	1.0	PPI	95	90	---	90	100	100	-	0	38	88	100	100	53	100	83
49.trifluralin +	0.5 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon	0.75	Post I	90	100	100	92	100	100	3	5	40	0	100	98	100	100	100
50.trifluralin +	0.5 +	PPI +															
dinoseb +	3.0 +	Pre +															
bentazon	1.0	Post I	95	97	100	100	95	98	0	3	42	0	100	100	100	100	93
51.EPTC +	3.0 +	PPI +															
dinoseb	0.375	Post I	100	100	100	97	95	100	12	1	58	98	100	99	88	100	67
52.EPTC +	3.0 +	PPI +															
dinoseb	0.75	Post I	98	98	85	88	100	97	25	3	48	99	95	95	85	100	53
53.EPTC +	3.0 +	PPI +															
acifluorfen	0.25 d/	Post I	97	100	57	43	100	100	47	3	35	97	100	100	80	100	87
54.EPTC +	3.0 +	PPI +															
acifluorfen	0.75 d/	Post I	100	100	47	38	40	100	80	0	48	99	100	100	95	100	80
55.napropamide (50W)	1.5	PPI	10	40	---	32	72	43	-	1	73	75	97	100	98	100	0
56.DCPA	6.0	Pre	100	100	---	97	100	100	-	0	0	0	100	100	100	100	60

Mean separation within columns by Duncan's multiple range test at 0.05 level.

a/ Planted May 22, 1979. Preplant incorporated on May 22. Preemergence applied May 22. Post I applied June 12 (snap beans in 1st trifoliate stage), Post II on June 20, Post III on July 5, Post IV on July 14.

b/ With oil concentrate at 1 qt/A.

c/ With non-ionic surfactant (X-77(R)) at 8 oz/100 gal water. Directed spray without shields.

d/ With AG-98 surfactant at 1 qt/100 gal.

e/ Snap bean emergence.

f/ Ratings made on Post I treatments only.

g/ Snap bean population rated as % of control.

h/ Based on the % of leaf surface area that is necrotic.

i/ Weed population: June 10 - common ragweed (RW) 11 plants/ft^2, yellow nutsedge (NUT) 7 plants/ft^2, large crabgrass (CG) 9 plants/ft^2, goosegrass (GG) 3 plants/ft^2, common lambsquarters (LQ) 11 plants/ft^2, carpetweed (CW) 3 plants/ft^2, tall, ivy leaf, and entireleaf morningglory (MG) 0.2 plants/ft^2. July 13 - (based on % of total number of weeds and foliage density) common ragweed (RW) 40%, yellow nutsedge (NUT) 23%, common lambsquarters (LQ) 22%, large crabgrass (CG) 15%.

Table 1.(Continued) Weed control in 18 inch spaced narrow-row 'GV-50' snap beans in a Norfolk loam sand in 1979.

Treatments			Percent Weed Control[i]											Stand[j]	Yield[k]
			June 17[f]							July 13				Plants	
Herbicide	Lb/A	Method[a]	RW	CG	GG	NUT	MG	CW	LQ	RW	NUT	LQ	CG	Per 10 Ft	Ton/A
1.Control	----	----	0	0	0	0	0	0	0	0	0	0	0	25.0 c	2.13 q-u
2.Handweeded	----	----	100	100	100	100	100	100	100	100	98	100	100	33.0 abc	6.05 a-f
3.EPTC (7E) + dinoseb + bentazon (4E)	3.0 + 3.0 + 0.75	PPI + Pre + Post I	92	93	98	100	78	100	100	90	90	100	88	32.3 abc	6.43 a-d
4.EPTC + dinoseb + bentazon	3.0 + 3.0 + 1.0	PPI + Pre + Post I	100	97	98	100	88	93	100	100	93	100	80	30.7 abc	6.43 a-d
5.EPTC + dinoseb + bentazon	3.0 + 3.0 + 1.5	PPI + Pre + Post I	100	100	100	100	100	100	100	99	100	100	87	28.3 abc	5.81 a-q
6.EPTC + dinoseb + bentazon	3.0 + 3.0 + 0.75	PPI + Pre + Post II	---	---	---	---	---	---	---	98	100	100	88	36.3 a	5.71 a-h
7.EPTC + dinoseb + bentazon	3.0 + 3.0 + 1.0	PPI + Pre + Post II	---	---	---	---	---	---	---	100	97	100	78	27.7 abc	6.0 a-f
8.EPTC + dinoseb + bentazon	3.0 + 3.0 + 1.5	PPI + Pre + Post II	---	---	---	---	---	---	---	100	100	100	82	27.7 abc	6.0 a-f
9.dinoseb (3E) + BAS 9052 OH (1.53E)	3.0 + 0.5	Pre + Post I[b]	0	83	80	0	0	0	0	22	0	93	67	27.0 abc	3.19 l-s
10.BAS 9052 OH + bentazon	0.5 + 0.75	Post I[b]	90	82	100	50	67	0	100	86	37	100	100	28.0 abc	5.27 b-k
11.BAS 9052 OH + bentazon	1.0 + 0.75	Post I[b]	90	87	92	47	33	0	100	93	0	100	100	25.0 c	5.33 b-j
12.BAS 479 OOH (1.66E)	0.5	Pre	---	---	---	---	---	---	---	40	100	100	100	28.7 abc	2.95 n-t
13.BAS 479 OOH	0.75	Pre	---	---	---	---	---	---	---	40	100	88	100	32.7 abc	1.64 stu
14.BAS 479 OOH	1.0	Pre	---	---	---	---	---	---	---	30	100	100	100	28.7 abc	1.74 r-u
15.BAS 479 OOH + bentazon	0.5 + 0.75	Pre + Post I	98	100	100	100	55	100	100	83	95	100	96	29.0 abc	4.6 e-n
16.BAS 479 OOH + bentazon	0.75 + 0.75	Pre + Post I	92	100	100	98	72	100	100	82	100	100	97	29.3 abc	4.01 g-p
17.paraquat (2E)	0.25[c]	Post I + III + IV	92	73	100	63	97	100	100	83	93	100	100	32.0 abc	5.52 b-i
18.paraquat	0.50[c]	Post I + III + IV	100	97	100	73	100	100	100	100	99	100	100	30.0 abc	5.71 a-h
19.paraquat	1.0[c]	Post I + III + IV	100	99	100	90	100	100	100	100	100	100	100	33.0 abc	4.6 e-n
20.metolachlor (8E) + dinoseb	1.25 + 3.0	Pre	---	---	---	---	---	---	---	23	100	87	100	29.3 abc	3.96 h-q
21.metolachlor + dinoseb	2.5 + 3.0	Pre	---	---	---	---	---	---	---	13	100	99	100	27.3 abc	3.53 j-r
22.metolachlor + dinoseb	1.25 + 3.0	PPI + Pre	---	---	---	---	---	---	---	42	67	75	100	26.7 bc	4.17 g-p
23.metolachlor + dinoseb	2.5 + 3.0	PPI + Pre	---	---	---	---	---	---	---	60	100	93	98	30.0 abc	4.98 c-l
24.DCPA (75WP) + dinoseb	6.0 + 3.0	Pre	---	---	---	---	---	---	---	40	33	100	100	27.3 abc	4.65 d-n
25.DCPA + dinoseb	12.0 + 3.0	Pre	---	---	---	---	---	---	---	40	0	100	100	24.7 c	4.40 e-o
26.ethalfluralin (3E)	0.5	PPI	---	---	---	---	---	---	---	30	17	100	100	27.0 abc	3.82 i-q
27.ethalfluralin + EPTC (7E)	0.5 + 3.0	PPI	---	---	---	---	---	---	---	15	100	100	100	29.3 abc	4.31 f-o
28.ethalfluralin + EPTC	1.0 + 3.0	PPI	---	---	---	---	---	---	---	53	100	100	99	30.0 abc	4.40 e-o
29.trifluralin + EPTC	0.5 + 3.0	PPI	---	---	---	---	---	---	---	32	100	100	100	24.0 c	4.54 e-o
30.trilfluralin + EPTC	1.0 + 3.0	PPI	---	---	---	---	---	---	---	13	100	100	100	25.7 c	4.54 e-o
31.EPTC	3.0	PPI	---	---	---	---	---	---	---	38	100	87	95	25.3 c	3.44 k-r
32.MON 55097 (5E) + dinoseb	1.5 + 3.0	Pre	---	---	---	---	---	---	---	57	98	100	100	35.3 ab	4.84 d-m
33.MON 55097 + dinoseb	2.0 + 3.0	Pre	---	---	---	---	---	---	---	50	100	80	100	28.0 abc	3.44 k-r
34.MON 55097 + dinoseb	3.0 + 3.0	Pre	---	---	---	---	---	---	---	77	100	93	100	29.7 abc	3.38 l-s

Footnotes at end of table (Continued)

Continued (Table 1)

Treatments			Percent Weed Control i/											Stand j/	Yield k/
			June 17 f/							July 13				Plants	
Herbicide	Lb/A	Method a/	RW	CG	GG	NUT	MG	CW	LQ	RW	NUT	LQ	CG	Per 10 Ft	Ton/A
35. Xylachlor + dinoseb	3.0 + 3.0	PPI + Pre	---	---	---	---	---	---	---	43	93	70	82	28.7 abc	3.88 i-q
36. Xylachlor + dinoseb	6.0 + 3.0	PPI + Pre	---	---	---	---	---	---	---	53	95	22	83	27.7 abc	3.53 j-n
37. Xylachlor (5.5E) + dinoseb (3E)	3.0 + 3.0	Pre	---	---	---	---	---	---	---	33	100	50	85	31.7 abc	3.96 h-q
38. Xylachlor + dinoseb	6.0 + 3.0	Pre	---	---	---	---	---	---	---	48	100	87	100	30.0 abc	3.15 l-t
39. alachlor (4E) + dinoseb	1.5 + 3.0	Pre	---	---	---	---	---	---	---	43	93	73	87	29.0 abc	3.78 i-q
40. alachlor + dinoseb	2.0 + 3.0	Pre	---	---	---	---	---	---	---	33	100	95	93	24.7 c	3.88 i-q
41. alachlor + dinoseb	3.0 + 3.0	Pre	---	---	---	---	---	---	---	52	100	88	97	31.0 abc	4.4 e-o
42. vernolate (7E)	3.0	PPI	---	---	---	---	---	---	---	37	92	100	93	25.3 c	3.82 i-q
43. vernolate (6E) + R-33865	3.0 + 0.5	PPI	---	---	---	---	---	---	---	23	100	100	100	27.0 abc	3.34 l-s
44. EPTC (6E) + R-33865	3.0 + 0.5	PPI	---	---	---	---	---	---	---	23	100	88	93	25.7 c	4.31 f-o
45. cycloate	3.0	PPI	---	---	---	---	---	---	---	17	100	100	98	24.0 c	3.19 l-s
46. UBI-S734 (75W)	0.5	PPI	---	---	---	---	---	---	---	20	67	77	92	25.0 c	27.2 o-t
47. UBI-S734	0.75	PPI	---	---	---	---	---	---	---	0	100	77	100	24.7 c	2.42 p-u
48. UBI-S734	1.0	PPI	---	---	---	---	---	---	---	30	100	52	100	28.7 abc	3.09 m-t
49. trifluralin + dinoseb + bentazon	0.5 + 3.0 + 0.75	PPI + Pre + Post I	100	100	100	43	97	100	100	93	13	100	100	27.3 abc	6.2 a-e
50. trifluralin + dinoseb + bentazon	0.5 + 3.0 + 1.0	PPI + Pre + Post I	100	97	100	43	97	100	100	99	45	100	97	30.0 abc	6.78 ab
51. EPTC + dinoseb	3.0 + 0.375	PPI + Post I	92	100	100	98	67	100	100	88	98	99	98	33.3 abc	7.36 a
52. EPTC + dinoseb	3.0 + 0.75	PPI + Post I	100	100	100	97	100	100	100	100	85	100	94	26.3 bc	6.64 abc
53. EPTC + acifluorfen	3.0 + 0.25 d/	PPI + Post I	100	100	100	97	100	100	100	100	82	100	93	30.7 abc	3.73 i-q
54. EPTC + acifluorfen	3.0 + 0.75 d/	PPI + Post I	100	100	100	100	100	100	100	100	82	100	100	26.3 bc	0.77 u
55. napropamide (50W)	1.5	PPI	---	---	---	---	---	---	---	38	23	100	95	16.0 d	1.41 tu
56. DCPA	6.0	Pre	---	---	---	---	---	---	---	22	33	100	100	26.7 bc	3.38 l-s

Mean separation within columns by Duncan's multiple range test at 0.05 level.

a/ Planted May 22, 1979. Preplant incorporated on May 22. Preemergence applied May 22. Post I applied June 12 (snap beans in 1st trifoliate stage), Post II on June 20, Post III on July 5, Post IV on July 14.

b/ With oil concentrate at 1 qt/A.

c/ With non-ionic surfactant (X-77(R)) at 8 oz/100 gal water. Directed spray without shields.

d/ With AG-98 surfactant at 1 qt/100 gal.

i/ Weed population: June 10 - common ragweed (RW) 11 plants/ft^2, yellow nutsedge (NUT) 7 plants/ft^2, large crabgrass (CG) 9 plants/ft^2, goosegrass (GG) 3 plants/ft^2, common lambsquarters (LQ) 11 plants/ft^2, carpetweed (CW) 3 plants/ft^2, tall, ivy leaf, and entireleaf morningglory (MG) 0.2 plants/ft^2. July 13 - (based on % of total number of weeds and foliage density) common ragweed (RW) 40%, yellow nutsedge (NUT) 23%, common lambsquarters (LQ) 22%, large crabgrass (CG) 15%.

j/ Snap bean plants per 10 ft counted on July 17.

k/ Harvested a 10 ft length in the center row of the plot on July 17.

Table 2. The influence of cultivation on weed control in 'GV-50' snap beans with postemergence diclofop and bentazon on a Norfolk loamy sand in 1979.

Herbicide	Lb/A	Method a/	Tillage b/	July 13, 1979 Leaf Burn c/	Vigor d/	% Weed Control e/ RW	NUT	LQ	CG	Plant Stand f/ Plants/10 Ft.	Yield f/ Ton/A
1a. Control	----	----	none	0	67	0	0	0	0	37.3 bc	2.34 g
1b. Control	----	----	cultv.	0	77	0	0	0	0	32.3 c	2.32 g
2a. Handweeded	----	----	none	0	100	100	100	100	100	44.7 ab	4.38 a
2b. Handweeded	----	----	cultv.	0	100	100	100	100	100	44.7 ab	3.85 ab
3a. dinoseb (3E) + diclofop (3E)	1.5 + 0.75	Pre + Post I	none	0	97	17	33	33	67	38.7 abc	2.95 ef
3b. dinoseb (3E) + diclofop (3E)	1.5 + 0.75	Pre + Post I	cultv.	0	100	35	87	63	93	40.7 abc	3.58 bcd
4a. dinoseb + diclofop	1.5 + 1.0	Pre + Post I	none	0	100	33	0	0	90	38.7 abc	2.69 fg
4b. dinoseb + diclofop	1.5 + 1.0	Pre + Post I	cultv.	0	100	13	67	97	88	42.7 ab	3.14 def
5a. dinoseb + diclofop	1.5 + 0.75	Pre + Post II	none	0	90	0	0	0	75	44.7 ab	2.75 fg
5b. dinoseb + diclofop	1.5 + 0.75	Pre + Post II	cultv.	2	100	38	73	90	95	40.0 abc	2.90 ef
6a. dinoseb + diclofop	1.5 + 1.0	Pre + Post II	none	0	100	17	23	20	73	46.0 a	2.85 efg
6b. dinoseb + diclofop	1.5 + 1.0	Pre + Post II	cultv.	0	100	42	57	92	100	39.7 abc	3.78 bc
7a. diclofop + bentazon (4E)	0.75+ 1.0	Post I	none	2	93	92	25	97	17	40.3 abc	3.39 b-e
7b. diclofop + bentazon	0.75+ 1.0	Post I	cultv.	0	92	97	92	100	78	41.7 ab	3.25 c-f
8a. diclofop + bentazon	1.0 + 1.0	Post I	none	3	100	84	52	100	32	43.7 ab	3.68 bcd
8b. diclofop + bentazon	1.0 + 1.0	Post I	cultv.	2	100	90	100	100	89	43.0 ab	3.9 ab
9a. diclofop + bentazon	1.0 + 1.0	Post II	none	3	100	93	100	100	30	40.7 abc	3.85 ab
9b. diclofop + bentazon	1.0 + 1.0	Post II	cultv.	0	100	100	100	100	93	40.3 abc	3.75 bc

Mean separation within columns by Duncans multiple range test at the 0.05 level.

a/ Planted May 22. Preemergence applied May 22. Post I on June 12. Post II on June 19.

b/ Cultivated on June 29, 1979.

c/ % of leaf area with necrosis.

d/ Rated as % of control, based on plant size.

e/ Weed population: based on a percentage of the total weeds of 28 plants/sq. ft. Common ragweed (RW) 40%, yellow nutsedge (NUT) 30%, common lambsquarters (LQ) 10%, large crabgrass (CG) 20%..Rated to the appropriate control.

f/ Snap bean plants counted and harvested on July 17, 1979. Based on 10 ft of a single row in the center row of each plot.

Table 3. Climatological Summary for the Vegetable Research Farm at Salisbury, Maryland for the Snap Bean Study in 1979

	Temp °F				Temp °F				Temp °F				Temp °F		
Day	Max	Min	Rainfall Inches	Day	Max	Min	Rainfall Inches	Day	Max	Min	Rainfall Inches	Day	Max	Min	Rainfall Inches
	May				June				June				July		
18	62	56	0.21	1	82	69	0.61	16	82	56		1	82	64	1.17
19	75	54	0.32	2	82	64		17	82	66	0.13	2	82	65	0.51
20	75	58		3	78	60		18	86	62		3	84	64	
21	79	56		4	72	58	3.15	19	84	61		4	82	66	0.09
22	80	62		5	80	62	0.70	20	82	53		5	73	56	0.03
23	84	63	0.02	6	88	63		21	82	54		6	79	53	
24	81	65	0.85	7	89	68		22	78	58	0.14	7	84	54	
25	78	64	2.00	8	87	66		23	86	64		8	86	57	
26	64	54	0.02	9	90	65		24	86	58	0.07	9	86	64	
27	78	54		10	86	65		25	74	52	0.05	10	86	58	0.03
28	74	62		11	74	56	2.62	26	79	49		11	86	66	0.02
29	82	56	0.05	12	74	52		27	84	50		12	92	66	0.15
30	84	58		13	80	54	1.0(irrig)	28	84	56		13	95	73	
31	80	64	1.49	14	82	50		29	86	62		14	91	72	
				15	82	50		30	87	65		15	90	72	
												16	90	74	
												17	90	70	

INTERACTION OF HERBICIDES, CULTIVATION, AND ROW SPACING FOR SNAP BEAN PRODUCTION

J.R. Teasdale and J.R. Frank[1/]

ABSTRACT

Two field experiments were conducted in 1979 to compare weed control and yield potential for two snap bean cropping systems. The first system included narrow row spacing and chemical weed control without cultivation. The second system included wide row spacing, herbicides, and mechanical cultivation. The same experiment was conducted at Beltsville, MD (loam, 2.2% O.M.) and Frederick, MD (silt loam, 1.8% O.M.). 'Checkmate' snap beans were planted in 10" (narrow) or 36" (wide) rows at the same plant density for both row spacings. Only the 36" rows were cultivated.

In general, those herbicide treatments which provided good weed control were equally effective at both the 10" and 36" row spacing. For those treatments which failed to control weeds, additonal cultivation improved weed control in 36" row plots compared to 10" row plots. At Beltsville, the two-way herbicide combinations of EPTC plus dinoseb, EPTC plus bentazon, and trifluralin plus bentazon provided at least 96% control of a vigorous population of yellow nutsedge (Cyperus esculentus L.) and common purslane (Portulaca oleracea L.). Three-way combinations did not improve weed control compared to these treatments. At Frederick, however, a variable population of perennial weeds was more difficult to control and the three-way combinations of EPTC or trifluralin plus dinoseb plus bentazon was more effective than two-way combinations in 10" row plots.

Past research has shown that narrow row spacings will increase bean yield compared to wide row spacings. Weed control was sufficient at both sites in this experiment to allow the potential yield advantage of narrow row spacings to be expressed. Comparing bean yield from 10" row and 36" row plots for the same herbicide treatment, yields in 10" row plots were greater than those in 36" row plots by an average of 62% at Beltsville and 27% at Frederick.

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WEED CONTROL IN CUCUMBERS WITH ETHALFLURALIN AND ORYZALIN

J.R. Teasdale[1/]

ABSTRACT

This herbicide evaluation was conducted during 1979 at Beltsville, MD on a sandy loam soil with 1.1% O.M. 'Poinsett 76' cucumbers were planted in 6' rows and five hand harvests were made at weekly intervals. The principle weeds in the field were common lambsquarter (Chenopodium album L.) and carpetweed (Mollugo verticillata L.). Carpetweed was controlled by all ethalfluralin and oryzalin rates so lambsquarter was the primary weed which influenced yield. No cultivations were made and above-average rainfall fell throughout the growing season. Therefore, these conditions provided a good test of the ability of these herbicides to provide season-long weed control.

Preemergence applications of ethalfluralin required rates of at least 2.0 lb/A for full season lambsquarter control. Ethalfluralin was safe on cucumbers except at the 4.0 lb/A rate which severely reduced crop stand and vigor. As a result, total fruit yield increased as lambsquarter control increased, reached a maximum of 29,100 kg/ha at 2.0 lb/A of ethalfluralin, and declined sharply at higher rates due to crop injury. Addition of a preemergence application of naptalam or a postemergence application of bentazon to 1.0 lb/A of ethalfluralin improved lambsquarter control and increased yields to a level comparable to the 2.0 lb/A rate of ethalfluralin alone.

Preemergence application of oryzalin required at least 3/8 lb/A for early season lambsquarter control but required 1/2 lb/A for full season control. However, cucumber stand, vigor, and yield were reduced at 1/2 lb/A. Therefore, optimum weed control was not realized at a rate safe for cucumbers. Sufficient weed control was obtained at 1/4 and 3/8 lb/A to provide yields of 22,700 and 23,500 kg/ha, respectively. Addition of a preemergence application of naptalam or chloramben or a postemergence application of bentazon to 3/8 lb/A of oryzalin provided improved lambsquarter control and similar yields to the 3/8 lb/A rate alone.

The best rates of ethalfluralin or oryzalin provided better full season weed control and yields five and four times, respectively, those obtained with the standard pre-plant incorporated application of bensulide plus naptalam. Registration of these materials would be of great benefit to the cucumber producer.

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SOIL RESIDUAL OF ETHALFLURALIN WITH CUCUMBERS[1/]

S. W. Williamson and C. E. Beste[2/]

Abstract. Preemergence ethalfluralin provided excellent weed control and acceptable cucumber tolerance at 0.75, 1.12 and 2.25 lb/A in a Norfolk loamy sand in 1979. Cucumbers replanted, either with or without tillage at two, four and eight weeks after preemergence ethalfluralin at 0.75, 1.12 and 2.25 lb/A did not reduce yields.

Tillage prior to sweet corn planting at two weeks after preemergence ethalfluralin application caused severe injury and a yield reduction; however, sweet corn planted without tillage was only slightly injured and yields were unaffected. Sweet corn planted without tillage four weeks after ethalfluralin preemergence application was normal; whereas, tillage before planting reduced vigor but not yields and sweet corn replanted eight weeks after ethalfluralin had vigor reduction only with tillage at the 2.25 lb/A rate.

INTRODUCTION

Ethalfluralin [*N*-ethel-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)-benzenamine] is a potential new preemergence herbicide for cucumbers (*Cucumis sativus* L.) which was not phytotoxic up to 2.25 lb/A but required 0.75 lb/A for acceptable weed control (1). Ethalfluralin has been shown to degrade during the growing season, allowing rotational crops to be seeded four to five months after application (3). Sorghum (*Sorghum bicolor* L.) recovered from initial stunting by ethalfluralin; however, 1.0 lb/A reduced crop yields by 14.8% (2).

The objective of this study was to evaluate preemergence ethalfluralin for weed control and seeded cucumber growth. Tillage effects on the residual activity of ethalfluralin on replanted cucumbers and sweet corn (*Zea mays* L. var. *rugosa*) were evaluated.

MATERIALS AND METHODS

A Norfolk loamy sand (0.6% organic matter) was prepared to planting with 600 lb/A of 10-8-10 and a spring tooth harrow plus disc and cultipacker on May 21, 1979. The seedbed was prepared on May 29 and 'Poinsett' cucumbers were planted 1 inch deep. Ethalfluralin was applied preemergence on May 29 at 0.75, 1.12 and 2.25 lb/A with a tractor mounted 15 ft boom sprayer at 25 GPA, 32 psi and 8003 nozzle tips. The plot size was 5 by 23 ft with one row per plot; however, each herbicide treatment consisted of seven one-row plots,

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each with guard rows, which were tilled and/or replanted in strips across the block. Each treatment area was 75 by 23 ft. The experimental design was a split-block with three replications. Plots were replanted at 2, 4 and 8 week intervals on June 12, June 26 and July 24, respectively. The plots were replanted either without tillage or after three discings. Each plot was replanted with 'NK-199' sweet corn (1.5 inch depth) and cucumbers (1 inch depth) in rows spaced 3 ft apart. The center row in the untilled-replanted plots was removed by hoeing and the guard rows were removed 3 weeks after replanting to avoid competition.

Original Planting - Cucumbers

Emergence rated as percent of control on June 6. Vigor rating of cucumbers made on June 8. On July 9, all plots sidedressed with 100 lb/A ammonium nitrate. On June 28, a weed control rating was made for common purslane (*Portulaca oleracea* L.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.), goosegrass (*Eleusine indica* (L.)Gaertn.), lovegrass (*Eragrostis cilianensis* (All.)Lutati), carpetweed (*Mollugo verticillata* L.). Plots were rated for general weed control on July 25. Marketable fruit were harvested from the entire plot throughout growing season from July 20 to August 30. An early yield was calculated by combining the yield of the first two weeks. A second early yield was calculated by combining the first three weeks harvest. A total yield for the season was also calculated.

1st Replanting - Corn and Cucumbers

Replanted on June 12 with 'Poinsett' cucumbers, and 'NK-199' corn. Sidedressed on July 9 with 100 lb/A ammonium nitrate. Heights of cucumbers and extended leaf heights of corn were measured on July 7. Cucumbers had one true leaf present. Plant heights were calculated to percent of control height. Corn stand counts were made on July 24, 6 weeks after replanting. Plants in a 15 ft section were counted for the population. Marketable fruit of cucumbers were harvested and combined into 1st, 2nd and total harvest, as for the original planting. Mature corn was harvested on August 23 and the height per ear of corn was calculated.

2nd Replanting - Corn and Cucumbers

Replanted with corn and cucumbers, as above, on June 26. Sidedressed with 100 lb/A of ammonium nitrate on July 20. Heights were measured and recorded for corn and cucumbers, as above. Stand counts of corn and cucumbers taken on July 24, four weeks after replanting. Cucumber harvest data was combined into 1st, 2nd and total harvest. Corn harvest was made on August 27.

3rd Replanting - Corn and Cucumbers

Replanted with corn and cucumbers on July 24. Heights and stand counts recorded on August 15. Dry weight of corn and cucumbers were determined since it was too late in the season to obtain yield data. Corn plants were harvested for dry weight analysis on September 3.

RESULTS AND DISCUSSION

The original planting of cucumbers showed a vigor reduction and delay of emergence with ethalfluralin at 1.12 and 2.25 lb/A (Table 1). A non significant reduction occurred only with ethalfluralin at 2.25 lb/A; however, the total yield was not affected by ethalfluralin. Discing prior to replanting cucumbers in ethalfluralin at 2.25 lb/A after 2 weeks caused a vigor reduction; however, yields were not reduced. Cucumbers replanted without tillage in 2.25 lb/A ethalfluralin 2 weeks after application did not reduce cucumber vigor or yield. Replanting without tillage caused a downward trend in yields compared to tillage prior to planting. However, tillage with the ethalfluralin after two weeks appeared to cause a reduction in vigor of replanted cucumbers with all rates. In the second replanting, tillage prior to replanting in ethalfluralin caused a vigor reduction with all rates of ethalfluralin; however, yields were not reduced. Insufficient weeding contributed to the lower yields of the control and ethalfluralin treatments at 0.75 and 1.125 lb/A compared to ethalfluralin at 2.25 lb/A which provided full season weed control in the second replanting. In the third replanting, the ethalfluralin appeared to be sufficiently dissipated to prevent vigor reduction of the cucumbers. The poor growth of cucumbers without tillage in the third replanting was probably due to soil compaction. Enhanced growth of cucumbers at the higher ethalfluralin rates was due to better weed control in the third replanting.

The replanting studies with sweet corn showed that tillage with ethalfluralin caused severe injury when replanted within 2 weeks after application and corn planted without tillage had less injury (Table 2). Corn yields were reduced with tillage of the ethalfluralin soil residue but not if tillage was omitted prior to planting. In the second replanting of corn, discing ethalfluralin four weeks after application caused severe injury; however, planting corn without tillage was not injurious. In the third replanting, only the 2.25 lb/A ethalfluralin caused corn injury with discing.

Weed control was excellent at the lowest rate of 0.75 lb/A and tillage prior to replanting within two weeks did not reduce weed control effectiveness (Table 3).

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Table 1. Cucumber response to preemergence ethalfluralin, and the effect of tillage prior to replanting, in a Norfolk loamy sand in 1979.

Treatment 5/29		Original Planting 5/29/79					First Replanting 6/12/79					Second Replanting 6/26/79					Third Replanting 7/24/79			
			Stand c/	Harvest (1000 Lbs/A) d/			Height e/		Harvest (1000 Lbs/A) d/			Height		Plant Stand f/	Harvest (1000 Lbs/A) d/		Height		Plant Stand g/	Dry Wt. h/
Ethalfluralin Lb/A	Tillage	Vigor b/	% Emergence	1st	2nd	Total	cm	% of Control	1st	2nd	Total	cm	% of Control	No./Ft.	1st	Total	cm	% of Control	No./Ft.	g/plant
Control	disc a/	---	---	---	---	---	8.3a	100	9.7b	13.1	13.8bcd	14.4a	100	6.8	4.7bc	5.1bc	4.9ab	100	2.0	18.8
	none	0	100.0	12.2a	18.1	27.1a	6.1bc	100	6.5c	10.9	10.9cd	7.6c	100	6.0	3.0cd	3.8c	2.7c	100	1.8	7.6
0.75	disc	---	---	---	---	---	7.3abc	88	10.0b	15.4	16.8abc	10.6abc	74	6.2	2.8cd	3.1c	4.6abc	94	2.1	11.8
	none	1	90.0	12.5a	17.7	27.1a	6.1bc	100	8.0c	11.7	13.1d	8.5bc	100	6.2	2.4d	3.1c	2.9bc	100	2.0	8.0
1.12	disc	---	---	---	---	---	7.6ab	92	11.8a	17.6	19.9a	13.4a	93	6.3	6.4b	7.0b	5.9a	100	1.9	28.2
	none	2	85.0	13.6a	19.2	27.4a	5.7c	93	8.1c	12.3	14.2bcd	9.1bc	100	6.4	5.5b	6.3b	3.5bc	100	2.3	15.0
2.25	disc	---	---	---	---	---	5.8c	70	10.8ab	18.0	20.8a	11.9ab	83	5.1	10.7a	12.0a	6.3a	100	2.5	36.5
	none	5	86.7	10.4a	16.6	27.0a	5.8c	95	9.9b	16.3	18.7ab	9.3bc	100	7.9	8.7a	10.7a	3.4bc	100	2.8	13.6

Mean separation within columns by Duncan's multiple range test at the 0.05 level.

a/ Disced twice 3 inches deep and a third time at 4.5 inch depth with disc and midwest harrow, or cucumbers were planted without tillage.

b/ Rated one week after planting, 6/8/79. 0 = no vigor reduction, 10 = plants were killed.

c/ Based on rating made on 6/6/79.

d/ 1st harvest included 1st 2 weeks of total harvest.
2nd harvest included 1st 3 weeks of total harvest.
Total harvest is total pounds of cucumbers produced per treatment.
Marketable cucumbers were harvested.

e/ Height measurement reported as % of control and cm.

f/ Counted 15 foot section 7/24/79, four weeks after replanting.

g/ Counted 15 foot section 8/15/79, four weeks after replanting.

h/ Dry weight of cucumbers determined since it was too late in season to obtain yield.

Table 2. The effect of tillage on the soil residual influence of preemergence ethalfluralin on sweet corn in a Norfolk loamy sand in 1979.

Pre Treat. 5/29		First Replanting 6/12/79					Second Replanting 6/26/79					Third Replanting 7/24/79			
Ethal-fluralin Lb/A	Tillage	Height[b/] cm	Height[b/] % of Control	Plant Stand[c/] No./Ft.	Yield 1000 Lbs/A	Ear Wt. Lb/Ear	Height[b/] cm	Height[b/] % of Control	Plant Stand[d/] No./Ft.	Yield 1000 Lbs/A	Ear Wt. Lb/Ear	Height[b/] cm	Height[b/] % of Control	Plant Stand[e/] No./Ft.	Dry Wt.[f/] g/Plot
Control	disc[a/]	35a	100	1.7	7.4a	0.48	64a	100	1.3	4.1a	0.42	41a	100	0.9	12.7
	none	30ab	100	2.0	5.7a	0.48	43b	100	1.0	1.6a	0.38	27b	100	0.9	6.3
0.75	disc	23c	66	1.8	5.2a	0.43	49b	77	1.2	2.0a	0.43	42a	100	1.1	14.5
	none	26bc	85	1.9	5.6a	0.42	54ab	100	1.1	2.1a	0.43	24b	89	0.8	5.3
1.12	disc	22cd	62	1.8	4.7a	0.30	55ab	86	1.2	4.9a	0.45	44a	100	1.0	19.1
	none	27bc	89	2.0	5.8a	0.50	52ab	100	1.2	3.4a	0.45	29b	100	0.8	7.2
2.25	disc	15d	44	1.6	5.4a	0.50	44b	69	1.1	5.4a	0.48	28b	68	1.0	12.9
	none	23c	76	1.8	4.8a	0.52	52ab	100	0.9	3.6a	0.50	22b	83	1.0	7.9

Mean separation within columns by Duncan's multiple range test at the 0.05 level.

a/ Disced twice 3 inches deep and a third time at 4.5 inch depth with disc and midwest harrow, or corn was planted without rillage.

b/ Height measurements reported in cm and as % of control for each tillage treatment. Measured plant with leaves fully extended.

c/ Counted 15 foot section, 7/24/79, six weeks after replanting.

d/ Counted 15 foot section, 7/24/79, four weeks after replanting.

e/ Counted 15 foot section on 8/14/79, three weeks after replanting.

f/ Dry weight of corn plants determined since it was too late in season to obtain yield.

Table 3. Weed control with ethalfluralin.

Herbicide (Lb/A)	% Weed Control (6/28/79)[a]					% Weed Control 7/25/79[b]
	PL	CG	GG	LG	CW	
Control	0	0	0	0	0	100[c]
0.75	100	100	100	100	100	94
1.12	100	100	100	100	100	96
2.25	100	100	100	100	100	98

a/ Rated 4 weeks after herbicide application. Control plots weed population: common purslane (PL), 28 plants/ft^2; crabgrass (CG), 2 plants/ft^2; goosegrass (GG), 6 plants/ft^2; lovegrass (LG), 3 plants/ft^2; carpetweed (CW), 5 plants/ft^2.

b/ Rated 8 weeks after herbicide application.

c/ All control plots handweeded weekly throughout season.

Table 4. Rainfall at the Vegetable Research Farm in 1979.

Date	Inches	Date	Inches	Date	Inches
May 23	0.02	June 22	0.14	July 25	0.07
24	0.85	24	0.07	29	0.24
25	2.60	25	0.05	30	0.17
26	0.02			31	0.14
29	0.05	July 1	1.17		
31	1.49	2	0.51	August 3	2.90
		4	0.09	10	0.16
June 1	0.61	12	0.15	12	1.59
4	3.15	18	0.13	13	0.70
5	0.07	20	1.68	18	0.16
11	2.62	21	0.32	21	2.35
17	0.13	24	0.61	26	0.53
				28	3.20

HERBICIDE TRIALS IN CABBAGE - A THREE-YEAR SUMMARY

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ABSTRACT

Several herbicides tested over a three-year period at the Long Island Horticultural Research Laboratory provided good to excellent control of barnyard grass (Echinochloa crus-galli (L.) Beauv.), crabgrass (Digitaria sanquinalis (L.) Scop) and purslane (Portulaca oleracea (L.). Alachlor, oryzalin, trifluralin, metolachlor, and AC206784 provided the best control for barnyard grass over this period. The control of purslane was marginal with the trifluralin, metolachlor and AC206784. Nitrofen did not provide adequate control of barnyard grass at the 3.36 kg/ha rate. This material did provide excellent control of purslane.

INTRODUCTION

Cabbage (Brassica oleracea cv. Capitata (L.)) continues to be a major crop on Long Island and is raised in rotation with other vegetables on a sandy loam soil. This crop is raised by either transplants or direct seeding and weeds, particularly the resistant weeds such as galinsoga (Galinsoga ciliata (Raf.) Blake) and pineappleweed (Matricaria matricariodes (Less) Porter) can become a problem. During the past three-years experiments were conducted to evaluate some of the standard herbicide treatments with chemicals that are being developed for herbicide use in vegetables.

MATERIALS AND METHODS

A cabbage field was prepared for direct seeding on July 18 on a sandy loam soil. The preplant incorporated treatments of S734 at 1.12 and 2.24 kg/ha, trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-o-toluidine) at 0.56 and 0.84 kg/ha were applied incorporated before seeding the cabbage variety Green Boy. The cabbage was planted with a Stand Hay planter with plots 2 rows by 7.62 m. Each treatment was replicated four times. The preemergence herbicides were applied on July 19 and included S734 at 1.12 and 2.24 kg/ha, AC206784 at 1.12, 1.56 and 2.24 kg/ha, diclofop (2-(4-2';-4'-Dichlorophenoxy)phenoxy)-methyl-propinate) at 0.56, 0.84 and 1.12 kg/ha, alachor (2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide) at 0.56, 0.84 and 1.12 kg/ha, oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide) at 0.84, 1.12, 1.4 kg/ha; nitrofen (2,4dichlorophenyl-o-nitrophenyl ether) at 4.48 kg/ha; metolachlor (2-chloro-N-(2- ethyl-6-methylphenyl)-N-(methoxy-1-methyl)-a,a,a-trifluoro-2,6-dinitro-Npropyl-p-toluidine) at 0.56, 0.84 and 1.12 kg/ha and DCPA (dimethyl tetrachloroterephthalate) at 6.72 kg/ha were applied preemergence to the weeds.

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In an adjacent area preplant incorporated treatments were repeated on August 14 prior to transplanting cabbage. The treatments were the same as in the direct seeded area with the addition of propachlor (2-chloroN-isopropylacetanilide) at 4.48 and 6.72 kg/ha both preplant incorporated and preemergence.

All treatments were made with a tractor-mounted sprayer delivering 61 l/ha at 2.5 atm. Ratings for control of weeds were made on August 21 and September 9 for the direct seeded plot and on September 5 and October 5 in the transplanted area.

This same plan was used in previous years and rates were comparable.

RESULTS AND DISCUSSION

There were no phytotoxic effects with any of the treatments in this experiment. Weed control ratings are given in Table 1 for the 1979 experiment and indicate that each of the materials provided 80% control or better of annual grasses except for the preemergence treatment of S734. It appears that S734 activity was improved when used preplant incorporated.

Purslane was well controlled by the application of alachlor, oryzalin, nitrofen and DCPA. The control with S734 at 2.24 and trifluralin at 0.84 kg/ha was fair. All of the materials used except DCPA and trifluralin provided satisfactory control of galinsoga. In general, the control later in the season on transplants was not as effective as the materials applied in July on the direct seeded cabbage.

The summary in Table 2 indicates that the materials alachlor, oryzalin, trifluralin, metolachlor, and AC206784 have consistantly given good control of crabgrass and barnyard grass and adequate control of purslane. Nitrofen did not control grasses as well, particularly the barnyard grass, but did give excellent control of purslane.

All of the materials summarized in Table 2 have an excellent place in the weed control program for cabbage growers and a combination of the preemergence or preplant incorporated treatment of alachlor, oryzalin, trifluralin or AC206784 followed by a later application with nitrofen should result in excellent weed control.

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Table 1. Percent control of annual weeds with herbicides in direct seeded and transplanted cabbage -- 1979.

Chemical	Rate kg/ha	Timing	Direct seeded: Barnyardgrass 8/21	Direct seeded: Barnyardgrass 9/12	Direct seeded: Crabgrass 8/21	Direct seeded: Crabgrass 9/12	Direct seeded: Purslane 8/21	Direct seeded: Purslane 9/12	Direct seeded: Galinsoga 9/12	Transplants: Barnyardgrass 9/5	Transplants: Barnyardgrass 10/5	Transplants: Crabgrass 9/5	Transplants: Crabgrass 10/5	Transplants: Purslane 10/5	Transplants: Pineappleweed 10/5	Transplants: Galinsoga 10/5
propachlor	4.48	pre								95	95	95	97	92		
propachlor	6.72	pre								98		98		93		
propachlor	4.48	ppi								100	98	98		97	93	
propachlor	6.72	ppi								90	98	83	97	87	98	
S734	1.12	pre	100	100	85	83										
S734	2.24	pre	43	57	73	33	10	0	63							
S734	1.12	ppi	100	100	100	100	85	73	97							
S734	2.24	ppi	100	100	100	100	95	83	100							
AC 206784	1.12	pre	96	90	80	92	65	47	98	87	83	85		60	88	
AC 206784	1.56	pre	83	88	97	100	71	55	87	83	85	78		72		97
AC 206784	2.24	pre	100	100	97	93	75	35	100	80	88	77		78		97
diclofop	0.56	pre	83	83	87	87	46	37	90	95	93	53		48	85	
diclofop	0.84	pre	70	93	75	87	20	13	85	95	95	75		70		83
diclofop	1.12	pre	80	95	93	85	10	0	88	93	93	50	98	35	93	
alachlor	0.56	pre	96	97	88	90	70	67	100	88	92	88	95	83	98	
alachlor	0.84	pre	98	97	93	93	98	100	100	85	85	91	98	87		
alachlor	1.12	pre	95	100	93	88	100	100	100	95	97	97		96		
oryzalin	0.84	pre	85	97	87	80	90	91	100	60	70	93		83		97
oryzalin	1.12	pre	98	97	95	95	95	93	93	77	82	87	97	85	98	90
oryzalin	1.4	pre	93	93	85	92	90	91	83	87	83	87	95	90		
nitrofen	4.48	pre	85	85	88	88	100	98	93	81	93	100	93	100	97	83
metolachlor	0.56	pre	96	97	97	98	83	77	93	91	95	77	95	55	93	97
metolachlor	0.84	pre	96	100	90	82	78	48	100	91	98	81	98	88		
metolachlor	1.12	pre	96	100	92	85	71	67	100	95	93	90	95	87	97	93
trifluralin	0.56	ppi	95	93	83	93	50	73	57	83	90	95		97	85	67
trifluralin	0.84	ppi	90	93	83	85	85	82		90	92	67		77	77	83
DCPA	6.72	pre	95	93	88	93	96	97	68	73	73	97		98		87
Check			1[1/]	5[2/]	3[1/]	18[2/]	5[1/]	40[2/]	30[2/]	4	2	1	1	5	1	1

[1/]density of plants per 0.3 m^2

[2/]percent cover

Table 2 Percent weed control over a three-year period with herbicides in cabbage.

Chemical	Rate timing kg/ha	Percent weed control 1/ barnyard grass 1978	barnyard grass 1979	crabgrass 1977	crabgrass 1979	purslane 1977	purslane 1979
alachlor	0.56 pre	90	93		90		73
alachlor	0.84 pre	93	91		94		95
alachlor	1.12 pre	96	97	97	93	97	99
alachlor	1.4 pre			95		99	
oryzalin	0.89 pre		78		87		88
oryzalin	1.12 pre	95	88.5	95	93.5	80	91
oryzalin	1.4 pre	94	89	94	90	99	90
trifluralin	0.56 ppi	86.5	90	88	90	84	73
trifluralin	0.84 ppi	89	91	85	81	78	81
metolachlor	0.56 pre	97	95		92		72
metrolachlor	1.12 pre	97.5	96		90.5		75
AC206784	1.12 pre		89		86		57
AC206784	2.24 pre		92		89		63
AC206784	3.36 pre	96.5					
AC206784	4.48 pre	97.5					
nitrofen	3.36	56.5					
nitrofen	4.48		87	88	92	99	99
check 2/		17.5	3	15	7	12	18

1/ Ratings are averages of ratings taken at one or more dates and trials

2/ density of plants per 0.3 m^2

TOLERANCE OF CHINESE CABBAGE TO FOUR HERBICIDES[1/]

A. R. Bonanno and R. D. Sweet[2/]

ABSTRACT

In a series of field experiments, four chemicals were investigated for their effect on growth and yield of two varieties of Chinese cabbage (Brassica pekinensis) and for their control of weeds. The chemicals were alachlor, DCPA, nitrofen, and trifluralin. The varieties of Chinese cabbage were 'Michili' and 'Salad King'.

When applied at the cotyledon stage, 2 and 4 lbs/A of nitrofen delayed crop growth but gave acceptable control of redroot pigweed, lambsquarters, annual bluegrass, chickweed, and Galinsoga. Alachlor applied 0.5 and 1.0 lb/A early post also gave acceptable control of these weeds. Excellent control was achieved preemergence with both rates of nitrofen and alachlor with DCPA 8.0 lb/A and trifluralin 0.75 lb/A (Table 1).

With transplants, nitrofen at 2.0 and 4.0 lb/A and trifluralin at 0.25 and 0.75 lb/A temporarily injured 'Salad King'. Nitrofen caused yield reductions of 'Michili' at both rates, whereas trifluralin reduced yields only at the high rate (Table 1).

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Table 1. Yield of direct seeded and transplanted Chinese cabbage.

Treatment	Form	lb/A	Timing	Yield (kg/5 plants) Michili	Salad King
			Direct Seeded		
DCPA	75 WP	4.00	PPI	5.5	7.0
DCPA	75 WP	8.00	PPI	6.3	8.5
trifluralin	4 EC	0.25	PPI	5.1	6.4
trifluralin	4 EC	0.75	PPI	5.4	8.8
nitrofen	50 WP	2.00	PPI	5.2	6.4
nitrofen	50 WP	4.00	PPI	5.3	8.0
alachlor	4 EC	0.50	PPI	4.2	7.4
alachlor	4 EC	1.00	PPI	5.8	8.1
DCPA	75 WP	4.00	PRE	3.0	10.1
DCPA	75 WP	8.00	PRE	5.4	6.5
trifluralin	4 EC	0.25	PRE	5.3	8.6
trifluralin	4 EC	0.75	PRE	6.3	9.1
nitrofen	50 WP	2.00	PRE	4.8	7.9
nitrofen	50 WP	4.00	PRE	5.5	8.3
alachlor	4 EC	0.50	PRE	6.3	8.5
alachlor	4 EC	1.00	PRE	3.9	8.0
DCPA	75 WP	4.00	E. POST	4.7	7.6
DCPA	75 WP	8.00	E. POST	4.5	8.7
trifluralin	4 EC	0.25	E. POST	4.0	6.5
trifluralin	4 EC	0.75	E. POST	4.2	5.2
nitrofen	50 WP	2.00	E. POST	4.1	5.3
nitrofen	50 WP	4.00	E. POST	2.8	4.3
alachlor	4 EC	0.50	E. POST	3.2	7.2
alachlor	4 EC	1.00	E. POST	3.1	7.1
hand weeded	--	--	--	5.3	7.5
untreated	--	--	--	4.3	6.1
		LSD 5%		2.72	3.03
			Transplanted		
DCPA	75 WP	4.00	POST	10.70	12.20
DCPA	75 WP	8.00	POST	13.20	12.20
trifluralin	4 EC	0.25	POST	11.37	11.10
trifluralin	4 EC	0.75	POST	9.33	14.43
nitrofen	50 WP	2.00	POST	7. 3	12.47
nitrofen	50 WP	4.00	POST	8.83	14.20
alachlor	4 EC	0.50	POST	12.13	16.23
alachlor	4 EC	1.00	POST	12.10	12.53
untreated	--	--	--	11.73	14.90
hand weeded	--	--	--	11.73	15.80
		LSD 5%		3.24	4.21

WEED CONTROL IN TRANSPLANTED CABBAGE, CAULIFLOWER, AND BROCCOLI

G. K. Stamm and R. A. Ashley 1/

ABSTRACT

A field experiment was conducted to test the potential of alachlor, CP 55097, trifluralin, napropamide, and a combination of trifluralin and napropamide for weed control in transplanted cabbage, cauliflower, and broccoli. Alachlor and CP 55097 gave excellent control of crabgrass, pigweed, lambsquarters, and ragweed. High rates of CP 55097 caused stunting in each of the three crops tested, with the stunting becoming more severe as the season progressed. Death of the terminal buds was noted in some of the cabbage plants treated with 3.5 kg ai/ha of CP 55097. Yield increases were noted in the alachlor and CP 55097 treatments.

INTRODUCTION

The acreage of commercially grown vegetables is increasing in Connecticut. Some of this new acreage is being double cropped with spring or winter cabbage. Large crabgrass (*Digitaria sanguinalis* (L.) Scop.), pigweed (*Amaranthus retroflexus* L.), ragweed (*Ambrosia artemisifolia* L.), and lambsquarters (*Chenopodium album* L.) are some of the common weed problems that have plagued local growers. As a result of this, we chose to look at these weeds in our study. Presently the variety of labeled herbicides for use in transplanted cabbage, cauliflower, and broccoli is limited. This can pose some problems if presently labeled herbicides are weak on certain weed species and/or are not flexible in a crop or herbicide program. The purpose of this experiment was to evaluate several herbicides for weed control and crop safety in cole crops.

MATERIALS AND METHODS

This experiment was conducted in 1979 at the Agronomy Farm at the University of Connecticut, Storrs, Connecticut. The soil type was a Woodbridge fine sandy loam with an organic content of 3 to 4 percent and a pH of 5.9. The soil was prepared prior to treatment by plowing and later followed by discing and planking. All herbicide treatments were made with an 11.4 liter, compressed air, knapsack sprayer using a 8004E nozzle at a volume of 374 l/ha and pressure at 2.8 kg/cm^2. No tank mixes were applied as preplant treatments; combination treatments were made as separate applications. Incorporated treatments were applied on May 11 and were incorporated to a depth of 10 cm by double discing. Preemergence applications were made on May 29 after the soil had been clean cultivated. The delayed preemergence treatment was made on June 12.

Plants of cabbage (*Brassica oleracea* cv. capitata 'Stonehead'), cauliflower (*Brassica oleracea* cv. botrytis 'Snowcrown'), and broccoli (*Brassica oleracera* cv. italica 'Spartan Early') were started in a greenhouse on April 19 in 6.35 cm

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diameter poly-trays. The plants were hand transplanted in the field on May 14. The experimental design was a randomized complete block with 3 replicates and a row of seven plants of each plant variety in each plot. The treatment area was 27 square meters with plot being 3 rows wide and 3 meters long.

Herbicides tested in this experiment were alachlor [2-chloro-2', 6' diethyl-N-(methoxymethyl) acetanalide] at 2.2 and 4.5 kg ai/ha preemergence, and 1.1 kg ai/ha preemergence + 1.12 kg ai/ha delayed-preemergence, CP 55097 (identity unknown) at 2.1, 2.8, and 3.5 kg ai/ha preemergence, trifluralin (α,α,α, -trifluro-2, 6, dinitro-N, N-dipropyl-p-toluidine) at 0.84 kg ai/ha ppi, and napropamide [2-(α-naphthoxy)-N, N,-diethylpropionamide] at 0.56 kg ai/ha ppi.

Weed control and injury ratings were made on June 7 and on July 2 with yield data being taken after the last observations. The mean weed population for the experimental period was determined to be 15 crabgrass, 11 pigweed, 1 ragweed, and 5 lambsquarters plants per 929 cm^2. All data were analyzed statistically and means were compared using the LSD test at a 5% probability level.

RESULTS AND DISCUSSION

Alachlor, CP 55097, and a trifluralin/napropamide combination, at the rates tested, were able to provide commercially acceptable levels of weed control (Table 1). The trifluralin/napropamide combination provided 90 percent weed control for all the weeds tested except for ragweed. Since no control of ragweed was noted, this combination would not be acceptable in fields with a moderate ragweed potential. Alachlor at 2.2, 4.5 kg ai/ha preemergence and 1.1 + 1.1 kg ai/ha preemergence plus delayed preemergence and CP 55097 at 2.1, 2.8, and 3.5 kg ai/ha preemergence consistently provided 90 percent control, or better, of crabgrass and pigweed for the entire experimental period. Alachlor and CP 55097, at the rates tested, tended to give variable control of ragweed and lambsquarters. Control of ragweed was anywhere between 70 and 100 percent in the treatments used. At all rates used CP 55097 provided 100 percent control, while alachlor at 1.1 + 1.1 kg ai/ha preemergence plus delayed preemergence and at 4.5 kg ai/ha preemergence gave 90 percent control of lambsquarters. Alachlor at 2.2 kg ai/ha was only able to provide 60 percent control of lambsquarters. These data tend to indicate that CP 55097 is more effective in controlling lambsquarters and that the reduced control noted with alachlor at the 2.2 kg ai/ha rate can be compensated for by applying a split application at the preemergence and predelayed stages.

CP 55097 was the only herbicide which produced any phytotoxic effects. Stunting, up to 10 to 20 percent, was noted in all three crops at the 2.8 and 3.5 kg ai/ha rate. Plants which exhibited this symptom were very slow to recover from this effect, if they did at all. The 3.5 kg ai/ha rate produced the most severe stunting symtoms of all; death of the terminal bud was noted in one replication of cabbage. This injury did not result in significant yield reductions. Injury was not noticeable in any of the other treatments.

In comparison to a weedy check, significant yield increases were only observed in cabbage by the use of alachlor at 2.2, 1.1, and 4.5 kg ai/ha and CP 55097 at 2.1 and 2.8 kg ai/ha. Significant yield increases were not noted in any of the other treatments.

In conclusion, alachlor and CP 55097 can provide excellent weed control of common weeds in transplanted cole crops and show promising potential as herbicides.

Table 1. Weed Control in Transplanted Cabbage, Cauliflower, and Broccoli

TREATMENT	Rate kg ai/ha	Time of Application	Weed Control Rating[a]				Injury Rating[a]			Mean Yield kg/plot		
			crab-grass	pig-weed	rag-weed	lambs-quarters	cab-bage	cauli-flower	broc-coli	cab-bage	cauli-flower	broc-coli
Alachlor	2.2	Pre	10[b]	10[b]	7[b]	6[b]	0[b]	0[b]	0[b]	10.8	8.1	4.2
	1.1 & 1.1	Pre-Predelayed	10	10	7	9	0	0	0	11.4	8.8	6.4
	4.5	Pre	10	10	9	9	0	0	0	11.3	8.5	4.7
CP 55097	2.1	Pre	9	10	10	10	0	0	0	12.0	8.2	5.3
	2.8	Pre	9	10	8	10	1	1	1	11.5	7.3	5.7
	3.5	Pre	10	10	9	10	1	2	2	8.8	7.8	4.9
Trifluralin	0.8	PPI	6	8	2	6	0	0	0	9.9	6.5	5.2
Trifluralin & Napropamide	0.8 & 0.6	PPI	9	9	0	9	0	0	0	8.8	7.3	4.8
Napropamide	0.6	PPI	0	0	0	0	0	0	0	8.3	6.7	4.7
Cultivated Check			10	10	10	10	0	0	0	10.6	9.2	5.8
Weedy Check			0	0	0	0	0	0	0	7.6	7.4	4.9
LSD (P = 0.05)			1.2	0.6	2.3	0.4	0.9	0.5	0.7	3.0	NS	NS

[a] Ratings taken 7/2/79.

[b] Ratings are on a 0 to 10 scale with 0 indicating no injury and 10 indicating total kill.

EFFECT OF SEVERAL COMBINATIONS OF ALACHLOR, LINURON, METRIBUZIN, AND CP 55097 ON YIELD, CROP INJURY, AND WEED CONTROL IN KATAHDIN POTATOES

H. J. Murphy and L. S. Morrow[1]

ABSTRACT

Single herbicide applications and combinations of alachlor, linuron, metribuzin, and CP55097 were evaluated as weed control treatments in white potatoes during 1979 at Aroostook Farm, Presque Isle, Maine. All of the treatments provided good control of annual barnyard grass and mustard, but several treatments were weak on quackgrass early in the season. These were the low rates of metribuzin applied alone or in combination with alachlor II G or metolachlor. Crop injury occurred in the treatments that included CP55097 and also the treatment with alachlor II G.

INTRODUCTION

Comparisons were made among several herbicide combinations including alachlor [2-chloro-2',6'-diethyl-*N*-(methoxymethyl)acetanilide], linuron [3-(3, 4-dichlorophenyl)-1-methoxy-1-methylurea], metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one], metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide], and the experimental herbicide, CP55097, for weed control in the white potato (*Solanum tuberosum* L.'Katahdin). Dinoseb [2-*sec*-butyl-4,6-dinitrophenol] plus dalapon [2,2-dichloropropionic acid] was used as the standard treatment. Besides the usual liquid formulation of alachlor, two others were also tested. One was a liquid product package mix of alachlor plus linuron and the other was a 20% granular formulation of alachlor. Most treatments were applied preemergence to the crop. The three rates of alachlor at layby were applied as a directed spray beneath the potato canopy. Weed populations of mustard (*Brassica campestris* L.), annual barnyard grass (*Echinochloa crusgalli* (L.) Beauv.) and quackgrass (*Agropyron repens* L.) are reported in Table 1.

MATERIALS AND METHODS

The test was conducted on a Caribou gravelly silt loam with an organic matter content of 3.5 percent. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with six replicates of each treatment. All herbicides were applied in 748 liters of water per hectare using 276 kPa pressure. A compressed air sprayer was used equipped with a two nozzle brush type boom. Nozzles were Delavan raindrop type with No. 3374-3 tips. Preemergence treatments were applied 16 days after planting, and a few potato shoots were beginning to emerge.

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Several alachlor treatments were applied at layby in mid-July using drop pipes to lower the nozzles below the potato canopy, while the preemergence application of alachlor II G, used in granular form, was spread evenly over the row with a hand shaker. Crop injury and weed control ratings were made on the three dates listed on Tables 1 and 2 using the "Cornell" rating system reported in percentage values. During July, weed counts were made and species, as reported in Table 2, were identified in the 'no treatment' plots.

RESULTS AND DISCUSSION

All treatments performed well in controlling mustard, although the mustard populations were barely sufficient to allow a good evaluation. All treatments showed excellent control of annual barnyard grass. While all treatments improved in quackgrass control as the season progressed, most were weak and several were poor for control during June. Those with the least early season response were the low rate of metribuzin applied alone and in combination with alachlor II G or metolachlor. The most important feature in Table 1 is the crop injury caused by CP55097 in June. Although the stunting was severe at first, the yields and crop injury ratings for the later months indicate the ability of the potato crop to recover. The alachlor II G also showed signs of crop damage in June, but this was also of short duration. The phytotoxic effects of alachlor and CP55097 may have, of course, been enhanced by the late timing of the preemergence treatments. Further testing would be in order to see if the crop injury would be reduced by applying the treatments closer to planting. While all treatments gave good mid-season control over the three most prevalent weed species in this study, mustard, quackgrass, and annual barnyard grass, consideration should be given to the stunting caused by CP55097 when the potato crop is beginning to emerge.

Table 1. Effect of several combinations of alachlor, linuron, metribuzin, and CP55097 on yield and crop injury of Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	Percent Crop Injury[2]		
		6-20	7-20	8-10
Check - no treatment	31.3	99	100	100
5.04 Dinoseb + 5.60 Dalapon, PE	30.8	100	100	100
0.56 Metribuzin + 2.80 Alachlor, PE (tank mix)	30.7	96	100	100
1.04 Linuron + 2.80 Alachlor, PE (tank mix)	32.9	98	100	100
1.04 Linuron + 2.80 Alachlor, PE (package mix)	32.1	98	100	100
0.56 Metribuzin, PE	32.4	100	100	100
1.04 Linuron, PE	33.2	99	100	100
2.80 Alachlor, PE	31.0	96	98	100
0.56 Metribuzin, PE + 1.12 Alachlor, LB (direct spray)	32.6	99	100	100
0.56 Metribuzin, PE + 2.24 Alachlor, LB (direct spray)	31.3	100	100	100
0.56 Metribuzin, PE + 3.36 Alachlor, LB (direct spray)	33.5	100	100	100
0.56 Metribuzin, PE + 2.80 Alachlor II G, PE	27.7	91	100	100
0.56 Metribuzin + 1.68 CP55097, PE	31.6	89	100	100
0.56 Metribuzin + 2.24 CP55097, PE	31.3	81	100	100
0.56 Metribuzin + 2.80 CP55097, PE	32.2	74	100	100
2.24 CP55097, PE	30.4	75	100	100
1.12 Linuron + 2.24 CP55097, PE	33.4	71	100	100
5.04 Dinoseb + 2.24 CP55097, PE	29.6	77	100	100
0.56 Metribuzin + 5.60 Dalapon, PE	32.4	99	100	100
0.56 Metribuzin + 2.24 Metolachlor, PE	31.1	94	99	100
Bayes L.S.D. (0.05)	6.6			

[1]Planted - May 21; killed - September 8; harvested - September 26, 1979.

Preemergence treatments (PE) applied - June 6. Sunny. Temperature - 18°C. Soil moist to dry. North wind 10-15 mph.

Layby treatments (LB) applied - July 13. Overcast. Temperature - 26°C. Soil dry. Northwest wind 4-5 mph.

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop and almost all crop plants killed.

Table 2. Effect of several combinations of alachlor, linuron, metribuzin, and CP55097 on weed control in Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Percent Weed Control[2] Barnyard-grass 6-20	7-20	8-10	Quackgrass 6-20	7-20	8-10	Mustard 6-20	7-20	8-10
Check - no treatment	80	97	94	87	95	94	95	97	98
5.04 Dinoseb + 5.60 Dalapon, PE	100	100	99	94	99	99	100	100	99
0.56 Metribuzin + 2.80 Alachlor, PE (tank mix)	100	100	99	93	98	98	100	100	99
1.04 Linuron + 2.80 Alachlor, PE (tank mix)	100	100	100	92	98	98	100	100	99
1.04 Linuron + 2.80 Alachlor, PE (pack. mix)	100	99	99	95	98	98	100	100	99
0.56 Metribuzin, PE	100	99	98	88	95	96	100	100	99
1.04 Linuron, PE	100	99	99	93	96	96	100	99	99
2.80 Alachlor, PE	100	100	99	92	96	96	100	99	99
0.56 Metribuzin, PE + 1.12 Alachlor, LB (direct spray)	100	100	99	92	96	96	100	99	98
0.56 Metribzuin, PE + 2.24 Alachlor, LB (direct spray)	100	100	99	91	97	96	100	100	99
0.56 Metribuzin, PE + 3.36 Alachlor, LB (direct spray)	100	99	99	93	98	99	100	100	98
0.56 Metribuzin, PE + 2.80 Alachlor II G, PE	100	100	99	82	96	95	100	100	99
0.56 Metribuzin + 1.68 CP55097, PE	100	100	99	91	98	95	100	100	99
0.56 Metribuzin + 2.24 CP55097, PE	100	100	98	90	97	97	100	100	99
0.56 Metribuzin + 2.80 CP55097, PE	100	99	99	97	98	97	100	100	99
2.24 CP55097, PE	100	99	99	89	95	96	100	100	98
1.12 Linuron + 2.24 CP55097, PE	100	100	99	97	98	99	100	100	99
5.04 Dinoseb + 2.24 CP55097, PE	100	100	99	91	95	96	100	100	100
0.56 Metribuzin + 5.60 Dalapon, PE	100	100	98	90	99	98	100	100	99
0.56 Metribuzin + 2.24 Metolachlor, PE	100	99	99	88	95	98	100	99	99

[1]Planted - May 21; killed - September 8; harvested - September 26, 1979.

Preemergence treatments (PE) applied - June 6. Sunny. Temperature - 18°C. Soil - moist to dry. North wind 10-15 mph.

Layby treatments (LB) applied - July 13. Temperature - 26°C. Overcast. Soil - dry. Northwest wind 4-5 mph.

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop and almost all crop plants killed.

Number and species of weeds per 0.0929 square meter (average of 6 replicates):

Agropyron repens - 4.2
Echinochloa crusgalli - 1.2
Brassica sp. - 0.8
Chenopodium album - 0.2

EFFICACY OF PENDIMETHALIN AND ORYZALIN ALONE AND IN COMBINATION WITH METRIBUZIN IN POTATOES

G. W. Selleck[1/]

ABSTRACT

Pendimethalin or oryzalin at rates up to 2.5 lb/A do not provide season-long control of barnyardgrass (Echinochloa crus-galli (L.) Beauv.) or Pennsylvania smartweed (Polygonum pensylvanicum L.) on light textured soils of Long Island. Combinations of pendimethalin or oryzalin (1 + .38 lb/A) were required for consistent control in potatoes, and the performance was usually comparable to alachlor-metribuzin mixtures, but with improved selectivity. Combinations of pendimethalin-metribuzin appeared to perform more consistently than oryzalin-metribuzin. Performance was generally superior with metribuzin in combination than with linuron or dinoseb.

INTRODUCTION

Barnyardgrass is the most widespread and vigorous competitor of the annual grasses on the approximately 23,000 acres of potatoes (Solanum tuberosum L.) on Long Island. Infestations of barnyardgrass at a density of 100 shoots/sq m have reduced tuber yields by 50% or more (1). Barnyardgrass germinates early in the spring, crabgrass (Digitaria sanguinalis (L.) Scop.) germinates in mid-summer and fall panicum (Panicum dichotomiflorum Michx.) germinates in mid-to late summer. Herbicides such as alachlor, [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] and EPTC(S-ethyl dipropylthiocarbamate) are effective for the control of annual grasses, but with the long growing season on Long Island, a single application rarely provides season-long control. Hence a preemergence herbicide followed by a postemergence application at layby is generally necessary to control annual grasses until harvest.

The herbicides oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide) and pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] have selectively controlled seedling Johnson grass (Sorghum halapense (L.) Pers.) (5) as well as annual grasses in soybeans (Glycine max). Oryzalin has also shown promise for weed control in no-till soybeans (2). The development of new herbicide candidates in large acreage crops has provided the opportunity for extended use in vegetable crops which could not otherwise support the cost of development.

MATERIALS AND METHODS

Herbicides oryzalin and pendimethalin were applied alone and in combination with metribuzin [4-amino-6-tert-butyl-3-(methylthio)as-triazin-5(4H)-one)], linuron [3-(3,4-dichlorophenyl)-1-methoxyl-1-methylurea] and dinoseb (2-sec-butyl-4,6-dinitrophenol), using alachlor as a standard. In some experiments, EPTC was combined with pendimethalin. Rates of application were pendimethalin and oryzalin .5 to 2.5 lb/A (.56 to 2.8 kg/ha) and alachlor 1.5 t 4 lb/A

1/ Professor, Cornell Univ., L. I. Hort. Res. Lab. Riverhead, N. Y.

(1.7 to 4.5 kg/ha) alone, with the lower rates mixed with metribuzin .25 to .75 lb/A (.28 to .84 kg/ha), and linuron .75 and 1.5 lb/A (.84 and 1.68 kg/ha). Dinoseb at 1.25 to 3 lb/A (1.4 to 3.35 kg/ha) and EPTC at 3 and 4 lb/A (3.35 and 4.5 kg/ha) were included in some of the treatments. Applications were made in plots 1.7 by 9 m replicated 4 times in soil texture ranging from Riverhead sandy loam to Haven loam, containing 2% or less of organic matter. Various combinations were applied from 1975 to 1979 with a tractor-mounted sprayer delivering 43 gpa at 35 psi. Preemergence herbicides were applied at dragoff, and treatments requiring incorporation were worked into the soil with a finger weeder at a depth of 5 to 8 cm. Percentage control of weeds in treated plots was determined visually in comparison with an adjacent, untreated check. Natural rainfall was augmented by sprinkler irrigation. Pertinent application data are provided in Table 1.

RESULTS AND DISCUSSION

In 1975, there was little difference in performance between oryzalin or pendimethalin at 1 to 2 lb/A (1.12 to 2.24 kg/ha), and alachlor at 2 lb/A for the control of barnyardgrass and smartweed (Table 2), except that the highest tuber yield was obtained with alachlor. In 1976, however, it was evident that oryzalin at 1.5 lb/A (1.7 kg/ha) was necessary for early control of barnyardgrass and smartweed, and by mid-August the control of barnyardgrass was only marginal. Similar results were obtained on barnyardgrass with pendimethalin at 1 and 1.5 lb/A, but smartweed was adequately controlled at the higher rate. In 1977, oryzalin and pendimethalin at both rates controlled annual grasses until mid-August and somewhat better than alachlor. None of the treatments was sufficiently durable for smartweed control late in the season. In 1978, pendimethalin efficacy at 1.5 lb was shorter on barnyardgrass than alachlor at 2 lb or oryzalin at 1.5 lb/A. Pendimethalin was also weak on smartweed under these conditions, while oryzalin and alachlor provided adequate control.

Phytotoxicity was not evident on cultivars of Katahdin, Superior or Hudson with oryzalin or pendimethalin at rates of 2 or 2.5 lb/A, but occurred with alachlor at 4 lb/A. Tuber yields however, were higher than those of the check, despite foliar injury symptoms (Table 2). Pendimethalin at 2.5 lb/A gave only marginal control of smartweed in mid-August. None of these products demonstrated sufficient residual for consistent season-long control of annual grasses or Pennsylvania smartweed. Neither pendimethalin or oryzalin was effective on common ragweed (*Ambrosia artemisiifolia* L.). Applied at groundcrack at high rates alone and in combination with metribuzin, linuron or dinoseb, unacceptable foliar symptoms of four potato cultivars were present only where alachlor was included in the combination. Two of the alachlor combinations adversely affected yields (Table 3). Pendimethalin or oryzalin at 1 lb/A in combination with .35 lb/A (.4 kg/ha) metribuzin provided adequate control of barnyardgrass and smartweed in 1975 (Table 4), and were equivalent to 2 lb/A alachlor in combination with metribuzin. Two of the oryzalin-metribuzin treatments yielded significantly higher than the check. In combination with linuron at 1 lb, oryzalin at 1.5 lb was necessary to maintain weed control until September. Combined with dinoseb, control of barnyardgrass and smartweed was only marginal and less effective than alachlor + dinoseb. In 1976, pendimethalin + metribuzin (1.5 + 0.5 lb) controlled barnyardgrass, smartweed and ragweed, while oryzalin plus metribuzin (1 + 0.5 and 1 + 0.3 lb) failed to meet an acceptable standard in mid-August. Early phytotoxic symptoms were visible with alachlor combinations. In another trial in 1976, pendimethalin combinations at higher rates with metribuzin controlled barnyardgrass without adverse effects or cultivars Katahdin, Superior or Hudson (Table 4). In 1977, all combinations gave 80% weed control or better except pendimethalin with linuron (1 + .75 lb/A) or EPTC (1 + 3 lb/A) (Table 5). Several of the treatments significantly increased tuber yields of the Katahdin cultivar. Applications of alachlor at 3 lb/A in combination provided foliar injury, but resulted in increased tuber yields. In 1978 pendimethalin at .75 lb/A combined with metribuzin at .38/lb did not provide season-long control of barnyardgrass, but smartweed was well controlled. Oryzalin from .5 lb to 1.5 lb/A in combination with .25 lb of metribuzin provided 80% control or better of the two weeds, but alachlor 1.5 lb plus metribuzin at .38 or .5 lb was more effective. In 1979, control of barnyardgrass with oryzalin + metribuzin (.75 + .25 lb) was not maintained until August, while pendimethalin at .75, 1 or 1.5 lb in combination with .38 lb metribuzin controlled both species until mid-August. Combined with linuron at .75 lb, pendimethalin at .75 lb was marginal on barnyardgrass and less effective than the linuron combined with pendimethalin at 1.5 lb/A. Smartweed control was not maintained with pendimethalin + EPTC. Combined with linuron, pendimethalin at .75 lb was somewhat weak on both barnyardgrass and smartweed but effective at 1.5 lb/A.

It would appear that on the light textured soils low in organic matter on Long Island, a rate of 1 lb/A pendimethalin is required with metribuzin at .38 lb/A to provide consistent control of annual grasses and Pennsylvania smartweed. The rate of pendimethalin can be decreased to .75 lb/A if the metribuzin rate is increased. This combination is more effective than with linuron in the mixture, in which case the rate of pendimethalin should be increased to 1.5 lb with .75 lb/A of linuron. Similarly, the performance of oryzalin was better with metribuzin than with linuron or dinoseb. A rate of 1.0 lb/A of oryzalin with metribuzin .35 lb/A would appear to be effective under most situations. Both pendimethalin and oryzalin appeared to be more selective on potatoes than alachlor at 2 lb/A either applied preemergence or at ground crack. The latter application increased the incidence of phytotoxicity

Pendimethalin and surflan should perform consistently on Long Island because of traditionally moist soils in spring (3). However, pendimethalin appeared to be somewhat more consistent than oryzalin, possibly because of the higher rate of breakdown which occurs under solar radiation (4) a characteristic of Long Island summers.

ACKNOWLEDGMENTS

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Table 1. Application data for herbicides in potatoes, 1975-1979.

Year	Planting date	Appli. date	Harvest date	Soil texture
1975	4/27	5/13	11/3	Haven loam
1976 (1)	4/24	5/10	9/22	Haven loam
1976 (2)	4/15	5/5	10/13	Haven loam
1977 (1)	5/12	5/18	10/31	Sandy loam to Silt loam
1977 (2)	4/19	5/3	10/11	Haven loam
1977 (3)	5/12	5/19	11/2	Sandy loam to Silt loam
1978	4/18	5/8	9/29	Haven loam
1979	4/23	5/8	10/18	Haven loam

Table 2. Percentage control and potato tuber[a] yields with oryzalin and pendimethalin, 1975-1979.

Treatment (lb/A)	Barnyard-grass		Smartweed		Ragweed		Yield[b] cwt/A		
1975	6/14	9/3	6/14	9/3			Kat		
Oryzalin 1 pre	65	90	60	91			328		
Oryzalin 1.5 pre	60	93	60	75			310		
Oryzalin 2 pre	55	93	55	85			294		
Alachlor 2 pre	90	94	80	89			363[b]		
Pendimethalin 1 pre	85	88	68	71			321		
Pendimethalin 1.5 pre	80	85	80	89			342		
Pendimethalin 2 pre	90	95	90	88			312		
Untreated (density/m^2)	9	10	10	20			307		
1976 (1)	6/3	8/19	6/3	8/19	6/3	8/19	Kat	Sup	
Oryzalin 1.0 pre-inc	68	0	30	20	15	0	218	252	
Oryzalin 1.5 pre-inc	93	62	84	20	45	--	259	285	
Pendimethalin 1.0 pre	87	58	73	40	25	15	230	290	
Pendimethalin 1.5 pre	88	65	90	88	0	0	233	305	
Untreated (density/m^2)	47	56	37	28	28	19	195	260	
1976 (2)		9/3				9/3	Kat	Sup	Hud
Oryzalin 2.0 pre		78	-	-	-	-	415	408	474
Pendimethalin 2.0 pre		95	-	-	-	-	443	421[b]	444
Alachlor 4.0 pre		97	-	-	-	-	399	450[b]	426
Untreated (density/m^2)		47	-	-	-	-	415	381	428
1977 (1)	6/24	8/11	6/24	8/11	FP	Crab	Kat		
Oryzalin 1.0 pre	-	80	85	68	85	85	225		
Oryzalin 1.5 pre	-	95	95	45	77	-	263		
Alachlor 2.0 pre	-	75	75	65	75	75	230		
Pendimethalin 1.0 pre	75	59		88	85	90	299[b]		
Pendimethalin 1.5 pre	75	65		88	85	88	256		
Untreated (density/m^2)	36	-		54	56	47	234		
1977 (2)	5/25	8/17	5/25	8/17			Kat	Sup	
Oryzalin 2.5 pre	83	91	-	95			391[b]	350	
Alachlor 3 pre	99	96	99	96			318	345	
Pendimethalin 2.5 pre	90	90	85	64			362	319	
Untreated (density/m^2)	22	42	20	29			318	316	
1978	6/13	10/8	6/13	10/8			Kat		
Oryzalin 0.5 pre	81	63	79	0			302[b]		
Oryzalin 0.75 pre	79	10	90	60			336[b]		
Oryzalin 1.5 pre	95	74	91	96			337[b]		
Alachlor 2.0 pre	98	96	98	97			331[b]		
Pendimethalin .75 pre	88	48	95	20			292		
Pendimethalin 1.5 pre	89	57	90	50			338[b]		
Untreated (density/m^2)	38	25	20	17			157		
1979	6/22	8/10	6/22	8/10			Kat		
Pendimethalin 0.75 pre	83	48	83	54			270		
Untreated (density/m^2)	23	30	28	35			269		

(footnotes on next page)

Table 2. (Footnotes concluded)

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[a]Kat = Katahdin, Sup = Superior, Hud = Hudson cultivars

[b]Difference statistically significant from the untreated check at the 5% level, F-test.

[c]FP = fall panicum, crab = crabgrass, assessed 8/11

Table 3. Phytotoxicity[a] and tuber yields[b] (cwt/A) of four potato cultivars in response to herbicides applied at ground-crack.

	Superior		Chippewa		Hudson		Russet B.	
Treatment (lb/A)	Phyto.	Yield	Phyto.	Yield	Phyto.	Yield	Phyto.	Yield
Oryzalin 2.5 pre	2.5	371	4	348	1.5	251	1	316
Alachlor 4 pre	6	339[b]	6	335	6	226	6	267
Oryzalin+linuron (2+1.5) pre	4.5	353	4	320	2	228	1	299
Alachlor+linuron (3+2) pre	6	324[b]	7	295	6	212	7	245
Alachlor+metribuzin (3+.5) pre	5	379	4	336	4.5	237	5.5	254
Oryzalin+metribuzin(2+.5) pre	3	359	-	-	2	228	1	299
Oryzalin+dinoseb (2+1.5) pre	4.5	362	-	-	1.5	247	-	-
Alachlor+dinoseb (3+1.5)	7	347	6	309	6	242	5.5	276
Untreated	1	389	1	310	1	258	1	287

[a]0 = no effect, 10 = complete kill

[b]Difference statistically significant from the untreated check at the 5% level, F-test.

Table 4. Percentage weed control, and potato[a] tuber yields (cwt/A) with herbicide combinations, 1975-1976.

Treatment (lb/A)	barnyd-grass		smartweed		ragweed		Yield[b] cwt/A		
1975	6/14	9/3	6/14	9/3			Kat		
Pendimethalin+metribuzin (1+.35) pre	88	95	93	93			339		
Pendimethalin+metribuzin (1.5+.35) pre	88	88	90	92			337		
Alachlor + metribuzin (2 + .35) pre	90	93	88	84			323		
Alachlor + metribuzin (2 + .5) pre	90	89	90	86			312		
Oryzalin + metribuzin (1 + .35) pre	85	97	90	93			349[b]		
Oryzalin + metribuzin (1 + .5) pre	88	95	90	89			350[b]		
Oryzalin + metribuzin (1.5 + .35) pre	85	94	88	89			323		
Alachlor + linuron (2.0 + 1.5) pre	90	93	90	88			277		
Oryzalin + linuron (1.0 + 1.0) pre	55	81	80	--			265		
Oryzalin + linuron (1.5 + 1.0) pre	88	90	88	90			312		
Oryzalin + dinoseb (1.0 + 1.25)pre	48	78	65	80			335		
Alachlor + dinoseb (2.0 + 1.25) pre	85	93	85	83			335		
Untreated (density/m^2)	9	10	10	20			307		
1976 Experiment (1)	6/3	8/19	6/3	8/19	6/3	8/19	Kat	Sup	
Pendimethalin+metribuzin (1.0+0.5)pre	94	82	94	88	88	80	276	365	
Oryzalin+metribuzin (1.0+0.5) pre	94	81	88	53	88	68	282	376	
Oryzalin+metribuzin (1.0+0.3) pre	85	50	80	61	80	49	305	366	
Untreated (density/m^2)	47	56	37	28	28	19	195	260	
1976 Experiment (2)		8/19					Kat	Sup	Hud
Oryzalin+metribuzin (1.5+75) pre		95					395	418	486
Alachlor+metribuzin (2.5+.75) pre		95					438	388	417
Pendimethalin+metribuzin (1.5+.75)pre		85					467	424	412
Untreated (density/m^2)		47					415	381	438

[a]Kat = Katahdin, Sup = Superior, Hud = Hudson cultivars

[b]Difference statistically significant from the untreated check, at the 5% level, F-test.

Table 5. Percentage weed control and potato[a] tuber yields (cwt/A) with herbicide combinations in potatoes, 1977.

Treatment (lb/A)	Percentage weed control: Smartweed	Smartweed	F.P.	Byd	Byd	Yield[b] cwt/A	
		8/11	8/11			Kat	
1977 (3)							
Oryzalin + dinoseb (1 + 3) pre		88	82			252	
Alachlor + dinoseb (2 + 3) pre		85	82			--	
Oryzalin + linuron (1.5+.5) pre		80	82			232	
Alachlor + linuron (1 + 1) pre		--	78			242	
Pendimethalin+linuron (1+.75) pre		75	62			235	
Oryzalin+metribuzin (1+.5) pre		88	89			249	
Alachlor+metribuzin (2 +.5) pre		92	88			239	
Pendimethalin+metribuzin(.75+.75)pre		95	89			242	
Pendimethalin+metribuzin(.5+.75)pre		90	90			228	
Pendimethalin + EPTC (1 + 3) pre		82	89			281	
Untreated (density/m^2)		31	37			215	
1977 (2)	5/25	8/17		5/25	8/17	Kat	Sup
Pendimethalin+linuron (1.5+1.5) pre	96	81		97	83	407[b]	325
Alachlor + linuron (3 + 1.5) pre	99	97		99	87	403[b]	314
Oryzalin + linuron (1.5 + 1.5) pre	70	89		99	85	361	298
Oryzalin+metribuzin (2 + 1) pre	99	97		71	90	389[b]	328
Alachlor+metribuzin (3 + 1) pre	99	99		99	92	395[b]	313
Pendimetnalin+metribuzin(1.5+1) pre	--	98		96	93	371	313
Oryzalin + dinoseb (2 + 3) pre	95	95		75	82	343	324
Alachlor + dinoseb (3 + 3) pre	99	93		88	90	380[b]	334
Pendimethalin + EPTC (1+3)pre-inc	25	78		38	81	377[b]	342
Untreated (density/m^2)	22	42		20	29	318	316

[a]Kat = Katahdin, Sup = Superior cultivars

[b]Difference statistically significant from the untreated check at the 5% level, F-test.

Table 6. Herbicide treatments, percentage weed control, and potato yields in potatoes, 1978-1979.

Treatment (lb/A)	Barnyard-grass		Smartweed		Yield[a] cwt/A
1978	6/13	10/8	6/13	10/8	Katahdin
Pendimethalin+metribuzin(.75+.38)pre-inc	90	70	99	81	296
Pendimethalin+metribuzin(.75+.38)pre	93	78	99	99	360
Alachlor+metribuzin(1.5+.38)pre	99	97	99	99	368
Alachlor+metribuzin(1.5+.5)pre	99	89	99	86	318
Oryzalin+metribuzin(.5+.25)pre	95	86	99	98	339
Oryzalin+metribuzin(.75+.25)pre	94	80	99	97	387
Oryzalin+metribuzin(1.5+.25)pre	92	85	99	99	323
Alachlor+linuron(1.5+.75)pre	99	99	99	99	358
Pendimethalin+linuron(.75+.75)	90	72	98	91	322
Pendimethalin + EPTC (.75+4)pre-inc	98	89	95	73	318
Untreated (density/m^2)	38	25	20	17	157
1979	6/22	8/10	6/22	8/10	
Oryzalin+metribuzin(.75+.25)pre-inc	80	64	95	83	292
Pendimethalin+metribuzin(.75+.38)pre	98	93	100	99	298
Pendimethalin+metribuzin(1.0+.38)pre	100	98	100	100	281
Pendimethalin+metribuzin(1.5+.38)pre	100	88	100	100	279
Pendimethalin+linuron (1.5+.75)pre	100	86	100	99	291
Pendimethalin+linuron(.75+.75)pre	78	70	98	79	278
Untreated (density/m^2)	23		28		269

[a]Treatment yields in 1978 are all significantly higher than that of the untreated check at the 5% level, F-test.

EFFECTS OF SELECTED ADJUVENTS ON WEED CONTROL AND YIELD OF POTATOES[1/]

P.L. Minotti and G.H. Bayer[2/]

ABSTRACT

Several adjuvents in combination with linuron applied preemergence were evaluated for their effect on weed control and potato yield. Adjuvents did not measurably affect emergence rate, foliage color, early vigor, resistance to moisture stress, control of redroot pigweed and common lambsquarter, or potato tuber yields. Adjuvents decreased the control of smooth crabgrass.

INTRODUCTION

The utility of adjuvents (surfactants) in improving the performance of chemicals applied to plant foliage is well recognized. On the other hand, relatively little is known regarding the ability of an adjuvent to alter the performance of chemicals applied to the soil. Nevertheless claims of adjuvents improving the performance of all types of agricultural chemicals, regardless of how applied are becoming more common. Some have even claimed improved water and nutrient utilization by plants in adjuvent treated soils with resultant increases in crop yield.

Evidence has been presented to show that an oil adjuvent increased non-foliar absorption of atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine] and alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] (1). Oil adjuvents may significantly reduce atrazine losses from vaporization (6). Surfactants have also been reported to reduce soil absorption of some herbicides and increase the leaching of others (5), all of which could conceivably affect either weed control or crop tolerance.

On the basis of two years work on Long Island with adjuvents and herbicides for potatoes (Solanum tuberosum L. 'Katahdin'), Selleck (7) speculated that under certain conditions adjuvents may improve soil water and nutrient availability and thus improve potato yields. Bayer (2) noted that potato yields with 1.25 lb/A of linuron [3-(3-4-dichlorophenyl)-1-methoxy-1-methyl urea] formulated as the 4L were significantly less than yields with an equivalent amount of wettable powder formulation to which the Wex adjuvent had been added. However, this comparison was confounded by different formulations so the possibility of some injury with the 4L has to be considered as well as an adjuvent effect.

The above observations prompted the investigation reported herein the objective of which was to determine if certain adjuvents added to linuron applied preemergence influenced either weed control or potato yields.

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MATERIALS AND METHODS

Katahdin potatoes were planted May 23 at Freeville, NY in a Howard gravelly loam soil with a pH of 5.9 and an organic matter content of 2.3%. At this time 800 lb/A of 13-13-13 fertilizer was banded 2 inches below and 2 inches to the side of seed pieces. On May 30, prior to potato emergence, treatments shown in Table 1 were applied in quadruplicate to 6 ft by 20 ft plots containing two 34 inch rows of potatoes. The soil was friable and moist on the surface at application time with plenty of moisture beneath. Surface and soil temperatures at the 2 to 3 inch depth were 68°F and 67°F respectively.

Atplus 300 F is the surfactant used in Agway's Booster +E, a widely used oil surfactant blend in the Northeast. Fifty ounces of Booster +E contains 8 oz of Atplus 300 F. Particularly high rates of adjuvent were employed in two treatments because there has been speculation by some, but not evidence, that much higher than usually recommended rates might be required to consistently realize benefits from soil applications. For some of the adjuvents tested information on their relative wetting speed was available and appear in Table 1. This refers to the time required for a given concentration of surfactant to re-wet air dried sphagnum peat moss (4).

On June 14, before emergence was complete, counts of sprouted tubers per plot were taken. There was heavy uniform weed pressure from redroot pigweed (*Amaranthus retroflexus* L.) and common lambsquarter (*Chenopodium album* L.). These were rated on July 31. There was also a smattering of common purslane (*Portulaca oleracea* L.) but this was too spotty for meaningful rating. The first 20 days in June were relatively dry with about 0.6 inches of rainfall in that period. Total June rainfall was 2.9 inches followed by a dry July with a total of 1.6 inches of rainfall and only 0.2 inches of that available the first half of the month. Rainfall for August and September was more uniformly distributed and totalled 3.9 and 4.2 inches respectively. Dinoseb (2-sec-butyl-4,6-dinitrophenol) was applied as a vine killer in mid-September and the potatoes were harvested on October 11.

RESULTS AND DISCUSSION

None of the surfactant treatments significantly influenced speed of emergence or potato yields (Table 1). Potatoes were graded into three size categories: small (1 7/8 to 2 1/2 inches), medium (2 1/2 to 3 1/4 inches), and large (> 3 1/4 inches). Again no significant treatment caused differences were found so only the total tuber yield is reported in the table.

In mid-July the potatoes showed marked wilting symptoms and were irrigated the following day with about .75 inches of water. Water was not applied prior to this time partly because one of the irrigation pumps on the farm was inoperable and partly because a certain amount of moisture stress added interest to the experiment in view of some of the claims made for a few of the adjuvents tested, e.g. greater availability of nutrients and water under certain conditions. All the plots in this experiment seemed equally affected by the water stress as far as visual observations of wilting could ascertain.

The control of pigweed and lambsquarter was nearly complete regardless of whether or not an adjuvent was present. Since weed control was nearly perfect with all treatments in this experiment differences in yield would be attributed to the effects of the adjuvent on potatoes per se rather than to effects from differential weed competition due to differential weed control.

TABLE 1. A comparison of several adjuvents applied preemergence with linuron[1] on weed control and yield of Katahdin potatoes in Freeville, NY, 1979.

Adjuvent	Rate fl.oz/A product	Manufacturer	Type[2]	Relative wetting speed[3]	Emerged tubers 6/14	Weed Control[4] 7/31 Rrpw	Weed Control[4] 7/31 Colq	Tuber yield cwt/A
none	-	----	-	-	20	8.8	9.0	417
Atplus 300 F	8	ICI America	N	fast	17	9.0	9.0	417
Atplus 300 F	64	ICI America	N	fast	19	9.0	9.0	417
Booster +E	50	ICI America	N	≠	16	9.0	9.0	416
Tween 20	8	ICI America	N	slow	17	8.8	9.0	405
Triton GR5	8	Rohm & Haas	A	v.fast	20	8.8	9.0	427
Wex	16	Conklin	N/A	≠	16	9.0	9.0	408
Amway AP	16	Amway	≠	≠	20	8.8	9.0	408
AGY 14901	16	Agway	≠	≠	15	8.5	9.0	406
Atphos 3206	75	ICI America	≠	≠	17	8.8	9.0	429
$LSD_{.05}$					NS			NS

[1] all plots received 1.0 lb/A a.i. of linuron 50 WP

[2] N = nonionic, A = anionic, N/A = nonionic surfactant with anionic charge of finished produce

[3] see Materials and Methods

[4] 1-9 rating, 9 = perfect control

Thus we can reasonably conclude that the adjuvents in this experiment did not exert any direct affect on potato yield.

The results for broadleaf weed control agree with those obtained in 1979 at the Agway Farm and Research Center in Fabius, NY where a similarly designed and executed potato experiment was conducted with quadruplicated treatments (3). Linuron was applied alone and with seven different adjuvents (Table 2). Five of the treatments were identical to five found in the present experiment. Of particular interest were the results for control of smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl]. Without exception every one of the seven adjuvents dramatically decreased crabgrass control over the linuron only treatment, while control of the other weed species was not affected. The reason is unclear at this time; perhaps when adjuvents were present, more linuron leached from the surface area where most of the crabgrass seeds were germinating. Yield data was not obtained in this experiment.

ACKNOWLEDGEMENTS

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TABLE 2. A comparison of several adjuvents applied preemergence with linuron[1/] on weed control with potatoes in Fabius, NY, 1979.

Adjuvent	Rate fl.oz/A product	Weed Control[2/] 9/11 Smcg	Bygr	Rrpw	Colq
none	-	9.0	8.8	9.3	9.3
Atplus 300 F	8	2.5	9.3	10.0	8.0
Booster +E	50	4.7	6.3	10.0	8.8
Tween 20	8	5.0	9.5	9.5	8.8
AGY 14901	16	4.7	9.8	9.0	8.3
Charger E	8	4.0	9.0	6.7	9.7
AGY 14902	16	2.3	8.5	10.0	7.8
AGY 14903	16	2.5	7.3	7.7	8.5

[1/] all plots received 1.0 lb/A a.i. of linuron 50 WP

[2/] 0-10 rating scale; 10 = perfect control

1977-1978 POTATO VINE DESICCATION RESULTS - UPSTATE NEW YORK[1/]

Joseph B. Sieczka[2/]

ABSTRACT

An application of ametryn at 1.4 or 1.6 lbs/A (1.6 or 1.8 kg/ha) followed by dinoseb at 0.9 or 1.0 lbs/A (1 or 1.1 kg/ha), endothall at 0.46 or 0.52 lbs/A (0.5 or 0.6 kg/ha) or tetrathiin at 0.44 lbs/A (0.5 kg/ha) six days later resulted in better potato vine desiccation than when these materials were used alone at considerably higher rates. Yield and specific gravity were lower when ametryn was used prior to the other vine desiccants. Rates of 0.4 and 0.8 lbs/A (0.45 and 0.9 kg/ha) of ametryn were not as effective as 1.6 lbs/A (1.8 kg/ha) when followed by dinoseb six days later. Split applications of dinoseb and tetrathiin were more effective than single applications when the total amount of chemical remained constant per unit area. Similar vine desiccation resulted when dinoseb was applied through standard Tee Jet 8004 nozzles mounted in a tractor boom or in a hand held boom or when low pressure 8004 nozzles were used in the tractor boom.

INTRODUCTION

Effective potato vine killing is important to facilitate harvest; help control tuber size, appearance and internal defects such as hollow heart; and minimize the effects of diseases such as late blight (*Phytophtora infestans*) and potato leaf roll virus. Chemical vine killers are used commercially throughout the Northeast. Weather conditions at time of vine kill often are cool and wet and thereby reduce the effectiveness of most of the compounds registered as potato vine desiccants. The primary purpose of the 1977 and 1978 potato vine desiccation experiments was to evaluate promising candidates for registration and methods which improve the performance of the presently registered compounds. A method which showed promise in previous years, the use of ametryn (2-(ethylamino)-4-(isopropylamino)-6-(methylthio)-*s*-triazine) as a means of predisposing potato plants to faster acting desiccants, was studied more closely. Split applications of dinoseb (2-*sec*-butyl-4,6-dinitrophenol), the use of adjuvants and several application techniques for research plots were also evaluated.

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MATERIALS AND METHODS

The 1977-1978 vine desiccation experiments were conducted on 'Katahdin' potatoes grown on a Howard gravelly loam at the Homer C. Thompson Vegetable Research Farm at Freeville, New York. In 1977 the potatoes were planted on May 16 and harvested October 11. Rows were 68" apart. The wide spacing facilitated spraying with a hand held boom and eliminated the need for guard rows. Plot size was 1 row by 20 feet long. In 1978 potatoes were planted on May 8 for the adjuvant and spray nozzle experiments (Tables 5 and 6) and May 18th for the two ametryn experiments (Tables 3 and 4). Plot size in 1978 was 2 rows by 20 feet long. Tractor mounted equipment was used in 1978 on all plots except in the sprayer nozzle experiment where hand held equipment was compared with the tractor mounted boom. Plot arrangement was modified to accommodate the mounted equipment. Two pairs of rows with between row spacing of 34 inches were planted in an area which normally would accommodate five rows. A space of 68 inches separated the two pairs of rows. Potatoes were not planted in the immediate vicinity of the outside row of each plot allowing tractor travel along the outside row. The space between the plots eliminated the need for a guard row. All plots were sprayed with a CO_2 pressurized sprayer with 35 psi pressure. Spray volume was 52 gallons/A in 1977 and 64 gallons/A in 1978.

The experimental design for all experiments except the 1978 ametryn experiment was randomized complete block with three or four replications. The 1978 ametryn experiment was a split plot design with three replications. Ametryn treatments were the main plots and other vine desiccants were the sub plots. Chemical compounds, rate of application, and data of application are listed in various tables. Data were collected on rate of vine kill, yield, specific gravity, and vascular discoloration. Vascular discoloration data are based on a 25 tuber sample from each plot.

RESULTS AND DISCUSSION

Single applications of tetrathiin (2,3-dihydro-5,6-dimethyl-1,4-dithiin-1,1,4,4 tetroxide) at 1 or 2 lbs/A did not provide satisfactory vine desiccation (See Table 1). Split applications of 1 lb/A each produced vine desiccation equivalent to split applications of dinoseb at 2.5 lbs/A each. These two treatments were by far the best in the tetrathiin-dinoseb experiment. Split applications of dinoseb at 1.3 lbs/A each were more effective than a single application of dinoseb at 2.5 lbs/A. The untreated check had the highest yield and specific gravity. This was also the case in the other experiment conducted in 1977 where registered compounds and diquat (6,7-dihydrodipyrido[1,2-α:2',1'-*c*]pyrazinediium ion) were evaluated (See Table 2). In this experiment, four treatments had yields significantly lower than the control. These were: dinoseb at 2.5 lbs/A plus Booster plus E, ametryn at 1.6 lbs/A followed by dinoseb at 1 lb/A or endothall (7-oxabicyclo[2.2.1] heptane-2,3-dicarboxylic acid) at 0.52 lbs/A, and a single application of diquat at 0.5 lbs/A. The best stem desiccation in this experiment was attained when ametryn was used prior to an application of dinoseb or endothall. The use of Booster plus E with a single application of ametryn greatly improved its performance. Wex however was inferior to the Booster plus E when used in combination with dinoseb. Increased vascular discoloration was not associated with any of the treatments used in 1977.

In 1978 the use of Wex, Saturall and Booster plus E resulted in similar vine desiccation (See Table 6). An application of ametryn six days before applications of dinoseb, endothall and tetrathiin were made, resulted in effective vine desiccation, eventhough these materials were used at relatively low rates. Paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) at 0.23 lbs/A preceded by ametryn resulted in a similar degree of vine desiccation as the paraquat treatment at 0.46 lbs/A. The rate of desiccation however was slightly faster for the ametryn-paraquat combination. Yields and specific gravity were significantly lower in the ametryn treatments. This effect is an indication of the more rapid vine desiccation. The timing of the ametryn treatments in this program therefore is critical from the standpoint of yield and specific gravity. Ametryn rates of 0.4 and 0.8 lbs/A were less effective than the 1.6 lbs/A rate (See Table 5).

The standard Tee Jet 8004 nozzles mounted in a tractor boom or in a hand held boom resulted in similar effects on vine deiccation (See Table 6). Low pressure nozzles of the same size had no adverse effect on vine kill when compared to the standard nozzle.

The use of ametryn as a precursor or pretreatment to the more rapid acting vine desiccants appears to be an effective means of killing potato tops. The use of an adjuvant with ametryn greatly enhances the performance and therefore should be used. One potential problem associated with the ametryn pretreatment method of vine kill is a reduction in yield if the ametryn treatment is applied too early. Careful observations on crop development and synchronization of vine kill with harvest date will minimize the adverse effects.

Table 1. Tetrathiin and Dinoseb Experiment-Upstate, N.Y.

Chemical, Rate (lb/A) & [1/] Date of Application	Total Yield (cwt/A)	Spec. Grav.	% Desiccation									
			Leaves					Stems				
			8/31	9/3	9/9	9/15	9/27	8/31	9/3	9/9	9/15	9/27
1. Check	452	1.075	0	0	7	23	45	0	0	0	3	10
2. dinoseb (2.5) & Booster plus E (2 qt) [8/31]	369	1.068	0	80	93	93	93	0	8	10	23	65
3. a) dinoseb (1.3) & Booster plus E (2 qt) [8/25] b) dinoseb (1.3) & Booster plus E (2 qt) [8/31]	367	1.065	30	80	97	97	97	3	17	43	68	72
4. a) dinoseb (2.5) & Booster plus E (2 qt) [8/25] b) dinoseb (2.5) & Booster plus E (2 qt) [8/31]	334	1.065	60	97	100	100	100	8	22	77	93	95
5. tetrathiin (1.0) [8/31]	402	1.066	0	80	93	93	93	0	8	8	8	35
6. tetrathinn (2.0) [8/31]	435	1.068	0	70	80	80	93	0	8	8	25	50
7. a) tetrathiin (1.0) [8/25] b) tetrathiin (1.0) [8/31]	327	1.066	40	77	100	100	100	8	17	70	97	98
8. a) tetrathiin (1.0) [8/25] b) tetrathiin (0.5) [8/31]	353	1.063	33	100	100	100	100	10	15	43	77	85
9. a) tetrathiin (0.5) [8/25] b) tetrathiin (0.5) [8/31]	332	1.066	43	80	93	100	100	8	8	33	72	78
$D_{(.05)}$ Tukey	(ns)	(0.011)										

1/ Tetrathiin treatments included 32 oz/A of UBI-1126

Table 2. 1977 Vine Desiccation Equipment-Upstate, N.Y.

Chemical, Rate (lb/A) & [1] Date of Application	Yield 2-4" (cwt/A)	Spec. Grav.	% Desiccation Leaves 8/31	Leaves 9/3	Leaves 9/9	Leaves 9/15	Leaves 9/27	Stems 8/31	Stems 9/3	Stems 9/9	Stems 9/15	Stems 9/27
1. Control	415	1.075	0	0	3	8	24	0	0	0	0	6
2. dinoseb (2.5) & Booster plus E (2 qt) [8/31]	328	1.065	-	90	95	98	98	-	4	11	33	64
3. dinoseb (2.5) & WEX (1 pt) [8/31]	346	1.067	-	65	75	75	81	-	5	8	8	59
4. ametryn (2.4) [8/31]	362	1.064	-	5	86	95	100	-	0	8	43	91
5. ametryn (2.4) & Booster plus E (2 qt) [8/31]	351	1.066	-	33	93	98	100	-	0	10	65	91
6. a) ametryn (1.6) & Booster plus E (2 qt) [8/25] b) dinoseb (1.0) [8/31]	289	1.062	53	100	100	100	100	0	33	85	91	96
7. a) ametryn (1.6) & Booster plus E (2 qt) [8/25] b) endothall (0.52) [8/31]	293	1.061	68	100	100	100	100	0	19	89	95	96
8. diquat (0.5) & X-77 (8 oz/100 gal) [8/31]	338	1.067	-	68	93	98	98	-	6	29	54	81
9. endothall (1.04) [8/31]	368	1.071	-	98	95	98	98	-	6	19	38	60
$D_{(.05)}$ Tukey	(75)	(0.004)										

[1] Booster plus E at 2 qt/A was included in treatment 6b.

Table 3. 1978 Ametryn Experiment-Upstate, N.Y.

Material, Rate, (lbs/A)[1/] and Date of Application	Total Yield (cwt/A)	Spec. Grav.	Percent Leaf Desiccation[2/] 9/1	9/5	9/8	9/14	9/22	Percent Stem Desiccation[2/] 9/1	9/5	9/8	9/14	9/22	Regrowth 9/22
ametryn (1.4) [8/24] Followed by:													
1) dinoseb (0.9) [9/1]	278	1.066	22	92	98	100	100	T	33	38	85	99	0.7
2) endothall (0.46) [9/1]	311	1.068	28	98	100	100	100	T	23	23	68	95	8.3
3) paraquat (0.23) [9/1]	292	1.065	30	90	98	100	100	T	40	40	85	98	3.7
4) tetrathiin (0.44) [9/1]	319	1.066	23	93	95	100	100	T	27	28	70	98	4.0
No ametryn													
5) dinoseb (2.2) [9/1]	354	1.067	T	47	58	70	93	T	10	12	38	66	3.7
6) endothall (0.92) [9/1]	346	1.068	T	87	90	97	100	T	17	20	38	76	2.0
7) paraquat (0.46) [9/1]	360	1.069	T	78	95	100	100	T	22	27	78	95	2.3
8) tetrathiin (0.44) [8/24] tetrathiin (0.88) [9/1]	337	1.069	32	87	95	100	100	T	17	20	37	88	2.0

1/ Booster plus E was added to the ametryn and dinoseb treatments at a rate of 1.75 qt/A, X-77 added to paraquat at 8 oz/100 gal and UBI-1126 added to tetrathiin at 24 oz/A.

2/ T = Trace

Table 4. 1978 Ametryn Rate Experiment-Upstate, N.Y.

Ametryn Rate[1/] (lb/A)	% Desiccation							
	Leaves				Stems			
	9/1	9/5	9/8	9/14	9/1	9/5	9/8	9/14
(0.4)	7	40	47	65	0	12	12	30
(0.8)	12	63	73	92	0	13	13	57
(1.6)	20	83	90	98	0	27	30	73

[1/] Ametryn applied August 24, 1978, all treatments received 1.0 lb/A dinoseb with 2 qts/A Booster plus E on September 1, 1978.

Table 5. The Effect Of Spray Nozzles On Vine Desiccation.

Treatment[1/]	% Desiccation							
	Leaves				Stems			
	9/5	9/8	9/14	9/22	9/5	9/8	9/14	9/22
Tractor Mounted								
8004 (Std)	88	98	100	100	15	15	37	75
8004 LP	92	98	100	100	20	20	50	77
Hand Held								
8004 (Std)	90	100	100	100	13	13	45	70

[1/] 2.5 lbs/A of dinoseb with 2 qts/A Booster plus E applied September 1, 1978.

Table 6. 1978 Adjuvant Experiment-Upstate, N.Y.

Adjuvant and[1/] Rate	% Desiccation							
	Leaves				Stems			
	9/5	9/8	9/14	9/22	9/5	9/8	9/14	9/22
Booster plus E (2 qt/A)	80	97	100	100	15	18	47	78
Wex (1 pt/A)	50	73	90	95	10	10	38	60
Saturall (1 pt/A)	43	70	92	98	10	12	37	70

[1/] 2.5 lbs/A of dinoseb applied September 1, 1978.

ALACHLOR PLUS METRIBUZIN FOR WEED CONTROL IN POTATOES

L. B. Lynn and G. E. Edwards 1/

ABSTRACT

Preemergence applications of alachlor plus metribuzin for potatoes were evaluated under an Experimental Use Permit in 1978-79. Experiments conducted over a wide range of soil types and potato varieties demonstrated technical advantages for the tank mix of alachlor plus metribuzin. Excellent control of redroot pigweed, lambsquarter, foxtails, crabgrass and barnyardgrass was observed in all trials. Improved crop safety and broader spectrum weed control are amongst the advantages for this tank mixture.

INTRODUCTION

Annual grasses, especially barnyardgrass (Echinochloa crusgalli (L) Beauv.) can be a serious problem in potatoes (Solanum tuberosum) grown in the northeastern states (1, 7, 8, 12, 20). Preemergence applications of metribuzin [4-amino-6-tert-butyl-3(methylthio)-as-triazin-4(4H)one] have demonstrated good to excellent control of many annual broadleafed weeds, but can be weak on certain annual grasses in potatoes (3, 6, 9, 10, 18). Alachlor [2-chloro-2'-6'-diethyl-N-(methoxymethyl) acetanilide] has been demonstrated to provide excellent preemergence annual grass control in potatoes (2, 5, 11, 13, 16).

Several university scientists have investigated the herbicidal advantages for a tank mixture of alachlor plus metribuzin in potatoes (3, 4, 14, 15, 16, 17, 19). Rationale for the tank mix includes: (a) improved spectrum of weeds controlled by taking advantage of the broadleaf control offered by metribuzin combined with the strong annual grass control with alachlor, (b) longer period of weed control, (c) improved crop safety due to reduced rates of each component, (d) reduced herbicide carry-over to cover crops, and (e) single application either early or delayed preemergence rather than preemergence plus one or two post emergence applications.

Both alachlor and metribuzin presently have EPA approval for use on potatoes. Under an Experimental Use Permit (524-EUP-38), Monsanto has been evaluating tank mixes of alachlor plus metribuzin for potatoes. Residue analysis indicate that the

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tank mix will not exceed the established tolerances of either alachlor or metribuzin. This paper summarized the results of 1978-79 E.U.P. trials conducted with alachlor plus metribuzin for potatoes in the northeastern states.

MATERIALS AND METHODS

Tank mixtures of alachlor plus metribuzin were applied to potatoes under authority of EPA Experimental Use Permit 524-EUP-38 effective January 1, 1978 through January 1, 1980. Applications were made with ground equipment except in two sites where aerial equipment was used. Applications were made after planting but before the potatoes emerged. In locations where dragging-off was a part of the cultural practice, applications were delayed until after the final drag-off.

Rates ranged from 1.5 to 3.0 lb/A alachlor plus 0.38 to 1 lb/A metribuzin. Materials used in this project were commercial formulations of alachlor and metribuzin with supplemental labels for the EUP. Dates of application ranged from late-May until mid-June due to the wide geographic distribution and corresponding climatic variations. Different rates were used for the general soil type classifications (coarse, medium, fine). Rates, locations, soil types, potato varieties and plot size are summarized in Table 1.

Table 1. Characteristics of Test Sites for Alachlor plus Metribuzin Experimental Use Permit Plots for Potatoes 1978-79

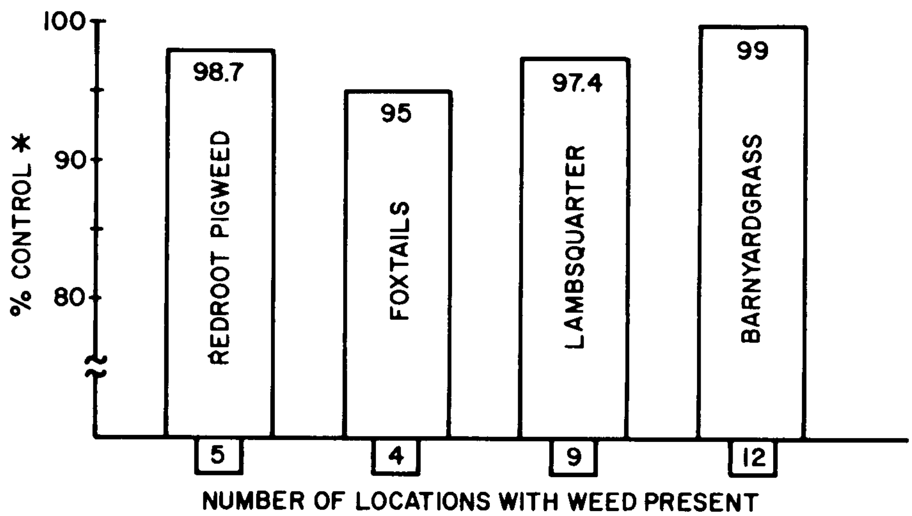
Location	Soil Type	% Organic Matter	Potato Variety	Plot Size (Acres)	Rate lb/A a.i. Alachlor + Metribuzin
Arkport, NY	Silt Loam	1.5	Katahdin	2.0	2.0 + 0.50
Southold, NY	Sandy Loam	1.0	Superior	0.5	2.0 + 0.50
Bliss, NY	Sandy Loam	2.0	Kennebec	0.8	2.0 + 0.38
Bliss, NY	Silt Loam	1.0	Kennebec	4.0	2.0 + 0.38
Jacksonville, NY	Sandy Loam	2.0	Kennebec	3.0	3.0 + 1.0
Valatie, NY	Sandy Loam	1.0	Norchip	2.0	2.0 + 1.0
Riverhead, NY	Sandy Loam	1.0	Superior	1.5	2.0 + 0.38
Riverhead, NY	Sand	2.0	Katahdin	0.5	1.5 + 0.30
Riverhead, NY	Sandy Loam	2.0	Abnaki	0.5	2.0 + 0.50
Riverhead, NY	Loam	2.0	Superior	0.5	2.0 + 0.38
Fabius, NY	Silt Loam	5.0	Katahdin	0.5	2.0 + 0.50
Drums, PA	Loam	4.0	Penn 71	1.0	3.0 + 0.75
Dover, DE	Silt Loam	2.4	Superior	0.5	1.5 + 0.50
Middleton, DE	Sandy Loam	1.8	Superior	0.5	1.5 + 0.50
Houlton, ME	Loam	3.0	Superior	1.0	2.8 + 0.50
Houlton, ME	Loam	1.0	Superior	1.0	3.0 + 0.50
Frenchville, ME	Loam	1.0	Superior	1.0	1.5 + 0.30
Ft. Kent, ME	Loam	1.0	Katahdin	10.0	2.0 + 0.75
Daigle, ME	Loam	1.0	Katahdin	10.0	3.0 + 0.50
Ft. Kent, ME	Clay Loam	1.0	Ontario	1.5	3.0 + 0.50
Caribou, ME	Loam	1.0	Burbank	8.0	3.0 + 0.63
Manawaska, ME	Loam	1.0	Katahdin	6.0	3.0 + 0.75
Presque Isle, ME	Sandy Loam	1.0	Belruss	6.0	2.5 + 0.75

Evaluations for the large plots adhered to statistical subsampling techniques. Weed control and crop tolerance evaluations were reported as percent of control (0-100%) for days after treatment (DAT).

RESULTS AND DISCUSSION

Tank mix applications of alachlor plus metribuzin provided excellent control of redroot pigweed (*Amaranthus retroflexus* L.), common lambsquarter (*Chenopodium album* L.), foxtails (*Setaria* spp.), and barnyardgrass (Figure 1). Since the data represents averages for the total season, both early and late season ratings indicated excellent weed control.

FIGURE I. WEED CONTROL WITH TANK MIXTURES OF ALACHLOR PLUS METRIBUZIN ON POTATOES



* CONTROL AVERAGED FOR ENTIRE SEASON

There were several sites where preemergence applications of metribuzin were compared to alachlor plus metribuzin. Metribuzin alone was almost as good as or equal to the tank mixture for control of broadleaved weeds, i.e., redroot pigweed, lambsquarter and mustard (*Brassica campestris* L.). However, in locations where barnyardgrass or crabgrass (*Digitaria* spp.) were present the tank mixture provided 6 to 12% increased control. This improved grass control was significant in sites where barnyardgrass or late germinating crabgrass completely covered untreated areas. Even after vine kill, the uncontrolled annual grasses were a hinderance to harvest operations.

Injury observations indicated that the alachlor plus metribuzin tank mixture caused less vigor reduction than metribuzin alone, 1.6% and 2.8% early season injury respectively. There was no measurable late season injury from any treatment. Several studies (15,16) have shown that herbicides such as alachlor can have an effect of delaying crop maturity with no effect on total yield. In sites where yields were measured, there were no differences attributed to crop injury; however, differences in yield tended to occur in sites where reduced annual grass control was noted with metribuzin alone.

The technical and commercial advantages of the alachlor plus metribuzin tank mixture for potatoes are amplified with the occurrence of hard-to-control annual grasses. The two aerial applied experiments followed trends of ground applied experiments. The overall performance of the alachlor plus metribuzin tank mixture demonstrated a fit especially for controlling one of the serious annual grass problems in potatoes - barnyardgrass.

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EFFECT OF TWO FORMULATIONS OF LINURON AND THREE FORMULATIONS OF METRIBUZIN IN COMBINATION WITH PENDIMETHALIN ON YIELD, CROP INJURY, AND WEED CONTROL IN KATAHDIN POTATOES

L. S. Morrow and H. J. Murphy[1]

ABSTRACT

Several formulations of both metribuzin and linuron were compared for weed control in white potatoes grown at Aroostook Farm, Presque Isle, Maine. Wettable powder and dry flowable formulations of metribuzin were tested, as were wettable powder and liquid formulations of linuron. The two metribuzin formulations and a third, liquid form, were also combined with pendimethalin. All of the treatments performed well in controlling early season barnyard grass but did not provide satisfactory control of quackgrass. The high rate of linuron was slightly phytotoxic to potatoes early in the season.

INDRODUCTION

The various formulations of both metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one] and linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea] were evaluated at two rates applied preemergence for weed control in potatoes (*Solanum tuberosum* L. 'Katahdin'). Two rates of each of the dry formulations of metribuzin were also combined with one rate of pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] to attain broad spectrum weed control. All of the treatments were compared with a check and a standard preemergence treatment of dinoseb [2-*sec*-butyl-4,6-dinitrophenol] plus dalapon [2,2-dichloropropionic acid]. Quackgrass (*Agropyron repens* L.) and annual barnyard grass (*Echinochloa crusgalli* (L.) Beauv.) populations, as reported in Table 2, were sufficiently high to evaluate the chemical control, but the populations of mustard (*Brassica campestris* L.) and lambsquarter (*Chenopodium album* L.) were low.

MATERIALS AND METHODS

The location of the test was on a Caribou gravelly silt loam with an organic matter content of 3.5 percent. All treatments were applied at preemergence 14 days after planting. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with six replicates of each treatment. All herbicide mixtures were applied in 748 liters of water per hectare using 276 kPa pressure. A compressed air sprayer equipped with a two nozzle brush type boom was used. Nozzles were Delavan raindrop type with No. 3374-3 tips. Weed control and crop injury ratings were made on the two dates listed

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in Tables 1 and 2 using the "Cornell" rating system reported in percentage values. During July weed counts were made and species were identified in the "no treatment" plots. These are listed in Table 2. Yields of potato tubers were taken in late September.

RESULTS AND DISCUSSION

Possible phytotoxicity to potatoes showed up at the high rate of linuron 50W and 4L, as seen under the crop injury ratings in Table 1, but the crop injury was minimal and only occurred early in the growing season. Any noticeable phytotoxic effects had disappeared by early July. All treatments provided good control over annual barnyard grass, but the results were not similar for quackgrass control. In this case, most treatments showed improvement over the check plots except for the two rates of pendimethalin applied alone and the combination of the lower rate of pendimethalin plus the low rate of metribuzin 50W. All other treatments compared favorably with the standard dalapon plus dinoseb, when considering quackgrass control. Yields were reduced by two treatments. The treatment of linuron 4L at the high rate may have caused lower yields because of the early season stunting, while the treatment with the low rate of pendimethalin could have caused reduced yields by the high weed pressure. This study indicates that the various formulations now available for linuron and metribuzin are quite similar in efficacy for control of grasses, and that pendimethalin should be combined with an herbicide which gives good control of quackgrass when that weed species is present.

Table 1. Effect of wettable powder, liquid, and dry formulations of metribuzin and linuron and metribuzin in combination with pendimethalin on yield and crop injury of Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	Percent Crop Injury[2]	
		6-20	8-9
Check - no treatment	32.0	100	100
0.56 Metribuzin 50W, PE	32.9	100	100
1.12 Metribuzin 50W, PE	34.1	99	100
0.56 Metribuzin DF, PE	32.5	100	100
1.12 Metribuzin DF, PE	34.6	100	100
2.24 Linuron 50W, PE	32.5	100	100
4.48 Linuron 50W, PE	34.4	96	100
2.24 Linuron 4L, PE	32.2	98	100
4.48 Linuron 4L, PE	28.3	93	100
0.56 Metribuzin 50W + 1.68 Pendimethalin, PE	31.1	100	100
1.12 Metribuzin 50W + 1.68 Pendimethalin, PE	34.4	100	100
0.56 Metribuzin 4L + 1.68 Pendimethalin, PE	31.6	100	100
1.12 Metribuzin 4L + 1.68 Pendimethalin, PE	31.3	100	100
0.56 Metribuzin DF + 1.68 Pendimethalin, PE	32.6	100	100
1.12 Metribuzin DF + 1.68 Pendimethalin, PE	31.9	100	100
5.04 Dinoseb + 5.60 Dalapon, PE	33.9	100	100
1.68 Pendimethalin, PE	27.0	99	100
3.36 Pendimethalin, PE	30.0	100	100
Bayes L.S.D. (0.05)	6.4		

[1]Planted - May 21; killed - September 8; harvested - September 25, 1979.

Preemergence treatments (PE) applied - June 4. Temperature - 24°C. Sunny and hazy. Soil - moist. Southeast wind 0-3 mph.

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop and almost all crop plants killed.

Table 2. Effect of wettable powder, liquid, and dry formulations of metribuzin and linuron and metribuzin in combination with pendimethalin on weed control in Katahdin potatoes. Maine - 1979.

Treatments Kg A.I. per Hectare	Percent Weed Control[2]							
	Barnyard grass		Quackgrass		Mustard		Lambs-quarter	
	6-20	8-9	6-20	8-9	6-20	8-9	6-20	8-9
Check - no treatment	80	100	64	78	95	95	98	100
0.56 Metribuzin 50W, PE	100	98	80	85	100	99	100	100
1.12 Metribuzin 50W, PE	100	99	81	89	100	99	100	100
0.56 Metribuzin DF, PE	100	99	80	89	100	99	100	100
1.12 Metribuzin DF, PE	100	98	81	85	100	99	100	100
2.24 Linuron 50W, PE	100	99	81	91	100	99	100	100
4.48 Linuron 50W, PE	100	97	86	95	100	99	100	100
2.24 Linuron 4L, PE	100	99	74	85	100	99	100	100
4.48 Linuron 4L, PE	100	99	91	99	100	100	100	100
0.56 Metribuzin 50W + 1.68 Pendimethalin, PE	100	98	70	75	100	99	100	100
1.12 Metribuzin 50W + 1.68 Pendimethalin, PE	100	97	83	89	100	100	100	100
0.56 Metribuzin 4L + 1.68 Pendimethalin, PE	100	99	81	89	100	99	100	100
1.12 Metribuzin 4L + 1.68 Pendimethalin, PE	100	97	80	88	100	99	100	100
0.56 Metribuzin DF + 1.68 Pendimethalin, PE	100	97	83	84	100	97	100	100
1.12 Metribuzin DF + 1.68 Pendimethalin, PE	100	98	75	86	100	100	100	100
5.04 Dinoseb + 5.60 Dalapon, PE	100	99	79	90	100	100	100	100
1.68 Pendimethalin, PE	100	96	60	76	99	99	100	99
3.36 Pendimethalin, PE	100	98	74	77	100	99	100	100

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds cominate crop and almost all crop plants killed.

Number and species of weeds per 0.0929 square meter (average of 6 replicates):

Agropyron repens - 4.6
Echinochloa crusgalli - 1.3
Mustard sp. - 0.8
Chenopodium album - 0.4

THE CONTROL OF YELLOW NUTSEDGE IN POTATOES WITH DPX 4129

G. W. Selleck[1/] and R. S. Greider[2/]

ABSTRACT

Yellow nutsedge (Cyperus esculentus L.) is widespread and difficult to control in Long Island potatoes. Through two years of testing DPX 4129 has given very good control of nutsedge when applied preplant in the fall, preemergence, preemergence-incorporated and postemergence to potatoes. Phytotoxicity to potatoes was evident only with applications at dragoff of potatoes.

Annual weeds were controlled when DPX 4129 was used in conjunction with metribuzin either as a tank-mix applied preemergence, or postemergence following metribuzin at dragoff.

INTRODUCTION

Yellow nutsedge is the most difficult weed to control in Long Island potato (Solanum tuberosum L.) fields. It is estimated that 10-15% of the cropland in Northeastern U.S. is infested with nutsedge (2), and it is likely that infestations are more extensive on Long Island (3). Presently labeled herbicides and cultural practices suppress nutsedge growth, but often control has not been commercially acceptable. Control is confounded by the long-lived (5-6 years) tubers which are buried at various depths (2). Late-germinating, deeply-buried tubers are generally not affected by early season applications of short residual herbicides.

Most commercially available herbicides, even under optimum conditions, have a limited effect upon nutsedge. Hence there is a need for a long residual, selective nutsedge-specific herbicide. Preliminary data with DPX 4129 indicate good activity on a variety of nutsedges, with selectivity in certain crops (1).

MATERIALS AND METHODS

Potato trials

Potatoes cv. Katahdin were planted May 11, 1978 and DPX 4129 was applied May 31 with a tractor-mounted sprayer delivering 40 gpa at 35 psi on quadruplicated plots 1.7 x 7.7 m on Riverhead sandy loam soil containing less than three percent organic matter. In addition to random checks, untreated strips were adjacent to each treated plot. Natural rainfall was augmented by sprinkler irrigation. Tillage consisted of field preparation, planting, dragoff, and a single hilling. Preemergence treatments of DPX 4129 at 0.28, 0.56 and 1.12 kg/ha pre- and pre- incorporated, were applied on May 31 immediately following dragoff and before emergence of nutsedge. Postemergence applications at 0.28 and 0.56 kg/ha were made on June 20 to nutsedge 2.5 cm tall.

Applications were similar in 1979, except that Katahdin potatoes were planted on May 1. Metribuzin [4-amino-6-tert-butyl-3-methylthio)-as-triazin-5(4H)one] at 0.56 kg/ha was combined with DPX 4129 at 0.14, 0.28 and

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0.56 kg/ha and applied preemergence on May 17 to potatoes at groundcrack and emerging nutsedge. The nutsedge was cultivated on May 22. Postemergence treatments of DPX 4129 at 0.14, 0.28 and 0.56 kg/ha to 4 cm nutsedge and 5 cm potatoes were preceded by 0.84 kg/ha metribuzin at groundcrack.

Rye trials

DPX 4129 at 0.1, 0.24 and 0.48 kg/ha was applied pre- and postemergence in rye (*Secale cereale* L.) planted as a winter cover crop in 1978. Application procedures were similar to those in potatoes except that a hand-held CO_2 sprayer was used for postemergence treatments. Katahdin potatoes were planted after the rye was plowed in early May, 1979. Natural rainfall was augmented by sprinkler irrigation at the postemergence location.

RESULTS AND DISCUSSION

Potato

DPX 4129 soil applied at all rates gave 85% control or better (Table 1) on July 6 and 75% or better on August 1. Postemergence applications were somewhat less effective, particularly on August 1. Control of barnyardgrass (*Echinochloa crus-galli* (L.) Beaiv.) was not commercially acceptable with any of the treatments.

Preemergence and pre- incorporated applications caused stunting and chlorosis on June 23, although the plants had outgrown the injury by July 6. Growers are unkliely to tolerate this degree of injury. Early control of nutsedge (June 19) was marginal because much of the nutsedge had emerged at the time of application. DPX at 0.14 kg/ha with 0.56 metribuzin gave only 50% control on August 23. The combination with 0.28 kg/ha DPX 4129 provided about 70% control and the 0.56 kg rate gave 80% control of yellow nutsedge (Table 2). As in 1978, phytotoxicity was evident with rates exceeding 0.14 kg/ha.

When applied postemergence as a follow-up to 0.84 kg/ha metribuzin at dragoff, DPX 4129 provided selective control (75%) at all rates and was more effective than the best of the pre- incorporated treatments.

Fall Rye

There was no evidence of phytotoxicity with DPX 4129 applied either pre- or postemergence to fall rye or to Katahdin potatoes which were planted after plowing of the rye. The DPX 4129 treatments provided a minimum of 70% control when assessed August 3, one year after application (Table 3).

DPX 4129 has demonstrated very good control of yellow nutsedge under varied conditions of application. Phytotoxicity to potato appears to be a problem on sandy soil when applications are made at dragoff. However,fall applications and postemergence sprays have been selective on both rye cover crop and potatoes. DPX 4129 appeared to have reduced nutsedge density for at least one year. It is probable that there was a reduction in formation of daughter tubers (1). Further studies are needed to determine long-term effects of nutsedge and the place of DPX 4129 in subsequent rotational crops.

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Table 1. Weed control and phytotoxicity ratings with DPX 4129 in Katahdin potatoes, 1978.

		% weed control					
		Nutsedge			Barnyardgrass		
Treatment (kg/ha)	Phyto[a]	6/23	7/6	8/1	6/23	7/6	8/1
DPX 4129 .28 pre	3	94	97	88	55	27	30
.56 pre	5	87	99	92	65	65	33
1.12 pre	6	68	97	88	64	79	58
.28 pre-inc	3	92	99	85	79	82	51
.56 pre-inc	1	70	85	75	55	64	63
1.12 pre-inc	5	82	95	88	77	73	56
.28 post	0	81	91	71	20	63	0
.56 post	1	74	88	60	65	55	0
check (density/sq m)	0	73	55	46	73	37	85

[a] 0 = no effect, 10 = complete kill

Table 2. Weed control and phytotoxicity ratings with DPX 4129 in Katahdin potatoes, 1979.

Treatment (kg/ha)	Phyto[a] 5/30	Phyto[a] 6/19	% weed control Nutsedge 6/19	Nutsedge 8/23	cg 8/23	byd 8/23	sw 8/23	lq 8/23	rr 8/23	Yield cwt/A
DPX 4129 .14 + metribuzin .56 pre-inc	0	0	33	50	80	98	100	93	100	248
DPX 4129 .28 + metribuzin .56 pre-inc	4	0	63	68	60	100	100	100	98	241
DPX 4129 .56 + metribuzin .56 pre-inc	3	0	73	80	80	98	100	100	95	259
Metribuzin .84 pre + DPX 4129 .14 post	0	0	48	80	78	100	100	100	100	320
Metribuzin .84 pre + DPX 4129 .28 post	0	0	75	78	78	93	93	100	100	306
Metribuzin .84 pre + DPX 4129 .56 post	0	0	83	88	73	98	100	100	98	296
check (density/sq m)	0	0	296	50[c]	14[c]	6[c]	9[c]	9[c]	1[c]	294

[a] 0 = no effect, 10 = complete kill

[b] cg = crabgrass, byd = barnyardgrass, sw = smartweed, lq = lambsquarters, rr = redroot pigweed

[c] = % cover

Table 3. Nutsedge control with DPX 4129 applied to rye cover crop, 1979.

Application date	Stage of rye	Soil texture	Rating date	Check no/sq m	% control Treatment kg/ha 0.1	0.22	0.45
9/21/78	3-5"	sandy loam	6/21	73	50	75	72
			8/3	84	83	85	92
11/3/78	pre	loam	6/3	95	89	93	98
			8/3	97	70	73	75

EFFECT OF PREPLANT INCORPORATED APPLICATIONS OF EPTC, CYCLOATE, AND VERNOLATE FOLLOWED BY PREEMERGENCE APPLICATION OF DINOSEB ON YIELD, CROP INJURY, AND WEED CONTROL IN KATAHDIN POTATOES

L. S. Morrow and H. J. Murphy[1]

ABSTRACT

EPTC, cycloate, and vernolate were evaluated in combinations with dinoseb for broad spectrum weed control in white potatoes grown at Aroostook Farm, Presque Isle, Maine in 1979. All combination treatments with dinoseb gave good control of annual barnyard grass, quackgrass, and mustard. Weed pressure from lambsquarters was not great enough to give a good evaluation. All treatments produced greatly improved yields over the control due to the high population of mustards in the field. Dinoseb applied alone gave poor control of the grasses, while EPTC and EPTC-33865 applied alone and one treatment of EPTC plus metribuzin did not give satisfactory control of mustard. None of the treatments caused any prolonged crop injury.

INTRODUCTION

Preplant incorporated treatments of EPTC [*S*-ethyl dipropylthiocarbamate], cycloate [*S*-ethyl *N*-ethylthiocyclohexanecarbamate], vernolate [*S*-propyl dipropylthiocarbamate], and experimental compound EPTC-33865 at two rates of each in combination with preemergence treatments of dinoseb [2-*sec*-butyl-4 , 6-dinitrophenol] were evaluated for weed control in potatoes (*Solanum tuberosum* L. 'Katahdin'). EPTC preplant incorporated was also tested in combination with two rates of metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one] both preplant incorporated and preemergence. Besides the combination treatments, EPTC, EPTC-33865, dinoseb, and metribuzin were applied alone and all treatments were compared to a check treatment and a standard of dinoseb plus dalapon [2,2-dichloropropionic acid]. The purpose of the study was to compare several thiocarbamate herbicides in combination with dinoseb for control efficacy of mustard (*Brassica campestris* L.), lambsquarter (*Chenopodium album* L.), annual barnyard grass (*Echinochloa crusgalli* (L.) Beauv.), and quackgrass (*Agropyron repens* L.). The population of lambsquarter was not sufficient to evaluate the treatment effects on this species.

MATERIALS AND METHODS

The test was conducted on a Caribou gravelly silt loam with an organic matter content of 3.5 percent. Preplant incorporated treatments of EPTC,

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cycloate, vernolate, EPTC-33865, and metribuzin were applied to a dry soil and incorporated (8-10 cm) with a rototiller. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with six replicates of each treatment. All herbicides were applied in 748 liters of water using 276 kPa pressure. A compressed air sprayer equipped with a two nozzle brush type boom was used to apply the various herbicides. Nozzles were Delavan raindrop type with No. 3374-3 tips. Weed control and crop injury ratings were made on the two dates listed in Table 1 using the "Cornell" rating system reported in percentage values. During July, weed counts were made and species, as reported in Table 2, were identified in the 'no treatment' plots. Yields of potato tubers were determined at harvest time.

RESULTS AND DISCUSSIONS

Referring to Table 1, concerning crop injury, none of the treatments caused notable damage early or late in the season. Preplant incorporated treatments at the high and low rates of EPTC and EPTC-33865, as well as EPTC plus metribuzin, gave poor control of mustard. Due to the increased weed pressure, these treatments also tended to decrease yields slightly, of which the two rates of EPTC proved significantly less than the standard of dinoseb plus dalapon applied preemergence. As might be expected, dinoseb applied alone at preemergence did not provide good control of annual barnyard grass and quackgrass, but was satisfactory in controlling mustard. Metribuzin applied as preplant incorporated and preemergence treatments also gave satisfactory control over all weed species present. All of the combination treatments of thiocarbamates and dinoseb provided good broad spectrum weed control without any noticeable crop injury. So, it would appear that either EPTC, EPTC-33865, cycloate, or vernolate will provide good control of grasses, but should be applied with a broadleaf herbicide, such as dinoseb, to give broadleaf weed control.

Table 1. Effect of preplant applications of EPTC, cycloate, and vernolate followed by preemergence applications of dinoseb on yield and crop injury of Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	Percent Crop Injury[2] 7-2	8-22
Check - no treatment	15.5	99	100
5.04 Dinoseb + 5.60 Dalapon, PE	30.9	99	100
3.36 EPTC, PPI	23.3	99	100
4.48 EPTC, PPI	26.0	98	100
3.36 EPTC, PPI + 1.68 Dinoseb, PE	30.5	99	100
4.48 EPTC, PPI + 1.68 Dinoseb, PE	30.7	99	100
3.36 Cycloate, PPI + 1.68 Dinoseb, PE	27.8	100	100
4.48 Cycloate, PPI + 1.68 Dinoseb, PE	29.6	99	100
3.36 Vernolate, PPI + 1.68 Dinoseb, PE	28.8	99	100
4.48 Vernolate, PPI + 1.68 Dinoseb, PE	30.5	99	100
3.36 EPTC-33865, PPI + 1.68 Dinoseb, PE	28.5	99	100
4.48 EPTC-33865, PPI + 1.68 Dinoseb, PE	28.3	99	100
3.36 EPTC-33865, PPI	27.3	100	100
4.48 EPTC-33865, PPI	29.3	98	100
1.68 Dinoseb, PE	29.1	100	100
3.36 EPTC, PPI + 0.56 Metribuzin, PE	32.3	98	100
3.36 EPTC, PPI + 0.28 Metribuzin, PE	30.4	97	100
3.36 EPTC + 0.56 Metribuzin, PPI	26.8	98	98
0.56 Metribuzin, PE	30.6	99	100
0.56 Metribuzin, PPI	32.0	99	100
Bayes L.S.D. (0.05)	4.6		

[1]Planted - June 5; killed - September 12; harvested - September 24, 1979.

Preplant incorporated treatments (PPI) applied - June 5. Temperature - 17°C. Sunny and hazy. Soil - dry. South wind 8-10 mph.

Preemergence treatments (PE) applied - June 7. Temperature - 21°C. Clear sky. Soil - dry. South wind 2-4 mph.

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.

0 percent = weeds dominate crop and almost all crop plants killed.

Table 2. Effect of preplant applications of EPTC, cycloate, and vernolate followed by preemergence applications of dinoseb on weed control in Katahdin potatoes. Maine - 1979.

Treatments Kg A.I. per Hectare	Percent Weed Control[1] Barnyard grass 7-2	Barnyard grass 8-22	Quackgrass 7-2	Quackgrass 8-22	Mustard 7-2	Mustard 8-22	Lambs-quarter 7-2	Lambs-quarter 8-22
Check - no treatment	67	91	93	100	46	47	98	99
5.04 Dinoseb + 5.60 Dalapon, PE	98	98	98	98	100	99	100	100
3.36 EPTC, PPI	100	100	99	100	72	80	100	100
4.48 EPTC, PPI	100	99	98	99	77	82	100	100
3.36 EPTC, PPI + 1.68 Dinoseb, PE	99	99	98	98	98	98	100	100
4.48 EPTC, PPI + 1.68 Dinoseb, PE	98	100	99	100	100	100	99	100
3.36 Cycloate, PPI + 1.68 Dinoseb, PE	95	99	98	100	96	98	100	100
4.48 Cycloate, PPI + 1.68 Dinoseb, PE	97	100	98	100	98	99	100	100
3.36 Vernolate, PPI + 1.68 Dinoseb, PE	98	100	99	99	99	100	100	100
4.48 Vernolate, PPI + 1.68 Dinoseb, PE	97	100	97	99	100	100	100	100
3.36 EPTC-33865, PPI + 1.68 Dinoseb, PE	97	99	96	98	99	95	100	100
4.48 EPTC-33865, PPI + 1.68 Dinoseb, PE	99	100	98	100	95	100	100	100
3.36 EPTC-33865, PPI	94	99	99	99	67	76	100	99
4.48 EPTC-33865, PPI	99	100	99	99	75	88	100	100
1.68 Dinoseb, PE	68	82	91	98	96	96	99	100
3.36 EPTC, PPI + 0.56 Metribuzin, PE	100	100	98	100	100	100	100	100
3.36 EPTC, PPI + 0.28 Metribuzin, PE	99	100	98	99	99	99	100	100
3.36 EPTC + 0.56 Metribuzin, PPI	99	100	97	100	74	84	99	100
0.56 Metribuzin, PE	94	97	97	98	99	98	100	100
0.56 Metribuzin, PPI	94	100	94	99	96	100	99	100

[1]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop and almost all crop plants killed.

Number and species of weeds per 0.0929 square meter (average of 6 replicates):

Agropyron repens	- 1.0	Brassica sp.	- 9.4
Echinochloa crusgalli	- 4.2	Chenopodium album	- 0.8

EFFECT OF SEVERAL HERBICIDES AND COMBINATIONS APPLIED PREEMERGENCE AND PREPLANT INCORPORATED ON YIELD, CROP INJURY, AND WEED CONTROL OF KATAHDIN POTATOES. MAINE - 1979

H. J. Murphy and L. S. Morrow[1]

ABSTRACT

Various applications in this experiment included two rates of R-40244 in combination with either metolachlor or EPTC, napropamide in combination with two rates of metribuzin and two rates of linuron in combination with pendimethalin. Several herbicides, as shown in Table 1, were also applied alone. The potato plots were located at Aroostook Farm, Presque Isle, Maine. Weed control ratings were made on annual barnyard grass (*Echinochloa crusgalli* (L.) Beauv.), quackgrass (*Agropyron repens* L.), mustards (*Brassica campestris* L.), lambsquarters (*Chenopodium album* L.), and other weed species which may have been present.

Soil type was a Caribou gravelly silt loam with 3.5 percent organic matter. All herbicides were applied in 748 liters of water using a compressed air sprayer with 276 kPa pressure. A rototiller was used to facilitate incorporation in the preplanting (PPI) treatments 8-10 cm or shallow PPI 5-8 cm. Weed control and crop injury ratings were made on the dates listed in Table 1 using the "Cornell" rating system reported in percentage values. Also listed are weed species and population counts from the 'no treatment' plots.

Yields ranged from 23.9 to 28.5 mt/ha with no significant differences. While crop injury ratings did not indicate any serious phytotoxic effects, perhaps the 0.56 kg a.i./ha rate of R-40244, when in combination with metolachlor or EPTC, was beginning to show signs of crop damage. Higher rates in these cases may cause crop injury problems.

Considering weed control, annual barnyard grass was controlled well in all of the combination treatments, but treatments with only R-40244, napropamide, pendimethalin, or linuron resulted in fair to poor control. All treatments showed good control over lambsquarters except for linuron applied alone which was weak in this regard. Quackgrass and mustards were not present in enough numbers to give a clear evaluation of control over these species.

The most important result to note on Table 1 would involve the barnyard grass control. To give good broad spectrum weed control, where weed pressure is high from barnyard grass, R-40244, napropamide, pendimethalin, or linuron should not be used alone but in combination with a compatible herbicide good for controlling this particular weed species. Linuron and pendimethalin, when combined, can also give good results over annual barnyard grass.

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Table 1. Effect of several herbicides and combinations applied preemergence and preplant incorporated on crop injury and weed control in Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Percent Crop Injury and Weed Control[2]					
	Crop injury		Barnyard grass		Lambs-quarter	
	7-3	8-22	7-3	8-22	7-3	8-22
Check - no treatment	99	100	58	88	83	86
5.04 Dinoseb + 5.60 Dalapon, PE	95	100	92	99	100	100
0.28 R-40244, PE	99	99	68	93	98	99
0.56 R-40244, PE	99	100	76	96	100	100
0.28 R-40244 + 2.24 Metolachlor, PE	98	99	99	99	100	100
0.56 R-40244 + 2.24 Metolachlor, PE	94	99	98	99	100	100
3.36 EPTC, PPI + 0.28 R-40244, PE	99	100	99	99	100	100
3.36 EPTC, PPI + 0.56 R-40244, PE	93	99	99	99	100	100
2.24 Metolachlor, PE	99	100	99	99	96	99
0.56 Metribuzin, PE	100	100	86	93	98	100
1.12 Napropamide, Shallow PPI	100	100	70	98	93	100
2.24 Napropamide, Shallow PPI	99	100	83	97	96	100
1.12 Napropamide, Shallow PPI + 0.56 Metribuzin, PE	100	99	95	98	100	100
1.12 Napropamide, Shallow PPI + 0.28 Metribuzin, PE	100	100	93	100	99	99
0.28 Metribuzin, PE	99	100	68	81	100	100
1.68 Pendimethalin + 1.12 Linuron, PE	99	100	97	100	99	100
1.68 Pendimethalin + 0.56 Linuron, PE	99	99	98	100	100	100
1.68 Pendimethalin, PE	99	100	78	90	96	96
1.12 Linuron, PE	100	100	62	87	87	93

[1]Planted - June 8; killed - September 12; harvested - September 25, 1979.

Preplant incorporated treatments (PPI) applied - June 8. Temperature-19^{o}C. Clear sky. Soil - dry. South wind 3-5 mph.

Preemergence treatments (PE) applied - June 8. Temperature-22^{o}C. Clear sky. Soil - dry. South wind 5-8 mph.

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop and almost all crop plants killed.

Number and species of weeds per 0.0929 square meter: *Agropyron repens* - 0.9, *Echinochloa crusgalli* - 6.3, *Brassica sp.*- 0.6, *Chenopodium album* - 1.3.

EFFECT OF EL5219, ORYZALIN, AND TRIFLURALIN IN COMBINATION WITH METRIBUZIN ON YIELD, CROP INJURY, AND WEED CONTROL IN KATAHDIN POTATOES MAINE - 1979

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ABSTRACT

EL5219, an experimental herbicide containing both oryzalin and trifluralin, was tested for efficacy in controlling certain weeds in Katahdin potatoes at Aroostook Farm, Presque Isle, Maine. The most predominant weed species were quackgrass (*Agropyron repens* L.) and mustard (*Brassica campestris* L.). EL5219 was applied preemergence (PE) to the crop at four varying rates and was also combined with two rates of metribuzin applied PE. For comparison, oryzalin applied PE and trifluralin applied preplant incorporated (PPI) were each combined with metribuzin.

The plots were located on a Caribou gravelly silt loam with an organic matter content of 3.5 percent. All herbicides were applied in 748 liters of water using a compressed air sprayer with 276 kPa pressure. PPI treatments with trifluralin were incorporated 8-10 cm deep with a rototiller. Weed control and crop injury ratings were made on the three dates listed in Table 1 using the "Cornell" rating system reported in percentage values. Table 1 also lists weed species and population counts which were recorded in July for the 'no treatment' plots.

Yields from most of the herbicide treated plots were not significantly different and the lowest yield which was sustained by the check, 'no treatment,' plot was likely a result of the mustard population competition with the crop. None of the herbicides showed signs of crop phytotoxicity at the rates used. EL5219 applied alone controlled barnyard grass well early in the season but could not be evaluated after June due to the suppression of this weed species by mustards in the check plot. None of the treatments showed significant improvement over the check plots for control of quackgrass, although most of the combination treatments which included metribuzin did read a couple of percentage points higher. EL5219 proved effective in controlling mustards, but was necessary at the higher two rates of 1.27 or 2.52 kg a.i./ha. The lower rates would require application of metribuzin to be effective on mustard species. Lambsquarter readings were also recorded, but an evaluation of control over this species was not possible due to the low population levels.

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Table 1. Effect of EL5219, oryzalin, and trifluralin in combination with metribuzin on yield and weed control in Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	Percent Weed Control[2]					
		Quackgrass			Mustard		
		6-20	7-20	8-8	6-20	7-20	8-8
Check - no treatment	28.6	85	85	90	86	80	86
5.04 Dinoseb + 5.60 Dalapon, PE	35.6	89	95	91	100	100	99
0.84 EL5219, PE	30.4	86	89	93	97	93	95
1.05 EL5219, PE	32.8	84	84	87	94	93	93
1.27 EL5219, PE	9.5	91	84	86	99	99	99
2.52 EL5219, PE	33.1	90	88	89	99	100	100
0.84 EL5219 + 0.28 Metribuzin, PE	32.3	92	93	90	100	100	99
1.05 EL5219 + 0.28 Metribuzin, PE	32.0	87	90	89	100	100	99
1.27 EL5219 + 0.28 Metribuzin, PE	33.4	89	92	92	100	100	99
2.52 EL5219 + 0.56 Metribuzin, PE	33.6	90	96	95	100	100	99
0.84 Oryzalin + 0.28 Metribuzin, PE	35.4	90	93	94	100	100	99
0.28 Metribuzin, PE	35.4	89	93	91	100	100	99
0.56 Metribuzin, PE	33.5	93	95	93	100	100	99
0.84 Oryzalin, PE	31.2	90	92	91	95	98	98
0.56 Metribuzin + 0.84 Oryzalin, PE	33.4	91	91	91	100	100	100
0.56 Metribuzin + 1.27 EL5219, PE	32.9	85	87	89	100	100	98
0.28 Metribuzin, PE + 0.84 Trifluralin, LB	35.4	90	87	90	100	100	100
0.28 Metribuzin, PE + 1.68 Trifluralin, LB	35.7	90	89	92	100	100	100
0.28 Metribuzin, PE + 0.28 Metribuzin, LB	31.1	88	91	93	100	100	98
0.28 Metribuzin, PE + 2.24 Alachlor, LB	33.8	89	88	91	100	100	100
Bayes L.S.D. (0.05)	6.3						

[1]Planted - May 21; killed - September 8; harvested - September 26, 1979.

Preemergence treatments (PE) applied - June 6. Sunny, 17°C. Soil - moist to dry. North wind 10-15 mph. Layby treatments (LB) applied - July 12. Overcast, 26°C. Soil - dry. Northwest wind 4-5 mph.

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop plants and almost all crop plants killed.

PROMISING CANDIDATES FOR THE CONTROL OF YELLOW NUTSEDGE IN POTATOES

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ABSTRACT

S734 has shown good activity and selectivity on yellow nutsedge (*Cyperus esculentus* L.) and annual grasses in two years of field trials in potatoes. Incorporated applications were more effective than those pre- or postemergence. A mixture with metribuzin selectively controlled a broad-spectrum of annual weeds in potatoes. Metribuzin has been inconsistent for yellow nutsedge control, but combined with acetanilide or carbamate herbicides under certain undefined conditions, nutsedge control can be considerably improved over the same herbicides used alone. The extender R33865 appeared to improve the efficacy of EPTC on yellow nutsedge in one year of field trials.

INTRODUCTION

Yellow nutsedge infests about 10,000 acres of 23,000 acres planted to potatoes (*Solanum tuberosum* L.) on Long Island. Severe infestations can result in significant losses both in yields and in loss of grade which occurs when nutsedge rhizomes pierce potato tubers.

Results with the grower's standard herbicide EPTC (S-ethyl dipropylthiocarbamate) is occasionally erratic, depending upon pre- and post application weather conditions. As the activity of EPTC is relatively short-lived, grower's applications in potatoes are generally made at layby. When this application is delayed beyond the time of nutsedge emergence, effectiveness is reduced. S734 has been described as providing selective control to nutsedge (*Cyperus* spp.) and annual grasses in certain broadleaf crops (1). S734, along with other herbicides, herbicide-combinations, and extenders were included in field trials, results of which are presented here.

MATERIALS AND METHODS

Field trials were conducted in 1978 and 1979 on a natural infestation of yellow nutsedge at Calverton, N. Y. on Riverhead sandy loam soil, containing less than 3% organic matter. Treatments of EPTC, EPTC and extenders and S734 [2-(1-(2,5-dimethylphenyl)ethylsulfonyl)pyridine N-oxide], alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide), metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide), and EPTC combined with metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-trizin-5(4H)-one) were applied to Katahdin potatoes with a tractor-mounted sprayer delivering 40 gpa at 35 psi on quadruplicated plots two rows by 25 feet.

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In addition to random checks, untreated strips were adjacent to each treated plot. Natural rainfall was augmented by sprinkler irrigation. Tillage consisted of field preparation, planting, dragoff and a single hilling. In 1979 emerged nutsedge was cultivated 5/22 after treatments were applied. Pertinent application data are listed in Table 1.

RESULTS AND DISCUSSION

Treatments were handicapped in 1979 because yellow nutsedge had emerged in many of the plots at the time of application.

EPTC Extender

The low percentage of control of yellow nutsedge with EPTC in 1979 was due partly to short residual activity, and partly to emerged nutsedge at the time of application. Nevertheless, EPTC at 4 lb/A plus R33865 extender at a 6:1 ratio improved nutsedge control to 70% August 23 compared with 33% with EPTC used alone (Table 2). Formulations with increasingly higher extender ratios were less effective. There was no evidence of phytotoxicity to potatoes.

S734

Yellow nutsedge control was improved with pre-incorporated applications of S734 vs preemergence in both 1978 and 1979, ranging from 75 to 85% without phytotoxicity to potatoes (Table 3). Postemergence applications were less effective. Similar activity was observed in annual grasses with excellent control of barnyardgrass (Table 3) and crabgrass (data not shown). In 1979, all S734 treatments controlled barnyardgrass 100% and large crabgrass (*Digitaria sanguinalis* (L.) Scop.) 88% or better. In two years of testing there has been no evidence of crop injury.

Metribuzin at 0.5 lb/A tank-mixed with S734 gave good control of Pennsylvania smartweed (*Polygonum pensylvanicum* L.), common lambsquarters (*Chenopodium album* L.) and redroot pigweed (*Amaranthus retroflexus* L.). The addition of metribuzin did not visibly improve nutsedge control.

Metribuzin tank-mixes

Combined with acetamilide and thiocarbamate herbicides, metribuzin provided excellent control of broadleaf weeds (Table 4). Used alone, metribuzin has been inconsistent on Long Island for nutsedge control (2,3) but additive effects have occurred in combination with certain herbicides.

Alachlor at 2 lb/A gave 50% control on June 19 and 35% control on August 23 (Table 4). With the addition of 0.5 lb/A metribuzin, control was increased to 85% and 83%, respectively, on June 19 and August 23. Metolachlor at 1.5 lb/A gave better control than the 2 lb/A rate of alachlor with 76% and 65% on June 19 and August 23. The addition of 0.5 lb/A metribuzin further improved efficacy to 85% and 83% control (Table 4). Data from 1978 show increased effectiveness for the metolachlor plus metribuzin treatment over metolachlor alone on the June 23 and July 6 ratings, but in August percent control was about equal (5).

An additive effect was not evident, however, with either alachlor or metolachlor in a similar experiment in 1977 (4). The addition of 1 lb/A metribuzin to EPTC at 4 lb/A significantly improved nutsedge control (Table 4).

Based on one year of field testing, the addition of extenders to EPTC appears to show promise in lengthening the period of weed control.

S734 has shown good activity on annual grasses and yellow nutsedge, and should have a place in potato production on Long Island. Combined with metribuzin, a broad-spectrum of annual weeds can be controlled. Metribuzin has been inconsistent for the control of yellow nutsedge alone and in combination, but under certain conditions (presently undefined), the additive effect of metribuzin to alachlor, metolachlor or EPTC can markedly improve nutsedge control.

Table 1. Application data of herbicides in Katahdin potatoes.

Stage	Date	(°F) Temp.	Wind mph	Soil sfce.
pre (5% emergence)	5/31/78	80	NW 7	dry
post (4" nutsedge)	6/12/78	75	S 10	dry
pre (2" nutsedge)	5/16/79	70	SW 3	dry

Table 2. Percentage control of yellow nutsedge with EPTC and extenders.

Treatment (lb/A)		Nutsedge 6/19	Nutsedge 8/23	Yield cwt/A
EPTC pre-inc	4	48	33	286
EPTC + R33865 6:1 pre-inc	4	65	70	268
EPTC + R33865 6:75 pre-inc	4	39	65	293
EPTC + R33865 6:5 pre-inc	4	25	40	236
EPTC + PPG650 8:1 pre-inc	4	38	45	251
Check (density/ft^2)		34	50[a]	294

[a]Percent cover

Table 3. Percentage of nutsedge and barnyardgrass with S734 alone and mixed with metribuzin.

Treatment lb/A	nutsedge		byd[a]
1978	6/23	8/1	8/1
S734 1 pre-inc	88	85	95
S734 2 pre-inc	82	93	80
S734 1 pre	84	77	89
S734 2 pre	74	86	95
S734 1 post	89	68	62
S734 2 post	88	48	78
Check (density/sq ft)	8	5	9
1979	6/19	8/23	8/23
S734 0.5 pre-inc	24	88	100
S734 1.0 pre-inc	61	95	100
S734 1.5 pre-inc	35	100	100
S734 1.0 pre	28	93	100
S734 1.5 pre	63	95	100
S734 1.0 + metribuzin 0.5 pre	79	88	100
S734 1.0 + metribuzin 0.5 pre-inc	10	100	100
Check (density/sq ft)	34	13[b]	4[b]

[a]barnyardgrass

[b]% cover

Table 4. Percentage weed[a] control with herbicides alone and mixed with metribuzin.

	% control								
	phyto.		nutsedge		cg	byd	sw	lq	rp
Treatment lb/A	5/30	6/19	6/19	8/23	8/23	8/23	8/23	8/23	8/23
Alachlor 2 pre	0	0	50	45	93	100	83	93	63
Alachlor 2 + metribuzin .5 pre	2.5	0	85	83	90	100	83	100	100
Metolachlor 1.5 pre	0	0	76	65	100	100	88	48	90
Metolachlor 1.5 + metribuzin 0.5 pre	0	0	83	83	98	95	100	90	88
EPTC 4 pre-inc	0	0	48	33	85	100	80	70	58
EPTC 4 + metribuzin 1.0 pre-inc	0	0	66	80	88	100	98	93	93
Check (density/sq ft)	0	0	34	50[b]	13[b]	4[b]	9[b]	9[b]	1[b]

[a]byd = barnyardgrass, cg = crabgrass, sw = smartweed, lq = lambsquarters
rp = redroot pigweed

[b]% cover

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EFFECT OF S734 IN COMBINATION WITH METRIBUZIN AND LINURON APPLIED PREPLANT INCORPORATED ON YIELD, CROP INJURY, AND WEED CONTROL IN KATAHDIN POTATOES

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ABSTRACT

Experimental herbicide, S734, was applied at various rates with either linuron or metribuzin to determine an effective preplant incorporated combination for broad spectrum weed control in white potatoes. The plots were located at Aroostook Farm, Presque Isle, Maine in 1979. Results indicated that while S734 performed well against annual barnyard grass and lambsquarters, it needed assistance in controlling mustard which metribuzin provided.

INTRODUCTION

A new herbicide, S734 (2-[1-(2,5-dimethylphenyl) ethylsulfonyl]), was tested for efficacy in controlling weeds in white potatoes (*Solanum tuberosum* L. 'Katahdin'). Three rates of S734 were applied alone, as was each rate in combination with two rates of either metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one] or linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea]. Single herbicide treatments of metribuzin, linuron, and EPTC [*S*-ethyl dipropylthiocarbamate] applied at one rate of each were also evaluated. The EPTC treatment was used to compare with the three rates of S734 applied alone. All of the above treatments were preplant incorporated and compared with a check and a standard preemergence application of dinoseb [2-*sec*-butyl-4,6-dinitrophenol] plus dalapon [2,2-dichloropropionic acid]. Weed control was evaluated on populations of mustard (*Brassica campestris* L.), lambsquarters (*Chenopodium album* L.), and annual barnyard grass (*Echinochloa crusgalli* (L.) Beauv.). Quackgrass (*Agropyron repens* L.) ratings were recorded, but for a minimal population.

MATERIALS AND METHODS

Treatments were applied to a Caribou gravelly silt loam soil with an organic matter content of 3.5 percent. Except for the standard treatment, all treatments were preplant incorporated 8-10 cm deep with a rototiller. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with six replicates of each treatment. All herbicides were applied in 748 liters of water per hectare using 276 kPa pressure. A compressed air sprayer was used equipped with a two nozzle brush type boom. Nozzles were

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Delavan raindrop type with No. 3374-3 tips. The preemergence treatment of dinoseb plus dalapon was applied three days after planting. Weed control and crop injury ratings were made on the two dates shown in Table 1 using the "Cornell" rating system reported in percentage values. During July, weed counts were made and species were identified in the 'no treatment' plots.

RESULTS AND DISCUSSION

Yields among treatments varied considerably in this experiment. None of the herbicides produced phytotoxic effects on the potato crop, so apparently, crop injury was not a factor in reduced yields. Weed pressure, from mustard especially, was quite high in some treatments which corresponded with the lower yields. Mustard which developed in the plots treated with only EPTC or S734 demonstrated the need for a broadleaf herbicide to be applied preplant incorporated to control the mustard weed species. Linuron was not effective for this purpose and when applied alone preplant incorporated, it was not effective for controlling annual barnyard grass. In contrast, the S734 and metribuzin combinations performed as well or better than the standard in controlling the four predominant weed species. The data also showed that when mustard populations are high, the high rate of metribuzin should be used.

Table 1. Effect of S734 in combination with metribuzin and linuron applied preplant incorporated on yield and crop injury in Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	% Crop injury[2] 7-3	8-22
Check - no treatment	15.1	100	100
5.04 Dinoseb + 5.60 Dalapon, PE	32.9	99	100
3.36 EPTC, PPI	26.5	99	100
0.56 S734, PPI	24.8	100	100
1.12 S734, PPI	17.4	100	100
1.68 S734, PPI	22.2	98	100
0.56 S734 + 0.43 Metribuzin, PPI	30.1	99	100
1.12 S734 + 0.43 Metribuzin, PPI	31.1	100	100
1.68 S734 + 0.43 Metribuzin, PPI	31.2	98	100
0.56 S734 + 0.84 Metribuzin, PPI	31.4	100	100
1.12 S734 + 0.84 Metribuzin, PPI	28.5	99	100
1.68 S734 + 0.84 Metribuzin, PPI	28.8	99	100
0.56 S734 + 0.84 Linuron, PPI	27.5	100	100
1.12 S734 + 0.84 Linuron, PPI	27.3	100	100
1.68 S734 + 0.84 Linuron, PPI	27.8	99	100
0.56 S734 + 1.12 Linuron, PPI	29.6	99	100
1.12 S734 + 1.12 Linuron, PPI	24.6	99	100
1.68 S734 + 1.12 Linuron, PPI	29.3	99	100
0.84 Metribuzin, PPI	30.6	100	100
1.12 Linuron, PPI	29.2	99	100
Bayes L.S.D. (0.05)	5.0		

[1]Planted - June 5; killed - September 12; harvested - September 24, 1979.

Preplant incorporated treatments (PPI) applied - June 5, incorporated within 1½ hours. Soil very dry. Temperature - 17°C. Sunny and hazy. South wind 8-10 mph.

Preemergence treatments (PE) applied - June 8, 1979. Temperature - 16°C. Sunny and hazy. Soil dry. South wind 4-7 mph.

[2]Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop and almost all crop plants killed.

Table 2. Effect of S734 in combination with metribuzin and linuron applied preplant incorporated on weed control in Katahdin potatoes. Maine - 1979.

Treatments[1] Kg A.I. per Hectare	Percent Weed Control[2] Barnyard-grass 7-3	Barnyard-grass 8-22	Quackgrass 7-3	Quackgrass 8-22	Mustard 7-3	Mustard 8-22	Lambs-quarter 7-3	Lambs-quarter 8-22
Check - no treatment	60	82	96	98	66	55	92	93
5.04 Dinoseb + 5.60 Dalapon, PE	92	91	95	97	90	90	100	100
3.36 EPTC, PPI	99	100	100	100	65	75	100	100
0.56 S734, PPI	89	99	98	100	62	57	96	100
1.12 S734, PPI	99	98	96	98	52	41	95	100
1.68 S734, PPI	98	97	98	99	55	50	97	99
0.56 S734 + 0.43 Metribuzin, PPI	89	95	98	100	80	83	99	100
1.12 S734 + 0.43 Metribuzin, PPI	97	98	97	99	91	98	100	100
1.68 S734 + 0.43 Metribuzin, PPI	99	100	99	99	85	99	100	100
0.56 S734 + 0.84 Metribuzin, PPI	97	100	95	100	95	100	100	100
1.12 S734 + 0.84 Metribuzin, PPI	100	100	99	100	96	100	100	100
1.68 S734 + 0.84 Metribuzin, PPI	100	100	99	100	94	96	100	100
0.56 S734 + 0.84 Linuron, PPI	96	100	98	100	72	81	99	100
1.12 S734 + 0.84 Linuron, PPI	96	100	96	99	73	71	100	100
1.68 S734 + 0.84 Linuron, PPI	100	100	98	99	83	86	99	100
0.56 S734 + 1.12 Linuron, PPI	95	100	96	99	76	86	99	100
1.12 S734 + 1.12 Linuron, PPI	99	100	98	100	67	71	97	99
1.68 S734 + 1.12 Linuron, PPI	98	97	98	99	79	89	100	100
0.84 Metribuzin, PPI	89	100	98	100	94	99	100	100
1.12 Linuron, PPI	61	91	95	99	66	85	99	100

Rating code: 100 percent = complete absence of weeds and perfect or ideal crop.
0 percent = weeds dominate crop and almost all crop plants killed.

Number and species of weeds per 0.0929 square meter (average of 6 replicates):

Agropyron repens - 0.9
Echinochloa crusgalli - 2.1
Brassica sp. - 8.2
Chenopodium album - 1.6

HERBICIDES FOR NEWLY PLANTED STRAWBERRIES

J. F. Ahrens [1]

ABSTRACT

Only a few herbicides are registered for use in newly planted strawberries. In two experiments during 1978, on a sandy loam soil, we evaluated sprays of other preemergence and postemergence herbicides for newly planted 'Raritan', 'Earliglow', or 'Red Chief' strawberries. These sprays were compared with DCPA or diphenamid alone or followed by chloroxuron. Injury ratings, counts of rooted runners in the fall, and yield of the 1978 planting were used to evaluate plant injury. The predominant weeds included large crabgrass (Digitaria suanguinalis (L.)Scop.), carpetweed (Mollugo verticillata L.), and redroot pigweed (Amaranthus retroflexus L.). Weed control was evaluated by periodic visual ratings followed by hand weeding, and by weeding times.

Napropamide at 3 or 4 lb/A, applied 1 or 3 weeks after the strawberries were planted on weed-free soil, controlled weeds for 3 to 4 months with no injury, but at 8 lb/A inhibited rooting of runners and reduced yields. Pigweed and weeds in the nightshade family were not adequately controlled by napropamide. Oxadiazon and oryzalin at 1 lb/A injured or reduced yield. Terbacil at 0.125 lb/A applied on seedling weeds at 3 or 4 weeks after planting, alone, with, or following DCPA or napropamide controlled weeds about as well as chloroxuron at 4 lb/A with only slight injury to the strawberries. Repeated applications of terbacil at 0.125/A effectively controlled seedling broadleaf weeds that escaped the preemergence treatments. Adding a surfactant to terbacil increased plant injury. Injury with terbacil was tolerable at 0.25 lb/A, but severe at .5 lb/A.

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NAPROPAMIDE ON NEWLY-SET STRAWBERRIES[1/]

C. E. Beste, H. D. Stiles and S. J. Olson[2/]

Abstract. Napropamide applied in May four weeks after planting provided better full-season grass control than diphenamid or DCPA on newly-set strawberries. Early-spring applications of napropamide in established strawberries controlled grasses for the full season. Preemergence napropamide applied immediately after planting caused reduced strawberry growth; however, applications four or more weeks after planting did not reduce plant vigor. In conjunction with runner clipping practices, napropamide at 3.0 lb/A applied ten weeks after planting caused a significant reduction of daughter plants; whereas, diphenamid at 6.0 lb/A did not significantly reduce daughter plants. However, strawberry yields were not affected by diphenamid or napropamide applied 10 weeks after planting. Applications of diphenamid, 6.0 lb/A or napropamide, 3.0 lb/A at 14 and 18 weeks after planting did not reduce strawberry daughter plants or yields. Napropamide at 2.0, 4.0 or 6.0 lb/A in combination with chloroxuron 3.0 lb/A was applied on newly-set plants 10 weeks after planting and the applications were repeated during the period of winter dormancy for two years with no effect on growth or yield.

INTRODUCTION

Napropamide (2-(α-naphthoxy)-*N*,*N*-diethylpropionamide) became registered for use on strawberries (*Fragaria chiloensis* Duchesne, var. *ananassa* Baily) in July of 1979 and the use on newly-set strawberries in the Mid-Atlantic area has not been adequately studied. Preplant incorporated napropamide has been shown to be phytotoxic to newly-set strawberries (1).

Napropamide was evaluated for weed control and growth in newly-set strawberries and compared with DCPA (dimethyl tetrachloroterephthalate), chloroxuron (3-[*p*-(*p*-chlorophenoxy)phenyl]-1,1-dimethylurea) and diphenamid (*N*,*N*-dimethyl-2,2-diphenylacetamide).

MATERIALS AND METHODS

These studies were conducted in a Norfolk loamy sand (0.6% O.M.) at the Vegetable Research Farm, Salisbury, Maryland.

In 1975, 'Surecrop' strawberries were planted on April 18 after preplant incorporated treatments with a rotatiller at a 3 inch depth. Preemergence

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treatments were applied on April 18 after planting. The plot size was 5 by 17 ft with one row per plot and plants spaced 2 ft apart in the row. The experimental design was a randomized complete block design with three replications. Postemergence treatments were applied on May 16, 1975. The spray volume was 31 GPA with fan-spray, 8003 nozzles. In 1975 the rainfall dates and amounts for 2 weeks after each treatment are as follows: 4/19 0.18", 4/24 0.30", 4/25 0.10", 4/26 0.37", 4/29 0.33", 5/4 0.80", 5/7 0.42", 5/13 0.69" and 5/22 0.04", 5/24 0.10", 5/25 0.15", 5/26 0.20", 5/31 0.24" and 6/1 2.10". Weed control ratings for fall panicum (*Panicum dichotomiflorum* Michx.), large crabgrass (*Digitaria sanguinalis* (L.)Scop), red stem filaree (*Erodium cicutarium* (L.)L'Hev.), common lambsquarters (*Chenopodium album* L.) common purslane (*Portulaca oleracea* L.) and carpetweed (*Mollugo verticillata* L.) were made on June 3. The plots were cultivated after the weed rating and during the season. On October 10, the control for crabgrass and lambsquarters was rated. On March 20, 1976, the control for marestail (*Conyza canadensis* (L.)Cron.) red stem filaree, and cutleaf evening primrose (*Oenothera laciniata* Hill) were made. Strawberry vigor was rated on June 3 and October 10, 1975.

In 1976, two varieties 'Sunrise' and 'Surecrop' were planted in each plot on April 22. Preemergence treatments were applied on April 30, 1976. The plot size was 5 by 17 ft with one row per plot and 4 plants of each variety were spaced 2 ft apart in each plot. The experimental design was a randomized complete block design with three replications. Postemergence treatments were applied on June 17, 1976. The plots were cultivated and handweeded after the weed ratings and during the growing season. The same napropamide and other treatments were applied on March 10, 1977 to the same plots. Cultivation was made on the established plants after the weed ratings. On March 21, 1978 the same napropamide and other treatments were reapplied to the established 2 year old strawberries. Rainfall after treatments was as follows: 1976 - 5/1 1.49", 5/8 0.45", 5/11 0.69", 5/19 1.02", 6/17 1.0", 7/1 0.51", 7/4 0.48", 7/8 0.13". 1977 - 4/13 0.32", 4/14 0.09", 4/18 0.25", 4/20 0.19", 4/22 0.61", 5/2 0.33", 5/4 1.4". 1978 - 3/22 0.19", 4/4 0.08", 4/12 0.12", 4/19 0.72", 4/20 0.12", 4/27 2.08", 4/28 0.24". Both varieties were rated for vigor and runner development in 1976. Weed control ratings were made on May 10, June 25, and November 12, 1976. Vigor and weed control ratings were made in 1977 and 1978. Some treatments were harvested in 1978.

In 1978, 'Redchief" strawberries were planted on April 7 in 9 by 20 ft plots with one row per plot and plants spaced 2 ft apart in the row. DCPA 8.0 lb/A was applied after planting to the entire experiment on April 12 and the plots were cultivated and handweeded the entire season. Diphenamid 6.0 lb/A or napropamide, 3.0 lb/A were applied on June 21, July 22, and August 28 to separate plots with controls for each treatment date. The runners were clipped with a rotary plastic strand weed cutter held vertically twice on July 10 and July 31. The runners were cut 9 inches on each side of the row and between the mother plants or 12 inches between plants in the row. Rooted daughter plants were counted on November 14, 1978 within the clipped area 9 inches on either side of the row for a 10 ft distance or outside the clipped area in a 10 ft length of row. Weed control in the spring of 1979 was obtained with terbacil (3-*tert*-butyl-5-chloro-6-methyluracil) at 0.4 lb/A applied on March 1, 1979 and DCPA 10.0 lb/A applied on April 10, 1979. The entire row was harvested for yield on May 18, May 21 and May 25, 1979. Rainfall in 1978 after the treatments was as follows: 6/22 0.46", 6/27 0.20", 7/2 0.32", 7/3 0.23"; 7/24 0.16", 7/25 0.42", 7/26 0.27", 7/31 1.23"; 8/31 0.15" 9/1 1.56", 9/23 0.03", 10/1 0.57".

RESULTS AND DISCUSSION

In 1975, chloroxuron tank mixed with napropamide, DCPA, or diphenamid appeared to reduce strawberry vigor which may have been due to additional surfactants in the combinations (Table 1). Neither diphenamid nor napropamide applied 4 weeks after planting reduced strawberry vigor, and crabgrass, red stem filaree, lambsquarters and purslane control with napropamide was better than diphenamid. Fall panicum control was equal with napropamide and diphenamid; however, fall panicum plants were smaller than crabgrass at the time of treatment. A 10 day interval without rain after the postemergence treatments reduced herbicide effectiveness. Chloroxuron with diphenamid provided equal crabgrass control as chloroxuron plus napropamide. Chloroxuron in combination with diphenamid or napropamide improved broadleaf weed control. DCPA, applied preemergence, provided the same weed control as DCPA plus chloroxuron postemergence. Chloroxuron postemergence with napropamide, diphenamid and DCPA provided full-season lambsquarters control. Napropamide, 2.0 lb/A, provided slightly better crabgrass control than diphenamid, 3.0 lb/A, and the vigor rating on October 10 generally indicates the degree of late-season weed control. None of the treatments controlled the winter weeds, and the apparent control with chloroxuron was due to the heavy crabgrass suppression of other weeds.

In 1976, preemergence napropamide caused serious vigor reduction in strawberries and postemergence napropamide in combination with chloroxuron was safe on newly-set strawberries when applied 8 weeks after planting (Table 2). No varietal difference in tolerance to napropamide was observed with 'Surecrop' and 'Sunrise'. Preemergence naproapmide provided good control of lambsquarters and red stem filaree with excellent rainfall after application and napropamide was superior to DCPA. However, DCPA did not reduce strawberry vigor. Postemergence chloroxuron provided good control of red stem filaree. The combination of napropamide plus chloroxuron postemergence was slightly weak on grasses since they were established prior to treatment. Napropamide plus chloroxuron provided some fall control of red stem filaree and cutleaf evening primrose; whereas, diphenamid and DCPA with chloroxuron were less effective. In 1977, some variability in the strawberry vigor was due to severe sand storms in the winter; however, napropamide treatments appeared to have reduced vigor compared to diphenamid. Late winter applications in March with the dry weather in Spring, 1977 may result in napropamide levels in the soil that might inhibit growth after the plants break dormancy. The reduced growth of strawberries treated with napropamide preemergence in 1976 persisted into 1977. Napropamide provided superior crabgrass control compared to diphenamid and this was indicated by excellent strawberry vigor with the napropamide treatments. In 1978, the spring was fairly wet and late winter napropamide applications did not appear to reduce strawberry vigor as indicated by treatment No. 8 of napropamide, 6.0 lb/A plus chloroxuron, 3.0 lb/A. Some of the variability in strawberry vigor was due to differences in weed competition. Napropamide plus chloroxuron appear to provide acceptable control of red stem filaree; whereas, diphenamid and DCPA did not control it. Marestail was not controlled by napropamide plus chloroxuron nor diphenamid or DCPA plus chloroxuron. Although not significant, the yield of 2 year old strawberries with three applications of napropamide at 6.0 lb/A for a total of 18.0 lb/A in three years exceeded the handweeded control yield. The handweeded control was twice the yield of the weedy control although not significantly different which indicated considerable variability

Table 1. Weed control with newly-planted 'Surecrop' strawberries in a Norfolk loamy sand in 1975

Treatment			Vigor[b/]		Percent Weed Control[c/]										
					June 3, 1975						Oct. 10		March 20, 1976		
Herbicide	Lb/A	Method[a/]	6/3	10/10	FP	CG	RSF	LQ	PL	CW	CG	LQ	MT	RSF	EP
1.Control	----	----	100	20	0	0	0	0	0	0	0	0	0	0	0
2.Control-handweeded	----	----	100	100	100	100	100	100	100	100	100	100	100	100	100
3.DCPA (75W)	6.0	Pre	95	70	100	98	97	100	100	100	33	83	0	0	0
4.DCPA +	6.0 +														
chloroxuron (50W)	3.0	Post	78	57	97	83	100	100	100	100	27	100	0	0	0
5.diphenamid (50W)	3.0	Post	90	50	100	60	0	60	0	100	50	0	0	0	0
6.diphenamid +	3.0 +														
chloroxuron	3.0	Post	72	60	100	87	100	100	100	100	40	100	0	0	0
7.chloroxuron	3.0	Post	98	37	67	48	100	100	100	100	0	67	68	68	68
8.napropamide (50W)	2.0	Post	93	78	100	77	87	83	83	100	73	43	0	0	0
9.napropamide	4.0	Post	95	73	100	82	100	92	93	97	85	53	0	0	0
10.napropamide +	2.0 +														
chloroxuron	3.0	Post	85	63	97	88	100	100	100	100	47	100	0	0	0
11.napropamide +	4.0 +														
chloroxuron	3.0	Post	77	98	97	90	100	100	100	100	83	100	0	0	0

a/ Planted April 18, 1975. Preemergence April 18, 1975. Postemergence May 16, 1975 and the stage-of-growth of weeds was red stem filaree - 3 inch rosette with 10 to 12 leaves; lambsquarters - 1 to 1.5 inch tall with 3 pr. true leaves; crabgrass - 1 inch tall with 2 true leaves; purslane - 0.5 inch tall with 1 pr. true leaves; fall panicum - 1 true leaf and strawberries had 3 new leaves.

b/ Strawberry plant vigor. Rated as % of control.

c/ Weed population: June 3, 1975: fall panicum (FP) 10%, large crabgrass (CG) 32%, red stem filaree (RSF) 10%, common lambsquarters (LQ) 27%, common purslane (PL) 8%, carpetweed (CW) 13%, based on the total number of weeds present approximately 35 weeds per sq. ft. October 10, 1975: crabgrass (CG) 70%, common lambsquarters (LQ) 30%. March 20, 1976: marestail (MT) 90 plants per ft^2, red stem filaree (RSF) 1 plant per ft^2, cutleaf evening primrose (EP) 3 plants per ft^2.

Table 2. Response of newly-set 'Sunrise' and 'Surecrop' strawberries and weed control with napropamide applied initially in 1976 and reapplied on one-year old plants in 1977 and two-year old plants in 1978 on a Norfolk loamy sand.

Spring 1976					Strawberry Growth (% of Control)													
					Vigor				Runner Growth[c]		Percent Weed Control[d]							
Treatment			Vigor[b]		June 5		Nov. 12				May 10		June 25				Nov. 12	
Herbicide	Lb/A	Method[a]	5/10	6/25	Sunrise	Surecrop	Sunrise	Surecrop	Sunrise	Surecrop	LQ	RSF	RSF	CG	PL	CW	RSF	EP
1. Control	----	----	100	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0
2. Control-handweeded	----	----	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	0
3. napropamide (50W)+ chloroxuron (50W)	2.0 + 3.0	Pre + Post	100	65	69	75	50	55	50	63	88	82	100	100	100	100	60	78
4. napropamide + chloroxuron	4.0 + 3.0	Pre + Post	100	59	64	60	43	35	58	63	95	88	100	100	100	100	87	100
5. napropamide + chloroxuron	6.0 + 3.0	Pre + Post	100	40	64	64	40	30	55	28	90	90	100	100	100	100	97	100
6. napropamide + chloroxuron	2.0 + 3.0	Post	100	93	97	100	84	81	94	92	0	0	100	94	100	100	44	80
7. napropamide + chloroxuron	4.0 + 3.0	Post	100	100	97	100	86	91	86	89	0	0	100	83	100	100	74	90
8. napropamide + chloroxuron	6.0 + 3.0	Post	100	100	97	97	93	93	93	93	0	0	100	89	100	100	95	96
9. DCPA (75W) + diphenamid (50W)+ chloroxuron	8.0 + 3.0 + 3.0	Pre + Post	100	93	97	90	90	83	95	88	20	25	100	97	100	100	0	25
10. DCPA + chloroxuron	8.0 + 3.0	Pre + Post	100	94	94	94	100	100	100	100	33	0	100	100	100	100	0	23

a/ Preemergence treatment on April 30, 1976 (planted on April 22, 1976); postemergence treatment June 19, 1976 to clean-cultivated field.

b/ Average for both varieties.

c/ Based on number and length of runners.

d/ Weed population: May 10 - common lambsquarters (LQ) 15 plants/ft^2, red stem filaree (RSF) 9 plants/ft^2; June 25 - red stem filaree (RSF) 7 plants/ft^2, large crabgrass (CG) 20 plants/ft^2, common purslane (PL) 2 plants/ft^2, carpetweed (CW) 25 plants/ft^2; November 12 - red stem filaree (RSF) 10 plants/ft^2, cutleaf evening primrose (EP) 5 plants/ft^2. Plots were handweed and cultivated after the weed ratings and during the season.

Spring 1977					Percent Weed Control[g]				
Treatment			Vigor[f]		May 20				Sept. 3
Herbicide	Lb/A	Method	5/20	9/3	RSF	CG	EP	MT	CG
1. Control	----	----	100	76	0	0	0	0	0
2. Control-Handweeded	----	----	100	100	100	100	100	100	100
3. napropamide + chloroxuron	2.0 + 3.0	Pre[e]	65	100	90	100	100	75	100
4. napropamide + chloroxuron	4.0 + 3.0	Pre	58	95	100	100	100	88	100
5. napropamide + chloroxuron	6.0 + 3.0	Pre	35	82	100	100	100	100	100
6. napropamide + chloroxuron	2.0 + 3.0	Pre	95	96	100	100	100	100	92
7. napropamide + chloroxuron	4.0 + 3.0	Pre	86	100	95	100	100	100	100
8. napropamide + chloroxuron	6.0 + 3.0	Pre	79	100	100	100	100	75	100
9. diphenamid + chloroxuron	3.0 + 3.0	Pre	95	65	78	50	100	100	33
10. diphenamid + chloroxuron	3.0 + 3.0	Pre	99	65	63	40	100	50	42

e/ Applied March 10, 1977, preemergence, 5% of plants had broken dormancy.

f/ Average for both varieties, rated as % of control.

g/ Weed population: May 20 - red stem filaree (RSF) 1.5 plants/ft^2, large crabgrass (CG) 14 plants/ft^2, cutleaf evening primrose (EP) 0.1 plants/ft^2, marestail (MT) 0.3 plants/ft^2; September 3 - large crabgrass (CG) 3 plants/ft^2.

Continued

Table 2 continued

Spring 1978 Treatment			Vigor[i]		Percent Weed Control[j] May 5			July 20		Yield[k]
Herbicide	Lb/A	Method	5/5	7/20	RSF	CG	MT	CG	MT	Lb/A
1. Control	----	----	40	48	0	0	0	0	0	960 a
2. Control-handweeded	----	----	100	100	100	100	100	100	100	1970 a
3. napropamide + chloroxuron	2.0 + 3.0	Pre[h]	80	80	74	100	0	98	0	----
4. napropamide + chloroxuron	4.0 + 3.0	Pre	83	83	96	100	0	75	0	----
5. napropamide + chloroxuron	6.0 + 3.0	Pre	66	63	100	100	35	100	8	----
6. napropamide + chloroxuron	2.0 + 3.0	Pre	69	65	15	100	18	93	0	----
7. napropamide + chloroxuron	4.0 + 3.0	Pre	79	80	69	100	18	100	0	----
8. napropamide + chloroxuron	6.0 + 3.0	Pre	95	75	100	100	36	100	25	2320 a
9. diphenamid + chloroxuron	3.0 + 3.0	Pre	53	55	0	40	0	43	0	----
10. DCPA + chloroxuron	8.0 + 3.0	Pre	40	60	15	50	0	50	0	----

Mean separation within columns with Duncan's multiple range test at the 0.05 level.

h/ Applied March 21, 1978.

i/ Average for both varieties, rated as % of control.

j/ Weed population: May 5 based on total number of weeds; red stem filaree (RSF) 60%, large crabgrass (CG) 10%, marestial (MT) 30%. Plots were not cultivated during the season.

k/ Harvested May 31, 1978. First picking only.

in the yields.

A reduction of rooted daughter plants occurred in 1978 with napropamide 3.0 lb/A applied 10 weeks after planting; whereas, diphenamid 6.0 lb/A did not affect daughter plants. Napropamide and diphenamid applied at 14 and 18 weeks after planting did not affect daughter plants. The runner clipping may have contributed to daughter plant reductions with napropamide. None of the delayed treatments reduced strawberry yields which indicated that daughter plants may not contribute greatly to yields in the first year.

In summary, napropamide appears to be potentially injurious to newly-set strawberries from the time of planting to approximately ten weeks after planting. Apparently, the reduction of rooted daughter plant populations may not be indicated by visual ratings. However, clipping practices for daughter plant control may not be advisable or need to be revised with napropamide. The lack of influence on daughter plants with mid or late summer applications of napropamide indicated that napropamide does not affect daughter plants after they are rooted. Therefore, napropamide could be used on newly-set strawberries after the desired number of daughter plants have rooted.

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Table 3. Growth and yield of newly-set 'Redchief' strawberries with delayed applications of napropamide and diphenamid after planting on a Norfolk loamy sand.

Treatment			Yield (Lb/A)[c/]		Rooted Daughter Plants[d/]	
Herbicide[a/]	Lb/A	Date[b/]	1st	Total	Close	Away
1.control	----	----	5520 a	14,550 a	25.8 a-d	26.5 a-d
2.diphenamid (50W)	6.0	6/21	5230 a	12,560 a	29.0 abc	17.5 cde
3.napropamide (50W)	3.0	6/21	6000 a	16,260 a	22.3 b-e	14.0 e
4.control	----	----	6200 a	14,570 a	25.0 a-e	21.0 b-e
5.diphenamid	6.0	7/22	6000 a	16,340 a	27.3 a-d	16.0 de
6.napropamide	3.0	7/22	6680 a	15,920 a	34.3 a	21.0 b-e
7.control	----	----	5810 a	14,550 a	23.0 a-e	22.5 b-e
8.diphenamid	6.0	8/28	6290 a	16,456 a	27.5 a-d	18.8 b-e
9.napropamide	3.0	8/28	6490 a	15,000 a	29.5 ab	18.5 b-e

Mean separation within columns by Duncan's MRT at the 0.05 level.

a/ DCPA 8.0 lb/A was applied to all the plots on April 12, 1978. Herbicides in the spring 1979 were terbacil 0.4 lb/A applied on March 1, 1979 and DCPA 10.0 lb/A on April 10, 1979. Strawberries were planted on April 7, 1979.

b/ Date of napropamide and diphenamid applications in 1978.

c/ Based on 5 ft. row spacing. First harvest on 5/18/79 and combined with harvests on 5/21 and 5/25 for total harvest.

d/ Counted on November 14, 1978. Close indicates daughter plants rooted within 9 inches of the row and 10 ft. in length or 15 sq. ft. Away indicates daughter plants rooted more than 9 inches away from the row in the 10 ft. row length. Duncan's MRT separation within and across columns under the same heading. Rooted plants withstood a gentle tug before counting.

WEED CONTROL IN ELDERBERRIES WITH SIMAZINE

O. F. Curtis, Jr. [1/]

ABSTRACT

Simazine has been used routinely at 4 lb/A ai to weed established plantings of the American elder (Sambucus canadensis L.) and at 2 lb/A in nursery plantings of hardwood cuttings without evidence of damage. Growth from cuttings was not impaired by 4.5 lb/A. On established plants 10 lb/A induced chlorosis in some cases but not serious damage. Pronamide at 6 lb/A in the fall showed no sign of injury to 4-year-old plants, while 2 lb. with 3 lb. simazine gave good control of quackgrass (Agropyron repens L. Beauv.). Diuron at 10 lb/A or dalapon at 11 lb/A caused temporary damage on leafy basal shoots wet by the spray. Damage resulted from an early spring application of dichlobenil at 6 lb/A or of terbacil at 1.6 lb/A in one year of test.

INTRODUCTION

Elderberry fruit has long been harvested from wild plants for home and commercial processing in preserves, pie fillings and juice. Economic conditions no longer encourage harvesting of wild fruit for commercial use. In the meantime clones with superior fruit and horticultural characters have been selected from native stands or breeding programs and are available for planting. Weed control is the main cultural problem (1), in spite of the fact that the dense shade of a healthy elder plant helps suppress weeds. The shallow root system is susceptible to damage by cultivation; and suckers from underground stems, needed to renew the fruiting growth every few years, are easily destroyed by hoeing (2).

Available herbicides could encourage the culture of elderberries, but we are unaware of any recommendations or published information. The purpose of this report is to put some information on record.

MATERIALS AND METHODS

Following encouraging preliminary results, simazine (2-chloro-4, 6-bis-(ethylamino)-s-triazine) has been used regularly since 1965 in maintenance of seedling and variety plantings at Geneva. The usual application has been in early spring at 4 lb/A ai on established plants, and at 2 lb/A on newly planted stock. Simazine has also been used routinely for several years at 2 lb/A on hardwood cuttings planted in the nurseries of the New York Fruit Testing Cooperative near Geneva. Checks and other rates were observed in some years. Possible alternatives or supplements to simazine, as dichlobenil (2,6-dichlorobenzonitrile), dalapon (2,2-dichloropropionic acid),

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diuron (3-(3,4-dichlorophenyl)-1,1-dimethylurea), pronamide (3,5-dichloro (N-1,1-dimethyl-2-propynyl)benzamide), and terbacil (3-tert-butyl-5-chloro-6-methyluracil) were also observed.

All herbidices except dichlobenil were applied in sprays of 50 to 100 gal/A. On established plants these were directed from two sides of the row, covering a total band width of 4 or 6 feet and wetting the basal 4 to 12 inches of the elder plants. On cuttings the spray band was centered on the row. All cutting plots had the nursery routine of cultivation at intervals of 3 to 6 weeks and hoeing if weeds remained. Herbicide rates are expressed as active ingredient. Any results mentioned refer to three or more replicates with individual plots consisting of 15 to 50 linear feet of row.

RESULTS AND DISCUSSION

On a 1970 planting of cuttings 1.4 lb/A of simazine provided good weed control and 4.5 lb/A gave almost complete control for more than 8 weeks (Table 1). Height of shoot growth from the cuttings under the high rate equalled that under the low rate or in the hoed checks. Weeds controlled included common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.), redroot pigweed (*Amaranthus retroflexus* L.), yellow foxtail (*Setaria lutescens* (Weigel)Hubb.), corn spurry (*Spergula arvensis* L.) ladysthumb (*Polygonum persicaria* L.), and toad rush (*Juncus bufonis* L.).

Table 1. Simazine on elderberry cuttings in Berrien fine sandy loam, 1970. Applied 4 weeks after planting, 2 weeks after cultivation, on 8 reps of 'York'. Accumulated rainfall after application: 0.8 inch in 3 days, 2.1 in 12 days, 3.0 in 30 days.

lb/A ai July 9	Height growth Nov., inches	No. growing, Nov., as % of		Weed cover	
		Planted	Growing July 23	3 weeks no./5 m^2	Sept. 1 rating
None	20.5	76.3	100	640	6.7 medium
1.4	20.1	74.0	100	45	2.3 v. light
4.5	20.9	68.1	96	0.1	0.4 trace
LSD 0.05	1.9	8.6			

Table 2. Simazine on elderberry cuttings grown in Arkport fine sandy loam, 1973. Applied 3 weeks after planting on 6 reps 'York', 3 reps 'NY 21'. Rainfall after application: 0.8 inch in first day, 3.5 in first 10 days.

lb/A ai June 11	No. growing at 6 weeks as % of		Injury at 6 weeks	
	Planted	Growing June 19	% of plants	Rating[1/]
None	76	95	3	0.1
1.7	67	94	10	0.4
6.4	69	95	15	0.7

[1/] 0-10 (dead). Symptoms as interveinal chlorosis and leaf tip necrosis.

Cuttings treated with simazine on another light soil in 1973 showed chlorosis of the early growth but not serious damage, even at 6.4 lb/A (Table 2). No plot to plot difference in height or spread of the elder plants could be discerned in sighting along the unusually uniform hedgelike rows at the end of the season. There is a hint in Table 1 and Table 2, though not statistically significant, that simazine may have reduced the number of cuttings that started growth in the first week or two after application.

Simazine at 12 lb/A, diuron at 10 lb/A, and dalapon at 11 lb/A were applied to one-year plants in Odessa silt loam in mid May of 1965 and again to the same plots in 1966. Emerging basal shoots wet with diuron spray showed necrosis and later abscission of the sprayed leaves. Dalapon on such shoots stunted the sprayed emerging leaves. At the end of the second season elder plant vigor under the three treatments was comparable to that of somewhat weedy checks.

Factorial combinations of pronamide at 0, 2, and 6 lb/A with simazine following at 0, 3, and 10 lb/A were applied at 3-year-old plants of 'Nova' and 'York' in Allendale fine sandy loam in early May of 1975. The same nine treatments were repeated in December following two rototillings during the summer. The only injury observed from pronamide was temporary stunting of basal shoots wet by the May spray. Simazine at 10 lb/A resulted in interveinal chlorosis of early emerging leaves plus slightly lighter leaf color in the 1975 and 1976 growing seasons, but not in obvious growth reduction. A heavy quackgrass stand was reduced to a trace in 1976 by 6 lb/A pronamide or by the 2 lb/A combined with simazine, and to about 20% by 2 lb/A pronamide alone or 10 lb/A simazine alone.

Established plants in Yates gravelly loam were damaged by terbacil at 1.6 lb/A and by dichlobenil at 6 or 12 lb/A in 4% granules applied in mid April of 1967. Terbacil resulted in serious foliage necrosis above the level of spray contact. Dichlobenil reduced or eliminated the growth of new shoots from underground stems.

The several years and conditions under which simazine has been observed on elderberries point to its safety at and above effective weed control rates. As supplements for surviving weeds, pronamide shows promise as a fall treatment, and dalapon is possible for spring treatment of perennial grasses.

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HERBICIDES FOR NEWLY PLANTED BLUEBERRIES

J. F. Ahrens [1/]

ABSTRACT

Herbicides were sprayed over three cultivars of highbush blueberry in May 1978, 4 weeks after the bushes were planted into a fine sandy loam soil. The sprays were applied again the following May. Terbacil at 0.5 lb/A gave excellent control of annual weeds for 2 months and fair control thereafter with temporary but not serious injury to the blueberry plants. At 1 or 2 lb/A, terbacil injured excessively. Diuron at 1 lb/A, simazine at 1 lb/A, oryzalin at 2 lb/A, and napropamide at 4 lb/A also gave acceptable control of annual weeds for 2 or more months with no serious injury to the blueberry plants. Double or triple these rates caused excessive injury that was more evident during the second season. Combinations of simazine at 1 lb/A plus oryzalin at 2 lb/A, or napropamide at 4 lb/A gave more complete and longer lasting weed control, but more plant injury than either herbicide alone. Directed sprays of glyphosate isopropylamine salt at 1, 2, or 4 lb ae/50 gal killed all established weeds without injury to the blueberry plants, but repeated applications were required as new seedlings germinated.

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WEED CONTROL EXPERIMENTS IN SMALL FRUITS ON LONG ISLAND

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ABSTRACT

Weed control experiments were conducted in 1979 in blueberries Vaccinium carymbosum; grapes (Vitis spp.), and strawberries (Fragaria spp.). In blueberries, two formulations of simazine 4L and 80W were applied at 3.36 and 4.48 kg/ha. Napropamide was applied at 3.36 and 4.48 kg/ha. Each of these treatments resulted in excellent control of downy brome (Bromus tectorum L.) at the June 4 rating. Control of Austrian fieldcress (Rorippa austriaca (Crantz) Bess) was good at the June 4 rating but decreased by July 5. The 4L formulation of simazine appeared to have a longer period of activity.

In grapes napropamide, diuron and simazine at 4.48 kg/ha each provided excellent control of barnyardgrass (Echinochloa crus-galli (L.) Beauv.). Napropamide at this rate was not effective on pineappleweed (Matricaria matricariodides (Less.) Porter) and the combination of napropamide and simazine each at 2.24 kg/ha was only 50% effective on this weed. In strawberries, some phytotoxicity was apparent with the use of diphenamid at 6.72 kg/ha and terbacil at 0.28 kg/ha at the June 22 rating but at later dates the injury was not apparent. DCPA at 10 kg/ha did not adequately control fall panicum (Panicum dichotomiflorum Michx.) . The treatments of diphenamid at 6.72, napropamide at 2.24, 3.36 and 4.48 kg/ha, terbacil at 0.1 and 0.28 kg/ha and a combination of diphenamid at 6.72 and napropamide at 3.36 all provided excellent control of fall panicum on June 22 and July 17. By August 24 the control with each of these materials decreased substantially except for the diphenamid/napropamide combination. Carpetweed (Mollugo verticillata L.) was controlled with the DCPA, napropamide and terbacil treatments. By August 24 the napropamide at 4.48 and combination of diphenamid 6.72 and napropamide at 3.36 kg/ha treatments continued to provide control of this weed.

INTRODUCTION

Interest in small fruits continue to increase on Long Island particularly for "pick-your-own" strawberries and blueberries and grapes for roadside stand and wine production. Many of the strawberry farmers have switched to the "pick-your-own" operation because of labor costs and often they would like to keep the beds in production for several years. In order to do this they must continue to control weeds. Grapes have drawn a great deal of interest on Long Island because with adequate disease control methods we can now raise the preminum vinifera varieties for wine production. In addition to this there is an increase in interest in fresh market or desert grapes that could be sold at roadside stands. With these things in mind, several trials were conducted to develop information and recommendations for adequate weed control in these small fruits.

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MATERIALS AND METHODS

The strawberry variety Raritan was planted during the first week in May on a sandy soil. Plots were 1.7 m. by 7.62 m. on a single-row of strawberries. All applications were replicated four times and applied with a tractor-mounted sprayer delivering 61 l/ha at 2.5 atmospheres. The soil was moist at the time of application. The materials applied included diphenamid (N N-dimethyl-2,2-diphenylacetamide) at 6.72 kg/ha, DCPA (dimethyl tetrachloroterephthalate) at 10 kg/ha, napropamide (2-(a-naphthoxy)-N,N-diethylpropionamide) at 2.24, 3.36 and 4.48 kg/ha, terbacil (3-tert-butyl-5-chloro-6-methyluracil) at 0.1 and 0.28 kg/ha and a combination of diphenamide at 6.72 and napropamide at 3.36 kg/ha. Ratings for the control of fall panicum were made on June 22, July 17 and 24 and August 24. Carpetweed ratings were made on July 24 and August 24.

In grapes napropamide, diuron (3-(3,4-dichlorophenyl)-1,1-dimethylurea) and simazine (2-chloro-4,6-bis(ethylamino)-s-triazine) were each applied at 4.48 kg/ha and a combination of simazine at 2.24 plus napropamide or diuron at 2.24 kg/ha were applied on April 11. Oryzalin (3,5-dinitro-N^4,N^4 dipropylsulfanilamide) was applied at 2.24, 4.48 and 8.96 kg/ha on June 19 to a non-bearing area of the vineyard. Treatments were replicated four times and applied with a tractor-mounted sprayer as in strawberries. Weeds present in the trial included barnyardgrass and pineappleweed. Ratings were made on June 1 for the materials applied in April and later during the season for all treatments.

In blueberries simazine at 3.36 and 4.48 and napropamide at 3.36 and 4.48 kg/ha were applied on April 17. The two rates of simazine were also duplicated using the 4L or 80W formulations. Weeds present included Austrian fieldcress and downy brome with ratings taken on June 4 and July 5.

RESULTS AND DISCUSSION

Percent weed control and phytotoxicity ratings in strawberries are given in table 1. All materials and combinations provided good to excellent early control of fall panicum. This control continued for several weeks, but by July 24 the low rate, 0.1 kg/ha of terbacil had decreased greatly. By the August 24 rating, only the combination of diphenamid and napropamide continued to provide excellent control of fall panicum. Carpetweed was controlled using DCPA, napropamide, and the diphenamid-napropamide combination. Terbacil at the 0.28 kg/ha rate continued to provide carpetweed control in July. By August 24, only the napropamide at 3.36 and 4.48 and the combination of diphenamid-napropamide continued to provide good control. This combination provided the best control in the trial.

Napropamide, diuron, and simazine provided near perfect control of barnyardgrass in grapes. However, napropamide at 4.48 kg/ha was not effective on pineapple weed and the combination of napropamide 2.24 and simazine 2.24 kg/ha was only 50% effective by June 1. Oryzalin at 2.24, 4.48, and 8.96 maintained complete control of barnyardgrass throughout the season with no phytotoxicity to the grapes. Oats planted on August 13 were severely stunted with only about 40% of a stand in the areas treated with napropamide and simazine. In blueberries, simazine at 3.36 and 4.48 kg/ha and napropamide at 3.36 and 4.48 kg/ha provided excellent control of downy brome and good control of Austrian fieldcress on June 4. By July 5 the percent control of both weeds had decreased. The simazine 4L formulation maintained better control of both weeds than the 80W formulation.

Table 1. Percent control of weeds and phytotoxicity with herbicides in strawberries

	Rate	Phytotoxicity[1/]	Percent Weed Control					
			Fall Panicum				Carpetweed	
Chemical	kg/ha	6/22	6/22	7/17	7/24	8/24	7/24	8/24
diphenamid	6.72	2.0	100.0	77.0	77.0	25.0	32.0	15.0
DCPA	10.08	0.0	85.0	92.0	70.0	52.0	95.0	62.0
napropamide	2.24	0.0	87.0	90.0	77.0	62.0	100.0	62.0
napropamide	3.36	0.0	85.0	98.0	85.0	72.0	97.0	82.0
napropamide	4.48	0.0	92.0	90.0	80.0	82.0	100.0	85.0
terbacil	0.1	0.0	82.0	75.0	27.0	25.0	67.0	25.0
terbacil	0.28	1.2	100.0	97.0	82.0	55.0	92.0	57.0
diphenamid	6.72							
napropamide	3.36	1.0	91.0	97.0	95.0	95.0	100.0	95.0
Check (shoots per 0.3 m^2)			4.7			5.2	2.5	3.5

[1/] 0 = no injury
10 = death

Table 2. Percent control of weeds with herbicides in blueberries

		Rate	Percent Weed Control			
			Austrian Fieldcress		Downy Brome	
Chemical	Formulation	kg/ha	6/4	7/5	6/4	7/5
simazine	4L	3.36	70	60	95	90
simazine	4L	4.48	80	60	95	70
simazine	80W	3.36	70	33	85	0
simazine	80W	4.48	85	73	90	33
napropamide	50WP	3.36			85	60
napropamide	50WP	4.48			95	63
Check (percent cover)				28		35

USE OF GLYPHOSATE ON CRANBERRY BOGS AND ITS EXTRACTION FROM CRANBERRIES[1/]

Robert M. Devlin and Karl H. Deubert[2/]

ABSTRACT

Glyphosate wipe treatments were tested as a method for the control of longleaf aster, spike rush, three-square sedges, and narrowleaf goldenrod on cranberry bogs. Complete control of all four weeds was achieved without cranberry vine injury or adverse effects on yield, berry size or color development. GLC analyses of berries from treated plots show no trace of glyphosate or its major metabolite, aminomethylphosphonic acid.

INTRODUCTION

Cranberry bogs of southeastern Massachusetts are plagued by a number of weeds for which there are no adequate controls. Four of these weeds--spike rush (*Juncus effusus* L.), narrowleaf golden rod (*Solidago tenuifolia* Pursh), three-square sedge (*Scirpus americanus* Pers.) and longleaf aster (*Aster novi-belgii* L.)--infest approximately 50% (5500 acres) of the bog acreage of this cranberry growing region (3) causing a 5% reduction in yield that is equivalent to an annual loss to the grower of $1,200,000.

All of the above-mentioned weeds, when mature, are considerably taller than cranberry vines, a situation that allows for the use of a wipe technique with a non-selective herbicide for their control. The present study describes a highly successful use of glyphosate N-(phosphonomethyl) glycine under

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these circumstances.

MATERIALS AND METHODS

Plots 60 sq m in area were established on two sections of the Cranberry Experiment Station state bog that contained longleaf aster, narrowleaf goldenrod, three-square sedge, and spike rush. Glyphosate was applied with a wooden frame, shaped like a hockey stick with its lower member wrapped with several thicknesses of absorbant material. The absorbant material was soaked with different concentrated solutions of glyphosate and then wiped onto the weeds above the cranberry (*Vaccinium macrocarpon* Ait. cv. Early Black) vines. The solutions of glyphosate tested were prepared by diluting the commercial product (Roundup-480 g a.i./l) with 20, 10, and 5 parts water. All applications were made on July 31, 1978 when the weeds were mature and all tests were replicated twice.

On September 28 the plots were scoop-harvested, the berries immediately weighed, and size determined by the number of berries required to fill a standard 250 cc cranberry measuring cup. Subsamples were taken from each sample at harvest and immediately frozen to stop further color development. Pigment concentration was determined after all of the subsamples had been frozen at least 30 days. Color was analyzed by the method of Fuleki and Francis (2) with slight modification (1).

Subsamples for extraction and analysis for possible glyphosate residue were taken from berries harvested from plots treated with the highest rate of glyphosate used in this study. The analytical residue method for glyphosate and aminomethylphosphonic acid in grapes, developed by Monsanto, was modified for the extraction of these chemicals from frozen cranberry fruit. The sample size was reduced to 12.5 g and the residues were eluted from the anion exchange resin (AG 1 X4, bicarbonate form) with 6 x 25 ml of 0.5 *M* ammonium bicarbonate. During column chromatography on AG 50 X8, the first 13 ml of eluate were discarded, the following 10 ml were collected (parent compound), the next 10 ml discarded, and the last 25 ml collected (metabolite).

These modifications resulted in 58% recovery at 0.3 ppm for the parent compound. The starting point for the collection of eluate for the parent compound from the cation column was important. Unknown compounds, eluting with the first 13 ml interfered with the derivatization of the residues. Elution of these compounds was not complete at 13 ml. Except for reduced sample size, no further attempts were made to improve the recovery.

The derivatized extracts were analyzed on a Varian 3700 gas chromatograph equipped with FPD and flow diverter. The 5' x 1/8" stainless steel column was packed with 3% OV 17 on 100/120 Varaport 30. Injector and detector temperatures were held at 220°C. The following temperature program was found to produce acceptable peaks: 140°-185°C, program (8°/min) starting 4 min after injection.

RESULTS AND DISCUSSION

As expected, all glyphosate wipe treatments gave complete control of spike rush, narrowleaf goldenrod, three-square sedge, and longleaf aster (Table 1). Also, 100% weed control was obtained with no adverse influence on vine growth or appearance (Table 1). Symptoms of phytotoxicity in the weeds were first observed as a gradual yellowing of the green tissues paralleled

Table 1. Influence of glyphosate wipe treatments in the control of longleaf aster, three-square sedges, spike rush and narrowleaf goldenrod.

Glyphosate Dilution	Vine Injury[a]	Aster	Sedge	Rush	Goldenrod
20 to 1	1	10	10	10	10
10 to 1	1	10	10	10	10
5 to 1	1	10	10	10	10

[a] Weed control and vine injury rated on a scale of 1-10; 1 represents no effect and 10 complete control.

by a slow withering of the growing tips. Twenty days after glyphosate application all treated plants were obviously dead.

Any consideration of the use of a herbicide on cranberry bogs has to take into account its effect on yield, berry size, and color development. Obviously, any significant reduction

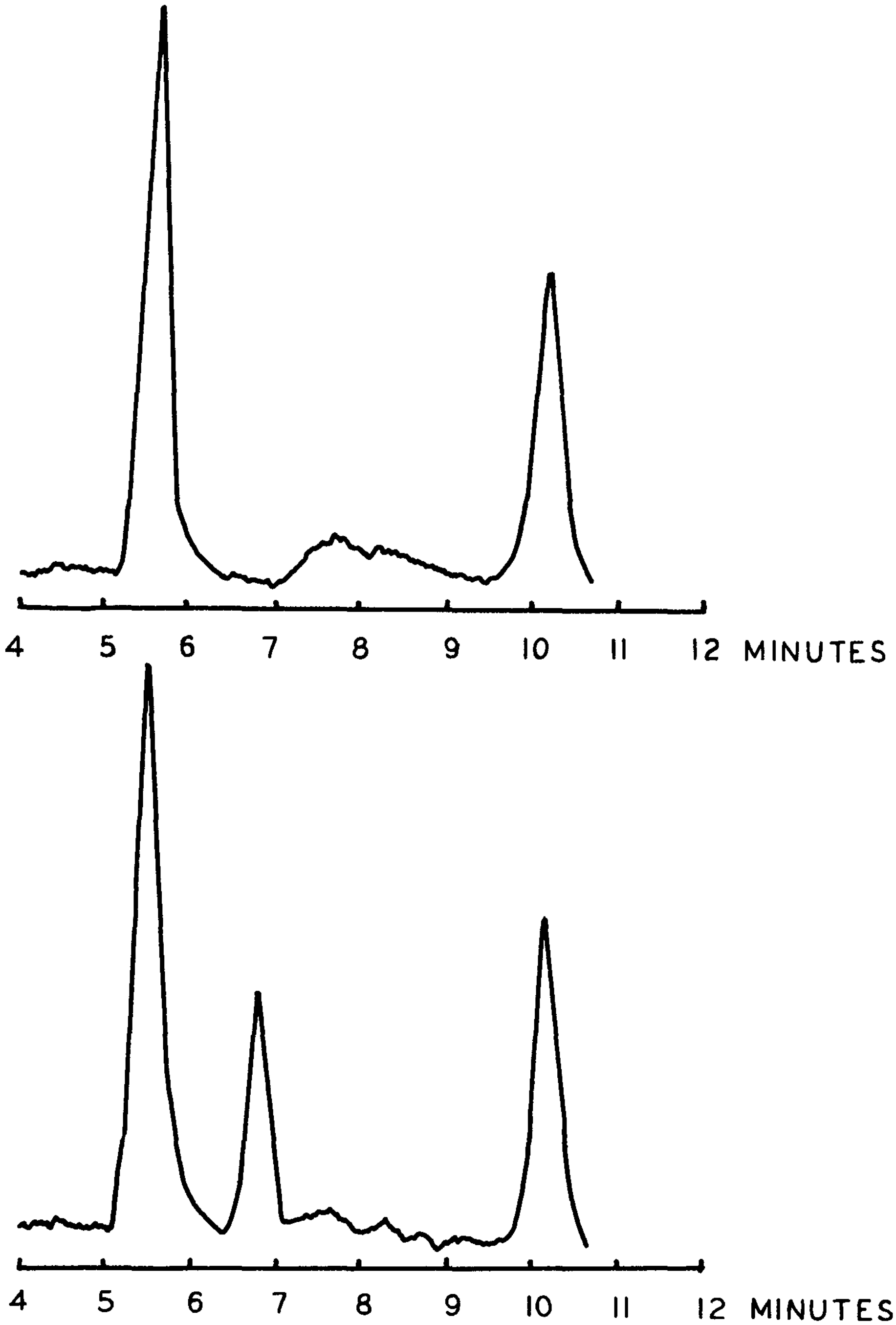

Figure 1. Analysis by GLC of derivatized glyphosate. The top chromatogram represents a field sample of cranberries and the bottom sample a field sample fortified to 0.3 ppm glyphosate.

in yield or berry size is important. Also, the cranberry owes much of its commercial value to its red color. Any herbicide that adversely influences this characteristic cannot be considered for use on cranberry bogs. Data in Table 2 show that glyphosate wipe treatments had no effect on color development, yield, or berry size.

Table 2. Influence of glyphosate wipe treatments on yield, berry size, and color development.

Glyphosate Dilution	Yield (kg/ha)	Anthocyanin (ug/g berry)	Cup Count
Control	14609	363	91.0
20 to 1	14214	351	95.5
10 to 1	14095	367	91.0
5 to 1	14826	337	93.0

As Figure 1 shows, no glyphosate was found in berries harvested from plots treated with the highest rate of glyphosate used in this study. This was also true for the major metabolite of glyphosate, aminomethylphosphoric acid. No residue was expected since the method of application excluded the cranberry vines from the herbicide.

This study demonstrates that glyphosate, as an over-the-top wipe treatment, could be a very effective and safe herbicide on cranberry bogs. In addition, this type of treatment precludes any herbicide contamination of the crop. Consequently, cranberry growers are anxious to obtain federal registration of glyphosate for use on cranberry bogs.

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THE INFLUENCE OF WATER QUALITY, VOLUME AND SURFACTANT ON EFFICACY OF GLYPHOSATE ON PERENNIAL WEEDS

G. W. Selleck[1/]

ABSTRACT

Certain commercial applications and experiments with glyphosate [N-(phosphonomethyl)glycine] on Long Island provided only marginal control of hedge bindweed (*Convolvulus sepium* L.) and yellow nutsedge (*Cyperus esculentus* L.). Hard water used as a carrier was suspect as being responsible for reduced efficacy.

The control of hedge bindweed was improved in 1977 experiments using tap water at 15 gpa containing 230 ppm Ca/Mg hardness vs 40 gpa. The reverse was true when distilled water was used, but glyphosate performance was improved with distilled water vs tap water. In 1979, mutsedge control was improved with distilled water vs tap water, with carrier volumes of 15 gpa vs 40 gpa and with the addition of 0.5% Mon 0011 surfactant by volume in the spray.

INTRODUCTION

Yellow nutsedge is widely distributed on the approximately 60,000 acres of agricultural land on Long Island. Yellow nutsedge is extremely competitive in vegetable crops such as onions, or crucifers and it's characteristic dense stand makes the establishment of slow growing seedling shrubs and trees very difficult. Hedge bindweed is also a vigorous perennial competitor which is becoming increasingly prevalent in vegetable and ornamental crop production. Glyphosate is effective for both yellow nutsedge and hedge bindweed, but due to a lack of selectivity, applications must be made in the off-season or in those few crops which are resistant.

Glyphosate treatments applied to hedge bindweed in the mid-bloom stage provided only 40 and 60% control at rates of 3.36 and 4.5 kg/ha, respectively, in late August. Applications at late bloom were more effective, and in each case efficacy was improved with the addition of surfactant Mon 0011 (3). This level of control was much lower than that obtained in previous experiments (2). In other experiments conducted the same year but in different locations, the degree of control ranged from fair to excellent. One of the differences was the source of water for spraying. Glyphosate performed well when applied in water with Ca, Mg hardness of 30 and 80 ppm, and the addition of surfactant Mon 0011 did not improve performance. At another location where the efficacy of glyphosate was sub-standard, the water had a Ca, Mg hardness of 230 ppm, and the addition of Mon 0011 surfactant at 1% by volume improved performance.

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Subsequently, occasional commercial applications of glyphosate for perennial weed control on Long Island have not provided the usual high standard of control. Experiments were conducted to ascertain if the performance of glyphosate could be affected by water hardness, water volume and the addition of Mon 0011 surfactant.

MATERIALS AND METHODS

Glyphosate at 2.24 and 4.5 kg/ha was applied June 4 in 1977, August 12, 1978 and July 1 in 1979. In 1978 and 1979, the application rates were reduced to 1.5 and 3 lb/A. Treatments were made at mid- to late - bloom stage with a knapsack sprayer on plots 2.2 by 9 m replicated three times. Each rate was applied in tap and distilled water at 15 and 40 gpa. Mon 0011 surfactant was applied at 0.5% total volume in 1978 and 1979. The water used in the test contained 230 ppm Ca and Mg in 1977 and 1978, and 100 ppm Ca and 22 ppm Mg in 1979. Percentage control was based on visual estimates of treatments and adjacent check plots.

RESULTS

In 1977, the control of hedge bindweed was significantly improved with glyphosate in 15 gpa vs 40 gpa using tap water, but the reverse was true with distilled water (Table 1). In 1979 with tap water containing only 122 ppm of Ca and Mg, the performance of glyphosate on yellow nutsedge was significantly less effective than that in distilled water (Table 2). Nutsedge control was improved with glyphosate applied in 15 gpa water vs 40 gpa, and the addition of Mon 0011 surfactant also significantly improved control (Table 2). Though trends appeared similar with hedge bindweed in 1979, the differences were not statistically significant. There were no differences in any of the treatments in 1978 due to predation of Argus Tortoise beetle (*Chelymorpha cassidea* Fab.) on hedge bindweed within a few days of application.

The apparent contradictory results with water volumes in 1977 could be explained on the basis that improved performance in tap water at 15 gpa reduced the amount of Ca and Mg salts to interact with glyphosate. In distilled water (free of salts), the improved spray coverage with 40 gpa could account for the improved control.

There are isolated cases of water hardnesses reaching 500 ppm on Long Island. It seems likely that the occasional sub-standard performance of glyphosate can be attributed to high levels of water hardness, a phenomenon which has occurred in other areas, for example in Saskatchewan, Canada (1).

Table 1. Percentage control of hedge bindweed with glyphosate in two volumes of distilled and tap water, 1977.

Water carrier		Rate lb/A		
Source	Volume	2	4	Mean[a]
Tap	40	79	85	81.0[b]
Tap	15	93	90	92.6[c]
Distilled	40	91	98	94.3[d]
Distilled	15	81	88	87.0[e]

[a]number designated [b] is statistically different from [c] and [d] from [e], at the 5% level, F-test.

Table 2. Percentage control of hedge bindweed and yellow nutsedge with glyphosate in two volumes of distilled and tap water, with and without Mon 0011 surfactant.

Water source or volume	Yellow nutsedge					Hedge bindweed				
	Surfactant		No surfactant			Surfactant		No surfactant		
	Tap	Dist	Tap	Dist	$\bar{X}$	Tap	Dist	Tap	Dist	$\bar{X}$
gpa 15	74	91	73	76	78.5[b]	77	91	75	83	81.5
gpa 40	68	81	61	71	70.3[c]	68	72	80	77	74.3
$\bar{X}$	78.5[d]		70.3[e]			77.0		78.8		
Tap H_2O	Surfactant		No surfactant		$\bar{X}$	Surfactant		No surfactant		$\bar{X}$
gpa 15	77		75		75.0[f]	74		73		69.0
	68		80			68		61		
Distilled H_2O										
gpa 15	91		83		80.8[g]	91		96		85.0
	72		77			81		71		

[a]number designated[b] is statistically different from [c], [d] from [e], and [f] from [g] at the 5% level F-test.

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WEED CONTROL FOR MUSKMELONS GROWN ON PLASTIC MULCH

S.F. Gorske [1]

ABSTRACT

Several herbicides were evaluated for weed control and muskmelon (*Cucumis melo*) phytotoxicity when used under a clear plastic mulch. Bensulide in combination with chloramben (methyl ester or salt), or naptalam did not adversely affect muskmelon yield. Other treatments of naptalam plus diclofop, or metolachlor did not adversely affect the muskmelon. Treatments with ethalfluralin and DCPA provided good results. Bensulide plus dinoseb reduced muskmelon plant vigor and yield.

There was no significant difference as to earliness of first harvest or total yield when comparisons were made between clear, black and photodegradable brown plastics.

The highest yielding treatments were not the most weed-free treatments. Most of the treatments provided acceptable weed control including the unweeded check.

The first year of this two year study was conducted at Bridgeton, NJ with the second year's trials being carried out at Columbus, OH.

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CUCUMBER RESPONSE TO DICLOFOP

C. E. Beste[1/]

ABSTRACT

Diclofop provided excellent grass control and cucumber safety when applied preemergence and postemergence in a Norfolk loamy sand (0.6% O.M.). In one study in 1979, the combination of diclofop preemergence plus post-emergence appeared to cause some vigor reduction. Naptalam, which is weak on grasses, provided erratic control of broadleaf weeds such as lambsquarters and purslane, and naptalam is only partially satisfactory for broadleaf weeds in a combination with diclofop. Chloramben or dinoseb combinations with diclofop did not completely control broadleaf weeds but yields were satisfactory. An effective broadleaf herbicide is needed for combinations with diclofop in cucumbers.

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GREEN PEPPER AND EGGPLANT TOLERANCE TO METRIBUZIN

S.F. Gorske [1]

ABSTRACT

Green pepper (Capsicum annum) and eggplant (Solanum melongena var. esculentum) transplants were evaluated during the summer of 1978 for tolerance to metribuzin. The study was conducted on an aura loam soil with 2% organic matter at Bridgeton, NJ. Metribuzin was applied with three different methods: preplant incorporation, preplant not incorporated, and post transplant. Rates of metribuzin varied from .07 kg/ha to .4 kg/ha.

Eggplants were severely injured when the metribuzin was applied preplant incorporated, however, the plants outgrew this injury and produced acceptable yields. Preplant applications of metribuzin produced few phytotoxic symptoms to the eggplant transplants. Post transplant treatments with the wettable powder formulation of metribuzin resulted in little foliar damage. However, the flowable formulation caused injury to most of the leaves on the eggplant.

All rates and methods of application of metribuzin caused varying degrees of phytotoxicity to green peppers. Low rates (.07 kg/ha) applied preplant and post transplant caused the least amount of injury. Preplant incorporated treatments were extremely phytotoxic to the green peppers.

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THIOCARBAMATE EXTENDERS IN SWEET CORN, DRY BEAN, POTATOES, AND YELLOW NUTSEDGE[1/]

D. T. Warholic, B. J. Hughes, A. McCue, and T. Vrabel[2/]

ABSTRACT

An effort was made to evaluate the performance of preplant incorporated treatments of EPTC, EPTC plus 25788, butylate, and vernolate with and without extenders on the following: sweet corn, dry bean, Irish potato, and in a non-crop yellow nutsedge situation. Formulations of EPTC and vernolate from two different companies, Stauffer (S) and PPG Industries (P), were also tested.

The sweet corn trial was located on very heavily infested nutsedge ground. Redroot pigweed was the principal broadleaf weed. Initial nutsedge control by EPTC plus 25788 (S) and butylate (S) at 4 or 6 lb/A was excellent. The addition of an extender to either compound did not increase the longevity of nutsedge control. The addition of 1 lb/A of atrazine at the spike stage of corn was more beneficial for redroot control than the addition of an extender. Yields were taken.

Formulations of 3 and 4 lb/A of EPTC (S,P) and vernolate (S,P) with and without an extender were evaluated in dry beans ('Redkloud'), primarily for control of redroot pigweed. None of the compounds provided adequate season-long control of redroot. The addition of an extender increased neither activity nor longevity of control. Crop toxicity was observed from 3 and 4 lb/A of vernolate (P) and vernolate plus extender (S). Yields were not taken.

In the potato test, no differences were observed in the activity of 3 or 4 lb/A of EPTC (S,P) or vernolate (S,P) for control of redroot or lambsquarters. The addition of an extender did not increase or prolong their activity. Excellent control of these weeds, however, was provided by delayed preplant incorporated treatments of 1 lb/A of linuron, 0.50 lb/A of metribuzin, or the 3.0 lb/A of EPTC (S) from the 23.4 SX formulation.

In the non-crop nutsedge test, butylate (S) at 3 or 4 lb/A provided better nutsedge control than either EPTC plus 25788 (S), EPTC (P), or vernolate (S,P). With the exception of EPTC plus 25788 no benefit was observed from the addition on an extender.

In summary, based on one year's work, it appears that both successful <u>initial</u> weed control and a wise choice of herbicide(s) for control of a specific weed spectrum were more important than the presence or absence of extenders.

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SWEET CORN AND WEED RESPONSE TO DIFFERENTLY TIMED POST EMERGENCE APPLICATIONS OF ATRAZINE, 2,4-D, DICAMBA, ALACHLOR AND METOLACHLOR[1/]

P.L. Minotti, B.J. Hughes, R.D. Sweet and D.T. Warholic[2/]

ABSTRACT

Applications of dicamba to sweet corn beyond the spike stage caused severe injury and yield reductions regardless of rate, although weed control was excellent. The addition of 2,4-D to atrazine oil mixtures or mixtures of atrazine, oil and alachlor injured corn 40 cm tall and reduced yields. However, spike stage applications were safe.

Excellent weed control was obtained with mixtures of low rates of atrazine, oil and acetanilides at low or higher rates. Differences in corn tolerance to these post emergence mixtures comparing alachlor and metolachlor at different rates and timings were subtle, not entirely consistent and somewhat dependent on variety. Further work is required to determine if any of these differences are of practical significance to growers.

INTRODUCTION

The utility of post emergence applications of 0.56 kg/ha of atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine] with an oil-surfactant blend for weed control in sweet corn (*Zea mays* var. *rugosa*) is well recognized (2). Moreover, with proper timing, excellent control of annual grasses has also been obtained with these same low rates when 0.84 kg/ha of alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] is added to the mixture (1). This three-way low rate combination is frequently used by growers in the Northeast.

Before the use of alachlor Dickerson and Sweet (3) demonstrated a considerable boost in activity against broadleaves, annual grasses and yellow nutsedge (*Cyperus esculentum* L.) when the atrazine-oil mixture was supplemented with 2,4-D [(2,4-dichlorophenoxy) acetic acid]. However, 2,4-D produced varying degress of crop injury and yields were reduced 10 to 15%. Growers sometimes ask about beefing up their atrazine oil mixtures, particularly if broadleaf perennials are present, and have been advised to back off because of our previous experience. However, the effect on spike stage corn is not known; the previous work relates to corn 20 cm or more in height.

Thus, one objective of the experiments reported herein was to examine more closely the effect of crop stage on tolerance to 2,4-D and other post emergence treatments. A second was to see if higher rates of alachlor might be safely utilized in atrazine-oil mixtures in hope of getting better control of later emerging grasses. A related objective was to see what extent metola-

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chlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetanide] might be substituted for alachlor in these atrazine-oil-acetanilide mixtures. Finally, for those who may wish to get away from atrazine entirely, we reexamined the safety of the very effective broadleaf herbicide dicamba (3,6-dichloro-O-anisic acid). As with 2,4-D, we had previously found dicamba to be unsafe but had not tried it on spike stage corn. We thus examined whether or not adjustments in timing and/or rate might produce the desired margin of safety.

MATERIALS AND METHODS

The two experiments reported herein were conducted in 1979 at the Homer C. Thompson Vegetable Research Farm in Freeville, NY. In the first (Table 1), Gold Cup sweet corn was planted June 18 in a Howard gravelly loam with a pH of 5.9 and an organic matter content of 3.3%. Rows of Japanese millet (*Echinachloa crus-galli* L. Beauv var. *frumentacea*) were seeded between the corn rows. The area had been fertilized with 672 kg/ha of 13-13-13. Treatments were quadruplicated and consisted of four rows 91 cm wide and 4.6 m long. The at spike treatments were applied on June 28 when the sky was overcast, the air temperature was 17.2°C, the humidity was high and the wind about 5 kph. Treatments to 40 cm corn were applied on July 16 under an intermittent sky with high humidity, air temperature of 29.4°C and a wind speed of 4 to 5 kph. Plots were frequently inspected for symptoms of crop damage and weed control ratings were taken on July 31. The center two rows of each plot were harvested for yield on September 19.

In the second experiment both Gold Cup and Silver Queen were planted on June 14 to an Eel silt loam with a pH of 6.4 and an organic matter content of 5.6%. The entire treatment area had received 1008 kg/ha of 13-13-13 fertilizer and 3.86 kg/ha of active butylate (S-ethyl diisobutylthiocarbamate) incorporated the same day. Treatment plots were in triplicate and the same size as above. The spike treatments were applied on June 26 under sunny skies and low humidity with an air temperature of 15.6°C and a 2 kph wind. Treatments to 20 cm corn were applied on July 13 under sunny skies, low humidity, air temperature of 30.6°C and with winds less than 4 kph. Treatments to 35 cm corn were applied on July 19 under sunny skies, high humidity, an air temperature of 30.6°C and wind less than 4 kph.

Corn injury and weed control ratings were recorded on July 23 and August 7 and plots were inspected regularly for injury symptoms. The center two rows of the four row plots were harvested for yield on September 10 for Gold Cup and September 15 for Silver Queen.

RESULTS AND DISCUSSION

Experiment 1

The addition of 2,4-D to mixtures of atrazine and oil or to mixtures of atrazine, oil and alachlor resulted in severe leaf distortion characterized by a rolling and twisting of the middle leaves when applied to 40 cm corn. This injury was reflected in yield reductions primarily due to reduced ear size (Table 1). The effect appeared worse when alachlor was present. The 2,4-D slightly improved the activity of the mixtures on the 18 cm millet even when low rates of alachlor were present. At this stage the higher rate of alachlor (2.24 kg/ha without 2,4-D) gave perfect millet control without corn injury.

In contrast, the same 2,4-D mixture causing injury to 40 cm corn was safe when applied to spike stage corn. At this stage 2,4-D slightly improved already acceptable activity of atrazine and oil on millet. Any mixture with alachlor gave perfect control at the spike stage. There was a suggestion that the higher rates of alachlor somewhat reduced ear size at the spike stage which was not the case when applied to 40 cm corn.

Experiment 2

Dicamba gave excellent weed control at all rates and timings but caused severe injury to both varieties when applied to either 20 cm or 35 cm corn (Table 2). Visual symptoms closely resembled those produced by the 2,4-D mixture applied to 40 cm corn in the previous experiment. If anything, they were more pronounced. Injury to 35 cm corn was greater than that on 20 cm corn. When applied to spike corn either formulation appeared safe for Gold Cup up to the .56 kg rate. There was a suggestion of reduced yields with Silver Queen, however.

The application of 2,4-D alone at the spike stage was safe for both varieties. Control was less effective than with dicamba but still acceptable.

All mixtures of atrazine, oil and alachlor or atrazine, oil and metolachlor gave excellent weed control even when the acetanilides were present at 0.84 kg rate. Substituting an equivalent rate of metolachlor for 0.84 kg of alachlor in the standard low rate mixture of atrazine-oil-alachlor made no difference with the Silver Queen variety, but may have been tougher on the Gold Cup variety. On the other hand 2.24 kg of metolachlor at spike stage seemed safer in the mixture than an equivalent amount of alachlor with the Silver Queen variety.

In general the effects of the acetanilide rates and timings on corn yields and the differences between alachlor and metolachlor were rather subtle. Further experimentation is required to determine if such differences are of practical significance to growers. On the other hand, it is clear that later than spike application of dicamba or 2,4-D with oil are very risky.

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TABLE 1. Yield and weed control in sweet corn as affected by postemergence applications of atrazine, atrazine plus 2,4-D, atrazine plus alachlor and atrazine plus alachlor plus 2,4-D at different growth stages.

Treatment[1/]	Rate kg/ha a.i.	Stage of corn	Crop[2/] rating 7/31	Weed Control[2/] 7/31 Millet	Rrpw	Plot Yields 9/19 #ears	kg/ear
atr + oil	.56	spike	9.0	7.8	9.0	28.0	0.25
atr + oil + 2,4-D	.56 + .42	spike	9.0	8.5	9.0	28.5	0.25
atr + oil + ala	.56 + .84	spike	9.0	9.0	9.0	26.0	0.25
atr + oil + ala + 2,4-D	.56 + .84 + .42	spike	9.0	9.0	9.0	27.0	0.24
atr + oil + ala	.56 + 2.24	spike	8.8	9.0	9.0	29.0	0.23
atr + oil	.56	40 cm	9.0	5.0	7.8	26.5	0.25
atr + oil + 2,4-D	.56 + .42	40 cm	5.3	6.5	9.0	28.5	0.22
atr + oil + ala	.56 + .84	40 cm	9.0	5.3	8.2	23.5	0.25
atr + oil + ala + 2,4-D	.56 + .84 + .42	40 cm	3.5	7.3	8.8	31.0	0.20
atr + oil + ala	.56 + .2.24	40 cm	8.8	9.0	8.5	27.8	0.25
handweeded check			9.0	8.0	6.8	26.3	0.25
unweeded check			9.0	3.2	2.0	21.5	0.18

[1/] Oil was Booster +E at 1.6% by volume. Atrazine applied as 4L, alachlor as 4EC and 2,4-D as amine salt (Formula 40, Dow).

[2/] Rating scale of 1-9; 9 = perfect crop or complete absence of weeds.

TABLE 2. Yield and weed control in sweet corn as affected by postemergence applications of dicamba, 2,4-D, atrazine plus alachlor and atrazine plus metolachlor at different growth stages.

Treatment[1]	Rate kg/ha a.i.	Stage of corn	Crop rating[2] 7/23 G.Cup	Crop rating[2] 7/23 S.Queen	Weed Control[2] 8/7 Colq	Rrpw	Galz	Shpu	Plot Yields G.Cup 9/10 #ears	G.Cup 9/10 kg/ear	S.Queen 9/15 #ears	S.Queen 9/15 kg/ear
dicamba 4S	0.28	spike	8.7	9.0	9.0	8.3	8.3	7.3	14.3	0.27	13.3	0.24
dicamba 4S	0.50	spike	8.0	8.3	9.0	9.0	9.0	8.0	17.5	0.27	13.3	0.22
dicamba 2S	0.50	spike	8.3	8.7	9.0	9.0	9.0	9.0	15.7	0.27	9.7	0.23
dicamba 4S	1.00	spike	6.7	8.0	9.0	9.0	9.0	9.0	13.5	0.25	16.0	0.23
dicamba 4S	0.28	20 cm	6.3	7.7	9.0	8.7	8.7	7.7	8.3	0.25	7.3	0.20
dicamba 4S	0.50	20 cm	5.3	5.3	9.0	9.0	9.0	8.0	16.3	0.21	10.0	0.19
dicamba 2S	0.50	20 cm	6.0	6.0	9.0	9.0	9.0	7.3	17.0	0.20	12.0	0.16
dicamba 4S	1.00	20 cm	5.0	5.3	9.0	9.0	9.0	9.0	12.0	0.18	11.7	0.14
dicamba 4S	0.28	35 cm	6.0	6.3	9.0	9.0	9.0	8.3	15.0	0.23	10.3	0.17
dicamba 4S	0.50	35 cm	5.0	4.7	9.0	9.0	9.0	7.7	16.3	0.21	7.3	0.14
dicamba 2S	0.50	35 cm	5.0	5.0	9.0	9.0	9.0	8.0	9.0	0.23	5.3	0.11
dicamba 4S	1.00	35 cm	3.3	4.0	9.0	9.0	9.0	9.0	9.0	0.22	8.7	0.09
2,4-D	0.14	spike	8.7	8.3	8.3	6.0	7.3	7.3	15.3	0.27	12.7	0.25
2,4-D	0.28	spike	8.7	8.3	8.3	8.3	7.7	7.7	16.5	0.26	12.7	0.25
atr + ala + oil	0.56 + 0.84	spike	8.3	8.7	9.0	9.0	9.0	9.0	17.0	0.26	11.0	0.25
atr + ala + oil	0.56 + 2.24	spike	7.0	8.0	9.0	9.0	8.7	9.0	16.0	0.25	11.0	0.22
atr + ala + oil	0.56 + 0.84	20 cm	8.7	7.7	9.0	9.0	9.0	9.0	15.0	0.25	9.3	0.26
atr + ala + oil	0.56 + 2.24	20 cm	6.7	6.7	9.0	9.0	9.0	8.7	13.5	0.26	12.7	0.23
atr + meto + oil	0.56 + 0.84	spike	7.7	8.7	9.0	9.0	9.0	8.7	14.3	0.24	12.7	0.24
atr + meto + oil	0.56 + 2.24	spike	6.7	7.0	9.0	9.0	9.0	9.0	12.0	0.25	12.3	0.24
atr + meto + oil	0.56 + 0.84	20 cm	7.7	7.7	9.0	9.0	9.0	9.0	16.0	0.22	13.0	0.23
atr + meto + oil	0.56 + 2.24	20 cm	6.0	6.3	8.7	9.0	9.0	9.0	11.0	0.28	12.3	0.23
check	--	--	8.5	8.9	5.5	5.2	7.0	7.3	9.5	0.25	11.0	0.22

[1]All plots including checks received 3.86 kg/ha a.i. butylate PPI on June 14. Checks were replicated 6 times. Alachlor was formulated as 4EC, metolachlor as 50WP, 2,4-D as the amine salt (Formula 40, Dow) and atrazine as the 4L. Oil was Booster +E at 1.6% by volume.

[2]Rating scale of 1-9; 9 = perfect crop or complete absence of weeds.

PROBLEMS ASSOCIATED WITH HERBICIDE USE IN ORCHARDS ON LIGHT SOILS

John A. Meade and William V. Welker 1/

In the second edition (1952) of "Weed Control" by Robbins, Crafts, and Raynor, the authors outlined the weed problems associated with orchards and concluded that weeds were detrimental to tree fruits in several ways and should be eliminated. Cultivation was suggested but precautions against forming a plow sole were emphasized. The authors warned against the use of sodium chlorate, borax, and carbon bisulfide but did suggest the use of heater oil, diesel oil with dinitrophenols and 2,4-D (used carefully). Shortly after the publication of this book, the substituted ureas and the triazines were introduced making weed control in orchards more effective as well as safer.

There remain, however, to this day some areas in which effective, safe weed control in tree fruits is difficult to obtain. One such area in New Jersey (and other coastal plain states) is the area of light sandy or porus gravelly soils of South Jersey. In a situation such as this with low clay and organic matter content, herbicides are not held in the soil and are readily available to the tree roots.

The problems showing up in these light soils are common to many crops. There is a notable difficulty in obtaining a balance between acceptable weed control and avoiding injury to the trees. The problem normally is more critical with peaches than with apples. There are several reasons for this. South Jersey peaches have, for years, been acknowledged as the best in flavor. Peach plantings have traditionally been established on higher elevations (10-20' above surrounding areas) for better air drainage. These knolls are also sandy. These soils dry out faster at peach ripening time and this contributes to the flavor and sweetness of the peaches. However, locating the peaches on such sites contributes to the problem of obtaining satisfactory weed control while avoiding injury to the peach trees. Herbicides penetrate these soils readily and easily reach the root system to cause injury while leaving the soil surface herbicide free. These light soils may also cause the tractor and sprayer to slow down thus increasing the rate of application of the herbicide.

Peach roots are generally within 3-6 inches of the soil surface. This makes cultivation difficult or impossible without causing damage to the trees from root pruning and bark damage. Indeed, one of the benefits of chemical weed control was the elimination of cultivation and hence less damage to the tree.

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Apples, on the other hand, tend to be established on heavier soils in which herbicides don't leach as readily. Apple feeder roots are known to be 18-24 inches below the soil surface so that contact with high concentrations of herbicides is greatly reduced. Apples also seem to exhibit injury symptoms much slower than peaches. Hence, we have far fewer problems with apples than peaches on these soils.

Herbicide applications in peaches start when the young trees are set in the field. Quite often they will be interplanted to vegetable crops and trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) or diphenamid (N,N-dimethyl-2,2-diphenylacetamide) may be used for control of weeds in those crops. No injury to the peach trees has been associated with this cultural system.

Application of low rates of simazine (2-chloro-4,6-bis(ethylamino)-s-triazine) have resulted in typical leaf chlorosis and even if yield isn't affected, the grower is such a perfectionist that he will stop use of the herbicide.

Terbacil (3-tert-butyl-5-chloro-6-methyluracil) has been shown to be an effective tool in the control of weeds in orchards on heavy soils. However, injury was observed with this compound even at low rates on these light soils. Once again these growers realized that they had some special problems.

These growers recognized that the most efficient management system was a single application of a preemergence, soil residual herbicide. It had become apparent, however, that they could not effectively use this approach.

In order to overcome the problems with light soils, paraquat (1,1'-dimethyl-4,4'bipyridinium ion) was quickly perceived as a means of circumventing their problems. Many growers adopted the practice of repeated applications of paraquat as needed to keep weed growth under control. This resulted in increased populations of perennial weeds which were less susceptible.

Some growers, in another approach to reduce the injury potential from application of preemergence herbicides in the spring, have turned to combinations. It became fairly commonplace to add diuron (3-(3,4-dichlorophenyl-1,1-dimethylurea), terbacil, or simazine to the paraquat. Also, tank mixes of diuron and simazine were used in an attempt to lower the amount of each applied to the orchards and to increase the spectrum of weed species controlled. Later, combinations of diuron and terbacil or terbacil plus simazine were added and these did help to reduce the problem of injury to the peach and improved the weed control.

A different approach is being used by some growers. Realizing that they couldn't "store" herbicides in the light soils as readily as growers on heavy soils, they developed a system of multiple applications to have the herbicides available over a longer period of time. They did this by applying a light rate of a preemergence herbicide in late April and again in June, usually in combination with paraquat. The drawback here, of course, is the cost of the repeated applications. However, by evaluating the monetary losses due to competitive effects of weeds, especially on shallow rooted peach trees, the danger of root pruning by discing and the injury potential of normal rates, they concluded that the cost of an extra application was more than justified.

While these all help alleviate the problems, research is needed to determine proper rates of application and also proportions of the different herbicides in combinations. Additional studies are needed in the area of new and improved cultural practices and interactions of cultural practices with herbicide applications. Information is needed on the best types of cultivation equipment to be used and the frequency and depth of working the soil.

TERBACIL AND PRONAMIDE ON NURSERY APPLE TREES

O. F. Curtis, Jr. [1/]

ABSTRACT

Apple (Malus domestica Borkh.) have been sprayed with terbacil at 3.2 lb/A ai in fall or spring after summer budding without impairing growth from the scion buds. Rates of 1.0 lb/A have given good control of quackgrass (Agropyron repens) in conjunction with the normal cultivation regime. Pronamide has been applied at 5.6 lb/A in the fall without sign of injury. However, 2.0 lb/A did not usually provide satisfactory control of quackgrass.

A block of M.26 rootstock infested with quackgrass was sprayed with pronamide at 1.1, 2.2, or 4.2 lb/A ai during a January thaw, or with terbacil at 0.9 or 2.3 lb/A ai in May of 1975. These supplemented a fall treatment with simazine at 2.0 lb/A ai. Scion buds which had been inserted the previous August were swelling at the time of the May application. Periodic cultivation plus one thorough hoeing to remove growing quackgrass was done in the summer.

Quackgrass was almost completely controlled through the season by the low 0.9 lb/A rate of terbacil (Table 1). Pronamide controlled it early in the season; but by August the cover in the 4.2 lb. plots equalled the checks, while lower rates showed heavier cover. Because early growth was suppressed in the latter, it escaped removal by the hoeing in early July. The fall simazine application reduced quackgrass to about half of that seen under cultivation alone in supplementary plots.

Growth from the scion buds as measured by percent starting growth, percent finally dug as marketable trees, or height of scion growth was not adversely affected by the higher herbicide rates (Table 1). On the other hand, tree growth did not benefit significantly from the more complete grass control. As an apparent artifact, fewer buds started under the low rate of terbacil than under the higher rate or other treatments. No visible injury was seen on any cultivar. These included one replicate each of 'Macoun', 'Niagara', 'Spijon' and 'Vista Bella', and two or more replicates of 'Burgandy', 'Empire', 'Imperial McIntosh', 'Jerseyman', 'Jonamac', and 'Mutsu'. Analysis of growth data for those with two or more replicates gave no indication of a cultivar x treatment interaction.

On an adjacent block of MM.106, terbacil at 1.1 lb/A ai in fall or spring provided quackgrass control of 97% or better through the 1975 season. Growth of M.9 scion buds, in number and length, was slightly greater than in checks at this rate and at a higher rate of 3.2 lb/A.

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Table 1. Response of quackgrass and from apple buds on M.26 rootstock to pronamide or terbacil on Allendale fine sandy loam, 1975. From 20 replicates with 12 stocks budded per plot in 1974.

Herbicide lb/A ai	Quackgrass cover Jan. %	May[2/] %	Aug. %	Oct. %	Scion buds growing June %	Trees dug as % of Buds %	June %	1975 Scion growth inches
Pronamide Jan. 12								
1.1	77	15	24	34	92	89	97	36.2
2.1	76	5	22	35	92	90	98	37.0
4.2	69	1	12	21	94	91	96	36.6
Terbacil May 8								
0.9	79	37	1	0.4	86	83	97	36.9
2.3	78	30	0	0.0	92	90	98	37.5
None	72	42	14	21	93	91	99	36.4
LSD 0.05								2.2

[2/] After a partial cultivation.

Terbacil at rates of 0.8 and 2.4 lb/A ai were applied in fall, May, or as a split application on a block of MM.106 budded to several cultivars. Quackgrass control observed between the two hoeings and at season's end in 1976 was poor by the 0.8 lb/A fall treatment. Scion growth of other terbacil treatments averaged a significant 10% greater than in hoed checks. Cultivars 'Holly', 'Idared', 'Julyred', 'Macoun', 'Mutsu', 'Niagara', 'Spigold', and 'Spijon' were observed in one replicate each. The May treatment was directed from two sides of the row to reduce deposit on early leaves just expanding from the buds. When sprayed over the row, 2.4 lb in 50 gal/A caused visible damage to these leaves and resulted in scion growth only equalling that of the checks.

GLYPHOSATE - A MANAGEMENT TOOL FOR WEED CONTROL IN TREE AND VINE CROPS

J. T. Richardson, L. B. Lynn and J. C. Graham 1/

ABSTRACT

Glyphosate (a formulation of the isopropylamine salt of glyphosate - ROUNDUP® herbicide) has recently been labeled for use in apples (*Malus demesticus* Borkh.), pears (*Pyrus communis*) and grapes (*Vitis* spp.). Numerous trials in the northeast and Great Lakes area have demonstrated excellent weed control and crop safety. Post directed treatments in established orchards and vineyards as well as site preparation treatments for glyphosate (derivative) have been shown to be a valuable addition to present management practices.

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ORYZALIN-SIMAZINE-PARAQUAT FOR PEACH TREES

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ABSTRACT

Oryzalin, a pre-emergence surface applied herbicide for the control of annual grasses and certain broadleaf weeds, has had a California label registration for non-bearing vineyards and certain tree fruits. The label was extended to a full U. S. registration (May 1979).

Peach trees (Prunus persica) ('Redhaven' and 'Late Sunhaven') grown on Hagerstown-Frederick cherty silt loam were tree-hoed three times during first year in the orchard. At the time of herbicide application (April 12, 1979), weed cover was 100%. The predominant weeds present were: shepherdspurse (Capsella bursa-pastoris), field pepperweed (Lepidium campestre), and Virginia pepperweed (Lepidium virginicum). A few plants of chickory (Cichorium intybus) and broadleaf dock (Rumex obtusifolius) were present. Replicated plots of three trees were treated with oryzalin at rates of 2.2, 4.5, and 9.0 kg/ha alone and in combination with simazine at 2.2 kg/ha. Paraquat at 0.6 kg/ha plus a surfactant was combined with each of the residual herbicide treatments to kill the existing weed cover. Oryzalin and simazine were formulated as 2.33 kg/L.

Weed control data was acquired from the entire 2 m by 18 m treated area of each plot. A total of 24 weed species were recorded within the treated area of the 24 plots. The ten most dominant weed species and their adjusted infestation ratings are: chickory (Cichorium intybus) 30, fall panic (Panicum dichotomiflorum) 17, barnyard grass (Echinochloa crus-galli) 15, ragweed (Ambrosia artemisiifolia) 13, redroot pigweed (Amaranthus retroflexus) 8, horsenettle (Solanum carolinense) 7, crabgrass (Digitaria sanguinalis and D. ischaemum) 7, broadleaf dock (Rumex obtusifolius) 2, ladysthumb (Polygonum persicaria) 1 and yellow foxtail (Setaria lutescens) 1.

Table 1. Weed control ratings, based on 0 to 100 where 0 is no control, and increases in tree trunk growth as influenced by treatments.

Material & Rate kg/ha	Mean Weed Control 7/10/79	Mean Weed Control 9/24/79	Mean Trunk Circumference Increase
None	0.0	0.0	4.97 cm
Oryzalin 2.2	52.5	40.0	6.51
Oryzalin 4.5	48.3	28.3	7.69
Oryzalin 9.0	61.7	52.6	8.02
Oryzalin-Simazine 2.2 + 2.2	83.3	77.6	9.58
Oryzalin-Simazine 4.5 + 2.2	86.7	84.3	6.93
Oryzalin-Simazine 9.0 + 2.2	96.0	93.6	8.06
Simazine 2.2	76.6	16.7	8.4

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EVALUATION OF VARIOUS ORCHARD MANAGEMENT SYSTEMS

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ABSTRACT

Good weed control can be a major factor in the operation of a successful orchard. The margin of profit may lie in the degree of weed control obtained by a vegetation management system. The same management system, however, cannot be used for all orchards.

Apples are deeper rooted than peaches and are therefore less subject to water stress than are the more shallow-rooted peaches. The fruit of the apple develops over a longer period of time than the fruit of the peach and is another reason that the apple can withstand more vegetation competition. The availability of water is especially critical during the brief period that the peach fruit makes its increase in size. Peaches require a more precise management system than do apples.

Before herbicides became available, apples were maintained in sod, usually whatever established naturally. This sod was sometimes mowed, usually, however, it was not mowed. Peaches were normally disked several times a year. When better equipment became available they were disked more frequently. Disking, however, resulted in root and bark damage to the peach tree which eventually caused a reduction in yield and often led to an early death of the tree.

When herbicides became available for use in orchards, a single herbicide was usually selected and the entire orchard was treated once each year with that herbicide. The results were spectacular compared to just mowing or disking. Soon, however, it became apparent that a mono-herbicide system, regardless of its simplicity, was not a satisfactory system. It did not control all the weeds present and resistant weeds soon became established. Herbicide rates were increased in attempts to obtain better weed control. Injury became a problem when the residual herbicides were used at the permitted limit for a number of years. A combination of tillage in early spring followed immediately with a preemergence herbicide was an improvement under certain conditions. Contact herbicides soon took

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the place of cultivation in many instances. They were either applied alone or in combination with a residual herbicide. Another system currently used is a herbicide rotation system. Herbicide A is used the first year and herbicide B is used the second year. This is an improvement over a mono-herbicide system. It reduces the danger of a herbicide building up in the soil and it also reduces the establishment of resistant weed species. One difficulty with this system is that only one herbicide is applied each year and if the weather conditions are not favorable for that herbicide, a weed problem can develop. The use of herbicide combinations has many advantages over either a mono-herbicide system or a herbicide rotation system. It greatly increases the weed spectrum that is controlled and reduces the chance of resistant weeds becoming established Another advantage in using a herbicide combination is that less of each herbicide can be used than if a single herbicide alone is used to obtain acceptable control. Another system that is increasing in use is an integrated herbicide system. This involves the use of herbicide combinations and herbicide rotations. This combines the advantages of the other systems, controls a wider weed spectrum, reduces the danger of a buildup in the soil of a single herbicide, and reduces the possibility of a resistant weed species becoming established. The selection of herbicides used can be tailored for the weed problem and the soil conditions, thus obtaining maximum weed control with minimum danger of crop injury.

The management system selected must take into consideration many factors including the initial weed problem, the age and size of the trees, and the soil type. It must be continuously reappraised and modified in subsequent years to meet the changing needs of the orchard.

FORESTRY USE OF THE HEXAZINONE FOR HARDWOOD SPROUT CONTROL

T.B. Saviello[1] and M.L. McCormack[2]

ABSTRACT

The effectiveness of Hexazinone[3] to control hardwood sprouts (red maple, gray birch, alder, trembling aspen and willows) in Maine was evaluated. Early in May 1979, Gridballs applied on 0.5 acre plots at rates of 10, 15, 20 and 40 pounds per acre (1.0, 1.5, 2.0 and 4.0 pounds active ingredient). The treatments were replicated on two areas in International Paper Company's Northern Experiment Forest in Howland, Maine. Site one was clearcut, chopped and broadcast burned. Site two was clear-cut and chopped.

In early September 1979, using a rating scale of 0 to 10, the plots were evaluated qualitatively for silvicultural effectiveness. The rating scale corresponds to the following: 0 to 4 represents little or no silvicultural advantage; 5 represents the dividing line between noneffective and effective; 6 to 10 represents increasing silvicultural effectiveness. Final evaluation of the treatments are presented in Table 1.

Table 1: Silvicultural effectiveness of the Hexazinone for hardwood sprout control on two site prepared locations in Maine.

	Treatment (lb/acre)			
Location	10	15	20	40
	Rating			
Site 1	1	2-3	2-3	6
Site 2	1	2-3	2-3	6

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3/ Velpar Gridball

The low effectiveness rating is probably due to the high total organic matter content and clay content of the soil, as presented in Table 2. The organic matter and clay content fixed the active ingredients of the

Table 2: The percent total organic matter and percent clay at two Hexazinone application sites in Maine.

Location	Soil Characteristics: Organic Matter, 0 Horizons	Organic Matter, Mineral Soil	Clay
	----- Percent -----		
Site 1	64	8	4
Site 2	--a	7	34

[a] Organic horizons were not present on this site.

Hexazinone. Marginal effectiveness of the 40 lb. application possibly resulted from excess herbicide remaining after the fixation by organic matter and clay particles.

For extensive forest management this application rate may be impractical. However, Hexazinone should not be dropped from a list of potential management tools. It may be very useful for raspberry control, individual stump-sprout control, and precommercial thinning.

1978-79 RESULTS WITH GLYPHOSATE FOR FORESTRY IN MAINE

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ABSTRACT

Silvicultural applications of a formulation of the isopropylamine salt of glyphosate (ROUNDUP®* herbicide) were made in 1978 under an experimental use permit. Trials in Maine involving 140 acres were aerially applied in several locations for site preparation or conifer release. Applications of 1.68 or 3.36 kg/ha a.e. glyphosate (derivative) to actively growing brush provided good to excellent suppression of species such as raspberry (*Rubus* spp.), willow (*Salix* spp.), pin cherry (*Prunus pensylvanica*), aspen (*Populus* spp.), beech (*Fagus* spp.) and birch (*Betula* spp.). For selective control of these species in established conifers, applications were made after dormancy of the conifer buds. In 1979 a 24(c) state label was granted in Maine to allow commercial applications of glyphosate (derivative) in forestry.

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* Roundup® is a registered trademark of Monsanto Company.

PROBLEMS IN ESTABLISHING COVER CROPS AFTER THE USE OF HERBICIDES ON NURSERY CROPS

A. Bing[1/] and T. Corell[2/]

ABSTRACT

Nurserymen want to effectively control weeds with preemergence applications of herbicides early in the growing season. To prevent soil erosion, improve soil structure and to protect smaller plants against wind damage, cover crops are planted in the late summer or early fall. Usually oats (*Avena sativa* L.) is planted between rows because it dies during the winter and therefore does not interfere with cultivation or plant digging in the spring. On areas cleared of crop plants in the early fall, rye (*Secale cereale* L.) or wheat (*Triticum aestivum* L.) may be used as a cover crop to be plowed under before planting a new nursery crop.

The experiment was designed to study the effect of treating Haven loam in a crop-free area with commonly used preemergence herbicides on April 24 and June 21 followed by a sequence of plantings of wheat var. Red Coat, annual rye and seed oats var. Garry on Sept. 4 and 18 and Oct. 5. The soil was treated in plots 68 in by 60 ft. To control weeds the entire area was disked twice during the growing season. The treatments on April 24 were simazine 4G [2-chloro-4,6-bis(ethylamino)-s-triazine] at 1, 2 and 4 lb/A, napropamide 50 WP [2-(*a*-naphthoxyl)-N,N-diethylpropionamide] at 4 lb/A, alachlor 15G [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] at 4 lb/A, oxadiazon 2G [2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2_4-1,3,4-oxadiazolin-5-one] at 2 lb/A, and oryzalin 75 WP (3-5-dinitro N^4,N^4-dipropylsulfanilamide) at 2 lb/A. The June 21 applications were made on untreated plots at the same rates as on April 24. Simazine was not repeated.

The April 24 treatments with simazine at 1 lb/A or the other herbicides caused no noticeable injury to the first cover crop planting. Oats planted on soil treated with simazine at 2 and 4 lb/A was severely bleached and mostly killed after it reached a height of 4-6 in. Plants not severely injured recovered and grew well later. This dieback and recovery was similar to that observed in commercial nurseries.

The June 21 treatments with napropamide and oryzalin caused a delayed response in oats which appeared as a bronzing and marked decrease in size of oats and to a lesser extent also in wheat and rye.

Growers that want to use oats as a cover crop will have to be very careful of the amount and time of application of simazine, oryzalin and napropamide.

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WEED CONTROL FOR AZALEAS IN GROUND BEDS

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ABSTRACT

Growing azaleas in raised ground beds can be a valuable method of producing large, high quality plants when effective weed control methods are used.

Four separate field experiments were conducted to evaluate and compare the weed control effectiveness and potential phytotoxicity of five herbicides when applied preemergence to established azaleas. Included in these evaluations were oxyfluorfen, oxadiazon, and prodiamine granular formulations at 2.2 and 4.5 kg/ha. Wettable powder formulations of napropamide at 4.5 and 8.9 kg/ha and DCPA at 11.2 kg/ha were also evaluated.

All applications were made preemergence over the top to established azaleas on May 30 or June 6, 1979. Following each evaluation the plots were handweeded.

The azaleas used in these experiments included one-year-old Hershey Red and Hinocrimson plants and two-year-old Hinocrimson and Delaware Valley White. These plants were grown in raised soil beds approximately 30 cm high. The one-year-old plants were mulched with decomposed pine needles and the two-year-old plants were mulched with pine bark.

Oxyfluorfen at 2.2 kg/ha and 4.5 kg/ha reduced percent weed cover by 58 and 80% respectively, napropamide at 4.5 and 8.9 kg/ha reduced percent weed cover 70 and 80%. Oxadiazon reduced percent weed cover 65 to 70% at both rates while prodiamine provided a 55% reduction in percent weed cover at 2.2 kg/ha and 60% at 4.5 kg/ha. DCPA at 11.2 kg/ha reduced the percent weed cover less than 35%.

The control plots with pine needle mulch seemed to have a higher percentage weed cover during the season than those mulched with pine bark.

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FACTORS INFLUENCING EFFECTIVENESS OF ALACHLOR FOR WEED CONTROL IN NURSERY LINERS

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ABSTRACT

Late season weed control of fall panicum and other annual grasses is frequently a problem for many nurseries. Alachlor has been shown to be effective against annual grasses. This experiment was undertaken to evaluate factors in its use for weed control in nursery liners.

The experiment was conducted on the University Farm at Newark on a Matapeake silt loam. Experimental plot was 55' x 75' and consisted of 8 rows of nursery liners spaced 5 feet apart and divided into 32 blocks, each 15 feet long; and containing one plant each of pin oak, silver maple, flowering dogwood, Colorado blue spruce, forsythia, evergreen privet, Pfitzer juniper and spreading Japanese yew.

Experimental design was a split plot with 0.75 inches of water and no irrigation as the main plots with 2 replications. Sub-treatments were alachlor, alachlor plus simazine and alachlor incorporated to a depth of 0.5 inches by hand raking.

The plots were cultivated and hand hoed to provide a weed free land. Treatments were applied July 11, 1977 with a hand sprayer with an approximate volume of 53 gal/a.

The factors which increased the effectiveness of alachlor for weed control in nursery liners were shallow incorporation and combination with simazine. Irrigation had little or no effect.

Dominant weeds in the study were purslane and crabgrass. Incorporation of alachlor greatly increased the control of purslane. Addition of simazine reduced both the total number of weeds and the number of weed species.

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TABLE 1. The effects of irrigation, incorporation and combination with simazine on weed control with alachlor.

Chemical	Rate Kg ai/ha	Irrigated 0.75" water	Incorporated 0.5"	% Weed Control[1/]
alachlor E. C.	3.36	X	X	90.50 a[2/]
alachlor E. C. simazine W. P.	2.24 1.40	X		83.25 a
alachlor E. C.	3.36		X	78.00 a
alachlor E. C. simazine W. P.	2.24 1.40			68.00 a
alachlor E. C.	2.24			38.25 b
alachlor E. C.	2.24	X		35.00 b
control				29.50 b
control		X		20.00 b

LSD .05 = 28.61

1/ Figures are % bare ground
Observations were made 8/8, 4 weeks after treatment.

2/ Numbers followed by the same letter are not significantly different using Duncan's multiple range test.
Dominant weeds were purslane and crabgrass.

1979 RESULTS WITH POSTPLANT PREEMERGENCE HERBICIDE TREATMENTS ON NURSERY LINERS

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ABSTRACT

Metolachlor at rates up to 16 lb/A and metolachlor plus simazine at rates up to 16 + 4 lb/A were safe on a wide variety of newly planted nursery liners except the 16 lb/A of metolachlor reduced the growth of Viburnum spp and 4 lb/A of simazine reduced growth of azalea. Higher rates of metolachlor and metolachlor plus simazine gave good weed control Prodiamine gave good weed control if applied to a weed free soil surface. Oryzalin was equally effective as a 75WP or a 5G. Oxyfluorfen at 4 and 8 lb/A was effective against weeds and safe to the nursery liner.

INTRODUCTION

This experiment is a continuation of a series to determine which preemergence herbicides are safe for use in nursery and landscape plants and also give satisfactory weed control (1) (2). Metolachlor is of interest because it is effective against yellow nutsedge (Cyperus esculentus L.). This experiment is partly sponsored by the IR4 program to generate the data necessary for label clearance.

MATERIALS AND METHODS

The nursery liners shown on Table 1 were planted at Farmingdale on April 24 to May 1 by students in the nursery management program at the State University, and at Riverhead the liners were planted on April 24 to May 1, 1979. They were planted one cultivar per row and 2 ft between plants in rows 34 in apart. All plants were cultivated once and emerged weeds were removed before treatments were applied. During the growing season, overhead irrigation was applied as needed. There was adequate rainfall during the treatment period.

Granular applications were made with a simple hand shaker and sprays with a hand pumped pressure sprayer with flat spray 8003 nozzle. Herbicides used are shown in Table 2. Applications were made at Farmingdale on May 9 and at Riverhead on May 11, 14 and 22, 1979. There were 4 blocks each with 17 treatments. Each treatment area was 3 plants in each row across the 14 rows. The delay in treatment at Riverhead may have given weeds especially barnyardgrass (Echinochloa crus-galli (L.) Beauv.) a head start.

The plots at Farmingdale were rated for weed control on June 28-30 (Table 3) and at Riverhead on June 27 (Table 4). The rating system was 1 for a plot full of weeds to 7 for satisfactory control to 10 for a weed free plot. A 10 could mean excellent control on the absence of the weed in the area. After ratings were made all weeds were removed by hand. The weed regrowth was observed at Farmingdale on Aug 27-31 (Table 5) and at Riverhead on Aug 13

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(Table 6). Then all areas were cultivated and handweeded. On Oct 11-18 at Farmingdale (Table 7) and at Riverhead on Oct 12 & 18, each individual nursery plant was rated for crop growth using an index of 1 for a dead or missing plant, 2-4 poor, 7 acceptable to 10 for excellent growth.

RESULTS AND DISCUSSION

The predominant weeds at Farmingdale were large crabgrass (*Digitaria sanguinalis* (L.) Scop.), galinsoga (*Galinsoga parviflora* Cav.), redroot pigweed (*Amaranthus retroflexus* L.), common purslane (*Portulaca oleracea* L.), groundsel (*Senecio vulgaris* L.), yellow foxtail (*Setaria lutescens* (Weigel) Hubb.) and common ragweed (*Ambrosia artemisiifolia* L.). At Riverhead the predominant weed was barnyardgrass and some common purslane and groundsel.

The metolachlor plus simazine at rates of 4 + 1 and higher gave very good to excellent control at Farmingdale and Riverhead as seen by the high ratings. Metolachlor alone at higher rates was also very effective. Prodiamine was more effective at Farmingdale, probably because there was a delay in application at Riverhead. Oryzalin granular and wettable powder were equally effective. Oxyfluorfen was fairly effective.

There was very little crop injury from any of the herbicide treatments. Crop injury as shown by low growth ratings (Tables 7 & 8) were only evident on *Viburnum* treated with metolachlor at 16 lb/A at Riverhead and azalea treated with simazine at 4 lb/A with metolachlor at Riverhead.

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Table 1. Nursery liners used in early 1979 preemergence weed control experiments at Farmingdale(F) and Riverhead(R).

Common name	Location	Scientific name
California privet	FR	Ligustrum ovalifolium Hassk.
Golden bells	FR	Forsythia intermedia Zab.
White pine	FR	Pinus strobus L.
Japanese black pine	FR	Pinus thunbergii Parl.
Torringo crabapple	FR	Malus Sieboldii (Reg.) Rehd.
Red stemmed dogwood	FR	Cornus stolonifera Mich.
Viburnum	F	Viburnum setigerum Hance.
Cranberry viburnum	R	Viburnum trilobum Marsh
Hicks yew	FR	Taxus cuspidata Hicksii Rehd.
Andorra juniper	FR	Juniperus horizontalis plumosa Rehd.
Japanese holly	F	Ilex crenata Thunb.
Red oak	F	Quercus borealis Mich.
Arbor vitae	R	Thuja occidentalis L.
Norway maple	R	Acer paltanoides L.
Roseum Elegans rhododendron	F	Rhododendron catawbiense Mich.
Hinocrimson azalea	F	Rhododendron obtusum Japonicum (Maxim.) Wils.)
Deciduous azalea	R	Rhododendron gandavense Rehd.
Euonymus	R	Euonymus fortunei radicans Rehd.
English ivy	R	Hedera helix L.
Canadian hemlock	F	Tsuga canadensis Carr.

Table 2. Preemergence herbicides used in early plantings.

Common name	Formulation	Chemical name
metolachlor	8E, 2G	[2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide]
oryazlin	75 WP, 5G	(3,5-dinitro-N^4,N^4-dipropylsulfanilamide)
prodiamine	50 WP	[2,4-dinitro-N^3,N^3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine]
simazine	4L	[2-chloro-4,6-bis(ethylamino)-s-triazine]

Table 3. Postplant preemergence weed control on nursery liners planted April 24 - May 1, treated June 9, 1979, rated June 28-30, 1979 at Farmingdale, New York.

Treatment			Weed control ratings[a]									
Common name	Formulation	lb/A	Gen[b]	Gr	Non-gr	Fox	Cg	Gal	Gnd	Purs	Rr	Rag
Untreated			4	6	4	8	6	7	8	8	7	8
Hand weeded			10	10	10	10	10	10	10	10	10	10
Metolachlor + simazine	8E 4L	2 + 1/2	6	8	7	8	9	8	8	8	8	8
"	"	4 + 1	8	9	8	9	10	9	9	8	9	10
"	"	8 + 2	10	10	10	10	10	10	10	10	10	10
"	"	16 + 4 (3)	10	10	10	10	10	10	10	10	10	10
Metolachlor	8E	2 (3)	6	9	7	10	10	10	7	10	10	10
"		4	6	9	6	10	10	10	7	8	9	8
"		8	8	10	8	10	10	10	8	9	10	9
"		16	8	10	8	10	10	10	10	10	10	10
Metolachlor	15G	4	6	8	6	8	10	8	7	8	8	7
Prodiamine	50 WP	1	5	8	6	8	8	8	8	8	7	8
"		2	8	10	8	9	10	10	9	8	9	10
"		4	8	10	8	9	10	9	9	10	10	10
"		8	9	10	9	10	10	10	8	10	10	10
Oryzalin	75 WP	2	8	9	8	9	10	8	8	10	10	8
"	5 G	2 (3)	8	9	8	9	10	9	8	9	10	10

(a) Ratings are for 4 replicates of 3 plants. (3) after rate indicates only 3 replicates. Rates are from 1, full of weeds, to 10, no weeds.

(b) Gen = General, Gr = Grass, Non-gr = Non-grass, Fox = Foxtail, Cg = Crabgrass, Gal = Galinsoga, Gnd = Groundsel, Purs = Purslane, Rr = Redroot, Rag = Ragweed

Table 4. Postplant preemergence weed control on nursery liners planted April 24 - May 1, 1979, treated May 11, 15 and 22, 1979 and rated on June 27, 1979 at Riverhead, New York.

Treatment			Weed control ratings[a]					
Common name	Formulation	lb/A	General	Grass	Non-grass	Barnyd grass	Smart-weed	Lambs-quarters
Untreated			2	4	5	4	6	8
Hand weeded			10	10	10	10	10	10
Metolachlor + simazine	8E 4L	2 + 1/2	9	10	9	10	9	9
"	"	4 + 1	10	10	10	10	10	10
"	"	8 + 2	10	10	10	10	10	10
"	"	16 + 4	10	10	10	10	10	10
Metolachlor	8E	2	8	10	8	10	9	9
"		4	8	10	8	10	8	9
"		8	9	10	9	10	10	9
"		16	9	10	9	10	10	10
Oxyfluorfen	2G	2	7	8	8	8	8	9
"		4	8	8	10	8	10	10
"		8	9	10	10	9	10	10
Prodiamine	2G	1	4	5	6	5	8	8
"		2	6	8	7	8	8	8
"		4	6	8	8	7	9	9
"		8	7	8	8	7	9	7

(a) Ratings are for 4 replicates of 3 plants; rates are from 1, full of weeds, to 10, no weeds.

Table 5. Postplant preemergence weed control on nursery liners planted April 24-30, treated May 9, 1979, rated first June 28-30, 1979 and hand weeded and rated for regrowth Aug 27-31, 1979 at Farmingdale, New York.

Treatment			Weed control ratings[a]										
Common name	Formulation	lb/A	Gen[b]	Gr	Nongr	Cg	Byd	Fp	Grd	Cw	Gal	Purs	Rr
Untreated			2	3	4	6	10	10	5	6	7	6	6
Hand weeded			10	10	10	10	10	10	10	10	10	10	10
Metolachlor + simazine	8E 4L	2 + 1/2	3	6	4	6	8	8	5	7	8	7	7
"	"	4 + 1	3	6	4	6	10	8	6	7	10	6	7
"	"	8 + 2	6	8	6	8	10	10	8	9	8	7	8
"	"	16 + 4(3)	8	9	8	9	10	9	9	9	8	8	8
Metolachlor	8E	2 (3)	2	5	4	6	7	10	5	7	8	6	7
"		4	2	6	3	6	7	10	5	6	7	7	8
"		8	3	9	4	9	10	9	5	7	7	6	10
"		16	5	10	5	10	10	10	6	8	8	6	10
Metolachlor	15G	4	2	5	3	7	7	10	4	6	7	6	8
Prodiamine	50 WP	1	3	6	5	7	10	8	6	7	7	7	8
"		2	5	8	6	8	9	10	6	10	8	8	10
"		4	6	9	6	10	9	10	6	10	9	10	10
"		8	8	10	8	10	10	10	8	10	10	10	10
Oryzalin	75 WP	2	4	8	5	8	10	10	6	9	8	8	10
"	5 G	2 (3)	5	6	6	7	8	8	6	8	8	8	8

(a) Ratings are for 4 replicates of 3 plants. (3) after rate indicates 3 replicates. Rates are from 1, full of weeds, to 10, no weeds.

(b) Gen = General, Gr = Grass, Nongr = Nongrass, Cg = Crabgrass, Byd = Barnyardgrass, Fp = Fall panicum, Grd = Groundsel, Cw = Carpetweed, Gal = Galinsoga, Purs = Purslane, Rr = Redroot

Table 6. Postplant preemergence weed control on nursery liners planted April 24 - May 1, 1979, treated May 11, 14 and 22, 1979, rated first June 27 and hand weeded and rated for regrowth Aug 13, 1979 at Riverhead, New York.

Treatment			Weed control ratings[a]					
Common name	Formulation	lb/A	General	Grasses	Nongrass	Barnyd-grass	Purslane	Groundsel
Untreated			5	6	7	5	6	6
Hand weeded			10	10	10	10	10	10
Metolachlor + simazine	8E 4L	2 + 1/2	6	9	7	9	7	8
"	"	4 + 1	8	9	8	9	10	9
"	"	8 + 2	10	10	10	10	10	10
"	"	16 + 4	10	10	10	10	10	10
Metolachlor	8E	2	6	9	6	9	7	6
"		4	5	9	5	9	7	6
"		8	8	10	8	10	8	8
"		16	9	10	9	10	10	9
Oxyfluorfen	2G	2	6	7	7	8	8	7
"		4	7	8	8	8	9	8
"		8	8	8	9	9	10	9
Prodiamine	2G	1	4	8	5	8	7	5
"		2	5	8	5	9	7	6
"		4	6	8	6	8	7	6
"		8	7	9	7	9	8	8

(a) Ratings are for 4 replicates of 3 plants. Rates are from 1, full of weeds, to 10, no weeds.

Table 7. Growth ratings of nursery liners planted April 25, 1979, treated May 9 and observed Oct 11 and 18, 1979 at Farmingdale, New York.

Treatment			Growth ratings													
Common name	Formulation	lb/A	Jbp[a]	Az	Rh	He	Il	Ju	Yew	Wp	So	Vib	Tca	Rsd	For	Pri
Untreated			7	5	3	8	6	7	10	5	4	6	8	9	8	8
Hand weeded			4	5	5	7	5	9	10	3	5	7	6	9	7	8
Metolachlor	8E	2(3)[b]	7	6	6	6	6	10	10	5	4	8	7	8	9	9
"		4	7	6	6	8	6	8	10	5	3	8	7	8	10	9
"		8	6	6	4	8	4	8	10	5	2	7	7	9	9	8
"		16	4	4	4	8	6	9	10	2	5	8	4	7	8	8
Metolachlor + simazine	8E 4L	2 + 1/2	6	6	8	7	6	8	10	6	4	7	7	9	8	9
"	"	4 + 1	6	4	6	8	6	8	10	4	6	8	8	7	10	9
"	"	8 + 2	6	5	5	6	6	8	10	4	3	7	8	9	10	9
"	"	16 + 4(3)	4	4	4	8	7	8	10	4	6	7	5	7	6	6
Prodiamine	50 WP	1	6	5	5	8	8	8	10	6	6	8	7	8	9	7
"		2	7	4	7	8	7	8	10	7	4	7	8	8	8	8
"		4	6	4	6	7	6	8	10	6	5	7	7	8	8	10
"		8	6	4	7	9	5	8	9	6	5	7	7	8	9	10
Metolachlor	15G	4	6	7	7	6	5	7	9	4	6	6	7	9	6	9
Oryzalin	75 WP	2	6	6	5	6	7	9	9	6	5	8	7	8	8	9
"	5 G	2(3)	7	6	6	6	9	9	10	6	6	7	4	9	9	10

a) Jbp = Japanese black pine, Az = Azalea, Rh = Rhododendron, He = Hemlock, Il = Ilex crenata, Ju = Juniper, Wp = White pine, So = Scarlet oak, Vib = Viburnum, Tca = Torringo Crabapple, Rsd = Redstemmed dogwood, For = Forsythia, Pri = Privet

b) (3) indicates only 3 replicates

Table 8. Growth ratings of nursery liners planted April 24 - May 1, treated May 11, 14, 22, 1979 and observed Oct 12 and 18, 1979 at Riverhead, New York.

Treatment			Growth ratings[a]													
Common name	Formulation	lb/A	Pri[b]	For	Rsd	Ca	Vib	Eun	Wp	Bp	Ju	Yew	Arb	Az	Ma	Ivy
Untreated			10	9	9	9	8	8	3	8	8	10	8	10	8	9
Hand weeded			10	10	9	8	7	8	4	5	10	10	9	9	8	9
Metolachlor + simazine	8E 4L	2 + 1/2	10	10	10	9	9	10	6	9	10	10	9	10	9	9
"	"	4 + 1	8	10	10	10	8	10	5	9	10	10	9	8	7	9
"	"	8 + 2	8	10	10	9	8	8	4	8	10	10	9	8	8	9
"	"	16 + 4	8	9	7	8	5	4	4	8	9	10	8	5	6	9
Metolachlor	8E	2	10	10	9	10	8	9	5	8	9	10	9	10	8	8
"		4	10	10	10	9	8	10	5	7	10	9	10	10	8	9
"		8	10	10	10	8	8	10	4	8	10	10	10	10	7	9
"		16	10	10	9	10	5	9	3	6	9	10	10	9	7	9
Oxyfluorfen	2G	2	10	10	9	8	8	10	5	8	10	10	10	9	8	9
"		4	10	10	10	9	7	10	5	8	10	10	10	10	7	9
"		8	10	10	8	8	8	8	4	8	10	10	9	10	6	9
Prodiamine	2G	1	10	9	10	10	7	8	6	8	9	9	9	10	8	9
"		2	7	10	10	10	8	10	4	8	10	10	9	10	9	9
"		4	10	10	10	9	7	10	4	8	10	10	9	10	9	9
"		8	10	10	8	10	8	9	4	8	10	10	9	10	8	8

(a) Ratings are an average of 4 replicates of 3 plants. Rating is from 1 = dead or missing plant, 10 = maximum growth.

(b) Pri = Privet, For = Forsythia, Rsd = Redstemmed dogwood, Ca = Crabapple, Vib = Viburnum, Eun = Euonymous, Wp = White pine, Bp = Black pine, Jun = Juniper, Arb = Arborvitae, Az = Azalea, Ma = Maple.

THE USE OF GLYPHOSATE IN WEED INFESTED NURSERY BEDS

C. Haramaki, L. Kuhns, and D. Grenoble[1]

ABSTRACT

A heavily weed infested nursery area planted with liners was sprayed with glyphosate at 1, 2, 4 and 8 pounds per acre. The amount of weeds was reduced and was still low after five weeks at 2, 4 and 8 pounds per acre. After twelve weeks the amount of grasses had increased; the amount of broadleaved weeds had increased, but it was still less than the untreated; and the amount of Canada thistle remained low at the 4 and 8 pounds rate. Common boxwood and Laland pyracantha at 1, 2 and 4 pounds per acre and inkberry at 1 and 2 pounds had little or no injury twelve weeks after glyphosate application.

INTRODUCTION

Glyphosate (N-(phosphonomethyl) glycine) is a useful, post-emergence, translocated herbicide for the elimination of emerged weeds in fields prior to the planting of nursery crops. Directed sprays of glyphosate has been used around the base of a number of ornamental trees and shrubs. Some observations have been made on broadcast sprays over the crop as well as the weeds. The objectives of this experiment were to evaluate glyphosate for post emergent weed control and to determine the tolerance of some broadleaf evergreen liners, when grown under a weed cover, to overhead applications of glyphosate.

METHODS AND MATERIALS

On July 6, 1979 a heavily weed infested nursery area containing established liners was sprayed with a CO_2 pressured sprayer at 20 psi at the rate of 40 gallons per acre using LP8002 nozzles fitted with 50 mesh screens. Common boxwood (Buxus sempervirens L.) cranberry cotoneaster (Cotoneaster apiculata REHD) inkberry (Ilex glabra GRAY) and Laland firethorn (Pyracantha coccinea lalandi ROEM) were sprayed with glyphosate at 1, 2, 4 and 8 pounds of active ingredient per acre. Each treatment which was applied to a 90 square feet plot was replicated 18 times including the control. The weather was clear and sunny, with winds between 5 and 8 miles per hour and the soil moisture was at field capacity. The temperatures at the start of the spraying were air - 58°F and soil surface - 72°F and at the end were air - 61°F and soil surface - 74°F. The experiment was conducted at The Pennsylvania State University Agricultural Research Center at Rock Springs.

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Table 1. Weed growth just prior to glyphosate application, 1979.

Rate	Grasses*	Broadleaves	Canada Thistle	All Weeds
0	0.45	3.67	2.67	6.67
1#/A	0.46	3.17	3.00	6.72
2#/A	0.23	4.06	2.72	6.89
4#/A	0.67	3.28	2.67	6.61
8#/A	1.00	3.89	2.44	7.33

*0 = No weeds, 10 = 100% coverage, Heavy Infestation.

Table 2. Effect of glyphosate on weed growth, five weeks after application, 1979.

Rate	Grasses*	Broadleaves	Canada Thistle	All Weeds	Weed Height**
0	0.83	6.67	1.17	8.67	2 - 3
1#/A	1.50	2.00	0.67	4.17	½ - 1
2#/A	0.58	0.75	0.50	1.83	½ - 1
4#/A	0.33	0.17	0.33	0.83	½
8#/A	0.75	0.41	0.33	1.50	½

*0 = No Weeds, 10 100% Weed Coverage, Heavy Infestation.

**Height in feet.

Table 3. Effect of glyphosate sprayed on weeds twelve weeks after application, 1979.

Rate	Grasses*	Broadleaves	Canada Thistle	All Weeds	Weed Height**	
0	0.27	7.89	1.11	9.38	3.21	2 - 4
1#/A	2.44	2.61	1.44	6.44	1.55	½ - 3
2#/A	2.27	2.89	1.16	6.44	1.83	1 - 3
4#/A	1.61	2.72	0.78	5.11	1.70	1 - 3
8#/A	2.50	3.38	0.55	6.44	1.75	½ - 3

*0 = No Weeds, 10 = 100% Coverage, Heavy Infestation.
** Height in feet.

Table 4. Liner growth prior to glyphosate application, 1979.

Rate	Boxwood*	Inkberry	Pyracantha	Cotoneaster
0	0.97	0.39	0.04	0.14
1#/A	0.60	0.33	0.31	0.15
2#/A	0.80	0.36	0.15	0.12
4#/A	0.40	0.40	0.06	0.05
8#/A	0.81	0.54	0.14	0.07

*Plant Injury 0 - No Injury, 5 - Dead

Table 5. Effect of glyphosate sprays on liner growth twelve weeks after application, 1979.

Rate	Boxwood*	Inkberry	Pyracantha	Cotoneaster
0	1.22	1.16	0.24	2.67
1#/A	0.95	1.39	0.55	2.19
2#/A	1.40	1.91	1.99	3.13
4#/A	1.40	2.41	2.97	4.78
8#/A	2.89	3.54	4.32	4.91

*Plant Injury 0 - No Injury, 5 - Dead

RESULTS AND DISCUSSION

On June 25, 1979 prior to the glyphosate application the plots were examined for weed growth (Table 1) and liner growth and injury (Table 4). There were a few grasses but the plots were covered mainly by broad-leaved weeds. The predominant weeds in decreasing order at the time of the glyphosate application were common ragweed (*Ambrosia artemisiifolia* L.) Canada thistle (*Cirsium arvense* SCOP.) hop clover (*Trifolium agrarium* L.) shepardspurse (*Capella bursa-pastoris* MEDIC.), perennial ryegrass (*Lolium perenne* L.) dandelion (*Taraxacum officinale* WEBER) hairy galinsoga (*Galinsoga ciliata* BLAKE), yellow foxtail (*Setaria lutescens* HUBB), Pennsylvania smartweed (*Polygonum pensylvanicum* L.), redroot pigweed (*Amaranthus retroflexus* L.) yellow woodsorrel (*Oxalis stricta* L.) and field pepperweed (*Lepidium campestre* R.BR.). The established liners had very little or no injury prior to glyphosate application.

After five weeks the amount of grasses present was still low (Table 2). The broadleaf weeds including Canada thistle was reduced with all applications of glyphosate and especially at the 2, 4 and 8 pounds per acre rates. Common ragweed which was the predominant weed was eliminated and the other predominant weed Canada thistle was greatly reduced. Yellow foxtail was eliminated and replaced by fall panicum (Panicum dichotomiflorum MICHX). The weed height was less as the rate of glyphosate application increased.

On September 26, 1979 which was twelve weeks after treatment the amount of grasses in the glyphosate treated plots had increased (Table 3). The amount of broadleaved weeds increased in all treatments while the amount of Canada thistle was still low. The weed heights in the treated plots were less than in the untreated control. Common boxwood exhibited slight or no injury in the control and 1, 2 and 4 pounds per acre plots (Table 5). Moderate necrosis was observed in the common boxwood when sprayed at 8 pounds per acre. Inkberry had only slight injury in the control and 1 and 2 pounds per acre treated plots, moderate necrosis at 4 pounds and severe injury at 8 pounds per acre. Laland pyracantha exhibited no injury at one pound per acre and also when not sprayed. There was moderate leaf necrosis and shoot tip dieback at 4 pounds and severe injury or death at 8 pounds per acre. The cranberry cotoneaster showed some injury regardless whether it was treated or not and were mostly dead at the 4 and 8 pounds of active ingredient per acre rate. The overstory growth of the weeds protected the liners at the lower rates of glyphosate but at the higher rates both the weeds and liners were injured or killed.

THE USE OF HERBICIDES TO CONTROL WEEDS IN A SALESYARD HOLDING AREA

A. Bing[1/]

ABSTRACT

Balled and burlapped (B&B) and container grown plants are often held for long periods of time in loading areas or salesyards. Weeds can become a serious problem on the ground or invade the soil surface of the containers or B&B plants. Perennial weeds could be controlled by spraying the growing weeds area with glyphosate [N-(phosphonomethyl)glycine] before placing plants in the area. Seedling weeds might be safely controlled with a preemergence herbicide application. Several years ago the author carried out a series of tests in a container production nursery using several combinations of simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] with other chemicals on the sandy soil surface before placing plants with reasonably good weed control and no injury to the nursery plants.

This past season an area was treated with glyphosate at 3/4 lb/A to control existing weeds which were predominantly curly dock (Rumex crispus L.). The area was covered with 4-6 in of sand and gravel to be used as a container growing area. Areas 10 by 10 ft were treated with simazine 4G at 1 lb/A plus alachlor 15G [2-chloro2',6'-diethyl-N-(methoxymethyl)acetanilide] at 4 lb/A or oryzalin 5G (3,5-dinitro N^4,N^4-dipropylsulfanilamide) at 2 lb/A or napropamide 50 WP [2-(a-naphthoxyl)-N,N-diethylpropionamide] at 4 lb/A or oxadiazon 2G [2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one] at 2 lb/A on June 19 and one area was untreated. After the soil treatment plants were placed on the gravel and the same treatments were repeated over the plants so the area not covered by the plants received a double treatment. There was very good weed control in all treated plots as observed on Sept. 26. The untreated area was heavily infested with weeds especially prickly lettuce (Lactuca serriola L.). None of the following B&B plants showed any signs of injury and several of them, especially Hetz juniper (Juniperus chinensis hetzii glanca L.) had roots growing into the treated sand and gravel, Hicks yew (Taxus cuspidata Hicksii Rehd.), Azalea var Hinocrimson (Rhododendron obtusum Japonicum (Maxim.) Wils.), Japanese holly (Ilex crenata Thunb.), Japanese andromeda (Pieris japonica (Thunb.) D.Don.). There was no injury on 2-gallon containers of azaleas, Rhododendron var. Roseum Elegans (Rhododendron catawbiense Mich.), and leucothoe (Leucothoe axillaris (Lam.) D. Don.) and English boxwood (Buxus sempervirens L.).

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PREEMERGENT WEED CONTROL IN ORNAMENTAL LINER BEDS

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ABSTRACT

Liners of mentor barberry, warty barberry, wintergreen barberry, rockspray cotoneaster, spreading euonymous, American holly, winter jasmine, and chionoides rhododendron were sprayed with alachlor, metolachlor, napropamide, oryzalin, and prodiamine at 1, 2, 4 and 8 pounds of active ingredient per acre. All of the liners were tolerant to the herbicides sprays. Spreading euonymous had poor growth in all treatments including the untreated plots. Good to excellent control of grasses was obtained at all rates of alachlor and metolachlor, napropamide at 2, 4 and 8 pounds; oryzalin at 4 and 8 pounds. Oryzalin at 8 pounds and prodiamine at 2, 4 and 8 pounds gave excellent control of the broadleaved weeds. The weed height was reduced as the concentration increased for all herbicides.

INTRODUCTION

There have been several herbicides cleared for use in ornamental nurseries but the number of species in which they are used is still limited. The objectives of this experiment were to determine the effectiveness of several herbicides to control annual grasses and broadleaved weeds and to determine their phytotoxicity to several different ornamental plant species.

METHODS AND MATERIALS

The experiment was conducted at The Pennsylvania State University Agricultural Research Center at Rock Springs. On June 28, 1979 eight different species of broadleaf evergreen were planted in a Hagerstown silt loam which had been previously double disced and spring tooth harrowed. Four liners of wintergreen barberry (Berberis julianae SCHNEID.), mentor barberry (Berberis x mentorensis L. M. AMES.), warty barberry (Berberis verruculosa HEMSL. and WILS.), rockspray cotoneaster (Cotoneaster horizontalis DCNE.), spreading euonymus (Euonymus kiautschovicus LOES.), American holly (Ilex opaca AIT.), winter jasmine (Jasminum nudiflorum LINDL.) and chionoides rhododendron (Rhododendron chionoides J. WAT.) were planted in each of the ninety-two plots.

On July 6, 1979 the herbicides alachlor (2-chloro-2',6' diethyl-N-(methoxymethyl) acetanilide), metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl) -N-(2-methoxy-1-methylethyl) acetanilide), napropamide (2-(α-naphthoxyl)-N,N-diethylpropionamide), oryzalin (3,5-dinitro N^4,N^4-dipropylsulfanilamide) and prodiamine (2,4 dinitro-N^3,N^3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine)

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Table 1. Effect of Pre-emergent Sprays on Weed Growth Twelve Weeks After Application, 1979

Chemical	Rate	Grasses*	Broad-leaves	All Weeds	Weed Height**
Check	0	4.58	5.25	9.83	3
Alachlor	1#/A	0.75	4.25	5.00	3
	2#/A	0.50	4.75	5.25	2
	4#/A	0	4.00	4.00	1
	8#/A	0	1.75	1.75	0.5
Metolachlor	1#/A	0.25	7.25	7.50	3
	2#/A	0.25	7.00	7.25	2
	4#/A	0.25	4.75	5.00	1.5
	8#/A	0	2.75	2.75	0.5
Napropamide	1#/A	2.50	6.50	9.00	3
	2#/A	1.00	6.25	7.25	3
	4#/A	1.00	5.50	6.50	2
	8#/A	0.25	4.25	4.50	1.5
Oryzalin	1#/A	3.75	3.00	6.75	2
	2#/A	2.00	2.25	4.25	1.5
	4#/A	0.75	2.00	2.75	0.5
	8#/A	0.25	0.50	0.75	0.5
Prodiamine	1#/A	1.25	1.75	2.25	1.5
	2#/A	2.50	0.75	2.25	1
	4#/A	0.50	0.75	1.25	0.5
	8#/A	0.25	0.50	0.75	0.5

* 0 = No weeds, 10 = 100% Coverage, Heavy Infestation.

** Height in feet.

were applied at the rate of 1, 2, 4 and 8 pounds of active ingredient per acre. The 135 square foot plots were sprayed with a CO_2 pressured sprayer at 20 psi at the equivalent of 40 gallons per acre using LP8002 nozzles with 50 mesh screens. All of the herbicide treatments were replicated four times and there were twelve untreated plots in the split plot designed experiment. At the time of application the sky was clear and sunny and the wind was less than one mile per hour. The soil was moist and at field capacity. The temperatures at the start of the spraying were: air - 43°F and soil surface - 47°F, and at the end they were air - 56°F and soil surface - 63°F. The plots were sprinkler irrigated immediately after spraying. The weeds were 1/8 inches tall at the time of herbicide application. The plots were irrigated periodically throughout the summer. On September 27, 1979 the plots were examined for weed growth and crop injury.

RESULTS AND DISCUSSION

After twelve weeks the predominant weeds in decreasing order of frequency in the control plots were redroot pigweed (*Amaranthus retroflexus* L.) yellow foxtail (*Setaria lutescens* HUBB.), common purslane (*Portulaca oleraceae* L.), field pepperweed (*Lepidium campestre* R.B.R.), common ragweed (*Ambrosia artemisiifolia* L.), barnyard grass (*Echinchloa crus-galli* BEAUV.), and tumble pigweed (*Amaranthus albus* L.).

Alachlor at 1, 2, 4 and 8 pounds of active ingredient per acre controlled all grasses. The broadleaved weeds were reduced slightly at 1, 2 and 4 pounds per acre, while 8 pounds per acre gave reasonably good control. Common purslane and shepardspurse (*Capella bursa-pastoris* MEDIG) was partially tolerant to alachlor. Metolachlor at all rates gave effective control of grasses. There was some reduction of broadleaved weeds at 4 pounds of active ingredient per acre while 8 pounds gave almost acceptable weed control. Common purslane and shepardspurse were more resistant to metolachlor than the other weeds. Napropamide reduced the number of grasses at 1 pound of active ingredient per acre and gave reasonably good control at 2 and 4 pounds. At 8 pounds per acre the grasses were effectively controlled. The broadleaved weeds were not controlled at 1, 2 and 4 pounds per acre while 8 pounds gave some reduction. Redroot pigweed and common purslane were less susceptible. Oryzalin reduced the grass population at 1 and 2 pounds of active ingredient per acre while 4 and 8 pounds gave acceptable grass control. At 1, 2 and 4 pounds the broadleaved weeds were reduced and effective control was obtained at 8 pounds per acre. Common purslane and shepardspurse were slightly tolerant. Prodiamine gave reasonably good control of both grasses and broadleaved weeds at 1 and 2 pounds of active ingredient per acre, while 4 and 8 pounds produced excellent weed control. In all herbicide treatments the average height of the weeds was reduced as the concentration was increased.

The mentor, warty and wintergreen barberries exhibited good growth and had very little or no injury regardless of treatment. Winter jasmine exhibited very slight injury in all plots. Rockspray cotoneaster also had good growth with negligible or no injury regardless of the herbicide or concentration treatment. American holly had little or no injury in all treatments. Chionoides rhododendron showed little or no injury in most treatments. There was slight injury in some of the plots treated with alachlor, oryzalin and prodiamine. This injury appeared to be more from being planted in an open field than from the herbicides. All of the spreading euonymus grew poorly and exhibited moderate to severe injury regardless if it was sprayed with herbicide or left untreated.

Table 2. Effect of Post-plant Sprays of Pre-emergent Herbicides on Liners Twelve Weeks After Application, 1979.

Chemical	Rate	Mentor Barb	Warty Barb.	Winter-Green Barb.	Winter Jasmine	Spread. Euonymus	Coton-easter	Amer. Holly	Rhodo-dendron
Check	0	0.10	0.38	0.58	1.73	3.81	0.40	0.71	1.03
Alachlor	1#/A	0	0.19	0. 9	1.69	2.87	0.19	0.44	1.56
	2#/A	0	0.31	0.25	0.94	2.94	0.62	0.38	0.81
	4#/A	0.13	0.31	0.38	0.75	3.44	0.13	0.56	2.00
	8#/A	0	0.19	0.31	0.94	3.50	0.38	1.69	2.19
Metolachlor	1#/A	0.13	0.38	0.31	1.75	3.69	0.25	0.31	0.56
	2#/A	0	0.63	0.63	1.56	3.69	0.69	0.38	0.88
	4#/A	0	0.31	0.25	1.38	3.31	0.50	1.00	1.16
	8#/A	0.06	0.94	0.13	1.38	3.69	0.06	0.56	1.44
Napropamide	1#/A	0	0.56	0.44	2.06	3.88	0.19	0.31	0.81
	2#/A	0.06	0	0.13	1.50	3.75	0.25	0.50	0.56
	4#/A	0.06	0.44	0.63	1.44	3.75	0.44	0.50	1.44
	8#/A	0	0.31	0	1.06	3.13	0.13	0.56	1.13
Oryzalin	1#/A	0.13	0	0.13	0.88	3.94	0	0.50	1.31
	2#/A	0.44	0	0.25	0.88	3.63	0.19	1.31	2.50
	4#/A	0	0.13	0.31	1.25	3.75	0.19	1.44	1.88
	8#/A	0.44	0	0.31	0.63	3.63	0.38	1.56	1.56
Prodiamine	1#/A	0.63	0.63	0.38	0.75	3.00	0.38	0.81	2.50
	2#/A	0.06	0.25	0.31	0.88	2.94	0.31	1.63	1.56
	4#/A	0	0	0.13	0.75	3.50	0.81	0.81	1.56
	8#/A	0.25	0.13	0.31	0.75	3.44	1.25	1.38	1.38

0 = No Injury, 5 = Dead

CONTROL OF YELLOW NUTSEDGE IN WOODY ORNAMENTALS

J. F. Ahrens [1/]

ABSTRACT

Herbicides were applied for the control of yellow nutsedge in established Japanese yews and before or after planting six woody ornamentals. In established yews, dichlobenil at 6 lb/A, but not napropamide at 6 to 10 lb/A, gave excellent control of nutsedge during the following season when applied in December and followed by precipitation. Applied in March on the soil surface and reapplied in June and incorporated, metolachlor at 6 lb/A gave seasonal control without injury to the yews. Alachlor was less effective than metolachlor.

Preplant incorporated applications of metolachlor at 4 or 8 lb/A gave 3 to 4 months control of yellow nutsedge with little injury to the woody ornamentals. UBI-S734 also gave long term control, but injured white pine and forsythia. EPTC at 1 lb/A with or without extender, napropamide at 8 lb/A, and alachlor at 4 or 8 lb/A controlled nutsedge for 2 months.

Postemergence applications of bentazon or acifluorfen with surfactant or oil gave poor control of yellow nutsedge and injured three ornamentals. Forsythia was the most susceptible ornamental to the herbicides tested.

INTRODUCTION

Yellow nutsedge (*Cyperus esculentus* L.) continues to present severe problems in the production of woody nursery stock. During the 1978 season we found that surface applications of metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide], and alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] gave fair control of nutsedge without injury to Japanese yews (2). Mixed results in nursery plantings have been reported with bentazon (3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide) and acifluorfen (5-[2-chloro-4(trifluoromethyl)phenoxy]-2-nitrobenzoic acid), napropamide [2-(α-naphthoxy)-N,N-diethylpropionamide) and dichlobenil (2,6-dichlorobenzonitrile) (1,2,3).

The objective of the work reported here was to compare these and other herbicides for controlling nutsedge in established and newly planted woody ornamentals.

MATERIALS AND METHODS

Two herbicide trials were conducted at a commercial nursery in Waterford, CT on fields with previously high populations of yellow nutsedge. On both sites the soils were silt loams with 7% organic matter. Sprays were applied with a hand-held boom on a calibrated knapsack sprayer delivering 50 gal/A,

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and granules were applied with calibrated auger-feed applicator. Weed control and plant injury ratings were made on a scale of 0 to 10: 0 = no weed control, or plant injury; 10 = complete weed control, or all plants dead.

Treatments in established *Taxus*. A field of *Taxus cuspidata* 'Densiformis' was planted as 4-year-old liners in April 1977. Herbicides were applied on December 7, 1978 or March 21, 1979 and June 5, 1979 on plots 6 ft by 14 ft, each containing two rows of plants spaced at 2 ft x 3 ft. Treatments were replicated four times in a randomized complete block design.

Treatments in December and March were applied over the plants and remained on the soil surface. Rain and snow totaling 1.6 in started a day after the December treatments and 1 in of rain fell in the 2 weeks following the March applications. On June 5, 1979 all plots were rotary tilled and hand weeded following evaluations of nutsedge control. Alachlor and metolachlor were then reapplied and the plots again were rotary tilled 3 in deep. Control of nutsedge and injury to the *Taxus* was evaluated on July 23.

Treatments before and after planting nursery stock. The field was fitted and laid out into plots 6 ft by 18 ft with 3-ft borders on the sides and 5-ft borders at plot ends. A randomized complete block design was used with four replicates and two control plots per replicate.

The preplanting treatments were applied on a dry soil surface on May 8, 1979 and incorporated 2 in deep with a rotary tiller within two hours. The following nursery plants were planted between May 8 and 10 in two rows spaced 3 ft apart within each plot: Japanese yews (*Taxus cuspidata*), 2 years old, 5 per plot; white pine (*Pinus strobus*), 3 years old, 3 per plot; forsythia (*Forsythia intermedia* 'Lynwood Gold'), rooted cuttings, 5 per plot; Andorra juniper (*Juniperus horizontalis plumosa*), 2 years old, 3 per plot; rhododendron (*Rhododendron catawbiense* 'Roseum Elegans'), 1 year old, 3 per plot; and arborvitae (*Thuja occidentalis* 'Pyramidalis'), 2 years old, 3 per plot. The plants were spaced 1 ft apart in the row. The roots of all plants in the plots treated with EPTC (S-ethyl dipropylthiocarbamate), except the rhododendrons, were dipped into a slurry of activated carbon at 1 lb/gal before planting. Post-plant preemergence treatments of oxadiazon [2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one], and oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide) were applied on May 10, 1978 on the dry soil surface. About 0.15 in of rain fell on May 12 and 0.9 in on May 18. Postemergence treatments were first applied on June 5, 1979 on nutsedge 2 to 5 in tall. Treatments of bentazon and acifluorfen were reapplied on June 15, 1979. The bentazon and acifluorfen sprays contained either X-77 surfactant at 0.5% v/v or Booster plus E [1/] at 1 qt per 50 gal/A. On June 20, when the nutsedge was 10 to 15 in tall control was evaluated and all except the postemergence plots were hand weeded and rotary tilled. On June 28 we evaluated the postemergence plots and then weeded and tilled all plots. The evaluation, hand weeding, and tilling were repeated on July 23 and August 21.

Rainfall during 1978 was about 1½ times normal in April, normal in May (3.6 in), half normal in June, 2/3 normal in July, and 2½ times normal in August.

1/ Crop oil plus surfactant.

Because of the severe competitive effects of yellow nutsedge on the growth of nursery stock, control ratings less than 9.0 (90% control) early in the season were considered commercially unacceptable.

RESULTS AND DISCUSSION

Treatments in established Taxus. December applications of dichlobenil (2,6 dichlorobenzonitrile), followed shortly by rain and snow effectively controlled nutsedge during the following season (Table 1). Similar results

Table 1. Control of yellow nutsedge with applications in established yews.

Herbicide	Rate, ai lb/A	Dates 1/ applied	Control of nutsedge (0-10) May 30	July 28
untreated			0	0
dichlobenil, G	6	12/7	9.3	9.0
	8	12/7	9.3	9.2
napropamide, WP	6	12/7	4.5	1.5
	8	12/7	6.7	3.2
	10	12/7	6.0	3.3
napropamide, WP	6	3/21	1.3	2.2
	8	3/21	1.8	4.0
	10	3/21	1.5	4.2
alachlor, EC	4	3/21, 6/5	2.8	6.2
	6	3/21, 6/5	4.9	8.1
	8	3/21, 6/5	7.0	7.8
metolachlor, EC	4	3/21, 6/5	8.0	9.0
	6	3/21, 6/5	9.1	9.2
	8	3/21, 6/5	9.4	9.6
LSD p = .05			2.3	2.8
.01			3.1	3.8

1/ Applications on 12/7/78 and 3/21/79 were on soil surface. Plots were tilled and weeded on 6/5/79; then herbicides were applied and rotary tilled into upper 3 inches of soil.

have been obtained in the past with dichlobenil when adequate precipitation followed shortly after application (1). Applied in December, napropamide gave better control than when applied in March, but still was not satisfactory even at 10 lb/A. Metolachlor applied in March and reapplied in June was much more effective than alachlor. These results agree with reports by Higgins, et al (4) and Warholic and Sweet (5). Two applications of metolachlor at 6 lb/A gave seasonal control of nutsedge. None of the treatments injured or reduced growth of Taxus 'Densiformis'. About 6 weeks elapsed between the March applications and emergence of nutsedge. Metolachlor and alachlor may have been more effective if they had been applied closer to the time of nutsedge emergence.

Treatments before and after planting. An obvious effect of incorporating the preplant herbicides (ppi) with the rotary tiller was a streak of nutsedge appearing wherever the depth rod moved soil out and failed to incorporate the herbicides. This effect resulted in lower nutsedge control ratings with several treatments than might have occurred with uniform incorporation.

Several of the preplant incorporated treatments gave excellent initial control of nutsedge, but residual control varied greatly (Table 2). Napropamide at 8 lb/A and EPTC at 4 lb/A alone or plus an extender to increase soil persistence gave excellent control for 2 months, but poor control thereafter. Neither napropamide nor EPTC seriously injured any of the six ornamentals (Table 3). Alachlor gave excellent control for 1 month at 4 lb/A and 2 months at 8 lb/A, whereas metolachlor gave longer control at both rates. Metolachlor at 8 lb/A ppi controlled nutsedge for 4 months without serious injury to any of the ornamentals.

Control of nutsedge with UBI-S734 (2-[1-(2,5-dimethylphenyl)ethylsulfonyl]-pyridine N-oxide) at 1 or 2 lb/A ppi was only fair to good, but the effect persisted for 4 months. At 4 lb/A, UBI-S734 gave excellent control for 4 months. UBI-S734 caused minor injury to *Taxus*, but unacceptable injury to forsythia and white pine.

As expected, oryzalin alone did not control nutsedge. None of the post-emergence treatments of bentazon or acifluorfen with surfactant or with oil plus surfactant gave satisfactory control of nutsedge after two applications. Injury to forsythia and rhododendron also was unacceptable with these treatments. These results confirm findings in earlier tests at this nursery where June applications of these herbicides did not control nutsedge (2).

Granular oxadiazon caused early stunting of nutsedge, but like oryzalin gave poor control. Apparent injury to forsythia by both oryzalin and oxadiazon was probably due to excessive competition from nutsedge which reduced growth of the forsythia. In August, nutsedge populations were smaller in many untreated plots than in treated plots, partly because of variation, and partly because some of the herbicides may have delayed nutsedge emergence.

The results reported here indicate that metolachlor can control yellow nutsedge either as a preplant incorporated treatment in a range of woody plant materials or as a broadcast application in tolerant plants such as *Taxus*.

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TABLE 2. Control of nutsedge with herbicides applied before or after planting nursery liners.

Herbicide-rate ai, lb/A		Timing	May 20	June 15	June 28	July 23	August 21
			Nutsedge Control Ratings on a 0 to 10 Scale				
untreated controls			0	0	-	1.0	5.7
napropamide, WP	4	ppi	8.1	4.5	-	2.5	3.5
	8	ppi	9.3	8.4	-	4.0	5.0
alachlor, EC	4	ppi	9.4	8.0	-	0	4.5
	8	ppi	9.6	9.3	-	1.5	1.5
metolachlor, EC	4	ppi	9.5	9.4	-	7.1	9.1
	8	ppi	9.7	9.8	-	9.3	9.6
UBI-S734	1	ppi	8.1	7.0	-	8.7	9.4
	2	ppi	8.1	8.5	-	8.3	9.7
	4	ppi	9.5	9.6	-	9.6	9.7
EPTC, EC	4	ppi	9.3	9.0	-	3.8	3.8
EPTC+extender	4	ppi	9.4	9.3	-	3.0	5.0
oxadiazon, G	4	pre	3.3	0	0	0	3.0
oryzalin+ bentazon+ surfactant 1/	3+1	pre+post	0	4.6	6.5	3 6	7.0
oryzalin+ bentazon+ oil 2/	3+1	pre+post	0	3.5	5.5	5.7	9.0
oryzalin+ acifluorfen+ surfactant 1/	3+1	pre+post	0	5.5	6.5	4.2	8.6
oryzalin+ acifluorfen+ oil 2/	3+1	pre+post	0	5.3	6.5	4.2	7.0
oryzalin, WP	3	pre	1.6	0	-	2.5	6.2

1/ Surfactant X-77
2/ Booster Plus E (oil plus surfactant)

TABLE 3. Injury ratings on nursery plants from herbicides applied before or after planting.

Herbicide-rate ai, lb/A		Timing	White pine 6/28	White pine 10/19	Taxus 6/28	Taxus 10/19	Juniper 6/28	Juniper 10/19	Forsythia 6/28	Forsythia 10/19	Rhod. 6/28	Rhod. 10/19	Arborvitae 6/28	Arborvitae 10/19
			Injury ratings on a 0 to 10 scale											
untreated controls			0	0	0	0	0	0	1.5	0.3	0	0	0	0
napropamide,WP	4	ppi	0	0	0	0	0	0	0.5	0	0	1.0	0	0
	8	ppi	0	0.25	0	0	0	0	0.3	0	0.3	0	0	0.5
alachlor,EC	4	ppi	0	0	0	0	0	0	0.3	0	0	0.3	0	0
	8	ppi	0	0	0	0	0	0	1.5	0.3	0.3	0.5	0	0.3
metolachlor,EC	4	ppi	0	0	0	0	0	0	1.0	0	0	0	0.3	0
	8	ppi	0.5	0.75	0.3	0	0	0	1.3	0	0.5	0	0	0
UBI-S734	1	ppi	0	1.5	0	0	0	0	1.3	0	0	1.5	0	0
	2	ppi	0.8	2.25	0	0	0	0	3.3	0.5	0.3	1.3	0	0
	4	ppi	1.5	3.75	0	0.8	0	0	3.8	2.0	0.3	1.3	0	0
EPTC, EC	4	ppi	0	0	0	0	0	0.3	0	0	0	0	0	0
EPTC+extender	4	ppi	0	0.3	0	0	0	0	0.3	0	0	0	0	0
oxadiazon, G	4	pre	0	0.5	0	0	0	0	1.3	0.5	0.3	0	0	0
oryzalin+ bentazon+ surf.1/	3+1	pre+ post	0	0	0	0	0	0	6.8	0.5	5.3	3.0	2.0	0.8
oryzalin+ bentazon+ oil2/	3+1	pre+ post	0	0	0	0	0	0	6.5	2.0	5.5	3.0	1.8	0
oryzalin+ acifluorfen+ surf.1/	3+1	pre+ post	0.3	0.8	0.3	0	0	0	6.0	2.8	4.0	3.0	1.0	0
oryzalin+ acifluorfen+ oil 2/	3+1	pre+ post	0	0	0.3	0	0	0.3	5.3	2.5	5.3	3.8	0.8	0
oryzalin	3	pre	0	0	0	0	0	0	2.5	0.5	0	0	0	0

1/ Surfactant X-77
2/ Booster Plus E (oil plus surfactant)

EFFECTS OF SURFACTANT OR PREEMERGENCE HERBICIDES ON THE SELECTIVITY OF ASULAM AND GLYPHOSATE IN WOODY PLANTS

J. F. Ahrens [1/]

ABSTRACT

Phytotoxicity to weeds and nursery plants from surfactant additions to sprays of asulam and glyphosate was determined in field experiments. Adding either the surfactant X-77 or a simazine-oryzalin mixture, or both, improved control of large crabgrass (*Digitaria suanguinalis* (L.)Scop.) and horseweed (*Conyza canadensis* (L.)Cronq.) by asulam at 1.67 lb/A without injury to Japanese yews or Andorra junipers. At higher rates of asulam, however, these additives made the sprays injurious to junipers. Adding only simazine to the asulam sprays improved weed control without plant injury.

The surfactant MON 0011 added to low rates of glyphosate applied in June markedly improved control of large crabgrass, fall panicum (*Panicum dichotomiflorum* Michx.) and common lambsquarters (*Chenopodium album* L.). In another trial at higher rates of glyphosate applied in September, MON 0011 increased injury to dormant white pines. Simazine did not affect injury to pines by glyphosate in September.

INTRODUCTION

Certain woody plants, and dormant conifers in particular, can tolerate over-the-top applications of glyphosate [N-(phosphonomethyl)glycine], and asulam (methylsulfanilylcarbamate) (1). Most actively growing evergreen plants are more sensitive than dormant plants to both herbicides. Junipers (*Juniperus* sp.) and yews (*Taxus* sp.) can tolerate applications of asulam even while actively growing. White pine (*Pinus strobus* L.) is more sensitive to glyphosate than white spruce (*Picea glauca*). While surfactants might increase the activity of these herbicides against weeds they may also reduce their selectivity.

In this report we describe changes produced in the selectivity of asulam or glyphosate in woody plants when these herbicides are mixed with surfactants or with preemergence herbicides.

MATERIALS AND METHODS

In trial A we tested the effects of added surfactant on the activity of asulam and glyphosate on annual weeds, and in two other trials we tested the effects of added surfactant on their selectivity over woody plants. The soil type in all three was a Merrimac sandy loam with 2 to 3 percent organic matter. Sprays were applied with hand-held booms calibrated to deliver 50 gal/A over

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swaths varying from 4.5 to 6 ft. Weed control and injury were rated visually on a scale of 0 to 10: 0 = no control or injury; and 10 = 100% control, or all plants dead. In trial A, a stand of annual weeds was treated on June 17, 1975. Plots were 6 ft by 10 ft and replicated three times in randomized complete blocks. The principal weeds were large crabgrass 1 to 4 in tall, fall panicum 4 to 10 in tall, and lesser amounts of common lambsquarters 2 to 4 in tall. The surfactant MON 0011[1/] was added at 1% v/v to sprays of glyphosate isopropylamine salt and X-77[2/] was added at 0.5% v/v to the asulam sprays. Control of each weed was rated at weekly intervals for 4 weeks after treatment.

In trial B, varying rates of glyphosate with and without MON 0011 at 0.25% v/v or simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] at 2 lb/A were applied over established white pines 3 to 4 ft tall on September 20, 1978. The pines had been sheared in June 1978 and new fasicle buds had formed on the terminals. The pines were dormant at treatment. Sprays were applied with a hand-held boom with the center nozzle held 6 to 8 in over the tops of the pines. Plots were 12 ft long each with three or four pines in rows spaced 6 ft apart. Fifteen treatments were applied in a randomized complete block design with four replicates. Few weeds were present in the plots. Injury ratings were made on May 29 and July 10, 1979, and terminal shoot growth was measured on July 27, 1979.

In trial C, asulam at varying rates alone or with X-77 surfactant at 0.25% v/v, or simazine at 2 lb/A and/or oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide) was sprayed over nursery plants. Plots were 15 ft long with three plants each of Japanese yew (*Taxus cuspidata*) and Andorra juniper (*Juniperus horizontalis plumosa*), established in the field 4 years. The herbicides were applied in a 4.5 ft swath over the ornamentals on July 6, 1979. Large crabgrass up to 10 in tall, and horseweed up to 12 in tall, were the dominant weeds at treatment, and horseweed seedlings invaded in the fall.

RESULTS AND DISCUSSION

The surfactant X-77 markedly increased the activity of asulam against large crabgrass, fall panicum, and horseweed, but not lambsquarters (Tables 1 and 2). With asulam at 1.67 lb/A, added surfactant improved weed control without injury to the yews or junipers. However, with asulam at 3.34 lb or 6.68 lb/A, added surfactant caused excessive injury in Andorra junipers, but not Japanese yews. The injury was chlorosis and reduced growth of branch tips. Adding either simazine or simazine plus oryzalin improved initial and residual control of horseweed and crabgrass with asulam at 1.67 lb/A, but also injured junipers with asulam at 6.68 lb/A (Table 2).

Adding surfactant to glyphosate improved control of crabgrass, fall panicum and lambsquarters (Table 1). Glyphosate at 0.25 lb/A with added surfactant killed most of the weeds, whereas the same rate without surfactant only controlled crabgrass. September applications of glyphosate at 0.375 lb/A with added

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1/ Nonionic surfactant composed of nonylphenol ethoxylates.
2/ Nonionic surfactant containing polyoxyethyleneglycol.

Table 1. Effect of surfactant on phytotoxicity of asulam and glyphosate to weed species.1/

Herbicide	lb/A	Surfactant 3/	Crabgrass 2/ 2 wks	Crabgrass 2/ 3 or 4 wks	Fall panicum 2/ 2 wks	Fall panicum 2/ 3 or 4 wks	Lambsquarters 2/ 2 wks	Lambsquarters 2/ 3 or 4 wks
asulam	2	0	4.7	7.3	1.7	3.7	0	0
	4	0	4.7	10.0	1.7	7.3	0	0
	2	+	4.7	10.0	3.0	7.3	0	0
glyphosate	0.125	0	5.7	6.3	1.3	1.7	2.0	1.0
	0.25	0	9.3	9.7	5.3	5.7	6.0	5.5
	0.5	0	10.0	10.0	9.8	10.0	10.0	10.0
	0.125	+	7.3	8.3	3.7	3.7	6.7	8.5
	0.25	+	10.0	10.0	8.1	9.2	9.3	10.0
LSD p = .05				1.5		1.7		
.01				2.0		2.3		

1/ 0 = no control, 10 = dead weeds. Sprays were applied on June 17, 1975.
2/ 3 weeks for glyphosate and 4 weeks for asulam.
3/ X-77 was added to asulam sprays and MON 0011 was added to glyphosate sprays.

Table 2. Effects of surfactant, simazine, and oryzalin on weed control and plant injury with asulam.1/

Herbicide	lb/A	Surfactant 2/	Weed control ratings 8/3 Crabgrass	Weed control ratings 8/3 Horseweed	Weed control ratings 10/26 All weeds	Injury ratings Taxus 8/3	Injury ratings Taxus 10/4	Injury ratings Juniper 8/3	Injury ratings Juniper 10/4
untreated			0	0	0	0	0	0	0
asulam	1.67	0	3.5	4.5	2.8	0	0	0	0
	3.34	0	8.8	9.9	2.3	0	0	0	0
	6.68	0	9.6	10.0	2.8	0	0	0	0
	1.67	+	9.1	10.0	3.9	0	0	1.0	0
	3.34	+	9.8	10.0	6.9	0.3	0	2.0	1.3
	6.68	+	9.9	10.0	4.0	0.5	0	3.3	3.3
asulam+	1.67+2	0	6.3	9.3	7.5	0	0	0	0
simazine	3.34+2	0	8.9	9.8	7.0	0	0	0	0
	6.68+2	0	10.0	10.0	8.1	0	0	0.3	0
asulam+	1.67+2+3	0	8.0	9.5	9.5	0	0	0	0
simazine+	3.34+2+3	0	9.6	10.0	9.6	0	0	0.8	0
oryzalin	6.68+2+3	0	9.8	9.8	9.6	0.3	0	2.3	0
	1.67+2+3	+	9.0	10.0	9.5	0	0	0.8	0
LSD p = .05			1.4						
.01			1.9						

1/ Sprays were applied on July 6, 1979. 2/ X-77 at 0.25% v/v.

surfactant did not injure dormant white pines, but at either .75, 1.12 or 1.5 lb/A with surfactant the pines were injured (Table 3). These latter mixtures

Table 3. Effect of surfactant on phytotoxicity to white pines of glyphosate alone or with simazine.

Herbicide rates lb/A glyphosate(ae)	simazine(ai)	Surfactant 2/	Injury 0-10 5/29	7/10	Pines with dead buds at tip 5/29 - %	Terminal shoot growth 7/27 - cm
0	2	0	0	0	0	32.1
0.375	0	0	0	0	0	29.6
0.75	0	0	0.3	0.2	0	29.2
1.12	0	0	0	0.2	0	28.8
1.5	0	0	0	0	0	38.2
0.375	0	+	0	0.3	0	31.3
0.75	0	+	1.5	0.4	14	28.1
1.12	0	+	2.5	1.8	27	20.7
1.5	0	+	2.8	1.6	13	16.9
0.375	2	0	0	0	0	37.8
0.75	2	0	0	0	0	37.9
1.5	2	0	0.5	0.2	0	29.8
0.375	2	+	0	0	0	37.2
0.75	2	+	0.8	0.5	7	29.6
1.5	2	+	1.3	1.4	20	23.7
LSD p .05						10.6
.01						14.2

1/ Sprays were applied on September 20, 1978.
2/ MON 0011 at 0.25% v/v.

killed some fasicle buds on the pine terminals and reduced terminal growth the following season. Adding only simazine did not increase injury from glyphosate sprays, but seems to have decreased injury when surfactant was also added.

These tests indicate that it may be possible to improve control of certain annual weeds with reduced rates of asulam and glyphosate by adding a surfactant, without sacrificing tolerance in woody plants. At rates of glyphosate usually required for control of perennial weeds, however, adding a surfactant increased injury to white pine.

LITERATURE CITED

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PREEMERGENCE WEED CONTROL IN ORNAMENTAL PERENNIAL CROPS

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ABSTRACT

A wide variety of container grown perennial plants were kept reasonably full of weeds and made normal growth when treated in the fall or spring with simazine at 0.5 lb/A plus oxadiazon at 2 lb/A. There was plant safety at 2, 4 and 8 lb/A of oxadiazon.

INTRODUCTION

During the past five years the use of ornamental prennials in landscape plantings has increased dramatically. Growers have responded to this demand with increased production. Weed control in containerized and field grown stock is an expensive operation. To try to reduce weeding expense a series of trials were initiated at three local nurseries to determine crop tolerance to the preemergence herbicides oxadiazon 2G (2-*tert*-butyl-4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one), simazine 4G (2-chloro-4,6-bis-(ethylamino)-*s*-triazine), and alachlor 15G (2-chloro-2',6'-diethyl-*N*-(methoxymethyl)acetanilide).

MATERIALS AND METHODS

Container studies were initiated at Martin Viette Nursery and Flower Time Nursery on containerized ornamental perennials. Most plants were growing in one or two gallon containers, sempervivum were in 2" and 4" pots and *Pachysandra termanalis* and *Hedera helix* were in flats containing 40-50 plants. Plants were placed in 100 sq ft blocks which were then treated with granular preemergence herbicides at rates found suitable for nursery liners. Herbicides were applied uniformly with a hand shaker over the plots. Treatments included (all rates lb/A active ingredient) simazine ½ plus oxadiazon 2, and oxadiazon at 2,4 & 8. The first treatment was made to freshly potted, weed free stock October 10, 1978 and this was evaluated on May 8, 1979. Plant growth ratings were recorded as was general weed growth and predominent weeds present. Plants were then hand weeded and retreated on May 22, 1979. The retreatment incorporated ½ lb/A active ingredient simazine in each plot in conjunction with oxadiazon to control chickweed. Follow up observations were recorded on August 29, 1979. Standard nursery practices were followed regarding fertilization, irrigation, overwintering, etc.

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RESULTS AND DISCUSSION

Table 1 shows weed control ratings and Table 2 and 3 crop tolerance. This data gives no clear cut indication that the herbicide treatments had any consistent undesirable effect on plant growth or quality. Some plants were added at the time of the second treatment at Flower Time Nursery. Rodents damaged 3 species at Martin Viette Nursery and made them unratable. Oxadiazon alone failed to control chickweed in all treatments. After handweeding simazine was added for chickweed control to all treatments. Crop tolerance was excellent indicating exceptional control could be obtained.

Overall weed control was not perfect but crop tolerance information on two treatments in one crop was more important. These combinations provided effective weed control on other crops in this area. It appears that all plants tested can tolerate two applications, one after potting in the fall and another in spring. This program would provide effective weed control for the entire production cycle of the crop and reduce weeding costs by approximately eighty-five percent.

A field trial was initiated at the Plantage on field grown ornamental grasses, daylilies and Hosta. Treatments were applied to freshly planted divisions (recently propagated). Four 900 sq. ft. plots were treated with (rates lb/A. active ingredient) simazine $\frac{1}{2}$ plus oxadiazon 2, simazine $\frac{1}{2}$ plus alachlor 4, oxadiazon 2 plus alachlor 4, and oxadiazon 4. Observations indicate no perceptable injury one month after treatment to any treated plants. Weed control was good in all treatment. Combinations of simazine plus alachlor and oxadiazon plus alachlor gave excellent weed control. The simazine plus oxadiazon combination resulted in acceptable weed control and oxadiazon alone was least effective marginally acceptable.

These results and ongoing work indicate that simazine oxadiazon combinations offer growers an effective safe method they can utilize to reduce weeding costs without reducing the quality of the crop.

Table 1. Postplant preemergence weed control in container grown ornamental perennials.

Herbicide at lb/A	Weed control rating[a)]	Predominant weeds present
Treatment at Martin Viette Nursery applied Oct. 10, 1978 and observed May 8, 1979.		
simazine ½ + oxadiazon 2	4.5	few marestail
oxadiazon 2	4	mouseear chickweed, marestail
oxadiazon 4	4	mouseear chickweed, marestail
Untreated	2.5	chickweed, bittercress, oxalis, annual bluegrass, galinsoga
oxadiazon 8	4.5	chickweed, marestail
Retreatment at Martin Viette Nursery applied May 22, 1979 and observed Aug. 29, 1979		
simazine ½ oxadiazon 2	3.5	groundsel, oxalis, galinsoga, wild aster
simazine ½ oxadiazon 2	3.5	groundsel, oxalis, galinsoga, wild aster
simazine ½ oxadiazon 4	3	groundsel, oxalis, galinsoga, wild aster
Untreated	2.5	oxalis, galinsoga
simazine ½ oxadiazon 8	4	chickweed
Treatment at Flower Time Nursery applied Oct. 10, 1978 and observed May 8, 1979		
simazine ½ + oxadiazon 2	4.5	few chickweed, groundsel
oxadiazon 2	4	chickweed, groundsel, bittercress
oxadiazon 4	4	chickweed, groundsel, marestail
Untreated	3	chickweed, groundsel, marestail, oxalis
oxadiazon 8	4	chickweed, groundsel, marestail
Retreatment at Flower Time Nursery applied May 22, 1979 and observed Aug. 29, 1979		
simazine ½ oxadiazon 2	4.5	few groundsel, marestail, crabgrass
simazine ½ oxadiazon 2	3.5	many groundsel
simazine ½ oxadiazon 2	4.5	few groundsel, marestail
Untreated	2.5	crabgrass, annual bluegrass, oxalis, marestail, groundsel
simazine ½ oxadiazon 8	4.5	few weeds present

a) 1 = poor weed control, 5 = total weed control (3.5 acceptable)

Table 2. Tolerance of container-grown ornamental perennials to preemergence herbicides at Martin Viette Nursery.

	Growth Ratings									
	Treatment Oct. 10, 1978 observed May 8, 1979					Treatment May 22, 1979 observed Aug. 29, 1979				
Plant Treatment	S-½ 0-2[a]	0-2	0-4	Untr.	0-8	S-½ 0-2	S-½ 0-2	S-½ 0-4	Untr.	S-½ 0-8
Astilbe sp. Buch. Ham.	5	5	3	3	4	5	5	5	4	5
Baptisia astralis R.Br.	–	–	–	–	–	–	–	–	–	–
Pachysandra terminalis Sieb. & Zucc.	5	4	5	5	5	5	5	5	5	5
Monarda didyma L.	4	4	5	4	5	5	5	3	3	5
Phlox subulata L.	3	3	2	3	2	2	3	2	2	2
Physostegia virginiana Benth.	4	4	4	4	3	4	5	5	5	5
Caltha palustris L.	5	5	4	3	3	2	3	3	2	2
Vinca minor L.	5	5	5	5	4	5	4	5	5	4
Dicentra spectabilis Lem.	5	4	5	4	3	5	3	5	4	3
Phlox paniculata L.	–	–	–	–	–	–	–	–	–	–
Alopecurus pratensis L. var. aureo-variegatum	5	5	5	5	5	4	4	4	4	4
Althea rosea cav.	–	–	–	–	–	–	–	–	–	–
Coreopsis verticillata L.	3	5	5	5	5	3	4	5	4	4
Convallaria majalis L.	–	–	–	–	–	4	4	4	4	4
Liriope Muscari Bailey	3	3	3	3	2	5	4	5	4	3
Epimedium pinnatum Fisch.	5	3	4	4	4	5	3	4	4	3
Anemone hupehensis Lemoine	5	5	4	5	4	5	4	3	4	5
Festuca ovina glauca Koch	5	5	5	5	5	2	2	3	3	2
Anemone pulsatilla L.	3	2	2	3	2	5	2	4	2	1
Paeonia officinalis L.	4	3	3	3	4	4	3	3	3	5
Hedra helix L.	5	5	5	5	5	5	5	5	5	5
Sempervivum tectorum L.	4	5	5	5	5	5	5	3	5	5
Sedum Sieboldii Sweet	5	4	4	5	3	5	5	5	4	3
Iris germanica penthouse L.	4	3	3	5	5	4	1	2	2	3
Aquilegia sp. L. cv. McKenna Hybrid	4	3	3	3	5	3	4	3	2	4
Digitalis purpurea L.	2	2	2	2	2	3	2	3	2	2
Thymus serpyllum L.	4	5	5	5	5	4	3	3	4	5
Aster alpinus L.	4	4	5	4	4	1	2	2	3	2

Table 2. (continued)

Plant Treatment	Growth Ratings: Treatment Oct. 10, 1978 observed May 8, 1979: S-½ 0-2[a]	0-2	0-4	Untr.	0-8	Treatment May 22, 1979 observed Aug. 29, 1979: S-½ 0-2	S-½ 0-2	S-½ 0-4	Untr.	S-½ 0-8
Iberis sempervirens L.	2	3	3	3	4	3	3	3	3	4
Teucrium chamaedrus L.	3	4	4	5	4	4	5	5	5	5
Linum perenne L.	5	5	5	5	5	2	3	4	3	4
Alyssum saxafile L.	5	4	5	5	5	2	2	4	3	3
Plumbago capensis Thunb.	1	1	1	1	1	3	3	3	3	3
Geum borissi Kellerer	5	5	5	5	5	5	5	5	5	5
Nepeta Mussinii Spreng.	3	3	3	3	2	4	4	4	4	4
Santolina chamaecyparissus L.	4	3	5	5	3	4	4	4	3	2
Sedum album murale Hort.	5	5	5	5	4	5	4	2	3	3
Achillea tomentosa L.	4	5	5	5	5	1	1	1	1	2
Gallardia aristata Pursh	2	4	4	3	2	3	3	4	3	3
Fragaria verginiana Duchesne	3	4	4	5	4	4	5	5	5	5
Dianthus barbatus L.	5	5	5	4	5	4	4	3	4	5
Gaultheria procembens L.	5	5	5	5	5	5	4	5	5	4
Hosta sp. Tratt.	5	5	5	5	5	5	5	5	5	5
Hemerocalis flava L.	4	4	3	5	4	5	5	5	5	5
Potentilla aurea L.	5	5	5	5	5	5	4	5	5	5
Heuchera sp. L. cv. Chatter Box	4	3	3	4	5	1	1	2	1	1

[a] S-½+0-2 = simazine ½ lb/A, oxadiazon 2 lb/A; 0-2 = oxadiazon 2 lb/A; 0-4 = oxadiazon 4 lb/A; Untr. = Untreated; 0-8 = oxadiazon 8 lb/A; S-½+0-2 = simazine ½ lb/A, oxadizon 2 lb/A; s-½+0-4 = simazine ½ lb/A, oxadizon 4 lb/A; S-½+0-8 = simazine ½ lb/A, oxadizon 8 lb/A.

Table 3. Tolerance of container grown ornamental perennials to preemergence herbicides at Flower Time Nursery.

Plant treated (c)	Growth ratings[(a)] Treatment 10/10/78, observed 5/8/79					Treatment 5/22/79, observed 8/29/79				
	S-1/2+0-2 (b)	0-2	0-4	Untr	0-8	S-1/2+ 0-2	S-1/2+ 0-2	S-1/2+ 0-4	Untr	S-1/2+ 0-8
Paeonia officinalis L. (16)	2	2	3	4	3	2	2	3	4	3
Sedum spectabile Boreau (16)	3	3	3	4	2	4	4	4	5	3
Dicentra spectabilis Lem. (12)[a]	-	-	-	-	-	3	2	3	2	3
Hosta Sp. Teatt. (16)	4	3	3	4	3	5	5	5	5	5
Hemerocallis flava L. (18)	4	3	4	4	4	5	5	5	5	5
Hedra helix L. (18)	5	5	5	4	4	5	5	5	4	5
Ajuga reptans L. (small pot 18)	2	2	3	3	2	5	4	5	5	5
Myosotis scorpioides L. (12)[d]	-	-	-	-	-	2	2	3	4	4
Opuntia compressa Macb. (12)[d]	-	-	-	-	-	5	5	5	5	5
Althea rosea cav. (12)	5	5	5	5	5	3	4	3	3	3
Yucca smalliana fern. (18)	5	4	4	5	4	5	5	4	5	5
Vinca minor L. (18)	4	4	4	5	3	4	4	4	4	4
Sempervivum tectorum L. (2" pot 108)	5	5	5	5	5	5	4	4	4	5
Sempervivum tectorum L. (4" pot 54)	5	5	5	5	5	5	4	4	5	4
Ajuga reptans L. (large pot 14)	5	5	5	5	4	5	5	5	5	5
Digitalis purpurea L. (12)[a]	-	-	-	-	-	5	5	4	5	5

(a) Growth ratings 1 = dead plant to 5 = maximum growth.
First treatment applied to freshly potted stock on Oct. 10, 1978, growth ratings on May 8, 1979.
Second treatment (1/2 lb/A simazine added to each treatment except untreated to control chickweed) applied May 22, 1979. Growth ratings on Aug. 29, 1979.

(b) S-1/2 = simazine 1/2 lb/A   0-2 = oxadiazon 2 lb/A   all active ingredient

(c) Number within parenthesis indicates number of plants treated. Sempervivums were in flats containing 40-50 plants.

(d) Plants added for second treatment.

AN EVALUATION OF 5 HERBICIDES APPLIED OVER LINERS REPRESENTING 8 GENERA OF ORNAMENTAL PLANTS

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ABSTRACT

Alachlor at 1.7, 3.4, 6.8, and 13.6 Kg/ha ai and oryzalin, oxyfluorofen, and prodiamine at 1.1, 2.2, 4.4, and 8.8 Kg/ha ai were applied over newly planted liners of azalea, euonymus, cotoneaster, firethorn, pieris, rhododendron, and two varieties each of arborvitae, juniper, and yew. At the time of application half of the area was weed free and half had broadleaf and grass weed seedlings up to 5 cm tall growing in it. Six weeks later weed control and phytotoxicity data were recorded and bentazon at 1.1, 2.2, 4.4, and 8.8 Kg/ha ai was applied to previously untreated blocks. Three weeks later weed control and phytotoxicity data were recorded for the bentazon treated blocks.

After 6 weeks alachlor at the highest rate and oxyfluorofen at all rates showed excellent weed control in the plots that were weed free at application. The three lower rates of alachlor, all rates of prodiamine, and the high rates of oryzalin provided adequate control. In the plots that had weed seedlings at application, alachlor at 13.6 Kg/ha provided adequate control and all rates of oxyfluorofen excellent control. Bentazon controlled broad-leaved weeds but not grasses. At the time of evaluation all bentazon treated plots were totally covered with weeds.

Oryzalin and prodiamine were not phytotoxic to any of the plants at any rate. Alachlor was slightly phytotoxic to firethorn at 6.8 and 13.6 Kg/ha. Bentazon was highly phytotoxic to cotoneaster, pieris, and Woodward arborvitae at all rates and rhododendron, pieris, and elegantissima arborvitae at the 2 highest rates. Depending on the rate, light to moderate phytotoxicity was evident on all other species except euonymus. Oxyfluorofen was not phytotoxic to arborvitae or yew at any rate. However, it was highly phytotoxic to azalea, cotoneaster, firethorn, and pieris at 4.4 and 8.8 Kg/ha. Other plants showed varying degrees of phytotoxicity depending on rate of application.

INTRODUCTION

Relatively few herbicides are labelled for use on woody ornamentals, and those that are have a limited number of genera listed on their labels. An additional problem is that newly planted stock is more susceptible to herbicide injury than well established plants, so several of the labelled herbicides can not be applied over liners.

Because nurserymen must dig, ship, and plant in the spring, their herbicides often are not applied on schedule. Weed seedlings may be emerging prior

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to the application of their preemergence herbicide. There are two objectives for this study. First to evaluate the effectiveness and phytotoxicity to liners of a wide range of ornamentals of three experimental herbicides and two herbicides with limited ornamentals labels. Second, to determine the postemergence activity of the herbicides evaluated.

METHODS AND MATERIALS

The experiment was conducted at a commercial nursery in Butler, Pennsylvania in 1979. The Gilpin soil was a silt loam with a pH of 5.2, contained 1.9% organic matter and was prepared with a Levy Rotteria. Half the plants were planted on May 21 with the remainder planted on June 11. Purple splendor azalea (Rhododendron L. 'Purple Splendor'), lowfast cotoneaster (Cotoneaster dammeri Schneid. 'Lowfast'), purple wintercreeper euonymus (Euonymus fortunei colorata Rehd.), compact Japanese pieris (Pieris japonica Thunb. 'Compacta'), Laland firethorn (Pyracantha coccinea Roem 'Lalandei'), and roseum elegans rhododendron (Rhododendron L. 'Roseum Elegans') were planted 46 cm apart; and blue Hetz juniper (Juniperus chinensis L. 'Glauca Hetzii'), andorra juniper (Juniperus horizontalis Moench. 'Plumosa'), Hicks anglojap yew (Taxus media Rehd. 'Hicksii'), Hatfield anglojap yew (Taxus media Rehd. 'Hatfieldii'), elegantissima american arborvitae (Thuja occidentalis L. 'Elegantissima'), and Woodward american arborvitae (Thuja occidentalis L. 'Woodwardi') were planted 25 cm apart. There was 1.2 m between all rows. Each block contained at least four plants of each species and all treatments were replicated four times. On June 12 alachlor [2-chloro-2',6'-diethyl-N-(methoxoymethyl) acetanilide] 15G, oryzalin [3,5-dinitro N^4, N^4-dipropylsulfanilamide] 75W, oxyfluorofen [2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene] 2EC, and prodiamine [2,4-Dinitro-N^3, N^3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine] 50W were applied; alachlor at 1.7, 3.4, 6.8, and 13.6 Kg/ha ai and oryzalin, oxyfluorofen, and prodiamine at 1.1, 2.2, 4.4, and 8.8 Kg/ha ai. At the time of application half of each block was weed free and the remainder of the block had broadleaved and grass weed seedlings up to 5 cm tall growing in it. The predominant weeds were barnyardgrass [Echinochloa crus-galli (L.) Beauv.] common ragweed (Ambrosia artemisifolia L.) common lambsquarters (Chenopodium album L.), fall panicum (Panicum dichotomiflorum Michx.), Pennsylvania smartweed (Polygonum pennsylvanicum L.) and shepardspurse [Capsella bursa-pastoris (L.) Medic.]. During application wind speed varied from 6.4 to 12.8 km per hour and the temperatures at the beginning and end of the application period were air 13° and 20°, and soil 14° and 19°C. The soil moisture was at field capacity and the weather was sunny with scattered clouds. The herbicides were applied with a CO_2 pressurized sprayer at 20 psi in the equivalent of 522 l/ha of water through LP 8002 nozzles with 50 mesh screens. The plots were not irrigated and there was no measurable rainfall until June 21 when there was .6 cm of rain. Weed growth and phytotoxicity were evaluated 6 weeks after application.

On July 20 bentazon [3-isopropyl-1 H-2,1,3-benzothiadiazin-4 (3H)-one 2, 2-dioxide] 4E was applied to previously untreated plots at 1.1, 2.2, 4.4, and 8.8 Kg/ha ai in the same methods previously described. The air and soil temperatures were 25° and 26°C, respectively, soil moisture was at field capacity, and the weather was calm, clear and sunny. The predominant weed species were barnyardgrass, common ragweed, common lambsquarters, fall panicum, Pennsylvania smartweed, and shepardspurse. Other weeds consistently present but in lower numbers were hedge mustard [*Sisymbrium officinale* (L.) Scop.], mayweed (*Anthemis cotula* L.), green foxtail [*Setaria viridis* (L.) Beauv.], broadleaf plaintain (*Plantago major* L.), common yarrow (*Achillea millefolium* L.), Virginia pepperweed (*Lepidium virginicum* L.), common purslane (*Portulaca oleracea* L.), curly dock (*Rumex crispus* L.), common burdock [*Arctium minus* (Hill) Bernh.], mouseear chickweed (*Cerastium vulgatum* L.), and common yellow woodsorrel (*Oxalis stricta* L.). Weeds were up to 36 cm tall at the time of application. Weed control and phytotoxicity were recorded 3 weeks after application.

RESULTS AND DISCUSSION

Oxyfluorofen was the outstanding herbicide in the study. It totally controlled weed growth in plots that were weed free at the time of application and only a few stunted weeds grew in areas that had existing weed seedlings at application (Table 1). Barnyardgrass, hedge mustard, and yarrow were the only weeds to survive the treatments and they were severely stunted.

Alachlor provided excellent weed control at 13.6 Kg/ha and adequate control at all other rates in soil that had been weed free (Table 1). Common ragweed and barnyardgrass were the most frequently occurring weeds in the alachlor treated plots, but fall panicum, common lambsquarter and Pennsylvania smartweed were also present in reduced numbers. When applied to existing weed seedlings, alachlor at 13.6 Kg/ha adequately controlled weed growth, while the lower rates only limited their growth. In addition to the same weeds which occurred in the other plots, hedge mustard, shepardspurse, Virginia pepperweed, mayweed, yarrow, and curly dock were found in the plots that had weed seedlings at the time of application. Generally, broadleaf weeds were more resistant to alachlor than grasses.

In the plots that had been weed free, oryzalin provided adequate weed control only at 8.8 Kg/ha (Table 1). Other levels of application limited weed growth but not to commercially acceptable levels. Prodiamine provided adequate weed control at all levels, but except for the highest rate it was marginally acceptable (Table 1). Weed populations were similar in both oxyzalin and prodiamine treated blocks, with barnyardgrass and common ragweed the predominant species. Mixtures of all the other weeds previously mentioned were also found in these plots. At the higher rates of application oryzalin controlled grasses better than broadleaves while prodiamine controlled broadleaves better.

Oryzalin and prodiamine did not control existing weed seedlings at any rate.

Bentazon did not reduce weed population or cover at any rate of application (Table 2). Though it effectively controlled broadleaved weeds when applied 6 weeks after soil preparation, and it reduced the relative amounts of broadleaved weeds when applied 9 weeks later, grasses quickly filled in any voids created. The difference in effectiveness caused by the 3 week delay in treatment was probably due to a canopy effect of larger weeds preventing adequate coverage of seedlings.

Table 1. Effect of postplant applications of 4 herbicides to soil which was weed free and soil on which weed seedlings up to 5 cm tall were growing, 1979.

		Soil Weed Free			Soil With Weed Seedlings		
Chemical	Rate (Kg/ha ai)	Grasses 1/	Broadleaves 2/	Weed Control 3/	Grasses 1/	Broadleaves 2/	Weed Control 3/
Check		60	40	1.1	30	70	0
Alachlor (15G)	1.7	70	30	7.8	45	55	2.8
	3.4	25	75	7.5	45	55	2.5
	6.8	25	75	8.3	20	80	3.5
	13.6	10	90	9.5	30	70	7.1
Oryzalin (75W)	1.1	55	45	2.3	35	65	0.3
	2.2	60	40	5.5	30	70	1.1
	4.4	40	60	5.7	20	80	1.2
	8.8	40	60	7.1	35	65	2.8
Oxyfluorofen (2E)	1.1			10.0	50	50	9.7
	2.2			10.0		100	9.9
	4.4			10.0		100	9.5
	8.8			10.0			10.0
Prodiamine (50W)	1.1	30	70	6.4	30	70	0.7
	2.2	40	60	6.2	45	55	1.0
	4.4	45	55	6.0	30	70	0.7
	8.8	65	35	7.3	25	75	1.4

1/ The percentage of the weeds which were grasses.
2/ The percentage of the weeds which were broadleaves.
3/ 0 = no control, 10 = total control

Oryzalin and prodiamine were not phytotoxic to any of the woody ornamentals at any rate of application (Table 3). Alachlor was safe for use on all plants except firethorn, on which it caused chlorosis and tip kill of some plants at 6.8 and 13.6 Kg/ha. Several plants were severely damaged, possibly a result of the uneven distribution which can occur with the 15% granules.

Bentazon severely injured cotoneaster at all rates, Woodward arborvitae at 2.2, 4.4, and 8.8 Kg/ha, and pieris and rhododendron at 4.4 and 8.8 Kg/ha (Table 3). Moderate injury occurred on Woodward arborvitae at 1.1 Kg/ha, and azalea and firethorn at 8.8 Kg/ha. Elegantissima arborvitae was not injured by the 1.1 and 2.2 Kg/ha levels and euonymus was not damaged at any level. However, all remaining treatment-species combinations resulted in phytotoxicity to the plants. Damage could possibly have been more severe but at the time of application the weeds were as tall or taller than the ornamentals and may have limited the spray reaching the ornamentals.

Oxyfluorofen was not phytotoxic to either of the arborvitae or yews at any rate, or either of the junipers except at 8.8 Kg/ha (Table 3). It caused severe injury to azalea, cotoneaster, and firethorn at 4.4 and 8.8 Kg/ha, and moderate injury at 1.1 and 2.2 Kg/ha. Pieris was severely injured at 8.8 Kg/ha and moderately injured at the other three rates. Euonymus was uninjured at 1.1 Kg/ha, lightly injured at 2.2 and 4.4 Kg/ha, and moderately injured by the 8.8 Kg/ha rate. Rhododendron was lightly injured by all four treatments. Leafspot, chlorosis, tip burn, and stunting were symptoms of oxyfluorofen injury.

The relatively poor weed control provided by oryzalin and prodiamine may have been due to the lack of rain for the 10 days following application. The soil was moist below the surface and the weed seeds may have germinated and emerged before coming in contact with the herbicides. Alachlor, which was shown to have some postemergence activity, and oxyfluorofen, which was a very effective postemergence herbicide in this study, were both apparently able to control the seedlings that emerged at this time. Oxyzalin and prodiamine showed no significant postemergence activity and could not control them.

The half of the area that was planted on May 21 had a relatively higher population of broadleaved weeds than the area that was planted on June 11 (Table 1). This was because the predominant grasses, barnyardgrass and fall panicum did not start germinating in high numbers until June.

Bentazon does not appear to be a good herbicide for nursery use. Though it effectively controlled broadleaved weeds, grasses quickly filled in the treated areas. In addition, it was phytotoxic to a wide variety of woody ornamentals.

Alachlor provided good preemergence weed control and adequate postemergence control at the highest rate, yet was phytotoxic to only one species.

Oxyfluorofen almost totally controlled weed growth at both the preemergence and postemergence stages. This characteristic would be of great value to nurserymen who miss applying their herbicides at the proper time. Though it was phytotoxic to many plants, this problem may be avoided in several ways. First, do not apply it to species susceptible to injury.

Second, decrease the application rate, as excellent weed control was obtained at even the lowest rate. Finally, apply it in the granular form, since most of the injury seemed to be caused by foliar contact.

Table 2. Effect of a July 20 application of bentazon on weed growth in plots made weed-free on May 21 and June 11, 1979.

		Weed-Free May 21			Weed-Free June 11		
Chemical	Rate (Kg/ha ai)	G 1/	BL 2/	Weed Control 3/	G 1/	BL 2/	Weed Control 3/
Check		30	70	0	60	40	0
Bentazon (4E)	1.1	50	50	0	85	15	0
	2.2	55	45	0	100	0	0
	4.4	75	25	0	95	5	0
	8.8	95	5	0	100	0	0

1/ The percentage of weeds which were grasses.
2/ The percentage of weeds which were broadleaves.
3/ 0 = no control

Table 3. Effect of postplant applications of 5 herbicides on a variety of woody ornamental liners, 1979.

Chemical	Rate (Kg/ha ai)	Elegantissima Arborvitae	Woodward Arborvitae	Azalea	Cotoneaster	Euonymus	Firethorn	Blue Hetz Juniper	Andorra Juniper	Pieris	Rhodo-dendron	Hicks Yew	Hatfield Yew
Check		0	0	0	0								
Alachlor (15G) 1/	1.7	0	0	0	0	0	0	0	0	0	0	0	0
	3.4	0	0	0	0	0	0	0	0	0	0	0	0
	6.8	0	0	0	0	0	3.0	0	0	0	0	0	0
	13.6	0	0	0	0	0	4.0	0	0	0	0	0	0
Bentazon (4E) 2/	1.1	0	5	3.5	8.5	0	1.5	2	0.5	3.1	2.3	2.1	2.8
	2.2	0	7.2	3.2	8.3	0	2.0	0.7	2.1	3.2	2.0	2.9	3.0
	4.4	3	7.3	3.5	9.5	0	1.5	2.5	0.8	7.0	6.3	1.5	2.4
	8.8	5	8.6	4.7	10.0	0	4.5	2.8	2.4	7.8	7.8	3.1	1.5
Oryzalin (75W) 1/	1.1	0	0	0	0	0	0	0	0	0	0	0	0
	2.2	0	0	0	0	0	0	0	0	0	0	0	0
	4.4	0	0	0	0	0	0	0	0	0	0	0	0
	8.8	0	0	0	0	0	0	0	0	0	0	0	0
Oxyfluorofen (2E) 1/	1.1	0	0	3.6	3.4	0	4.0	0	0	3.5	2.0	0	0
	2.2	0	0	4.9	4.3	0.7	4.5	0	0	4.2	2.8	0	0
	4.4	0	0	6.8	6.4	3.8	6.2	0	0	4.4	3.7	0	0
	8.8	0	0	7.4	7.9	4.0	8.1	4.1	3.3	6.2	3.5	0	0
Prodiamine (50W) 1/	1.1	0	0	0	0	0	0	0	0	0	0	0	0
	2.2	0	0	0	0	0	0	0	0	0	0	0	0
	4.4	0	0	0	0	0	0	0	0	0	0	0	0
	8.8	0	0	0	0	0	0	0	0	0	0	0	0

1/ Applied 6 weeks prior to evaluation
2/ Applied 3 weeks prior to evaluation
3/ 0 = no phytotoxicity, 10 = dead

CRABGRASS CONTROL AND TURFGRASS INJURY RESULTING FROM PRE- AND POSTEMERGENT HERBICIDES [1]

R.J. Cooper and J.A. Jagschitz [2]

ABSTRACT

Trials were initiated on established turfgrass to evaluate pre- and postemergent herbicides for control of smooth crabgrass [*Digitaria ischaemum* (Schreb.) Muhl.]. The effects of rate, formulation, application date, and application frequency were investigated. Effectiveness of treatments was based on percent crabgrass control and turfgrass injury. In the preemergent test, bensulide, butralin, DCPA, diclofop, and prosulfalin provided excellent control (90-100%). A second application of bensulide or DCPA was not needed to obtain seasonal control. Wettable powder formulations of DCPA caused more injury than granular formulations. Certain rates and formulations of oxadiazon gave excellent control, and 2% granular formulations provided better control than their 5% counterparts. Benefin applications at 3 lb ai/A resulted in good (80-89%) to excellent control. May application of benefin or oxadiazon resulted in greater turf injury than March application. Siduron provided excellent control when applied in May, but less control when applied in March. Excellent postemergent control was achieved with two applications of DSMA or MSMA. Diclofop provided less control and resulted in objectionable turf injury. DPX-4129 provided poor control (less than 70%), but higher rates could be investigated. Surfactant applications at several rates and frequencies resulted in no effective crabgrass control.

INTRODUCTION

Although smooth crabgrass is often a troublesome turfgrass weed, effective control can be achieved with herbicides. Factors influencing control include type of formulation, application date, and application frequency (2,5). Experimental herbicides are continually being evaluated to find materials which provide better control, longer residual activity, and less turfgrass injury (1,3,6).

In 1979, tests were conducted to evaluate several standard and newer preemergent herbicides at various rates and in different formulations. Materials were applied in late March, and May to determine optimum application date. A second application of some materials was made in June to determine if this would improve control of late emerging crabgrass.

When preemergent herbicides are not used, or are ineffective, postemergent herbicides can provide control. However, postemergent materials

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often cause turfgrass injury and require several applications to achieve control (1,3). Several postemergent materials were applied at various rates and frequencies in 1979, and evaluated for crabgrass control and turf injury.

Mitchell et al. (4) have suggested that surfactants may inhibit crabgrass germination. Several rates of a surfactant were applied in late 1978 to determine their effectiveness as a crabgrass control.

MATERIALS AND METHODS

The preemergent test was conducted during 1979 at the University of Rhode Island Turfgrass Research Farm. The test area consisted primarily of red fescue (*Festuca rubra* L.) with some Kentucky bluegrass (*Poa pratensis* L.) and was mown at one inch. Crabgrass emergence began in late May with most emergence occurring by late June. Herbicides, formulations, rates, and application dates are listed in Table 1. Granular materials were applied by hand, and all others were applied as sprays in 86 gallons of water per acre.

The postemergent herbicide test was initiated in 1979 on a practice football field at the University of Rhode Island. The turf consisted mainly of Kentucky bluegrass mown at 1.5 inches. Crabgrass plants had begun tillering when the first application was made (July 19). Herbicides, rates, and application dates are given in Table 2. All materials were applied as sprays in 50 gallons of water per acre.

The surfactant test was initiated in November of 1978 on turf consisting primarily of red fescue with some Kentucky bluegrass, and was mown at one inch. Surf-Side #21, a non-ionic surfactant (various mole counts of nonylphenoxpoly ethanol and octyl phenol), was applied at several rates on the dates listed in Table 3. Treatments were made using a sprinkling can applying 40 gallons of water per 1000 sq ft.

Plot size in all tests was 4 by 5 feet with treatments replicated three times. All tests were irrigated when necessary to avoid drought stress and insure crabgrass germination. Both pre- and postemergent tests were rated for turfgrass injury monthly through August. A scale of 0-10 was used with 0 indicating no injury and 10 indicating brown turf. A rating of 2.0 or greater was considered objectionable. All tests were rated for percent crabgrass control by comparing percent crabgrass cover in treated plots to that of the untreated check plots. The preemergent herbicide and surfactant tests were rated on August 16 and 17, and the postemergent test on August 23.

Herbicides tested include: benefin (*N*-butyl-*N*-ethyl-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine), bensulide [*O*-*O*-diisopropyl phosphorodithioate *S*-ester with *N*-(2-mercaptoethyl)benzenesulfonamide], butralin [4-(1,1-dimethylethyl)-*N*-(1-methlpropyl)-2,6-dinitrobenzenamine], DCPA (dimethyl tetrachloroterephthalate), diclofop [2-(4-(2,4-dichlorophenoxy)phenoxy) propanoic acid], oxadiazon [2-tert-butyl-4(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one], prosulfalin[*N*-[(4-(dipropylamino)-3,5-

dinitrophenyl) sulfonyl]-S,S-dimethylsulfilimine], siduron [1-(2-methylcyclohexyl)-3-phenylurea], DSMA (disodium methanearsonate), DPX-4129, and MSMA (monosodium methanearsonate).

RESULTS AND DISCUSSION

Preemergent crabgrass control

The effects of preemergent herbicides on crabgrass control and turfgrass injury are shown in Table 1. Bensulide, butralin, diclofop and prosulfalin provided excellent control (90-100%) without objectionable turf injury (2.0 or greater) regardless of rate, formulation, or application date. Granular and wettable powder formulations of DCPA provided excellent control in March and May at rates of 7.5 lb ai/A or greater, however, wettable powder formulations caused more red fescue injury. Previous research has yielded similar results (3,5). March and May application of wettable powder DCPA at 10 lb ai/A resulted in objectionable turf injury, while the granular formulation caused objectionable injury in May only.

Several differences among oxadiazon formulations were noted. The 2% granular formulations provided better control than their 5% counterparts in all cases. This was probably due to the application of more material per unit area with the 2% material. The 2% formulations provided excellent control when applied at 3 lb ai/A in May. This appears to be the optimum rate for oxadiazon (3,5). Oxadiazon 25/50 materials provided somewhat better control than the 18/35 materials with 5% formulations, but similar control with 2% formulations. Injury from oxadiazon was greater with later applications, with late May application resulting in objectionable turf injury. This trend differs from results previously reported (5).

Benefin applications at 3 lb ai/A resulted in good (80-89%) to excellent control, however, May applications resulted in objectionable turf injury. Granular and wettable powder formulations of siduron provided excellent control when applied in May, while March applications resulted in less control probably due to poor residual activity. Siduron caused no objectionable turf injury.

A second application of bensulide or DCPA was unnecessary since a single application provided excellent control. This was probably due to the lack of late germinating crabgrass in our trials. The maximum time between herbicide application and crabgrass emergence was about 14 weeks. Had emergence continued later into the season, a second application may have been of value. Additional applications of bensulide did not increase turf injury, however, there was evidence of increased injury with second applications of DCPA.

Postemergent crabgrass control

The effects of postemergent herbicides on crabgrass control and turf injury are listed in Table 2. Excellent control without objectionable turf injury was provided by standard and experimental formulations of DSMA

TABLE 1. Crabgrass control and turfgrass injury from preemergent herbicides applied to predominantly red fescue turf, 1979.

			Percent Crabgrass Control[a]			Maximum Turf Injury[b]		
			Application dates			Application dates		
Herbicide	Granular or Spray	Rate lb ai/A	Mar 23	May 3	May 14	Mar 23	May 3	May 14
Benefin	G (2.5%)	2	--	75	--	--	.4	--
Benefin	G (2.5%)	3	87	89	93	.9	2.0	2.1
Bensulide	G (3.6%)	7.5	100	99	98	.2	.2	.2
Bensulide	G (7% S)[c]	7.5	--	95	--	--	.0	--
Bensulide	G (7% M)[c]	7.5	--	94	--	--	.7	--
Bensulide	G (7% M)	7.5-7.5[d]	--	97	--	--	.5	--
Bensulide	G (7% M)	11.3	--	99	--	--	.3	--
Bensulide	G (12.5%)	7.5	--	98	--	--	.0	--
Bensulide	S (EC)	7.5	99	97	100	.0	.5	.0
Bensulide	S (EC)	7.5-7.5	--	99	--	--	.3	--
Bensulide	S (EC)	11.3	--	99	--	--	.3	--
Butralin	G (2%)	4	97	--	90	.5	--	1.1
DCPA	G (5%)	7.5	--	90	--	--	.7	--
DCPA	G (5%)	10	96	--	94	.3	--	2.2
DCPA	G (5%)	10.5	--	98	--	--	1.3	--
DCPA	S (WP)	7.5	--	99	--	--	.8	--
DCPA	S (WP)	7.5-7.5	--	99	--	--	3.2	--
DCPA	S (WP)	10	99	--	99	3.3	--	3.4
DCPA	S (WP)	10.5	--	99	--	--	2.6	--
DCPA	S (WP)	10.5-5.25	--	99	--	--	2.0	--
DCPA	S (WP)	10.5-10.5	--	99	--	--	3.0	--
Diclofop	S	4	--	99	--	--	.3	--
Diclofop	S	6	--	97	--	--	.3	--
Oxadiazon	G (2% 18/35)	2	--	86	--	--	.5	--
Oxadiazon	G (2% 18/35)	3	--	98	--	--	.5	--
Oxadiazon	G (2% 18/35)	4	--	94	--	--	.8	--
Oxadiazon	G (2% 25/50)	2	--	85	--	--	.7	--
Oxadiazon	G (2% 25/50)	3	88	99	99	.8	1.1	3.7
Oxadiazon	G (2% 25/50)	4	--	97	--	--	1.3	--
Oxadiazon	G (5% 18/35)	2	--	22	--	--	.4	--
Oxadiazon	G (5% 18/35)	3	--	83	--	--	.2	--
Oxadiazon	G (5% 18/35)	4	--	75	--	--	.3	--
Oxadiazon	G (5% 25/50)	2	--	64	--	--	.3	--
Oxadiazon	G (5% 25/50)	3	--	79	--	--	.1	--
Oxadiazon	G (5% 25/50)	4	--	89	--	--	.1	--
Prosulfalin	S (WP)	1.5	98	99	99	.4	.0	.2
Prosulfalin	S (WP)	2	--	99	--	--	.0	--
Siduron	G (3.1%)	10	--	98	--	--	.0	--
Siduron	G (3.5%)	10	80	--	99	.5	--	.3
Siduron	G (3.7%)	10	--	90	--	--	.0	--
Siduron	S (WP)	10	81	90	99	.0	.0	.1

[a] Control based on 33-45% crabgrass cover in check plots.
[b] Scale 0-10 (10 = brown) July through August
[c] (S) Stauffer Chemical product; (M) Mallinckrodt product
[d] Additional application made on June 15.

TABLE 2. Crabgrass control and turfgrass injury from postemergent herbicides applied to predominantly Kentucky bluegrass turf 1979.

Herbicide	Rate (lb ai/A) Application dates 7/19	7/27	8/6	Percent Crabgrass Control[a] August 23	Maximum Turfgrass Injury[b]
DSMA	2.7	2.7	--	99	.3
DSMA	2.7	2.7	2.7	99	.7
DSMA	3.6	3.6	--	99	1.1
DSMA	3.6	3.6	3.6	100	.9
DSMA (201)	2.7	2.7	--	99	.9
DSMA (201)	2.7	2.7	2.7	100	.7
DSMA (201)	3.6	3.6	--	100	1.3
DSMA (201)	3.6	3.6	3.6	100	.9
DSMA (701)	2.7	2.7	--	99	1.0
DSMA (701)	2.7	2.7	2.7	100	.5
DSMA (701)	3.6	3.6	--	99	1.0
DSMA (701)	3.6	3.6	3.6	100	1.4
Diclofop	2	--	2	21	1.0
Diclofop	4	--	4	75	3.5
Diclofop	6	--	6	83	3.3
DPX-4129	.125	--	--	1	.0
DPX-4129	.125	.125	--	1	.2
DPX-4129	.25	--	--	1	.0
DPX-4129	.5	--	--	4	.1
MSMA	1.5	1.5	--	99	.7
MSMA	2.0	2.0	--	100	1.3

[a] Control based on 88% crabgrass cover in check plots.
[b] Scale 0-10 (10 = brown) July through August

TABLE 3. Crabgrass control from Surf-Side #21 surfactant.

Surf-Side #21 oz/1000 sq ft	Application Dates 1978	Percent Crabgrass Control, 8/16/79
8	Nov. 17, 28; Dec. 1, 8, 15	0
16	November 17	7
32	November 17	7
None	-------	-

when applied twice at 2.7 lb ai/A, and MSMA when applied twice at 1.5 lb ai/A. Increases in rate and/or application frequency were not necessary. Two applications of diclofop at 6 lb ai/A were necessary to achieve good control, however, this resulted in objectionable turf injury. DPX-4129 provided poor control (less than 70%), however, higher rates could be investigated since turf injury was very slight.

Surfactant crabgrass control

As previous research has shown (5), Surf-Side #21 did not provide notable crabgrass control (Table 3). Five weekly applications at 8 oz/1000 sq ft or single applications at higher rates provided no effective control. No objectionable turf injury resulted from surfactant use.

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CONTROL OF SMOOTH CRABGRASS IN TURF USING REDUCED RATES THE SECOND YEAR

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ABSTRACT

Prosulfalin (50W), DCPA (75W and 5G), siduron (50W), bensulide (EC and 3.6G), and benefin (2.5G) had been applied to Kentucky bluegrass for smooth crabgrass control in 1978. All materials were applied in single applications and prosulfalin, DCPA, and siduron were also applied in split applications. Application rates to the same plots in 1979 were lower than the single rates applied in 1978 and only one half of each plot was retreated. The objective of this experiment was to compare crabgrass control resulting from reapplication at reduced rates with no reapplication. With 90% control used as an acceptable level of control, all 1979 treatments were acceptable except reapplication to siduron and the split application of DCPA (5G). Reapplication to benefin treated turf increased control into the acceptable range. Ratings of areas that were not retreated revealed that granular bensulide provided the best residual control (70%) while prosulfalin, DCPA, and bensulide (4EC) controlled carbgrass nearly 60% without reapplication. Siduron, however, provided only 25% control without retreating. Split applications of prosulfalin, DCPA, and siduron had less residual control than single applications. No turfgrass injury was found as a result of 1979 treatments.

INTRODUCTION

Little information is available on the control of smooth crabgrass in turf when reduced rates are applied to areas that had received recommended rates the previous year. Traditionally, preemergence crabgrass herbicides have been tested on turf at different rates, but on new or overseeded sites (2, 3, 4). Previous research at The Pennsylvania State University (1) has shown that December applications of DCPA and bensulide have provided season long crabgrass control the following year, but siduron and benefin did not maintain control throughout the season. This research has shown that these materials have varied residual capability and spring applications at reduced rates should be assessed.

The purpose of this research was to compare crabgrass control resulting from reapplication at reduced rates with no reapplication.

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MATERIALS AND METHODS

This research was conducted at The Joseph Valentine Turfgrass Research Center, The Pennsylvania State University. A 13 year-old-stand of Kentucky bluegrass (Poa pratensis L.) was treated on May 4, 1979 with five herbicides. The turf was maintained at a 3.2 cm cutting height. Supplemental irrigation was applied once during the season. Germination was first noticed on May 10, but significant germination did occur until later in the month. The crabgrass stand varied across the plot area from 50 to nearly 100%. The experiment was designed with two replications of each herbicide with an untreated control plot adjacent to each application. This design facilitated rating by eliminating the problem of varied crabgrass encroachment.

Sprayed materials were applied to 0.9 by 3.7 m plots with a hand held boom sprayer calibrated to deliver 704 L/ha. Granular formulations were applied to 1.2 by 0.9 m plots with a shaker bottle.

The materials used were; DCPA (dimethyl tetrachloroterephthalate) 5G and 75W, prosulfalin (N-[[4-(di-propylamino)-3,5-dinitrophenyl]sulfonyl]-S,S-dimethylsulfilimine) 50W, bensulide (o,o-diisopropylphosphorodithioate S-ester with N-(2-mercaptoethyl)benzenesulfonamide) 3.6G and 4EC, benefin (N-butyl-N-ethyl-α,α,α,trifluro-2,6-dinitro-p-toluidine) 2.5G, and siduron 1-(2-methyl-cyclohexyl)-3-phenylurea. Application rates and dates appear in Table 1. Control and injury were rated on August 20, 1979.

RESULTS AND DISCUSSION

Reapplication of prosulfalin at 1.7 kg/ha gave excellent control of crabgrass without injury on turf that had received both a single and split application the previous year (Table 1). Previous studies have shown prosulfalin injury to Kentucky bluegrass at rates above 1.7 kg/ha (2). Lower rates (1.7 kg/ha) in subsequent years appear to be a viable solution to these phytotoxicity problems without sacrificing crabgrass control. Crabgrass control did not exceed 60% when reapplication was not made.

Reapplication of DCPA 75W at 5.6 kg/ha resulted in excellent control of crabgrass without injury on turf that received both single at split application the previous year. Reapplication of the 5G formulation to turf that received a split application in 1978 did not provide acceptable control. However, reapplication to turf that had received the recommended rate in a single application in 1978 resulted in excellent control, (97%).

A split application of siduron in 1978 did not result in acceptable control in 1978 and reapplication at 6.8 kg/ha in 1979 did not result in acceptable control, but control was slightly better than in 1978. Siduron applied at the recommended rate in single application in 1978 followed by a 6.8 kg/ha reapplication in 1979 did not provide acceptable control in 1979. Other studies have shown that residual control of crabgrass was relatively poor when siduron was applied at the recommended rate in December and control was rated the following July and September (1).

Both formulations of bensulide (4EC and 3.6G) gave excellent control of crabgrass when reapplied at 5.6 kg/ha to turf that had received 11.2 or 8.4 kg/ha in 1978. Residual crabgrass control in turf that was not retreated appeared better for the granular formulation (approximately 15% for both rates compared to the 4EC). No injury was observed for any of the treatments.

Benefin provided excellent control when reapplied at 1.7 kg/ha (95%). In 1978, when applied at 2.24 kg/ha benefin controlled crabgrass 88%, therefore it appears that annual reapplications improve overall control. A crabgrass control rating of 45% was recorded for benefin on turf that was not retreated in 1979.

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Table 1. Control ratings for preemergence herbicides reapplied to Kentucky bluegrass at reduced rates the second year. Herbicides were applied on May 4 and ratings were made on August 20, 1979.

Treatment	Application Dates 1978	Application Dates 1979	Rates ai kg/ha 1978	Rates ai kg/ha 1979	% Crabgrass Control 1978 Rating	% Crabgrass Control Retreated	% Crabgrass Control Not Retreated
Prosulfalin 50W	5/9 + 6/9	5/4	1.7 + 1.7	1.7	99	98	50
Prosulfalin 50W	5/9	5/4	2.8	1.7	96	97	60
DCPA 75W	5/9 + 6/9	5/4	8.4 + 5.6	5.6	97	94	55
DCPA 75W	5/9	5/4	11.8	5.6	97	97	63
DCPA 5G	5/9 + 6/9	5/4	8.4 + 5.6	5.6	95	88	60
DCPA 5G	5/9	5/4	11.8	5.6	98	97	65
Siduron 50W	5/9 + 6/9	5/4	9.0 + 6.8	6.8	80	85	20
Siduron 50W	5/9	5/4	13.4	6.8	93	83	25
Bensulide 4EC	5/9	5/4	8.4	5.6	95	97	48
Bensulide 4EC	5/9	5/4	11.2	5.6	97	97	55
Bensulide 3.6G	5/9	5/4	8.4	5.6	97	95	65
Bensulide 3.6G	5/9	5/4	11.2	5.6	99	95	70
Benefin 2.5G	5/9	5/4	2.24	1.7	88	95	45

BROADLEAF WEED CONTROL IN TURFGRASS WITH HERBICIDES

John A. Jagschitz [1]

ABSTRACT

Nine studies, over a four-year period, were conducted to evaluate herbicides for the selective control of dandelion, mouseear chickweed and white clover in cool-season turfgrass. Standard amd newer herbicides were tried alone and in various combinations. Attempts were made to determine the influence of tank mixes, seasonal application and adjuvants on herbicide efficacy. There was variability in the results from one test to another. Herbicide applications made in October provided results that were similar to those applied in May or June. None of the herbicides applied alone provided consistent control of the three weeds. 2,4-D and R-40244 provided better dandelion control but R-40244 caused some grass injury. The following materials applied alone were more effective on clover and/or chickweed than on dandelion: dicamba, dichlorprop, mecoprop, silvex, Vel-4207, triclopyr and dikegulac. The latter two herbicides caused some grass injury. Combinations of 2,4-D with one or more of the following -- dicamba, dichlorprop, mecoprop, silvex or Vel-4207 did provide improved broad spectrum control. Some of the 2,4-D plus dichlorprop granular combinations did not perform as well as spray applications. The efficacy of the 2,4-D plus dicamba combination was not enhanced by the use of adjuvants such as AL-1448, PACE and X-77. Tank mixing a post-emergence crabgrass herbicide such as DSMA and/or a preemergence crabgrass herbicide such as bensulide, DCPA and siduron with the broadleaf weed combination of 2,4-D with either dicamba or silvex did not provide any problem in spray application. Except for a few tank mixes they provided weed control similar to that which would be obtained if the materials were applied seperately. Many broadleaf herbicide combinations provided a reduction in crabgrass. Three to five monthly applications of 2,4-D, dicamba or a combination of both did not cause objectionable grass injury while in some situations weed control was greater and of a longer duration.

INTRODUCTION

Herbicides are used to selectively control broadleaf weeds in turfgrass. Combinations rather than single herbicides have provided more effective, broad-spectrum control (1,2,3,4). Recent studies have shown variable control with some herbicide applications (4). Attempts to find newer chemicals and better combinations are the goal of many researchers. Substitute herbicides are needed to replace those not available or banned from use.

Studies were initiated to evaluate new and substitute herbicides, alone and in combinations, for the control of dandelion (*Taraxacum officinale* Weber.), mouseear chickweed (*Cerastium vulgatum*) and white clover (*Trifolium repens* L.). Treatments were applied in the spring and fall to determine seasonal variation in control. Various adjuvants were evaluated in an attempt to lower herbicide concentrations and increase efficacy. Some herbicides were tank mixed with crabgrass control herbicides to determine compatibility and efficacy.

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MATERIALS AND METHODS

Nine weed control studies were initiated at the Turf Research Farm and athletic field complex of the University of Rhode Island. The turf was several years old and contained red fescue (Festuca rubra L.), Kentucky bluegrass (Poa pratensis L.) and some colonial bentgrass (Agrostis tenuis Sibth.). The turfgrass was maintained at about a 1.5 inch cutting height. Spray materials were applied with water at the rate of 50 gallons to the acre. Granular herbicides were applied by hand to moist turf and weeds. The herbicides, formulations, rates and dates of application are presented in Tables 1 to 4. These were applied to plots measuring 4 by 4 or 4 by 5 feet in size and replicated three to seven times. Treatments were applied to separate tests in October of 1975 and 1976, May of 1976, 1977 and 1979 and June of 1978. No appreciable rain occurred within 24 hours following any of the treatments. Initial estimates of weed populations in each plot were made at the time of treatment. Final estimates of weed populations were made as indicated in the tables. These were usually about eight months following October treatments and two months after May or June treatments. Percent control was calculated by comparing the initial and final weed populations adjusted to the changes taking place in the untreated plots. Turfgrass injury readings were taken periodically throughout all tests. The visual scale used was 0 to 10 with 10 being brown or dead turf. A reading of 2.0 could be considered objectionable.

RESULTS AND DISCUSSION

Results obtained from nine tests for the control of dandelion, mouseear chickweed and/or white clover are presented in Tables 1 to 4. There was variability in the results from one test to another. In previous tests rainfall within 24 hours following herbicide applications appeared to influence results (4). In these trials rainfall was not considered to be of any consequence. The variability does not appear to be related to season of application since herbicides applied in October provided results that were similar to those applied in May or June (Tables 1 and 2).

Single herbicides

In general applications of 2,4-D alone resulted in greater control of dandelion than of clover or chickweed. R-40244 also provided better dandelion control (Table 4) but this material caused objectionable turfgrass injury (greater than 2.0 on scale of 0 to 10 where 10 equals brown). The following materials applied alone were more effective on clover and/or chickweed than on dandelion: dicamba, dichlorprop, mecoprop, silvex, Vel-4207, triclopyr and dikegulac (RO-7-6145). The latter two herbicides caused objectionable turfgrass injury (Table 1 or 2). The results indicate that no single herbicide applied alone will consistently provide control of the three weeds.

Herbicide combinations

Combinations of 2,4-D with one or more of the following -- dicamba, dichlorprop, mecoprop, silvex or Vel-4207, although somewhat variable in results from test to test, did provide improved broad spectrum control without damaging the turfgrass. Combinations of 2,4-D with either dikegulac (RO-7-6145) or triclopyr provided improved control but the potential for turf injury exists (Tables 1,2,3). The addition of gibberellic acid to dicamba did not improve control (Table 1). Some of the 2,4-D plus dichlorprop granular combinations did not perform as well as spray applications.

The use of adjuvants such as AL-1448, Pace and X-77 at concentrations of .1 and .5% had little effect on the results obtained from the combination of 2,4-D plus dicamba. Combining DSMA (postemergence crabgrass herbicide) and several preemergence crabgrass herbicides such as bensulide, DCPA or siduron with the broadleaf combination of 2,4-D with either dicamba or silvex did not provide any problems in spray application. Most of the combinations provided weed control similar to that which would be obtained if the materials were applied separately. Research should be carried on further since there were about four combinations which provided less dandelion, clover or crabgrass control (Table 2) and more turf injury (Table 3). Many broadleaf herbicide combinations provided some crabgrass control. This was especially true for high rates of granular formulations containing 2,4-D with either dichlorprop or silvex. Crabgrass control was probably preemergence and due to herbicide residues in the thatch or soil layer at the time crabgrass seed was germinating.

In an attempt to determine the effect of repeat treatments on turfgrass tolerance and weed control, dicamba (.25 lb), 2,4-D (1 lb) and a combination of both (.13 + 1 lb) were applied three to five times at monthly intervals. No objectionable grass injury was detected during the test period. In some situations weed control was greater and of a longer duration. In general, dandelion control from most other treatments decreased during the 2-month to 4-month period following treatment. Part of this reduction in the degree of control may be due to new dandelion plants from seed in August.

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Table 1. Control of dandelions, white clover and mouseear chickweed from herbicides applied on October 8, 1975 and May 27, 1976 to lawn turf.

			Percent Control*					
			Dandelion		White Clover		Mouseear Chickweed	
Herbicide	Other Information	lb ai/A	Oct. Test	May Test	Oct. Test	May Test	Oct. Test	May Test
2,4-D	amine	1	94	90	45	59	62	82
2,4-D	ester	1	92	83	--	58	--	82
2,4-D	dacamine	1	98	--	--	--	--	--
Mecoprop	amine	1	45	8	99	96	100	100
Silvex	ester	.5	41	24	98	94	99	97
Dicamba	Banvel	.25	87	29	99	99	99	90
VEL-4207	EC	.25	48	14	98	99	94	50
VEL-4207	EC	.5	--	35	100	99	99	85
Dichlorprop	ester	1	--	22	--	99	--	100
Dichlorprop	ester	2	--	66	--	99	--	99
Triclopyr	amine M-3724	1	--	52	--	99	--	99
Triclopyr	amine M-3724	2	--	56	--	100	--	100
RO-7-6145	WSP	2.7	--	20	--	6	--	88
RO-7-6145	WSP	5.4	--	33	--	38	--	99**
2,4-D + Mecoprop	Turf Kleen	1 + 1	94	83	98	98	99	99
2,4-D + Silvex	Weed-B-Gon	1 + .5	98	64	97	99	99	99
2,4-D + Dicamba	amines	1 + .25	99	79	100	100	100	100
2,4-D + Dicamba + Mecoprop	amines	.75 + .25 + .5	--	85	--	99	--	100
2,4-D + VEL-4207	amine + EC	1 + .25	99	51	99	99	99	100
2,4-D + VEL-4207	amine + EC	1 + .5	--	83	--	99	--	99
2,4-D + VEL-4207	amine + EC	.75 + .75	--	67	--	99	--	100
2,4-D + VEL-4207	ester mix	.75 + .25	--	76	--	97	--	88
2,4-D + VEL-4207	ester mix	1.5 + .5	--	76	--	100	--	100
2,4-D + VEL-4207 + Mecoprop	ester mix + amine	.75 + .25 + .5	--	70	--	100	--	99
2,4-D + Dichlorprop	A-510	1 + 1	--	85	--	96	--	100
2,4-D + Dichlorprop	A-510	2 + 2	--	82	--	99	--	100
2,4-D + Triclopyr	amines	1 + 1	--	78	--	100	--	99
2,4-D + Triclopyr	amines	1 + 2	--	85	--	100	--	100
2,4-D + RO-7-6145	amine + WSP	1 + 2.7	--	90	--	68	--	87
2,4-D + Mecoprop + Dicamba	Trimec	1 + .5 + .1	98	85	--	99	--	100
2,4-D + Mecoprop + Dicamba	Trex-San	1 + .5 + .125	--	71	--	99	--	100
2,4-D + Silvex + Dicamba	3D-Weedone	1 + .5 + .125	100	74	--	99	--	100
MCPA + Mecoprop + Ioxynil + Dicamba + 2,4,5-T	Selectox-Royal	.5 + 1 + .17 + .05 + .15	86	27	99	99	100	100
2,4-D + Dichlorprop	A-354 gran	2 + 1	--	79	--	99	--	99
2,4-D + Dichlorprop	A-426 gran	2 + 1	--	72	--	99	--	96
2,4-D + Silvex	Amchem gran	2 + 1	--	92	--	99	--	100
2,4-D + Mecoprop	Scott gran	1.4 + 1.4	--	89	--	99	--	100
Dicamba + gibberellic acid	Banvel + Pro-Gibb	.25 + (.15g)	--	22	--	99	--	91
Dicamba + gibberellic acid	Banvel + Pro-Gibb	.25 + (.25g)	--	18	--	99	--	93
2,4-D + Mecoprop + Dichlorprop	A-339	1 + .5 + .5	97	--	--	--	--	--
2,4-D + Dicamba + Dichlorprop	EH-527	.5 + .125 + .5	99	--	--	--	--	--
Weeds or % cover in checks -	Time of treatment		17	56	39%	28%	24%	4%
-	Time of control		16	73	20%	41%	37%	2%

*Control on June 7, 1976, for October, 1975, test and on July 27, 1976, for May, 1976, test.

**Objectionable grass injury, 3.4 on scale of 0 to 10, 10 = brown.

Table 2. Control of dandelions, white clover and mouseear chickweed from various herbicides applied in two tests in October of 1976 and in one test in May of 1977.

			Percent Control*							
			Dandelion			White Clover		Mouseear Chickweed		Crab-grass
Herbicide	Rate lb/A	Other Information	Oct. Test I	Oct. Test II	May Test	Oct. Test I	May Test	Oct. Test I	May Test	May test
2,4-D	1	Weedar 64	93	100	90	95	66	98	91	31
dicamba	.25	Banvel	94	100	--	99	--	97	--	--
Vel-4207	.5	EC	66	96	--	100	--	99	--	--
2,4-D+dicamba	.5+.1	-	--	--	92	--	99	--	100	38
2,4-D+dicamba+Pace (.1%)	.5+.1	-	--	--	90	--	88	--	99	0
2,4-D+dicamba+Pace (.5%)	.5+.1	-	--	--	87	--	98	--	97	0
2,4-D+dicamba+AL 1448 (.1%)	.5+.1	-	--	--	87	--	95	--	99	16
2,4-D+dicamba+AL 1448 (.5%)	.5+.1	-	--	--	93	--	96	--	93	41
2,4-D+dicamba+X-77 (.1%)	.5+.1	-	--	--	94	--	99	--	96	3
2,4-D+dicamba+X-77 (.5%)	.5+.1	-	--	--	89	--	92	--	99	35
2,4-D+dicamba	1+.25	-	100	100	95	100	100	100	100	46
2,4-D+dicamba+DSMA	1+.25+4	-	--	--	97	--	100	--	99	67
2,4-D+dicamba+DSMA+bensulide	1+.25+4+10	-	--	--	77	--	99	--	97	97
2,4-D+dicamba+bensulide	1+.25+10	-	--	--	85	--	99	--	100	96
2,4-D+dicamba+DSMA+DCPA	1+.25+4+10	-	--	--	97	--	100	--	100	98
2,4-D+dicamba+DCPA	1+.25+10	-	--	--	99	--	100	--	100	79
2,4-D+dicamba+DSMA+siduron	1+.25+4+10	-	--	--	99	--	99	--	99	99
2,4-D+dicamba+siduron	1+.25+10	-	--	--	96	--	99	--	99	86
2,4-D+Val 4207	1+.5	-	94	100	88	99	99	99	100	17
Dichlorprop	1	ester	53	99	--	94	--	99	--	--
2,4-D+dichlorprop	1+1	A-510	100	100	85	88	100	99	99	44
2,4-D+dichlorprop	1.5+1.5	A-510	--	--	96	--	99	--	99	19
2,4-D+dichlorprop	2+2	A-468 gran	--	--	76	--	88	--	84	46
2,4-D+dichlorprop	3+3	A-468 gran	--	--	76	--	99	--	98	80
2,4-D+dichlorprop	2+2	A-535 gran	--	--	90	--	99	--	99	50
Mecoprop	1	MCPP	89	100	--	100	--	99	--	--
2,4-D+mecoprop+dicamba	1+.5+.125	Trex-San	100	96	97	95	100	98	99	27
2,4-D+mecoprop	1+1	Turf Kleen	66	89	88	100	99	99	98	6
2,4-D+mecoprop	1.4+1.4	Scott gran	--	--	96	--	96	--	99	57
Silvex	.5	ester	44	95	--	100	--	99	--	--
2,4-D+silvex	1+.5	Weed-B-Gone	100	100	88	98	94	100	99	71
2,4-D+silvex+DSMA	1+.5+4	-	--	--	93	--	95	--	99	55
2,4-D+silvex+DSMA+bensulide	1+.5+4+10	-	--	--	75	--	96	--	100	96
2,4-D+silvex+bensulide	1+.5+10	-	--	--	88	--	74	--	99	96
2,4-D+silvex+DSMA+DCPA	1+.5+4+10	-	--	--	92	--	99	--	.98	99
2,4-D+silvex+DCPA	1+.5+10	-	--	--	96	--	94	--	100	89
2,4-D+silvex+DSMA+siduron	1+.5+4+10	-	--	--	96	--	99	--	99	98
2,4-D+silvex+siduron	1+.5+10	-	--	--	98	--	98	--	100	94
2,4-D+silvex+dicamba	1+.5+.125	3D-Weedone	98	100	91	100	100	99	100	45
2,4-D+silvex	2+1	Weedone gran	--	--	95	--	99	--	99	91
Triclopyr	1	amine M-3724	61**	100**	--	100**	--	99**	--	--
2,4-D+triclopyr	1+1	-	90	99**	94	100	100	99	99	77
2,4-D+mecoprop+RO 7-6145	.64+1.27+4.46	ACR 1255	--	--	91	--	99	--	99	25
2,4-D+mecoprop+RO 7-6145	.76+1.53+5.35	ACR 1255	--	--	97	--	99	--	99	52
2,4-D+mecoprop+RO 7-6145	.89+1.78+6.24	ACR 1255	--	--	99	--	99	--	100	33
2,4-D+mecoprop+RO 7-6145	.96+1.91+4.46	ACR 1294	--	--	89	--	99	--	100	27
2,4-D+mecoprop+RO 7-6145	1.15+2.29+5.35	ACR 1294	--	--	94	--	99	--	100	36
2,4-D+mecoprop+RO 7-6145	1.34+2.67+6.24	ACR 1294	--	--	94	--	98	--	100	50
Unknown	5	EH-536 B	--	--	89	--	100	--	100	48
Unknown	1 gal/A	EH-539	--	--	91	--	99	--	99	35
Unknown	.375 gal/A	EH-839	--	--	94	--	98	--	99	26
Unknown	.375 gal/A	EH-881	--	--	96	--	98	--	100	41
Number of weeds or % cover in checks - Time of treatment			9	66	25	25%	14%	28%	12%	--
- Time of control			10	29	40	11%	12%	4%	13%	32%

* In the October test control was recorded on June 8, 1977. Control was recorded in the May test on July 20 for dandelions and on August 1 for clover, chickweed and crabgrass.

** Objectionable grass injury, scale 0 to 10, 10 = brown. Test I 2.0 and Test II 2.2.

TABLE 3. Control of mouseear chickweed, dandelion and white clover in lawn turf from herbicides applied on June 16, 1978.

			Percent Control		
			Test 1		Test 2
Herbicide	Rate - June 16 lb ai/A	Other Information	Chickweed Aug 31	Dandelion Sept 7	Clover Aug 21
2,4-D	1	Weedone LV4	85	99	81
2,4-D	1	Weedar 64	35	98	87
dicamba	1/4	Banvel	55	90	100
dicamba	1/2	Banvel	99	99	--
mecoprop	1	Amine, MCPP	99	27	99
mecoprop	1.5	Amine, MCPP	99	44	--
silvex	1/2	Ester, 2,4,5-TP	73	73	100
silvex	3/4	Ester, 2,4,5-TP	88	83	--
2,4-D + dicamba	1 + 1/4	Amines	99	99	100
2,4-D + dicamba	1.44 + .46	Scott I, gran	99	98	100
2,4-D + dichlorprop	1 + 1	A510, ester	99	99	99
2,4-D + dichlorprop	1 + 1	A510, ester	99	100	99
2,4-D + dichlorprop	1.5 + 1.5	A510, ester	98	99	100
2,4-D + dichlorprop	2 + 2	A468, gran	38	55	100
2,4-D + dichlorprop	2 + 2	A468, gran	47	58	99
2,4-D + dichlorprop	3 + 3	A468, gran	60	84	--
2,4-D + dichlorprop	2 + 2	A535, gran	82	98	100
2,4-D + dichlorprop	2 + 2	A535, gran	93	97	100
2,4-D + mecoprop	1 + 1	Amines	98	100	100
2,4-D + mecoprop	1.46 + 1.46	Scott II, gran	98	96	100
2,4-D + silvex	1 + 1/2	Esters	99	99	100
2,4-D + dicamba + mecoprop	1 + 1/8 + 1/2	Trex-San	99	99	100
(above) + bensulide + DSMA	(above) + 10 + 4	Tank Mix	99	98	100
2,4-D + dicamba + silvex	1 + 1/8 + 1/2	3D-Weedone	100	99	100
(above) + bensulide + DSMA	(above) + 10 + 4	Tank Mix	99	100 *	100
2,4-D + mecoprop + dikegulac	.67 + 1.34 + 4.69	ACR-1255	100	99 **	99 **
2,4-D + mecoprop + dikegulac	.89 + 1.79 + 6.25	ACR-1255	100	99 **	100 **
2,4-D + mecoprop + dikegulac	1.12 + 2.23 + 7.81	ACR-1255	100	99 **	100 **
Weed cover in check plots - at treatment time			8%	22%	37%
- at control time			6%	16%	28%

* Objectionable (2.0+) red fescue injury, 2.3 on scale 0 to 10 (10 = brown)

** Ky. bluegrass and red fescue injury 2.3 to 3.8

TABLE 4. Control of mouseear chickweed, dandelion and white clover in lawn turf from herbicides applied on May 31 and/or other dates in 1979.

Herbicide	Rate - 5/31 lb ai/A	Other Information	% Control - Test 1 Chick-weed 10/15	% Control - Test 1 Dandelion 7/25	% Control - Test 1 Dandelion 10/15	% Control - Test 2 Clover 9/17	% Control - Test 2 Dandelion 7/25	% Control - Test 2 Dandelion 9/17
2,4-D	1	Weedone LV4	52	88	55	49	100	97
2,4-D	1/2	Weedar 64	10	84	58	68	99	100
2,4-D	1	Weedar 64	75	100	88	100	99	99
2,4-D *	1*	Weedar 64	92	99	99	100	100	100
dicamba	.13	Banvel	60	78	34	100	80	58
dicamba	1/4	Banvel	63	87	60	100	97	76
dicamba *	1/4 *	Banvel	100	100	95	100	100	99
dichlorprop	1	Ester	97	72	41	100	94	89
dichlorprop	1	A287, oil amine	92	76	2	100	93	65
mecoprop	1	Amine, MCPP	100	54	0	100	81	53
2,4-D + dicamba	1 + 1/4	Provel	29	64	20	96	79	44
2,4-D + dicamba	1 + 1/10	Pre-Mix	24	92	55	100	100	96
2,4-D + dicamba	1 + 1/10	Super D	63	79	33	100	100	99
2,4-D + dicamba	1.44 + .46	Scott I, gran	100	99	68	100	100	98
2,4-D + dicamba	1/2 + .06	Amines	47	88	52	100	99	88
2,4-D + dicamba	1/2 + .13	Amines	62	98	49	100	99	91
2,4-D + dicamba	3/4 + .06	Amines	45	87	53	100	100	95
2,4-D + dicamba	3/4 + .13	Amines	69	86	46	100	100	98
2,4-D + dicamba	1 + .06	Amines	45	91	68	67	100	96
2,4-D + dicamba	1 + .13	Amines	91	99	38	100	100	96
2,4-D + dicamba *	1 + .13 *	Amines	100	100	98	100	100	100
2,4-D + dichlorprop	1 + 1	A 510, ester	98	88	51	100	100	98
2,4-D + dichlorprop	1.5 + 1.5	A 510, ester	100	75	51	100	100	99
2,4-D + dichlorprop	1 + 1	A 582, oil amine	95	99	71	100	100	93
2,4-D + dichlorprop	1.5 + 1.5	A 582, oil amine	99	100	50	100	100	96
2,4-D + mecoprop	1/2 + 1	Diamond amines	100	96	61	100	100	98
2,4-D + mecoprop	1 + 1	Turf Kleen	100	74	59	100	100	93
2,4-D + mecoprop	1.46 + 1.46	Scott II, gran	100	99	77	100	96	97
2,4-D + mecoprop	1.49 + 1.49	Scott Plus 2, gran	100	94	84	100	99	99
2,4-D + dicamba + dichlorprop	1 + 1/8 + 1	A 510 + Banvel	100	98	94	100	100	100
2,4-D + dicamba + mecoprop	1/4 + 1/10 + 3/4	Trimec-Bent	100	97	53	100	99	92
2,4-D + dicamba + mecoprop	.61 + .11 + 1.1	33 Plus	100	98	32	100	100	99
2,4-D + dicamba + mecoprop	1 + 1/10 + 1/2	Trimec	100	100	59	100	98	95
2,4-D + dicamba + mecoprop	1 + 1/8 + 1/2	Trex-San	100	98	40	100	97	99
R-40244	1/2 (7/3 only)	2E	43	74	52**	66	86	47**
R-40244	1 (7/3 only)	2E	50	92	45**	---	---	---
Weed cover in check plots - at treatment time			9%	7%	7%	14%	10%	10%
- at control time			5%	6%	15%	9%	8%	21%

* also applied 7/3 and 8/1 and in test 2 again on 9/4 and 10/15.

** objectionable (2.0+) Ky. bluegrass and red fescue injury 2.9 to 4.8 on scale 0 to 10 (10 = brown)

DICHLORPROP AS A REPLACEMENT FOR SILVEX IN BROADLEAF WEED CONTROL

Barbara H. Emerson and John F. Koerwer 1/

ABSTRACT

Alternative materials to control broadleaf weeds, especially those resistant to 2,4-D, were tested in anticipation of possible label registration cancellation for the use of silvex on turfgrasses. Accumulated data from studies begun in 1973 indicates that none of the candidate compounds applied alone are as herbicidally active as silvex.

The performance of dichlorprop butoxyethyl ester added to the same amount of 2,4-D butoxyethyl ester and applied at the combined rate of 2.25 kg ai/ha has generally equalled and occasionally surpassed that of recommended rates of registered amine formulations of 2,4-D with mecoprop and dicamba, and nearly equalled that of a registered butoxyethyl ester formulation of 2,4-D with silvex and dicamba, with satisfactory turfgrass tolerance.

Similar granular formulations for dry application followed the same efficacy pattern. No combination of only dichlorprop and mecoprop performed satisfactorily.

Responses of weeds and turfgrasses to treatments at various locations have been tabulated.

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SOME TREATMENTS FOR VERONICA AND OXALIS CONTROL IN TURFGRASS

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ABSTRACT

With the loss of silvex [2-(2,4,5-trichlorophenoxy)propionic acid] there is definite need for a chemical to control yellow wood sorrel (*Oxalis stricta* L. an annual, and *Oxalis corniculata* L., a perennial form). Small scale earlier tests by the authors showed silvex to give inadequate control of *Oxalis*. Tests were made on *Oxalis*-infested turf areas at the West Hills School at Huntington Station, N. Y. and the Long Island Horticultural Research Laboratory at Riverhead, N. Y. in mid-July. A commercial formulation of 2,4-D[(2,4,-dichlorophenoxy)acetic acid], dicamba (3,6-dichloro-o-anisic acid) and mecoprop [2-(4-chloro-o-tolyl)oxylpropionic acid] at 2 qt/A; 2,4-D plus mecoprop; or dicamba at recommended rates were ineffective against *Oxalis*. The experimental compounds 76A 510 and 77A 582 which are mixtures of equal amounts of 2,4-D and dichlorprop [2-(2,4-dichlorophenoxy) propionic acid] at 1 and 1.5 lb of each/A gave what appeared to be good kill but after 6-8 weeks there was regrowth from basal buds. Repeat treatments were made.

Ground ivy and white clover appeared to be completely knocked out by the 2,4-D dichlorprop treatments.

Different species of speedwell (*Veronica spp.*) require different herbicides for effective control. DCPA (dimethyl tetrachloroterephthalate) applied postemergence to creeping speedwell (*Veronica filiformis* Sm.) gives good control. A comparison of a May 7 application of DCPA at 12 lb/A with 6 lb on May 7 and again on June 19 showed the repeat treatment to give slightly better control as of Oct. 19. HLR ACR 1255 at 0.5 oz/100 sq ft on May 7 gave good initial control as observed June 19 but there was considerable regrowth by Oct. 19.

Controlling *Oxalis* is still a problem but DCPA is effective against *Veronica filiformis*.

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RE-ENCROACHMENT BY VERONICA DURING 1979 INTO TURF TREATED WITH HERBICIDES DURING 1978

T. L. Watschke[1/]

ABSTRACT

Creeping speedwell is commonly found in many lawns, parks, golf courses, and cemeteries in the northeastern United States. Recently, DCPA has been labeled for creeping speedwell control at 17.9 kg/ha from the wettable formulation. Other materials are also being evaluated at various locations. An experiment was conducted in 1978 on the campus of The Pennsylvania State University using DCPA, ACR 1255, and a combination of 2,4-D, MCPP, and dicamba in single and split applications for creeping speedwell control. Results of this study were reported in The Proceedings of The Northeast Weed Science Society in 1979. On August 20, 1979, the 1978 test was rated for creeping speedwell encroachment. Turf treated with a single application of the 2,4-D, MCPP, dicamba combination had approximately the same amount of creeping speedwell as on September 12, 1978 (which was nearly the same as the amount that existed prior to treatment). Reapplication of the 2,4-D, MCPP, dicamba combination during 1978 kept the creeping speedwell population below the original level and no increase in encroachment occurred during 1979. Control from both ACR 1255 application rates was good through September 12, 1978, however by August 20, 1979, the creeping speedwell population had increased. The percentage of creeping speedwell in the plots was still below that which occurred in turf treated with either of the 2,4-D, MCPP, dicamba combination treatments. Both DCPA treatments provided excellent control through September 12, 1978. Some re-encroachment occurred during 1979, but for both treatments, creeping speedwell was not greater than 20% of the population. For efficacy and longevity, DCPA appeared to be the best treatment for creeping speedwell control, but re-encroachment data indicate that complete control may require additional applications in ensuing years.

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Table 1. Creeping speedwell population changes in plots treated with herbicides in 1978.

Treatments	Application Dates	Rates kg/ha	Date of Observation 5/25[a]	6/11	6/20	8/2	9/12	8/22/79
			% Creeping Speedwell					
2,4-D + MCPP + dicamba	5/25	1.2 + 0.6 + 0.1	52	25	9	48	53	50
2,4-D + MCPP + dicamba	5/25 + 6/23	1.2 + 0.6 + 0.1	62	25	7	23	43	30
ACR 1255 (Ro7-6145 + MCPP + 2.4-D)	5/25	5.9 + 1.7 + 0.8	53	18	3	3	9	15
ACR 1255 (Ro7-6145 + MCPP + 2,4-D)	5/25 + 6/73	5.9 + 1.7 + 0.8	65	18	3	6	6	24
DCPA 75W	5/25 + 6/23	8.9	50	13	3	3	2	12
DCPA 75W	5/25	17.9	47	16	2	1	2	17

[a]Creeping speedwell present prior to treatment.

CONTROL OF FALL PANICUM AND NUTSEDGE IN KENTUCKY BLUEGRASS WITH POSTEMERGENCE HERBICIDES[1]

John A. Jagschitz[2]

ABSTRACT

To find more effective and safer control measures in developing Kentucky bluegrass sod several postemergence herbicides were evaluated for the control of fall panicum and yellow nutsedge. The effect of treatment date, rates and number of treatments was also investigated. Effectiveness of treatments was based on weed control and degree of injury to Kentucky bluegrass. Excellent panicum control with only slight turfgrass injury was obtained by single applications of DSMA. Late July DSMA treatments were more effective, however they caused more grass injury. Results with bentazon, DPX-4129 and R-40244 for panicum control were unsatisfactory. Control of nutsedge was provided by certain treatments with bentazon and DSMA. Nutsedge did not appear to be more susceptible to later applications in the season. Kentucky bluegrass was more tolerant to bentazon than methanearsonates. R-40244 nutsedge control and grass injury results were unsatisfactory. DPX-4129 appears promising for nutsedge control. Spray mixtures of bentazon or DSMA with the combination of bromoxynil and dicamba were not antagonistic.

INTRODUCTION

Fall panicum (*Panicum dichotomiflorum* Michx.) and yellow nutsedge (*Cyperus esculentus* L.) are two troublesome weeds found in turfgrass areas. Methanearsonates have been used to control these weeds but they often cause some grass injury and usually require two or more applications for effective results (1,2,3,4,5,6). To find more effective and safer control measures in developing Kentucky bluegrass (*Poa pratensis* L.) sod several methanearsonate formulations and some newer materials were evaluated in 1979. Bentazon [3-isopropyl-1H2,1,3-benzothiadiazen-(4)3*H*-one 2,2-dioxide], a newer herbicide, has shown promise for selective nutsedge control (2,4). To find the most effective use of bentazon it was applied at various rates and with single and double applications. Nutsedge has been shown to be easier to control with late season rather than early season treatment (4,5). In our 1979 trial we also studied the effect of treatment date with bentazon and the methanearsonates. The spray compatability of these two materials with bromoxynil (3,5-dibromo-4-hydroxybenzonitrile) and dicamba (3,6-dichloro-*o*-anisic acid) was also studied

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MATERIALS AND METHODS

The test was initiated in 1979 at a local sod farm where field crops were grown the previous year. The turf was Kentucky bluegrass seeded the previous fall and maintained at a height of about 1.5 inches. At the start of treatments (June 29) Kentucky bluegrass and fall panicum were well established and tillering. Kentucky bluegrass cover was about 40 percent. Nutsedge plants were also well established and appeared to be from nutlets rather than from rhizomes. At this time about 98% of the total number of plants evident by the end of the test (August 10) had emerged.

The herbicides, rates and treatment dates are shown in Table 1. All treatments were applied as sprays at the rate of 50 gallons of water per acre to plots measuring 4 by 4 feet with three replications. Visual estimates of turfgrass injury were made through August using a 0 to 10 evaluation scale with 10 indicating brown turf. A reading of 2.0 could be considered objectionable. Fall panicum control was determined on August 16 by comparing the panicum cover in each plot to that of untreated check plots (30% cover). Nutsedge plant counts were made in each plot between August 10 to 16. Percent control was determined by comparing treated to untreated plots which averaged 85 plants per sq. ft.

RESULTS AND DISCUSSION

Fall panicum control

The results with herbicides applied in 1979 for postemergence control of fall panicum in developing Kentucky bluegrass sod are shown in Table 1. Excellent control (90-100%) with no objectionable grass injury (less than 2.0) was obtained from a single 2.7 lb application of DSMA in mid-July or two applications at the rate of 3.6 lb at a 1-week interval starting in late June. Late July treatments were more effective in controlling panicum, however they also caused more Kentucky bluegrass injury. This was probably caused by higher temperatures following treatment in late July (high 80's F^{o}) while in June and early July temperatures were not above the 70's. The drought stress following the July 19th treatments may also have contributed to the increase in herbicide activity. The two formulations of DSMA (201 and 701) provided very similar results to the standard commercial material. Two applications of MSMA applied only in late July at the 1.5 lb rate provided excellent panicum control, however turfgrass injury was objectionable. Fewer applications, lower rates or use of MSMA in late June might have resulted in more satisfactory results.

At the rates used in this trial the following herbicides were ineffective in controlling panicum: bentazon, DPX-4129 and R-40244. The latter material caused considerable Kentucky bluegrass injury which would limit its use for panicum control in such turf.

Combining DSMA with a mixture of bromoxynil and dicamba did not reduce its effectiveness and there appeared to be no antagonistic effects. The latter mixture is often used for controlling seedling broadleaved weeds in developing Kentucky bluegrass sod. The addition of DSMA to the mixture would provide broad spectrum weed control--annual weedy grasses and broadleaved weeds.

Nutsedge control

The data from the postemergence treatments for control of yellow nutsedge are presented in Table 1. A single application of bentazon at .5 lb per acre applied in mid-July and a single or split 1 lb rate in late June provided excellent results. Except for one difficult to explain bentazon treatment having objectionable turfgrass injury the tolerance of developing Kentucky bluegrass sod to bentazon seems very good. Using several times the rate required for excellent results did not cause objectionable injury. There is little evidence in this trial to indicate that nutsedge is more susceptible to herbicides when applied later in the season as concluded in earlier research (4,5). Had total nutsedge emergence not occurred by the time treatments were started than earlier applications might have been less successful.

Excellent nutsedge control without objectionable grass injury was obtained from a single application of DSMA at the 3.6 lb rate in late June or the 2.7 lb rate in mid-July. Treatment date with DSMA did not appear to influence nutsedge control although as was explained earlier there was an increase in panicum control and grass injury from late July treatments. The two formulations of DSMA provided results similar to the standard material. The MSMA treatments resulted in excellent nutsedge control, however grass injury was objectionable.

Poor nutsedge control was obtained from the use of R-40244 and because of the degree of injury to the Kentucky bluegrass higher rates need not be investigated. The experimental material DPX-4129 appears to have some value for nutsedge control in turf. Because of the slow action of this material it was difficult in this trial to determine if nutsedge death was a result of chemical action or natural die back (by early September). Estimated control at the .25 lb rate was about 85%. Spray mixtures of bentazon and DSMA with the bromoxynil and dicamba mixture were not antagonistic.

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TABLE 1. Effect of herbicides, rates and treatment number and dates on nutsedge control, fall panicum control and turfgrass injury when applied to developing Kentucky bluegrass sod in 1979.

Herbicide	Rate - lb ai/A June 29	July 6	July 19	July 27	Percent Nutsedge Control *	Percent Panicum Control *	Maximum Turfgrass Injury **
Bentazon	-	-	.5	-	94	0	.7
Bentazon	-	-	.75	-	99	0	.5
Bentazon	1.0	-	-	-	97	0	.0
Bentazon	-	-	1.0	-	99	0	2.8
Bentazon	.5	.5	-	-	99	0	.0
Bentazon	-	-	.5	.5	99	0	.7
Bentazon	.75	.75	-	-	99	0	.2
Bentazon	-	-	.75	.75	99	0	.7
Bentazon	1.0	1.0	-	-	99	0	.0
Bentazon	-	-	1.0	1.0	99	2	1.0
Bentazon	-	-	4.0	4.0	99	13	1.5
DSMA	-	-	2.7	-	97	97	1.2
DSMA	3.6	-	-	-	93	44	.0
DSMA	-	-	3.6	-	99	98	2.0
DSMA	2.7	2.7	-	-	99	86	.3
DSMA	-	-	2.7	2.7	99	98	2.6
DSMA	3.6	3.6	-	-	98	97	.3
DSMA	-	-	3.6	3.6	99	100	3.4
DSMA (201)	2.7	-	-	-	89	2	.0
DSMA (201)	2.7	2.7	-	-	97	84	.5
DSMA (201)	3.6	-	-	-	92	33	.3
DSMA (201)	3.6	3.6	-	-	98	90	.3
DSMA (701)	2.7	-	-	-	82	11	.0
DSMA (701)	2.7	2.7	-	-	98	69	.0
DSMA (701)	3.6	-	-	-	93	23	.0
DSMA (701)	3.6	3.6	-	-	96	87	.0
DPX-4129	-	-	.06	-	10***	0	.4
DPX-4129	-	-	.13	-	30***	0	.3
DPX-4129	-	-	.25	-	85***	0	.0
MSMA	-	-	1.5	1.5	99	100	2.4
MSMA	-	-	2.0	2.0	99	100	3.7
R-40244	.5	.5	-	-	40	19	7.3
Bromoxynil +	.5	-	-	-			
dicamba +	.13	-	-	-			
bentazon	.75	.75	-	-	99	0	.0
Bromoxynil +	.5	-	-	-			
dicamba +	.13	-	-	-			
DSMA	3.6	3.6	-	-	98	96	.6

* Control based on 85 nutsedge plants per sq ft and 30% fall panicum cover in untreated plots on August 10-16, 1979.

** Scale 0 to 10 where 10 equals brown June through August.

*** Approximation because of slow action merging with fall die back.

EFFECTS OF HERBICIDES ON COLD TEMPERATURE TOLERANCE OF BERMUDAGRASS

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ABSTRACT

Preemergence and postemergence herbicides were applied to 'tufcote' bermudagrass grown in the growth room. Plugs were removed from the field in October after top growth had stopped and were transplanted into plastic pots to determine the effects of herbicides on cold temperature tolerance. Herbicides were applied at recommended rates either four weeks before or four weeks after plants were exposed to a -6°C temperature for 6 hours. Herbicide treatments resulted in a greater reduction in plant growth when applied after freezing than when applied before freezing. Bensulide, DCPA, and Oxadiazon reduced top growth regardless of the time of application. Benefin at 2.24 Kg/ha applied before freezing did not reduce plant growth. The postemergence herbicides 2,4-D, mecoprop, DSMA, and dicamba did not reduce plant growth when applied before or after freezing. Silvex at 1.12 Kg/ha or 0.56 Kg/ha in combination with other postemergence herbicides reduced plant growth, especially when applied after freezing.

INTRODUCTION

Winter survival is a major problem associated with the use of bermudagrass (Cynodon sp.) for lawn and golf turf in the northern limits of its distribution. Winterkilling is most frequently caused by the direct effects of low temperature, i.e. ice formation in plant tissue or cell sap, and dissication (1), although other factors such as disease and insects may contribute to winterkilling.

Many factors have been shown to be associated with winter survival of plants. However, quantitative data on the winter survival of bermudagrass are limited. Simmons and Lynd (6) found that winter survival of a forage bermudagrass was not affected by 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) applied immediately after planting. Fullerton et al. (3) reported that three preemergence herbicides resulted in increased winter injury of several bermudagrass cultivars when applied in the summer. Bingham (2) and Huffine (5) reported that soil surface applications of some preemergence herbicides prevented rooting of bermudagrass stolon nodes. However, no attempt was made to relate these effects to winter survival. Fullerton et al. (4) reported a significant increase in winterkilling of 'tifgreen' bermudagrass from applications of dimethyl tetrachloroterephthalate (DCPA) to plots sprigged in July or later. They concluded that DCPA interfered with the winter hardening process by maintaining vegetative growth into the normal period of winter hardening.

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The purpose of this greenhouse study was to determine the effects of preemergence and postemergence herbicides on cold temperature tolerance of 'tufcote' bermudagrass when applied before or after freezing.

MATERIALS AND METHODS

Plugs of 'tufcote' bermudagrass were removed from the field in October after top growth had stopped. These plugs, approximately 15 cm. in diameter and 10 cm. in depth, were put in plastic pots and placed in a growth chamber maintained at 1 to 2°C with approximately 171 μ Einstine/m^2/sec of light from fluorescent lamps for 10 hours per day. One set of replicated plugs was treated with herbicides 6 days after removal from the field and 4 weeks before freezing. Herbicide treatments were applied to another set of plugs 4 weeks after freezing. Herbicide treatments are shown in table 1. The freeze treatment consisted of exposing the plugs to uniform freezing conditions in cold chambers. Temperature was controlled to provide a prefreeze period at -1.0°C for 24 hours. The temperature was then reduced approximately 1°C per hour until a temperature of -6°C was reached. Following 6 hours at -6°C, the potted grasses were placed back in the growth chamber at 1 to 2°C and 10 hours light for 29 days. Following the after freezing herbicide treatments, the pots were transferred to a greenhouse and dry weight measurements of top growth, number of tillers, and height measurements for three replications were made after 8 weeks.

RESULTS AND DISCUSSION

Growth of plants that received the freeze treatment but no herbicide (control) appeared normal. Response to herbicide treatments occurred as a reduction in number of tillers and/or height of plant growth. In general, the largest response to herbicides applied before freezing was a reduction in number of tillers. Response to herbicides applied after freezing was reduced growth as well as a reduction in tillers. Because of the two types of response to herbicides, we concluded that dry weight of top growth was the best measurement of treatment effects.

Preemergence herbicides, except benefin applied before freezing, significantly reduced top growth (Table 2). Reduction in mean yield of top growth was greater when herbicides were applied after freezing. The decrease in yield was from .69 to .31 grams per pot with benefin and .54 to .27 grams per pot with bensulide. The greater reduction in top growth with herbicide applications after freezing may be due to increased absorption of the herbicides after freezing of plant tissue. Also, herbicide concentrations may have been higher at the time of growth initiation with the after freeze treatments. The reduction in top growth with DCPA and oxadiazon was 41% and 69%, respectively, when compared with the control. Our results with DCPA agree with those reported by Fullerton (4).

The postemergence herbicides 2,4-D, mecoprop, DSMA, and dicamba did not reduce top growth when applied before or after freezing (Table 3).

Silvex at 1.12 Kg/ha significantly reduced growth, especially when applied after freezing (Table 3). The reduction in growth with silvex prior to freezing and after freezing was 29% and 77% respectively, when compared with the control. The injurious effects of silvex were also obtained in mixtures with other postemergence herbicides (Table 4). Injury was substantially increased when mixtures containing silvex were applied after freezing. The reduction in top growth with silvex was due primarily to reduced height of growth rather than a reduction in the number of tillers. 2,4-D + mecoprop + silvex at rates of 1.12 + 0.56 + 0.56 Kg/Ha, respectively, was the only combination of herbicides to significantly reduce the growth when applied before freezing.

Our results suggest that the injurious effects of herbicides were due to inhibition of root and shoot growth. This differs from the promotion of vegetative growth into the normal period of winter hardening suggested by Fullerton et al. (4). Bermudagrass roots are still functional in late fall and winter after top growth has stopped. During this period the hardening process continues (Murray, unpublished data). In the spring, new leaves and shoots are produced before new root initiation. Beard (personal communications), in Texas, observed that new root growth was initiated 6 to 7 days after leaf and shoot growth and approximately 21 days were required before rooting reached a depth of 29 cm. In our test, the detrimental effects from herbicides applied before freezing may have resulted from root injury during the continuing hardening process after top growth had stopped. However, the increased injury with herbicides applied after freezing suggests that injury was due to the presence of herbicides when new growth was initiated. These theories need testing in more detailed experiments.

These data indicate that a reduction in winterkill of bermudagrass may be obtained by delaying herbicide applications, especially preemergence herbicides, in the spring until after new growth is well established. Winter survival may also be increased by not applying preemergence herbicides later than mid-summer, or by using benefin rather than the other herbicides in this test.

Table 1. Herbicide treatments applied to tufcote bermudagrass four weeks before and four weeks after freezing.

Herbicide		Dosage (a.e. Kg/ha)
Benefin	N-butyl-N-ethyl-α,α,α-Trifluoro-2, 6-dinitro-p-toluidine	2.2
Bensulide	N-(2-mercaptoethyl)benzenesulfonamide	11.2
DCPA	dimethyl tetrachloroterephthalate	11.2
Oxadiazon	2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one	1.1
2,4-D	(2,4-dichlorophenoxy)acetic acid	1.1
mecoprop	2-[(4-chloro-o-tolyl)oxy]propionic acid	1.1
DSMA	disodium methaneorsonate	3.4
Dicamba	3,6-dichloro-o-anisic acid	0.3
Silvex	2-(2,4,5-trichlorophenoxy)propionic acid	1.1
2,4-D + mecoprop		1.1 + 1.1
2,4-D + silvex		1.1 + 0.6
2,4-D + dicamba		1.1 + 0.3
2,4-D + mecoprop + silvex		1.1 + 0.6 + 0.6
2,4-D + mecoprop + dicamba		1.1 + 0.6 + 0.3

Table 2. Growth of 'tufcote' bermudagrass treated with preemergence herbicides four weeks before or after exposure to -6°C for 6 hours.

Herbicide	Dosage a.e. Kg/ha	Top growth - Dry wt. in g/pot[a] Before freezing	After freezing
Control	--	---------.71a----------	
Benefin	2.24	.69a	.31c
Bensulide	11.20	.54b	.27cd
DCPA	11.20	.43bc	.41c
Oxadiazon	1.12	.27cd	.18d

[a] Values are averages for 3 replications. Values followed by the same letter are not significantly different (DMR-.05).

Table 3. Growth of 'tufcote' bermudagrass treated with postemergence herbicides four weeks before or after exposure to -6°C for 6 hours.

Herbicide	Dosage a.e. Kg/ha	Top growth - Dry wt. in g/pot[a] Before freezing	After freezing
Control	--	---------1.01a----------	
DSMA	3.36	1.06a	.99a
2,4-D	1.12	1.02a	.93a
mecoprop	1.12	.96a	.93a
Dicamba	0.28	.94a	.87a
Silvex	1.12	.72b	.23c

[a] Values are averages for 3 replications. Values followed by the same letter are not significantly different (DMR-.05).

Table 4. Growth of 'tufcote' bermudagrass treated with mixtures of postemergence herbicides four weeks before or after exposure to -6°C for 6 hours.

Herbicide	Dosage a.e. Kg/ha	Top growth - Dry wt. in g/pot[a] Before freezing	After freezing
Control	--	---------.98a---------	
2,4-D + mecoprop	1.12 + 1.12	.97a	1.01a
2,4-D + dicamba	1.12 + 0.28	.95a	.81ab
2,4-D + silvex	1.12 + 0.56	.83ab	.38c
2,4-D + mecoprop+dicamba	1.12 + 0.56 + 0.28	.84ab	.79b
2,4-D + mecoprop+silvex	1.12 + 0.56 + 0.56	.79b	.41c

[a] Values are average for 3 replications. Values followed by the same letter are not significantly different (DMR-.05).

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PERFORMANCE OF PESTICIDES IN TURF AREAS TREATED EARLIER WITH ACTIVATED CHARCOAL

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ABSTRACT

Past studies at the Turf Research Farm of the University of Rhode Island have shown that activated charcoal can adsorb various chemical residues and alter their effect on plant growth. Improved grass stands were obtained by using charcoal in chemically contaminated seedbeds. Where sod was transplanted charcoal improved rooting and reduced grass injury. Charcoal also alleviated damage to turfgrass where chemical spills, misuse or overapplication took place. However, the use of charcoal might affect the future performance of pesticides. Charcoal could adsorb them thereby reducing their effectiveness. Earlier studies have shown some reduction in the activity of preemergence crabgrass herbicides. Six tests were conducted during 1978 and 1979 to study the influence of charcoal on the subsequent performance of certain fungicides, herbicides and insecticides. The results of these trials are presented in Tables 1 through 6.

Charcoal applied 13 days before the use of such fungicides as anilazine (Dyrene), benomyl (Tersan 1991), chlorothalonil (Daconil 2787), cycloheximide (Acti-dione/Thiram), iprodione (Chipco 26019) and triadimefon (Bayleton) did not reduce their effectiveness for controlling brown patch disease and/or dollar spot disease (Tables 1 and 2). Three insecticides used for the control of Japanese beetle grubs were not influenced by charcoal treatment six days earlier (Table 3). The insecticides used were carbaryl (Sevin), diazinon (Diazinon), and trichlorfon (Proxol).

The herbicide activity of preemergence crabgrass herbicides, such as benefin (Balan), bensulide (Betasan), DCPA (Dacthal) and siduron (Tupersan), was not reduced in soil treated with surface applications of charcoal seven months earlier (Table 4). These four herbicides along with oxadiazon (Ronstar) and prosulfalin (Sward) were not influenced by charcoal applied to the surface of established turfgrass nine months earlier (Table 5). In earlier work we did note some reduction in herbicide activity where charcoal was applied to turf surfaces five months earlier.

Herbicides such as 2,4-D, dicamba (Banvel) and mecoprop (MCPP), used for the control of broadleaved weeds such as dandelion, chickweed and clover, performed well when applied 17 days following charcoal use (Table 6). One might expect other postemergence herbicides such as the methanearsonates and bentazon (Basagran) to perform as well.

It appears from these studies that pesticides will not be influenced by the earlier use of activated charcoal. With the passage of time most adsorptive sites on charcoal will become saturated and pesticides can be expected to perform satisfactorily. Pesticides that perform their function on plant foliage are the least likely to be affected. Rains will wash charcoal off of plant surfaces and new plant tissue will be charcoal free. Where charcoal is needed to safely establish turf or prevent grass damage then the concern over a possible disease, insect or weed problem in the future should be of secondary importance.

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TABLE 1. Brown patch disease in a perennial ryegrass lawn on August 16 after the use of fungicides on August 3 and 10 where activated charcoal was applied 13 days earlier (July 21, 1978).

Fungicide	Material and rate per 1000 sq ft		Charcoal 0	Charcoal 300 lb/A
			— % Disease* —	
anilazine	Dyrene 50W	4 oz	0 a**	0 a
benomyl	Tersan 1991 50W	2 oz	0 a	0 a
chlorothalonil	Daconil 2787 75W	4 oz	0 a	0 a
cycloheximide	Acti-dione/Thiram .75 + 75W	4 oz	3 a	5 a
iprodione	Chipco RP26019 50W	2 oz	0 a	0 a
triadimefon	Bayleton 25W	2 oz	0 a	0 a
none	--	--	28 b	31 b

* Cooperative effort with Dr. Noel Jackson, Plant Pathologist Univ. of R.I.

** Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

TABLE 2. Dollar spot disease in a creeping bentgrass putting green on October 31 after the use of fungicides on August 3, 10 and 18 where activated charcoal was applied earlier (July 21, 1978).

Fungicide	Material and Rate per 1000 sq ft		Charcoal 0	Charcoal 300 lb/A
			— % Disease* —	
anilazine	Dyrene 50W	4 oz	2 a**	5 a
benomyl	Tersan 1991 50W	2 oz	1 a	1 a
chlorothalonil	Daconil 2787 75W	4 oz	4 a	4 a
triodimefon	Bayleton 25W	2 oz	1 a	1 a
none	--	--	78 c	66 b

* Cooperative effort with Dr. Noel Jackson, Plant Pathologist at Univ. of R.I.

** Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

TABLE 3. Japanese beetle grubs (Oct 24 - Nov 3) in a Kentucky bluegrass lawn treated with insecticides on September 21 following an application of activated charcoal six days earlier (September 15, 1978).

Insecticide	Material	Rate lb ai/A	Charcoal 0	Charcoal 300 lb/A
			— Grubs/sq ft* —	
carbaryl	Sevin 50W	8.5	26 b**	39 bc
diazinon	Diazinon AG500	5.8	30 b	36 bc
trichlorfon	Proxol 80SP	6.4	3 a	7 a
none	--	--	65 d	54 cd

* Cooperative effort with Dr. Richard A. Casagrande, Entomologist at Univ. of R.I.

** Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

TABLE 4. Crabgrass stand on June 19 in a soil area treated with herbicides on April 25 where the soil surface was treated seven months earlier (September 29, 1978) with activated charcoal.

Herbicide	Material	Rate lb ai/A	Charcoal 0	Charcoal 300 lb/A
			— % Stand —	
benefin	Balan 2G	3	14 b*	19 b
bensulide	Pre-San 4E	10	1 a	3 a
DCPA	Dacthal 75W	10	1 a	3 a
siduron	Tupersan 50W	12	2 a	4 a
none	--	--	77 c	--

* Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

TABLE 5. Crabgrass stand in a red fescue--Kentucky bluegrass lawn on August 16 after the use of herbicides on May 15 where activated charcoal was applied nine months earlier (August 29, 1978).

Herbicide	Material	Rate lb ai/A	Charcoal 0	Charcoal 300 lb/A
			— % Stand —	
benefin	Balan 2.5G	3	3 a*	5 a
bensulide	Betasan 7G	7.5	1 a	2 a
bensulide	Pre-San 4E	7.5	1 a	3 a
DCPA	Dacthal 75W	10	1 a	1 a
oxadiazon	Ronstar 2G	3	1 a	1 a
prosulfalin	Sward 50W	1.5	1 a	1 a
siduron	Tupersan 50W	10	2 a	1 a
none	--	--	37 b	38 b

* Means followed by the same letter do not differ significantly at the 5% level using Duncan's multiple range test.

TABLE 6. Dandelion, mouseear chickweed and white clover stand in a lawn area on September 26 after the use of Trex-San* on August 7 where activated charcoal (300 lb/A) was applied 17 days earlier (July 21, 1978)

Treatment	Dandelion	Chickweed	White clover
		% stand	
Trex-San*	0	0	0
Trex-San* plus charcoal	0	0	0
None	14	5	26

* 2,4-D + mecoprop + dicamba at 1+1/2+1/8 lb ai/A

INVASION OF ROADSIDE TURFGRASSES BY *ARISTIDA OLIGANTHA* AND OTHER WEEDY ANNUAL GRASSES

C.D. Sawyer and R.C. Wakefield[1/]

ABSTRACT

Successful establishment and maintenance of stands of perennial grass or perennial grass-legume mixtures is essential in stabilizing soils along highways. Loss of vegetative cover may result in soil erosion and cause sedimentation and pollution in the immediate roadside environment. Successional patterns occurring along many Rhode Island highways are resulting in the displacement of seeded grass species by less desirable perennial grasses (e.g. *Andropogon* spp., *Danthonia spicata*), perennial broadleaf weeds (e.g. *Hieracium* spp., *Plantago* spp.) and annual grasses (e.g. *Digitaria* spp., *Aristida* spp. and *Sporobolus* spp.). Emphasis in this study is placed on *Aristida oligantha* and *A. dichotoma* as these species have formed relatively large monospecific stands in short periods of time.

Studies of *Aristida* spp. indicate that, like crabgrasses, germination and growth coincide with dormancy of perennial grasses. The rapid spread of *Aristida* spp. indicates superior competitive abilities and studies have suggested that biochemical inhibition is involved. Other factors contributing to the deterioration of seeded species appear to be poor mowing practices, low soil fertility, and damage from deicing salts.

Experiments are being conducted to investigate the effect of mowing height and fertility levels on deterioration of seeded turf, and herbicides effective in controlling *Aristida* spp. Results of preliminary experiments indicate that inadequate management practices contributed to deterioration of desirable grass species and subsequent invasion by *Aristida* spp. Siduron preemergent and DSMA postemergent herbicides were effective in controlling *A. oligantha*; however, more than a single application would be necessary to adequately control *A. dichotoma*. The ecology of *A. oligantha* is being studied, with emphasis on the allelopathic effects of the species on seeded perennial grasses.

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RESPONSES OF TURFGRASSES TO CHEMICAL RETARDANTS AND OTHER MANAGEMENT FACTORS

Robert W. Duell [1]

ABSTRACT

For two consecutive years certain retardants were applied to the same plots of 'Delta' Kentucky bluegrass and also 'Manhattan' perennial ryegrass under lawn management. MH at 4.5 kg/ha, mefluidide at .28, .42, and .56 kg/ha, and MBR 18337 at .14, .28, and .56 kg/ha retarded Delta more effectively without supplemental N in the spring of 1978. Foliar retardation and seedhead suppression of Delta was markedly affected by these treatments in early May while their effects on Manhattan were minimal. The effects of similar treatments reapplied in 1979 were enhanced by mowing one week later. Foliar injury by retardants was nil, but discoloration of turf was greater in mowed plots and this was attributed to the fact that senescent foliage in effective treatments was more exposed because new canopy growth was minimal. Regeneration of roots of 'Park' Kentucky bluegrass from treated plugs was retarded significantly by half the recommended rates of MH (2.2 kg/ha) but only at double (1.1 kg/ha) recommended rates of mefluidide. Manhattan roots were more severely retarded by MH than other chemical retardants. Later in the season only Manhattan treated with MH developed red thread.

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GROWTH REGULATION OF KENTUCKY BLUEGRASS AND TALL FESCUE[1/]

D. J. Wehner[2/]

ABSTRACT

The growth regulators mefluidide, MBR 18337, ethephon, and EL 72500 (two formulations) were applied to stands of tall fescue and Kentucky bluegrass to evaluate growth suppression and phytotoxicity. Turfgrass color, density, and height were the parameters measured. On Kentucky bluegrass, both formulations of EL 72500 reduced the height of the grass up to 60% compared to the nonmowed check 8 weeks after treatment. The other chemicals reduced height from 18 to 32%. All chemicals except ethephon discolored bluegrass to some degree, while density was reduced by mefluidide and MBR 18337. By 5 weeks after treatment, EL 72500 reduced the height of tall fescue up to 42% compared to the nonmowed check. Tall fescue height was reduced 10 to 29% by the other chemicals. Mefluidide and EL 72500 caused some discoloration of the turf. Density was reduced only by mefluidide. EL 72500 shows promise as a growth regulator for use on turfgrass.

INTRODUCTION

Energy resources in the United States are a major factor influencing the maintenance cost of fine turfgrass stands. The rising price of fertilizers and pesticides, which is indirectly tied to the cost of petroleum, and direct fuel costs have made it difficult to provide a high level of maintenance with reasonable expenditures. Because of this, growth regulators, which have the potential of reducing the energy input into turf maintenance through reduced mowing, are gaining interest among turf managers.

A large number of chemicals have been evaluated over the past few years for their potential as growth regulating compounds (1, 2, 3, 4, 6). Mefluidide [N-[2,4-diemthyl-5-[[(trifluoromethyl) sulfonyl]amino]phenyl]acetamide], the latest retardant to be commercially released, has been shown to suppress growth to a greater degree than chlorflurenol (methyl 2-chloro-9-hydroxyfluorene-9-carboxylate, methyl 2, 7 dichloro-9-hydroxyfluorene-9-carboxylate) and MH (1,2-dihydro-3,6-pyridazinedione) (5) which were previously two of the most widely used growth regulators. However, turfgrass injury with mefluidide has been found to be equal to (4) or more severe (3) than with MH or chlorflurenol. An ideal growth regulator should provide season long growth suppression with no injury. The purpose of this research was to compare three experimental growth regulators to mefluidide for growth suppression and injury to Kentucky bluegrass (<u>Poa pratensis</u> L.) and tall fescue (<u>Festuca arundinacea</u> Schreb.).

1/ Scientific Article No. ________ and Contribution No. ________ of the Maryland Agricultural Experiment Station, Dept. Agron., Univ. Maryland, College Park.

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MATERIALS AND METHODS

The growth regulators used in this study were mefluidide 2S, MBR 18337 (undisclosed) 2EC, EL 72500 (undisclosed) 50 WP and 1G, and ethephon (2-chloroethyl-phosphoric acid) 2 S. Rates of application appear in Table 1.

Treatments were applied to 1 m by 3 m plots of both Kentucky bluegrass and 'Kentucky 31' tall fescue. The bluegrass stand was comprised of the cultivars 'Merion', 'Adelphi', and 'South Dakota Certified' with a small percentage of 'Pennlawn' red fescue (Festuca rubra L.) also present. The stands were growing on a Chillum silt loam at the Plant Research Farm in Fairland, MD. The experimental design was a randomized complete block with three replications. Sprayable materials were applied with a CO_2 pressurized small plot sprayer at 2.8 kg/cm^2 in 98 liters of water per hectare. The granular formulations of EL 72500 was applied with a drop-type spreader.

Three sets of plots were treated with growth regulators (all plots were trim mowed 1 week after the initial growth regulator application). One set of Kentucky bluegrass plots was treated on 30 April 1979 (ethephon applied 7 May), and allowed to grow without mowing or retreatment. A second set of bluegrass plots was treated on 30 April, mowed on 6 June, and retreated on 25 June. These plots were subsequently mowed on 4 September and 3 October. The tall fescue plots were treated on 7 May, mowed on 13 June, retreated on 25 June and subsequently mowed on 4 September and 18 September.

Five turfgrass height measurements were made in each plot at the time intervals indicated in Tables 1 and 5. The mean value for each plot was used for statistical analysis. When the plots were mowed, clippings from a 0.52 m by 3 m swath were collected, dried in an oven at 70C, and weighed. Plot color and density were visually rated on the dates indicated in Tables 4 and 6. A rating scale of 1 to 9 was used with 9 equal to ideal density or color. All data were statistically analysed.

RESULTS AND DISCUSSION

Height measurements from Kentucky bluegrass treated with a single application of a growth regulator are presented in Table 1. Twenty-nine days after treatment, the highest rate of mefluidide and MBR 18337 resulted in the greatest height reductions compared to the nonmowed check, while the lowest rate of EL 72500 resulted in the least height reduction. This difference was probably due to the fact that both mefluidide and MBR 18337 are foliar absorbed (Personal Communication, John Matteson) while EL 72500 is root absorbed (Personal Communication, Ed Hayes). Since treatments were applied to an actively growing stand of bluegrass it appeared that the foliar absorbed chemicals were faster acting. The ranking of the treatments began to reverse 37 days after treatment (Table 1). Kentucky bluegrass treated with EL 72500 did not increase in height between the 29th and 37th days. However, the turf in plots receiving the other chemicals grew several centimeters. Between 37 and 57 days after treatment, the effects of mefluidide and MBR 18337 began to wear off. Average height reductions compared to the check 57 days after treatment ranged from 63% for the high rate of EL 72500 (50 WP) to 18% for the low rate of mefluidide. Measurements were discontinued on this set of plots because the turf in the check plots began to lodge and it became

Table 1. Height measurements (cm) from Kentucky bluegrass turf 29, 37, and 57 days after treatment (ethephon 22, 30, and 50 days) with growth regulators.

Treatment		Rate (Kg/ha)	Days After Treatment 29	37	57	% Height Reduction Compared to Check (57 days)
			---	(cm)	---	
EL72500	1G	1.12	11.7	11.5	13.8	47
EL72500	1G	2.24	11.2	10.8	10.5	60
EL72500	1G	3.36	11.1	9.7	10.4	60
EL72500	50WP	1.12	12.5	12.5	14.9	44
EL72500	50WP	2.24	10.1	10.1	11.0	58
EL72500	50WP	3.36	9.9	9.4	9.6	63
MEFLUIDIDE	2S	0.28	8.6	13.2	21.5	18
MEFLUIDIDE	2S	0.56	7.9	11.6	19.6	25
MBR18337	2EC	0.14	9.6	12.8	21.2	19
MBR18337	2EC	0.28	9.0	12.9	20.6	21
MBR18337	2EC	0.56	7.7	12.0	19.4	26
ETHEPHON	2S	4.48	10.5	12.6	17.9	31
ETHEPHON	2S	6.72	10.3	12.8	17.7	32
CHECK			16.6	19.1	26.1	--
FLSD (.05)			1.3	1.4	2.3	--

Table 2. Height reductions (as % of nonmowed check) for Kentucky bluegrass and tall fescue turf 37 days after initial treatment and 46 days after retreatment with growth regulators.

Treatment		Rate (Kg/ha)	37 Days After Treatment: Kentucky Bluegrass	Tall Fescue	46 Days After Retreatment: Kentucky Bluegrass	Tall Fescue
			-----------------	%	-----------------	
EL72500	1G	1.12	36	38	29	9
EL72500	1G	2.24	43	44	42	19
EL72500	1G	3.36	43	42	43	24
EL72500	50WP	1.12	34	29	16	8
EL72500	50WP	2.24	45	39	27	14
EL72500	50WP	3.36	48	42	42	18
MEFLUIDIDE	2S	0.28	32	21	3	0
MEFLUIDIDE	2S	0.56	40	25	0	10
MBR18337	2EC	0.14	30	10	0	0
MBR18337	2EC	0.28	22	15	0	6
MBR18337	2EC	0.56	29	29	0	10
ETHEPHON	2S	4.48	29	12	10	0
ETHEPHON	2S	6.72	31	19	17	0

Table 3. Dry weights of clippings harvested from Kentucky Bluegrass and tall fescue turf treated with EL72500.

Treatment		Rate (Kg/ha)	Days After Retreatment: K. Bluegrass 70	K. Bluegrass 93		Tall Fescue 70	Tall Fescue 84
			--	--	(g)	---	--
EL72500	1G	1.12	196	65		194	71
EL72500	1G	2.24	120	81		102	61
EL72500	1G	3.36	105	72		75	50
EL72500	50WP	1.12	347	60		168	68
EL72500	50WP	2.24	188	71		121	63
EL72500	50WP	3.36	90	80		84	57
CHECK			334	59		255	65
FLSD (.05)			105	NS		54	11

Table 4. Color and density ratings for Kentucky Bluegrass treated with growth regulators on April 30,1979 (ETHEPHON-May 7) and June 25, 1979.

Treatment		Rate (Kg/ha)	Color* 5/18	Color* 6/4	Color* 7/17	Density* 5/18
EL72500	1G	1.12	9.0	6.0	8.6	8.0
EL72500	1G	2.24	9.0	6.0	7.3	8.0
EL72500	1G	3.36	9.0	5.6	6.0	8.0
EL72500	50WP	1.12	9.0	6.6	9.0	8.0
EL72500	50WP	2.24	8.6	6.0	8.0	8.0
EL72500	50WP	3.36	7.6	5.3	6.6	7.6
MEFLUIDIDE	2S	0.28	6.3	8.0	7.6	7.0
MEFLUIDIDE	2S	0.56	6.0	7.0	7.3	6.6
MBR18337	2EC	0.14	7.0	8.0	8.0	7.3
MBR18337	2EC	0.28	7.0	7.6	8.0	7.0
MBR18337	2EC	0.56	6.3	7.0	7.3	7.0
ETHEPHON	2S	4.48	8.6	9.0	8.0	8.6
ETHEPHON	2S	6.72	9.0	8.6	8.0	8.0
CHECK	MOWED		8.0	8.0	8.3	9.0
CHECK	UNMOWED		9.0	8.3	8.0	8.0
FLSD (.05)			0.7	0.6	0.8	0.5

* Color and Density rated 1 to 9 with 9 = ideal color and density.

impossible to obtain accurate height measurements.

A second set of bluegrass plots received two applications of the growth regulators. Results from the first application were the same as those reported above. The second application of all the chemicals except EL 72500 did not retard the height of the turf as much as the first application (Table 2.). For example, 37 days after the first treatment, the height of the mefluidide (0.28 kg/ha) treated turf was 32% lower than the check; 46 days after retreatment, the mefluidide (0.28 kg/ha) treated turf was the same height as the check. This finding agrees with an earlier study (5).

The EL 72500 plots were harvested 70 and 93 days after retreatment. Dry weights of the clippings are presented in Table 3. The dry weights from the EL 72500 treated plots were significantly less than the untreated turf 70 days after retreatment, but not significantly different 90 days after retreatment.

Color and density ratings for Kentucky bluegrass receiving two applications of growth regulators are presented in Table 4. All chemicals except ethephon discolored the turf at some time during the study. Discoloration on the mefluidide and MBR 18337 treated turf on 18 May was due to the presence of Helminthosporium leafspot. The problem of increased disease on turf treated with growth regulator has been reported (3). Fungicides applied with mefluidide have been shown to be compatable and reduce disease incidence (3). Discoloration on the EL 72500 treated turf on 4 June was due to the presence of a few seed heads mixed with some dried leaf tips. Discoloration on the EL 72500 treated turf on 17 July was also due to the presence of dried leaf tips. In both cases the discoloration eventually disappeared. Density of the treated turf was less than the mowed check on 18 May, but except for the mefluidide and MBR 18337 plots, was not significantly less than the nonmowed check.

Height measurements for tall fescue that received applications of growth regulators are presented in Table 5. Results were similar to those found with Kentucky bluegrass. Initially, the mefluidide and MBR 18337 treated plots were the shortest, but after 37 days, the EL 72500 treatments had reduced turf height more than the other chemicals. Generally, height measurements taken after retreatment (25 June) indicated that the second application was not as effective as the first in controlling the heights (Table 2.). forty-six days after retreatment, the highest rate of EL 72500 had reduced turf height 24%.

Dry weights of clippings from tall fescue treated with EL 72500 and harvested 70 and 84 days after treatment are presented in Table 3. There was a small growth reduction (2 to 15g) of the turf treated with the two highest rates of EL 72500 compared to the check between 70 and 84 days.

Color and density ratings for the tall fescue are presented in Table 6. The color ratings of the mefluidide and EL 72500 treated turf were lower than the checks on 4 June. The color ratings of the EL 72500 plots were also lower than the check on 13 June and 17 July. The color reduction on turf treated with EL 72500 would be objectionable on a home lawn or fine turf area but would probably not be noticed on a roadside or nonuse area. The turf density was reduced by mefluidide only.

Table 5. Height measurements (cm) from tall fescue turf 22, 30, and 37 days after treatment with growth regulator.

Treatment		Rate (Kg/ha)	Days After Treatment 22	30	37	% Height Reduction Compared to Check (37 days)
			----	(cm)	----	
EL72500	1G	1.12	12.8	13.0	13.7	38
EL72500	1G	2.24	12.0	12.0	12.5	44
EL72500	1G	3.36	12.3	12.0	12.8	42
EL72500	50WP	1.12	13.4	14.2	15.8	29
EL72500	50WP	2.24	12.5	12.5	13.7	39
EL72500	50WP	3.36	12.3	12.0	13.0	42
MEFLUIDIDE	2S	0.28	10.7	12.0	17.6	21
MEFLUIDIDE	2S	0.56	10.5	12.1	16.7	25
MBR18337	2EC	0.14	14.3	15.1	20.2	10
MBR18337	2EC	0.28	12.8	13.9	19.1	15
MBR18337	2EC	0.56	10.8	12.1	15.8	29
ETHEPHON	2S	4.48	13.9	16.1	19.6	12
ETHEPHON	2S	6.72	13.3	14.4	18.1	19
CHECK			16.3	17.4	22.2	--
FLSD (.05)			1.3	1.5	1.9	--

Table 6. Color and Density ratings for tall fescue treated with growth regulator on May 7, 1979 and June 25, 1979.

Treatment		Rate (Kg/ha)	Color* 5/18	6/4	6/13	7/17	Density* 5/18
EL72500	1G	1.12	8.6	6.3	4.0	7.6	9.0
EL72500	1G	2.24	8.3	6.3	4.0	6.0	9.0
EL72500	1G	3.36	8.3	5.6	4.3	5.3	9.0
EL72500	50WP	1.12	9.0	6.6	5.3	7.0	9.0
EL72500	50WP	2.24	8.6	6.0	4.6	6.3	8.6
EL72500	50WP	3.36	8.6	6.3	4.3	5.6	8.3
MEFLUIDIDE	2S	0.28	8.0	7.6	8.6	7.6	8.6
MEFLUIDIDE	2S	0.56	8.0	7.0	8.0	7.0	7.6
MBR18337	2EC	0.14	9.0	8.0	8.0	8.0	8.6
MBR18337	2EC	0.28	8.6	7.6	8.3	7.6	8.6
MBR18337	2EC	0.56	7.6	6.6	7.6	7.3	8.0
ETHEPHON	2S	4.48	9.0	9.0	8.3	8.0	9.0
ETHEPHON	2S	6.72	9.0	9.0	8.6	8.0	9.0
CHECK	MOWED		8.0	9.0	9.0	8.6	9.0
CHECK	UNMOWED		9.0	9.0	8.3	8.0	9.0
FLSD (.05)			0.7	1.6	0.8	0.7	0.7

* Color and Density rated 1 to 9 with 9 = ideal color and density.

CONCLUSIONS

EL 72500 shows promise as a growth regulator on Kentucky bluegrass. Further testing is necessary to determine the effects of EL 72500 on heat and drought stressed turf. Cool season turfgrasses were not under stress this year because of unusually good weather conditions. Ethephon and MBR 18337 were less successful than EL 72500. Ethephon did not injure the bluegrass but only reduced turf height by 30%. MBR 18337 resembled the commercially available mefluidide in its characteristics.

EL 72500 did not look as promising on tall fescue as it did on bluegrass. Growth suppression was less and the color ratings lower. Perhaps higher rates should be tested on tall fescue; however, discoloration would still be a problem. Ethephon did not injure the tall fescue but only reduced height 19%. MBR 18337 resembled mefluidide in its characteristics.

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IMPROVING BROADLEAF WEED CONTROL IN BLUEGRASS

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ABSTRACT

Established bluegrass containing several weed species was selected for these studies. Low rates of dicamba and 2,4-DP in mixture with 2,4-D were evaluated in single and multiple applications. Weed control ratings were made at about 6-week intervals throughout the summer. A single application of 2,4-D, dicamba or low rates of dicamba and 2,4-D mixture did not provide full season control of dandelion, white clover, and mouseear chickweed and gave very little control of yellow woodsorrel and purslane speedwell. Repeated applications of dicamba and dicamba plus 2,4-D mixtures provided excellent control of dandelion, white clover, red sorrel and mouseear chickweed and provided inadequate control of yellow woodsorrel and purslane speedwell. Mixtures of 2,4-D and 2,4-DP gave initial control of dandelion, white clover, mouseear chickweed, and yellow woodsorrel (applied in May) and less than desirable control of purslane speedwell and red sorrel.

INTRODUCTION

With a broad spectrum of weeds occurring in turfgrasses, 2,4-D [(2,4-dichlorophenoxy)acetic acid] has provided the wide base needed for control of broadleaf weeds (1, 3, 4). Silvex [2-(2,4,5-trichlorophenoxy)propionic acid] was shown to be effective for several weeds not adequately controlled with 2,4-D (2). Thus, during the last two decades, a mixture of 2,4-D and silvex became the generally used formulations by many turfgrass managers including the lawn care industry. Recently, silvex was suspended from sale or use in the United States. This suspension was brought about by a contaminant, dioxin, occurring in the formulated product.

Dicamba (3,6-dichloro-*o*-anisic acid) and mecoprop {2-[(4-chloro-*o*-tolyl) oxy]propionic acid} are considered partial replacements for silvex in turfgrass broadleaf weed control. Dicamba controlled the weeds with a few exceptions but does cause an additional problem where ornamentals and trees are found in the turfgrasses growing on sandy soils. Mecoprop has not provided the broad spectrum of weed control; however, safety around woody species is superior over dicamba.

METHODS AND MATERIALS

Two experiments with 4 replications of 6.7 m^2 plots in a randomized complete block design were located on established common Kentucky bluegrass at Blacksburg, VA. A bicycle wheel plot sprayer was used to apply the treatments at 421 l/ha with Experiments I and II initiated on April 18 and May 16, 1979, respectively. Selected treatments were repeated at monthly intervals (see Tables). Weed control

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ratings on individual broadleaf weeds were recorded at about 6-week intervals throughout the summer. Lawn type management with 2-inch clipping height was utilized.

Formulations of 2,4-D and dicamba (0.48 kg/l were dimethylamine salts. Mixtures were largely tank mixed with exceptions of 0.223 plus 0.0223 and 0.6 plus 0.06 kg/l formulations. A commercially available mixture of dicamba and 2,4-D for turfgrasses (0.0132 and 0.126 kg/l) and the 3-way mixture containing mecoprop (0.012, 0.12 and 0.06 kg/l) were also utilized. Ester and oil soluble amine (OSA) formulations of 2,4-D and 2,4-DP [2,4-dichlorophenoxy)propionic acid] were compared (0.12 plus 0.12 kg/l).

RESULTS AND DISCUSSION

The herbicides utilized in these studies were for postemergence control of broadleaf weeds. In most instances, seedlings began to emerge to reinfest the bluegrass after several weeks.

Dandelion

The plots ranged from 43 to 98 dandelions per m^2 in the study areas. One application of dicamba alone at 0.28 kg/ha provided a fair level of dandelion control; while 0.56 kg/ha or repeated 0.28 kg/ha treatments gave complete control (Table 1). For 2,4-D, 1.12 kg/ha repeated at monthly intervals provided complete control when treatments were initiated in April, but only satisfactory results were observed when treatments were started in May. A single application of 0.56 to 1.12 kg/ha of 2,4-D did not control dandelions adequately. Even 2.24 kg/ha of 2,4-D provided only fair temporary control of dandelion; while 4.48 kg/ha of 2,4-D controlled all existing dandelion plants with a few emerging after 2 to 3 months.

Dicamba + 2,4-D + mecoprop and dicamba + 2,4-D (commercially available formulations) gave a low level of dandelion control using single treatments in April and slightly better results were obtained from May treatments. These treatments needed to be repeated in September to maintain a satisfactory level of dandelion control. The two experimental formulations (0.0223 + 0.223 and 0.06 + 0.5 kg/l dicamba + 2,4-D, respectively) gave similar to slightly poorer results to the above mixtures. The specially prepared sprayer tank mixes of dicamba plus 2,4-D were also quite similar and required repeated treatments to provide complete control of dandelion.

Two formulations of 2,4-D and 2,4-DP (ester and oil soluble amine) at 1.12 to 2.24 kg/ha of each herbicide provided control of dandelion for 3 to 4-1/2 months. Although several dandelions emerged by September in these plots, it was better than 2,4-D alone.

White Clover

This was the most predominant weed in the test areas. Dicamba gave excellent control of existing plants; however, repeated treatments were needed for continuous complete control (Table 2). All mixtures of 2,4-D and dicamba gave good initial control and repeated treatments provided continuous control. The 2,4-D plus 2,4-DP formulations were also similar in white clover control to the dicamba plus 2,4-D mixtures.

Mouseear chickweed

The 2,4-D plus 2,4-DP formulations were superior to all other single applications for mouseear chickweed control (Table 3). Dicamba at 0.28 kg/ha provided excellent control; however, in the case of the mixtures with 2,4-D, the amount of dicamba was considered too low for successful results. Higher amounts of dicamba in the tank mixtures with 2,4-D or repeated monthly treatments were better. Generally, 2,4-D alone did not control this weed.

Red sorrel

Repeated applications of dicamba or 2,4-D were generally effective for this weed (Table 4). Single treatments of either herbicide or mixture of the two herbicides were generally less effective. The 2,4-D plus 2,4-DP treatment (single applications) were also unsatisfactory.

Yellow woodsorrel

This is an annual plant that emerged predominantly after the first experiment was initiated. In the second experiment, both formulations of 2,4-D plus 2,4-DP were excellent for yellow woodsorrel control (Table 5). After 4 applications with high rates of 2,4-D or dicamba, the amount of control improved. Single applications of 2,4-D plus dicamba were generally ineffective. This was one weed that silvex controlled that dicamba will be a poor replacement. The 2,4-DP may be the better replacement.

Purslane speedwell

This weed emerges from seed each year in February or March. The control was very erratic with all formulations evaluated (Table 6). As the second experiment was evaluated later in the year, some of this weed had flowered and began to die in the control plots.

In general, dicamba may be a suitable replacement for silvex on turfgrass areas. However, it must be remembered that dicamba is more mobile in soil and plants than silvex. The potential for ornamental and tree damage is very great for dicamba on sandy soil with the added route of uptake through roots as well as leaves. The 2,4-DP without the dioxin contaminant was the better replacement for silvex for yellow woodsorrel control.

There was no injury observed on the common bluegrass during these treatments and evaluation periods. In some cases the turfgrass was left thin initially from the control of weeds and, near the end of the year, ground cover with bluegrass was better with broadleaf weed control as compared to untreated check plots.

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Table 1. Effectiveness of herbicide mixtures for broadleaf weed control in bluegrass (Treated Exp I April 18 and Exp II May 16, 1979).

Herbicides & Formulation	kg/ha	Dandelion control ratings[1/]						
		Experiment I				Experiment II		
		6/1	7/16	8/20	9/26	6/28	8/10	9/20
Dicamba	0.15[2/]	2	0	4	1	3	2	5
"	0.28[2/][3/]	7	10	10	8	7	9	9
2,4-D	0.56[2/]	5	2	3	0	8	7	5
"	1.12[2/][3/]	10	10	10	8	9	10	9
Dicamba + 2,4-D	0.07+0.56[2/]	6	5	5	3	7	3	3
"	0.07+0.84[2/]	8	4	3	2	6	4	3
"	0.07+1.12[2/][3/]	10	10	10	9	10	10	10
"	0.15+0.56[2/]	8	6	5	2	7	5	3
"	0.15+0.84[2/]	8	8	6	4	8	3	5
"	0.15+1.12[2/][3/]	10	10	10	10	10	10	10
Dicamba + 2,4-D (0.06 + 0.6 kg/l)	0.11+1.12	7	5	5	3	6	4	3
Dicamba + 2,4-D + mecoprop (0.012 + 0.12 + 0.06 kg/l)	0.11+1.12+0.56	6	6	5	1	6	3	1
Dicamba + 2,4-D (0.0223 + 0.223 kg/l)	0.15+1.46	7	4	4	2	-	-	-
Dicamba + 2,4-D (0.0132 + 0.126 kg/l)	0.12+1.18	5	6	3	3	6	5	4
2,4-D + 2,4-DP (ester)	1.12+1.12	8	7	6	4	10	9	6
"	1.68+1.68	9	6	6	2	10	8	5
"	2.24	9	8	7	3	10	10	6
2,4-D + 2,4-DP (OSA)	0.84+0.84	5	3	3	2	9	5	3
"	1.68+1.68	9	7	7	3	10	8	4
"	2.24+2.24	8	8	4	2	9	7	4
Dicamba + 2,4-D (0.0223 + 0.223 kg/l)	0.11+1.12	3	4	2	3	9	7	3
2,4-D	1.12[2/]	5	4	4	1	10	8	7
"	2.24[2/]	8	8	7	4	10	9	6
Check	--	0	0	0	0	1	2	3
"	--	0	0	0	0	0	1	0
"	--	1	0	0	0	-	-	-

[1/]0-10 scale where 0 = no control and 10 = complete control

[2/]In experiment II the rate was double this amount.

[3/]Retreated on May 18, June 14 and July 17, 1979 in Experiment I; June 13, July 17 and August 9 in Experiment II.

Table 2. Effectiveness of herbicide mixtures for broadleaf weed control in bluegrass (Treated Exp I April 18 and Exp II May 16, 1979).

Herbicides & Formulation	kg/ha	White Clover Control ratings[1/]						
		Experiment I				Experiment II		
		6/1	7/16	8/20	9/26	6/28	8/10	9/20
Dicamba	0.15[2/]	9	6	5	3	8	6	6
"	0.28[2/3/]	10	10	10	10	10	10	10
2,4-D	0.56[2/]	9	2	3	2	3	3	1
"	1.12[2/3/]	10	10	10	8	8	7	8
Dicamba + 2,4-D	0.07+0.56[2/]	10	6	6	5	10	8	7
"	0.07+0.84[2/]	10	7	6	2	10	6	4
"	0.07+1.12[2/3/]	10	10	10	9	10	10	10
"	0.15+0.56[2/]	10	8	7	5	10	9	8
"	0.15+0.84[2/]	10	8	7	4	10	9	7
"	0.15+1.12[2/3/]	10	10	10	9	10	10	10
Dicamba + 2,4-D (0.06+0.6 kg/l)	0.11+1.12	10	7	8	6	6	5	4
Dicamba + 2,4-D+mecoprop (0.012+0.12 +0.06 kg/l)	0.11+1.12+0.56	10	7	7	2	10	9	7
Dicamba + 2,4-D (0.0223+0.223 kg/l)	0.15+1.46	7	6	5	2	-	-	-
Dicamba + 2,4-D (0.0132+0.126 kg/l)	0.12+1.18	10	8	9	7	9	10	4
2,4-D + 2,4-DP (ester)	1.12+1.12	10	5	5	5	10	9	8
"	1.68+1.68	10	6	5	2	10	9	8
"	2.24+2.24	10	8	8	5	10	10	9
2,4-D + 2,4-DP (OSA)	0.84+0.84	9	2	2	2	10	8	6
"	1.68+1.68	10	6	5	4	10	9	7
"	2.24+2.24	10	7	7	4	10	9	8
Dicamba + 2,4-D (0.0223+0.223 kg/l)	0.11+1.12	9	8	8	7	9	7	7
2,4-D	1.12 [2/]	10	5	6	3	8	7	5
"	2.24 [2/]	10	8	8	7	10	9	8
Check	--	2	0	0	0	1	2	0
"	--	3	0	0	0	1	0	0
"	--	2	0	0	0	0	-	-

[1/] 0-10 scale where 0 = no control and 10 = complete control.

[2/] In Experiment II the rate was double this amount.

[3/] Retreated on May 18, June 14 and July 17, 1979 in Experiment I and June 13, July 17 and August 9, 1979 in Experiment II.

Table 3. Effectiveness of herbicide mixtures for broadleaf weed control in bluegrass (Treated Exp I April 18 and Exp II May 16, 1979).

Herbicides & Formulation	kg/ha	Mouseear chickweed control ratings[1]					
		Experiment I			Experiment II		
		7/16	8/20	9/26	6/28	8/10	9/20
Dicamba	0.15[2]	3	7	9	4	4	3
"	0.28[2/3]	10	10	10	10	10	4
2,4-D	0.56[2]	1	6	5	1	3	4
"	1.12[2/3]	10	7	2	1	6	6
Dicamba + 2,4-D	0.07+0.56[2]	6	7	3	5	6	6
"	0.07+0.84[2]	5	7	6	0	3	3
"	0.07+1.12[2/3]	10	10	10	9	9	6
"	0.15+0.56[2]	10	9	8	3	4	5
"	0.15+0.84[2]	9	10	10	3	4	5
"	0.15+1.12[2/3]	10	10	10	10	10	8
Dicamba + 2,4-D (0.06+0.6 kg/l)	.11+1.12	6	8	7	0	2	5
Dicamba + 2,4-D + mecoprop (0.012+0.12+ 0.06 kg/l)	0.11+1.12+0.56	8	9	4	4	7	3
Dicamba + 2,4-D (0.0223+0.223 kg/l)	0.15+1.46	4	7	5	-	-	-
Dicamba + 2,4-D (0.0132+0.126 kg/l)	0.12+1.18	5	5	4	1	2	4
2,4-D + 2,4-DP (ester)	1.12+1.12	9	9	7	10	10	8
"	1.68+1.68	8	9	7	10	8	5
"	2.24+2.24	10	10	10	10	10	8
2,4-D + 2,4-DP (OSA)	0.84+0.84	9	10	6	7	8	7
"	1.68+1.68	10	10	9	9	9	9
"	2.24+2.24	10	10	7	10	10	6
Dicamba + 2,4-D (0.0223+0.223 kg/l)	0.11+1.12	6	5	6	2	3	6
2,4-D	1.12[2]	0	1	6	1	3	6
"	2.24[2]	2	0	2	5	4	7
Check	--	1	2	0	4	4	4
"	--	2	1	0	0	0	3
"	--	1	4	0	-	-	-

[1] 0-10 scale where 0 = no control and 10 = complete control.

[2] In experiment II the rate was double this amount.

[3] Retreated on May 18, June 14 and July 17, 1979 in Experiment I and June 13, July 17 and August 9, 1979 in Experiment II.

Table 4. Effectiveness of herbicide mixtures for broadleaf weed control in bluegrass (Treated Exp II May 16, 1979).

Herbicides & Formulations	kg/ha	Red sorrel control ratings[1]-Exp II		
		6/28	8/10	9/20
Dicamba	0.28	7	5	7
"	0.56[2]	10	10	10
2,4-D	0.11	3	6	5
"	2.24[2]	7	10	9
Dicamba + 2,4-D	0.14+1.12	2	9	4
"	0.14+1.68	3	5	7
"	0.14+2.24[2]	10	10	10
"	0.28+1.12	6	7	6
"	0.28+1.68	2	6	7
"	0.28+2.24[2]	10	10	10
Dicamba + 2,4-D (0.06+0.6 kg/l)	0.11+1.12	3	6	6
Dicamba + 2,4-D + mecoprop (0.012+0.12+ 0.06 kg/l)	0.11+1.12+0.56	3	0	6
Dicamba + 2,4-D (0.0132+0.126 kg/l)	0.12+1.18	0	6	7
2,4-D + 2,4-DP (ester)	1.12+1.12	7	6	7
"	1.68+1.68	3	4	6
"	2.24+2.24	6	8	10
2,4-D + 2,4-DP (OSA)	0.84+0.84	6	4	6
"	1.68+1.68	3	6	6
"	2.24+2.24	3	4	6
Dicamba + 2,4-D (0.0223+0.223 kg/l)	0.11+1.12	3	6	6
2,4-D	2.24	10	10	10
"	4.48	10	9	7
Check	--	2	4	3
"		6	6	7

[1]0-10 scale where 0 = no control and 10 = complete control.

[2]Retreated on June 13, July 17 and August 9 in Experiment II.

Table 5. Effectiveness of herbicide mixtures for broadleaf weed control in bluegrass (Treated Exp I April 18 and Exp II May 16, 1979.

Herbicides & Formulation	kg/ha	Yellow Woodsorrel control ratings[1/]					
		Experiment I			Experiment II		
		7/16	8/20	9/26	6/28	8/10	9/20
Dicamba	0.15[2/]	1	4	3	0	2	7
"	0.28[2/3/]	2	1	0	0	3	9
2,4-D	0.56[2/]	1	2	3	0	1	4
"	1.12[2/3/]	8	6	7	0	4	6
Dicamba + 2,4-D	0.07+0.56[2/]	0	2	5	0	2	7
"	0.07+0.84[2/]	0	1	3	0	2	6
"	0.07+1.12[2/3/]	10	7	6	1	2	10
"	0.15+0.56[2/]	1	5	1	0	2	5
"	0.15+0.84[2/]	0	1	6	2	5	8
"	0.15+1.12[2/3/]	9	8	7	3	4	10
Dicamba + 2,4-D (0.06+0.6 kg/l)	.11+1.12	0	1	4	0	4	2
Dicamba + 2,4-D + mecoprop(0.012+0.12) +0.06 kg/l)	0.11+1.12+0.56	0	1	3	0	2	8
Dicamba + 2,4-D (0.0223+0.223 kg/l)	0.15+1.46	0	0	4	-	-	-
Dicamba + 2,4-D (0.0132+0.126 kg/l)	0.12+1.18	4	2	0	0	5	4
2,4-D + 2,4-DP (ester)	1.12+1.12	2	1	0	10	9	10
"	1.68+1.68	1	1	4	9	9	9
"	2.24+2.24	4	4	3	10	9	10
2,4-D + 2,4-DP (OSA)	0.84+0.84	2	1	4	9	8	9
"	1.68+1.68	3	1	3	9	7	8
"	2.24+2.24	4	2	3	9	8	6
Dicamba + 2,4-D (0.0223+0.223 kg/l)	.11+1.12	2	1	6	0	3	6
2,4-D	1.12[2/]	1	5	1	4	8	3
"	2.24[2/]	4	2	7	7	8	2
Check	--	0	0	0	0	3	2
"	--	0	0	0	0	2	0
"	--	0	0	0	-	-	-

[1/] 0-10 scale where 0 = no control and 10 = complete control.

[2/] In experiment II the rate was double this amount.

[3/] Retreated on May 18, June 14 and July 17, 1979 in Experiment I and June 13, July 17, and August 9, 1979 in Experiment II.

Table 6. Effectiveness of herbicide mixtures for broadleaf weed control in bluegrass (Treated April 18 and Exp II May 16, 1979).

Herbicides & Formulations	kg/ha	Purslane speedwell control ratings[1]		
		Experiment I		Experiment II
		6/1	7/16	6/28
Dicamba	0.15 [2]	2	0	9
"	0.28 [2/3]	5	0	0
2,4-D	0.56 [2]	6	3	5
"	1.12 [2/3]	8	8	8
Dicamba + 2,4-D	0.07+0.56 [2]	4	3	4
"	0.07+0.84 [2]	5	3	7
"	0.07+1.12 [2/3]	8	9	5
"	0.15+0.56 [2]	5	2	5
"	0.15+0.84 [2]	4	2	7
"	0.15+1.12 [2/3]	10	8	2
Dicamba + 2,4-D (0.06+0.6 kg/l)	0.11+1.12	4	1	5
Dicamba + 2,4-D + mecoprop (0.012+ 0.12+0.06 kg/1)	0.11+1.12+0.56	6	3	6
Dicamba + 2,4-D (0.0223+0.223 kg/1)	0.15+1.46	5	2	-
Dicamba + 2,4-D (0.0132+0.126 kg/1)	0.12+1.18	1	1	9
2,4-D + 2,4-DP (ester)	1.12+1.12	6	0	7
"	1.68+1.68	7	1	10
"	2.24+2.24	9	1	10
2,4-D + 2,4-DP (OSA)	0.84+0.84	6	0	3
"	1.68+1.68	8	2	8
"	2.24+2.24	8	0	10
Dicamba + 2,4-D (0.0223+0.223 kg/1)	0.11+1.12	1	1	8
2,4-D	1.12 [2]	2	0	8
"	2.24 [2]	6	1	10
Check	--	0	1	7
"	--	1	2	4
"	--	0	1	-

[1] 0 -10 scale where 0 = no control and 10 = complete control.

[2] In experiment II the rate was double this amount.

[3] Retreated on May 18, June 14 and July 17, 1979 in Experiment I and June 13, July 17 and August 9, 1979 in Experiment II.

CONTROL OF SWAMP DODDER ON CRANBERRY BOGS WITH BUTRALIN[1/]

Robert M. Devlin and Karl H. Deubert[2/]

ABSTRACT

On cranberry bogs the parasitic weed swamp dodder can be successfully controlled with spring application of butralin. Liquid and granular formulations were tested and liquid was found to have the most efficient herbicidal effect. The liquid formulation, however, resulted in higher residues of butralin in the soil when analyzed at harvest. No measurable residue was found in the leaves at harvest. All rates of butralin adversely affected cranberry yield, the highest rate tested (6.72 kg/ha) causing a 78% decrease. It was concluded that butralin could be safely used for the control of dodder, but cranberry growers would have to determine if the benefits of control exceeded the risk of lower yields in the year of application.

INTRODUCTION

Swamp dodder (*Cuscuta gronovii* Wild.) is a persistent and costly weed problem to the Massachusetts cranberry grower. At least 10% of the cranberry bogs are infested with dodder causing an annual crop loss of about 2% (5). In a heavily infested area a loss in yield of 80 to 100% can be expected.

In preliminary field tests pre-emergence applications of butralin 4-(1,1-dimethylethyl)-*N*-(1-methylpropyl)-2,6-dinitrobenzenamine gave acceptable control of dodder. However, some

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spring applications were much more successful than others both in weed control and in damage to the cranberry crop. This suggested that precise timing of application may be an important factor in the control of dodder with butralin.

The present study reports on the effects of two different formulations (granular and liquid) of butralin on dodder control when applied at three different dates and at two different dosage rates. Efficacy data on crop phytotoxicity as well as plant and soil analyses for butralin persistence are also presented.

MATERIALS AND METHODS

Field studies. A section of bog known to be heavily infested with dodder but relatively free of other weeds was chosen for dodder control tests and plant and soil residue analyses. The bog section contained a uniform stand of 'Early Black' cranberry vines (*Vaccinium macrocarpon* Ait). Butralin was applied in liquid (0.48 kg/l) or granular (2G) formulation on three different dates (5/20/76, 5/28/76, and 6/3/76) at 2.4 and 4.48 kg a.i./ha. Liquid formulations were delivered with a hand-pumped pressure sprayer at a rate of 935 l/ha. There were three replicates of each treatment and the plots (6.4 m^2) were randomized within replicates. Estimates of dodder control and samples for residue analyses were taken on September 4, 1976. The soil samples were taken from the top 10 cm layer with a 50 mm inner diameter soil borer. Only plots treated with 4.48 kg/ha butralin were sampled because at this rate commercially acceptable control was obtained. Three soil cores from each plot were combined, immediately frozen and stored in polyethylene bags at $-20^{o}C$. Under these conditions no interferences from plasticizers have been experienced in the past. Samples of cranberry vines for plant residue analyses were stored in the same manner as the soil samples.

To determine the influence of butralin on cranberry growth a section of uniform bog was chosen that was free of weeds. Butralin (0.48 kg/l) was applied April 28, 1976 at 2.24, 4.48, and 6.72 kg/ha to 6.4m^2 plots. There were six replicates and plots were randomized within replicates. On September 14 the plots were hand-harvested and the berries immediately weighed and berry size determined by the number of berries required to fill a standard 250 cc cranberry measuring cup.

Residue analyses. Dry weight of every soil sample was determined by drying a 2 g subsample of soil at 104^{o}C for 24 h. After thawing and thorough mixing, 100 g of moist soil was transferred to a 500 ml Erlenmeyer flask. Distilled water was added until a slurry was obtained. Residues were extracted with 150 ml of 30% isopropyl alcohol in n-hexane by shaking the flasks for one h on a wrist-action shaker. The extract was separated from the solids on an 11 cm Buchner funnel using vacuum followed by washing with two 25 ml portions of extracting solvent. The alcohol was removed by washing the extracts two times with 100 ml of water. After drying over anhydrous sodium sulphate, the solvent volume was reduced to 2 ml on a rotary evaporator. Recovery was 89% at 0.1 ppm.

For plant residues 25 g of frozen leaves were extracted with acetonitrile according to the method described in section 29.011 (2) of Horwitz (4). Petroleum ether was evaporated and the residues taken up with hexane prior to cleanup by column chromatography as described in the original method developed by Amchem Products, Inc. (1). The extracts were analyzed by GLC/ECD and GLC/AFID using two gas chromatographs. The first gas chromatograph was a Barber Colman 5260 equipped with a 300 mc tritium source and a 4 m i.d. x 183 cm Pyrex column packed with 5% QF-1 on 100/120 Varaport 30. Temperatures maintained were injector port 230^{o}C, column 200^{o}C, and detector 205^{o}C. Nitrogen was used as carrier gas at the rate of 65 ml/min. The electrometer setting was 3 x 10^{-9} amp/mv at attenuation 1. Signals were recorded with a 1 nw strip chart recorder at 12.7 mm/min chart speed. Butralin emerged after approximately 16 min. The second gas chromatograph used was a Varian 2740 Moduline equipped with an AFID (Rb_2SO_4) and a 3 mm o.d. x 152 cm stainless steel column packed with 3% OV-210 on 100/210 Varaport 30. Temperatures maintained were, injector port 220^{o}C, column 180^{o}C, and detector 250^{o}C. Nitrogen was used as carrier gas at the rate of 23 ml/min. The electrometer setting was 10^{-12} amp/mv at attenuation 16. Signals were recorded with a 1 mv strip chart recorder at 12.7 mm/min chart speed. Butralin emerged after approximately 5 min. The data reported are the means of two separate analyses and were not corrected for percentage recovery. The calculations were based on dry weight.

RESULTS

Butralin applied in granular form did not give good control of dodder. Only at the latest date applied (6/3/76) could 50%

control be observed (Table 1). However, the liquid formulation of butralin gave commercially acceptable control when applied at 4.48 kg/ha (Table 1). For example, early application (5/20/76) of the liquid formulation at 4.48 kg/ha gave 90% control while late application (6/3/76) at the same rate gave 80% control.

Table 1. Dodder control by butralin applied on three different dates. Control is presented on a 0 to 10 basis, 0 representing no control and 10 complete control.

Butralin (kg/ha)	Control (granular)	Control (liquid)	Date applied
2.24	0.7	4.7	5/20/76
4.48	3.7	9.0	
2.24	2.7	3.3	5/28/76
4.48	2.7	5.0	
2.24	4.0	6.7	6/3/76
4.48	5.0	8.0	

All rates of butralin lowered cranberry yields. Butralin at 2.24, 4.48, and 6.72 kg/ha decreased yields by 42, 62, and 78%, respectively (Table 2). Decrease in berry size only occurred at the 6.72 kg/ha rate (Table 2).

Table 2. Influence of butralin on cranberry yield and berry size.

Butralin (kg/ha)	Yield (kg/ha)	Cup count
0	8110	100
2.24	4715	103
4.48	3070	101
6.72	1755	108

Good correlations were obtained between butralin residues in the soil and application time (Table 3). If we assume an initial concentration of 3.4 ppm (4.48 kg/ha rate) based on a 1.3 volume weight of bog soil, then only 6% of the butralin applied in granular form on May 20 was present in soil sampled 116 days later. Only 14% and 18% of the granular butralin applied at the two later dates were present in the soil samples

Table 3. Butralin residues in cranberry bog soil treated with 4.49 kg/ha butralin. Maximum and minimum amounts found are given directly under the mean for three replicates. Amounts are given in mg/kg dry soil.

Quantity (kg/ha)	Formulation	Date of Application 5/20/76	5/28/76	6/3/76
4.48	Granular	0.19	0.49	0.60
		0.13-0.25	0.39-0.52	0.52-0.71
4.48	Liquid	0.60	0.81	1.33
		0.49-0.64	0.80-0.81	1.31-1.34

109 and 103 days later (Table 3). Butralin applied in liquid form was more persistent. For example, 39% of the herbicide applied on June 3 was still present 103 days later (Table 3. No measurable butralin residue was found in the cranberry leaves (Figure 1).

DISCUSSION

At 4.48 kg/ha the liquid formulation of butralin gives commercially acceptable control of dodder. From the data presented it is difficult to establish the most efficient time of application. Visual observations of cranberry vines treated with butralin indicate that the herbicide inhibits flower development or terminal vegetative growth (2). This results in crop reduction and extensive side shooting.

Applications of the liquid formulation resulted in larger residues in the soil than applications of the granular formulation. It is safe to assume that during spray application more of the active ingredient came in contact with the organic debris covering the soil surface and was adsorbed on organic particles. Compounds like butralin, whose molecules have sizeable nonpolar regions relative to polar regions are likely to adsorb on hydrophobic areas of organic matter by means of van der Waals forces reinforced by hydrophobic bonding (3).

Absence of measurable residue amounts in cranberry leaves suggests that the chemical is rapidly metabolized by the plant. Degradation of butralin in the soil indicates that, even with the larger residues after application of the liquid formulation, chances of a build-up as a result of annual applications

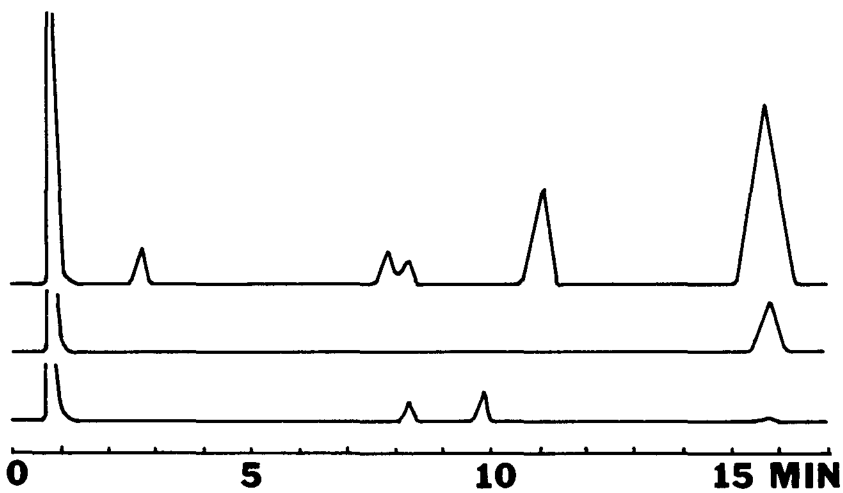

Figure 1. Comparison of gas chromatographic responses to a soil extract (top) a leaf extract (bottom), and a butralin standard (middle). Liquid phase 5% QF-1; EC detector (tritium). Operating conditions are described under Materials and Methods. Butralin peak is on the far right.

would be minimal.

Butralin can be used to control dodder on cranberry bogs without effecting the quality of the soil. However, growers would have to determine if the benefits of dodder control would exceed the risk of lower yields in the year of application.

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ETHANOL AND OTHER ANESTHETICS AS STIMULANTS OF SEED GERMINATION

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Dormancy in seeds of several annual weedy grasses, especially fall panicum (Panicum dichotomiflorum Michx.), may be overcome by treatment with ethanol. Applications of 0.1 to 0.5 M ethanol solutions for several hours to a day during a preliminary 35° C incubation are effective. Treatments with other short-chain alkanols, chloroform, ethyl ether, and halothane (2-bromo-2-chloro-1,1,1-trifluoro ethane) are also effective. The actions suggest the stimulants act as a result of their anesthetic properties (see Planta 145:507-510). Highest stimulation of germination in fall panicum is found with ethanol and chloroform. Among tested anesthetics, ethanol stimulates seed germination on the greatest number of weedy grass species. While not tested in detail, stimulation of germination by anesthetics of broadleaved species is low. Greenhouse pot tests show ethanol stimulation of fall panicum germination.

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HERBICIDE TRIAL IN ONIONS - A THREE-YEAR SUMMARY

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ABSTRACT

A three-year summary of several herbicide combinations used in onions (*Allium cepa* L.) is presented. Both preemergence and postemergence applications of herbicide is necessary for broadspectrum weed control in this crop. DCPA applied preemergence at 6.72 kg/ha followed by nitrofen post at 3.36 or diclofop at 1.12 kg/ha provided good to excellent control of barnyard grass (*Echinochloa crus-galli* (L.) Beauv.), pineapple weed (*Matricaria matri carioides* (Less) Porter), purslane (*Portulaca oleracea* L.), crabgrass (*Digitaria sanguinalis* (L.) Scop.), fall panicum (*Panicum dichotomiflorum* Michx.). However, control of galinsoga (*Galinsoga ciliata* (Raf.) Blake), was only fair.

Propachlor at 4.48 and 6.72 kg/ha applied both pre- and postemergence resulted in excellent control of pineapple weed and galinsoga but only good to fair control of the grasses present. AC206784 at 2.24 kg/ha pre- and postemergence resulted in fair control of the annual grasses and broadleaf weeds.

From experiments conducted over several years, it is obvious that combinations of two or more herbicides are needed with applications both pre- and postemergence to control a broad spectrum of weeds in onions.

INTRODUCTION

Onions are raised on a very limited acreage on sandy-loam soils of Long Island. This crop does not compete with weeds and they must be controlled if the grower is to produce this crop economically. Presently registered herbicides have been effective in controlling most grasses and broadleaf weeds, but because of the continually changing weed spectrum and label restrictions, weed control in onions continue to be a problem. Pineappleweed and galinsoga are two excellent examples of weeds that have come in to infest this crop and cause economic losses when uncontrolled.

MATERIALS AND METHODS

In 1979, a series of trials were conducted on onions on a sandy-loam soil at the Long Island Horticultural Research Laboratory at Riverhead. The onions were seeded on April 6th with a Stan Hay seeder with three rows per bed, with the bed 1.8 meters wide. All applications of herbicides were made using a tractor-mounted sprayer delivering 61 l/ha at 2.5 atm, with four replications.

These trials were similar to those conducted in 1977 and 1978.

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Applications of propachlor (2-chloro-N-isopropylacetanilide) at 3.36, 4.48 and 6.72 kg/ha; DCPA (dimethyl tetrachloroterephthalate) at 6.72 kg/ha; and AC 206784 at 1.12 and 2.24 kg/ha were made on April 24th preemergence to both the crop and weeds.

Postemergence applications of nitrofen (2,4-dichlorophenyl-p-nitrophenyl ether) at 3.36 kg/ha, KK80 at 1.12 kg/ha, propachlor at 4.48 or 6.72 kg/ha were applied over several of the propachlor preemergence treatments. Postemergence applications of diclofop (2-(4-(2':4'-Dichlorophenoxy)-phenoxy)-methyl-proprionate) at 0.56, 0.84, 1.12 and 2.24 kg/ha were applied in areas treated with DCPA. One application of nitrofen was also used post-emergent to a DCPA treatment. There were two treatments involving DCPA at 6.72 preemergence followed by nitrofen at 3.36 and diclofop at 0.84 or 1.12 kg/ha postemergence. The material AC206784 at 1.12 and 2.24 was used postemergence following the same treatment preemergent. These treatments are shown in Table 2.

Several of the postemergence treatments were applied on June 2 with all of these being repeated on June 22 and again on July 17. The early post treatments corresponded to the three to four-leaf stage and the July 17 to the twelve-inch stage of onions.

All treatments were hand-hoed prior to the post treatments so that in effect although the herbicides were applied postemergence to the onions, they were still preemergence to weeds. Data was taken on May 29 and June 22 for all preemergence treatments and on July 11 and August 20 for all postemergence treatments.

RESULTS AND DISCUSSION

There were no phytotoxic effects from any of the treatments used in 1979 as in the previous years. Yield data on Table 2 indicate that the DCPA treatment followed by the combination of nitrofen and diclofop resulted in the highest yield and this was significantly higher than the check. Other than this one treatment there were no statistically significant difference in yield between any of the treatments.

Propachlor continues to provide excellent control of pineapple weed and galinsoga but does not adequately control the grasses, particularly in a wet season. DCPA and nitrofen or diclofop will provide good to excellent control of the annual grasses, barnyard, crabgrass and fall panicum. Propachlor both at 4.48 and 6.72 kg/ha applied pre- and postemergence resulted in poor control of purslane. The combination of DCPA and propachlor applied preemergence provided excellent control of all weeds present.

From the three-year summary given in Table 3, it is very obvious that a combination of DCPA, propachlor, nitrofen, diclofop and AC206784 must be considered depending on weed problems in a particular field. For the control of the annual grasses, DCPA should be used preemergence early in the season followed by later applications of either nitrofen or diclofop. Where pineapple weed, and galinsoga are serious, propachlor should be included in the program based on the registration and application of labels.

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Table 1. Percent control of annual weeds in onions with herbicide treatments -- 1979.

Chemical	Rate	Timing	Pineappleweed		Lambsquarters		Galinsoga		Purslane	Crabgrass
	kg/ha	4/24	5/29	6/22	5/29	6/22	5/29	6/22	6/22	6/22
propachlor	3.36	pre	98	93.5	100.0	90.0	100.0	98	-	95
propachlor	4.48	pre	88	88.0	100.0	47.0	100.0	89	33	77
propachlor	6.72	pre	92	93.0	100.0	43.0	100.0	93	38	80
DCPA	6.72	pre	71	65.0	74.0	81.0	90.0	94	81	-
AC 206784	1.12	pre	63	65.0	93.0	48.0	95.0	85	45	53
AC 206784	2.24	pre	40	28.0	93.0	43.0	83.0	85	30	70
Check (shoots per 0.3 m^2)			1	0.5	2.6	3.5	0.25	0	1	1

Table 3. Percent weed control and yield of onions over a three-year period.

Chemical	Rate	Timing	barnyardgrass			pineapple weed		purslane			crabgrass			galinsoga		fall panicum		yield		
	kg/ha		1977	1978	1979	1977	1979	1977	1978	1979	1977	1978	1979	1978	1979	1978	1979	1977	1978	1979
propachlor	4.48	pre + post	94.0	93.0	61.0	99.0	95.0	90.0	76.0	28.0	80.0	99.0	59.0	-	99.0	92.0	90.0	35.1	30.6	22.3
propachlor	6.72	pre + post	94.0	95.0	73.0	99.0	100.0	77.0	88.0	62.0	78.0	99.0	72.0	-	90.0	99.0	85.0	29.8	28.3	27.8
DCPA	6.72	pre																		
+ nitrofen	3.36	post	99.0	80.0	86.0	99.0	-	97.0	99.0	95.0	84.0	89.0	96.0	-	65.0	97.0	95.0	28.4	24.6	25.8
DCPA	6.72	pre																		
+ diclofop	1.12	post	-	71.0	95.0	-	95.0	-	91.0	40.0	-	94.0	98.0	25.0	93.0	95.0	100.0	-	27.1	28.6
DCPA	6.72	pre																		
+ nitrofen	3.36	post																		
+ diclofop	1.12	post	-	-	99.0	85.0	-	95.0	-	100.0	89.0	-	96.0	-	-	-	100.0	31.6	-	38.0
propachlor	4.48	pre																		
+ nitrofen	3.36	post	-	88.0	70.0	-	98.0	-	76.0	92.0	-	98.0	84.0	-	97.0	98.0	70.0	-	23.4	28.6
AC 206784	2.24	pre + post	-	96.0	73.0	-	70.0	-	77.0	-	-	-	74.0	92.0	89.0	98.0	75.0	-	29.4	22.6
Check (shoots per 0.3 m^2)			3.0	4.0	13.0	5.0	0.2	2.0	3.0	14.0	2.0	2.5	6.0	1.0	0.6	1.0	8.0	33.2	25.9	28.3

Table 2. Percent control of annual weeds in onions with herbicide treatments -- 1979.

Chemical	Rate kg/ha	Timing	Post[1/] application 6/2	Post[1/] application 6/22	Pine-apple weed 7/11	Barnyardgrass 7/11	Barnyardgrass 8/20	Galinsoga 7/11	Galinsoga 8/20	Purslane 7/11	Purslane 8/20	Crabgrass 7/11	Crabgrass 8/20	Carpet-weed 8/20	Fall panicum 8/20	Yield[2/] 8/20
propachlor	4.48	pre														
nitrofen	3.36	post		x	98.0	70	70	98.0	96	83	98	82	86	100	70	28.6
propachlor	6.72	pre														
KK80	1.12	post		x	93.0	83	96	95.0	95	100	10	88	94	95	100	26.8
propachlor	3.36	pre														
DCPA	6.72	pre			100.0	95	76	100.0	99	100	99	98	93	100	90	27.0
propachlor	4.48	pre														
propachlor	4.48	post		x	95.0	48	74	98.0	100	43	13	70	48	85	90	22.3
propachlor	6.72	pre														
propachlor	6.72	post		x	100.0	68	78	80.0	100	70	54	65	78	81	85	27.8
DCPA	6.72	pre														
diclofop	0.56	post	x	x	-	-	96	-	75	-	25	-	96	95	100	29.1
DCPA	6.72	pre														
diclofop	0.84	post	x	x	75.0	95	90	95.0	80	70	45	100	98	75	100	25.5
DCPA	6.72	pre														
diclofop	1.12	post	x	x	95.0	100	90	98.0	89	70	10	100	96	89	100	28.6
DCPA	6.72	pre														
diclofop	2.24	post	x	x	-	-	98	-	89	-	84	-	100	91	99	26.5
DCPA	6.72	pre														
nitrofen	3.36	post	x	x	-	-	86	-	65	-	95	-	96	90	95	25.8
DCPA	6.72	pre														
nitrofen	3.36	post	x	x												
diclofop	0.84	post	x	x	-	-	98	-	-	-	100	-	95	100	100	36.6
DCPA	6.72	pre														
nitrofen	3.36	post	x	x												
diclofop	1.12	post	x	x	-	-	99	-	-	-	100	-	96	100	100	38.0
AC 206784	1.12	pre														
AC 206784	1.12	post		x	68.0	60	69	98.0	88	30	20	95	73	92	80	24.0
AC 206784	2.24	pre														
AC 206784	2.24	post		x	70.0	60	86	90.0	88	55	26	80	68	83	75	22.6
Check (shoots/0.3 m^2)					0.2	2	24	0.2	1	2	26	1	11	6	8	28.3

1/all post treatments were repeated July 17.

2/Yield = lbs per plot.

TREATMENT OF TALL WEEDS IN HORTICULTURAL CROPS WITH GLYPHOSATE USING WIPER AND WICK SPRAY APPLICATORS

G. W. Selleck[1], T. Corell[2], A. Bing[1] and L. B. Lynn[3]

ABSTRACT

The wiper applicator applying a 10% sol of glyphosate was very effective in controlling many weeds that were taller than potatoes (*Solanum tuberosum* L.), boxleaf holly (*Ilex crenata convexa* Makino) or strawberries (*Fragaria virginiana* Duchesne). Injury to these crops occurred only when the wiper contacted the crop plants. The wick applicator with rates as high as 50% glyphosate was ineffective.

INTRODUCTION

Preemergence weed control in many crops can fail because of inadequate or late application resulting in fields with weeds that grow taller than the crop. This happens more often with grassy weeds. There is a definite need for a spray that can be applied topically to weeds and crops that will give effective control but cause negligible damage to the crop. Ahrens (1) found that asulam (methyl sulfanilycarbamate) could be safely sprayed on crabgrass (*Digitaria sp.*) with no injury to small yew (*Taxus cuspidata*) plants. Blueberry growers controlled weeds by dragging a 2,4-D moistened burlap over the crop.

With the development of the recirculating sprayer and the rope wick and wiper applicators, it appeared desirable to try some of these on vegetable and ornamental crops. Dale (2) was very successful using the rope wick applicator to apply glyphosate [N-(phosphonomethyl)glycine] to tall growing johnsongrass (*Sorghum halepense* (L.) Pers.) in late planted soybeans (*Glycine Max* Merr.) and other tall weeds in crops. He and his co-workers found that they changed the weed population by removing tall weeds and allowed low growing weeds to take over. After a better performance with the wiper, compared to the wick on potatoes, only the wiper was used on strawberries and holly.

MATERIALS AND METHODS

Glyphosate at 2.5, 5, 10 and 20% solutions in water was applied with a wiper applicator and at 15, 33 and 50% water solutions with a wick applicator over a weedy field of Katahdin potatoes. The applicators were adjusted to 12 in above the crop plants. On the wiper the flow setting was 2.5 with a cylinder rotation of 48 rpm and a ground speed of 1.7 mph. Applications were made at different concentrations to triplicate 11 by 50 ft plots on July 30. The barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.) and common lambsquarters (*Chenopodium album* L.) were 4 ft tall at application time and Pennsylvania

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smartweed (Polygonum pensylvanicum L.) was about 1.5 ft tall. Tall coarse weeds were folded under the tractor axles and wheels with the movement of the tractor and were not well contacted by the rotating cylinder of the wiper. Tall weeds only were treated with the wiper using a 25% solution of glyphosate over a bed of strawberries.

A planting of 18 in tall boxleaf holly that was full of 4 ft weeds was treated with a 10% glyphosate solution in the wiper on Sept 25. Ground speed was 1.5 mph. The wiper applicator was mounted at the rear of the tractor at a height that would just miss the holly plants.

RESULTS AND DISCUSSION

Weed control on the potato plots treated with the wiper and rope wick applicators were evaluated on Aug 22. As seen in Table 1 the wiper applicator with 10% glyphosate controlled barnyardgrass and lambsquarters 80% or better, but smartweed was poorly controlled probably because it was not tall enough to be contacted at the time of treatment. Weeds covered 87% of the area in the untreated plots. There was no visible injury to the potatoes. A less dense population with more resilient stems may have been adequately controlled with a 5% solution of glyphosate. Even using a 50% solution of glyphosate on the wick applicator failed to control weeds.

A 25% solution of glyphosate with wiper gave good control of tall weeds in strawberries but did not affect weeds only 2-3 in taller than the strawberries. Only strawberry plants actually contacted by the roller were injured.

The field of boxleaf holly was evaluated on Sept 25. Only branches hit by the wiper were defoliated or showed necrosis. The following tall weeds were dead: pearly everlasting (Anaphalis margaritacea L.), mugwort (Artemisia vulgaris L.), common milkweed (Asclepias syriaca L.), annual sowthistle (Sonchus oleraceus L.), Pennsylvania smartweed (Polygonum pensylvanicum L.), fall panicum (Panicum dichotomiflorum Michx.), horseweed (Conyza canadensis (L.) Cronq.), common lambsquarters (Chenopodium album L.), beggarticks (Bidens spp.), and redroot pigweed (Amaranthus retroflexus L.). Weeds that were below the applicating cylinder and therefore were not controlled were as follows: hedge mustard (Sisymbrium officinale (L.) Scop.), red sorrel (Rumex acetosella L.), Canada thistle (Cirsium arvense L.) and field pepperweed (Lepidium campestre L.).

The wiper applicator can be safely and effectively used to control weeds that are appreciably taller than a crop using a 5-10% solution of glyphosate. The applicator would be more effective if the roller were placed in front of the tractor so the weeds are contacted before being pushed down by the wheels and underside of the tractor.

Table 1. Percent control of weeds with glyphosate applied with Wiper and Wick applicators in potatoes.

Applicator	Glyphosate % solution	Barnyardgrass	Smartweed	Lambsquarters
Wiper	2.5	52	40	80
	5	68	37	--
	10	82	47	100
	20	89	67	--
Rope Wick	15	17	7	--
	33	3	0	--
	33	5	0	23
	50	18	13	--
Untreated check (% cover)		65	22	4

LITERATURE CITED

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RESPONSE OF RED MAPLE AND PIN OAK TO INJECTIONS OF DIKEGULAC AND MEFLUIDIDE

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ABSTRACT

A syringe-type pressure injector was used to introduce growth retardants dikegulac and mefluidide into the vascular system of red maple (*Acer rubrum* L.) and pin oak (*Quercus palustris* Muenchh.) trees. The injector consisted of a modified 28-cm, Vise-Grip locking pliers with a tapered stainless steel injector barrel and disposable syringe. After the trees were pruned in April, two holes were drilled into the trunk opposite one another with a cordless electric drill about 10 cm above ground level. The tapered injector barrel was inserted into each hole and 10 ml of chemical solution forced into the hole via the disposable syringe. Two concentrations of dikegulac (3750 mg/L and 7500 mg/L) and mefluidide (300 mg/L and 600 mg/L) were selected by extrapolating from greenhouse seedling studies. Shoot growth was measured during two periods: from June 27 to July 2 and from September 11 to 14. Treatments were replicated 5 times and analyzed with Duncan's multiple range test.

Both dikegulac and mefluidide inhibited shoot growth of red maple until the end of the growing season in September (Table 1). Less shoot growth occurred on red maple after injections of dikegulac than mefluidide; however, injury occurred from dikegulac at 7500 mg/L in the form of dead buds and dwarfed, chlorotic foliage. With pin oak, shoot growth was inhibited by injections of 7500 mg/L of dikegulac and 300 mg/L and 600 mg/L of mefluidide through early July but by September only 7500 mg/L dikegulac inhibited growth significantly different from the control. No injury was observed on pin oak from either chemical.

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Table 1. Shoot growth of red maple and pin oak trees after pruning and stem injection of growth retardants in April.

Growth retardant		Growth per shoot[a/] Red maple June 27	Red maple Sept 11	Pin oak July 2	Pin oak Sept 14
	(mg/L)	(cm)			
Control	0	47 c	62 c	77 b	85 b
Dikegulac	3750	12 ab	16 a	64 ab	81 b
	7500	8 a	8 a	44 a	53 a
Mefluidide	300	20 b	37 b	50 a	66 ab
	600	20 b	37 b	53 a	74 ab

[a/]Mean separation in columns by Duncan's multiple range test, 5% level.