WEED CONTROL IN CORN WITH SOME THIOCARBAMATE HERBICIDES FOLLOWED BY DICAMBA POSTEMERGENCE

R.D. Ilnicki and R.W. Michieka[1/]

ABSTRACT

The thiocarbamate herbicides, EPTC and butylate, are effective preplant soil incorporated herbicides that can be used in corn culture for the control of fall panicum (Panicum dichotomiflorum Michx.) and other annual grasses. They sometimes fail to give complete control of broadleaf weeds such as lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.) and velvetleaf (Abutilon theophrasti Medic). Dicamba, on the other hand, can be effective postemergence on the above-named broadleaf weeds but not on fall panicum or other annual grasses. Furthermore, effective control of broadleaf weeds may not be realized with preemergence applications of dicamba at rates that would be safe to use on corn. Later applications of dicamba may be successful on broadleaf weeds without serious injury to corn. It was with these principles in mind that this study was undertaken.

Preplant incorporated applications of EPTC and butylate at 3.36 kg/ha were followed by dicamba at 0.56 kg/ha immediately after planting and at the spike stage and at 0.03 kg/ha when corn was in the 5 to 6-leaf stage (20.3 cm). Dicamba was also applied alone at the same rates at the same stages of growth.

Control of fall panicum was complete with EPTC and butylate with very good control of redroot pigweed and velvetleaf. Control of lambsquarters was poor. Preemergence applications of dicamba were effective only on velvetleaf. A later application of dicamba at the "spike" stage was effective on broadleaf weeds but poor on fall panicum. A still later application of dicamba, alone, at the 5 to 6-leaf effected good control of redroot pigweed and velvetleaf.

The sequential application of dicamba over preplant incorporated EPTC or butylate was effective on all species save lambsquarters. Later applications of dicamba, at lower rates, when the weeds were larger, were more effective than a similar sequence applied earlier.

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A THREE YEAR SUMMARY OF VELVETLEAF CONTROL IN CORN

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ABSTRACT

Field experiments were conducted in 1976, 1977 and 1978 on the Agway Research Center located at Fabius, New York to evaluate the commercially available herbicides for preplant incorporated, preemergence and postemergence control of velvetleaf. The soil was a Halsey gravelly loam, with a pH of 7.4, organic matter of 6.0% and a C E C of 7.0. The area had no previous history of velvetleaf, so it was broadcast seeded with this species in each year prior to final fitting. In all three years the corn was planted in mid-May. The experimental design was a randomized block design with four replications. Preplant incorporated treatments were disced twice. Preemergence materials were applied the same day or shortly after planting. Early postemergence treatments were applied when the corn was in the 3-5 leaf stage and the velvetleaf in the 1-2 leaf stage except in 1976 when the velvetleaf had 5-6 leaves. Late postemergence treatments were only applied in 1976 and 1977. In both years the corn had 5-6 leaves. In 1976 the velvetleaf was quite large with 8-10 leaves, while in 1977 it had 6 leaves. All treatments were applied with a CO_2 hand carried sprayer. Rainfall patterns in the critical two-three week period after planting varied. In 1976, 2.87 inches fell within 7 days after planting and another .83 inches the following week. In 1977 we only received .81 inches for the entire three week period including .50 inches which fell one day following the preemergence applications. Rainfall in 1978 was also low. Twenty-two one hundredths fell two days after planting followed by fourteen days of drought.

Ratings were made of velvetleaf control several times each season. The rating scale used for evaluation was: 0 = no effect, 10 = complete kill. Evaluation of crop injury was made but were considered minor and are not reported. The thiocarbamates (see Table I) and pendimethalin plus atrazine provided the most consistent and highest degree of control. Preemergence applications of atrazine were very dependent on rainfall for effectiveness. Alachlor and cyanazine were very weak on this weed.

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Table 1. Control of velvetleaf with various herbicides and combinations 1976, 1977 and 1978 in corn.

Trt. No.	Chemical & Formulation	Timing	Rate ai/A	Vele Control 1976	1977	1978
1.	EPTC + antidote + atrazine	PPI	4.0 + 1.5	9.3	9.8	10.0
2.	EPTC + antidote + atrazine	PPI	6.0 + 1.5	9.8	10.0	9.3
3.	butylate + antidote + atrazine	PPI	4.0 + 1.5	9.0	9.5	9.3
4.	butylate + antidote + atrazine	PPI	6.0 + 1.5	9.3	9.5	10.0
5.	EPTC + antidote	PPI	4.0	-	8.8	7.3
6.	EPTC + antidote	PPI	6.0	-	10.0	8.7
7.	butylate + antidote	PPI	4.0	-	8.3	6.7
8.	butylate + antidote	PPI	6.0	-	8.5	9.7
9.	atrazine	PPI	1.5	-	7.3	8.0
10.	atrazine	PPI	2.0	-	8.7	8.0
11.	atrazine	Pre	1.5	9.5	0.3	0
12.	atrazine	Pre	2.0	-	0.3	0
13.	pendimethalin	Pre	2.0	8.3	-	-
14.	pendimethalin + atrazine	Pre	1.5 + 1.5	9.8	6.5	-
15.	pendimethalin + atrazine	Pre	2.0 + 2.0	-	8.0	10.0
16.	alachlor	Pre	2.5	3.3	-	-
17.	alachlor + atrazine	Pre	2.0 + 1.5	-	-	0
18.	alachlor + atrazine	Pre	2.5 + 1.5	9.5	-	-
19.	alachlor + cyanazine	Pre	1.0 + 1.0	0.7	0.5	-
20.	alachlor + cyanazine	Pre	2.0 + 2.0	4.0	-	-
21.	pendimethalin + atrazine	EPo	1.5 + 1.0	-	-	10.0
22.	pendimethalin + atrazine + oil concentrate 1/	EPo	1.0 + 1.0	-	-	10.0
23.	pendimethalin + atrazine + oil concentrate	EPo	1.5 + 1.0	-	10.0	10.0
24.	pendimethalin + atrazine + oil concentrate	LPo	1.5 + 1.0	-	8.0	-
25.	pendimethalin + oil concentrate	EPo	1.5	-	10.0	10.0
26.	pendimethalin + oil concentrate	LPo	1.5	-	6.5	-
27.	pendimethalin + cyanazine	EPo	1.5 + 2.0	-	-	10.0
28.	pendimethalin + cyanazine + oil concentrate	EPo	1.5 + 2.0	-	10.0	-
29.	pendimethalin + cyanazine + oil concentrate	LPo	1.5 + 2.0	-	9.0	-
30.	atrazine + oil concentrate	EPo	2.0	10.0	-	-
31.	alachlor + cyanazine	Pre	1.0 + 1.0	0.7	0.5	0.0
32.	+ atrazine 2/	EPo	2.0	-	-	10.0
33.	+ atrazine + oil concentrate	EPo	2.0	10.0	-	10.0
34.	+ atrazine + non-ionic surf. 3/	EPo	2.0	-	-	10.0
35.	+ cyanazine	EPo	2.0	6.7	-	9.8
36.	+ dicamba	EPo	.25	5.5	6.5	5.3
37.	+ dicamba + 2,4-D	EPo	.25 + .50	10.0	9.0	-
38.	+ bentazon	EPo	.75	8.7	8.5	8.3
39.	+ bentazon + oil concentrate	EPo	.75	-	-	7.0
40.	+ bentazon + non-ionic surf.	EPo	.75	-	-	9.0
41.	+ 2,4-D	EPo	.50	5.0	1.5	3.0
42.	+ dicamba	LPo	.25	4.3	1.5	-
43.	+ dicamba + 2,4-D	LPo	.25 + .50	6.5	7.0	-
44.	+ bentazon	LPo	.75	6.0	6.5	-
45.	Check			0	0	0

1/ oil concentrate = Booster Plus E. Rate = 1.7% V/V

2/ 1# of alachlor + 1# of cyanazine was applied preemergence to treatments 32 - 44 to eliminate completing weed species

3/ non-ionic surf. = blend of alkyl aryl polyethoxylate and potassium alkanoate Rate = 0.2% V/V

COMBINATION OF THREE RESIDUAL HERBICIDES FOR FALL PANICUM CONTROL IN NO-TILLAGE CORN

J. V. Parochetti[1]

ABSTRACT

Fall panicum (Panicum dicotomifolum Michx.) is the most serious annual weed problem in no-tillage corn production in the mid-Atlantic states. An experiment was established in an extremely heavily infested area of fall panicum at the Wye Institute, Queenstown, Maryland. The area had been abandoned the previous year because of the heavy infestation of fall panicum. No-tillage corn was planted in mid-May in the undisturbed plant residues. Herbicides were applied 5.5 and 3 weeks prior to planting corn (Zea mays L.). A few seeds of the fall panicum had begun to germinate when the last herbicide treatments were applied. The experiment was randomized complete block design with three replications. Herbicides were applied with experimental sprayers in water at 30 gpa. Weed control observations were made throughout the year with only those results at the end of the season discussed.

Non-residual herbicides, glyphosate and paraquat, were used with residual herbicides. The following residual herbicides were applied in various combinations: atrazine, simazine, alachlor, metholachlor, and cyanazine.

The best treatment was a three way residual herbicide combination containing atrazine (1.25 lb/A) + simazine (1.25 lb/A) + metholachlor (2 lb/A) with paraquat (0.25 lb/A) applied 3 weeks before planting. This treatment resulted in 90% fall panicum control when observed in mid-September. 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) resulted in about 75 percent control when observed in mid-September; similar control resulted from paraquat (0.25 lb/A) + atrazine (1.25 lb/A) + cyanazine (4 lb/A) and paraquat (0.25 lb/A) + atrazine (1.25 lb/A) + metholachlor (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 far poorer fall panicum than a comparable treatment containing metholachlor. Generally, herbicides applied 5.5 weeks (mid-April) prior to planting no-tillage corn resulted in far poorer fall panicum control than applications made 3 weeks prior to corn planting.

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FALL PANICUM CONTROL IN CORN WITH SEVERAL POSTEMERGENCE HERBICIDES

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ABSTRACT

Experiments were designed to establish whether fall panicum (Panicum dichotomiflorum Michx.) can be controlled with post-emergence applications of single and combination herbicides in corn. Sometimes fall panicum is not controlled by herbicides applied preemergence because of unfavorable weather or because of their ineffectiveness when applied at this time.

A number of herbicides were applied to corn when in the "spike" stage, when in the 2-leaf stage, and at the 5 to 6-leaf stage. Effective herbicides applied alone at the "spike" stage included alachlor at 2.24 to 4.48 kg/ha and metolachlor at 2.24 to 2.80 kg/ha. Some of the effective herbicide combinations included alachlor plus atrazine at 1.68 to 2.24 plus 1.4 to 1.68 kg/ha; and alachlor or metolachlor plus cyanazine at 2.24 plus 1.68 to 2.24 kg/ha. At this time, fall panicum was just emerging.

Applications at the 2-leaf stage were not as effective as earlier applications. Metolachlor at 2.24 to 2.80 kg/ha and cyanazine at 1.68 to 2.24 kg/ha effected good control. Alachlor was not included at this time. Fall panicum was in the 2-leaf stage and 1.3 to 2.5 cm tall.

Reasonably good control of fall panicum resulted from atrazine plus cyanazine at 1.12 to 1.5 plus 2.24 to 2.8 kg/ha respectively, when corn was in the 5 to 6-leaf stage and fall panicum had 2 to 3 leaves and 1.9 to 2.5 cm tall.

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PENDIMETHALIN AND ATRAZINE, SIMAZINE OR CYANAZINE FOR FALL PANICUM CONTROL IN NO-TILLAGE CORN

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ABSTRACT

Fall panicum (Panicum dichotomiflorum Michx.) was effectively controlled in no-tillage corn by simazine or pendimethalin at 2 lb ai/A when applied at intervals from five months to five weeks before planting and preplant or preemergence the day of planting (Table 1).

Corn 'Pioneer 3780' was planted on May 7 following a very dry April but with adequate rainfall after planting.

Simazine gave the best fall panicum control when applied five weeks before planting on March 30. Earlier and later treatments were somewhat less effective. Fall panicum control with pendimethalin improved as application date approached the time of germination. Mixtures of simazine and pendimethalin gave excellent fall panicum control whether applied in December or on March 30. Later treatments were not included.

Atrazine plus cyanazine applied post emergence on June 8 when fall panicum was in the two to three leaf stage gave good fall panicum control with no significant corn stand or yield loss when compared to the hoed check

Corn yields are given with soil pH effects removed by analysis of covariance. Soil pH which is known to have an effect on the activity of all herbicides in this trial did vary from plot to plot. Corn yields in the first column include effects of the herbicide and the weeds, corn yields in the second column show herbicide effects only, with soil pH and weed effects removed with covariance.

Simazine caused no significant reduction in corn stand or yield regardless of application date.

Pendimethalin caused a 60 percent corn stand and yield reduction when applied preemergence, probably due to incorporation of pendimethalin by the fluted coutler on the no-tillage corn planter. Preemergence applications were safer but there was still a 35 percent reduction in corn stand and corresponding yield reductions. When pendimethalin was applied nine days before planting, the corn stand and yields were significantly better, but only when applied five weeks before planting or in December were corn stands and yields equal to the hoed check.

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Table 1. Corn stand, fall panicum dry wts., and corn yields following treatments with simazine, pendimethalin, atrazine and cyanazine applied on various dates in '75-'76.

Treatment Applic. Date	Herbicide	Rate lb ai/A	Corn Stand plants/A	Fall Panicum Dry Wt. lb/A	Corn Yield 15.5% H_2O bu/A[a]	Corn Yield 15.5% H_2O bu/A[b]
12/17/75	simazine	2	15907 a[c]	976 e	116.7 abc	122.7 a
3/30/76	simazine	2	17134 a	132 a	124.1 ab	120.4 a
5/7/76	simazine PP	2	14423 ab	785 e	109.5 bc	113.7 ab
5/7/76	simazine Pre	2	14714 ab	458 d	113.6 abc	112.7 ab
12/17/75	pendimethalin	2	14617 ab	471 d	110.1 bc	110.3 ab
3/30/76	pendimethalin	2	15391 a	425 cd	109.5 bc	108.5 ab
4/29/76	pendimethalin	2	10874 bc	366 abcd	92.8 cd	91.2 bc
5/7/76	pendimethalin PP	2	5969 d	294 abcd	60.3 e	57.2 d
5/7/76	pendimethalin Pre	2	9841 cd	111 a	83.4 d	78.7 c
12/17/75	simazine +	2 + 2	17424 a	157 a	132.8 a	128.4 a
3/30/76	pendimethalin	2 + 2	15843 a	47 a	120.0 ab	114.9 a
6/8/76	atrazine + cyanazine	1 + 2	15327 a	380 bcd	114.4 abc	112.9 ab
	Hoed Check	---	15068 a	124 a	114.8 abc	109.6 ab
	Weedy Check	---	13875 abc	2877 f	82.4 de	103.0 ab

[a] Corn yield - Soil pH effects removed with covariance. We do not have enough data yet to show exactly what the effect of soil pH is, so through analysis of covariance we have removed the pH variable. These are the yields we would expect due to treatment effects and fall panicum competition if the soil pH in every plot were the same.

[b] Corn yield - Soil pH and weed yield affects removed with covariance. These are the yields we would expect due to treatment only, as if the soil pH and fall panicum competition were the same in every plot. This very closely estimates the true effect of the treatment on corn yield and one would expect the "hoed check" and "weedy check" to be the same within experimental error.

[c] Values followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

TRIAZINE RESITANT REDROOT PIGWEED CONTROL IN FIELD CORN IN MARYLAND

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ABSTRACT

A biotype of redroot pigweed which is not controlled by s-triazine herbicides was noted in Central Maryland during 1976. Confirmation of resistance was obtained through greenhouse studies. Four replicated field trials were conducted in 1977 and 1978 to determine herbicidal treatments that would be effective against this pigweed biotype in field corn. Treatments applied preplant incorporated were combinations of atrazine with butylate, EPTC, and vernolate. The protectant, R-25788, was included with all thiocarbamate herbicides. Preemergence treatments consisted of alachlor, metolachlor, and pendimethalin alone or in combination with atrazine. Also tested were preemergence tank mixes of alachlor and metolachlor with cyanazine and dicamba. Postemergence applications of dicamba and 2,4D were also tested.

Results from the 1977 test, where preemergence treatments only were included, indicated that atrazine plus simazine were ineffective while alachlor and metolachlor gave very good control at rates of 1.68 kg a.i./ha or greater. Inclusion of either atrazine, cyanazine, or dicamba with alachlor or metolachlor did not contribute to additional pigweed control. Pendimethalin applied alone at 1.68 kg a.i./ha or in combination with 1.4 kg. a.i./ha atrazine gave fair early season control while these treatments were only slightly effective late in the season.

During 1978 three tests were conducted under heavy rainfall conditions. Combinations of butylate, vernolate or EPTC with atrazine applied preplant incorporated effected very good pigweed control. As in 1977, both alachlor and metolachlor combined with atrazine were very effective in preemergence treatments. Pendimethalin tank mixes with atrazine while giving control superior to that obtained in 1977 were only moderately effective in 1978. Postemergence applications of dicamba at 0.28 kg a.i./ha or 2,4D at 0.56 kg a.i./ha gave very good control of escaping pigweed.

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While control of triazine resistant redroot pigweed offers a new challenge to the corn grower, several options are available. Preplant treatments including the thiocarbamate herbicides or preemergence applications of alachlor or metolachlor will effect commercial control. Pendimethalin did not give control which was as consistent as that observed with either the thiocarbamate or acetanilide herbicides. In all cases, there is a need for atrazine in combination with the above herbicides to control other broadleaf weeds. In the event that a postemergence treatment should be required, both dicamba and 2,4D have been very effective.

POSTEMERGENCE GRASS CONTROL IN SOYBEANS WITH BAS 9052 O H

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ABSTRACT

BAS 9052 O H, a new postemergence herbicide from Nippon Soda Company Ltd. and developed by BASF Wyandotte Corporation, was tested extensively throughout the United States in 1978 for its effectiveness in controlling annual and perennial grasses in soybeans. Nine trials were conducted in New Jersey where evaluations were made for yellow foxtail, green foxtail, large crabgrass, barnyardgrass and quackgrass. Rates tested ranged from .125 to 1.0 lb ai/A with and without oil concentrates. Single treatments were applied to grasses from 2 to 10 inches tall and to soybeans from the second to the eighth trifoliate leaves. BAS 9052 O H was broadcast over the top of the crop and weeds at 40 psi in 25 gpa of water.

Generally, control of annual grasses was about 90% at the .5 lb ai/A rate. Higher rates and .5 lb ai/A with oil concentrate provided 98 to 100% control. At these rates, large annual grasses were almost as sensitive as the smaller ones.

Control of quackgrass at the 4 leaved to the 10 leaved stages with single applications of BAS 9052 O H ranged from 50 to 80% at rates of .5-1.0 lb ai/A plus oil concentrate. Over 90% control of quackgrass was obtained with double applications of .5 lbs ai/A plus oil. Studies outside the northeast show promising control of shattercane, wild proso millet, volunteer corn, and rhizome johnsongrass.

BAS 9052 O H has shown no injury to soybeans or broadleaved weeds such as lambsquarters, common ragweed, Pennsylvania smartweed, horsenettle, Canada thistle, milkweed, velvetleaf, or redroot pigweed. Tolerance is also shown by yellow nutsedge. Such selectivity can be anticipated in most broadleaved crops.

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BIFENOX ALONE AND WITH SELECTED HERBICIDES APPLIED INCORPORATED VERSUS PREEMERGENCE FOR SOYBEAN WEED CONTROL[1/]

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

ABSTRACT

Field studies were conducted from 1976 to 1978 with bifenox, alachlor, trifluralin, and pendimethalin to evaluate the effects of incorporation, rate, and herbicide combination on soybean injury and weed control. Incorporating bifenox either shallowly at 2.5 cm or at 5 to 7.5 cm eliminated soybean injury found when bifenox was applied preemergence on the soil surface. Weed pressure and control varied from year to year. In 1976, giant green foxtail, redroot pigweed, and common lambsquarters were controlled by incorporating 1.68 kg/ha bifenox tank mixed with 1.68 kg/ha alachlor but not by bifenox used alone. In 1977, the same bifenox plus alachlor treatment controlled giant green foxtail and common lambsquarters only when applied preemergence (not when incorporated) but preplant incorporated combinations of 1.68 kg/ha bifenox with 0.56 kg/ha trifluralin or 0.84 kg/ha pendimethalin did provide control of these two weeds. In 1978, 1.79 to 2.24 kg/ha bifenox (applied preemergence or preplant incorporated) effected control of common lambsquarters. When tank mixed with 0.84 kg/ha trifluralin (applied preplant incorporated) or 1.68 kg/ha alachlor (applied preemergence or preplant incorporated) both common lambsquarters and fall panicum were controlled, although similar results could be obtained by using trifluralin alone. Incorporation depth (2.5 cm or 5 to 7.5 cm) did not affect weed control. When compared to the control, yields were increased by bifenox used alone preplant incorporated or by bifenox with alachlor or trifluralin applied preemergence or preplant incorporated.

INTRODUCTION

Bifenox (methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate) is labeled for preemergence application in soybeans (*Glycine max* L.) to control jimsonweed (*Datura stramonium* L.), common lambsquarters (*Chenopodium album* L.), pigweed (*Amaranthus* sp.), prickly sida (*Sida spinosa* L.), Pennsylvania smartweed (*Polygonum pensylvanicum* L.), and velvetleaf (*Abutilon theophrasti* Medic.)[3/].

1/ Scientific Article No. A-2543 and Contribution No. 5576 of the Maryland Agricultural Experiment Station, Department of Agronomy, College Park, Maryland.

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3/ 1978 Modown 80 WP label, EPA Reg. No. 2224-50, Mobil Chemical Co., Richmond, Virginia 23261.

The herbicide is absorbed by contact with the germinating shoot. Bifenox preemergence applications alone or with other herbicides can cause soybean chlorosis, necrosis, and stunting of early growth though the soybeans seem to subsequently outgrow the injury (1,3). Previous studies of similar preemergence injury caused by dinitramine (N^4, N^4-diethyl-α,α,α-trifluoro-3,5-dinitrotoluene-2,4-diamine) had shown that incorporation could decrease crop injury and that shallow incorporation affected less injury than deep incorporation (2,4). In this report we have compiled results from field experiments conducted with bifenox and other herbicides from 1976 to 1978 evaluating the effects of herbicide incorporation, rate, and combination on soybean injury and weed control.

MATERIALS AND METHODS

Field studies were conducted at the Wye Institute, Queenstown, Maryland. Soil type is a Mattapex silt loam with 1.5% organic matter. In each experiment, 3 m by 6 m plots (each containing four rows spaced 76.2 cm apart) were arranged in a randomized complete block design with four replications. Herbicides were diluted with water and applied with a carbon dioxide pressurized experimental sprayer delivering 280.5 L/ha. Weed control and crop injury were visually rated using the 1 to 9 European scale. Yields were taken from the center two rows after trimming 0.6 m of row from each end. Data were analyzed by analysis of variance and a Bayes LSD was used to compare treatment means.

1976

In experiment W0876 several herbicides (Table 1) were used alone and in combinations applied preemergence (on the soil surface), preplant incorporated, and postemergence to soybeans. Preemergence and preplant incorporated treatments were sprayed and Williams soybeans planted on June 3. The sky was clear air temperature was 24 C, and the wind was calm. Incorporation was done with a rototiller immediately after spraying. Postemergence treatments were sprayed on June 25. The sky was clear, air temperature was 32 C, and the wind was calm. Rain occurred on June 16 (1.85 cm).

1977

In experiment W0677 various preplant incorporated and preemergence herbicides (Table 2) were evaluated in soybeans. Essex soybeans were planted on June 8, 1977 after incorporation of preplant incorporated treatments with a rototiller immediately after spraying. The sky was clear, air temperature was 20 C, and the wind was breezy (approximately 6 km/hour). Preemergence treatments were applied two days later on June 10 (cloudy, 18 C, wind calm during spraying) and at cracking treatments on June 14 (overcast, 22 C, wind calm). Rain fell within the first weeks after preplant incorporated treatments on June 9 (2.18 cm), June 21 (0.71 cm), and June 29 (0.18 cm).

1978

Experiment WY0678 was designed to test the effects of incorporating bifenox at very shallow (2.5 cm) or moderate (5 to 7.5 cm) depths alone and

in combination with alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide) and trifluralin (α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine). All treatments were sprayed and Miles soybeans planted on June 12. The sky was clear, air temperature was 27 C, wind was moderately breezy (approximately 5 km/hour), soil temperature at 5 cm was 27C, soil pH was 6.0, and the soil was dry to a depth of 2.5 cm. Treatments were incorporated with a rototiller immediately after spraying. Before planting the entire field was leveled by incorporating again (in the same direction) to a depth of 5 to 7.5 cm (except 2.5 cm on treatment numbers 6, 11, 12, 13). Precipitation fell on June 13 (1.52 cm), June 14 (0.25 cm), June 20 (0.43 cm), and June 22 (2.51 cm).

RESULTS AND DISCUSSION

Actual treatments used and results obtained are listed in Tables 1, 2 and 3. Rates are expressed as kg ai/ha.

1976

Because of the lack of rainfall within the first 2 weeks after treatment in June 1976, most preemergence treatments did not work well. Preemergence combinations of 1.68 kg/ha bifenox with 1.68 kg/ha alchlor did not control giant green foxtail (*Setaria viridis* var. *major*) or common lambsquarters, but redroot pigweed (*Amaranthus retroflexus* L.) control was about 97% both early and midseason (Table 1). Incorporating bifenox plus alachlor combination significantly improved giant green foxtail and common lambsquarters control to about 95% 3 weeks after treatment but control dropped to 75% by midseason. Incorporating bifenox alone gave poor results with all three weeds. Despite the lack of herbicide activity on weeds, significant soybean stunting (8%) occurred with the preemergence bifenox plus alachlor combination, whereas incorporation reduced injury to 2% or less.

1977

One month after treatment 1.68 kg/ha bifenox applied preemergence had effected 94% control of common lambsquarters but required the addition of 1.68 kg/ha alachlor (tank mix) to adequately control (97%) giant green foxtail (Table 2). Unlike the previous year, however, incorporating 1.68 kg/ha bifenox plus 1.68 kg/ha alachlor did not control either weed. Incorporated combinations of 1.68 kg/ha bifenox with 0.56 kg/ha trifluralin or 0.84 kg/ha pendimethalin (N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine) controlled 95% of both common lambsquarters and giant green foxtail. Late season weed control was not evaluated.

1978

Common lambsquarters and fall panicum (*Panicum dichotomiflorum* Michx.) presssure was only moderate early in 1978 and even lighter late in the season. Distribution was also slightly erratic. Bifenox used alone reduced common lambsquarters population when compared to the control 5 weeks after treatment regardless of rate, method of application, or formulation of bifenox (Table

3). Combinations of 1.79 to 2.24 kg/ha bifenox with 1.68 kg/ha alachlor controlled both common lambsquarters and fall panicum regardless of method of application or formulation of bifenox as did combinations of 1.34 to 2.24 kg/ha bifenox with 0.84 kg/ha trifluralin incorporated 5 to 7.5 cm. Alachlor used alone incorporated (only 2.5 cm depth tested) controlled fall panicum. However, trifluralin used alone incorporated (only 5 to 7.5 cm depth tested) controlled both common lambsquarters and fall panicum as effectively as when combined with bifenox.

Quantitative measurements of soybean injury were not recorded. Qualitative observations indicated that leaf burning and shoot stunting resulted from all preemergence applications of bifenox (alone or in combination with alachlor or trifluralin), but that injury was eliminated by incorporating the herbicides.

Yields with bifenox used alone applied preemergence were not significantly different than the control but incorporating bifenox to either depth did result in yields significantly greater than the control. Bifenox in combination with alachlor increased yields beyond those from bifenox alone only with the preemergence applications. The addition of trifluralin to bifenox boosted only the yield of the lowest rate of bifenox (1.34 kg/ha) incorporated 5 to 7.5 cm. However, as with weed control, yields from the combination were not greater than yields from trifluralin used alone.

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Table 1: 1976 - W0876 Preplant Incorporated, Preemergence, and Postemergence Herbicide Study For Soybeans

Treatment	Rate (kg ai/ha)	Method of Application	6/24 Giant Green Foxtail	6/24 Common Lambsquarters	6/24 Redroot Pigweed	6/24 Soybean Stunting	7/21 Giant Green Foxtail	7/21 Common Lambsquarters	7/21 Redroot Pigweed
1. control			9.0	9.0	9.0	1.0	8.7	8.7	6.2
2. control, cultivated			2.0	1.7	1.7	1.0	5.0	4.7	4.0
3. trifluralin (Treflan)	0.84	PPI	2.2	1.7	1.2	1.0	4.7	5.0	3.2
4. dinitramine (Cobex 50W)	0.37	PPI	3.2	1.5	1.7	3.0	4.5	5.2	2.5
5. fluchloralin (Basalin)	0.84	PPI	1.5	1.2	1.0	1.0	2.7	4.7	2.0
6. trifluralin + chloraxuron (Tenoran) + 5% surfactant	0.84 1.68	PPI Post	2.0	1.7	1.0	1.0	5.0	1.5	1.5
7. chloroxuron + 0.5 surfactant	1.68	Post	7.0	7.0	7.0	1.5	6.7	3.7	4.2
8. dinitramine + chloroxuron + 0.5% surfactant	0.37 1.68	PPI Post	4.2	3.2	3.0	2.5	6.2	2.5	2.5
9. fluchloralin + chloroxuron + 0.5% surfactant	0.84 1.68	PPI PPI	2.7	2.2	1.5	1.7	3.7	4.2	2.5
10. dinitramine + USB 3153	0.185 0.185	PPI PPI	2.7	1.7	1.0	5.0	4.0	4.2	2.0
11. USB 3153	0.37	PPI	2.7	2.7	1.0	5.0	4.0	5.5	2.0
12. bifenox (Modown 2EC)	1.68	PPI	8.5	7.2	6.5	1.0	9.0	6.7	5.2
13. bifenox (Modown 2EC) + alachlor (Lasso)	1.68 1.68	PPI PPI	3.2	2.5	1.5	1.7	5.7	6.2	3.5
14. bifenox (Modown 80WP) + alachlor	1.68 1.68	Pre Pre	6.7	7.2	3.2	3.2	8.2	8.2	2.2
15. bifenox (Modown Flowable) + alachlor	1.68 1.68	Pre Pre	6.7	5.2	2.0	4.2	8.2	6.7	1.7
16. butralin (Amex)	2.8	PPI	2.0	2.0	1.5	1.2	3.7	6.2	3.5
Bayes $LSD_{0.05}$			2.13	2.20	2.27	1.51	2.23	1.66	2.09

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: 1977 - W0677 Preplant Incorporated Herbicides for Soybeans

Treatment	Rate (kg ai/ha)	Method of Application	7/8 Common Lambsquarters	7/8 Giant Green Foxtail
1 control			9.0	9.0
2. control, cultivated			1.0	1.0
3. trifluralin (Treflan 4E)	0.84	ppi	4.0	3.0
4. trifluralin (Treflan 4E) + metribuzin (Lexone 50W)	0.84 0.43	ppi ppi	3.2	3.0
5. pendimethalin (Prowl 4E)	0.84	ppi	5.0	3.5
6. pendimethalin (Prowl 4E) + linuron (Lorox 50W)	0.84 0.56	pre pre	3.0	4.8
7. profluralin (Tolban 4E)	0.84	ppi	6.5	4.8
8. profluralin (Tolban 4E) + naptalam } Dynap 33% + dinoseb } Dynap 33%	0.84 3.4	ppi at cracking	1.8	2.0
9. fluchloralin (Basalin 4E)	1.1	ppi	3.5	2.2
10. ethalfluralin (Sonalan 3E)	0.84	ppi	3.2	3.0
11. ethalfluralin (Sonalan 3E) + metribuzin (Lexone 50W)	0.84 0.43	ppi ppi	3.2	3.0
12. metribuzin (Lexone 50W)	0.43	ppi	7.0	7.0
13. bifenox (Modown 80W)	1.68	ppi	7.5	7.5
14. bifenox (Modown 80W)	1.68	pre	3.2	6.5
15. bifenox (Modown 80W) + trifluralin (Treflan 4E)	1.68 0.56	ppi ppi	3.2	2.5
16. bifenox (Modown 80W) + pendimethalin (Prowl 4E)	1.68 0.84	ppi ppi	3.0	2.8
17. bifenox (Modown 80W) + alachlor (Lasso 4L)	1.68 1.68	ppi ppi	6.0	5.2
18. bifenox (Modown 80W) + alachlor (Lasso 4L)	1.68 1.68	pre pre	2.0	2.2
Bayes $LSD_{.01}$			1.2	1.1

European rating used: for weed control 1=100%, 2=97.5%, 3=95%, 4=90%, 5=85%, 6=75%, 7=66%, 8=33%, 9=0%.

Table 3: 1978 - WY0678 Preplant Incorporated Bifenox in Soybeans

#	Herbicide Treatment	Rate kg ai/ha	Method of Application	June 29, 1978 Soybean Injury	July 18, 1978 Common Lambsquarters	July 18, 1978 Fall Panicum	September 18, 1978 Common Lambsquarters	September 18, 1978 Fall Panicum	November 2, 1978 Yield kg/ha
1.	control	-	-	-	7.8	6.8	4.8	5.5	1782
2.	control, cultivated	-	-	-	6.0	4.5	1.2	2.0	2812
3.	bifenox (Modown 80WP)	1.34	ppi, 5-7.5 cm	-	5.0	5.0	3.2	2.8	2059
4.	bifenox (Modown 80WP)	1.79	ppi, 5-7.5 cm	-	3.5	4.0	3.0	3.0	2752
5.	bifenox (Modown 80WP)	2.24	ppi, 5-7.5 cm	-	3.0	4.8	1.8	3.8	2416
6.	bifenox (Modown 80WP)	1.79	ppi, 2.5 cm	-	3.0	4.2	2.5	3.8	2416
7.	bifenox (Modown 80WP) + trifluralin (Treflan 4EC)	1.34 0.84	ppi, 5-7.5 cm ppi, 5-7.5 cm	-	1.2	1.5	1.5	1.2	2970
8.	bifenox (Modown 80WP) + trifluralin (Treflan 4EC)	1.79 0.84	ppi, 5-7.5 cm ppi, 5-7.5 cm	-	1.5	1.8	1.8	1.5	2911
9.	bifenox (Modown 80WP) + trifluralin (Treflan 4EC)	2.24 0.84	ppi, 5-7.5 cm ppi, 5-7.5 cm	-	1.2	1.5	2.0	1.5	2336
10.	trifluralin (Treflan 4EC)	0.84	ppi, 5-7.5 cm	-	1.2	1.2	2.0	1.8	2594
11.	alachlor (Lasso 4EC)	1.68	ppi, 2.5 cm	-	5.0	1.8	5.8	2.2	2515
12.	bifenox (Modown 80WP) + alachlor (Lasso 4EC)	1.79 1.68	ppi, 2.5 cm ppi, 2.5 cm	-	2.8	2.0	2.5	1.5	2693
13.	bifenox (Modown 80WP) + alachlor (Lasso 4EC)	2.24 1.68	ppi, 2.5 cm ppi, 2.5 cm	-	1.8	1.5	1.8	1.8	2772
14.	bifenox (Modown 80WP) + alachlor (Lasso 4EC)	1.79 1.68	pre	+	1.8	1.5	2.0	1.8	2792
15.	bifenox (Modown 80WP) + alachlor (Lasso 4EC)	2.24 1.68	pre	+	1.0	1.2	2.2	1.2	2911
16.	bifenox (Modown 80WP)	1.79	pre	+	1.8	3.2	2.2	3.8	2218
17.	bifenox (Modown 80WP)	2.24	pre	+	2.0	4.5	2.0	5.8	1841
18.	bifenox (Modown 4F)	1.79	pre	+	1.2	4.0	2.2	5.0	1940
19.	bifenox (Modown 4F) + trifluralin (Treflan 4EC)	2.24 0.84	ppi, 5-7.5 cm ppi, 5-7.5 cm	-	1.0	1.8	2.2	2.0	2475
20.	bifenox (Modown 4F) + alachlor (Lasso 4EC)	2.24 1.68	ppi, 5-7.5 cm ppi, 5-7.5 cm	-	2.0	1.5	2.0	1.2	2673
	Bayes $LSD_{.05}$				1.73	1.67	1.99	2.11	550

Crop injury (qualitative rating): + equals injury, - equals no injury.
Weed control (European rating system): 1=100%, 2=97.5%, 3=95%, 4=90%, 5=85%, 6=75%, 7=66%, 8=33%, 9=0%.

HERBICIDE COMBINATIONS FOR ESTABLISHING SOYBEANS IN A NO-TILL DOUBLE-CROP SYSTEM

R.W. Michieka and R.D. Ilnicki[1/]

ABSTRACT

Herbicide combinations were evaluated in no-till double-crop soybeans following wheat. Paraquat and glyphosate, knockdown herbicides, were used with residual herbicides that included alachlor, propachlor, oryzalin, and pendimethalin in combination with either linuron or metribuzin. Included also was acifluorfen-sodium applied immediately after planting and at one and two weeks after application of paraquat or glyphosate.

The combination of alachlor and linuron was very effective on most weeds with either glyphosate or paraquat but slightly better with glyphosate. Similarly, combinations of propachlor and linuron were successful but slightly better with glyphosate.

When metribuzin was substituted for linuron, there was a slight improvement in weed control with no difference between paraquat or glyphosate. When propachlor was substituted for alachlor, the combinations with metribuzin were slightly better with paraquat than glyphosate.

Combinations of oryzalin and linuron and oryzalin and metribuzin proved effective; oryzalin and linuron with glyphosate being slightly better than with paraquat. Oryzalin and metribuzin with paraquat was slightly better than with glyphosate.

Combinations of pendimethalin and linuron were compared to pendimethalin and metribuzin. The latter was slightly better and with paraquat more than with glyphosate.

There were no real differences in control with acifluorfen-sodium whether used with glyphosate or paraquat. There were increases in control from delayed applications following use of either glyphosate or paraquat.

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SOME POSTEMERGENCE TREATMENTS FOLLOWING PREEMERGENCE HERBICIDES FOR WEED CONTROL IN SOYBEANS

R. D. Ilnicki and R. W. Michieka[1/]

ABSTRACT

The use of alachlor as a preemergence herbicide in soybeans is a widely accepted practice. This herbicide is effective for the control of fall panicum (Panicum dichotomiflorum Michx.) and other annual grasses but may fail to completely control common broadleaf weeds associated with the crop. A relatively new herbicide, oryzalin, with potential for use in soybeans, has effectively controlled many weeds, but sometimes complete control of all weeds is not achieved with it. As of late, the combination of naptalam and dinoseb (dyanap) has proved successful for use in soybeans as a postemergence treatment in addition to its use preemergence. More recently, the introduction of acifluorfen-sodium and bentazon as postemergence herbicides in soybeans has attracted the attention of weed research workers as possible candidates for use in weed control programs. It was the objective of this study to determine whether some of these newer postemergence herbicides can be safely used in soybean culture as follow-up treatments to preemergence herbicides.

Alachlor at 1.68 to 3.36 kg/ha was applied preemergence and followed by naptalam plus dinoseb at rates of 3.36 plus 1.12 kg/ha, respectively, at "cracking" and at the first trifoliate stage of soybeans and these schedules produced excellent control of all weeds with no injury to soybeans, save some reduction in vigor at the later stage with high rates of the combination. Similarly, alachlor followed by acifluorfen-sodium at rates of 0.28 to 0.56 kg/ha effected excellent control of all weeds with no crop injury.

Bentazon at 1.12 kg/ha at the latter stage following preemergence alachlor produced excellent weed control.

Weed species in the experimental site included redroot pigweed (Amaranthus retroflexus L.) and velvetleaf (Abutilon theophrasti Medic) in addition to fall panicum.

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Weed Control in No-Tillage Soybeans

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ABSTRACT

An estimated 40,000 ha of soybeans (Glycine max (L.) Merr.) are produced annually in Delaware using no-tillage or reduced tillage methods. Most of these soybeans are planted in mid- to late-June following the harvest of cereal grains. A principal advantage of the no-tillage system is the reduction of seed bed preparation time associated with use of the mold-board plow. The earlier planting dates achieved by this practice usually result in significantly higher yields. Success, however, is dependent on effective chemical weed control. Failure to consistantly achieve this prompted an evaluation of several non-selective and residual herbicide treatments. Glyphosate, paraquat, and dinoseb plus crop oil were compared as non-selective treatments during 1977 and 1978. These were applied across twelve residual herbicide treatments in a split plot design. Soybean yields, across all residual treatments, averaged 19.1, 12.2, and 9.8 q/ha for the glyphosate, paraquat and dinoseb treatments, respectively. The glyphosate plots, even without a residual herbicide treatment produced 99% of the yield achieved with the most effective paraquat-residual herbicide combination. The principal weed species involved were large crabgrass (Digitaria sanguinalis L. Scop.) and fall panicum (Panicum dichotomiflorum Michx.). In 1978, where these species were effectively controlled by glyphosate there were relatively more broad-leaf weeds present than in paraquat and dinoseb treated plots. Under these conditions a post-emergence application of RH6201 significantly improved the over-all weed control.

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COMPETITION BETWEEN SEEDLING ALFALFA AND CRABGRASS AS INFLUENCED BY HERBICIDE TREATMENTS

R. A. Peters[1]

ABSTRACT

The evaluation of herbicides for selective control of large crabgrass in new seedings of alfalfa was carried out on a May 22, 1978 alfalfa seeding at the Storrs Agricultural Experiment Station. EPTC, profluralin and benefin doubled yields of alfalfa over the control. Even more effective were preemergence applications of HOE 29152 and postemergence BAS 2901 OH. Diclofop applied preemergent significantly decreased crabgrass yields in both cuts but the postemergence applications did not result in decreased crabgrass until the second cut alfalfa yield was increased in the second cut. R-40244 was a very active compound but displayed no selectivity.

INTRODUCTION

Large crabgrass (Digitaria sanguinalis (L.) Scop.) has become probably the most prevalent weed in the Northeast in new spring seedings of alfalfa. This can be related to the buildup of crabgrass which has occurred in corn fields treated with atrazine (2-chloro-4-(ethylamino)-6 (isopropylamino)-s-triazine). When these corn fields are seeded down to alfalfa (Medicago sativa L.) heavy stands of crabgrass develop which are highly competitive.

Herbicides are available which are effective for crabgrass control but they must be soil incorporated prior to alfalfa planting. There is a distinct need for a selective postemergence herbicide for crabgrass and other annual grass weeds. HOE 23408 (diclofop) has been reported (2) as being promising for preemergence and early postemergence control of large crabgrass. HOE 29152 applied postemergence has also been shown (1) to be active on crabgrass as large as 20 cm in height without injury to alfalfa.

MATERIALS AND METHODS

The following experiment was carried out at the Agronomy Research Farm at Storrs, CT. the soil type was a Paxton fine sandy loam, coarse-loamy, mixed, mesic Typic Fragiochrept. The field was fertilized with 165 kg/ha P_2O_5 and K_2O. The experimental design was a randomized complete block replicated four times.

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Plot size was 1.5 by 6.1 m with a .9 by 5.2 m strip removed for dry matter determinations. Saranac alfalfa was seeded at 13 kg/ha with a grain drill on May 22, 1978. The predominate volunteer weed was large crabgrass. Lambsquarters (Chenopodium album (L.) Scop.) was also present at less than 5% of the total cover.

Preplant and preemergence herbicide treatments were made on May 22, 1978. Soil moisture was ample. Postemergence applications were made on June 6, 1978 when 50% of the alfalfa was in the first true leaf stage and crabgrass was in the 3-4 leaf stage. The R-40244 late postemergence treatment was applied when the crabgrass was 20-30 cm and alfalfa 20-25 cm tall.

Herbicides evaluated included diclofop (methyl 2-[4-(2,4-dichlorophenoxy) phenoxy]propanoate), EPTC (S-ethyl dipropyl thiocarbamate), benefin (N-butyl-N-ethyl, trifluoro-2,6-dinitro-p-toluidine), profluralin (N-(cyclopropylmethyl) trifluoro-2,6-dinitro-N-propyl-p-toluidine, R-40244 (1-(m-trifluoromethylphenyl) -3-chloro-4-chloromethyl-2-pyrrolidone), BAS 2901 OH (identity unknown) and HOE 29152 (methyl 2-[4-(trichloromethylphenoxy) phenoxy]propanoate). Applications were made in 448 l/ha of water using a small plot sprayer.

Estimates of injury on a 0-10 scale were made periodically of the alfalfa and large crabgrass. Yields of dry matter were determined on July 31 and September 28, 1978. Crabgrass samples were taken for the first harvest for hand separations into the alfalfa and crabgrass components. At the time of the second harvest estimates were made of the % biomass of alfalfa and crabgrass. This estimate was used to partition the total dry matter yield into alfalfa and crabgrass components.

RESULTS AND DISCUSSION

The vigor and density of the crabgrass that developed in the seeding is shown by the yield data in Table 1. At both harvests the crabgrass dry matter in the control was 1 1/2 times as great as that of the alfalfa. The competitiveness of the crabgrass was shown by a 50% yield reduction of alfalfa in the control as compared to the standard EPTC treatment.

The effectiveness of EPTC, benefin and profluralin in controlling crabgrass injury to the legume is shown by the July 8 ratings. The decrease in ratings by July 28 and September 22 was associated with competition developing from crabgrass which had not been controlled. Alfalfa yields were significantly increased in both cuts by these materials.

The most effective treatment in the experiment was the early postemergence treatment with the experimental material BAS 9201 OH. This chemical, with or without surfynol, gave essentially complete control of the crabgrass with no injury to the alfalfa resulting in a total dry matter yield of over 2 metric T/ha in the 2 cuts obtained. HOE 29152 at 1.1 kg/ha applied preemergence was also very effective resulting in a combined yield of just under 2 metric T/ha of alfalfa.

Diclofop applied as a preemergence treatment significantly reduced crabgrass yields over the control in both the first and second cuts. The postemergence applications of diclofop significantly reduced crabgrass yields only in the second cut. There was no increase in first cut alfalfa yields in any of the diclofop treatments; however, in the second cut alfalfa yields were significantly greater than in the control. The slow impact of diclofop on the crabgrass was reflected in the increased control ratings on September 22 when the ratings for other materials showed little change from the earlier ratings.

R-40244 proved to have very little selectivity at the rates used. Both the alfalfa and the crabgrass were essentially eliminated in the first cut. In the second cut a few remaining crabgrass plants had proliferated in the absence of any competition from alfalfa.

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Table 1. Effect of herbicides on seedling alfalfa and crabgrass

Herbicide	Rate kg/ha	Time	Alfalfa Control Ratings[1] July 7	July 28	Sept 22	Yields July 31	Sept 22	Total	Crabgrass Control Ratings July 7	July 28	Sept 22	Yields July 31	Sept 22	Total
1. Control			4.6	7.7	4.8	990 b[2]	780 g	1770	0.0	1.4	2.9	1630 ab	1130 c	2760
2. EPTC	3.30	ppi	0.5	3.3	1.8	2265 a	1580 b	3845	9.0	7.0	8.3	250 d	195 g	445
3. Benefin	1.65	ppi	0.3	3.3	1.8	2010 a	1520 bc	3530	8.5	6.3	7.5	630 cd	430 b	1060
4. Profluralin	1.10	ppi	0.0	3.8	2.3	2050 a	1450 bcd	3500	8.0	6.0	6.0	710 cd	555 b	1265
5. HOE 29152	1.10	pre	0.0	0.0	1.5	2580 a	1360 cde	3940	10.0	10.0	8.8	45 d	435 b	480
6. BAS 9201 OH	1.10	early post	1.0	0.0	1.0	2735 a	1710 a	4445	9.0	9.0	9.0	10 d	10	20
7. BAS 9201 OH + .5% surfynol	1.10	early post	0.0	0.0	2.0	2305 a	1795 a	4100	10.0	9.0	7.0	10 d	10	20
8. Diclofop	1.65	pre	1.9	4.4	2.3	1170 b	1315 def	3655	8.0	6.0	5.5	810 cd	610 f	1420
9. Diclofop	.69	early post	3.8	8.0	3.0	965 b	1665 a	2630	1.3	2.3	4.5	2305 a	610 b	2915
10. Diclofop	.83	early post	2.8	7.5	3.8	1280 ab	1300 def	2580	2.3	1.8	3.5	1750 ab	1035 cd	2785
11. Diclofop	1.65	early post	2.7	6.7	3.3	1190 b	1180 b	2370	4.6	2.3	4.8	1775 ab	900 de	2675
12. Diclofop + surfynol 104-ES75	.83	early post	5.0	6.5	3.0	1190 b	1240 ef	2430	1.8	1.0	4.5	1370 bc	840 e	2210
13. R-40244	.55	late post	2.8	8.3	6.3	385 c	385 h	770	0.0	3.0	2.0	1375 bc	1435 b	2810
14. R-40244	.55	pre	10.0	8.5	8.5	255 c	160 i	415	10.0	9.0	4.3	10 d	1720 a	1730
15. R-40244	1.10	pre	10.0	10.0	9.0	80 c	385 h	465	10.0	10.0	5.0	10 d	1180 c	1190

[1] 0 - no effect; 10 - complete kill

[2] Means followed by a common letter are not significantly different at the 5% level DMR test

QUACKGRASS AND DANDELION CONTROL IN ESTABLISHED ALFALFA

J. M. Hutchinson and R. A. Peters[1/]

ABSTRACT

Prior to the start of the experiment at The Storrs Agricultural Experiment Station, an eight year old alfalfa stand had thinned down to an average of 8 plants per square meter. A heavy infestation of quackgrass and dandelion had occured as well. Half the experimental area was cut to a 5 cm height prior to application of herbicide treatments in midfall, late fall or midspring.

First harvest and second harvest alfalfa yields following December 3, 1977 and April 14, 1978 treatments were all significantly reduced by cutting. In contrast dandelion yields were significantly greater in the mowed plots.

Pronamide was the most effective of the treatments applied October 23, 1977. Pronamide (2.24 kg/ha) and buthidazole (2.24 kg/ha) were the most effective of treatments applied December 3, 1977 or April 14, 1978. Pronamide applications resulted in increased dandelion yields when applied in December or April. Metribuzin (1.12 kg/ha), terbacil (1.12 kg/ha) and buthidazole (2.24 kg/ha) were most effective in controlling dandelion when applied in December or April. None of the October treatments showed significant dandelion control. Metribuzin (1.12 kg/ha) and buthidazole (2.24 kg/ha) showed significant second harvest increases in alfalfa yields when applied in the late fall or midspring.

INTRODUCTION

Quackgrass (Agropyron repens (L.) Beauv.) has long been considered a noxious weed in established alfalfa stands in the Northeast especially in older stands. Ingress of dandelion (Taraxacum officinale L.) is also a widespread problem as older alfalfa (Medicago sativa L.) stands thin out. There is a need for continuing evaluation of herbicides giving selective control of quackgrass and dandelion in established alfalfa.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Research Station at Storrs, CT. A split plot design with four replications was employed. The cultural treatments (mowing vs. non-mowing) were assigned as whole plots. The subplots were 3.4 by 1.5 meters. The soil was a Charlton fine sandy loam, coarse-loamy, mixed, mesic Typic fragiochrept. The soil pH was 6.8 in 1:1 soil/distilled water. Two hundred and twenty-six kilograms of 0-15-30 were applied on June 27, 1978 after the first harvest. The experimental area had been in alfalfa for eight years prior to the start of the experiment. When the experiment was started alfalfa stands had thinned down to an average of 8 plants per square meter. Quackgrass and dandelion had volunteered in the spaces between alfalfa clumps. Stands of alfalfa and quack were both quite variable from plot to plot.

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To determine the influence of time of application on the selected herbicides, three different timings were tested. Herbicides evaluated were terbacil (3-tert-butyl-5-chloro-6-methyluracil) at 1.12 kg/ha pronamide (3,5-dichloro[N-1,1-dimethyl-2-propynyl]benzamide) at 2.24 kg/ha, a terbacil (1.12 kg/ha) and pronamide (1.12 kg/ha) mix, HOE 29152 at 1.12 and 2.24 kg/ha, buthidazole (3-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-y]-4-hydroxy-1-methyl-2-imadazolidinone) at 1.12 and 2.24 lbs/ha, and metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5[4H]-one) at 1.12 kg/ha. All chemicals were applied in 449 liters/hectare of water with a small plot sprayer.

Prior to the start of the experiment one half of the experimental area was mowed September 30, 1977 to a five centimeter stubble height. The alfalfa at the time of cutting was 40 cm tall.

Herbicides were applied on three different dates. The midfall chemical treatment (October 23, 1977) was applied when the unmowed alfalfa was 40 to 44 cm tall. Mowed alfalfa stubble was two to five inches tall. The late fall chemical treatment (December 3, 1977) was applied when the unmowed alfalfa was 40 to 46 cm tall and showing distinct symptoms of frost injury. The midspring chemical treatment (April 14, 1978) went on when the alfalfa was 16 to 20 cm tall in the unmowed plots and 10 to 14 cm tall.

Plant topgrowth dry matter yields were determined on June 6, 1978 and again on August 17, 1978. Individual dry matter yields of alfalfa, quackgrass and dandelion components were obtained from botanical separations of grab samples taken at the time of harvest.

Percentage of each species component of total biomass was rated on June 4, 1978 and again on July 18, 1978.

RESULTS AND DISCUSSION

First harvest alfalfa yields were significantly reduced by the fall clipping at all times of chemical treatment, as shown in Table 1. Second harvest alfalfa yields were also significantly reduced by clipping when herbicides were applied at the late fall or midspring timing.

Quackgrass showed no significant reduction in yield overall associated with the fall mowing. In contrast, dandelion yields were significantly greater in the fall mowed plots than in the unmowed plots.

Second harvest dandelion yields were also significantly greater in the mowed over the unmowed plots. Moreover, our actual figures for late fall and midspring yields from the June harvest, and our recorded figures from midspring second harvest yields appear to also indicate a trend towards increased dandelion growth as a result of the fall cutting prior to herbicide application.

These data suggest that mowing was deleterious to the alfalfa stands by causing a decrease in winter food reserves. Dandelion because of its rosette habit of growth in the fall, was influenced much less by mowing. It increased in biomass production in the mowed plots because of decreased competition from the weakened alfalfa.

Table 1. Effect of cutting management prior to herbicide applications on component yields.

	Alfalfa			Quackgrass			Dandelion		
	Time of Application			Time of Application			Time of Application		
	Mid Fall	Late Fall	Mid Spring	Mid Fall	Late Fall	Mid Spring	Mid Fall	Late Fall	Mid Spring
	kg ai/ha	kg ai/ha	kg ai/ha	kg ai/ha	kg ai/ha	kg ai/ha	kg ai/ha	kg ai/ha	kg ai/ha
Unmowed									
1st Cut:	1940	2180	1955	460	455	330	125	120	125
2nd Cut:	1815	1935	2110	220	305	215	100	65	70
Total:	3755	4115	4065	680	760	545	225	185	195
Mowed									
1st Cut:	1335	1228	1375	405	655	365	200	145	135
2nd Cut:	1355	1240	1495	210	330	235	125	120	120
Total:	2690	2468	2870	615	985	600	325	265	255
$LSD_{.05}$									
1st Cut:	490	540	190	N.S.	N.S.	N.S.	80	N.S.	N.S.
2nd Cut:	N.S.	340	285	N.S.	N.S.	N.S.	N.S.	35	50
$LSD_{.01}$									
1st Cut:	655	715	255	N.S.	N.S.	N.S.	105	N.S.	N.S.
2nd Cut:	N.S.	450	380	N.S.	N.S.	N.S.	N.S.	45	65

Because of the rosette growth habit of dandelion the biomass ratings indicate a higher percentage of dandelion relative to total plot biomass than is shown in the yield data.

Midfall treatments

When treatments were made in midfall, all herbicides significantly reduced total quackgrass yields at the $P_{.05}$ level. All treatments but terbacil reduced the quackgrass at the $P_{.01}$ level. Pronamide was the most effective in reducing quackgrass yield. Terbacil was the least effective herbicide. There was no herbicide effect on dandelion yields. None of the herbicide treatments caused a significant change in alfalfa yields.

Late fall treatments

Total quackgrass yields were reduced only by buthidazole at 2.24 kg/ha and pronamide at $P_{.01}$. Total dandelion yields were significantly reduced by metribuzin and both rates of buthidazole. Yields of dandelion in the first cut were greater in plots treated with pronamide and HOE 29152 at the 2.24 kg rate. There was no significant treatment effect on the first cut alfalfa. However, in the second harvest there was a significant increase in alfalfa from metribuzin and buthidazole at 2.24 kg/ha.

Midspring applications

All herbicide treatments significantly reduced quackgrass yields at the $P_{.01}$ level. Pronamide and either rate of buthidazole were the most effective. The least effective were terbacil and metribuzin. Dandelion yields were reduced by metribuzin and terbacil and both rates of buthidazole. Significant increases in dandelion yields, however, followed treatments of pronamide. Alfalfa yields were increased by metribuzin and both rates of buthidazole in for second harvest.

Pronamide has been reported (1) as effectively controlling quackgrass in first cutting yields of alfalfa. Our data could not substantiate this increase in alfalfa yield. However, second harvest yields of alfalfa were significantly greater for plots treated with metribuzin or buthidazole at 2.24 kg/ha when applied on either late fall or midspring. Midspring applications of buthidazole at 1.12 kg/ha also increased alfalfa yields.

While pronamide significantly decreased quackgrass in late fall or midspring timings, dandelion infestation significantly increased. Midfall mowed pronamide plots also showed a trend towards increased dandelion infestation. Apparently quackgrass control is not enough in established alfalfa with a sizeable infestation of dandelion. In other studies (2) .84 kg/ha of metribuzin gave partial control of dandelion, while 1.12 kg/ha gave complete suppression of quackgrass in established alfalfa. We found metribuzin at 1.12 kg/ha to provide significant quackgrass control when applied midfall or midspring while providing significant dandelion suppression when applied midspring.

LITERATURE CITED

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Table 2. Quackgrass component as affected by herbicides and timing of application

Treatment	Rate[3] kg/ha	Midfall application (10/23/77) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha	Late fall application (12/3/77) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha	Midspring application (4/14/78) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha
1. Terbacil	1.12	2.2	1.3	655	245	900	2.4	1.2	585	340	925	2.0	0.8	440	330	770
2. Terbacil + pronamide	1.12 1.12	0.9	0.7	190	190	380	1.6	1.0	430	410	840	1.5	1.5	270	195	465
3. HOE #29152	1.12	2.4	0.9	2	2	2	2.3	1.1	2	2	2	1.4	0.9	255	165	420
4. HOE #29152	2.24	2.8	0.8	175	185	360	2.8	1.3	695	340	1035	0.8	0.8	260	130	390
5. Pronamide	2.24	0.3	0.9	15	115	130	0.6	0.5	170	195	365	0.6	0.5	75	150	225
6. Buthidazole	1.12	2.7	1.0	2	2	2	1.8	1.1	785	480	1265	0.5	0.6	120	200	320
7. Buthidazole	2.24	1.0	0.9	300	225	525	0.5	0.6	95	75	170	0.7	0.1	110	30	140
8. Metribuzin	1.12	2.9	1.7	715	2	2	2.4	0.9	600	335	935	1.4	0.7	355	365	720
9. Untreated	--	3.3	1.4	960	325	1285	3.2	1.3	710	355	1065	3.8	1.5	1230	605	1835
L.S.D. .05				266	96	362			310	120	430			205	125	330
L.S.D. .01				369	128	497			413	161	574			275	165	440

[1] Visual estimates of % of total biomass

[2] No grab samples taken for separation

[3] All materials expressed in terms of active ingredients

Table 3. Dandelion component as affected by herbicides and timing of application

Treatment	Rate[3] kg/ha	Midfall application (10/23/77) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha	Late fall application (12/3/77) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha	Midspring application (4/14/78) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha
1. Terbacil	1.12	1.0	0.8	100	130	230	1.0	1.4	120	70	190	1.1	0.9	90	60	150(1)
2. Terbacil + pronamide	1.12 1.12	1.6	1.1	165	120	285	1.8	1.6	130	130	260	1.6	0.4	70	130	200(2)
3. HOE #29152	1.12	1.4	1.5	2	2	2	1.8	1.1	2	2	2	1.5	1.0	135	120	255(3)
4. HOE #29152	2.24	1.0	1.1	225	110	335	1.5	1.7	255	125	380	1.2	1.5	170	140	310(4)
5. Pronamide	2.24	2.0	1.2	245	165	410	1.5	1.3	280	120	400	1.9	1.5	230	185	415(5)
6. Buthidazole	1.12	1.5	1.3	2	2	2	1.5	1.0	60	90	150	0.5	0.4	30	35	65(6)
7. Buthidazole	2.24	1.5	1.1	35	35	70	0.7	0.3	25	20	45	0.3	0.4	25	15	40(7)
8. Metribuzin	1.12	0.9	1.3	190	2	2	1.0	1.4	80	45	125	0.5	0.9	35	25	60(8)
9. Untreated	--	1.3	0.8	165	115	280	1.2	0.9	125	145	270	1.2	1.4	150	135	285(9)
L.S.D.$_{.05}$				N.S.	N.S.	N.S.			60	60	120			60	45	105(LSD$_{.05}$)
L.S.D.$_{.01}$				N.S.	N.S.	N.S.			75	75	150			75	60	135(LSD$_{.01}$)

[1] Visual estimates of % of total biomass

[2] No grab samples taken for separation

[3] All materials expressed in terms of active ingredients

Table 4. Alfalfa component as affected by herbicides and timing of application

Treatment	Rate[3] kg/ha	Midfall application (10/23/77) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha	Late fall application (12/3/77) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha	Midspring application (4/14/78) %Biomass 6/4	Ratings[1] 7/18	1st Cut kg/ha	2nd Cut kg/ha	Total kg/ha
1. Terbacil	1.12	6.8	7.9	1605	1610	3215	6.6	7.4	1570	1440	3010	6.9	8.3	1495	1820	3315
2. Terbacil + pronamide	1.12 1.12	7.5	8.2	1880	1505	3385	6.6	7.4	1610	1475	3085	6.9	8.1	1575	1685	3260
3. HOE #29152	1.12	6.2	7.6	2	2	2	5.9	7.8	2	2	2	7.1	8.1	2040	1510	3550
4. HOE #29152	2.24	6.2	8.1	1650	1585	3235	5.7	7.0	1600	1115	2715	8.0	7.7	2010	1760	3770
5. Pronamide	2.24	7.7	7.9	1545	1560	3105	7.9	8.2	1910	1630	3540	7.5	8.0	1695	1625	3320
6. Buthidazole	1.12	5.8	8.2	2	2	2	6.7	7.9	1650	1610	3260	9.0	9.0	1395	2185	3580
7. Buthidazole	2.24	8.2	8.0	1335	1730	3065	9.0	9.1	1875	1850	3725	9.0	9.5	1445	1920	3365
8. Metribuzin	1.12	6.2	7.0	1580	2	2	6.6	7.7	1650	1910	3560	8.1	8.4	1515	2195	3708
9. Untreated	--	5.4	7.8	1765	1505	3270	5.6	7.8	2020	1410	3430	5.0	7.1	1805	1480	3285
L.S.D. .05				N.S.	N.S.	N.S.			N.S.	343	N.S.			N.S.	285	N.S.
L.S.D. .01				N.S.	N.S.	N.S.			N.S.	458	N.S.			N.S.	381	N.S.

[1] Visual estimates of % of total biomass

[2] No grab samples taken for separation

[3] All materials expressed in terms of active ingredients

CHEMICAL CONTROL OF ORCHARDGRASS PRECEEDING A NO-TILL ALFALFA SEEDING

G. W. Mueller-Warrant, D. W. Koch, and J. R. Mitchell 1/

ABSTRACT

Several rates of fall applied pronamide and Velsicol-5026 and fall and spring applied glyphosate and paraquat were evaluated for suppression of a mixed sward dominated by orchardgrass (Dactylis glomerata L.), but which also contained considerable amounts of Kentucky bluegrass (Poa pratensis L.) and various perennial broadleaf weeds. The site in Lee, New Hampshire was a well drained, shallow, somewhat drouthy Hollis soil with a pH of 5.7 in the top 5 cm. Limestone at 2 mT/ha and 1 kg/ha 2,4D were applied in summer of 1977, a year prior to the seeding. Herbicides were applied to 1.8 m by 4.9 m subplots with a hand held boom, CO_2 pressurized backpack sprayer system. Alfalfa (Medicago sativa L. 'Saranac') was seeded into randomized main plots on April 29, 1978 (18.3m by 4.9m) and May 13, 1978 (18.3m by 9.8m) using a J. D. Powrtill seeder. Ten fall herbicide treatments (#'s 1 thru 10) were employed for both the April 29 and May 13 seedings. An additional 10 herbicide treatments spring applied or mixed fall and spring applied were used for the May 13 seeding (#'s 11 thru 20).

Light insect feeding on unifoliate and trifoliate leaves of seedlings was noted in mid May after wet weather, so 0.35 kg/ha a.i. of Furadan was broadcast over the entire area on May 22. To reduce competition from broadleaf weeds, 2.8 kg/ha a.i. of 2,4DB was broadcast on June 7. The May 18 paraquat application was made during a period of misty, foggy weather.

On July 17 all plots were rated by 3 observers for estimated % dry matter contribution from alfalfa, all grasses (orchardgrass, bluegrass, and annuals) and all other weeds. Plots were harvested on July 18 with a self-propelled Carter forage harvester, and subsampled for moisture and % crude protein. Percent alfalfa was estimated by 3 persons on September 5, prior the second harvest. Second harvest trends were similar to those for the first harvest. Rainfall was abundant thru early June, but very limited for the remainder of the summer. Annual grasses were a sporadically serious problem.

Fall applied glyphosate was as effective at 1.12 kg/ha as at 2.24 kg/ha. Spring applied glyphosate was less effective at 1.12 kg/ha than at 1.68 kg/ha or 2.24 kg/ha, which were equally effective. Following fall applied glyphosate, both the first and second harvest alfalfa compositions were lower for May 13 seeding than for April 29 seeding. Pronamide effectiveness as a fall applied pre-plant herbicide increased with rate up to 3.36 kg/ha a.i.. The medium rate of pronamide when followed by 0.28 kg/ha paraquat was as effective in establishing alfalfa as glyphosate. Split applications of paraquat increased its effectiveness, fall+early spring+immediately post seeding treatment being the most effective (#16). Pronamide+paraquat or split application paraquat treatments encountered less annual weed problems than did fall applied glyphosate. Velsicol-5026 was not effective as a fall applied pre-plant herbicide at the highest rate used (1.68 kg/ha a.i.), nor when used at a 1.12 kg/ha rate followed by 0.28 kg/ha of paraquat.

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TABLE 1

VISUALLY ESTIMATED PRECENT SPECIES COMPOSITION-FIRST HARVEST

#	Herbicide Treatment			Seeding Dates April 29 Alfalfa	April 29 Grass	May 13 Alfalfa	May 13 Grass
1	Glyphosate*	Nov. 5	1.12 kg/ha	63	4	58	11
2	"	"	2.24 "	54	4	47	22
11	"	May 11	1.12 "			68	23
12	"	"	1.68 "			85	7
13	"	"	2.24 "			88	7
3	Pronamide	Nov. 21	1.12 kg/ha	9	43	10	45
17	"	"	1.12 " +			56	36
	Paraquat	May 18	0.28 "				
4	Pronamide	Nov. 21	2.24 "	21	14	18	34
18	"	"	2.24 " +			84	12
	Paraquat	May 18	0.28 "				
5	Pronamide	Nov. 21	3.36 "	38	6	57	12
6	Vel-5026	Nov. 21	0.56 kg/ha	1	56	6	83
7	"	"	0.84 "	2	72	3	76
19	"	"	0.84 " +			26	57
	Paraquat	May 18	0.28 "				
8	Vel-5026	Nov. 21	1.12 "	5	72	10	77
20	"	"	1.12 " +			37	49
	Paraquat	May 18	0.28 "				
9	Vel-5026	Nov. 21	1.68 "	10	53	17	60
14	Paraquat**	May 18	0.56 kg/ha			51	35
15	"	Apr. 25	0.28 " +			56	35
	"	May 18	0.28 "				
16	"	Nov. 22	0.28 " +			73	24
		Apr. 25	0.28 " +				
		May 18	0.28 "				
10	None			1	73	2	63

April 29 vs May 13 Split plot analysis:

Treatment #'s 1 - 10	LSD 5% within a column	15	19	15	19
	LSD 5% between columns	16	21	16	21

May 13 RCB analysis

Treatment #'s 1 - 20	LSD 5% within column	21	22

*Glyphosate expressed on isopropylamine salt basis
**Paraquat expressed on cation basis
Pronamide and Vel-5026 on a.i. basis

BROADLEAF WEED CONTROL PRECEEDING A NO TILLAGE CLOVER SEEDING

J. R. Mitchell, G. W. Mueller-Warrant and D. W. Koch 1/

ABSTRACT

A pasture sod containing a mixture of broadleaf weeds and grass species was selected as a site to establish a sod seeding of red clover utilizing broadleaf weed control treatments. The site in Lee, New Hampshire was on a shallow and sometimes droughty soil classified as a Hollis sandy loam. The site was treated with two tons of lime per hectare in the fall of 1976. Dominant broadleaved species present were dandelion (Taraxacum officinale Weber), broadleaf plantain (Plantago major L.) and grass leaved stitchwort (Stellaria graminea L.). Unlike the broadleaved weeds, the grass species, including quackgrass (Agropyron repens L. Beauv.) and orchardgrass (Dactylis glomerata L.) were not uniformly present throughout the trial area.

The area was clipped on May 13, 1977 to remove the early grass growth. Herbicide treatments were applied on May 23, June 1 and June 8. These treatments were applied to the plots 2, 3 and 4 weeks prior to a June 22 sod seeding. The herbicides used were dicamba, 2,4-D and a formulation providing a 3 to 1 ratio of 2,4-D and dicamba. Dicamba was applied at .56, 1.12 and 2.24 kg/ha. 2,4-D was used as a standard and was applied at 1.12 kg/ha. The combination was applied at 1.12, 2.24 and 4.48 kg/ha. Herbicides were applied with a hand held small plot sprayer supplying 185 liters per hectare at 1.40 kg/cm^2. A broadcast application of Paraquat (.56 kg/ha) was applied on June 21 to the area using a field sprayer.

A broadcast application of 0-20-20 was applied at 897 kg/ha just prior to seeding. A sod seeding of 'Pennscott' red clover (Trifolium pratense L.) was made on June 22 using a John Deere Powrtill seeder. The experiment design was split plot replicated three times on plots of 1.83 m by 3.35 m.

Treatments applied three and four weeks prior to seeding showed good control of the dominant broadleaf weeds at the time of seeding. Light rates of all material applied two weeks prior to seeding failed to show a definite suppression of broadleaf weeds. However, there was a uniform suppression of the dominant broadleaf weeds four weeks following the seeding. No phytotoxic effects from rates or dates of herbicide applications were observed during the seedling year.

A September harvest indicated that the weed free yields of red clover were related more closely to the degree of competition from the grass species than the control of broadleaf weeds. A second harvest made on June 30, 1978 shows excellent yields of red clover from all treatments. Many plots yielded 95-100 percent pure stands of red clover. However, the plots that were heavily infested with quackgrass and/or orchardgrass produced a very light yield of red clover and in some instances less than a ten percent stand of red clover.

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CONTROL OF BROADLEAF PERENNIALS IN A NO-TILLAGE TREFOIL SEEDING

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

ABSTRACT

Applications of 2,4-D and dicamba alone and in combination were applied in October and May on an old pasture sod.

The predominate weed, dandelion, was controlled best by the combination with the poorest control from dicamba. Adequate control was obtained from either time of application but the May treatment was best. A no-tillage seeding of birdsfoot trefoil was made in June after application of paraquat. There was a much closer correlation between the trefoil establishment and the perennial grasses stand in the plots than with the broadleaf weed control.

INTRODUCTION

Paraquat (1,1'-dimethyl-4,4' bipyridylium dichloride) is frequently used for sod suppression (Akhavein & Linscott, 1968). Paraquat acts primarily as a contact desiccant (Brian, 1966). It exhibits differential species selectivity among perennial sods (Van Keuren & Triplett, 1972; Linscott & Vaughn, 1978). Generally paraquat causes only temporary topkill of perennial broadleaves such as dandelion (Taraxacum officinalis L.) (Waddington & Bowren, 1976). Ground cover of dandelion has been observed to increase following the application of paraquat to pasture (Triplett, Van Keuren, & Watson, 1975). Hoffman and McClellan (1975) suggested that legumes could be established by no-tillage if broadleaf perennials were controlled prior to seeding. Linscott and Hagin (1976) reported that 2,4-D (2,4 dichlorophenoxy acetic acid) at 1.1 kg/ha applied to sod one week prior to seeding improved the establishment of birdsfoot trefoil (Lotus corniculatus L.).

MATERIALS AND METHODS

The site was a northwest slope of approximately twenty percent at the Storrs Agricultural Experiment Station. The soil was a Paxton fine sandy loam, coarse-loamy, mixed, mesic, Typic Fragiochrept. The field had been intermittantly grazed by dairy cattle for several years. Manuring had been practiced. Prior to the fall application the vegetative ground cover was estimated to be approximately thirty-five percent perennial broadleaf weeds. The remaining portion was predominantly orchardgrass (Dactylis glomerata L.) and Kentucky bluegrass (Poa pratense L.).

The pH was 5.9 in 1:1 soil/distilled water. Exchangeable cations were: 3250 kg Ca/ha, 250 kg Mg/ha, and 400 kg K/ha as measured in 1.0 N NH_4OAc buffered to pH 4.8 (Griffin & Lorton, 1970). Extractable soil phosphorus was 390 kg P/ha as measured by Bray number one extractant (Bray & Kurtz, 1945). No lime or fertilizer was applied.

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The non-seeded species were assessed as ground cover following the definition of Greig-Smith (1957). Legume establishment was assessed as linear band cover, that portion of the no-tillage seeded silts within a given unit area occupied by the introduced legume.

Dicamba (3,6-dichloro-o-anisic acid) and 2,4-D each alone at two rates and in combination were applied to separate plots in the fall and in the spring (Table 1). The amine salt of both herbicides were used. The experimental layout was a completely randomized block design with eleven treatments in all each replicated four times.

On 19 June all plots were harvested and the total dry matter yields determined. A second random sample was taken at the same time and hand separated into two categories: grasses and broadleaf perennials. On 23 June paraquat was applied broadcast to all plots at 1.1 kg/ha. On 26 June Viking birdsfoot trefoil was seeded at 10 kg/ha with a Midland Zip Seeder. On 27 July cover estimates of the sward were made by species. No cover estimates were recorded for the small trefoil seedlings. On 2 August all plots were opened to intermittant grazing. Approximately forty dairy cattle periodically grazed in the five hectare field containing the plots for two days at a time for the remainder of the grazing season. On 5 September cover estimates of the sward were again made by species. Birdsfoot trefoil establishment was assessed as linear band cover.

Both ground cover and linear band cover were taken as percents. These data were therefore converted to arcsins prior to statistical analysis. Botanical separation data were log transformed to eliminate heterogeneity of variances.

RESULTS AND DISCUSSION

Significant differences (P 0.01) in the biomass of the broadleaf weeds were found (Table 1). Orthogonal comparisons indicated that herbicide treatments reduced the biomass of broadleaf perennials (P 0.01), that spring applications were more effective than fall applications (P 0.01), that dicamba was associated with more initial reduction in broadleaf biomass than was 2,4-D (P 0.05), and that the combination of the two herbicides was associated with a greater reduction in broadleaf biomass than either of the herbicides alone (P 0.01).

Significant differences were observed in the biomass of broadleaf perennials among the plots treated with herbicides applied in the fall. No significant differences were observed among spring applied herbicides at the time of the June harvest. However, only thirty days had elapsed between the May spraying and the June harvest which may have been a factor in the difference in response. Mean biomass of broadleaf perennials from the fall sprayed dicamba plots at both rates was 16 gm/kg versus a mean of 60 gm/kg for both rates of the fall applied 2,4-D. Biomass of the broadleaf perennials in the plots sprayed in October with 2,4-D at 0.8 kg/ha was not significantly different from that of the control plots.

Table 1. Dry matter yields of broadleaf weeds obtained from botanical separations on 19 June 1978.

Herbicide	Rate	Date of Application 17 Oct 77	Date of Application 19 May 78	Mean
	kg/ha ae or ai	gms/kg[1]	gms/kg[1]	
control[2]	0	167[2] a[3]	167[2] a	167[2]
2,4-D	0.8	101 ab	12 de	56[4]
2,4-D	1.6	20 bcd	6 de	13[4]
dicamba	0.3	22 bc	7 de	14[4]
dicamba	0.6	11 cde	4 de	8[4]
2,4-D plus dicamba	0.8 plus 0.3	2 e	8 de	5[4]
	mean	31[4]	7[4]	

[1] gms/kg of total harvested biomass

[2] The single control treatment received only paraquat at 1.1 kg/ha on 23 June.

[3] Any treatment means followed by the same letter do not differ at the 5% level as determined by Duncan's multiple range test.

[4] Mean of treatments with applied herbicide, control not included.

Approximately 85% of the perennial broadleaf biomass was dandelion. Other species in order of prevalence were stichwort (*Stellaria sp.*), white clover, (*Trifolium repens* L.), plantains (*Plantago sp.*), and white cockle (*Lynchis alba* Mill.). Dandelion, stichwort, and white clover were found in 78,36, and 30 percent of the total plots, respectively. While stichwort was found in two-thirds of fall sprayed and control plots it was wholly lacking from all spring sprayed plots.

No significant differences were found in yields of total harvested biomass. The accumulated spring growth of the grasses comprised the bulk of the harvest. Broadleaf perennials comprised less than two percent of the measured biomass.

Significant effects of the herbicide treatments on dandelion cover were observed on 27 July (Table 2). In contrast to the harvest of 19 June dandelion cover in plots which had received spring applications of dicamba at either rate was not significantly different from that of the control plots. Cover

of dandelion in plots which had received May applied 2,4-D at either rate or October applied 2,4-D at 1.6 kg/ha or October applied dicamba at 0.6 kg/ha was not significantly different from those which had received the combination in either fall or spring. Dandelion cover did not differ between plots sprayed with the lower rates of 2,4-D or dicamba in the fall. Likewise, there was no significant difference between dandelion cover in the plots sprayed with 2,4-D or dicamba at their respective higher rates in the fall.

On 5 September (Table 2) significant reductions of dandelion cover resulted from applications of the combination of 2,4-D plus dicamba applied either fall or spring and for both rates of spring applied 2,4-D and the higher rate of fall applied 2,4-D. Dicamba alone or the application of 2,4-D at 0.8 kg/ha in the fall had not significantly reduced the cover of dandelion. Seedling dandelions had entered the sward and tended to obscure treatment effects. However, the mean of the dandelion cover in the plots which received both 2,4-D plus dicamba in either fall or spring was approximately one third that of the control plots (10% versus 32%).

On 5 September estimations of birdsfoot trefoil establishment were made. No significant differences in trefoil establishment were directly related to the herbicide treatments (Table 3).

Weed competition in this sward could be assigned to three general classes: perennial grasses-chiefly orchardgrass and quackgrass, (Agropyron repens L.) annual grasses-chiefly crabgrasses, (Digitaria sp.), and perennial broadleaves-chiefly dandelion (Table 4). Orchardgrass recovered rapidly from the topkill of paraquat and was very competitive with the trefoil. Quackgrass was not initially a large component of this sward. It became increasingly prevalent in some plots following the application of paraquat and the relative demise of Kentucky bluegrass. Crabgrass entered the sward chiefly where perennials were reduced. It proliferated most rapidly in August. Dandelion did not appear to compete for open space in the sward to the extent exhibited by the annual and perennial grasses.

Plots with the most cover of perennial grasses had the least cover of trefoil. Table 5 presents adjusted treatment means for the linear band cover of trefoil when ground cover of the perennial grasses on the same date is considered as a covariant. Analysis of covariance indicated that significant differences (P 0.01) are found between adjusted treatment means. The combination of 2,4-D plus dicamba in May most favored the establishment of trefoil.

Herbicide treatments produced significant differences in the biomass and the cover of the perennial broadleaf weeds; but significant differences in trefoil establishment were not evident. Observations on the character of plant competition on this site indicated that the predominant competitive factor in trefoil establishment was the response to the perennial grasses. Considering the perennial grasses in an analysis of covariance indicated that herbicide treatment applied to control perennial broadleaf weeds had significantly increased trefoil establishment.

Table 2. Ground cover of dandelion on two dates following seeding.

Herbicide	Rate	Date of Application 17 Oct 77	Date of Application 19 May 78	Mean
	kg/ha ae or ai	Observations on 27 July %		
control[1]	0	26[1] a[2]	26[1] a	26[1]
2,4-D	0.8	12 bc	6 cd	9[3]
2,4-D	1.6	7 cd	2 d	4[3]
dicamba	0.3	15 bc	24 a	20[3]
dicamba	0.6	4 d	22 a	13[3]
2,4-D plus dicamba	0.8 plus 0.3	2 d	4 d	3[3]
	mean	8[3]	14[3]	8[3]
	kg/ha ae or ai	Observations on 5 September %		
control[1]	0	32 a	32 a	32
2,4-D	0.8	19 abc	11 bc	15[3]
2,4-D	1.6	15 bc	13 bc	14[3]
dicamba	0.3	24 ab	18 abc	21[3]
dicamba	0.6	20 abc	22 ab	21[3]
2,4-D plus dicamba	0.8 plus 0.3	10 c	11 bc	10[3]
	mean	18[3]	15[3]	

[1] The single control treatment received only paraquat at 1.1 kg/ha on 23 June.

[2] Any treatment means followed by the same letter do not differ at the 5% level as determined by Duncan's multiple range test.

[3] Mean of treatments with applied herbicide, control not included.

Table 3. Linear band cover of birdsfoot trefoil on 5 September 1978.

Herbicide	Rate	Date of Application 17 Oct 77	Date of Application 19 May 78
	kg/ha ae or ai	%	
control	0	20	20
2,4-D	0.8	30	47
2,4-D	1.6	54	50
dicamba	0.3	46	32
dicamba	0.6	50	42
2,4-D + dicamba	0.8 + 0.3	57	46

The above treatment means do not differ at the 5% level as determined by an F test of the arcsin converted data.

Table 4. Changes in species composition following the 23 June application of paraquat at 1.1 kg/ha and the 26 June no-tillage seeding of trefoil.

Species	Dates			
	27 July 78		5 September 78	
	Control[1]	All other plots[2]	Control[1]	All other plots[2]
	%			
Orchardgrass + Quackgrass	19	18	28	29
Dandelion	26	10	32	16
Crabgrasses	>1	2	7	22
Dandelion + Crabgrasses	26	12	39	38

[1] mean of 4 plots

[2] mean of 40 plots

Table 5. Estimated linear band cover of birdsfoot trefoil on 5 September adjusted for covariance due to ground cover of perennial grasses.

Herbicide	Rate	Date of Application		Mean
		17 Oct 77	19 May 78	
	kg/ha ae or ai	%		
control[1]	0	25[1] a[2]	25[1] a	25[1]
2,4-D	0.8	29 ab	49 e	39[3]
2,4-D	1.6	52 e	52 e	52[3]
dicamba	0.3	40 c	33 bc	36[3]
dicamba	0.6	37 c	45 d	41[3]
2,4-D plus dicamba	0.8 plus 0.3	47 de	62 J	54[3]
	mean	41[3]	48[3]	

[1] The single control treatment received only paraquat at 1.1 kg/ha on 23 June.

[2] Any treatment means followed by the same letter do not differ at the 5% level as determined by Duncan's multiple range test.

[3] Mean of treatments with applied herbicide, control not included.

The combination of 2,4-D plus dicamba was superior to 2,4-D alone which was superior to dicamba alone for the reduction of the cover of dandelion and the subsequent establishment of birdsfoot trefoil. May applications were generally superior to applications the preceding October.

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INFLUENCE OF TEMPERATURE AND DAYLENGTH ON QUACKGRASS (*Agropyron repens* (L.) Beauv.) DEVELOPMENT

B. A. Majek and W. B. Duke [1/]

ABSTRACT

Experiments were conducted in growth chambers to determine the effects of temperature and daylength on quackgrass growth. Shoot and rhizome growth were affected by temperature and daylength. Shoots grew most vigorously at 70°F and elongated to differentiate an inflorescence when exposed to a daylength longer than 14 hours. Rhizome apical tips remained below ground when grown at 70°F and the plants received 12 or 16 hours of daylight, but curved up and emerged from the soil when quackgrass was grown at 90°F or 50°F, or when the plants received 8 or 14 hours of daylight.

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SEASONAL FIELD DEVELOPMENT OF QUACKGRASS (*Agropyron repens* (L.) Beauv.)

B. A. Majek and W. B. Duke [1/]

ABSTRACT

A field experiment was established to follow the growth of quackgrass through the growing season and to relate the growth of quackgrass in the field to the effects of temperature and daylength on quackgrass growth observed in growth chambers.

Quackgrass shoots grew most vigorously when temperatures were moderate and elongated and differentiated an inflorescence when the plants received more than 14 hours of daylight. Rhizome apical tips remained below ground when temperature was moderate and the plants received 16 hours of daylight in late spring or 12 hours of daylight in early fall. Quackgrass rhizome tips grew vertically and emerged from the soil in mid-summer when the temperature was hot and the daylength decreased to 14 hours, and in late fall when the temperature became cold and the daylength decreased below 12 hours.

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INFLUENCE OF THE TIME OF APPLICATION AND PLOWING OF QUACKGRASS (*Agropyron repens* (L.) Beauv.) CONTROL WITH GLYPHOSATE AND HOE 29152

B. A. Majek and W. B. Duke 1/

ABSTRACT

Quackgrass was treated with glyphosate at 1.0 lb./A and HOE 29152 at 3.0 lb./A. Treatments were applied at the 3 and 6 leaf stage in the spring and after quackgrass had been plowed on May 2, June 20, and August 14, 1978.

Control of quackgrass shoots, old mother rhizomes, and new primary rhizomes with glyphosate was dependent on quackgrass leaf stage and the date application was made. HOE 29152 activity was not affected by quackgrass leaf stage or date of application, but HOE 29152 did not control old quackgrass mother rhizomes in the soil.

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ECONOMIC LOSSES DUE TO WEEDS IN SOYBEANS IN THE NORTHEASTERN UNITED STATES IN 1977

J. V. Parochetti[1]

ABSTRACT

Economic losses in soybeans (Glycine max L.) due to weeds were estimated for the following five Northeastern states reporting soybean acreage in the U.S. Department of Agriculture Crop Reporting Service: Delaware, Maryland, New Jersey, New York and Pennsylvania. Estimates were based on the 1977 crop year. The value of this crop was slightly more than $120,000,000, based on an average price of $6.00 per bushel. Total costs of herbicides used was $7,301,500 which were used on about 90% of the acreage. In spite of this expenditure for herbicides, weeds still were estimated to cause an income reduction of $7,186,420. This estimated reduction was attributed to direct yield losses due to weed competition, expenses in extra land preparation and/or cultivation, dockage for reduced seed quality when marketing soybeans, and increased harvest costs due to weeds.

INTRODUCTION

This report was developed in response to the Weed Science Society of America's Weed Loss Committee. It was undertaken to document weed losses in soybean production in the five Northeastern states that have commercial soybean production.

PROCEDURE

Estimates of herbicides and losses due to weeds were conducted by contacting research or extension specialists at the land grant universities of the five Northeastern states that have reported soybean acreage in the U.S. Department of Agriculture Crop Reporting Service. Estimates of yield losses found in Table 1 are the best judgements of these scientists for their respective states. For economic calculations, a value of $6 per bushel was used as the price of soybeans. Estimates were made for the year of 1977.

RESULTS AND DISCUSSION

The acreage and average soybean yields for the five states surveyed were taken from the U.S. Department of Agriculture Crop Reporting Service. The total value of the soybeans was slightly more than $120,000,000. The total costs of herbicides used was $7,310,500 (obtained from adding item A in Table 1 for all states). The loss due to weeds was $7,186,420 (obtained from adding items B, C, D, and E in Table 1.)

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Loss in Yield: Yield losses for each state were calculated by estimating the percent of the soybean acreage that had some reduction due to weed competition and the corresponding effect of yield loss on those acreage. These estimates varied from 22% of the acreage in New Jersey with about a 17% loss on these acreage to a high of 70% of that acreage for New York with about a 15% loss on that acreage.

Loss in Extra Land Preparation and/or Cultivation: These estimates were based on the percent of land requiring special tillage treatment in addition to normal land preparation. Such weed problems as johnsongrass and yellow nutsedge required extra tillage and cultivation during the growing season and were one of the factors used in estimating this loss.

Loss in Quality: The major factor considered when estimating these losses were the amount of weed seeds that would result in dockage when marketing soybeans.

Loss in Increased Cost of Harvesting: It was estimated that those acres infested with weeds resulted in an average increase of about 25% more time to harvest soybeans.

Weed Population Appraisal for the Northeastern States Producing Soybeans: Table 2 lists the ten most common weeds and the percentage of crop infested assuming that herbicides were used as a standard practice. It is interesting to note that most weeds are common for all five states. In addition, only two to four weeds are considered to be increasing in the Northeastern United States in soybean production.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the help of the following scientists: Dr. William Mitchell, University of Delaware; Dr. Richard Ilnicki, Dr. John Meade, and Dr. James Justin, Rutgers State University, New Jersey; Dr. Russell Hahn, Cornell University, Ithaca, New York; and Dr. Nathan Hartwig, The Pennsylvania State University.

Table 1. Estimated economic losses in soybean production for 1977 in the Northeastern United States.

	DE	MD	NJ	NY	PA
Acreage	225,000	325,000	177,000	19,000	67,000
A. Cost of Herbicides:					
1. Percentage of acreage treated	90%	90%	90%	95%	85%
2. Cost per acre	$9.50	$10.00	$10.00	$14.50	$10.50
3. Total cost	$1,923,750	$2,925,000	$1,593,000	$261,725	$597,975
B. Loss in Yield:					
1. Percentage of acreage involved	60%	40%	22%	70%	50%
2. Bu/A lost	1.6 Bu/A	2.7 Bu/A	4 Bu/A	3.5 Bu/A	3.1 Bu/A
3. Total cost	$1,896,000	$2,106,000	$934,560	$279,300	$62,310
C. Loss in Extra Land Preparation and/or Cultivation					
1. Percentage of acreage involved	30%	12%	22%		10%
2. Cost per acre	$2.50/A	$3.50/A	$6.00/A	minor	$1.90/A
3. Total cost	$168,750	$136,500	$231,840		$12,730
D. Loss in Quality:					
1. Percentage of acreage involved	50%	20%	4%		50%
2. Cost per acre	$1.44/A	$1.62/A	$27.00/A	minor	$1.70/A
3. Total cost	$162,000	$105,300	$191,160		$56,950
E. Loss in Increased Cost of Harvesting					
1. Percentage of acreage involved	60%	20%	22%	70%	50%
2. Cost per acre	$3.00/A	$3.00/A	$3.00/A	$2.00/A	$3.00/A
3. Total cost	$405,000	$195,000	$115,920	$26,600	$100,500
F. Grand Total of B+C+D+E:	$2,631,750	$2,542,800	$1,473,480	$305,900	$232,490

Table 2. Weed population appraisal for 1977 for the Northeastern United States involved in commercial soybean production.

	Delaware	Maryland	New Jersey	New York	Pennsylvania
A. Most common weeds and % of crop infested (assuming herbicides used as standard practice):	1. Morningglory[a] 15% 2. Common lambsquarters 15% 3. Redroot pigweed 15% 4. Giant foxtail 15% 5. Common ragweed 15% 6. Fall panicum 10% 7. Velvetleaf 5% 8. Jimsonweed 5% 9. Cocklebur 3% 10. Yellow nutsedge 3%	1. Giant/Giant Green Foxtail 15% 2. Common lambsquarters 15% 3. Common ragweed 15% 4. Redroot pigweed 10% 5. Jimsonweed 10% 6. Fall panicum 10% 7. Morningglory[a] 10% 8. Johnsongrass 5% 9. Velvetleaf 5% 10. Horseweed 5%	1. Yellow nutsedge 15% 2. Morningglory, ivy 15% 3. Giant foxtail 10% 4. Fall Panicum 10% 5. Velvetleaf 8% 6. Barnyardgrass 7% 7. Common ragweed 7% 8. Jimsonweed 5% 9. Common lambsquarters 5% 10. Redroot pigweed 5%	1. Common ragweed 40% 2. Quackgrass 35% 3. Common lambsquarters 20% 4. Yellow foxtail 20% 5. Giant foxtail 15% 6. Barnyardgrass 15% 7. Fall panicum 15% 8. Redroot pigweed 10% 9. Yellow nutsedge 10% 10. Velvetleaf 10%	1. Yellow nutsedge 10% 2. Giant foxtail 10% 3. Barnyardgrass 8% 4. Johnsongrass 5% 5. Volunteer corn 5% 6. Fall panicum 5% 7. Common ragweed 5% 8. Velvetleaf 5% 9. Morningglory[a] 4% 10. Redroot pigweed 3%
B. Weeds increasing in importance and % of crop infested:	1. Cocklebur 3% 2. Jimsonweed 5% 3. Fall panicum 10% 4. Volunteer corn 1%	1. Jimsonweed 10% 2. Redroot pigweed 10% 3. Fall panicum 10%	1. Volunteer corn 30% 2. Johnsongrass 4% 3. Cocklebur 3%	1. Velvetleaf 10% 2. Yellow nutsedge 10%	1. Yellow nutsedge 10% 2. Johnsongrass 5% 3. Volunteer corn 5% 4. Wire stem muhly 3%

[a] Tall and ivy

ECONOMIC LOSSES IN POTATOES DUE TO WEEDS

Hugh J. Murphy[1]

ABSTRACT

A recent survey conducted by our WSSA Weed Losses Representative for the Northeast Region, G. W. Selleck, indicates the total economic losses due to weeds in potatoes was $6,590,700 or about $31.25 for each of our 211,000 acres. Of this $31.25 per acre, about $14.00 was for cost of the herbicides and the remainder due to yield and quality losses and the increased harvesting costs because of weedy fields.

INTRODUCTION

This report is intended as a partial report on the assessment of economic losses in various crops produced in the United States. This particular report is concerned with potatoes grown in the Northeast and was summarized in table form by Joseph B. Sieczka using data contributed by Richard Ashley, Richard Illnicki, Richard Cole, and Henry Wilson. Presumably, these data will become part of a detailed report by G. W. Selleck for WSSA.

MATERIALS AND METHODS

There was a reporting format suggested by WSSA which was modified by each of Selleck's area chairmen to fit the characteristics of the specific crops. Each person reporting was asked to report some statistical data pertaining to the potato crop in his area and also to make some educated guesses about specific losses due to weeds. How each person approached his assignment is beyond my knowledge, but we do have some figures for your perusal.

RESULTS AND DISCUSSION

Data presented in Table 1 for each state indicate that in total almost 3 million dollars were spent annually for weed control in potatoes, or an average per acre cost of about $14.00. Total yield losses of about 1.5 million dollars plus quality losses of about 875 thousand and increased harvesting costs of 570 thousand totaled to the fantastic amount of nearly 3 million dollars. In total, over 6.6 million dollars in the Northeast must be considered as the economic losses in potatoes due to weeds.

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Another aspect of this survey was what each reporting area considered as their major weed problems in potatoes. Each reporter was asked to arrange his area weed problems in descending order of importance and these lists are presented in Table 2. It would certainly appear that annual barnyard grass, quackgrass, and nutsedge are among the species that cause considerable economic losses in the Northeast.

Table 1. Economic losses due to weeds in potatoes - Northeast U.S.A.

	Maine	Upstate New York	Long Island New York	Pennsylvania	New Jersey	TOTAL
Acres	124,000	26,000	23,500	29,000	8,000	211,000
Cost of Herbicide	$1,798,000	$265,000	$482,500	$300,000	$112,000	$2,957,500
Cost of Herbicide/A.	$14.50	$10.19	$20.53	$10.34	$14.00	$14.02
Yield Loss	$299,200	$260,000	$470,000	$400,000	$156,000	$1,585,200
Quality Loss	$184,800	$130,000	$235,000	$200,000	$124,800	$874,600
Water and Nutrient Loss	NA	NA	$117,500	NA	NA	$117,500
Loss in Extra Land Preparation Cultivation	$15,500	$20,000	$47,500	NA	$96,000	$92,600
Increased Cost of Harvest	$420,000	$40,000	$8,000	$100,000	$4,000	$572,000
Sub-total	$2,717,500	$715,000	$1,360,500	$1,000,000	$046,400	$6,199,400
Economic loss/Acre	$21.92	$27.50	$57.89	$34.48	$50.80	$31.25
Crop Injury due to Herbicides	$366,500	$4,000	NA	NA	$20,800	$391,300
TOTAL						$6,590,700

Table 2

WEED PROBLEMS IN POTATOES

NORTHEAST U.S.A.[1]

Maine	Upstate, New York	Long Island, New York
Barnyard grass	Quackgrass	Barnyard grass
Lambsquarters	Yellow nutsedge	Yellow nutsedge
Wild Mustard	Pigweed	Crabgrass
Ladysthumb	Lambsquarters	Fall panicum
Quackgrass	Barnyard grass	Ladysthumb
Redroot pigweed	Ragweed	
Canada Thistle	Foxtail sp.	
Wild Radish	Ladysthumb	
Nutsedge	Wild Mustard	
Crabgrass*		
Wild Buckwheat*		

Pennsylvania	New Jersey
Quackgrass	Barnyard grass
Yellow nutsedge	Lambsquarters
Pigweed	Nutsedge
Ragweed	Ragweed
Lambsquarters	Smartweed
Barnyard grass	Crabgrass
Fall panicum	
Witchgrass	
Green Foxtail	
Giant Foxtail	

*New Infestations

[1]Arranged in descending order of importance.

ECONOMIC LOSSES DUE TO WEEDS - LEGUMES

Dean L. Linscott [1/]

ABSTRACT

Estimates on losses were received from representatives of the 12 Northeastern states. The loss categories follow: cost of herbicides, loss in yield, loss in quality, loss in extra land preparation and cultivation, loss in land value, loss in increased cost of harvesting, crop injury. Data on the losses will be presented at the conference and published in the supplement after a recheck by the contributors with data from other states available to them.

In the population survey, problem weeds most frequently mentioned in a listing of the top ten were: dandelion, quackgrass, yellow rocket, chickweed, annual grasses (foxtail, fall panicum, annual bromes, barnyard grass) curley dock, white cockle, lambs quarters, wild mustard, pigweed.

Weeds appearing with increasing frequency included yellow nutsedge, the annual grasses, fall panicum and crabgrass, milk weed and fleabane.

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A COMPARISON OF TWELVE ADJUVANTS USED WITH DIQUAT FOR POTATO VINE DESICCATION IN MAINE

H. J. Murphy and L. S. Morrow[1]

ABSTRACT

Several adjuvants in combination with diquat as the desiccant herbicide were evaluated for potato vine killing at Presque Isle, Maine during the Fall of 1978. None of the adjuvants increased the efficacy of diquat more than the recommended X-77. In general, none of the treatments did a satisfactory job of killing potato vines in Maine during 1978.

INTRODUCTION

Desiccation of potato vines *(Solanum tuberosum* L. 'Katahdin'*)* in Maine is a difficult task in most years and for a number of reasons including cool weather, extremely heavy vine growth, and reluctance on the part of growers to take much longer than 14 days to kill the vines. Efficacy of the vine desiccants available or labeled is probably another factor over which we should have some control. The addition of adjuvants to the herbicide desiccant mixture presumably should increase the activity of the desiccant and thus improve the vine kill efficacy and shorten the time span to kill the vines.

The purpose of the study reported in this paper was (1) to evaluate several adjuvants being advocated for potato vine killing, and (2) to gain some insight into a better procedure for evaluating adjuvant activity.

MATERIALS AND METHODS

All treatments were applied to actively growing potato vines and on the dates indicated at the bottom of Table 1. Diquat (6,7-dihydrodipyrido[1,2-α:2',1'-*c*]pyrazinediium ion) was used as the desiccant for convenience with dinoseb [2-*sec*-butyl-4,6-dinitrophenol] plus oil as the standard treatment. All treatments were applied in 303 liters of water using 40 psi pressure. A compressed air sprayer equipped with a two-nozzle brush type boom was used to apply the desiccant treatments. Nozzles were Delavan raindrop type equipped with No. 3374-3 tips. Plot size was a single row, 6.1 meters long arranged in a randomized block design with single buffer rows between treatments. Vine kill ratings were made at 4, 7, 14, and 21-day intervals following treatments. Vine regrowth ratings were also made

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at 14 and 21-day intervals after treatments using a 1 to 10 scale, as described at the bottom of Table 1. Since vine desiccation is also another opportunity to clean up weeds that escaped earlier herbicide applications, weed control ratings were also made 14 days after desiccant treatments were applied.

RESULTS AND DISCUSSION

Data presented in Table 1 suggest that none of the diquat-adjuvant treatments provided 100% desiccation of leaves and stems in this study during 1978. Diquat at 2.34 liters per hectare plus 0.58 liters of X-77 and a split application of 1.17 l/ha plus 0.58 l/ha of X-77 applied 5 days apart provided the best desiccation at the end of the 21-day time period. The omission of the recommended X-77 from diquat did not reduce the regrowth in this study, as had been previously suggested by earlier studies. The addition of surfynol (Blend 66c) and Herb-I-Max showed a little increased activity for diquat but, in general, none of the treatments did a satisfactory desiccation job. Note that all treatments, however, cleaned up or burned back all weeds present at the time the ratings were made. No great conclusions should be drawn from this study other than the fact that we need better vine desiccants than are now labeled for use in potatoes. Secondly, none of the adjuvants in this study did very much to increase the activity of diquat.

Table 1. A comparison of several surfactants with diquat on vine desiccation of Katahdin potato vines. Maine - 1978.

Treatments[1]		Vine Kill Ratings[2]								Regrowth [3]		Weed Control[4]		
Desiccant L/Ha	Adjuvant L/Ha	4 days		7 days		14 days		21 days		14 days	21 days	Barn-grass	Mus-tards	Quack-grass
		leaves	stems	leaves	stems	leaves	stems	leaves	stems					
Check - no treatment		0	0	0	0	0	0	0	0	0	0	0	0	0
1.17	Diquat +													
0.58	X-77	2.2	0.0	2.4	0.4	3.0	1.6	3.8	1.4	10.0	10.0	10.0	10.0	10.0
1.17	Diquat													
	(no adjuvant)	1.8	0.2	2.8	0.2	3.2	1.4	4.2	1.8	9.6	10.0	10.0	10.0	10.0
2.34	Diquat +													
0.58	X-77	6.4	2.0	6.6	1.8	7.2	5.2	8.0	7.0	8.4	9.6	10.0	10.0	10.0
2.34	Diquat													
	(no adjuvant)	5.8	1.2	6.2	1.2	7.0	4.2	7.6	5.6	7.6	8.8	10.0	10.0	10.0
1.17	Diquat +													
0.58	X-77													
	(5 days later)	2.4	0.2	4.6	0.6	7.2	4.0	8.0	7.0	7.6	8.0	9.8	10.0	10.0
1.17	Diquat													
	(no adjuvant)													
	(5 days later)	2.2	0.2	2.8	0.4	4.6	1.2	6.0	3.6	9.2	9.8	10.0	10.0	10.0
1.17	Diquat +													
1.17	Charger E	3.4	0.2	3.4	0.2	4.8	1.8	4.6	2.2	9.6	9.8	10.0	10.0	8.2
1.17	Diquat +													
2.34	Wex	3.2	0.4	3.8	0.4	4.0	1.6	4.8	2.6	9.4	10.0	10.0	10.0	10.0
1.17	Diquat +													
3.51	Surfynol 465	2.4	0.8	2.8	0.2	3.6	2.0	5.0	2.6	9.8	10.0	10.0	10.0	10.0
1.17	Diquat +													
3.51	Surfynol													
	(Blend 66C)	4.0	0.4	5.4	0.8	5.4	2.4	5.4	3.6	9.2	10.0	10.0	10.0	10.0
1.17	Diquat +													
3.51	Surfynol													
	104ES-75	2.6	0.6	3.2	0.4	3.4	1.6	4.2	2.4	10.0	10.0	10.0	10.0	9.8
1.17	Diquat +													
4.68	SRC-101	3.2	0.4	4.2	0.4	4.2	2.2	5.0	3.0	10.0	10.0	10.0	10.0	10.0

Table 1 - continued

Treatments[1]		Vine Kill Ratings[2]								Regrowth[3]		Weed Control[4]		
Desiccant L./Ha	Adjuvant L./Ha	4 days		7 days		14 days		21 days		14 days	21 days	Barn-grass	Mus-tards	Quack-grass
		leaves	stems	leaves	stems	leaves	stems	leaves	stems					
1.17 Diquat + 4.68 Herb-I-Max		4.0	0.8	3.6	0.6	5.2	3.2	5.6	3.4	10.0	10.0	10.0	10.0	10.0
1.17 Diquat + 1.17 Lux		1.6	0.4	1.8	0.0	2.0	0.8	3.0	1.4	10.0	10.0	10.0	10.0	10.0
1.17 Diquat + 1.17 Basic-H		2.0	0.2	2.4	0.0	2.8	0.8	4.0	1.6	10.0	10.0	10.0	10.0	10.0
1.17 Diquat + 1.17 Armak TD2080		2.0	0.4	2.6	0.0	2.6	1.8	3.6	2.4	9.8	10.0	10.0	10.0	10.0
1.17 Diquat + 1.17 Amway		1.6	0.4	2.4	0.2	3.2	1.2	4.0	1.4	10.0	10.0	10.0	10.0	10.0
2.34 Dinoseb + 28.05 #2 oil		2.0	0.2	2.6	0.0	2.6	0.8	2.8	1.4	6.2	10.0	10.0	10.0	10.0
2.34 Dinoseb + 14.02 #2 oil + 2.34 Amway		1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0	6.2	10.0	10.0	10.0	10.0

[1]Planted - May 31; harvested - September 29, 1978.

First treatments applied - August 25. Sunny. 18C. Soil - dry.
Second treatments applied - August 30. Sunny. 22C. Soil - wet.

[2]Vine kill ratings - leaves and stems rated separately.

0 = no kill	3 = 30%	6 = 60%	9 = 90%
1 = 10%	4 = 40%	7 = 70%	10 = 100%
2 = 20%	5 = 50%	8 = 80%	

[3]Regrowth ratings based on visual percent of hills initiating new growth.

[4]Weed control ratings made 14 days after desiccant treatments using: 0 = no control; 10 = all weeds killed.

AN EVALUATION OF ADJUVANTS WITH HERBICIDES AND DESICCANTS

G. W. Selleck[1/]

ABSTRACT

Several adjuvants were tested during 1975-1978 in combination with desiccants and herbicides to determine possible benefits to potato production. The performance of most desiccants was improved by addition of adjuvants. Booster + E, X 77 and UBI-1126 were consistent high performers. Under dry soil conditions, certain added adjuvants improved weed control of some herbicides. Although differences were seldom statistically significant, a tendency for increased tuber yields would suggest that under certain conditions, the addition of adjuvants may improve soil nutrient availability.

INTRODUCTION

Adjuvants are an integral part of herbicide formulations. Most basic manufacturers conduct an extensive testing program of adjuvants for inclusion in the formulation of a specific pesticide. Once a pesticide has been commercialized, most suppliers recommend against inclusion of additional adjuvants at the time of application. An exception to this are desiccants for vine killing in potatoes in which the inclusion of an adjuvant is usually recommended.

In recent years, numerous adjuvants have been advertised to growers, often with recommendations for inclusion in all farm chemicals including fungicides, insecticides, herbicides, desiccants, and particularly where combinations of pesticides or fertilizers are involved. Some of the claims for adjuvants include improved distribution, penetration, and coverage of the pesticide and consequently improved efficacy. The Amway adjuvant for example, is reported to reduce soil tension, making irrigation water and soil nutrients more available, and resulting in increased yields (1).

Herbicides generally do not provide season-long weed control in potatoes on Long Island, and any means of improving performance of herbicides or extending the efficacy period would be of commercial benefit. It was the purpose of these trials to test some of the more common commercially-available adjuvants to determine what benefits may be obtained in combination with herbicides and desiccants on Long Island.

MATERIALS AND METHODS

Several adjuvants including dinoseb (2-sec-butyl-4,6-dinitrophenol), paraquat (1,1'-dimethyl-4,4'-bipyridinium ion), diquat (6,7-dihydrodipyrido (1,2-α: 2',1'-c) pyrazinediium ion) and UBI-252 were combined with various desiccants for vine killing of potatoes in autumn during 1975-1978. Applications were made on quadruplicated plots, 3 rows by 7.6 m with a tractor-

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mounted sprayer delivering 153 l/ha at 26 atm, on Haven loam soil. The adjuvants usually included UBI-1126, X77, Booster + E, Amway, Wex and #2 oil. In 1978, Neptune and HA 420 were also included. All applications were usually made prior to the initiation of potato senescence for maximum challenge to the treatment.

Adjuvants Wex and Amway were added to herbicides metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one), linuron (3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea), alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide), chlorbromuron (3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea), and combinations of alachlor with linuron, or dinoseb applied preemergence in 1977. A similar trial was conducted in 1978 in which adjuvant HA 800D and herbicide EPTC (S-ethyl dipropylthiocarbamate) were included and herbicide combinations omitted. Applications were made with a tractor-mounted sprayer delivering 61 l/ha at 2.5 atm on quadruplicated plots 2 rows wide by 7.6 m long on Haven-loam soil containing 2% o.m. Irrigation which augmented natural precipitation usually amounted to three applications of 2.5 cm per year. In another experiment in 1977, Amway and Wex were applied to potatoes 15 and 30 cm tall, respectively, and immediately prior to first and second irrigations. Experiments were designed to determine whether the addition of adjuvants improved weed control or potato tuber yield. The whole plot area was treated preemergence with linuron at 1.4 kg/ha.

RESULTS AND DISCUSSION

In 1975, Booster + E or #2 fuel oil in combination with 2.2 kg/ha dinoseb provided equivalent Katahdin stem control 14 days after treatment (dat) and better than X77 (2). In 1976 assessed 5 dat, the combination of UBI-1126 and X77 was slightly more effective on Katahdin vines than the other adjuvants (3). With dinoseb, the best results were obtained with Sun oil. With paraquat at two rates, the adjuvant UBI-1126 was slightly better than X77 (3). At 14 dat the vines were completely killed with all the treatments because of the salty rain which occurred with Hurricane "Belle". In 1977, UBI-252 performed better for stem control (80%) at 14 dat with Booster + E, X77 or Wex (Table 1). The conditions in 1977 being cool and moist, dinoseb was less effective, providing 50% stem control combined with Booster + E, followed by X77. Stem control with diquat was 90% or better with the best adjuvants being Booster + E, UBI-1126, Wex and Amway. The performance of endothall (7-oxabicyclo(2.2.1)heptane-2,3-dicarboxylic acid) was not improved with adjuvants. Paraquat responded best with the addition of UBI-1126 followed by Wex (Table 1). In 1978, stem control with dinoseb and diquat responded best to Booster + E followed by HA 420 and Neptune. The performance of UBI-252 was best with X77 or Wex (Table 1). In another experiment in 1978, stem kill with UBI-252 was about equivalent with X77, Dupont wk and combinations of UBI-1126 and UBI-1201 (4).

An attempt was made to provide an overall rating of the adjuvants as expressed in terms of average stem kill in combination with all of the desiccants. In 1976, X77 rated highest with assessments taken 5 dat (Table 2).

In 1977, the highest desiccant ratings 14 dat were obtained with X77 and Booster + E followed closely by UBI-1126. In 1978, Booster + E was the best performer 14 dat, followed by Neptune and Wex.

Weed control

Due to a dry spring, soil conditions were dry at the time of application and emergence of crops and weeds during 1977. The addition of adjuvants Wex and Amway to linuron under these conditions improved the percentage control of barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.) by 25% or more in 1977 (Table 3). There also was a slight response with metribuzin and chlorbromuron, but not with combinations of alachlor and linuron or dinoseb. There appeared to be a slight response in tuber yield with the adjuvants combined with linuron and chlorbromuron, but these differences were not statistically significant. However, yields with all herbicides applied were significantly higher than the untreated checks. Further, adjuvants applied alone yielded significantly higher than the water check (Table 3). Similarly, tuber yields of surfactant treatments at two stages of potato development and at first and second irrigations all yielded slightly higher than comparable water checks, possibly indicating a trend, but the differences were not statistically significant (Table 4).

In a similar experiment in 1978, during moist soil conditions at the time of application and emergence, barnyardgrass was only slightly better controlled with metribuzin plus adjuvants compared with metribuzin alone. There was a suggestion of a response also with linuron combined with adjuvants Wex or Amway, but not with any of the other herbicide treatments. Yields were slightly improved when adjuvants were added to chlorbromuron at 1.7 kg/ha but the differences were not statistically significant. All of the Wex checks yielded higher than water alone, with the incorporated treatments yielding slightly higher than preemergence treatments, one of which was statistically significant (Table 3).

Based on these data during 1977 and 1978, it would appear that where moisture is limited, the addition of surfactants may improve weed control with certain herbicides, linuron, for example. It would appear also, that with dense weed populations and probable moisture stress, the addition of an adjuvant may improve tuber yields over water used alone. Such an effect could be explained by decreased surface tension, improved permeability and increased mobility of the nutrients. Under conditions of moist soil in spring, good weed control and irrigation practices, and therefore minimum stress and optimum growth, the benefits of surfactants would appear to be minimal. Adjuvants may be of possible benefit in improving weed control and tuber yields where soil moisture is traditionally a limiting factor to plant growth.

ACKNOWLEDGEMENTS

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Table 1. The effect of adjuvants with desiccants on potato vines.

				dat 14[1]			
				leaves[3]		stems[3]	
Treatment	lb/A	Adjuvant	l/ha	77	78	77	78
UBI-252	.56	UBI-1126	.38	9.9	9.8	7.8	4.5
UBI-252	.56	X-77	.09	10.0	10.0	8.0	9.2
UBI-252	.56	Wex	.09	10.0	10.0	8.0	9.1
UBI-252	.56	Amway	.09	9.9	9.9	6.9	5.6
UBI-252	.56	Neptune	.09	-	10.0	-	7.7
UBI-252	.56	HA-420	.77	-	9.8	-	4.3
UBI-252	.56	Booster + E	.77	10.0	9.9	8.0	5.9
Diquat	.56	X-77	.09	10.0	10.0	9.0	7.9
Diquat	.56	Wex	.09	10.0	9.9	9.4	8.9
Diquat	.56	Amway	.09	10.0	10.0	9.4	8.8
Diquat	.56	Neptune	.09	-	10.0	-	9.8
Diquat	.56	HA-420	.77	-	10.0	-	9.5
Diquat	.56	UBI-1126	.38	10.0	-	9.5	-
Diquat	.56	Booster + E	.77	10.0	10.0	9.5	9.6
Dinoseb[2]		#2 oil	7.7	8.5	9.6	2.6	6.7
Dinoseb[2]		Booster + E	.77	9.4	10.0	5.0	9.7
Dinoseb[2]		HA-420	.77	-	10.0	-	7.1
Dinoseb[2]		X-77	.09	9.2	10.0	4.3	5.8
Dinoseb[2]		Amway	.09	8.6	8.9	2.5	3.6
Dinoseb[2]		Neptune	.09	-	8.8	-	7.1
Dinoseb[2]		Wex	.09	7.1	9.5	1.6	5.8
Dinoseb[2]		UBI-1126	.38	8.1	-	3.2	-
Paraquat	.25	X-77	.09	9.7	-	5.8	-
Paraquat	.25	Amway	.09	9.5	-	6.0	-
Paraquat	.25	Wex	.09	9.8	-	7.9	-
Paraquat	.25	UBI-1126	.38	9.9	-	8.6	-

[1]dat = days after treatment
[2]Dinoseb rate 1.1 kg/ha in 1977, 2.2 kg/ha in 1978
[3]0 = no effect, 10 = complete kill

Table 2. Potato foliage rating with adjuvants 14 dat[1] in combination with several desiccants during 1976-78.

	Vines[2]	leaves[3]		stems[3]	
Adjuvant	1976	77	78	77	78
X-77	5.9	9.8	10.0	7.5	7.6
Wex	5.2	9.4	9.8	7.0	7.9
Amway	5.5	9.6	9.6	6.5	6.0
Neptune	-	-	9.6	-	8.2
HA-420	-	-	9.9	-	7.0
Booster + E	5.1	9.8	10.0	7.4	8.4
UBI-1126	5.6	9.5	-	7.2	-

[1]dat = days after treatment [2]dat 5 [3]0 = no effect, 10 = complete kill

Table 3. The effect of adjuvants with herbicides on weed control and tuber yields.

Treatment	Adjuvant ml/ha	Barnyardgrass[1] 1977	Barnyardgrass[1] 1978	Yield kg/ha 1977[5]	Yield kg/ha 1978
Metribuzin pre	-	8.4	9.2	33,900	37,290
Metribuzin + Wex pre	95	-	9.9	--	41,584
Metribuzin + Wex pre	189	9.0	9.6	34,013	38,307
Metribuzin + Amway pre	95	9.2	9.4	31,414	37,177
Metribuzin + HA 800 (D) pre	.57 kg[2]	-	9.7	--	38,420
Linuron pre	-	5.8	8.9	28,702	34,804
Linuron + Wex pre	95	8.5	9.5	33,900	36,838
Linuron + Amway pre	95	8.8	9.4	31,753	33,674[6]
Linuron + HA 800 (D) pre	1.13 kg[2]	-	8.9	--	40,454
Alachlor pre	-	7.5	9.9	27,459	38,194
Alachlor + Wex pre	95	-	9.9	--	36,273
Alachlor + Amway pre	95	5.8	9.9	25,538	35,708
Alachlor + HA 800 (D) pre	1.7 kg[2]	-	9.9	--	36,612
Alachlor + Wex pre	189	7.5	9.9	25,312	36,612
Chlorbromuron pre	-	7.5	9.1	27,346	32,883[6]
Chlorbromuron + Wex pre	95	-	9.3	--	36,160
Chlorbromuron + Amway pre	95	8.2	8.8	31,188	38,533
Chlorbromuron + HA 800 (D) pre	1.7 kg[2]	-	8.7	--	36,725
Chlorbromuron + Wex pre	189	8.4	8.9	30,284	34,352
EPTC pre-inc	-	-	9.9	--	39,889
EPTC + Amway pre-inc	95	-	9.2	--	37,064
EPTC + Wex pre-inc	95	-	9.8	--	36,725
EPTC + HA 800 (D) pre-inc	2.27 kg[2]	-	9.5	--	41,923
EPTC + Wex pre-inc	189	-	9.5	--	41,358
Check water pre	-	7.6[3]	9.0[4]	14,690	27,685
Check Wex pre	95	-	0	--	30,510[6]
Check Wex pre	189	6.6[3]	0	26,103	29,493[6]
Check Wex pre-inc	95	-	0	--	35,482
Check Wex pre-inc	189	-	0	--	31,866[6]
Check Amway pre	189	6.2[3]	-	23,956	--

[1]0 = no control, 10 = complete control

[2]ai

[3]cover, 0 = none, 10 = 100%

[4]density/5 cm^2

[5]All treatment differences significant 5% level from water check

[6]Differences not statistically significant from water check

Table 4. Katahdin yields with surfactant treatments, 1977.

Treatment	ml/ha	Stage	Yield kg/ha
Wex	189	15 cm potatoes	30,510
Amway	189	15 cm potatoes	27,572
Water		15 cm potatoes	27,120
Wex	189	30 cm potatoes	27,572
Amway	189	30 cm potatoes	28,589
Water		30 cm potatoes	26,894
Wex	95	before 1st irrigation	28,137
Wex	189	before 1st irrigation	30,284
Amway	95	before 1st irrigation	31,414
Amway	189	before 1st irrigation	28,363
Water		before 1st irrigation	27,233
Wex	95	before 1st & 2nd irrigations	28,363
Amway	95	before 1st & 2nd irrigations	29,041
Wex	95	before 1st & 2nd irrigations	32,544
Amway	95	before 1st & 2nd irrigations	27,346

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ADJUVANTS FOR ATRAZINE AND ALACHLOR IN SWEET CORN[1/]

R. D. Sweet, H. H. Hatfield, and D. T. Warholic[2/]

ABSTRACT

Research by the authors and others shows that at least three factors influence the performance of adjuvants in atrazine and alachlor sprays: the dosage level of the herbicide, the stage of growth of the crop and the weeds, and the kind of adjuvant. Where surfactants were beneficial, the oil type alone or an oil/surfactant blend were frequently superior to other types. The oils promoted greater uptake of atrazine and alachlor from both leaves and underground parts, whereas the other adjuvants primarily influenced spray tank conditions or leaf wetting. In designing tests for evaluating adjuvants care must be taken to insure they are reflective of actual conditions under which they will be used.

INTRODUCTION

The widespread acceptance of atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine] 80 WP by farmers caused a dramatic upsurge in the use of adjuvants in herbicidal sprays. There were at least three reasons for this. First, prior to atrazine the two most widely used herbicides were 2,4-D [(2,4-dichlorophenoxy)acetic acid] and dinoseb (2-sec-butyl-4,6-dinitrophenol). Formulations were either salts or esters which offered few sprayability problems even at 5-10 gal/A because they either went into solution or suspension quite readily. With WP atrazine, however, at least 20 gal of water was needed to avoid nozzle plugging. Furthermore, many sprayers had inadequate agitation in the tank. Some operators turned to adjuvants as a means of overcoming some of these problems. A second important aspect was the relatively low activity of atrazine against well established weeds. Fields which were not treated preemergence, or where the early spray failed, required a post emergence spray. Adjuvants were turned to as a means of enhancing the activity of atrazine under these unfavorable conditions. A third consideration was the persistance of atrazine. Normal rates often carry over and injure sensitive crops the following season. Some investigators, including the authors of this paper, studied the use of adjuvants as a possible means of increasing the activity of atrazine so that the dosage could be lowered and thus the risk to succeeding crops lessened.

The purpose of this paper is to review some of the research with adjuvants for atrazine and alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] which illustrates the influence of herbicidal dosage, time of application and type of adjuvant on the results obtained.

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DOSAGE OF HERBICIDE

Many researchers have reported in the last ten years that when atrazine is applied at 2-3 lbs/A of formulated material either preemergence or early post emergence to the weeds there usually is little or no advantage to the use of an adjuvant. If rates were reduced to only 25% of this level, adjuvants frequently can be quite helpful (3,4,5,6,11,12,16). Unfortunately, the evidence with alachlor is not very extensive and furthermore shows no similar clear cut trends regarding rate. This may be due partially to the fact that alachlor is formulated as an e.c. and may already have sufficient formulants that extra surfactant will not have an influence (1). Another difficulty in summarizing the influence of adjuvants on alachlor is that many of the field studies were done with alachlor in combination with atrazine. Since there can be a beneficial interaction between these two herbicides (1) it is difficult to give specific values, if any, to the effect of adjuvants on alachlor.

TIMING

Perhaps the factor which influences performance of adjuvants is the stage of weeds and crop at time of spraying. Dickerson and Sweet (5,6) and Lynch (13) as well as others have shown that applications at time of planting give variable responses to adjuvants, i.e. sometimes they are enhanced, sometimes there is no influence and sometimes performance is decreased. On the other hand, post emergence applications often are enhanced by adjuvants. As is shown in Table 1 from Lynch (13) the use of an oil type adjuvant greatly increased the herbicidal activity of both atrazine and alachlor, singly or in combination at the extremely low rate of 4 oz/A each when applied a few days after emergence. However, these low rates are relatively ineffective if applied when grasses have three or more leaves and broadleaves are well established. Under these situations foliage burn occurs but the weeds recover.

Many investigators have found that the use of an oil type adjuvant with atrazine sprays applied post emergence results in a higher level of herbicide in the foliage of both corn (*Zea mays*) and weeds. Unfortunately, some investigators have erroneously implied that this increase was due mostly to increased direct foliage absorbtion. However, the work of Akobundu (1) in which leaves were protected but the soil was exposed, demonstrated that an oil adjuvant greatly increased non-foliar absorbtion of atrazine and alachlor. Their research showed that perhaps 2/3 of the activity of those two herbicides when applied early post emergence was from non-foliar uptake. Nishimoto (15) in studies with nutsedge (*Cyperus esculentus* L.) confirm the importance of root absorbtion of atrazine whether from pre or post emergence applications. Nalewaja (14) suggest that oil adjuvants significantly reduce atrazine losses due to vaporization and thus provide a better opportunity for more atrazine absorbtion by leaves or for rainfall to wash it into the root zone.

KIND OF ADJUVANT

Extensive research with adjuvants for herbicides has been reported by Jansen (9), Behrens (2), Jansen (10) and by many others. However, Jones and Anderson (11) were one of the earliest investigators to report on the value

of petroleum oils as additives for post emergence sprays of atrazine. Several investigators followed up their findings with detailed studies on the physical and chemical properties of oils, dosage levels, etc. (5,6,12). They suggested that oils customarily used to control certain insects of fruit were highly effective adjuvants that were safe on corn foliage when used at 1-2 gal/A. About 1% emulsifier was required in the oil in order to obtain good tank mixing and sprayability. A few years later Agway, Inc. developed an oil/surfactant blend 83/17% by volume which only required 1-2 qts/A to be effective. This now has widespread acceptance in the Northeast for post emergence atrazine sprays.

The oil/surfactant blend was reported by Hatfield (7) to have superiority over a wide range of other types of adjuvants in regard to safety to crop foliage (Table 2). They found little or no correlation between the toxicity to corn foliage and the ability of an adjuvant to enhance the herbicidal qualities of atrazine. It also should be noted in Table 2 that spraying sweet corn 30 cm tall was much more detrimental to the crop than spraying pre or early post emergence.

Hatfield (8) and in four unreported subsequent years, evaluated a wide range of types of adjuvants for their value in atrazine plus alachlor applications. They found that adjuvant types such as detergents, silicone oils, and acetylenes were beneficial but somewhat less so than the oils and oil surfactant blends. Two proprietary adjuvants of undisclosed types, SRC 101 and WEX, had little influence on herbicidal activity.

It is postulated that oils or oil/surfactant blends exert their beneficial influence in at least three different ways, all of which contribute to increasing the amount of atrazine and alachlor absorbed: 1) modifying leaf surfaces to permit better direct foliage penetration; 2) reducing losses due to vaporization of atrazine from leaf and soil surfaces; 3) reducing the speed of adsorbtion of atrazine by soil particles.

In contrast to the effects produced by oils, many of the other adjuvants less effective with atrazine and alachlor produce considerably different effects such as: 1) enhance stability of the suspension in the spray tank; 2) improve sprayability; 3) improve leaf wetting. However, since these factors usually are not limiting the performance of post emergence atrazine and alachlor sprays, it is not to be expected they would give noticeable enhancement.

It is highly probable that each herbicide type will require a specific adjuvant. Perhaps even the same herbicide will require different adjuvants if it is utilized in widely different situations. In evaluating adjuvants it is important that the tests employed reflect the probable conditions under which the spray will be utilized. Furthermore, conclusions need to be restricted to only those situations represented by the tests.

Table 1. The effect of atrazine, alachlor and an oil adjuvant on fresh weight of beans when applied early post.[a]

Treatment	Total Fresh Wt. (oz) 10 plants
oil (Sun 11N) 1 gal	64
atrazine 4 oz	53
atrazine + oil (4 oz + 1 gal)	33
alachlor 4 oz	73
alachlor + atrazine (4 oz + 4 oz)	16
alachlor + atrazine + oil	5

[a]Data from Lynch et al. (1970)

Table 2. Selected adjuvants included in preemergence and postemergence applications.[a]

Adjuvant	Chemical	Type	Source	Growth Stage		
				Pre	E Post	Post
Booster+E	83/17 oil/surfactant blend	N	Agway	x	x	x
Herbimax	80/20 oil/surfactant blend	N	Union Carbide	x	x	x
Soil Penetrant 80	A blend of alkyl poly-(oxyethylene) ether type surfactants	N	Union Carbide	x	x	x[b]
Tergitol 15-S-9	9-moleethylene oxide adduct of a linear secondary alcohol	N	Union Carbide	x	x	x[b]
Tergitol TMN	Ethylene oxide adduct of a branched primary alcohol	N	Union Carbide	x	x	x[b]
Tergitol NP 27	7-mole ethylene oxide adduct of nonylphenol	N	Union Carbide	x	x	-
Triton CS7	Alkyl aryl polyethoxylate and sodium alkylsulfonated alkylate	N	Rohm and Haas	x	x	-
Triton XA	Alkyl aryl polyethoxylate and potassium alkaroate	N	Rohm and Haas	x	x	x[b]
Triton 114 SB	Octyl phenoxy polyethoxy ethanol	N	Rohm and Haas	x	x	x[b]
Triton GR-5	Dioctyl sodium sulfosuccinate	A	Rohm and Haas	x	-	-
Triton GR-7	Dioctyl sodium sulfosuccinate	A	Rohm and Haas	x	-	x[b]
Tronic	Alkyl aryl polyethylene glycols, petroleum distillates alkyl sulfates, alkyl amine acetate	A	Colloidal Product	x	x	-
Charger E	Octyl phenoxy polyethoxy ethanol	N	Agway	x	x	-
Spredrite	alkylaryl polyethoxyethylene ethers + isopropanol	N	Barker	x	x	-
Surfactant WK	Dodecyl ether of polyethylene glycol	NA	Dupont	x	x	-
Bestline	--	-	Bestline	x	x	-
T-MULZ	Blend of anionic and nonionic components	NA	Thomp-Hayward	x	x	-
Citowett	Alkyl aryl polyglycol ether	A	BASF	x	x	-
Tween 20	Polyoxyethylene sorbitan monolaurate polysorbate 20	N	Atlas	x	x	x
Ortho X-77	Alky aryl oxyethylene glycols, fatty acids + isopropanol	N	California Spray Chemical Corp.	x	-	-

[a]Taken from Hatfield and Sweet (1973)

[b]permanent damage to corn

x = included in test

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EVALUATION OF SEVERAL SURFACTANTS WITH PARAQUAT IN SMALL GRAIN STUBBLE

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ABSTRACT

Field experiments were conducted in 1977 and 1978 to determine the efficacy of several surfactants with paraquat to control existing vegetation in small grain stubble. Differences existed between surfactants and between surfactant concentrations. Oil-surfactant mixtures were less effective with paraquat than were surfactants. Common lambsquarters (*Chenopodium album* L.) and fall panicum (*Panicum dichotomiflorum* Michx.) responded differently to surfactants and surfactant concentrations.

INTRODUCTION

A favorable climate and length of growing season in eastern Virginia lends the area to many double-cropping systems involving both vegetable and agronomic crops. Two important double cropping sequences are fall-planting of barley (*Hordeum vulgare* L.) and wheat (*Triticum vulgare* L.) followed by early-summer planting of soybeans (Glycine max [L.] Merr.) after harvest of the small grains. The soybeans may be planted into a seed-bed prepared by conventional tillage practices or may be planted no-til. Difficulty in obtaining good control of existing weeds with paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) at the time of planting has been a deterrent to expansion of the no-til system in spite of its advantages in time and labor saving. Numerous reasons exist for incomplete control including weed size and species, nozzle tips used, spray volume and rainfall. However, perhaps the factor differing most from grower to grower is the surfactant used. For this reason, it was decided to compare the efficacies of several surfactants for enhancing the activity of paraquat under no-til conditions.

MATERIALS AND METHODS

Research was conducted during 1977 and 1978 at the Virginia Truck and Ornamentals Research Station, Painter. Applications both years were made at a volume of 40 gpa using standard herbicide spray tips[2/] at a pressure of 35 psi. Propane was the source of pressure.

Rates of surfactants were selected on the basis of label recommendations by the manufacturer. Where a range was given, only one rate was included, the mean rate was generally selected. In several instances, product label discussed rates on the basis of product per acre; in these instances the amount of product has been calculated to permit presentation in this paper on the basis of pt/100 gallons and percent v/v. The chemistry and manufacturers of many of the surfactants has been previously published (1). For the remaining products,

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2/Tips were manufactured by Spray Systems Co., Bellwood, IL 60104 and in 1977 were Teejet No. 730615 and in 1978 were Teejet 8005.

manufacturers and chemistry are listed in Table 1. Throughout the text, products are discussed by trade names since generic names are not available. Test sites were fields of rye stubble in which weeds had been permitted to grow for at least two weeks following rye harvest. Predominant species in 1977 were common lambsquarters that varied in height but measured up to 20 inches.

In 1978, fall panicum was predominant and varied in height up to 18 inches. Visual estimates of percent control were made four and eight days following treatment in 1977 and one and eleven days following treatment in 1978. In 1978 the 3 lb/gal formulation of glyphosate (N-(phosphonomethyl)glycine) was included in the study. All data were analyzed statistically and means were compared using Duncan's new multiple range test.

Table 1. Trade names, sources of products and principle functioning agents of some of the surfactants included in these studies.

Trade Name or Code	Source	Principle functioning agent
AL-1448	ICI Americas Inc. Wilmington, DE 19897	Primarily a blend of non-ionic surfactant
FLO-MO	Sellers Chemical Corp. Harahan, LA 70183	Alkyl polyoxyethylene ether - 80%
CITTOWET PLUS	BASF Wyandotte Corp. Parsippany, NJ 07054	Alkylaryl polyglycol ether - 50%
PACE	Amchem Products Inc.	Paraffin base petroleum oil - 83% Surfactant blend - 16%
CHARGER-E	Agway Inc. Syracuse, NY	Octyl phenoxy polyethoxy ethanol
TRITON AG-98	Rohm and Haas Co. Spring House, PA	Alkyl aryl polyoxyethylene glycols - 80%
TRONIC	Colloidal Products	Alkylaryl polyoxyethylene glycols, mixed petroleum distillates, alkylamine acetate, alkylaryl sulfonates, polyhydric alcohol
OLDE WORLDE PRODUCTS	Olde Worlde Products Inc. North Canton, Ohio	Nonyl phenoxy polyethoxy ethanol - 25%

Table 2. Effects of several surfactants on the activity of paraquat against common lambsquarters four and eleven days after application in 1977.[1]

Surfactant[2]	Surfactant rate[3] (pt/100 gal)	Surfactant rate[3] (% v/v)	Lambsquarters control[4] (%) 4 DAT	Lambsquarters control[4] (%) 8 DAT
None	-	-	43 f	50 f
X-77	1/2	0.06	82 a	78 abcd
	1	0.12	83 a	87 a
	2	0.25	87 a	83 ab
AL-1448	1/2	0.06	67 d	65 de
	1	0.12	65 d	65 de
	2	0.25	70 d	65 de
FLO-MO	3 3/4	0.50	78 abc	72 abcd
CITTOWET	3 3/4	0.50	67 d	67 cd
AMWAY	2 1/2	0.33	83 a	78 abcd
WEX	1	0.12	78 abc	81 abc
BEST LINE LC	1	0.12	80 ab	83 ab
PACE	2 1/2	0.33	53 e	52 ef
AL-411F	2 1/2	0.33	50 ef	50 f
CHARGER E	1	0.12	73 bcd	70 bcd
Check			0	0

1/Paraquat was applied at the rate of 3/8 lb/A.

2/Surfactant names are trade names or codes since generic names are not available.

3/As suggested on product labels or calculated on the basis of 40 gpa spray volume.

4/Days after treatment. Means within columns followed by the same letter do not differ significantly at the 5% level according to Duncan's New Multiple Range Test.

Table 3. Effects of several surfactants on the activity of paraquat against fall panicum in 1978.

Paraquat Rate (lb/A)	Surfactant[1]	Surfactant Rate[2] (pt/100 gal)	Surfactant Rate[2] (% v/v)	Fall Panicum Control (%)[3] 1 DAT	Fall Panicum Control (%)[3] 13 DAT
1/4	X-77	1/2	0.06	55	48 g
1/4	X-77	1	0.12	52	67 de
3/8	X-77	1	0.12	67	70 de
1/2	X-77	1	0.12	60	82 c
1/4 + 1/4[4]	X-77	1	0.12	42	97 a
1/4	TRITON AG-98	1/3	0.04	52	72 d
1/4	TRITON AG-98	1/2	0.06	52	62 ef
1/4	TRITON AG-98	1	0.12	50	48 g
3/8	TRITON AG-98	1	0.12	52	68 de
1/2	TRITON AG-98	1	0.12	60	85 bc
1/4 + 1/4[4]	TRITON AG-98	1	0.12	48	98 a
1/4	CHARGER E	1/2	0.06	48	55 fg
1/4	CHARGER E	1	0.12	53	65 de
1/4	TRONIC	2	0.25	40	68 de
1/4	AMWAY	2.5	0.31	65	38 h
1/4	OLDE WORLDE	1	0.12	55	50 g
3/4[5]	-	-	-	0	96 a
1 1/8[5]	-	-	-	0	99 a
Check				0	0

1/Surfactant names are trade names or codes since generic names are not available.

2/As suggested on product labels or calculated on the basis of 40 gpa spray volume.

3/Days after treatment. Means within columns followed by the same letter do not differ significantly at the 5% level according to Duncan's New Multiple Range Test.

4/Separate applications 4 days apart.

5/These two treatments were glyphosate.

RESULTS AND DISCUSSION

In Tables 1 and 2 can be found the results obtained with surfactants in 1977 and 1978 respectively. Although most surfactants increased the activity of paraquat, differences existed between surfactants in 1977. Control of common lambsquarters of 80% or more when evaluated four days after application was obtained with paraquat plus X-77, AMWAY ALL PURPOSE SPRAY ADJUVANT and BESTLINE LC. Control with the addition of WEX reached 78% while controls from CHARGER E and CITTOWET were lower at 73% and 67% respectively. The experimental surfactant AL-1448 and the oil-surfactant mixtures AL-411F and PACE did not perform satisfactorily. Although ratings made 8 days after treatment were slightly different from the earlier ratings, relative differences between surfactants generally did not change. Of particular interest in 1977 was the fact that rate did not affect control with X-77 and AL-1448. In 1978, ratings of fall panicum control were not significantly different one day after treatment because of variability in the data. However, 13 days after treatment, significant differences were evident. Contrary to results obtained in 1977, rates of X-77, TRITON AG-98 and CHARGER E influenced control of fall panicum. With X-77 and CHARGER E the 0.12% rate performed better with paraquat than the 0.06% rate; with TRITON AG-98 control decreased as the rate increased from 0.04% to 0.12%. With both X-77 and AG-98 control increased as the rate of paraquat increased to 1/2 lb/A and with repeat applications of 1/4 lb/A paraquat at 4-day intervals. The performance of TRONIC at 0.25% v/v equaled the control obtained with X-77, TRITON AG-98 and CHARGER at their most effective respective concentrations. AMWAY ALL PURPOSE SPRAY ADJUVANT and OLDE WORLDE ALL PURPOSE SPRAY ADJUVANT were less effective than other products in 1978.

Differences between years may be due to differences in susceptibility of the common lambsquarters in 1977 and fall panicum in 1978. Concentrations of surfactants required to provide maximum activity of paraquat may differ between these two weed species. Further research should be conducted to confirm the results against various species and under different environmental conditions.

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Influence of Surfactants on Activity of Glyphosate and Paraquat in No-Tillage Soybeans

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ABSTRACT

Successful production of no-tillage soybeans (Glycine max (L) Merr.) can be achieved only if weeds are controlled. Experience has shown that the key component in a no-tillage weed control program is the non-selective or knock-down herbicide. Failure to control existing vegetation at the outset generally leads to a disappointing performance by residual herbicides. The extent to which surfactants could improve the performance of paraquat and glyphosate was studied in no-tillage soybeans following a cereal grain in a double cropping system. Paraquat was applied at 0, 1.2, 1.8, and 2.5 liters per hectare. Glyphosate was used at 0, 2.5, 3.7, and 4.9 liters per hectare. Each herbicide was applied by itself and with three surfactants at rates of 0.0, 0.5 and 1.0 % (v/v). Alachlor and linuron were applied uniformly as a residual herbicide treatment. Principal weed species were fall panicum (Panicum dichotomiflorum Michx.) and large crabgrass (Digitaria sanguinalis L. Scop.). Glyphosate caused significantly better control of fall panicum than paraquat and control was improved as the rate of application increased. The surfactant ion charge appeared to have little effect on the activity of paraquat but an anionic surfactant was less effective than non-ionic surfactants with glyphosate. Increasing the concentration of surfactant improved the activity of glyphosate, especially as measured by the control of fall panicum, and this was associated with larger soybean yields. The average yields for the paraquat and glyphosate treatments were 13.0 and 22.6 quintals per hectare respectively. At the 2.5 liter per hectare application rate of glyphosate, the soybean yield was increased sharply by increasing the surfactant concentration to 1 % (v/v). This did not occur at the higher application rates.

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EFFECT OF DIFFERENT SURFACTANTS, NOZZLES, AND LIQUID CARRIERS ON SPRAY VOLUME[1/]

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ABSTRACT

The effects of surfactants, liquid carriers, and nozzles on spray volume were investigated. First, 23 surfactants were sprayed through a flat fan nozzle with water as a liquid carrier. The presence or choice of a surfactant had no effect on spray volume. Four representative surfactants were then used to determine the effect of liquid carriers when using a flat fan nozzle. Again, the presence or absence of a surfactant had not effect. The liquid carriers were significantly different, however, with complete fertilizer solution delivering 9.1% less volume than water and aqueous nitrogen delivering 11.7% less volume than water. Finally, using water as a liquid carrier, the four representative surfactants were sprayed through three different nozzles. The flood jet nozzle delivered a greater volume than the flat fan nozzle, and the flat fan nozzle delivered a greater volume than the cone jet nozzle. Once again, the presence or choice of a surfactant had no practical effect.

INTRODUCTION

Research has shown that surfactants can increase herbicide effectiveness in several ways. The lipophilic and hydrophilic characteristics of surfactants enable them to dissolve surface waxes and to reduce the surface tension of water-based sprays. Increased herbicidal activity occurs by increasing uptake in the stomata and cuticle, by providing maximum contact of spray solution with the plant surface, by decreasing evaporation, and by increasing the solution's spreading ability and retention (2). In many cases, the rate of herbicide needed is reduced. By increasing the size and stability of spray droplets and by increasing the stress strength of the spray solution, surfactants are effective in reducing drift in both aerial and ground applications of herbicides (1). Negatively, surfactants have been shown to reduce soil adsorption of some herbicides while increasing leaching of others (3). They may also increase crop injury.

One possible mode of action which has not been adequately investigated is that the addition of a surfactant may simply increase the volume of herbi-

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cide spray solution being delivered by the sprayer. This could be of practical significance since sprayers are not always calibrated, as they should be, with the actual solution to be sprayed. This study was conducted to document the effects of surfactants, liquid carriers, and sprayer nozzles on the amount of spray volume delivered.

MATERIALS AND METHODS

A two gallon stainless steel tank was connected to a single spray nozzle using a manually operated throttle valve to control flow to the nozzle. Pressure was maintained at 30 psi using carbon dioxide as a propellant. For each trial, the spray was collected within a timed interval and its volume measured. The ml/sec observations were converted to L/ha to aid understanding the results in practical terms. A tractor speed of 4 mph and recommended nozzle spacings (20" for flat fan, 30" for cone jet, 40" for flood jet) were assumed to carry out this transformation. The apparatus was rinsed with methanol and water after each trial. Treatments were arranged in a randomized complete block design with three replications. Data were analyzed by analysis of variance and a Bayes LSD at the 5% level of probability was used to compare treatment means.

Experiment 1 - Surfactants vs. Water (flat fan nozzle)

A comparison was made of 23 different surfactants (appendix 1) at a 1% (v:v) solution with water sprayed through a flat fan (SS8004)[3/] nozzle. Each trial was sprayed for 20 sec.

Experiment 2 - Surfactants vs. Liquid Carriers (flat fan nozzle)

Four surfactants were selected as being representative of types present in the original 23 from experiment 1. The surfactants were: Booster Plus E (an oil/surfactant combination), Sunoco Spray Oil (an oil), Miller Aide (a menthene) and Ortho X-77 (an alkylarylpolyoxyethylene glycol). These were compared using three liquid carriers: water, a 30% aqueous nitrogen solution, and a 14-8-8 complete fertilizer solution. A 1% (v:v) solution of each surfactant-liquid carrier combination was sprayed for 20 sec. through a flat fan nozzle (SS8004).

The 30% aqueous nitrogen solution was made of approximately 50% NH_4NO_3 and 50% urea. The 14-8-8 complete fertilizer solution was made by reacting phosphoric acid and anhydrous ammonia and dissolving KCl into the resulting hot mixture. The fertilizer had no clay base.

Experiment 3 - Surfactants vs. Nozzles (Water carrier)

The four representative surfactants used in Experiment 2 were also used in this experiment to determine the effect of three different spray nozzles. A 1% (v:v) solution of surfactant and water was sprayed through a cone jet

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3/ All spray nozzles from Spraying Systems Co., Wheaton, Illinois

nozzle (TXSS10), a flat fan nozzle (SS8004) and a flood jet nozzle (TKSS5) for 10, 20 and 40 seconds, respectively.

RESULTS AND DISCUSSION

Experiment 1 - Surfactants vs. Water (flat fan nozzle)

Water, when sprayed alone, delivered 232.9 L/ha. The volume of surfactant-water solution sprayed ranged from 232.9 to 240.2 L/ha (Table 1). The presence or choice of a surfactant with water did not significantly change the volume sprayed.

Although spraying equipment is often calibrated using water, the addition of surfactant to a spray mix will not affect the delivery rate.

Experiment 2 - Surfactants vs. Liquid Carriers (flat fan nozzle)

A difference in spray volume was found when the overall means of the three different liquid carriers were compared (Table 2). Water sprayed the highest volume (236.5 L/ha). Complete fertilizer solution sprayed less volume (215.0 L/ha) while aqueous nitrogen sprayed the least volume (208.8 L/ha). The addition of Booster Plus E, Miller-Aide, Sunoco Spray Oil or Ortho X-77 to the three different liquid carriers had no effect on spray volume.

Differences in spray volume between the three liquid carriers should be considered when calibrating spray equipment.

Experiment 3 - Surfactants vs. Nozzles (water carrier)

Differences in spray volume occurred among different spray nozzles (Table 3). Overall, the flood jet delivered 277.2 L/ha, the flat fan delivered 236.5 L/ha, and the cone jet delivered 66.8 L/ha. The presence or choice of a surfactant were not significant when using a cone jet. With a flat fan, a slight increase in volume was noted when spraying Ortho X-77 with water compared to spraying water alone. With a flood jet, a slight decrease in volume was noted when spraying Miller Aide with water compared to spraying water alone. Although these exceptions are statistically significant there is doubt whether or not they are of practical importance.

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2. Holly, K. 1976. Selectivity in relation to formulation and application methods. In Herbicides: Physiology, Biochemistry, Ecology; 2nd Edition; Vol. 2:249-277.

3. Koren, E. 1972. Leaching of trifluralin and oryzalin in soil with three surfactants. Weed Sci. 20:230-232.

Table 1. The effect of 23 surfactants at 1% (v:v) with water on the delivery rate of water through a SS8004[a] flat fan nozzle.

Surfactant	Volume Delivered (L/Ha)
Adjuvan-T	237.4
Surfynol-465	235.6
Surfynol-104-E5-75	237.4
Surfynol-440+465+E	239.3
Agrow-LC	236.5
Unite	234.7
Charger E	238.4
AI-1448	237.4
Max	234.7
Booster Plus E	237.4
CN-110-242	235.6
Sunoco Spray Oil	237.4
Face	236.5
Miller Aide	234.7
Triton Ag-98	232.9
Amway All Purpose Spray Adjuvant	233.8
Dynawet	236.5
Compex	233.8
Big Wet	236.5
Wex	234.7
Teco Wet 7X	236.5
Ortho X-77	240.2
SA-77	236.5
Water alone	232.9
Bayes $LSD_{.05}$	N.S.

[a] Spraying Systems Co., Wheaton, Illinois

Table 2. Selected surfactants at 1% (v:v) with three different liquid carriers through a SS8004[a] flat fan nozzle.

Effect		Volume Delivered (L/Ha)
Surfactants with specific liquid carriers		
Surfactant:	Liquid carrier:	
Booster Plus E	water	237.4
Sunoco Spray Oil	water	237.4
Miller Aide	water	234.7
Ortho X-77	water	240.2
Booster Plus E	aqueous nitrogen solution	209.0
Sunoco Spray Oil	aqueous nitrogen solution	209.9
Miller Aide	aqueous nitrogen solution	209.0
Ortho X-77	aqueous nitrogen solution	207.1
Booster Plus E	complete fertilizer solution	214.5
Sunoco Spray Oil	complete fertilizer solution	215.4
Miller Aide	complete fertilizer solution	213.6
Ortho X-77	complete fertilizer solution	214.5
-	water	232.9
-	aqueous nitrogen solution	209.0
-	complete fertilizer solution	218.1
Bayes $LSD_{.05}$		N.S.
Surfactant		
Booster Plus E		220.3
Sunoco Spray Oil		220.9
Miller Aide		219.1
Ortho X-77		220.3
liquid carrier alone		220.0
Bayes $LSD_{.05}$		N.S.
Liquid carrier		
water		236.5
aqueous nitrogen solution		208.8
complete fertilizer (14-8-8) solution		215.0
Bayes $LSD_{.05}$		4.2

[a] Spraying Systems Co., Wheaton, Illinois

Table 3. Selected surfactants at 1% (v:v) with water sprayed through three different nozzles: flat fan (SS8004)[a], cone jet (TXSS10)[a], flood jet (TKSS5)[a].

Effect		Volume Delivered (L/Ha)
Surfactants with specific nozzles		
surfactant:	nozzle:	
Booster Plus E	flat fan	237.4
Sunoco Spray Oil	flat fan	237.4
Miller Aide	flat fan	234.7
Ortho X-77	flat fan	240.2
water	flat fan	232.8
Booster Plus E	cone jet	66.6
Sunoco Spray Oil	cone jet	67.6
Miller Aide	cone jet	66.6
Ortho X-77	cone jet	66.9
water	cone jet	66.3
Booster Plus E	flood jet	281.4
Sunoco Spray Oil	flood jet	278.6
Miller Aide	flood jet	271.3
Ortho X-77	flood jet	275.0
water	flood jet	280.5
Bayes $LSD_{.05}$		6.0
Surfactant		
Booster Plus E		195.1
Sunoco Spray Oil		194.6
Miller Aide		190.9
Ortho X-77		194.0
water alone		192.9
Bayes $LSD_{.05}$		N.S.
Spray Nozzle		
flat fan		236.5
cone jet		66.8
flood jet		277.2
Bayes $LSD_{.05}$		4.5

[a] Spraying Systems Co., Wheaton, Illinois

APPENDIX I

Surfactants Used in This Experiment

Adjuvan-T	CIBA-Geigy, Greensboro, NC
Surfynol-465	Air Products, Wayne, PA
Surfynol-104-ES-75	Air Products, Wayne, PA
Surfynol-440+465+E	Air Products, Wayne, PA
Agrow LC	Better Living Products Inc., Chicago, IL
Unite	Hopkins, Madison, WI
Charger E	Agway Inc., Syracuse, NY
Al-1448	ICI Americas, Wilmington, DE
Max	Agway Inc., Syracuse, NY
Booster Plus E (4115)	Agway Inc., Syracuse, NY
CN-110-242	Velsicol, Chicago, IL
Sunoco Spray Oil	Sun Oil Co., Philadelphia, PA
Pace (4115)	Amchem, Ambler, PA
Miller Aide	Miller Chemical Co., Hanover, PA
Triton Ag 98	Rhom & Haas, Philadelphia, PA
Amway All Purpose Spray Adjuvant	Amway, Ada, MI
Dynawet	Dow Chemical Co., Midland, MI
Compex	Kalo Lab. Inc., Kansas City, KN
Big Wet	JBL Internatl. Chemicals, Hialeah, FL
Wex	Conklin, Shakopee, MN
Tecowet 7X	Agrotec Inc., Salisbury, MD
Ortho X-77	Chevron Chemical Co., San Francisco, CA
SA-77	JBL Internatl. Chemicals, Hialeah, FL

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SURFYNOL® ADJUVANTS - GREENHOUSE AND FIELD STUDIES

Robert J. Tedeschi 1/

ABSTRACT

SURFYNOL® Adjuvants are unique surfactant products comprising mainly acetylenic diols which are structurally characterized by a symmetrically substituted triple bond and adjacent hydroxyl groups. Their chemical and physical properties have been described in previous publications.

Greenhouse studies are now correlated with varied field data. The greenhouse studies have involved testing seven SURFYNOLS with five important commercial herbicides (Atrazine, Bentazon, fluometuron, Propanil and Methane arsonic acid - mono sodium salt), and six typical weeks (barnyard grass, cocklebur, Johnson grass, morning glory, pig weed and velvet leaf). Comparisons with three commercial adjuvants or surfactants were also carried out.

An important variable measured in the greenhouse studies was the ability of the adjuvant to increase herbicide activity via increased phytotoxicity against the target weed. Increased activity was measured statistically by the use of a frequency parameter known as the "a" range. In these tests SURFYNOL 465 tested superior to other adjuvants. A chi square classification using the frequency "a" range data, showed chances of the results being random were less than 1 chance in a 1,000.

Field Studies with SURFYNOLS during the last three years are encouraging, and broadly support the greenhouse studies. Promising areas are early to mid-post treatments of corn and soybeans with important herbicides such as Atrazine (AATREX 80#), Alachlor (LASSO 4E),bentazon (Basagran 4 lbs./gal.) and chloroxuron (Tenoran 50W) Some of the most promising SURFYNOL® Adjuvants are S-SE, Blend C and S-465, The table below summarizes both greenhouse and field studies in an overview approach.

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SUMMARY GREENHOUSE AID FIELD HERBICIDE TESTS WITH SURFYNOL ADJUVANTS

HERBICIDE(6)	SURFYNOL REC.	TEST[1] (GH,F)	CROP[2]	AV. RATE[3] HERB. (aia)	AV. RATE[3] SURF. (Vol.%)	APPL.[4]	WEEDS CONTROLLED[5] (70-100% AV.) LQ	RW	PW	SW	VL	C	JM	JG	PS	MG	FP	BG
Atr.	S-465:S-SE Blend C+ Oil	GH,F	C	0.5-1.5	0.1-0.5	Pr EP	+		+		+						+	
Ala.	S-365:S-TGE S-SE,Blend C	F	C	0.5-2.0	0.1-0.5	Pr EP	+	+	+	+							+	
Ben.	S-465:S-SE Blend C	GH,F	SB	0.8-1.0	0.25-1.0	P			+		+	+					+	
Chl.	S-TGE:S-465 Blend C	F	SB	0.8-1.0	0.1-1.0	P	+		+		+						+	
Flu.	S-TGE:S-SE S-465,S-440	GH	Cot.	0.3	0.1-0.3	P			+					+	+	+		
MSMA	S-TGE:S-SE S-485	GH	Cot.	0.8	0.1-0.3	P			+					+	+	+		
Pro.	S-804LS-SE S-440,S-465	GH	R	2-4	0.3-1.0	P			+	S +								+
Tri.	S-465:S-SE Blend C+Oil	GH, F	DB	0.4-0.8	0.3-0.5	EP			+				+					

(1) GH: Greenhouse; F. Field (2) Crop: C. Corn: SB , Soy beans: Cot., Cotton
(3) Rate: herbicide, active ingredient per acre (aia); Rate, Surfynol-Volume % of the spray
(4) Application: Pr, pre-emergence; EP, early post emergence; P, post emergence
(5) Weeds controlled: LQ, lambs quarter; RW, Rag weed: PW, pig weed: SW. Smart seed, S. Setorea; VL, Velvet leaf; C, Cocklebur; JM, Japanese millet: JG, Johnson grass; PS, prickley sida: MG. morning glory; FP, fall panicum; BG, barnyard grass.
(6) Herbicide:Atr., Atrazine;(ATTREX 80-W); Ala. Alachlor (LASSO 4EC):Ben., Bentazon (Basagran 4EC) Chl. Chloroxuron (TENORAN 50W). Flu. Fluometuron (COTORAN 80W), MSMA (ANSAR 170) Pro. Propanil (Stam F-34); Tri. (TREEFLAN 4EC)

THE MONOCOTYLEDONOUS WEEDS OF LONG ISLAND

Richard Stalter [1/]

ABSTRACT

The monocotyledonous weeds of Long Island were studied from August 1971 to August 1978. 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. Twenty-two families, one hundred thirty-eight genera and four hundred fifty-eight species have been identified.

INTRODUCTION

Long Island, New York, is 118 miles long and extends from the entrance of New York harbor (Longitude 74° 2' W) to a point due south of the eastern boundary of Connecticut (71° 50' W). The island varies in width from less than a mile at the eastern end of the north and south forks to a maximum of nearly twenty miles near the center of the island. Conspicuous are the two morainal ridges that form the backbone of the island. While in the western part of the island the fundamental soil substrata are marine deposits of Cretaceous age, most of the soils of the island are of glacial origin. Most of the surface materials have been deposited during the Pleistocene age. The soils are highly variable in texture and range from coarse outwash sands and gravels to unsorted clay rich glacial tills. To a large degree the soil development controls the vegetation development and present day land use throughout the island.

The present study commenced in August, 1971 and continued through August, 1978. Herbarium specimens were examined in the Brooklyn and Bronx Botanical Gardens. Field work by the author and his students was done in various habitats on Long Island including dunes, sandy areas, gravel pits, glacial till, forests, bogs, burned-over areas, cultivated areas, pastures, abandoned fields, shrub aspect on old fields, cut-over forest, and relatively undisturbed forest. The diverse community types found on the aforementioned sites are: (1) field communities; (2) shrub communities; (3) forest communities (post-climax, mesic, preclimax); (4) bogs; (5) freshwater marsh; (6) lakes and streams: acid waters, all stages of aquatic succession

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from open water to swamp forest; (7) streams: clear water, dark water, fast flowing, slow flowing; (8) lakes: clear water, dark water, shallow; (9) marine habitats; (10) coastal dunes: stabilized and unstabilized; (11) sand beach; (12) salt marsh.

MATERIALS AND METHODS

The objective of this study was to determine the monocotyledonous species present on Long Island. A second objective was to identify troublesome weeds (Table 1.) Plant specimens were collected over an eight year period beginning August 1971 to August 1978. Plant taxonomists on Long Island and in New York City assisted in the study. Herbarium specimens were examined at the Brooklyn and Bronx Botanical Gardens since these institutions have two of the most complete collections of Long Island plants.

RESULTS AND DISCUSSION

To date twenty-two families, one hundred thirty-eight genera, and four hundred fifty-eight species have been identified. It is unlikely that more than twenty-five new species will be identified by the author and other Long Island investigators. Since much of Long Island has been developed, many plants previously identified on Long Island are now extinct as new houses, shopping centers, and roads were built to accommodate an expanding population.

Several weed species are particularly troublesome. Much money and time are spent in an effort to eradicate these taxa from pastures, potato fields, and farms. These include: *Agropyron repens* (quackgrass), *Cyperus esculentus* (yellownut sedge), *Digitaria ischaemum* (smooth crabgrass), *Digitaria sanguinalis* (large crabgrass), *Echinochloa crusgalli* (barnyard grass), *Eleusine indica* (goosegrass), *Festuca rubra* (Fescue), *Panicum capillare* (witchgrass), *Panicum dichotomiflorum* (fall panicum), and *Setaria viridis* (green foxtail).

Those who maintain rights-of-way are particularly concerned about the growth of *Smilax rotundifolia* (bull briar) and *Smilax glauca* (catbriar). These two species form impenetrable masses as they rapidly invade rights-of-way on roadsides, power lines, and railroads.

Additional work in this area will be continued by the author. It is hoped that this study will encourage further work in identifying the flora and weedy species in the northeastern United States. A list of the monocotyledonous species follows. Troublesome weeds are preceded by an asterisk (*). Classification follows that of Fernald (1).

LITERATURE CITED

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The monocotyledonae of Long Island. An asterisk (*) precedes troublesome weeds.

TYPHACEAE
Typha angustifolia L.
Typha latifolia L.
SPARGANIACEAE
Sparganium americanum Nutt.
Sparganium androcladum (Engelm.) Morong.
Sparganium eurycarpum Engelm.
ZOSTERACEAE
Zostera marina L.
*Potamogeton amplifolius Tuckerm.
*Potamogeton berchtoldi
var. acuminatus Fieber
*Potamogeton berchtoldi
var. tenuissimus (Mert. & Koch.) Fern.
*Potamogeton capillaceus Poir.
*Potamogeton crispus L.
*Potamogeton epihydrus Raf.
*Potamogeton epihydrus Raf.
var. nutalli (C. + S.)Fern.
*Potamogeton oakesianus Robbins
*Potamogeton pectinatus L.
*Potamogeton perforliatus
var. bupleuroides (Fern.) Farw.
*Potamogeton pulcher Tuckerm.
*Potamogeton robbinsii Oakes
*Potamogeton spirillus Tuckerm.
Ruppia maritima L.
Zannichellia palustris L.
NAJADACEAE
Najas flexillis (Willd.) Rostk. + Schmidt
JUNCAGINACEAE
Triglochin maritima L.
ALISMATACEAE
Alisma subcordatum Raf.
Alisma triviale Pursh.
Echinodorus tenellus (Mart) Buchenau
Sagittaria engelmanniana J.G.S m.
Sagittaria graminea Michx.
Sagittaria latifolia Willd.
Sagittaria latifolia
var. obtusa (Muhl.) Weig.
Sagittaria teres S. Wats.
HYDROCHARITACEAE
Elodea nuttallii (Planch.) St. John
Vallisneria americana Michx.
GRAMINEAE
*Agropyron repens (L.) Beauv.
Agrostis alba L.
Agrostis hyemalis (Walt.) BSP.
Agrostis perennans (Walt.) Tuckerm.
Aira caryophyllea L.
Alopecurus geniculatus L.
Ammophila breviligulata Fern.
Andropogon gerardi Vitman.
Andropogon scoparius Michx.
Andropogon scoparius Michx.
var. frequens F.T. Hubbard
Andropogon scoparius
var. littoralis (Nash) Hitchc.
Andropogon scoparius Michx.
var. septentrionalis Fern. + Grisc.
Andropogon virginicus L.
Andropogon virginicus
var. abbreviatus (Hack.) Fern. + Grisc.
*Anthoxanthum odoratum L.
Aristida dichotoma Michx.
Aristida Longespica Poir.
Aristida oligantha Michx.
Aristida purpurascens Poir.
Aristida tuberculosa Nutt.
Arrhenatherum elatius (L) Mert. + Koch
Avena sativa L.
Brachyelytrum erectum (Schreb.) Beauv.
*Bromus commutatus Schrad.
Bromus erectus Huds.
Bromus mollis L.
Bromus purgans L.
Bromus secalinus L.
*Bromus tectorum L.
Calamagrostis canadensis (Michx.) Nutt.
Calamagrostis cinnoides (Muhl.) Bart.
Calamagrostis epigejos (L.) Roth
Cenchrus longispinus (Hack.) Fern.
Cenchrus tribuloides L.
Cinna arundinacea L.
Cinna latifolia (Trev.) Griseb.
Corynephorus canescens (L.) Beauv.
*Cynodon dactylon (L.) Pers.
*Dactylis glomerata L.
Danthonia compressa Aust.
Danthonia sericea Nutt.
Danthonia spicata (L.) Beauv.
Deschampsia caespitosa (L.) Beauv.
var. parviflora (Thuill) Richter
Deschampsia flexuosa (L.) Trin.
*Digitaria ischaemum (Schreb.) Muhl.
*Digitaria sanguinalis (L.) Scop.
Distichlis spicata (L.) Greene
*Echinochloa crusgalli (L.) Beauv.
Echinochloa walteri (Pursh) Nash
*Eleusine indica (L.) Gaertn.
Elymus candensis L.
Elymus villosus Muhl.
Elymus virginicus L.
Elymus virginicus L.
var. halophilus (Bickn.) Wieg.
Eragrostis capillaris (L.) Nees
Eragrostis megastachya (Koel.) Link
Eragrostis pectinacea (Michx.) Nees.

*Festuca elatior L.
Festuca obtusa Biehler
*Festuca ovina L.
*Festuca rubra L.
Glyceria acutiflora Torr.
Glyceria canadensis (Michx.) Trin
Glyceria melicaria (Michx.) F.T. Hubbard
Glyceria obtusa (Muhl.) Trin.
Glyceria pallida (Torr.) Trin.
Glyceria septentrionalis Hitchc.
Glyceria striata (Lam.) Hitchc.
Heleochloa schoenoides (L.) Host
Hierochloe odorata (L.) Beauv.
Holcus lanatus L.
Hordeum jubatum L.
Hystrix patula Moench
Leersia oryzoides (L.) Sw.
Leersia virginica Willd.
Leptoloma cognatum (Schultes) Chase
Lolium multiflorum Lam.
*Lolium perenne L.
Lolium temulentum L.
Miscanthus sinesis Anderss
Muhlenbergia frondosa (Poir.) Fern.
Muhlenbergia mexicana (L.) Trin.
Muhlenbergia schreberi J.F. Gmel.
Muhlenbergia tenuiflora (Willd.)B.S.P.
Muhlenbergia uniflora (Muhl.)Fern.
Panicum aculeatum Hitchc.+ Chase
Panicum agrostoides Spreng.
Panicum amarum Ell.
Panicum bicknellii Nash
Panicum boscii Poir.
Panicum boscii Poir.
var.molle (Vasey) Hitchc.
*Panicum capillare L.
Panicum clandestinum L.
Panicum columbianum Serivan
Panicum columbianum Scribn.
var. oricola (Hitchc.& Chase) Fern.
Panicum commonsianum Ashe
Panicum commonsianum Ashe
var Addisonii (Nash) Fern.
Panicum commutatum Schultes
Panicum commutatum Schultes
var. Ashei (Pearson) Fern.
Panicum depauperatum Muhl.
Panicum depauperatum Muhl.
var. psilophyllum Fern.
*Panicum dichotomiflorum Mich.
Panicum dichotomum L.
Panicum dichotomum L.
var.barbulatum (Michx.)
Panicum langinosum Ell.
Panicum lanuginosum Ell.
var. fasiculatumi (Torr.)Fern.
Panicum lanuginosum
var. implicatum (Scribn.) Fern.
Panicum lanuginosum
var. Lindheimeri (Nash) Fern.
Panicum latifolium L.
Panicum linearifolium Scribn.
var. Werneri (Scribn.) Fern.
Panicum longifolium Torr.
Panicum lucidum Ashe
Panicum mattamuskeetense Ashe
Panicum meridionale Ashe
Panicum meridionale Ashe
var. albemarlense (Ashe) Fern.
Panicum microcarpon Muhl.
Panicum miliaceum L.
Panicum oligosanthes Schultes
var. Scribnerianum (Nash) Fern.
Panicum polyanthes Schultes
Panicum sphaerocarpon Ell.
Panicum spretum Schultes
Panicum verrucosum Muhl.
Panicum villosissimum Nash
Panicum villosissimum Nash
var. pseudopubescens (Nash) Fern.
Panicum virgatum L.
Panicum virgatum L.
var. cubense Griseb.
Panicum virgatum L.
var. spissum Linder
Panicum wrightianum Scribn.
Paspalum ciliatium Michx.
var. Muhlenbergii (Nash.) Fern.
Paspalum psammophilium Nash
Paspalum setaceum Michx.
Phalaris canariensis L.
*Phleum pratense L.
Phragmites communis Trin.
Poa alsodes Gray
Poa angustifolia L.
*Poa annua L.
Poa bulbosa L.
Poa compressa L.
Poa nemoralis L.
Poa palustris L.
Poa pratensis L.
Poa trivialis L.
Puccinellia fasiculata (Torr.) Bickn.
Secale cereale L.
Setaria geniculata (Lam.) Beauv.
*Setaria glauca (L.) Beauv.
Setaria verticillata (L.) Beauv.
Setaria verticillata (L.) Beauv.
var. ambigua (Guss.) Parl.
*Setaria viridis (L.) Beauv.
Sorghastrum nutans (L.) Nash
Spartina alterniflora Loisel.

Spartina alterniflora Loisel.
var. pilosa (Merr.) Fern.
Spartina caespitosa A.A. Eat.
Spartina cynosuroides (L.) Roth
Spartina patens (Ait.) Muhl.
Spartina patens (Ait.) Muhl.
var. monogyna (M.A. Curtis) Fern.
Spartina pectinata Link
Sphenopholis intermedia Rydb.
Sphenopholis nitida (Biehler) Scribn.
Sphenopholis obtusata (Michx.) Scribn.
Sporobolus asper (Michx.) Kunth
Sporobolus cryptandrus (Torr.) Gray
Sporobolus vaginiflorus (Torr.) Wood
Stipa avenacea L.
Triodia flava (L.) Smyth
Triplasis purpurea (Walt.) Chapm.
Tripsacum dactyloides L.
Trisetum pensylvanicum (L.) Beauv.
Triticum aestivum L.
Zizania aquatica L.
Zizania aquatica L.
var. angustifolia Hitch.

CYPERACEAE

Bulbostylis capilaris (L)C.B. Clarke
Carex abdita Bickn.
Carex abscondita Machenz.
Carex alata T.&.G.
Carex albolutescens Schwein
Carex amphibola Steud.
var. turgida Fern.
Carex annectens Bickn.
Carex artitecta Mackenz.
Carex atlantica Bailey
Carex barrattii Schwein. & Torr.
Carex bicknellii Britt.
Carex blanda Dew.
Carex brevior (Dew.) Mackenz
Carex bullata Schkuhr
Carex canescens L.
var. disjuncta Fern.
Carex caroliniana Schwein.
Carex cephalantha (Bailey) Bickn.
Carex cephalaphora Muhl.
Carex collinsii Nutl.
Carex comosa Boott.
Carex conoidea Schkuhr.
Carex convoluta Mackenz.
Carex crinita Lam.
Carex crinita Lam.
var. gynandra (Schwein. & Torr.)
Carex cristatella Britt.
Carex davisii Schwein and Torr.
Carex debilis Michx.
Carex digitalis Willd.
Carex emmonsii Dew.
Carex extensa Good.
Carex festucacea Schkuhr
Carex flaccosperma Dew
var. glaucodea (Tuckerm.) Kuckenth.
Carex folliculata L.
Carex gracillima Schwein
Carex granularis Muhl.
Carex granularis Muhl.
var. Haleana (Olney) Porter
Carex grayii Carey
Carex hirsutella Mackenz.
Carex hirtifolia Mackenz.
Carex hormathodes Fern.
Carex Howei Mackenz.
Carex hystericina Muhl.
Carex incomperata Bickn.
Carex intumescens Rudge
Carex lacustris Willd.
Carex laevivaginata (Kuckenth.) Mackenzie
Carex lanuginosa Michx.
Carex lasiocarpa Ehrh.
Carex laxiculmis Schwein
Carex laxiflora Lam.
Carex laxiflora Lam.
var. pautlifolia (Dew.) Carey
Carex leptalea Wahlenb.
Carex longii Mackenz.
Carex lupulina Muhl.
Carex lurida Wahlenb.
Carex molesta Mackenz.
Carex Muhlenbergii Schkuhr
Carex Muhlenbergii Schkuhr
var. enervis Boott
Carex normalis Mackenz.
Carex pallenscens L.
Carex pensylvanica Lam.
Carex pensylvanica Lam.
var. distans Peck
Carex plantaginea Lam.
Carex polymorpha Muhl.
Carex prairea Dew.
Carex prasina Wahlenb.
Carex projecta Mackenz.
Carex radiata (Wahlenb.) Dew.
Carex retroflexia Muhl.
Carex rosea Schkuhr
Carex rostrata Stokes
Carex scabrata Schwein
Carex scoparia Schkuhr
Carex seorsa Howe
Carex silicea Olney
Carex sparganiodes Muhl.
Carex sprengellii Dew.
Carex squarrosa L.
Carex stipata Muhl.
Carex straminea Willd.
Carex stricta Lam.

Carex styloflexa Buckl.
Carex swanii (Fern.) Mackenz.
Carex tenera Dew.
Carex tetanica Schkuhr
Carex tonsar (Fern.) Bickn.
Carex tribuloides Wahlenb.
Carex trisperma Dew.
Carex trisperma Dew.
var. Billingsii Knight
Carex typhina Michx.
Carex umbellata Schkuhr
Carex venusta Dew.
var. minor Boeckl.
Carex vesicaria L.
Carex vestita Willd.
Carex virescens. Muhl.
Carex vulpinoidea Michx.
Carex walteriana Bailey
Cladium mariscoides (Muhl.) Torr.
*Cyperus dentatus Torr.
Cyperus diandrus Torr.
Cyperus Engelmanii Steud.
Cyperus erythrorhizos Muhl.
*Cyperus esculentus L.
Cyperus filicinus Vahl.
Cyperus filiculmis Vahl.
Cyperus flavescens L.
Cyperus Grayii Torr.
Cyperus Houghtonii Torr.
Cyperus iria L.
Cyperus odoratus L.
Cyperus ovularis (Michx.) Torr.
Cyperus retrorsos Chapm.
Cyperus strigosus L.
Cyperus tenuifolius (Steud.) Dendy
Dulichium arundinaceum (L.) Britt.
Eleocharis acicularis (L.) R. + S.
Eleocharis Engelmanni Steud.
Eleocharis equisetoides (Ell.) Torr.
Eleocharis geniculata (L.) R.+ S.
Eleocharis halophila Fern. + Brack.
Eleocharis intermedia (Muhl.) Schultes
Eleocharis melanocarpa Torr.
Eleocharis obtusa (Willd.) Schultes
Eleocharis obtusa (Willd.) Schultes
var. ellipsoidalis Fern.
Eleocharis olivacea Torr.
Eleocharis ovata (Roth) R. + S.
Eleocharis Robbinsii Oakes
Eleocharis rostellata Torr.
Eleocharis Smallii Britt.
Eleocharis tricostata Torr.
Eleocharis tuberculosa (Michx.) R. + S.
Eleocharis wolfi Gray
Eriophorum tenellum Nutt.
Eriophorum virginicum L.
Eriophorum viridicarinatum (Engelm.) Fern.
Fimbristylis autumnalis (L.) R. + S.
Fimbristylis caroliniana (Lam.) Fern.
Fimbristylis castanea (Michx.) Vahl.
Fuirena squarrosa Michx.
Hemicarpha micrantha (Vahl.) Pax.
Psilocarya nitens (Vahl.) Wood
Psilocarya scirpoides Torr.
Rhynchospora alba (L.) Vahl.
Rhynchospora capitellata (Michx.) Vahl.
Rhynchospora capitellata (Michx.) Vahl.
Rhynchospora globularis (Chapm.)
var. recognita Gale
Rhynchospora fusca (L.) Ait. f.
Rhynchospora glomerata (L.) Vahl.
Rhynchospora inundata (Oakes) Fern.)
Rhynchospora macrostachya Torr.
Rhynchospora pallida M.A. Curtis
Scirpus americanus Pers.
Scirpus atrovirens Willd.
Scirpus atrovirens Willd.
var. georgianus (Harper) Fern.
Scirpus cyperinus (L.) Kunthe
Scirpus heterochaetus Chase
Scirpus lineatus Michx.
Scirpus maritimis L.
var. Fernaldi (Bickn.) Beatle
Scirpus olneyi Gray
Scirpus paludosus Nels.
Scirpus polyphyllus Vahl.
Scirpus robustus Pursh.
Scirpus rubrotinctus Fern.
Scirpus smithii Gray
Scirpus subterminalis Torr.
Scirpus torreyi Olney
Scirpus validus Vahl.
Scirpus verecundus Fern.
Scleria pauciflora Muhl.
Scleria reticularis Michx.
Scleria triglomerata Michx.

ARACEAE

Acorus calamus L.
Arisaema dracontium (L.) Schott
Arisaema triphyllum (L.) Schott
Arisaema triphyllum (L.) Schott
forma pusillum (Peck) Fern.
Orontium aquaticum L.
Peltanda virginica (L.) Schott + Endl.
Symplocarpus foetidus (L.) Nutt.

LEMNACEAE

Lemna minor L.
Lemna trisulca L.
Lemna valdiviana Phil.
Spirodela polyrhiza (L.) Schleid.

XYRIDACEAE

Xyris caroliniana Walt.
Xyris flexuosa Muhl.

ERIOCAULACEAE
Eriocaulon septangulare With.
COMMELINACEAE
Commelina communis L.
Commelina virginica L.
Tradescantia virginiana L.
PONTEDERIACEAE
Pontederia cordata L.
JUNCACEAE
Juncus acuminatus Michx.
Juncus balticus Willd.
Juncus biflorus Ell.
Juncus brachycarpus Engelm.
Juncus brachycephalus (Engelm.) Buchenau
* Juncus bufonius L.
Juncus canadensis J. Gay
Juncus debilis Gray
Juncus dichotomus Ell.
Juncus dudleyi Wieg.
Juncus effusus L.
Juncus filiformis L.
Juncus gerardi Loisel.
Juncus grenei Oakes & Tuckerm.
Juncus marginatus Rostk.
Juncus maritimus Lam.
Juncus militaris Bigel.
Juncus pelocarpus Mey.
Juncus scirpoides Lam.
Juncus tenuis Willd.
Juncus torreyi Coville
Luzula campestris (L.) D.C.
Luzula multiflora (Retz) Lejeune
LILIACEAE
Aletris farinosa L.
Allium porrum L.
Allium tricoccum Ait.
* Allium canadense L.
Allium porrum L.
Allium tricoccum Ait.
Allium vineale L.
Amianthium muscaetoxicum (Walt.)
Asparagus officinalis L.
Chamaelirium luteum (L.) Gray
Convallaria majalis L.
Erythronium americanum Ker.
Hemerocallis fulva L.
Lilium canadense L.
Lilium philadelphicum L.
Lilium superbum L.
Maianthemum canadense Desf.
Medeola virginiana L.
Muscari botryoides (L.) Mill.
Muscari racemosum (L.) Mill.
Ornithogalum umbellatum L.
Polygonatum biflorum (Walt.) Ell.
Polygonatum canaliculatum (Muhl.) Pursh.
Polygonatum pubescens (Willel) Pursh.
Smilacina racemosa (L.) Desf.
Smilacina stellata (L.) Desf.
Smilax glauca Walt.
Smilax glauca Walt.
var. leurophylla Blake
Smilax herbacea L.
Smilax rotundifolia L.
Trillium cernum L.
Trillium erectum L.
Trillium erectum L.
var. album (Michx.) Pursh.
Trillium undulatum Willd.
Uvularia perfoliata L.
Uvularia pudica (Walt.) Fern.
var. nitida (Britt.) Fern.
Uvularia sessilifolia L.
Veratrum viride Ait.
Yucca filamentosa L.
Zigadenus leimonthoides Gray
HAEMODORACEAE
Lachnanthes tinctoria (Walt.) Ell.
DIOSCOREACEAE
Dioscorea villosa L.
AMARYLLIDACEAE
Hypoxis hirsuta (L.) Coville
IRIDACEDE
Belamcanda chinensis (L.) DC.
Iris prismatica Pursh.
Iris versicolor L.
Sisyrichium angustifolium Mill.
Sisyrinchium arenicola Bickn.
Sisyrinchium atlanticum Bickn.
Sisyrichium romangoffiana Cham.
Sisyrinchium tuberosa Raf.
Sisyrichium vernalis Engelm. & Gray
ORCHIDACEAE
Arethusa bulbosa
Calopogon pulchellus (Salis.) R. Br.
Corallorhiza maculata Raf.
Corallorhiza odontorhiza (Willd.) Nutt.
Corallorhiza trifida Chatelain
Cypripedium acaule Ait.
Cypripedium calceolus L.
var. parviflorum (Salisb.) Fern.
Goodyera calceolus L.
var. pubescens (Willd.) Correll
Goodyera repens (L.) R. Br.
Habenaria blephariglottis (Willd.) Hook
Habenaria ciliaris (L.) R. Br.
Habenaria clavellata (Michx.) Spreng.
Habenaria cristata (Michx.) R. Br.
Habenaria flava (L.) R. Br.
Habenaria lacera (Michx.) Lodd.
Habenaria psycodes (L.) Spreng.
Liparis lilifolia (L.) Richard
Liparis Loeseli (L.) Richard
Listera australis Lind.
Malaxis unifolia Michx.
Pogonia ophioglossoides (L.) Ker.
Spiranthes cernua (L.) Richard
Spiranthes gracillis (Bigel.) Beck.
Spiranthes lucida (H.H. Est.) Ames
Spiranthes praecox (Walt.) S. Wats.
Tipularia discolor (Pursh) Nutt.

THE WEEDS OF LONG ISLAND II. THE COMPOSITAE

Richard Stalter 1/

ABSTRACT

The present study 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. The compositae, the largest family of dicotyledonous plants on Long Island, is represented by fifty eight genera and two hundred three species.

INTRODUCTION

The earliest work on the flora of Long Island was initiated by Jellife (3), who listed approximately 1350 species of native vascular plants. Taylor compiled an unpublished list of 1694 plants that were native to Long Island in the 1920's. Other investigators have limited their work to restricted areas, e.g. the flora of Gardiner's Island. Fernald's (2) monumental work lists the names of taxonomists who have contributed to the understanding of the flora of the northeastern United States and includes keys to the flora indigenous to Long Island. The objective of the present study was to identify the genera and species of the compositae, the largest family of vascular 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 1978, and involved an intensive study of a large variety of sites on Long Island described by the author in the 1979 NEWSS Proceedings. These sites were visited by the author and his students and the taxa there were collected and identified. Additional help was provided by taxonomists on Long Island and New York City. Taxa in Long Island collections of the Brooklyn and Bronx Botanical Gardens were examined in compiling the present list.

RESULTS AND DISCUSSION

Fifty eight genera and two hundred three species of compositae have been identified. Many of these species are our

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most common weeds including the showy dandelion (Taraxacum officionale), bright yellow goldenrods (Solidago spp.) which are common in abandoned fields and roadsides and the ubiquitous Asters which add a dash of color to old fields. Like the goldenrods, Asters are an important species in plant succession (1, 4). Within the compositae are several genera that certainly deserve the connotation "weeds" since these unwanted genera are the bane of the owner of farms and pasture lands. These troublesome weeds are: Ambrosia artemisiifolia (ragweed), Artemisia vulgaris (mugwort), Cirsium arvense (Canada thistle), Erigeron canadensis (horseweed), Erigeron annuus (annual fleabane), Galinsoga parviflora (smallflower galinsoga), Matricaria matricariodes (pineappleweed), Senecio vulgaris (common groundsel), Taraxacum officionale (dandelion), and Xanthium spp. (common cocklebur). Of the species listed above, ragweed is particularly bothersome since it affects hayfever sufferers. In addition, ragweed rapidly invades old fields and may be strongly competitive with certain crops. Galinsoga matures rapidly and is often associated with vegetable crops.

The genus Cirsium, the unpalatable thistles, is more of a problem in pastures where grazing often enhances its success in competing with grasses and forbs. A list of the compositae follows. Classification follows that of Fernald (2). Important weeds are preceded by an asterisk (*).

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3. Jelliffe, S.E. 1899. The Flora of Long Island. The New Era Printing Company

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Table 1. The compositae of Long Island. An asterisk (*) preceeds troublesome weeds.

Species

Achillea millefolium L.
*Ambrosia artemisiifolia L.
Ambrosia trifida L.
Anaphalis margaritacea (L.) C.B. Clarke
Antennaria fallax Grune
Antennaria neglecta Grune
Antennaria neodioica Grune
Antennaria parlinii Fern.
Antennaria plantaginifolia (L.) Hook
Anthemis arvensis L.
Anthemis cotula L.
Arectium minus (Hill) Bernh.
Artemisia absinthium L.
Artemisia biennis Willd.
Artemisia caudata Michx.
Artemisia stelleriana Bess.
*Artemisia vulgaris L.
Aster acuminatus Michx.
Aster Concolor L.
Aster cordifolius L.
Aster divaricatus L.
Aster dumosus L.
Aster ericoides L.
Aster herveyi Gray
Aster infirmus Michx.
Aster laevis L.
Aster lateriflorus (L.) Britt.
Aster lineriifolius (L.)
Aster lowrieanus Porter
Aster macrophyllus L.
Aster nemoralis Ait.
Aster novae-angliae L.
Aster novi-belgii L.
Aster novi-belgii L.
var. elodes (T+G) Gray
Aster novi-belgii L.
var. litoreus Gray
Aster patens Ait.
Aster patens Ait. forma roseus Svenson
Aster praealtus Poir.
Aster puniceus L.
Aster puniceus L.
forma lucidulus (Gray) Fern.
Aster radula Ait.
Aster simplex Willd.
Aster spectabilis Ait.
Aster subulatus Michx.
Aster tataricus L.f.
Aster tenuifolius L.
Aster tradescanti L.
Aster umbellatus Mill.
Aster undulatus L.
Aster vimineus Lam.
Baccharis halimifolia L.
Bellis perennis L.
Bidens bipinnata L.
Bidens cernua L.
Bidens comosa (Gray) Weig.
Bidens connata Muhl.
Bidens coronata (L.) Britt.
var. tenuiloba Fern
Bidens coronata (L.) Britt.
var. trichosperma (Michx.) Fern.
Bidens discoides (T.+G.) Britt.
Bidens frondosa L.
Bidens laevis (L.) BSP.
Carduus nutans L.
Centaurea calcitrapa L.
Centaurea cyanus L.
Centaurea jacea L.
Centaurea maculosa Lam.
Centaurea nigra L.
Chrysanthemum leucanthemum L.
Chrysanthemum parthenium (L.) Bernh.
Chrysopsis falcata (Pursh.) Ell.
Chrysopsis graminifolia (Michx.) Ell.
Chrysopsis horridulum Michx.
Chrysopsis mariana (L.) Ell.
Cichorium intybus L.
*Cirsium arvense (L.) Scop.
Cirsium discolor (Muhl.) Spreng.
Cirsium muticum Michx.
Cirsium pumilum (Nutt.) Spreng.
Cirsium vulgare (Savi) Tenore
Coreopsis grandiflora Hogg
Coreopsis rosea Nutt.
Coreopsis tripteris L.
Cosmos bipinnatus Cav.
Crepis capillaris (L.) Wallr.
Echinacea purpurea (L.) Moench
Eclipta alba (L.) Hassk.
Erectites hieracifolia (L.) Raf.
*Erigeron annuus (L.) Pers.
*Erigeron canadensis L.
Erigeron philadelphicus L.
Erigeron pulchellus Michx.
Erigeron strigosus Muhl.
Eupatorium album L.
Eupatorium aromaticum L.
Eupatorium dubium Willd.
Eupatorium hyssopifolium L.
Eupatorium hyssopifolium L.
var. laciniatum Gray
Eupatorium leucolepsis (DC) T.+G.
Eupatorium perfoliatum L.
Eupatorium pilosum Walt.
Eupatorium pubescens Muhl.
Eupatorium purpureum L.

Eupatorium rotundifolium L.
Eupatorium rugosum Houtt.
Eupatorium sessilifolium L.
*Galinsoga parviflora Cav.
Gnaphalium macounii Greene
Gnaphalium obtusifolium L.
var. praecox Fern.
Gnaphalium obtusifolium L.
var. helleri (Britt.) Blake
Gnaphalium purpureum L.
Gnaphalium uliginosum L.
Helenium autumnale L.
Helianthus angustifolius L.
Helianthus ennuus L.
Helianthus decapetalus L.
Helianthus divaricatus L.
Helianthus giganteus L.
Helianthus mollis Lam.
Helianthus strumosus L.
Helianthus trachelifolius Mill.
Helianthus tuberosus L.
Heliopsis helianthoides (L.) Sweet
Hieracium aurantiacum L.
Hieracium gronovii L.
Hieracium marianum Willd.
Hieracium murorum L.
Hieracium paniculatum L.
Hieracium pilosella L.
Hieracium pratense Tausch
Hieracium scabrum Michx.
Hieracium venosum L.
Hieracium vulgatum Fries
Hypocheris radicata L.
Inula helenium L.
Iva frutescens L.
Krigia biflora (Walt.) Blake
Krigia virginica (L.) Willd.
Lactuca biennus (Moench) Fern.
Lactuca canadensis L.
Lactuca hirsuta Muhl.
Lactuca pulchella (Pursh.) DC.
Lactuca scariola L.
Lapsana communis L.
Leontodon autumnalis L.
Liatris borealis Nutt.
Liatris graminifolia (Walt.) Willd.
Liatris scariosa (L.) Willd.
Liatris spicata (L.) Willd.
Matricaria chamomilla L.
Matricaria maritima L.
*Matricaria matricarioides (Less.) Porter
Mikania scandens (L.) Willd.
Onopordum acanthium L.
Picris hieracioides L.
Pluchea camphorata (L.) DC.
Prenanthes alba L.
Prenanthes altissima L.
Prenanthes racemosa Michx.
Prenanthes serpentaria Pursh
Prenanthes trifoliolata (Cass.) Fern.
Rudbeckia fulgida Ait.
Rudbeckia hirta L.
Rudbeckia laciniata L.
Rudbeckia triloba L.
Senecio aureus L.
Senecio obovatus Muhl.
Senecio pauperculus Michx.
var. balsamitae (Muhl.) Fern.
*Senecio vulgaris L.
Sericocarpus asteroides (L.) BSP.
Sericocarpus linifolius (L.) BSP.
Silphium perfoliatum L.
Solidago altissima L.
Solidago arguta Ait.
Solidago bicolor L.
Solidago caesia L.
Solidago canadensis L.
Solidago elliottii T.+G.
Solidago erecta Pursh.
Solidago flexicaulis L.
Solidago gigantea Ait.
Solidago gigantea Ait.
var. leiophylla Fern.
Solidago graminifolia (L.) Salisb.
Solidago hispida Muhl.
Solidago juncea Ait.
Solidago microcephala (Greene) Bush
Solidago nemoralis Ait.
Solidago odora Ait.
Solidago patula Muhl.
Solidago puberula Nutt.
Solidago rigida L.
Solidago rugosa Ait.
Solidago rugosa Ait.
var. aspera (Ait.) Fern.
Solidago rugosa Ait.
var. sphagnophila Graves
Solidago sempervirens L.
Solidago speciosa Nutt.
Solidago tenuifolia Pursh
Solidago uliginosa Nutt.
Solidago uliginosa Nutt.
var. linoides (T.+G.) Fern.
Solidago ulmifolia Muhl.
Sonchus arvensis L.
*Sonchus asper (L.) Hill
Sonchus oleraceus L.
Tagetes erecta L.
Tanacetum vulgare L.
*Taraxacum officinale Weber
Tragopogon major Jacq.
Tragopogon pratensis L.
Tussilago farfara L.
Vernonia noviboracensis (L.) Michx.
Xanthium chinense Mill.
Xanthium echinatum Murr.
Xanthium italicum Morretti
Xanthium spinosum L.
*Xanthium strumarium L.

UTILIZATION OF AXENIC CULTURE IN ALLELOPATHIC STUDIES

M. M. Reynders and W. B. Duke [1/]

ABSTRACT

In general, allelopathic research has primarily been conducted from an ecological point of view. Observations have been made out in the field, and when factors involving competition - light, nutrients, moisture, pH, etc. - have been ruled out, allelopathy was ruled in. In recent years, we have been concerned with developing the methodology to observe plant-plant interactions in an environment where competitive factors, on the whole, can be eliminated.

Initial work on this system was begun by David Melrod, a previous graduate student. Utilizing agar as a media, he determined that known allelopathic compounds could be incorporated into agar, and subsequently extracted with various solvents. Yields were as high as 80%. The extracts were assayed spectrophotometrically as well as by thin layer chromatography to determine that the compounds had not been altered in the incorporation and extraction processes. Since the results of these experiments were positive for the utilization of agar with allelopathic compounds cited in literature, this method was used in this work.

Different genera of plants were grown aseptically in agar in test tubes at growth chamber conditions for 2 to 3 weeks. The potential donor plants were extricated from the test tubes and were replaced with another plant. After repeated trials, agar in which field bindweed had been initially grown was found to be highly allelopathic to the growth of redroot pigweed. The detrimental effects to pigweed growth has been observed in 100% of the experiments.

Results of experiments have shown that the compound is extremely thermal-stable since heating (90 C) the bindweed agar has no effect on the toxicity nor does autoclaving (120 C, 15 psi for 15 min.).

Further research is being undertaken to extract the allelopathic compound from the agar media.

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THE BLOCKING OF CAROTENOID SYNTHESIS IN CORN WITH THE EXPERIMENTAL HERBICIDE R-40244

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ABSTRACT

The experimental herbicide R-40244 (1-[m-trifluoromethylphenyl]-3-chloro-4-chloromethyl-2-pyrrolidone) dramatically reduces chlorophyll production in corn (Zea mays L. 'Merit'). A 40% loss of chlorophyll content was recorded in corn seedlings treated with 320 uM R-40244. Carotenoid production was also inhibited by R-40244, 320 uM of the herbicide causing a 44% reduction in corn. The inhibition of carotenoid production which, in turn, allows chlorophyll to be photooxidized, may represent the mode of action of R-40244.

INTRODUCTION

Preemergence and postemergence control of a number of annual grass and broadleaf weeds has been demonstrated with the experimental herbicide R-40244. (7). Plants treated with R-40244 typically respond with extensive chlorotic development followed by necrosis of the effected tissue. This type of response has also been observed in plants treated with the herbicides norflurazon (4-chloro-5-[methylamino-]-2-[α,α,α trifluoro-m-

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tolyl]-3(2H)-pyridazinone) and fluridone (1-methyl-3-phenyl-5-[3-trifluromethylphenyl]-4(1H)-pyridinone). Chlorophyll destruction in plants treated with norflurazon or fluridone is caused by the herbicides blocking carotenoid synthesis (3,5,6, 10). Our data suggests that this is also the way R-40244 causes chlorosis.

MATERIALS AND METHODS

Corn seeds were imbibed for 6 hr in solutions of R-40244 containing 3.2, 32, 320, and 1600 uM (w/v) of the herbicide. The imbibed seeds were then sown in styrofoam pots containing pre-wet vermiculite and placed in a growth chamber (Confiron Model E-7) where constant conditions of light (white, 10.8 klux, continuous) and temperature (25±1°C) were maintained. Eight high-output fluorescent lamps (F48T 12-CW-HO) and four 60-W incandescent light bulbs provided the light source. After 6 days of growth corn seedlings were collected for measurements and the extraction of chlorophyll and carotenoid pigments. All experiments were replicated four times.

Chlorophyll and carotenoid extractions were done according to the methods of Devlin et al. (5). The amount of chlorophyll present in the extracts was calculated according to the equations of Arnon et al. (2) and the amount of carotenoid present according to the equation of Schnarrenberger and Mohr (9).

RESULTS

Seedlings treated with 3.2 uM R-40244 did not show a drop in chlorophyll content. However, chlorotic development could be observed soon after the emergence of the shoot from seeds treated with 32 uM of the herbicide (Table 1). Compared to untreated seedlings, corn seedlings treated with 32 uM R-40244 showed a 5% decrease in chlorophyll content. Corn seedlings treated with 320 uM R-40244 were partially bleached, a 40% drop in chlorophyll content being observed (Table 1). At the highest concentration of R-40244 tested (1600 uM), there was an 81% drop in chlorophyll content. Both chlorophyll a and chlorophyll b diminished proportionately with the total chlorophyll content (Table 1).

Chlorophyll loss due to R-40244 was accompanied by a con-

comitant loss in carotenoid content. For example, corn seedlings treated with 320 uM R-40244 showed a 44% drop in carotenoids (Table 1). Under the same circumstances a 39% decrease in chlorophyll was observed (Table 1).

Table 1. Effect of R-40244 on the chlorophyll and carotenoid content of corn seedlings 6 days after germination. Pigment data is presented as ug/g fresh tissue.

R-40244	Chl a	Chl b	Total Chl	Carotenoid
0	864	152	1015	28.3
3.2	824	187	1010	24.4
32	788	174	963	23.3
320	516	101	617	15.7
1600	174	15	190	9.6
LSD 1%	111	63	99	2.3
5%	81	46	72	1.7

In addition to its influence on chlorophyll and carotenoid production, R-40244 had an inhibitory effect on shoot length. At the highest concentration applied (1600 uM) growth of corn shoots was inhibited 18%. Root growth was not affected (Table 2).

DISCUSSION

Considerable reduction in chlorophyll content occurs in corn seedlings treated with R-40244. One way to reduce chlorophyll content is to block carotenoid synthesis as has been shown with the herbicides norflurazon (5,3,10) and fluridone (3,6). The presence of carotenoids in green plant tissue is necessary to protect chlorophyll from photooxidation (1,4,8). Since R-40244 dramatically reduces carotenoid content in corn, the drop in chlorophyll content in those plants treated with R-40244 is most likely due to the photooxidation of chlorophyll.

Table 2. Effect of R-40244 on the root and shoot lengths (mm) of corn 6 days after germination.

R-40244 (uM)	Shoot	Root
0	90	146
3.2	89	146
32	84	136
320	81	140
1600	74	145
LSD 1%	6	15
5%	4	11

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ANATOMICAL ASPECTS OF 2,4-DB TOLERANCE IN SOYBEAN

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ABSTRACT

The herbicide 2,4-DB is widely used for postemergence control of morningglory (Ipomoea spp.) in soybean (Glycine max Merrill) fields. Most often it is applied as a directed spray. However, the need for morningglory control in narrow-row and close-planted soybeans, and the relative economy of 2,4-DB, suggest the desirability of overhead, broadcast application.

Resistance to 2,4-DB in the Leguminosae is based on minimizing the formation of herbicidally active 2,4-D from 2,4-DB. This is accomplished by reduced rates of beta oxidation, and by the formation of long-chain homologues that are not herbicidally active (D.L.Linscott et al., 1968, J. Agr. Food Chem. 16:844-848). Yet, some soybean injury results, with symptoms that include stem and leaf epinasty, delayed maturity, and stem diameter enlargement. The purpose of this study was to investigate the effects of 2,4-DB on soybean stem anatomy.

Greenhouse-grown soybean plants (var. 'Celest') were overhead sprayed at 27 days after planting, with an aqueous solution of the dimethyl amine salt of 2,4-DB at 0 and 0.56 kg acid equivalent/hectare. At 2, 4, 8 and 15 days post-treatment, plants were harvested and a portion of the internode below the unifoliate leaves was prepared for microscopic study.

Findings included the following:

1. Stem cortex area is converted to callus-like tissue. By the 15th day, the cross-sectional area of cortex has increased 3-fold in 2,4-DB treated plants.

2. No changes due to treatment are detected in the cross-sectional areas of the xylem and the pith.

3. By 15 days, total phloem cross-sectional area is greatly increased in 2,4-DB treated plants. However, 2,4-DB induces cell division and enlargement that obliterates the conducting phloem of the metaphloem and early secondary phloem, thereby shortening the life of the conducting phloem cells. Similar observations were made in an earlier study of the action of 2,4-D on peas (A. J. Eames, 1950, Am. J. Bot. 37:840-847).

4. Accelerated differentiation of secondary conducting phloem in 2,4-DB treated plants compensates for phloem obliteration, so that the cross-sectional area of conducting phloem is the same as in control plants. This enhanced differentiation appears to be an additional, anatomical mechanism of resistance to 2,4-DB in legumes, which they do not have against 2,4-D.

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WEEDS OF THE WORLD. IIe., THE WEEDS OF AFRICA SOUTH OF THE SAHARA - A SUMMARY

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ABSTRACT

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 alphabetical checklist of 606 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 were also included.

INTRODUCTION

The present study is a summary of one section of a long-term project on "Weeds of the World" (10-19). The weed checklist of "Africa South of the Sahara" (19) 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. (7) and of Reed (22) with their excellent bibliographies should also be consulted.

The African continent (11,586,000 square miles) is the second largest continent - comprising 20 percent of the land area of the world. It is about three times the area of Europe, and is considered a great peninsula of the Eurasian continent. According to Hutchinson (8) there are in Africa about 3,712 genera and over 40,000 species of flowering plants. An estimate of 20,530 has been placed for the number of species in the Union of South Africa (471,443 square miles).

From an agricultural standpoint the more productive area of the African continent is the vast area lying to the south of the Sahara desert - comprising somewhat less than one-half the area of the entire continent. Africa is now believed to have been part of an ancient continent which included most of South America, India and Australia.

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The swamp vegetation becomes noxious principally through restriction of navigation. Reference has already been made in a preceding study to the Papyrus swamps of the Sudd area, and of Uganda (see, Carter, 4). Pichi-Sermolli (see, 19) in his ecological survey of tropical East Africa recognized several types of swamps, including the grass swamp (with Phragmites communis); the rush swamps (chiefly with Typha australis); the reed swamps (Cyperus papyrus var. antiquorum, and C. immensus); and others. The vast areas of the Congo River infested with the water hyacinth (Eichhornia crassipes) have been studied by Robyns (see, 19) and others. The latter species had first been observed in the river in 1954, but probably had been introduced during 1950-1951.

In his preface to the weeds of Rhodesia, Wild (23) notes that in this country European farming has gone on for two generations at the most and the land is only just beginning to become adapted to a new range of crops. In a large percentage of cases the land was virgin savanna woodland, until recently, or was subject to shifting native cultivation only. This has meant that new weeds were introduced at a rapid rate over the last 50 or 60 years and at the same time some of the indigenous species adapted themselves for the first time as weeds.

An outstanding feature of weed control in South Africa has been the biological control of the prickly pear cactus (Opuntia spp.). This work has been reviewed by Pettey (20) and others.

For the size of the vast area here considered only a small number of weed publications was utilized for the checklist when the first draft was prepared (late 1950's) - and they were about the only ones available at that time. Adams and Baker's extensive list for Ghana (1) published in 1966 has added immeasurably to the species covered in the present checklist. However, the weed publications for this region have become quite extensive and are well surveyed in the bibliographies of Holms et al., "The World's Worst Weeds" (7) and in Reed's "Economically Important Foreign Weeds," also published in 1977. A selection of a few other important weed publications is included in the literature cited for this paper (3, 6, 9). Except as noted below they were not utilized in the preparation of the present checklist. Thus this study is only a beginning; others perhaps will contribute to its eventual completion.

The checklist of African weeds has been compiled from a large number of sources. A list of 100 weeds from Rhodesia has been taken from the publication of Wild (23), and the list of weeds from the Union of South Africa was obtained from Philips (21). Some material has been taken from papers in the

1950 Proceedings of the South African Weed Control Conference and the 1957 Proceedings of the First East African Herbicide Conference. The weeds of Kenya were obtained from the publications of Bogdan (2) and of Cunningham-van Someren (5). A few references to the weeds of Madagascar (Malagasy) and Mauritius have also been included. For Mauritius note the publications of Rochecuste: the biotypes of Cynodon dactylon (10, p. 259); his studies of weeds in the genera Hydrocotyle, Centella, Heliotropum and Plantago; and his survey of weeds of sugarcane (22, pp. 712-713).

See Holm et al. (7) for a review of such serious African and world-wide weeds as the aquatic plants (Salvinia fern, Pistia and Eichhornia), as well as Lantana, Cyperus spp. and others. The parasitic witchweed, Striga lutea, is also considered in detail by these authors. See Wild (24) for a survey of harmful aquatic plants.

DISCUSSION AND SUMMARY

The total number of species and varieties listed as weeds or ruderals in the checklist for this area totals 606. If this total should represent 10 percent of the entire vascular flora, then the vascular flora for this vast region might comprise some 6,060 species and varieties - a number far below the total number of species for the region, or for the Union of South Africa noted above.

A survey of the genera represented by generally six or more species (indicated by the number in parentheses) includes the following:

Acacia (19) (Leguminosae)
Centaurea (8) (Compositae)
Chenopodium (11) (Chenopodiaceae)
Crotalaria (7) (Leguminosae)
Cyathula (8) (Amaranthaceae)
Cyperus (13) (Cyperaceae)
Digitaria (6) (Gramineae)
Euphorbia (8) (Euphorbiaceae)
Eragrostis (6) (Gramineae)
Heliotropum (6) (Boraginaceae)
Opuntia (6) (Cactaceae)
Oxalis (8) (Oxalidaceae)
Senecio (10) (Compositae)
Sida (7) (Malvaceae)
Solanum (10) (Solanaceae)
Sonchus (6) (Compositae)
Striga (5) (Scrophulariaceae)
Typha (5) (Typhaceae)

Some principal plant families represented by generally large numbers of genera include:

Boraginaceae (11)
Compositae (16)
Gramineae (26)
Leguminosae (26)
Polygonaceae (10)

Africa, South of the Sahara, is such a vast and diversified area that any summary is most difficult. Some attempt to summarize certain regional problems may be found in the introduction to the checklist (19).

ACKNOWLEDGMENTS

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COMPETITION BETWEEN PEAS AND BROADLEAF WEEDS

A. S. McCue and P. L. Minotti[1/]

ABSTRACT

A two year study was conducted to elucidate competitive interactions between peas and two broadleaf weeds, redroot pigweed and common lambsquarters. Factors studied were crop and weed populations, duration and timing of weed competition, competitiveness of pea cultivars and growth analysis of crop and weeds at various intervals in both a competitive and non-competitive situation. General methods involved sowing Early Sweet 11, a tall early maturing cultivar in 18 cm rows.

Populations. In 1977 peas were sown in both 18 and 36 cm rows. Increased pea density resulted in higher yields and decreased weed competition. On a per plant basis, however, peas in 36 cm rows had greater fresh and dry weight, more pods, and a higher pea yield. In 1978, three weed population levels were designated according to natural stand. At final harvest, weed alone plots produced 129, 73, 60 weeds/m^2 whereas in competition with peas, weed densities were reduced to 52, 50, 27/m^2. Due to pea competitiveness, weeds at any density had no significant effect in this experiment.

Duration. Critical period studies were conducted both years where plots were maintained weed free or weedy for selected 10 day intervals and multiples thereof. Pea yields were reduced an average of 30% while weed yields were reduced by 80% from all season interspecific interference. If peas were maintained weed free for the first 30-40 days later emerging weeds were effectively suppressed and no pea yield reduction occurred.

Cultivars. In 1978, pea cultivars including Early Sweet 11, Sparkle (an early dwarf), Dark Skin Perfection (a late dwarf) and B372-156 (a semi-leafless variety) were grown alone and with weeds. Sparkle was the most competitive suffering a 23% yield reduction compared to Early Sweet 11 at 37%, Dark Skin Perfection at 48% and B372-156 at 55%. Weed growth reductions due to the pea varieties were 61%, 32%, 34% and 44%, respectively.

Growth analysis. At 10 day intervals destructive harvests were taken of peas alone, weeds alone and peas and weeds in competition. In 1977 pea growth was not significantly reduced at any stage by weeds. In 1978 pea growth was significantly reduced by the 40 and 50 day stage. In both years a pea caused decrease in weed growth was evident by 30 days.

The pea plants' competitiveness against these broadleaves is attributed to large seed size, fast emergence at lower temperatures, rapid early growth, dense population, general morphology, general adaptability to spring conditions. In spite of excellent crop competitiveness overall reductions in pea growth and yield were substantial enough to warrant weed control measures.

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YELLOW NUTSEDGE COMPETITION IN SEEDED TOMATOES

C. E. Beste[1/]

ABSTRACT

A three year study with seeded tomatoes ('Campbell 28') and yellow nutsedge (Cyperus esculentus L.) has shown thata six week yellow nutsedge-free period after planting was required to prevent yield reductions. Early yields were not significantly reduced if the yellow nutsedge-free period was three weeks. The study was conducted on a Norfolk loamy sand with 0.6% organic matter and the yellow nutsedge population was 20 plants per sq. ft. Diphenamide was applied preemergence and all other weeds were removed to permit only yellow nutsedge competition.

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COMPETITION BETWEEN RED KIDNEY BEANS AND ANNUAL BROADLEAF WEEDS

A. F. Senesac and P. L. Minotti[1/]

ABSTRACT

Two field experiments were designed to examine the effects of time and duration of weed competition on red kidney dry beans. In one experiment, Redkloud dry beans were planted on Eel Silt loam which was heavily infested with Galinsoga spp. In some plots, the beans were maintained weedfree by weekly hand hoeing for specified time periods (two-week intervals), while in other plots, weeds were allowed to grow before being removed at two-week intervals. The second experiment, a follow-up on 1977 work, was similarly designed except that the beans were planted on Howard gravelly loam which had a heavy infestation of redroot pigweed.

Redkloud was able to tolerate the presence of Galinsoga for the first six weeks if the crop was maintained weedfree for the remainder of the season. Conversely, if the crop was weedfree for the first four weeks, subsequent weed growth did not significantly reduce bean yields. Redroot pigweed, on the other hand, caused some yield loss if allowed to compete for the first four weeks. However, if Redkloud was weedfree for the first four weeks then late season pigweed growth did not reduce yields.

Full season competition with redroot pigweed reduced bean yield by 90% while full season Galinsoga competition reduced yields by 45%. Full season bean competition reduced pigweed yields by 20% and Galinsoga yields by 45%. One thorough hand weeding at four weeks was sufficient to avoid yield loss with Galinsoga but not with pigweed. Factors contributing to differences betwen competitive ability of the two species include time of emergence, gross morphology and growth rate.

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LIVING MULCH: A PRELIMINARY REPORT ON GRASSY COVER CROPS INTERPLANTED WITH VEGETABLES

B. J. Hughes and R. D. Sweet[1/]

ABSTRACT

Continuous vegetable cropping has caused serious problems on many New York soils. Excessive tillage and insufficient return of organic matter has increased soil compaction and erosion by wind and water and has contributed to decreased organic matter reserves. One possible solution to these problems is a management system based on a concept we are calling "living mulch". As foreseen at this time, a cover crop planted in either the spring or fall would be grown simultaneously with vegetables in a reduced tillage system. Management of the cover by chemical or cultural practices to prevent significant competition with the crop for water, nutrients and light would be essential. Advantages of this system would be: 1) continuous ground cover especially important for establishment of tender plants, 2) erosion control, 3) reduction of leaching losses, 4) increased organic matter return, 5) less energy consumption in terms of fuel for tillage and chemicals, and 6) possibly decreased disease, insect, and weed problems as shown by some multiple cropping systems.

During 1978 preliminary experiments were conducted to study the regulation of grassy cover crops. Chemicals were applied in the spring to fall seeded perennial ryegrass and wheat. HOE 29152 and diclofop gave excellent growth suppression of perennial ryegrass. Growth ceased at time of application and the cover gradually turned brown, but remained upright. Renewal of growth occurred late in the season. Broadleaf weeds were effectively controlled in plots with dense covers; however, covers treated with glyphosate or paraquat disintegrated to a much greater degree allowing broadleaf weeds to become rapidly established. HOE 29152 effectively suppressed wheat, but the cover it provided was not dense enough to shade out weeds.

Cabbage and beets were interplanted into spring seeded oats, rye, and perennial ryegrass. Rates determined by preliminary log tests to be satisfactory for regulation of cover crops rather than kill were not satisfactory in this test. In most cases the low rates had little or no effect while higher rates killed the cover too rapidly. In cases where the covers were not stunted, competition was great and yield of vegetables was unacceptable. Although too competitive with vegetables, the covers did give excellent control of broadleaf weeds which flourished in no cover plots.

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INFLUENCE OF VARIETY AND SPACING OF POTATOES ON YIELD AND WEED SUPPRESSION

A. K. M. Amzad Hossain and P. L. Minotti[1/]

ABSTRACT

Two potato varieties, Hudson and Katahdin, were previously shown to differ substantially in their competitive ability against weeds at standard spacing. In this study they were compared at three different in the row spacings (15, 25 and 35 cm) as to their effect on broadleaf weeds and their ability to yield in both weedy and weed free situations.

Hudson was more competitive than Katahdin at all spacings. Hudson emerged earlier, was more extensively branched and in the early stages, exhibited more leaf area per hill, all contributing to greater light interception at the base of the plants. Close spacing increased competitiveness of both varieties but the spacing effect was more dramatic with the less competitive Katahdin. Thus although differences in varietal performance against weeds were minimized by closer spacing they still existed. The combination of competitive variety, close spacing and a hilling operation provided enough weed control to avoid tuber yield losses from in the row broadleaves in this experiment.

Yields of the two varieties were comparable in weed free situations which suggests that the canopy characteristics of Hudson which allow it to effectively suppress weeds (in addition to early emergence) may not be inconsistent with canopy characteristics which contribute to high yields at high populations.

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Table 1. Phenylalanine and tyrosine reversal of inhibition of alfalfa callus growth by glyphosate. Average fresh weight in grams per plate of five alfalfa calli.

Treatments:	Experiment No. 1	2	3	4
1. 0.1 mM phenylalanine + 0.1 mM tyrosine	3.35a	1.99a	5.17a	5.23a
2. 1 mM phenylalanine + 1 mM tyrosine	3.30a	2.57b	4.84a	4.90a
3. 0.1 mM phenylalanine + 1 mM tyrosine + 1 mM glyphosate	2.34b	0.36c	0.67b	0.88b
4. 1 mM phenylalanine + 1 mM tyrosine + 1 mM glyphosate	2.56b	0.87d	2.07c	2.00c
5. Control without glyphosate or amino acids	3.21a	1.86a	5.02a	4.89a
6. Control with 1 mM glyphosate	2.30b	0.29c	0.49b	0.85b
Protected LSD:	0.64	0.43	0.51	0.69

Significant differences are indicated by values followed by differing letters. The experiments each have their own LSD value.

BIOLOGICAL CONTROL OF HEDGE BINDWEEDS ON LONG ISLAND

G. W. Selleck[1/]

ABSTRACT

Larvae of the Argus Tortoise Beetle consumed all leaves of hedge bindweed in about 2 ha in an abandoned field, and about 1 ha in volunteer field of rye. Only a few plants around the perimeter of a dense infestation escaped depredation from larvae, to be consumed later by adults. Larvae selected plants such as goldenrod for pupation. Adult beetles which emerged in about 7 days attacked the bindweed which infested an adjoining field of sweet corn. The 24 rows of corn was completely cleaned of bindweed within 10 days.

Larvae and adults were successfully transferred to hedge and/or field bindweed infesting ornamental crops and vegetables. The fact that the Tortoise Beetle feeds only on plants on the Convolvulaceae family makes it an interesting candidate for the control of bindweed and morningglory in areas and crops where insecticides are not used during periods of larval and adult feeding.

INTRODUCTION

Bindweed, particularly field bindweed is one of the most prevalent and difficult to control perennial weeds in North America and Europe. The weeds are troublesome in cereals, fruit and ornamental crops and are virtually impossible to control in potatoes (*Solanum tuberosum* L.). Hedge bindweed (*Convolvulus sepium* L.) infests waste places, roadsides, nurseries, and some cropland on Long Island. Roadsides and waste places serve as common sources of re-infestation for cropland. The Argus Tortoise Beetle (*Chelymorpha cassidea* Fabr.) a native of U. S. and occurring in Canada, was first reported by Fabricius in 1975. According to early reports, this insect feeds on bindweeds, morningglory (*Ipomoea* spp.) and in 1919 was reported as a pest on sweet potato (*Ipomoea batatas*) (1). The species is distributed over a wide area of the United States from Washington to Texas, Florida, the Northeastern states and the eastern tier of the Midwestern states. Although the insect has been observed on many plants including corn, cabbage, strawberries, raspberries and goldenrod, members of the family Convolvulaceae are considered to be the sole source of food for the Argus Tortoise Beetle (1).

This insect is prey for at least 14 species of birds, particularly the starling (Sturnus vulgaris), and kingbird (*Tyrannus tyrannus*). Insect parasites include an egg parasite (*Emersonella niveipes* Gir.), a minute chalcidoid, a parasitic fly on larvae (*Masicera exilis* Coq.) and a larvae-eating bug (*Apateicus bracteatus* Fitch.) (1).

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METHOD AND MATERIALS

An ecological study of Argus Tortoise Beetle was conducted from May to August 1977 and during 1978 in hedge bindweed and associated plants on an abandoned field and in horticultural crops on Long Island, New York. Observations included insect predation of hedge bindweed infesting rye and sweet corn, as well as a beetle migration into sweet potatoes.

The insect was reared in the laboratory from emergence of the egg through larval and pupal stages to mature adults on fresh leaves of hedge and field bindweeds. Leaves of Irish potatoes, field dodder (Cuscuta campestris Yunck) and the tuber of sweet potato were selected also as a potential source of food. Larvae and beetles were transferred to corn, zucchini, rye, pine, grape, Rhododendron, Euomymus and Pachysandra at six locations infested with hedge or field bindweed to assess adaptability and establishment of new colonies.

RESULTS

Field studies

In May of 1977, mature beetles, eggs and larvae were observed on hedge bindweed plants comprising an area of about 0.5 ha. Beetles were present on several weeds including mustards (Brassica spp.), goldenrod (Solidago spp.), and ladysthumb (Polygonum persicaria L.), but eggs were laid only on the undersides of hedge bindweed leaves. From early May to mid-July, larvae developed from 1 mm to 1 cm long, during which time an area approximately 7 x 7 m^2 of bindweed was decimated. Annual grasses and forbs subsequently competed intensively in this small area of denudation, and regrowth of hedge bindweed did not occur throughout the remainder of the 1977 season (3). Tortoise beetles were observed feeding on hedge bindweed in the surrounding area until mid-August, at which time adults disappeared. Several ha of bindweed flowered, matured and set seed.

In late May of 1978, adult Tortoise beetles were observed to be copulating and laying eggs on hedge bindweed plants in an area of approximately 2.5 ha. Within a week larvae were hatching and consuming tender, new leaves. Egg-laying continued until late June, but by mid-June some plants were virtually stripped of their leaves, and larvae had developed to approximately 1 cm in length. The cycle of development also included bindweed in an adjacent field of rye, and developing larvae effectively released the plants from entwining bindweeds. By the end of June, adult beetles had virtually disappeared, and the main infestation of bindweed was completely defoliated by the golden-hued larvae. The larvae selected such plants as goldenrod, milkweed (Asclepias), bindweed stems, rye leaves or plot stakes for pupation. Pale-yellow pupae were evident June 27, and were common by July 1. On this date, bindweed plants intact with leaves could be found only on the perimeter of the main infestation.

By July 9 most pupae had metamorphosed to pale yellow adult beetles. After a day or two, these adults migrated on foot to remaining bindweeds and

began to feed. By July 12, every single bindweed was defoliated in the entire area, and hence beetles migrated into sweet potatoes nearby. Because of the overwhelming population, an application of foliar insecticide although effective, failed to protect the plants. Approximately 50 ml of beetles died of poisoning at the base of each plant. The invading beetles also discovered hedge bindweed in an adjoining field of sweet corn about 20 cm tall. Although cultivated between the rows, and tilled 6 times prior to planting, the bindweed had reached 12 to 15 cm tall within rows, and were entwined about the corn plants. Within 10 days, hordes of adult beetles had consumed the bindweed across 24 rows, releasing the sweet corn for commercial production. On July 23, most of the population had wandered away, with only a few beetles remaining in the tall corn, and a few others attacking emerging bindweed in late corn plantings. On the abandoned field, dead beetles were prevalent everywhere, and live ones were extremely difficult to find. There was no indication of any egg-laying by the adults, and at the end of July, live specimens of either Tortoise beetle or bindweed were rare indeed.

Throughout the season, mature beetles were often found on grasses and several other species including grape, rye, milkweed (Asclepias), and goldenrod as well as lambsquarters (Chenopodium album L.), wild mustard (Brassica kaber (D.C.), and ladysthumb, but there was no sign of feeding on the foliage of any of the plants. The masses of dead beetles in the area confirm observations that the insect cannot survive on plants other than members of the morningglory family.

A few beetles (only one find in 20 samples) which appeared dormant were found beneath the debris among bindweed rhizomes on July 30. Proliferation of shoots at nodes on rhizomes examined at 20 locations suggested that beetles had repeatedly consumed emerging shoots. In the abandoned field and in rye where hedge bindweed was attacked by both larvae and adult beetles, regrowth from rhizomes occurred in less than 1% of the area by September 18, and about 10% by October 10. Regrowth was more evident where vegetative competition was lacking, and more prevalent where bindweed was disturbed by vehicular traffic. On the other hand, corn which was freed of bindweed by adult beetles on July 23, was regrown with bindweed from rhizomes by September 18. On October 10, bindweed in the corn was 75 to 100 cm tall. Regrowth in this field occurred seven times following cultivation and defoliation.

Tortoise beetle larvae (ranging in length from 4 to 15 mm) were transferred to a field bindweed infestation and to hedge bindweed at three locations, one in sweet corn and zucchini, one in rye, and one in an abandoned field. Specimens transferred to the abandoned field failed to survive because of nearby applications of foliar insecticides in potatoes. The larvae demolished the hedge bindweed in corn and zucchini. In the rye, larvae pupated and produced adults which also fed on the bindweed.

Mature first generation beetles were transferred to hedge bindweed in pines, grapes, rye, corn, Euonymus, Rhododendron, and Pachysandra, and in abandoned fields at 3 locations on July 9. Beetles began to feed at the new locations on ornamentals, in pines and in corn, and survived at the new locations except in one in which foliar insecticides were applied nearby. Although some copulation was observed, there was no sign of egg-laying by first

generation beetles at any of the locations. By the first week in August, the beetles had disappeared from these locations, even though bindweed foliage was still abundant.

Laboratory studies

Egg clusters on hedge bindweed leaves, and hatched larvae were reared in petri-plates in the laboratory. The larvae continued to develop on bindweed leaves which were collected every two days. Although the eggs failed to hatch, minute larvae which just emerged from eggs developed normally, pupated, and emerged as adults. The adults continued to feed on either hedge or field bindweed leaves which were collected. Larvae and beetles were offered leaves of Irish potato and field dodder, but refused to eat and died within a few days. Second generation beetles given choices of three substrates in petri plates: 1) thinly-sliced tuber of sweet potato 2) mashed raw sweet potato and 3) boiled, mashed sweet potato preferred the sliced tuber, but ate little. Neither did they feed on bindweed leaves which were added after 24 hours, suggesting the possibility that the feeding cycle was completed. These beetles also ceased activity by mid-August.

DISCUSSION

The larvae and adult of the Argus Tortoise Beetle thoroughly decimated approximately 3 ha of hedge bindweed in 1978, and regrowth occurred on only about 10% of the infestation by mid-October. Regrowth did not occur after severe depredation and competition by weeds in 1977. It is likely that infestations of hedge and field bindweed can be eradicated with three consecutive years of depredation. It remains to be seen, however, whether the beetle population can be maintained in 1979, since the insect population exceeded food supply in 1978. The observation of beetles in soil litter suggests that sufficient adults may overwinter to repopulate the area in 1979, particularly since earlier observations have indicated that adult beetles hibernate in late August (2). Bindweed regrowth occurred within a few days after each tillage operation, confirming earlier observations (4). Regrowth also occurred following applications of the herbicide glyphosate on emerged bindweed at the same location in June (4). Regrowth was less prevalent after predation from both larvae and adults, possibly because feeding occurred on shoots before they emerged. Regrowth was vigorous (in corn) six weeks following a July defoliation by adult beetles. However, this regrowth could have been stimulated by earlier tillage operations which severed the rhizomes, thus releasing bud dormancy.

The Argus Tortoise Beetle, particularly adults, have been observed on the foliage of several species, but feeding has occurred only on plants of the family Convolvulaceae. The fact that this native insect has not developed secondary food preferences suggests the possible utility of this species for control of weeds of the morningglory family. The fact that larvae, and particularly beetles can survive after being transferred to new locations, provides the opportunity for establishment of populations for the control of hedge and field bindweed and possibly morningglory in ornamental and field crops, vegetables and waste areas. However, the use of insecticides in crops during the active period of larvae and beetles negates the utility of this

insect for biological control. Beetles can be reared in the laboratory on bindweed and possibly sweet potato tuber, to serve as a source of supply for establishment of insect populations in troublesome weed infestations.

ACKNOWLEDGEMENTS

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RESPONSES OF TOMATO AND GALINSOGA TO WATER STRESS

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ABSTRACT

Hairy galinsoga (Galinsoga ciliata Raf. Blake) is a troublesome weed for tomato growers in the northeastern United States. Weeds are known to compete with crop plants for various environmental factors. A major competitive factor is water. This study characterizes the responses to osmotic water stress observed for tomato 'Heinz 1350' and galinsoga plants grown in nutrient culture in a growth chamber. Water stress was achieved using polyethylene glycol, molecular weight 1000 (PEG_{1000}) as the osmoticant. PEG_{1000} was added to the nutrient solution in increasing concentrations to produce stress levels of -0.5, -3, -5, -7 and -9 bars.

Both tomato and galinsoga responded significantly to induced water stress. The osmotic potential was positively correlated with the growth rate ($r=0.97$), and root xylem water potential ($r=0.93$) and negatively correlated with the stomatal diffusive resistance ($r=-0.96$) in tomato. Comparable correlations for galinsoga and osmotic potential were $r=0.90$, 0.95 and -0.72 for growth rate, root xylem water potential and stomatal diffusive resistance respectively. These responses to water stress are well documented in the literature for many plant species.

While the two species responded similarly to the imposed water stress, the degree of stress required to show response varied considerably. Significant reductions in growth of tomatoes were observed at an osmotic potential of -5 bars. With galinsoga, significant reduction in growth did not occur until an osmotic potential of -7 bars was reached. Tomato showed significant reductions in root xylem water potential at -7 bars osmotic potential as compared to -9 bars for galinsoga. At the levels which first significantly altered tomato's functioning galinsoga was functioning normally. This suggests that galinsoga is more tolerant of water stress than tomato.

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THE INTERACTION OF NITROGEN FERTILIZATION, pH AND TRIAZINE BREAKDOWN

G. W. Burt and R. L. Holmes[1/]

Reduction of pH by 1 to 2 pH units can occur after the addition of nitrogen in the liquid form. Under no-tillage situations this pH reduction remains in the upper soil surface and could result in an increase in triazine breakdown.

Radioactive ^{14}C-ring labeled atrazine was applied to soil treated with nitrogen at a rate of 100 lb/A in both the $NaNO_3$ and liquid nitrogen form. At 0, 10, 20 and 30 days after treatment the soil was sectioned in fractions of 4 different depths (0-.5, .5-1, 1-2, 2-4cm). Each of these fractions were soxhlet extracted with 95% ethanol. Atrazine and its metabolites were quantitatively determined by thin layer chromatography and differential scintillation counting procedure. After soxhlet extraction the soil samples were extracted a second time with 3N NaOH. Results of these studies indicated that 30 days after application approximately 6% of atrazine was metabolized to the hydroxy form. No differences in atrazine metabolism were detected between $NaNO_3$ and a commercial liquid nitrogen. Adsorption studies with ^{14}C-atrazine will also be discussed.

Similar studies were conducted using oat to determine the quantity of atrazine in the soil. Oat was planted 0, 2, 4 and 6 weeks after applying atrazine plus 100 lb/A of nitrogen as either $NaNO_3$ and liquid nitrogen. Oat response was recorded by visual estimates and dry weights. As with the ^{14}C-studies, results indicated that there were no differences in quantity of atrazine present between soil treated with $NaNO_3$ and liquid nitrogen. The lack of any differences occurred even though the treatments contained greater than one pH unit difference over a period exceeding 4 weeks.

Field experiments and observations have indicated that triazine activity can be reduced under no-tillage conditions when acid forms of nitrogen are used. Laboratory experiments have confirmed the pH differences resulting from the use of different nitrogen forms, however, no differences in plant response or herbicide metabolism were detected.

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THE DISTRIBUTION OF ATRAZINE IN CORN FIELD SOILS AT VARIOUS ELEVATIONS

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ABSTRACT

Atrazine was applied to a 16.4 hectare corn field at a rate of 1.7 kg/ha, during the 1976 growing season. Soil analysis for atrazine indicated different distribution patterns in the surface 30 cm plowed zone depending on elevation. Atrazine was more evenly distributed in the lowest elevation field soils. For equal surface area, total atrazine concentration in the soil column at the lowest elevation fields were generally higher than the soil from upper field soils.

Atrazine concentration data indicated a pattern of gradual movement from fields at higher elevation to lower fields and eventually to drainage waters. A weir monitoring station was instrumented at the bottom of the corn field immediately adjacent to the lowest elevation field, but about 650 meters away from highest elevation on the fields.

The first storm event occurred eleven days after application. This storm discharged 55% of the total runoff loss of the 1976 growing season and about 90% of the total runoff loss occurring within two months of planting. The occurrence of atrazine carry-over is supported by detectable atrazine residues one year after field application.

INTRODUCTION

Atrazine [2-chloro-4-(ethylamino)-6-isopropylamino-s-triazine] is primarily used as a pre-emergence herbicide for broadleaf weeds and grasses in corn fields. Atrazine usage has become very popular and it is now one of the most commonly used herbicides in corn on the Atlantic Coastal Plain.

The increased use of atrazine has led to studies by agronomists and environmentalists to measure the distribution and concentration in the aquatic environment (3, 4, 10). For example, one monitoring program discovered that atrazine levels were 2-17 ppb in the Mississippi River and its major tributary streams in June and July of 1975 (7). The report also noted that detectable atrazine was present in most streams sampled throughout the remainder of the year.

The transport of pesticides from agricultural land has become a worldwide concern (5). In order to study the atrazine transport process, an understanding of its distribution in field soils is necessary. This paper will report our study results from a corn field site during the 1976 growing season.

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MATERIALS AND METHODS

Study Site. The experiment was conducted on a 16.4 ha drainage basin (Figure 1), one of 12 intensively studied watersheds at the Chesapeake Bay Center for Environmental Studies located in Maryland on the western shore of Chesapeake Bay. The basin consisted of four major corn fields, with 10.4 ha of cleared crop land. About 6 ha of hedges and wooded streambank areas were also located on the basin. The watershed has an average slope of 5.4%. Figure 1 indicates four major topographic contours, i.e., 30, 22.5, 15, and 9 meter elevations. At the bottom of the fields, a V-notch weir was built to monitor hydrological, physical and chemical characteristics of the runoff from the fields.

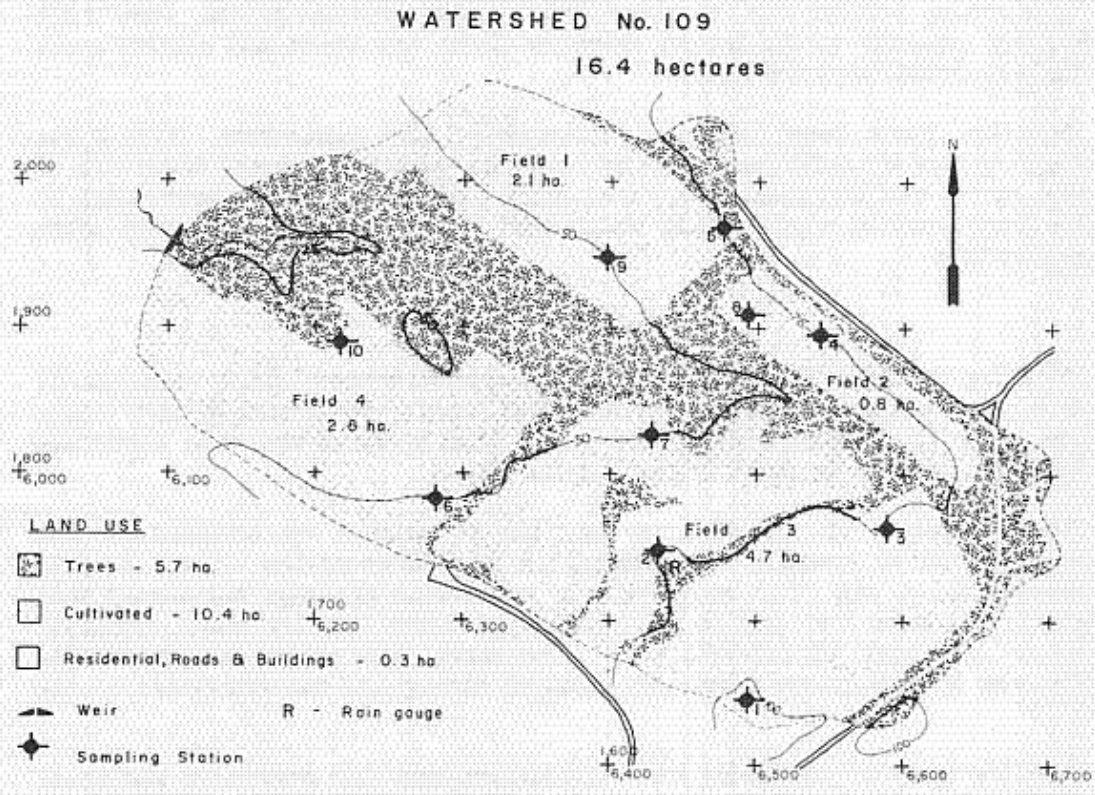

Figure 1 Detailed map of the study site - a 16.4 hectare corn field.

Ten stations were established for taking soil samples. At each station, sensors for measuring soil temperature and moisture were installed. Moisture and temperature probes were buried at depths of 5, 15, 30, and 75 cm with electrical leads connected to sockets in a junction box aboveground for manual readings. Delmhorst gypsum block moisture sensors and a Delmhorst model KS-1 moisture tester were used. Temperature was measured with Fenwall precision unicurve thermistors coated with epoxy cement and resistance was read with a battery powered Fluke digital multimeter.

A tilting bucket rain gauge (Stevens) with a resolution of 0.01 inch per pulse and a readout on paper tape every five minutes was installed in the field for rainfall measurements.

Sampling. The field was plowed to about 30 cm and planted with corn in the spring of 1976. The application of atrazine (also alachlor) was done with a tractor-pulled sprayer on May 18, 1976. The atrazine application rate was 1.7 kg/ha with an initial atrazine concentration of 9.7 ug/g of dry weight in the top 1 cm of soil. The application rate was determined by the analysis of (a) atrazine concentration in the spraying tank and spraying rate, (b) 10 filter discs placed in the fields, and (c) sampling with a large diameter (20 cm) soil coring tube made of stainless steel. After the spraying day, soil samples were taken with a smaller diameter stainless steel coring tube (2 cm). From four to twelve soil cores were taken at each of the ten soil stations (Figure 1). Soil cores were divided into eight segments; 0-1, 1-2.5, 2.5-5, 5-8, 8-12, 12-18, 18-24, 24-30 cm. Segments of like depth from stations located on the same elevation contour were composited. In order to reduce the number of samples necessary for analysis, soil segments from 2.5 to 30 cm were combined for the four stations located at the 15 m elevation and for the four stations located at the 22.5 m elevation. Sampling frequency was highest initially. A total of 148 days were monitored with 14 samplings.

The water samples from runoff were collected at the weir monitoring station with a continuous sampling technique. Water samples from runoff were collected with a volume integrating sampler into 15 liter glass jars over one week intervals (2).

Laboratory Analysis. Soil samples were homogenized and frozen until ready to process. About 20 g of wet soil was weighed and then transferred to a glass thimble which contained 5 g of anhydrous sodium sulfate. The soil samples were then extracted in a soxhlet extractor with a mixture of 150 ml dichloromethane and 50 ml of benzene. Immediately after weighing the 20 g of soil, moisture content of the soil sample was determined gravimetrically on duplicate aliquots of soil.

Particulates in runoff water samples were flocculated with 5 g of calcium chloride per liter of water. The water samples were then filtered through a 142 mm Gelman glass filter. Atrazine in the filtrate was extracted with 150 ml of benzene and subsequently with 100 and 50 ml of dichloromethane. Atrazine on the filters was extracted in a soxhlet extractor with a solvent mixture of 50 ml benzene and 150 ml dichloromethane (11).

The organic extract was first dried over anhydrous sodium sulfate overnight, and then concentrated to about 10 ml with a Kuderna-Danish evaporator. A chromatographic column was packed with 15 g of activity Grade V alumina (15 g of H_2O and 85 g Al_2O_3) and topped with 5 g of anhydrous sodium sulfate. The column was first washed with 50 ml of petroleum ether, the concentrated organic extract (10 ml) was then applied and the column was eluted with 100 ml of hexane and then with a mixture of 50 ml benzene and 50 ml hexane. The eluted organic solution was then concentrated to about 4 ml and its volume was accurately measured. This solution was used for gas chromatographic analysis.

A Tracor 560 gas chromatograph equipped with a nickel 63 electron capture detector was used for the analysis. A 183 cm x 4 mm coiled all glass column, packed with 10% DC 200 on 100/120 mesh GCQ (Applied Science Laboratories, State College Pennsylvania), was used. The isothermal operation conditions are: column temp. 190° C, inlet temp. 180° C, detector temp. 350° C. The flow rate of nitrogen carrier gas was set at 65 ml/min. An atrazine standard solution was injected between every three sample injections.

Recovery efficiency was measured by analyzing nine spiked soil samples. Average recovery was 86.7%. Range of recovery was 85-88%. The data reported are those actually determined. No attempt was made to use correction factors for atrazine recovery efficiencies.

RESULTS AND DISCUSSION

Major minerals in the soils at all four elevations were montmorillonite, illite, and kaolinite for clay particles and quartz for silt particles. Average mean bulk density of the 18 soils studied for all depths was 1.2 g/ml. The soil texture is that of sandy loam with the top 1 cm consisting of less than 5% of organic matter, while soils at the lower layers generally contained more than 10% organic matter. Soils below 1 cm showed uniform, rather consistent particle composition, generally with 50% sand, 30 - 50% silt and ~ 10% clay, while the top 1 cm soil showed larger variation. Soil pH was usually between pH 5 and pH 7.

The rainfall on the basin during the study period is given in Table 1. Heavy, intense rainstorms occurred on June 16, July 16, August 7-9, August 14-15, and October 9.

The soil moisture content varied widely with depth, time of day, rainfall, etc. It is very difficult to make generalizations about soil moisture content and to relate it to soil atrazine concentrations. However, soil moisture was normally more than 190 mg H_2O per cubic centimeter of soil volume. It can be safely stated that, throughout the entire growing season, (a) the soil moisture content in the lowest elevation field (9m) was higher than that found in the soils at higher elevations, (b) while upper field soil profiles did not have clear patterns, a consistent trend of soil moisture existed in the soil profile of the lowest elevations with a maxima at the 15 cm depth and the lowest value at the surface. During May 24 to October 18, 1976, the lowest value recorded for 9 m elevation soil was 353 mg H_2O per cubic centimeter of soil volume. This is much higher than was found for soils at higher elevations.

Table 1. Rainfall on watershed basin during the 1976 growing season (May 10 - November 8)

Date	Days After Spraying Date	Rainfall (cm)	Date	Days After Spraying Date	Rainfall (cm)
May 12	-6	0.58	August 7-9	86-88	5.64
May 14-18	-4-0	1.68	August 14-15	93-94	3.96
May 19	1	0.46	August 27	102	3.07
May 26	8	0.05	September 2	108	0.20
May 27	9	0.46	September 10	116	0.64
May 29-31	11-13	3.56	September 15-17	259-261	4.22
June 16	30	4.90	September 20	126	0.08
June 19-20	33-34	0.13	September 26-27	132-133	0.84
June 21-22	35-36	0.61	September 30- October 3	136-139	5.13
June 30	44	0.30	October 9	145	4.62
July 3-6	47-50	0.25	October 16-17	152-153	0.94
July 7	57	0.64	October 20	156	3.89
July 11	61	2.67	October 24-25	160-161	3.43
July 12	62	0.20	October 30	166	2.54
July 15	66	0.86			
July 16	67	3.10			
July 21	72	0.23			
July 29	77	0.74			
July 30- August 1	78-80	0.84			

Atrazine concentrations in soil depth segments are reported as a histogram (Figure 2) for the soils from the four different elevations. The data are obtained from the analysis of composite samples of soil cores at like depths from stations at the same elevation. Variation in the data was mainly caused from sampling soil cores from fields which were sprayed unevenly. It is difficult to spray herbicides uniformly on a field scale basis because of such factors as variations in wind velocity, the oscillation of sprayer and booms, overlaps and missed strips.

During the first six days after application, most of the atrazine in the 30 meter elevation soils remained in the surface 5 cm. Atrazine was detected in deeper soil profiles at later dates. This correlated with decreased atrazine concentrations in the surface layers. After 148 days, atrazine (0.83 ug/g of soil) was detected at 18-24 cm depths, while the upper soil segments from the same composited cores contained no detectable atrazine (< 0.01 ug/g).

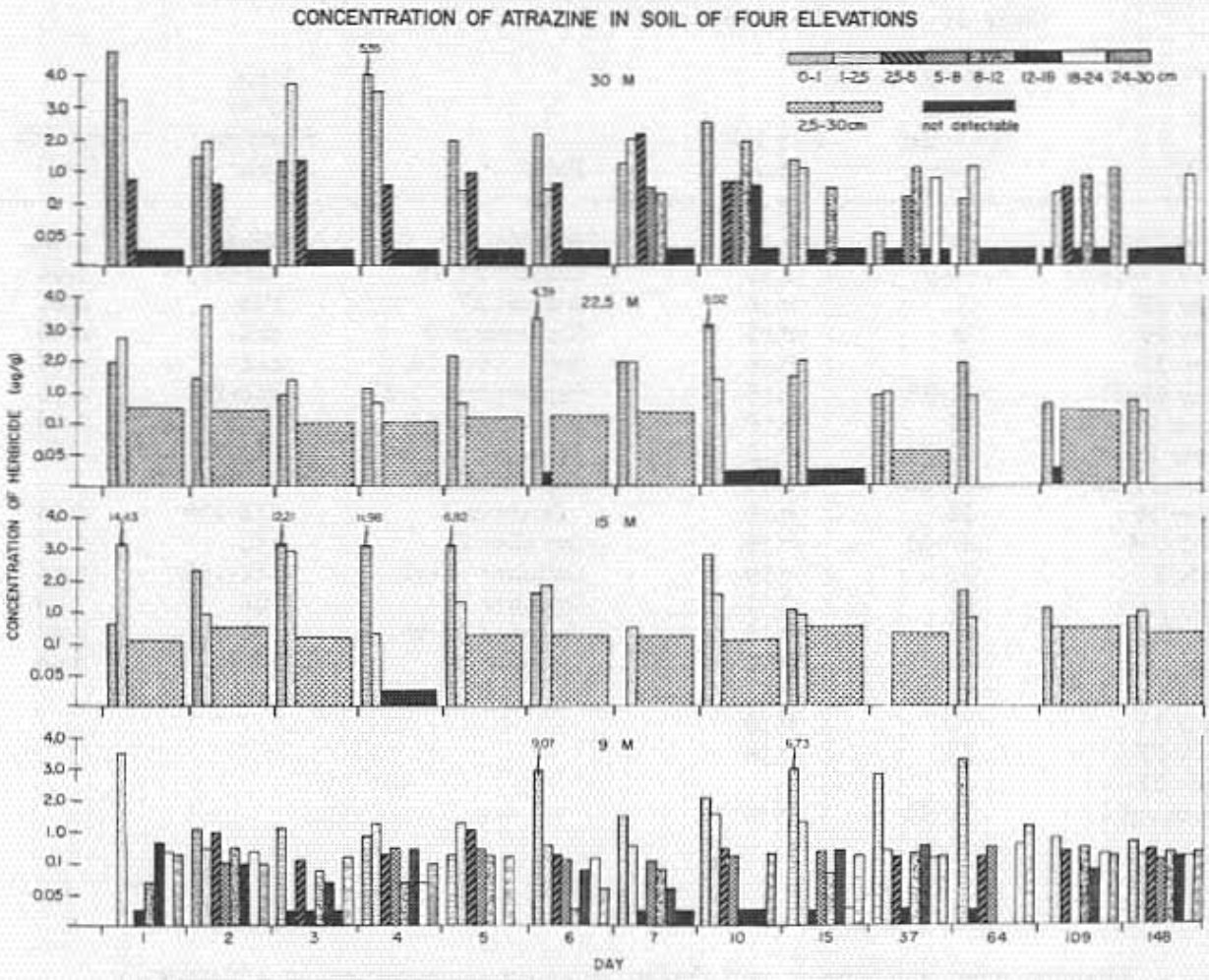

Figure 2 Histogram of the concentration of atrazine in soils of four elevations. The concentration scale below 1 ug/g were enlarged.

Three soil segments (0-1, 1-2.5, and 2.5-30 cm) were analyzed for atrazine collected from fields at elevations of 22.5 m and 15 m. Atrazine concentration in surface zones (0-1 cm and 1-2.5 cm) decreased very slowly to about 1 ug/g at the end of the 148 day study period. Atrazine concentration in the 2.5-30 cm soil segments changed very little during the study period, with some variation and three values below detection limits. The surface layer at the 15 m elevation contained higher atrazine concentrations. The explanation of high variations in atrazine soil concentrations (non-detectable and high values) may involve surface erosion and deposition and uneven atrazine application.

Throughout the entire 148 days of the study period, atrazine concentrations at the 9 m elevation were distributed more evenly in the vertical profile of the 0-30 cm layer. Atrazine concentration in the top 1 cm of soil decreased the first 2 days

after atrazine application, but then oscillated with no clear trend the rest of the time period. Atrazine concentration near the end of the 1978 growing season (148 days after the atrazine application in fields) were 0.2 to 0.7 ug/g in each of the eight soil segments and was distributed rather evenly in a vertical profile.

Thus, in this study the downward movement of atrazine from the surface into soils of 0-30 cm depths is apparent. This is in agreement with many other similar studies (1 & 6). Hall (1978) detected atrazine to a depth of 76 cm approximately 2 months after application.

It is known that the disappearance of atrazine in field soils is caused by various physical, chemical, and biological processes. It is not possible, from the results of this study, to quantitatively separate the significance of leaching, volatilization, or degradation process. This study indicates that atrazine is transported from upper elevation contours of the field topography to lower contours during the growing season. This study does not distinguish whether this transport was due to surface runoff and erosion or to soil water percolation.

Atrazine concentration in the runoff water from the corn field watershed ranged from non-detectable (< .08 ug/l) to 35 ug/l. Total atrazine discharged during the growing season amounted to 177 g or 10.86 g/ha. The relationship between flow, atrazine concentration, and the atrazine discharged is reported in Figure 3. Figure 3 reports discharge volume of water (per one week intercal) only when atrazine concentration in runoff was analyzed.

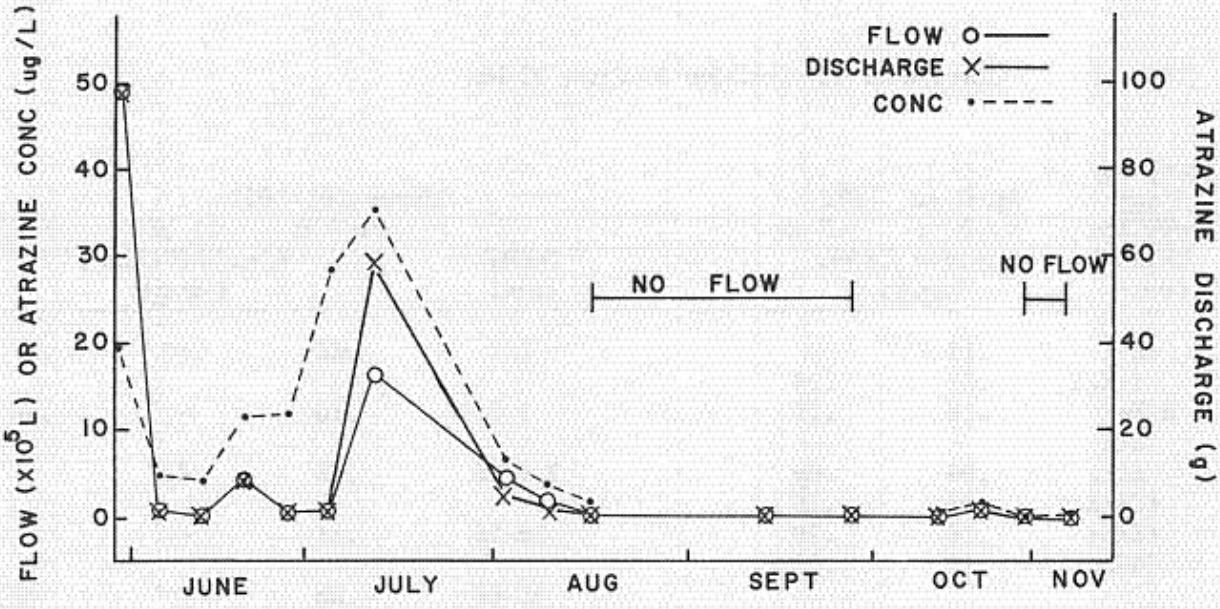

Figure 3 Flow, atrazine concentration in the drainage channel, and the quantity of atrazine discharged. Whenever analyses for atrazine were not done, the data points on the water flow were omitted from the graph.

The storms during the study period occurred on May 29-31, June 16, July 16, and eight storms came after August (> 3.07 cm rainfall). It can be seen from Fig. 3 that the first storm event, which occurred 11 days after the herbicide application, accounted for 55% of the atrazine runoff loss. Another major runoff discharged an additional 32% on July 16, 62 days after the spraying of the herbicide atrazine. This result is in agreement with a great many researchers who have suggested that the quantity of pesticide transported directly off of farm fields is greatest during rains occurring soon after application (10, and twelve references cited in the article). However, Figure 3 also indicates the following: (a) Atrazine concentration in the runoff waters varied with the water volume being discharged, but no strong correlation was found, and (b) Trace quantities of atrazine were still detected in runoff water near the end of the growing season.

The possibility of atrazine carry-over in the corn field soil is apparent from results reported in Figure 2. At the end of the growing season, residual atrazine still remained in field soils. Hall et al. (1978) estimated that 3 to 21% of the atrazine applied to the field soil remained in the surface 46 cm of soil at the end of the growing season. Talbert & Fletchall (1964) reported that 0.16 lb/A of atrazine remained one year after its application at 2 lb/A. Field soils were collected before planting began in 1976 and after the 1976 growing season in 1977 (Table 2). Soil samples collected on April 12, 1976 indicated the atrazine carried-over from the 1975 application. Soils collected on March 18, 1977 reflect atrazine carry-over from the 1976 growing season (Table 2).

Table 2 Carry-over of Atrazine in Corn Fields

Sampling Date	April 12, 1976		March 18, 1977			
Elevation	22.5 m	15 m		22.5 m	15 m	9 m
Depth (cm)	Atrazine Conc. (ug/g)		Depth (cm)	Atrazine Conc. (ug/g)		
0-1	.11	—	0-1	.06	.19	.87
1-2.5	.42	.23				
2.5-5	.14	.19	1-7.5	.10	—	.40
5-8	—	—				
8-12	.04	.04	7.5-15	.42	.34	—
12-18	.04	.32				
18-24	.18	.26	15-30	.11	—	—
24-30	.11	.06				
			30-60	.08	—	ND

— No Sample
ND Below detection limit (< .01 ug/g)

Our results are comparable with those observed by Ritter et al. (1978) where residual atrazine was between 0.09 and 0.56 ug/g one year after field application. It is difficult to determine the percentage of atrazine carry-over. If we estimated simply by summation of a soil column, between 5 and 13% of atrazine was carried-over to the next year's growing season. It is known that these 10.4 ha of fields were planted with corn during the 1975 growing season and that they had been cultivated continuously during the previous five years. The April 12, 1976 soil analysis may be the results of atrazine carry-over of the 1975 growing season plus the accumulated residual atrazine over previous years, while the March 18, 1977 soil analysis should include atrazine carry-over of the 1976 growing season and that of previous years. When the atrazine values of the soil samples from two different sampling dates of Table 2 are compared, no significant increase of atrazine level can be found in the later sampling date. Thus, the accumulation of residual atrazine over several growing seasons was not indicated.

ACKNOWLEDGEMENTS

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SEARCH FOR LINURON RESIDUES IN TRIBUTARIES OF THE CHESAPEAKE BAY

E. W. Zahnow and J. D. Riggleman 1/

ABSTRACT

It has been suggested that herbicides which are used on corn and soybean fields bordering the Chesapeake Bay and its tributaries may be a contributing factor to reported declines in the abundance of grasses in the Bay. As part of a program to determine the contribution, if any, of linuron to the problem, samples of mud and water have been taken from areas likely to show linuron if it is being transferred from fields into adjacent bodies of water. Samples from these areas showed no linuron residue; i.e., less than 10 ng/g (10 ppb) in the mud and less than 0.2 ug/liter (0.2 ppb, W/V) in the water. These samples were analyzed using an extraction procedure followed by measurement with liquid chromatography. From these data, it is concluded that linuron is not accumulating in the Chesapeake Bay.

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EVALUATION OF INCORPORATION EQUIPMENT ON TRIFLURALIN IN SNAP BEANS

R.J. Precheur, R.A. Miller, D. Marini and
J.C. Howell, Jr. 1/

ABSTRACT

Crop diversity on Massachusetts vegetable farms is the rule making weed control one of our major problems. The dinitroaniline and the thiocarbamate compounds are commonly used. Our growers, limited in the amount of equipment available, often ask which implement provides maximum herbicide activity upon incorporation.

In this study, trifluralin was applied under very moist conditions at the rate of 0.75 lbs/A and immediately incorporated with a: tandem disc, spring tooth harrow, Fuerst flexible tine harrow, finger weeder and a rototiller. The controls were 1. no herbicide and 2. herbicide applied but unincorporated. The experiment was conducted as a randomized block with 3 replications. Each plot measured 9 ft. by 15 ft. Snap bean cv. Long Tendergreen was planted following herbicide incorporation on June 7, 1978.

Plots incorporated with the spring tooth harrow and the rototiller had significantly greater herbicide activity than other treatments. Weed control with the other implements was only significantly greater than controls and below acceptable levels.

Snap bean yield was highest in rototilled plots and only significantly greater than finger weeder and spring tooth incorporated plots. The tandem disc, Fuerst flexible tine harrow and the rototiller generally improved herbicide activity. Yield in spring tooth and finger weeder incorporated plots was not significantly greater than controls due to increased weed pressure and lack of herbicide activity.

In summary, rototiller incorporation had a significantly higher snap bean yield than spring tooth and finger weeder incorporation. All other incorporation tools were equally effective in improving herbicide activity.

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SUTAN+ INCORPORATION EFFECTIVENESS WITH VARIOUS TILLAGE TOOLS

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

ABSTRACT

Various tillage tools common to the Northeast were used to incorporate butylate at 3 lb ai/A and a flourescent dye into a silt loam soil at State College, PA. Both weed control and soil profile photographs of the flourescent dye under UV light were used as methods of determining effectiveness of incorporation.

The tillage systems included:

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

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

Incorporation of the dye was the most even with the roterra, homogeneous distribution down to 1.5 inches following a plow and 3.5 to 4 inches following a chisel plow or heavy disk. The cultimulcher also did a very good job of incorporation, down to 2 inches, following a plow and tandem disk.

The tandem disk also did an excellent job of incorporation, down to 3 inches following a plow and tandem disk, 3.5 to 4 inches after a chisel plow, and 4.5 to 5 inches after plowing. It appears that the rougher the surface to which the dye was applied, the deeper the incorporation.

The spring tooth harrow did a poor job of incorporation following a plow and tandem disk and incorporation with a heavy disk was very poor. The distribution pattern with a heavy disk was haphazard with a concentration of dye at the full depth of disk blade penetration.

The ideal depth of incorporation in this trial, where yellow foxtail and witchgrass were the primary weeds, was 2 to 3 inches. If yellow nutsedge were the problem weed, I would expect that incorporation to 3 to 4 inches would provide better control.

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COMPARISON OF THE BICYCLE AND HERBI® SPRAYER APPLICATIONS

Clair G. Erickson and William B. Duke[1]

ABSTRACT

Controlled droplet application can increase uniformity of droplet size and distribution, and thereby feasibly increase the penetration of the herbicide into target plants resulting in greater herbicidal efficacy. Glyphosate [N-(phosphonomethyl) glycine] was applied to quackgrass [*Agropyron repens* (L) Beauv.] using a conventional bicycle sprayer and the Herbi (an ultra-low volume, controlled droplet application sprayer). Quackgrass stands were reduced 19% at a 0.56 kg/ha rate with the bicycle sprayer as indicated by rhizome weight while the Herbi reduced stands by 33% at the same rate. Higher rates of glyphosate masked the method of application effects. When Booster plus E was applied in conjunction with glyphosate, the quackgrass stands were reduced 16-23% more than when glyphosate was applied alone.

INTRODUCTION

The Herbi sprayer, developed by Micron West, Inc., has introduced an application technique that takes advantage of recent application concepts. The Herbi utilizes controlled droplet size applications to reduce hazzards of drift and volitilization which are common problems with the conventional types of pesticide applications. Due to controlled droplet size applications, the Herbi has been shown to give more uniform coverage. This uniformity can increase herbicide efficacy especially when used in conjunction with a light, low viscosity oil and emulsifier.[2] Control of quackgrass with glyphosate was enhanced when applied with the Herbi sprayer.

MATERIALS AND METHODS

Glyphosate was applied at rates of 0.56, 1.11, and 2.22 kg/ha on quackgrass at the Aurora Research Farm, Aurora, New York, on June 15, 1978, using a conventional bicycle sprayer and the Herbi sprayer. Glyphosate was also applied at these rates with 1.67% Booster plus E added. Due to limited suitable space available, the glyphosate plus Booster plus E treatments were only applied using the Herbi. The Herbi was hand-held approximately 20.3 cm above the quackgrass and covered about a 1.22 m swath. It was carried at 3.57 kph and delivered 10.19 liters per hectare. The bicycle sprayer delivered approximately 233.75 liters per hectare. The experiment was set up in a randomized block design and replicated 4 times. A 0.186 sq. m sample was randomly excavated and the shoot number and weight and rhizome node number and weight recorded for each sample.

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RESULTS

At low rates, glyphosate was more effective at reducing quackgrass stands when applied with the Herbi than with a conventional bicycle sprayer (Table 1). At 0.56 kg/ha the bicycle sprayer reduced the quackgrass rhizome node weight by 19% with no reduction in shoot weight while the Herbi application was reduced by 33 and 38% node and shoot weight respectively. At 1.11 and 2.22 kg/ha the glyphosate masked any difference between the bicycle and the Herbi methods of application. A further 16-23% reduction of quackgrass rhizome node weight and 25-30% reduction of shoot weight was obtained at all rates when Booster plus E was added to the glyphosate-Herbi applications (Table 1).

DISCUSSION

The Herbi sprayer can be used to apply herbicides more uniformly and more effectively than conventional bicycle sprayers. The Herbi utilizes a spinning disc atomizer to produce uniform sized droplets while conventional sprayers produce droplets which vary greatly in diameter. The spinning disk rotates at a constant speed such that the droplets formed are a uniform 250 microns in diameter and are displaced uniformly throughout the 1.22 m swath.[2] The bicycle sprayer, which is generally operated by air pressure and utilizes conventional nozzle tips, produces droplets which can range from 5 to 600 microns in diameter.[2]

The uniform size and distribution of the droplets produced by the Herbi reduce application problems experienced with conventional sprayers. Conventional sprayers produce a large number of extremely small water droplets. These fines are basically responsible for the drift and volatilization problems experienced with conventional pressure sprayers. Since the Herbi does not produce fines, the problems of drift and volatilization are largely eliminated. In a slight wind the Herbi can be lowered to about 10.2 cm above the target and maintain a controllable 1.22 m swath which is slightly offset to windward.[2]

The uniformity of coverage by the Herbi should also allow for a more uniform penetration of the herbicide into the target plant. This could be the reason for the increased control of quackgrass when sprayed with glyphosate using the Herbi sprayer. It also follows that the use of an oil such as Booster plus E enhances penetration of the herbicide and therefore, increases the herbicidal efficacy.

Table 1. Rhizome and Mean Shoot Weights of Quackgrass Following Glyphosate Treatments Using the Bicycle and Herbi Sprayers

Application Method	Treatment	Rate kg/ha	Mean Rhizome Wt. (gm)	Mean Shoot Wt. (gm)
Untreated	Glyphosate	0	222.13	108.81
Bicycle Sprayer	Glyphosate	0.56	180.73	134.86
	Glyphosate	1.11	116.12	67.22
	Glyphosate	2.22	84.88	29.20
Herbi Sprayer	Glyphosate	0.56	149.00	85.32
	Glyphosate	1.11	105.06	45.72
	Glyphosate	2.22	115.70	64.85
Herbi Sprayer	Glyphosate + Booster plus E	0.56	105.51	50.95
	Glyphosate + Booster plus E	1.11	53.36	15.69
	Glyphosate + Booster plus E	2.22	84.77	33.18
LSD 0.05			55.74	36.34

RECYCLE SPRAYERS

Thomas D. Luck[1]

ABSTRACT

The Recycle Sprayer is designed to apply herbicides to weeds growing taller than the crop canopy. Herbicide which does not contact the weed is caught and recycled. This relatively new technique has proven to be an effective post-emergence control of johnsongrass, wild cane, and other weeds in field crops and pastures, reducing herbicide costs dramatically.

The heart of any spray system is its pump. The Chem-Farm Recycle Sprayer is equipped with a centrifugal pump capable of delivering 40 gpm. This is necessary to supply proper pressure to drop booms and to provide correct venturi function in emptying the catch boxes.

The pressure head control system comes standard on all Chem-Farm spray units. It is a one-lever, cable-controlled pressure head that has a 3/4-inch boom outlet and a 3/4-inch return outlet to assure adequate volume, insuring proper flow to drop boom nozzles and return. It is equipped with a gauge, stainless steel gauge protector, plus a line strainer with a stainless steel screen to reduce corrosion and prevent gauge clogging.

From the pressure head, a 3/4-inch line feeds the metered manifold, which distributes the herbicide equally through different length hoses to the drop booms. (Without metered manifold, equal hose lengths need to be used.) The drop booms hold three conventional nozzle bodies, caps, screens, and stainless steel (D2) spray discs. A hardened stainless steel spray disc is used to prevent excessive wear. Operated at 20 psi, the spray disc shoots three streams of herbicide across the crop canopy into a catch box. Low pressure reduces spray drift and splash.

The catch box is made of fiberglass and is supported in a steel reinforced frame. The frame is mounted on a 4-inch by 4-inch bar and has a positive spring-loaded trip to protect the catch box from severe damage. This construction provides a sturdy, light-weight unit important for safe operation.

A sloped fender on the front of each catch box guides the weeds around the catch box into the streams of herbicide. Otherwise, the weeds would drag beneath the catch box with as much as 35 percent reduction in control. Each catch box has a drop boom on either side thus catching spray from two rows. The catch box can easily be disassembled for cleaning purposes. A curved baffle in the top half of the catch box is used to stop the streams of herbicide rather than the sometimes-used horsehair screens. A curved baffle offers resistance to splash and provides a cleaner operating system. The lower part of the catch box has a large screen to catch leaves, seeds, insects, and other debris that would impede operation by clogging the venturi.

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The venturi system returns the herbicide solution that has been collected in the catch boxes to the 100-gallon aluminized steel recycle tank. The solution then returns through the pressure head to the metered manifold, which provides equal distribution at the venturi so that all catch boxes are emptied equally. A gauge on the manifold supplying the drop booms operating at 20 psi and a gauge on the manifold supplying the venturi operating at 55 psi will assure all boxes will empty.

As a general rule, no agitation is required after herbicide has been suspended. The venturi return provides adequate agitation. As herbicide becomes diluted with dust and dirt, it loses strength and poor results can occur. Therefore, by mixing small quantities, depleting the supply, and mixing a new solution this occurrence can be prevented.

A speed from three to five mph will usually provide the most optimum coverage and is best for field operation. Height adjustment of boom during operation is important as the drop booms should be operated approximately six inches above the crop canopy. Differences in height of crop and uneven ground conditions facilitate this constant adjustment.

The Recycle Sprayer appears to have a great future in a total chemical farming program due to its spot control of weeds that cannot be controlled by conventional chemicals applied with broadcast-type booms.

RECIRCULATING SPRAYER: ANOTHER WAY TO APPLY GLYPHOSATE

Glynadee A. Edwards 1/

ABSTRACT

The recirculating sprayer allows the application of a herbicide to weeds in crops without destroying the crop. This application allows the applicator to kill weeds which have escaped through other herbicide treatments. For several years, glyphosate has been experimentally applied through the recirculating sprayer to control Johnsongrass in soybeans and cotton. Now, applications are being made to other weeds to determine the results which can be obtained.

This presentation will deal with the description of the recirculating sprayer, the calibration of the sprayer, and results of weed control when glyphosate was applied through the recirculating sprayer. Results will include not only Johnsongrass control, but also other weeds. Rate of glyphosate and timings of application will also be presented.

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WEED CONTROL IN CHERRY AND PLUM NURSERIES

O.F. Curtis Jr. and H.O. Bennett[1/]

ABSTRACT

Simazine has been used at 1.0 to 2.0 lb/A ai for at least eight years as an annual routine in the two year cycle of producing budded cherry and plum trees in the nursery of the New York State Fruit Testing Cooperative. The hand labor needed to supplement cultivation is greatly reduced by such treatment. However, chlorosis of foliage is often visible, particularly on seedlings of Myrobalan (Prunus cerasifera Ehrh.) used as a rootstock for plums and Mahaleb (Prunus mahaleb L.) used as rootstock for 'Montmorency' cherry (Prunus cerasus L.). One question is whether this is a symptom of more profound effects as 1) on the success of scion growth from the inserted buds, which is often very low, and 2) on growth of rootstock in the first year and of scion in the second year.

In two early experiments 1.0 and 3.0 lb/A simazine was applied on Myrobalan stock at the time of planting and repeated the next spring. Percentage successful scion growth from buds inserted late in the first summer was equal to that in hoed checks at both the high and low rate.

Growth of Myrobalan rootstock in their second year under 0, 1, and 3 lb simazine differed by less than 4% in spite of chlorosis affecting 15% of the leaf area at midsummer at the high rate. A slow-release additive, SRC-101, at one gallon per 20 lb ai did not reduce the incidence of chlorosis in this experiment or in another on Mahaleb stock.

In 1975 a wide difference in foliage chlorosis was not reflected in measurable growth difference of Mahaleb rootstock (Table 1). Furthermore, regression analysis of individual plant height on chlorosis rating of that plant showed an insignificant correlation within the simazine treatments. Chlorosis was more prevalent and severe under May application than from the same rate of simazine applied in February. There was little or no indication of increasing rate of simazine impairing the percentage growth of 'Montmorency' scions or height growth of them or the regrowth from Mahaleb stock. 'Montmorency' scions did not show chlorosis from simazine.

Napropamide treatments showed a trend for higher scion success and taller regrowth from rootstock as compared with simazine. Compared with 1.3 lb simazine, 8 lb napropamide gave less control of established chickweed (Stellaria media (L.) Cyrillo) and later emerging ladysthumb (Polygonum persicaria L.), better control of barnyardgrass (Echinochloa crus-galli (L.) Beauv) and crabgrass (Digitaria sanguinalis (L.) Scop.). Methazole at 6 lb/A reduced percentage scion success, apparantly due to contact action on swollen or opening buds, but allowed normal height growth.

[1/] New York Agricultural Experiment Station and New York State Fruit Testing Cooperative, Geneva, N.Y. 14456.

Table 1. Herbicides effects on percentage success and growth of 'Montmorency' scions and on vigor of regrowth from the rootstock. 1975, 6 reps.

Herbicide	Lb/A ai Feb 4	Lb/A ai May 9	Weed[z] cover July 28 no./m²	Final scions /no. budded %	Height growth Montm. scion inch	Height growth Mahaleb stock[y] inch	Chlorosis Mahaleb stock x/
1. Napropamide	8	-	1.5	33	38	30	-
2. Napropamide	4	-	2.3	30	40	29	-
3. Napropamide + simazine	4 1	-	0.1-	31	40	30	-
4. Simazine	4	-	0.1-	21	42	28	9 ± 3
5. Simazine	2	2	0.1-	23	38	29	21 ± 3
6. Simazine	-	4	0.1	29	40	27	36 ± 3
7. Simazine	1.3	-	1.7	29	39	28	1 ± 1
8. Simazine	0.6	0.6	0.8	25	41	28	2 ± 1
9. Simazine	-	1.3	0.6	26	40	26	4 ± 1
10. Methazole	-	6	1.1	17	39	30	-
11. None	-	-	11.8	27	40	28	-
Combine treatments:							
Napropamide			(1,2,3)	31.4	39.3	29.4	-
Simazine 4 lb			(4,5,6)	24.9	39.8	27.9	22
Simazine 1.3 lb			(7,8,9)	26.9	40.0	27.5	2
LSD 0.05					1.9	1.7	

z/ In narrow row band undistrubed by cultivation.

y/ Regrowth from cutback rootstock on which scion bud failed to grow.

x/ August 20. Approximately the percentage of leaf area chlorotic.

The Control of Redroot (*Lachnanthes tinctoria*)

William V. Welker, Jr.[1/]

ABSTRACT

Redroot [*Lachnanthes tinctoria* (Walt.) Ell.] is a troublesome weed in both cranberry (*Vaccinium macrocarpon*) and blueberry (*Vaccinium carymbosum*) plantings. Preliminary studies were conducted in the greenhouse for two years. Herbicides that showed promise in these studies were selected for a field study in 1977. The herbicides were applied as sprays to a uniform, natural stand of redroot that was about 98% pure. No crop was involved. The soil was a Leon sand with a pH of 4.3 suitable for blueberry production.

The time of herbicide application was included as a variable. Treatments were applied each month from May through August in 1977. Visual ratings were made in 1977 and 1978 as well as counts of flowering stems and weights of the whole plant in 1978.

The outstanding herbicide was terbacil (3-tert-butyl-5-chloro-6-methyluracil) giving excellent control at 2 and 4 lb ai/A through the 1978 growing season. Perfluidone (1,1,1-trifluoro-*N*-[2-methyl-4-(phenylsulfonyl) phenyl]methanesulfonamide) at 4 and 8 lb ai/A gave good to excellent control through 1978. Glyphosate [*N*-(phosphonomethyl)glycine] at a rate of 2 lb ai/A gave good control while the 4 lb ai/A treatment gave excellent control through 1978. Paraquat (1,1-dimethyl-4,4'-bipyridinium ion) at rates of 1 and 2 lb ai/A gave good initial control in 1977. The residual control in 1978 was fair to good. The time of application had a marked effect upon the activity of each of the herbicides used in this study.

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BRAMBLE CONTROL IN APPLE ORCHARDS WITH GLYPHOSATE 1/

Roger S. Young 2/

ABSTRACT

Glyphosate at 1.7 kg/ha effectively controlled brambles when applied in late October to actively growing first year canes from plants cut off or partially dug out with a grub hoe between July 20 to August 15.

INTRODUCTION

Brambles (Rubus spp.) are a problem in apple (Malus domesticus Borkh. 'Delicious', 'Golden Delicious', 'Stayman') orchards especially during the harvesting operation. Brambles have been effectively controlled with the use of glyphosate (N-(phosphonomethyl)glycine) (1, 2, 3).

Current label registration (4) allows glyphosate to be used on non-bearing apple trees. The purpose of this experiment was to determine the effectiveness of bramble control from glyphosate applications in apple orchards following fruit harvest.

METHODS AND MATERIALS

Between July 20 to August 15 bramble canes were cut off with attempts to dig or "grub" out the plants under the tree canopy with a grub hoe. Regrowth occurred with developing first year canes attaining a height of 15 to 30 cm by the end of October.

Nine bramble infested plots located in the tree row area were treated with glyphosate at 1.7 kg/ha. The application was made October 29, 1976 using a boom sprayer calibrated to apply 298 l/ha (32 gal/A). Each plot was 9 m^2 (4.5 m by 2 m). Bramble canes were assumed to be actively growing since the foliage was still green even though temperatures of -3.3° to -9.4°C (15 to 26°F) occurred on six occasions during October. The foliage of non-herbicide treated canes continued to remain green until late November (low temperatures ranged from -3.3° to -9.4°C on 15 occasions). Many of the leaves on canes not disturbed by grubbing or cutting in the July-August period were red and bronzed in color at the time of the glyphosate application. This would indicate that these undisturbed plants were in a stage of senescence. Cane counts were made from the total area of each plot.

1/ Published with the approval of the Director of the West Virginia Agricultural and Forestry Experiment Station as Scientific Paper No. 1576

2/ Associate Professor, Agricultural Scientist-Horticulture, West Virginia University Experiment Farm, Kearneysville, West Virginia.

RESULTS AND DISCUSSION

Actively growing first year bramble canes during the period of late October through November were produced where old bramble canes were cut off and plants partially dug out during the summer. This permitted a post apple harvest application of glyphosate to be applied to "green" bramble foliage. This effectively reduced the number of canes the following two growing seasons (Table 1). Eradication of brambles was not accomplished with this one glyphosate application.

The total number of canes present at the time of the glyphosate application ranged from 68 to 308 for each 9 m^2 plot. The average cane number was 199. Twelve months following the herbicide application the cane number had been reduced to an average 23 per plot. The nine plots ranged from 4 to 56 canes. Twenty-four months following the herbicide application, the cane number had increased to an average of 26 per plot. The nine plots range from 5 to 58 canes.

Table 1. Bramble cane response from glyphosate applied late October to actively growing first year canes.

Observation Time	Mean number of first & second year canes/m^2	S. D.
At time of 1.7 kg/ha Glyphosate (October 29, 1976)	22.1	9.9
12 months following application (November 10, 1977)	2.5[a]	2.2
24 months following application (October 24, 1978)	2.9[a]	2.0

[a]Treatment means are significantly different at 1% level.

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SIMAZINE FOR WEEDING GRAPE CUTTINGS

O. F. Curtis, Jr. and H. O. Bennett [1/]

ABSTRACT

Field plantings of cuttings of several cultivars were treated with simazine at 1.2 to 6.0 lb/A ai. Rates of 1.2 to 2.0 lb/A gave commercially acceptable weed control. Final stand of rooted cuttings usually equalled that of weeded checks. An exception, when 6 inches of rain fell within the first 10 days after application, was reduced stand and growth of Aurore under 4.4 lb/A. DeChaunac was not damaged under the same treatment. Diuron, in a single year of observation, damaged DeChaunac at 3.0 lb/A while simazine at 3.5 lb/A did not.

INTRODUCTION

The high labor input required for weeding field plantings of grape (*Vitis sp.*) cuttings, and encouraging results in preliminary trial has led to routine use of simazine (2-chloro-4,6-bis(ethylamino)-s-triazine) on most blocks planted by the N. Y. State Fruit Testing Cooperative over the past 10 years. Check plots were observed in all years. Replicated plots of higher and lower rates compared with checks were established in four years. We offer here a summary of the latter.

MATERIALS AND METHODS

Hardwood cuttings approximately 8 inches long were planted in the field between mid May and late June. Cutting condition when planted, varying with cultivar and year, ranged from dormant and unrooted as taken from the storage cellar to partially rooted and leafted out after glasshouse exposure in rooting boxes. Herbicides were applied within two weeks after planting in 50gpa on a band 3 to 4 feet wide over the top of the row. Experimental plots of cultivars were in randomized blocks of 3 to 6 replicates with individual plots 10 to 50 feet long containing 12 to 80 planted cuttings. Routine cultivation and hoeing was received by all plots, sometimes before weed record were taken. Soil was Berrien fine sandy loam with 3% to 4% OM. No irrigation was employed. Final stand recorded at the end of the season was as number with root and shoot growth.

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1/ New York State Agricultural Experiment Station and New York State Fruit Testing Cooperative, Geneva, N.Y. 14456.

RESULTS AND DISCUSSION

At a low rate of 1.2 to 1.6 lb/A simazine has given good to excellent control of the important first crop of weeds (Table 2). Predominant species in this case were common ragweed (Ambrosia artemisiifolia), redroot pigweed (Amaranthus retroflexus L.), lambsquarters (Chenopodium album L.), large crabgrass (Digitaria sanguinalis L.), yellow foxtail (Setaria lutescens(Weigel) Hubb.), common chickweed (Stellaria media (L.) Cyrillo), Pennsylvania smartweed (Polygonum pennsylvanicum L.), laydysthumb (Polygonum persicaria L.), barnyard grass (Echinochloa crus-galli L. Beauv.), and Virginia copperleaf (Acalypha virginica L.). At the time of application the most advanced of these were in the cotyledon to first leaf emerging stage of development. Later emergence of these and a winter annual crop of common chickweed and field pepperweed (Lepidium campestre (L.) R. Br.) was often reduced in the narrow row band least disturbed by cultivation (Table 1). Such late control was usually evident only at rates of 2 lb/A or higher.

Final stand and height of 'DeChaunac' under 1.2 or 3.5 lb/A simazine were equal to the check in 1970 (Table 1). In contrast diuron (3-(3,4-dichlorophenyl) -1, 1-dimethylurea) at 3.0 lb/A ai resulted in reduced stand and a suggestion of reduced growth.

Table 1. Effect of herbicides on response of 'DeChaunac' grapes cuttings and weeds. 1970.

Herbicide	lb/A ai June 24	Final stand % of planted	Height growth Aug. 20	Weed cover Sept. 1
		%	inches	1-10
Simazine	3.5	52a[z/]	7.6a	0.7
Simazine	1.2	49a	7.2a	2.7
Diuron	3.0	40b	6.4a	1.3
None	-	50a	7.6a	6.7
LSD 0.05			1.6	

[z/] Mean separation in columns by chi-square or Duncan at 0.05.

The 1972 season was exceptional in that 6.1 inches of rain fell at the nursery site within 10 days after application. Under this severe test, stand and growth of 'Aurore' was markedly reduced by 4.4 lb/A of simazine Table 2. 'DeChaunac' showed no such damage; however the increasing stand between 4.4 lb, 0, and 1.6 lb hint of a response (p=0.06 by chi-square). Six other cultivars showed no stand reduction under 2.0 or 3.0 lb and the same rainfall (Table 4).

Table 2. Weed and cutting response to simazine in a planting of two grape cultivars. 1972.

Lb/A June 19	Weed cover July 20	Final stand/ no. planted Aurore	DeChaunac	Height growth, Aug. 20 Aurore	DeChaunac
	1-10	%	%	inches	inches
4.4	0.2a[z/]	23b	45a	6.3b	4.4a
1.6	0.5a	42a	57a	9.0a	5.0a
None	5.6	42a	51a	10.2a	4.8a

[z/] Mean separation by chi-square or Duncan at 0.05.

A summary of final stand observed in several years and cultivars is given in Table 3. Although the listed rates of one column (3.5 to 6.0) nearly overlap the other(1.2 to 3.0), the rate of one was at least double that of the other on any one line. Where entry is made only under the low rate the application rate was 2.0 or 3.0 lb/A.

There is no hint of impaired stand in any lot at the 1.2 to 3.0 range of rates; the trend is for better survival than in the checks. A double or higher rate reduced stand markedly only in the one case of Aurore under extraordinary rainfall. If simazine had any direct effect in reducing stand it was no more than the hoe damage done to check plots. Symptoms as interveinal chlorosis were not lacking in the various treated lots. They were only occasional at 2 lb/A or less, more pronounced and prevalent at higher rates in some years and cultivars.

A summary of the limited data on height growth at 5 to 16 weeks after treatment is given in Table 3. The slight trend for lesser growth under simazine (6% less than checks) is insignificant unless the damaged Aurores of an unusual season are added to the means.

Table 3. Effect of simazine on height growth from grape cuttings. 1970-72.

Rate, lb/A	Height growth, inches 16 reps	Add Aurore of 1972
3.1 to 4.4	5.6	5.7
1.2 to 1.6	5.7	6.4
None	6.0	6.8
LSD 0.05	0.5	0.9

The acceptable weed control had by 1.2 to 2.0 lb/A and the usual absence of clear damage at higher rates speak favorably for the usefulness of simazine. The several cultivars observed, varying stages of development when treated and the different seasons, particularly the one of high rainfall, are further reassurance.

Table 4. Effect of simazine on final stand from cuttings of several grape cultivars.

Rainfall [z1/]	Cultivar	Final stand, % Rate, lb ai/A 3.5 to 6.0	1.2 to 3.0	None	No. planted per trt.
		%	%	%	no.
1970					
1.1, 3.8	DeChaunac [y/]	52	50	51	480
1971					
1.5, 4.9	?	45	62	53	150
1972					
6.1, 11.0	Aurore	23	42	42	80
	Baco Noir		63	62	180
	Chelois		46	39	190
	Colobel		33	27	80
	DeChaunac [y/]	45	57	51	175
	GW 9		26	20	75
	Veeport		11	10	70
	Mixed		59	37	120
1973					
0.9, 2.3	Aurore	58	66	70	70
	Cascase	68	69	71	150
	GR 3	31	46	41	70
	GW 5	58	44	45	80
	Naples	16	22	11	50
	Glenora	3	8	7	60
	Steuben	38	39	44	90
	Yates	32	29	27	50
	Grafted on Couderc 3309 rootstock:				
	Buffalo	12	11	13	90
	Marechal Foch	49	43	40	90
	Pinot Noir	40	32	43	70
	Suffolk Red	53	59	62	60
					2530
	Means, retransformed from angle transformations:				
	17 lots	43.9	47.2	47.2	LSD .05 4.2
	25 lots	-	42.2	39.7	LSD .05 2.7

[z1/] Within 10, 30 days after application.

[y/] Represented by 3 and 2 lots respectively in the means

In contrast with these results damage has been reported as occurring in vine nurseries under 2, 4, or 8 kg/ha simazine, compared with none from 4 to 8 kg/ha diuron (1). Kill of rooted cuttings has been observed when planted in sand culture with 5 ppm simazine (equal to approximately 2.5 lb/A in the top 6 inches of soil) (2). This medium would lack the adsorptive capacity of soil. Diuron caused similar damage at a lower rate of 0.5 ppm.

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EFFECT OF SOME GROWTH REGULATORS ON SHOOT ELONGATION AND BRANCHING OF APPLE

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ABSTRACT

Two new growth regulators, M&B 25105 and RH-6201, applied on apple seedlings as foliar sprays checked shoot elongation for various periods of time depending on the concentration in the spray solution. M&B 25105 was more effective in promoting lateral growth during the period of interrupted shoot elongation than the RH-6201. However, at effective concentrations both compounds caused more leaf abnormalities and/or phytotoxicity than ABG-3001, a formulation containing 6-benzylamino purine and gibberellins A_4+A_7. Combinations of M&B 25105 and of RH-6201 with ABG-3001 increased lateral formation but were not superior to the results obtained with ABG-3001 alone.

INTRODUCTION

Several growth regulators have been evaluated on apple (Malus domestica Borkh) with regard to their ability to modify and redirect vegatative growth and flowering. Some of these, including [butanedioic acid mono (2.2-dimethylhydrazide)] (daminozide), [(2-chloroethyl) phosphonic acid] (ethephon) and (α-naphthaleneacetic acid)(NAA) have come into widespread use. By adjusting the concentration and time of application these growth regulators alone or in combination can restrict vegetative growth in various parts of the tree, and can enhance flower bud formation (1,2,9). On the other hand they have little or no influence on the number of lateral or axillary vegetative buds that develop into spurs or shoots. The enhancement of this lateral growth can be beneficial to the development of the tree canopy and to early production, particularly with cultivars such as Delicious which is often tardy coming into bearing.

Recent work has shown that several experimental growth regulators can promote this development. These include P293 (2,3-dihydro-5,6-diphenyl-1,4-oxathiin) and PP528 [ethyl 5-(4-chlorophenyl)-2H-tetrazole-2-acetate] (2,4,5). Extension growth of the shoot apex is stopped for short periods following foliar application of the material. During this period lateral buds may grow into spurs or shoots depending on the time of application, concentration of growth regulator, shoot vigor and probably other factors. It has been shown that 6-benzylamino purine (BA) (8,10) and ABG-3001, a commercial formulation containing BA and gibberellins A_4+A_7(GA_{4+7}) (3) also promote lateral bud development in apple. Recently it was reported that M&B 25105 can induce laterals to form on nursery trees without damaging the central axis or leader (6). Another new growth regulator, (sodium 5-[2-chloro-4-(trifluoromethyl)-phenoxy]-2-nitrobenzoate) (RH-6201), a post emergence soybean herbicide (7) appeared to have growth control properties on apple seedlings. These growth regulators have been evaluated alone and in combination to determine their effectiveness on growth control and lateral

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development on apple seedlings and cultivars. Comparisons with proven growth regulators were also made in this study, the results of which are reported here.

MATERIALS AND METHODS

Apple seedlings grown in the greenhouse were used in these trials. Vigorous, uniform, actively growing plants about 30 cm in height were selected for the treatments. Usually from four to six replicate seedlings were used for each treatment. In some trials one or two year old clonal trees growing in the greenhouse or older trees in the field were utilized. Treatments were applied as a foliar spray with thorough coverage of leaf and stem surfaces to point of runoff. Data were collected on length growth of the shoots following treatment and on number of lateral buds to develop into shoots or spurs. In some cases the length of the laterals and the angle formed with the main axis were also measured.

RESULTS AND DISCUSSION

In the first experiment with RH-6201 growth of the seedlings during a 34-day period after treatment with 200 ppm was approximately 50% of the control. (Table 1) However, this concentration failed to induce lateral shoot growth even though length growth was sharply reduced during the first three weeks. In addition this concentration caused some abnormalities in the new leaves that developed following treatment, and some necrosis of older leaves. Foliar effects were less pronounced at lower concentrations but these also failed to induce laterals to form during the short period of interrupted shoot elongation. In a preliminary trial not included in the Table rates of RH-6201 above 200 ppm caused severe phytotoxicity and frequently killed the apical growing point. In such cases some lateral growth eventually developed, but such a sequence would not

TABLE 1. Effect of RH-6201 and ABG-3001 on shoot growth and lateral development in apple seedlings.1/

Treatment (conc, ppm)	Shoot growth (cm)	Laterals per seedling	Average length, laterals (cm)
Control	25.2	0	--
RH-6201 25	23.5	0	--
RH-6201 200	13.7	0	--
ABG-3001 500	17.3	2.0	3.5
RH-6201 25 + ABG-3001 500	23.0	2.6	3.1
RH-6201 25 + ABG-3001 500 + daminozide 2000	11.8	7.7	1.2
ABG-3001 500 + daminozide 2000	15.1	5.2	1.8

1/ New terminal shoot growth and lateral growth measurements made 34 days after treatment.

appear to be beneficial in developing a desirable tree structure.

The ABG-3001 at 500 ppm checked shoot elongation and promoted the growth of laterals in this experiment with apple seedlings (Table 1). The combination of RH-6201 and ABG-3001 at the concentrations used provided little or no benefit over the response obtained with ABG-3001 alone. The addition of daminozide to the combination of the two growth regulators significantly reduced shoot growth and increased the number of laterals produced. However, some phytotoxicity also resulted from this combination and would appear to have little benefit over the results obtainable with ABG-3001 alone or the daminozide - ABG-3001 combination.

In this study with apple seedlings M&B 25105 showed activity in the concentration range of 250 to 2000 ppm (Table 2). Length growth of the shoots was slowed or stopped altogether at the 1000 to 2000 ppm range for periods of from two to four weeks depending on the concentration. Many new leaves which differentiated after the application and subsequently unfolded were narrow and more deeply serrated than normal leaves. The symptoms were somewhat similar to the modification in leaf shape caused by 2,4-D on susceptible apple cultivars. After about 4 to 10 cm of new growth leaves of normal shape and size were produced, and the continuing shoot growth appeared normal in all respects. This indicates that degradation of the parent compound had occurred during the period of two to four weeks after treatment.

Table 2. Effect of some growth regulators on shoot length and lateral development in apple seedlings.[1/]

Treatment (conc. ppm)	Shoot growth (cm)	Laterals per seedling	Average length, laterals (cm)
Control	23.0 a[2/]	0	0
M&B 25105 250	10.0 b	0	0
M&B 25105 1000	5.0 c	0	0
M&B 25105 1500	4.8 c	1.0	9.2
M&B 25105 2000	4.7 c	0.5	0.5
Daminozide 1500	1.2 d	0	0
ABG-3001 150	12.5 b	0	0
ABG-3001 250	8.5 b	0.8	1.3
ABG-3001 500	7.8 b	4.8	3.6
M&B 25105 250 +ABG-3001 250	6.5 bc	2.0	8.1
M&B 25105 1000 +ABG-3001 250	2.6 d	6.2	2.1

1/ New terminal shoot growth and lateral growth measurements made 40 days after treatment.

2/ Mean separation by Duncan's Multiple Range Test, 5%

A few lateral shoots developed during the period of interrupted growth at the 1500 and 2000 ppm concentrations, with significantly more laterals of greater average length at the 1500 ppm rate. It is likely that the additional injury and extended duration of effect at the higher M&B 25105 contributed to the weaker lateral development. ABG-3001 at 250 and 500 ppm also induced strong lateral development on the treated seedlings. The response from the 500 ppm rate was similar to that in the earlier trail with RH-6201 (Table 1). Combining ABG-3001 with M&B 25105 increased lateral development over that resulting from the M&B 25105 alone.

It is apparent from these trials that various degrees and forms of growth modification can be obtained with M&B 25105, RH-6201, daminozide and the BA-GA_{4+7} complex. Other growth regulators such as ethephon, UNI-P293 and the straight chain fatty acids (1) can also exert significant growth modification effects on apple. Since relatively few compounds that come under review and field testing are likely to be registered for use on apple and other deciduous tree fruits, it is desirable to examine combinations of existing or registered growth regulators that may produce the desired response and have some likelihood of coming into commercial use.

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EVALUATION OF HERBICIDES FOR WEED CONTROL IN ONIONS

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ABSTRACT

Direct-seeded onions (Allium cepa L.) were treated with various herbicides, both pre- and postemergence, to evaluate control of barnyard grass (Echinochloa crusgalli (L.) Beauv), purslane (Portulaca oleracea L.), crabgrass (Digitaria sanguinalis (L.) Scop.), fall panicum (Panicum dichotomiflorum Michx.), and hairy galinsoga (Galinsoga ciliata (Raf) Blake). In this experiment, propachlor at 3.36, 4.48, 6.72, and 8.96 kg/ha; DCPA at 6.72 kg/ha; diclofop at 0.84, 1.12, and 1.4 kg/ha; and AC 206784 at 2.24, 3.36, and 4.48 kg/ha were applied preemergence on April 25 to both the crop and weeds. These treatments were followed by a postemergence treatment of nitrofen at 3.36 kg/ha; diclofop at 0.84 and 1.12 kg/ha; or AC 206784 at 2.24, 3.36, and 4.48 kg/ha.

There was no phytotoxic effect with any of these treatments. Propachlor, diclofop, and AC 206784 resulted in excellent control of the grasses present. Most of these treatments were weak on purslane under the 1978 cool growing conditions. Nitrofen was the only material which provided consistent control of purslane. Propachlor, with both pre and post applications provided moderate purslane control.

INTRODUCTION

Onions are raised on a very limited acreage on the sandy-loam soils of Long Island. The primary method of production is through direct seeding. Presently registered herbicides have been effective in controlling most weeds; but because of the changing weed spectrum and label restrictions, weed control in onions continues to be a problem. With its minor crop status, it is difficult to obtain labels for use on onions and many potential herbicides have been disregarded for use on this crop.

MATERIALS AND METHODS

The onion variety Pronto S was planted on April 10 on a sandy-loam soil at the Long Island Horticultural Research Laboratory. Seeding was accomplished with a Stan Hay seeder three rows per bed, with the bed 1.8 meters wide. All herbicide applications were made using a tractor-mounted sprayer delivering 61 l/ha at 2.5 atm, on four replications.

Applications of propachlor (2-chloro-*N*-isopropylacetanilide) at 3.36, 4.48, 6.72, and 8.96 kg/ha; DCPA (dimethyl tetrachloroterephthalate) at 6.72 kg/ha; diclofop (2-(4-(2':4'-Dichlorophenoxy)-phenoxy)-methyl-proprionate) at 0.84, 1.12, and 1.4 kg/ha; and AC 206784 at 2.24, 3.36, and 4.48 kg/ha were made on April 25, preemergence, to both the crop and weeds.

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Two postemergence applications of nitrofen (2,4-dichlorophenyl-*p*-nitrophenyl ether) at 3.36 kg/ha followed preemergence treatments of propachlor, DCPA, and AC 206784. Diclofop at 0.84 kg/ha followed the preemergence diclofop treatment. Two applications of diclofop at 1.12 kg/ha followed DCPA preemergence. Two applications each, propachlor at 3.36, 4.48, and 6.72 kg/ha and AC 206784 at 2.24, 3.36, and 4.48 kg/ha postemergence, followed the same rates applied preemergence. The outline for these treatments appears in the Table. The first postemergence treatments of June 16 corresponded to the three- to four-leaf stage and the July 7 treatment to the 1-1/2"-bulb-diameter stage of onion growth.

All treatments were hand-hoed prior to the postemergence treatments so that applications postemergence to the crop were actually preemergence to weeds. Weed control ratings were made on June 14, June 30 and August 15 with yield data taken at harvest after the last reading.

RESULTS AND DISCUSSION

There was no phytotoxicity evident with any of the treatments used. Yield data (Table 1) indicate no significant differences between treatments.

All of the propachlor, diclofop, and AC 206784 treatments gave excellent control of the barnyard grass, crabgrass and fall panicum. Most of these treatments were marginal on purslane with the exception of nitrofen at 3.36 kg/ha applied postemergence on June 16. The postemergence treatments of propachlor gave fair control which improved at the higher (6.72 kg/ha) rate. Galinsoga was present in some plots but not sufficiently uniform to provide adequate information for all treatments. However, propachlor followed by postemergence treatments of nitrofen at 3.36 kg/ha gave excellent control.

All herbicides used in this trial provided excellent control of the grasses present, and there is no question that if the weeds had not been controlled either with herbicides or hand hoeing, that yields would have been significantly reduced. As in past years, propachlor, both pre- and post-emergence treatments, and nitrofen postemergence are excellent for the control of a broad spectrum of weeds in onions (1,2).

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Table 1. Percent weed control and yield of onions treated with herbicides.

Chemical	Rate kg/ha	Timing[1/]	Weed Control: Barnyard grass 6/14	Barnyard grass 6/30	Barnyard grass 8/15	Purslane 6/14	Purslane 6/30	Purslane 8/15	Crabgrass 6/30	Crabgrass 8/15	Fall Panicum 6/30	Galinsoga 8/15	Yield kg/plot
propachlor	4.48	pre											
nitrofen	3.36	post	95	85	83	40	92	96	98	--	98	--	23.4
propachlor	6.72	pre											
nitrofen	3.36	post	98	96	83	55	95	96	99	92	99	98	25.4
propachlor	8.96	pre											
nitrofen	3.36	post	98	99	86	73	99	96	99	68	99	--	23.1
propachlor	3.36	pre + post	85	80	93	13	63	86	99	--	95	--	30.6
propachlor	4.48	pre + post	86	95	97	69	75	83	99	--	92	--	28.3
propachlor	6.72	pre + post	93	98	93	85	92	86	--	99	99	--	25.9
DCPA	6.72	pre											
diclofop	1.12	post	42	72	99	0	--	91	94	--	95	25	27.1
DCPA	6.72	pre											
nitrofen	3.36	post	67	77	95	65	--	99	89	--	97	--	24.6
diclofop	0.84	pre + post	83	96	98	39	40	88	99	--	99	--	25.2
diclofop	1.12	pre											
diclofop	0.84	post	97	98	99	35	69	90	99	94	98	--	25.8
diclofop	1.40	pre											
diclofop	0.84	post	98	99	99	14	75	79	99	94	99	--	28.4
AC 206784	2.24	pre											
nitrofen	3.36	post	98	98	91	34	98	97	99	75	99	94	25.2
AC 206784	3.36	pre											
nitrofen	3.36	post	91	99	94	43	99	97	99	75	99	95	27.7
AC 206784	4.48	pre											
nitrofen	3.36	post	98	99	97	22	99	96	99	99	99	--	28.7
AC 206784	2.24	pre + post	97	95	97	60	80	90	--	--	98	92	29.4
AC 206784	3.36	pre + post	98	98	99	76	67	88	--	94	99	99	26.1
AC 206784	4.48	pre + post	98	99	99	75	73	89	98	99	99	99	26.6
Check[2/]			5	4	3	3	3	2.5	2	3	1	1	25.9

1/ Preemergence treatments were made April 25th. All postemergence treatments were made on June 16 and July 7.

2/ Numbers indicate density of weeds per 0.3 m^2.

HERBICIDE EVALUATIONS FOR CUCUMBERS

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ABSTRACT

The cool spring of 1978 provided a good evaluation of herbicide toxicity to cucumbers. The addition of dinoseb to the combination of bensulide plus naptalam did not improve the control of goosegrass (Eleusine indica (L.) Gaertn.) and common purslane (Portulaca oleracea L.). Butralin, preplant incorporated, appeared to cause a vigor reduction at 1.0 lb/A but provided acceptable tolerance and weed control at 0.5 lb/A. Oryzalin, preemergence caused a vigor reduction at 0.75 lb/A or higher rates; however, 0.375 lb/A provided acceptable weed control and yield. Slight phytotoxicity occurred with oryzalin at 0.5 lb/A. Ethalfluralin was not phytotoxic up to 2.25 lb/A and required 0.75 lb/A for acceptable weed control. The control of purslane and goosegrass was erratic with ethalfluralin at 0.75, 1.0 and 1.12 lb/A. Chloramben methyl-ester was safe from 1.5 to 3.0 lb/A; however, weed control was not acceptable. DCPA incorporated at 4.0, 6.0, 8.0 and 12.0 lb/A caused a vigor and yield reduction. Dichlofop was safe at 1.0 and 2.0 lb/A in combination with chloramben methyl ester and provided excellent grass control with marginal purslane control. Postemergence dichlofop or bentazon treatments were acceptable. Napropamide caused severe injury, premergence or preplant incorporated, at 1.0 lb/A. Nitrofen, premergence, appeared to be tolerated at 3.0 lb/A. The soil type was a Norfolk loamy sand (0.6% O. M.) and the rainfall four weeks after planting was 8.44 inches.

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EVALUATION OF HERBICIDES FOR WEED CONTROL IN CABBAGE

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ABSTRACT

This experiment was conducted on transplanted cabbage (Brassica oleracea cv. capitata L.) on a Haven-loam soil at the Long Island Horticultural Research Laboratory. Herbicides were applied preplant incorporated, preemergence, or postemergence to weeds.

Good to excellent control of barnyard grass (Echinochloa crus-galli (L.) Beauv.) was achieved at all rates used of preplant incorporated trifluralin, tank mix trifluralin plus RH 2915, oryzalin, fluchloralin, and preemergence applications of AC 206784, alachlor, oryzalin, metolachlor, profluralin, and tank mix oryzalin plus nitrofen. There was one treatment involving nitrofen preemergence plus diclofop.

The only material which did not provide excellent control of barnyard grass was nitrofen at 3.36 kg/ha preemergence.

INTRODUCTION

Barnyard grass is one of the major weed problems in fall-planted vegetables, particularly on Long Island where crucifers follow potatoes. This experiment was conducted to evaluate some of the standard herbicide treatments with some of the new chemicals that are being developed for use on cabbage.

In the past several years, herbicide experiments were conducted on direct-seeded cabbage (1,2) on Long Island, but there is still about 2,500 acres of transplanted crucifers so that there is interest by farmers for information on herbicides applied to the transplanted crop.

MATERIALS AND METHODS

Prior to transplanting cabbage, a field was laid out for the herbicide experiments and preplant incorporated treatments were applied and disked in on August 10. The ppi treatments include trifluralin (*α,α,α*-trifluoro-2, 6-dinitro-*N,N*-dipropyl-*p*-toluidine) at 0.56, 0.84, and 1.12 kg/ha; tank mix of trifluralin 0.84 + RH 2915 at 0.42 or and 0.56 kg/ha; oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide) at 1.12 kg/ha; fluchloralin (*N*-(2-chloroethyl)-2,6-dinitro-*N*-propyl-4-(trifluoromethyl)aniline) at 0.56, 1.12, and 1.68 kg/ha. After the initial treatments were made, the variety A and C #5 cabbage was transplanted into plots two rows wide by 7.62 m long. The preemergence applications were made on August 18 and include AC 206784 at 2.24, 3,36 and 4.48 kg/ha; alachlor (2-chloro-2',6'-diethyl-*N*-(methoxymethyl)acetanilide) at 0.56, 0.84,

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1.12 kg/ha; nitrofen (2,4-dichlorophenyl-*p*-nitrophenyl ether) at 3.36 kg/ha; oryzalin at 1.12 and 1.68 kg/ha; a tank mix of oryzalin at 1.12 plus nitrofen at 3.36 kg/ha; metolachlor (2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(methoxy-1-methylethyl acetamide) at 0.56, and 1.12 kg/ha; and profluralin (*N*-(cyclopropyl-methyl)-*a*,*a*,*a*-trifluoro-2,6-dinitro-*N*-propyl-*p*-toluidine) at 0.84 and 1.12 kg/ha. One treatment included nitrofen at 3.36 kg/ha followed by diclofop (2-(4-2';4'-Dichlorophenoxy)-phenoxy)-methyl-propionate) at 1.12 kg/ha postemergence. The postemergence treatment was applied on August 29.

All of the chemicals were applied using a tractor-mounted sprayer delivering 61 l/ha at 2.5 atm and were replicated four times. Ratings for control of barnyard grass were made on September 5 and September 28.

A 1.5 meter check strip was adjacent to each one of the treatments to obtain a better weed control score.

RESULTS AND DISCUSSION

There were no phytotoxic effects with any of the treatments in this experiment. The weed control ratings given in Table 1 indicate that each of the materials except for nitrofen at 3.36 kg/ha preemergence gave acceptable barnyard grass control at the September 5 rating. Immediately following the first rating, the plots were hand weeded and then graded on September 28. As indicated, all of the treatments gave excellent control of the barnyard grass at the second evaluation, except for the nitrofen treatment. Oryzalin applied ppi was slightly more effective than the preemergence treatment.

Metolachlor was more active than alachlor when used at equal rates. Cabbage also appears to be more tolerant of alachlor when transplants are used compared to the direct-seeded experiment of previous years (1,2).

Unfortunately, with only one grass species present, it is impossible to comment on the spectrum of weed control provided by these herbicides. There is no question that many of these materials did provide excellent weed control of barnyard grass in transplanted cabbage. Promising new herbicides for transplanted cabbage include alachlor, profluralin, oryzalin and metolachlor.

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Table 1. Barnyard grass control with herbicides in cabbage.

Chemical	Rate kg/ha	Timing	Percent Weed Control 9/5	9/28
AC 206784	2.24	pre	89	96
AC 206784	3.36	pre	94	99
AC 206784	4.48	pre	96	99
alachlor	0.56	pre	88	92
alachlor	0.84	pre	90	96
alachlor	1.12	pre	94	98
trifluralin	0.56	ppi	81	92
trifluralin	0.84	ppi	83	95
trifluralin	0.84			
+ RH 2915	0.42	ppi	85	95
trifluralin	0.84			
+ RH 2915	0.56	ppi	94	93
oryzalin	1.12	pre	93	97
oryzalin	1.12	ppi	92	99
oryzalin	1.68	pre	90	98
oryzalin	1.12			
+ nitrofen	1.68	pre	88	96
nitrofen	3.36	pre	57	56
nitrofen	3.36	pre	92	96
+ diclofop	1.12	post		
fluchloralin	0.56	ppi	78	94
fluchloralin	1.12	ppi	92	97
fluchloralin	1.68	ppi	73	96
metolachlor	0.56	pre	95	99
metolachlor	1.12	pre	96	99
profluralin	0.84	pre	62	91
profluralin	1.12	pre	65	76
Untreated check (density/.3m^2)			11	24

WEED CONTROL FOR VEGETABLES GROWN ON CLEAR PLASTIC MULCHES

Stanley F. Gorske[1]

ABSTRACT

Several herbicides and herbicide combinations were evaluated for weed control and phytotoxicity to eggplant, seeded cucumber and transplanted muskmelon grown on a clear plastic mulch or bare soil using trickle irrigation. Weed control was generally better under the clear plastic mulch than on the bare soil. Some evidence indicates that weed control was enhanced under the clear plastic mulch due to higher soil temperatures than were present on the bare soil plots. Phytotoxicity to the crop plant was the same whether grown on the clear plastic mulch or bare soil.

All three vegetable crops responded well to the plastic mulch with higher and earlier yields when compared to the bare soil treatments.

INTRODUCTION

Many vegetable crops are grown on plastic mulches to increase yield and promote earliness. When clear plastic is used, there is an additional problem of weed control which is not encountered when black plastic is used. Soil fumigation will control weeds under clear plastic, but the cost may be prohibitive. If soil-borne diseases are not a problem, an herbicide may be all that is needed to control the weeds under clear plastic.

The purpose of this study was to evaluate several herbicides and herbicide combinations for weed control and phytotoxicity to eggplant (*Solanum melongena* L. var. *esculentum* 'Hibush'), seeded cucumber (*Cucumis sativus* 'Marketmore 70') and transplanted muskmelons (*Cucumis melo* 'Iroquois') grown on a clear plastic mulch.

MATERIALS AND METHODS

Three experiments were conducted in 1978 at the Rutgers Research & Development Center-Bridgeton and certain procedures were common to all. The soil type was an Aura sandy loam with 1.3% organic matter.

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The 3 plots received 1 inch of overhead irrigation within 1 hr after the herbicide treatments were applied. Five days later the treatments were covered with 1½ mil, 5-foot wide clear polyethylene mulch. As the mulch was being laid, twin-wall trickle irrigation tubing was being placed 2 inches deep and 6 inches off the center of the rows under the plastic. Half of each treatment in the eggplant and cucumber plot was left unmulched (split plot design) to allow for a comparison of herbicide behavior and crop response to the plastic mulch and bare soil. The muskmelon experiment was established on plastic mulched treatments only.

The following day eight-week-old 'Harris Special Hibush' seedlings were planted 3 feet apart on 7-foot rows which were 50 feet long. 'Marketmore 70' cucumber seed were planted 2 seeds to a hill, 1 foot apart on 8-foot rows, 50 feet long. Three-week-old 'Iroquois' muskmelon seedlings were planted 3 feet apart on 8-foot rows, 25 feet long. Eggplant and cucumber treatments were arranged in a split plot design with 3 replicates and muskmelons were arranged in a randomized complete block design with 3 replicates. Treatments were analyzed for statistical differences using Duncan's multiple range test at the 5% level of probability.

RESULTS AND DISCUSSION

Eggplant yield was increased by the use of clear plastic mulch. Mulched eggplant produced an average of 58.9 lb of fruit per 25-foot row compared to 9.3 lb of fruit for the unmulched eggplant.

Most of the mulched herbicide treatments provided excellent weed control and did not cause any noticeable phytotoxicity to the eggplant. However, the highest yielding mulched treatments were not statistically better than the untreated check for fruit number or weight (Table 1).

(See following page for Table 1)

This suggests that weed growth under the clear plastic mulch does not significantly reduce yield. The weeds are restricted in their growth by the plastic and possibly this does not allow them to compete with the eggplant as severely.

Herbicide behavior was similar for the plastic mulched and unmulched eggplant with one exception. The combination of alachlor [2-chloro-2',6'-diethyl-*N*-(methoxymethyl)acetanilide] and chloroxuron [3-[*p*-(*p*-chlorophenoxy)phenyl]-1,1-dimethylurea] in the mulched eggplant significantly reduced yield and the eggplant growth was visually stunted when compared to the highest yielding treatments. However, this combination was the highest yielding treatment on the unmulched eggplant and had significantly higher yields than many of the other treatments. The plastic mulch was undoubtedly creating an unfavorable microclimate below it that resulted in the herbicides being phytotoxic to the eggplants. The other herbicide

TABLE 1. Eggplant yield and weed counts for plastic mulched and unmulched herbicide treatments. This table is a summarization of the highest yielding treatments from a larger experiment.

Treatment	Lb ai/A	Mulched			Unmulched		
		No. Fruit	Lb Fruit	No.* Weeds	No. Fruit	Lb Fruit	No.* Weeds
Oryzalin - Pre	0.75	69 a	75 a	0	16 efg	16 hij	1 bl
Profluralin - PPI+ Napropamide - PPI	1.00 1.00	69 a	72 ab	0	20 def	22 ghij	1 bl
Trifluralin - PPI+ Metribuzin - Pre	0.50 0.13	64 ab	72 ab	0	12 efg	11 ij	1 bl
Fluchloralin - PPI+ Napropamide - PPI	1.50 1.00	65 ab	69 ab	0	14 efg	13 hij	1 bl
Napropamide - PPI	0.50	62 ab	68 ab	3 g	6 fg	5 ij	7 g+ 9 bl
Trifluralin - PPI+ Napropamide - PPI	0.50 1.00	61 ab	67 ab	1 g	13 efg	12 ij	1 bl
Napropamide - PPI	1.00	59 ab	65 abc	2 g	11 efg	10 ij	1 g+ 4 bl
Unweeded check	-	57 ab	59 abcd	30 g+ 4 bl	1 g	1 j	30 g+ 12 bl
Alachlor - Pre+ Chloroxuron - Pre	2.00 3.00	49 bc	52 bcde	0	23 de	24 fghi	0

* Weed counts are per 1 square foot (average of 2 counts per rep), g = grass, bl = broadleaf

treatments were in approximately the same order as to yield as they were for the mulched eggplant (Table 1).

Seeded cucumbers also showed a marked increase in yield due to the plastic mulch. The highest yielding treatment was a combination of bensulide [*O,O*-diisopropyl phosphorodithioate *S*-ester with *N*-(2-mercaptoethyl) benzenesulfonamide] and naptalam [*N*-1-napththylphthalamic acid] which produced an average of 149.5 lb of fruit per 25-foot row (Table 2). The highest yielding unmulched treatment produced 43.2 lb of fruit (handweeded check).

All of the herbicide treatments provided commercially acceptable grass control. Carpetweed (*Mollugo verticillata* L.) was the main broadleaf weed present in the plastic mulched treatments. Carpetweed is a small weed with a prostrate growth habit which provided little or no competition to the cucumber plants. The treatments that were not mulched had a severe infestation of common ragweed (*Ambrosia artemisiifolia* L.). This ragweed problem was not controlled by any of the herbicide treatments and had a detrimental effect on cucumber yield.

TABLE 2. Cucumber yield and weed counts for plastic mulched and unmulched herbicide treatments. This table is a summarization of the highest yielding treatments from a larger experiment.

Treatment		Lb ai/A	Mulched			Unmulched		
			No. Fruit	Lb Fruit	No.* Weeds	No. Fruit	Lb Fruit	No.* Weeds
Bensulide Naptalam	- Pre+ - Pre	4.0 2.0	201 a	150 a	4 bl	29 f-i	21 g-k	2 bl
Diclofop Chloramben[1]	- Pre+ - Pre	1.5 1.5	192 a	149 a	8 bl	14 g-i	11 i-k	16 bl
Diclofop Naptalam	- Pre+ - Pre	1.5 2.0	199 a	143 a	1 bl	21 f-i	16 h-k	3 bl
DCPA	- PPI	4.0	174 a	140 a	5 bl	0 i	0 i	1 g+ 3 bl
Bensulide Chloramben[2]	- Pre+ - Pre	4.0 2.0	163 ab	122 ab	5 bl	22 f-i	16 h-k	7 bl
Bensulide Dinoseb	- Pre+ - Pre	4.0 1.5	147 abc	115 abc	8 bl	8 hi	7 jk	2 g+ 12 bl
DCPA	- PPI	8.0	155 ab	114 abc	1 bl	2 i	1 k	1 g+ 4 bl
Unweeded check		-	20 fghi	12 ijk	25 g+ 4 bl	7 i	4 jk	43 g+ 8 bl
Handweeded check		-	-	-	-	61 d-i	43 e-k	0

* Weed counts are per 1 square foot (average of 2 counts per rep), g = grass, bl = broadleaf

[1] Salt

[2] Methyl ester

Common ragweed control in the mulched treatments was undoubtedly a result of the plastic mulch increasing the soil temperature. It is a recognized fact that soil temperature as low as 30°C inhibits germination of common ragweed seed (1).

Muskmelon yields were not significantly reduced by the presence of weeds (unweeded check) when compared to weed-free treatments (Table 3). This response was also present in the eggplant experiment (Table 1) and again suggests that weed growth under plastic is not as competitive with the crop as in unmulched areas.

Few of the herbicide treatments controlled all the weeds and several of the highest yielding treatments had several weeds present (Table 3).

All of the treatments were irrigated with twin-wall trickle irrigation. There was no apparent breakdown of the herbicides around the

trickle tube which might have been caused by the concentration of moisture. The weeds that were present were scattered around the bed and were not concentrated in any one area.

TABLE 3. Muskmelon yield and weed counts for plastic mulched and unmulched herbicide treatments. This table is a summarization of the highest yielding treatments from a larger experiment.

Treatment	Lb ai/A	No. Fruit	Lb Fruit	No.* Weeds
Thalfluralin - PPI	1.12	22.7 a	99.6 a	0
Penoxalin - PPI	0.50	23.7 a	92.2 a	5 g
Bensulide - Pre+ Chloramben[1] - Pre	4.00 2.00	22.3 a	86.6 ab	3 bl
Napropamide - PPI	1.00	20.3 ab	85.6 ab	5 bl
Thalfluralin - Pre	3.00	22.0 a	85.1 ab	0
Thalfluralin - Pre	1.50	19.0 ab	71.7 abc	1 bl
DCPA - PPI	8.00	17.7 ab	71.3 abc	1 g
Bensulide - Pre+ Naptalam - Pre	4.00 2.00	20.3 ab	68.9 abc	0
Unweeded check	-	19.3 ab	62.0 abc	25 g+ 5 bl

* Weed counts are per 1 square foot (average of 2 counts per rep), g = grass, bl = broadleaf

[1] Methyl ester

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WEED CONTROL SYSTEMS FOR TRANSPLANTED TOMATOES

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ABSTRACT

A two-year study comparing four weed control systems involving cultivation, hoeing and herbicides was undertaken in northwest Ohio in 1977 and 1978. Under very light weed pressure in 1977, tomato yields were not significantly affected by the weed control program used and mechanical cultivation provided the most economical method while reliance strictly on herbicides proved to be the most expensive system. Moderate weed pressure in 1978 resulted in completely different results, with tomatoes only receiving mechanical cultivation suffering a 41% yield reduction as a result of competition from in-row weed escapes. Hand hoeing, in addition to cultivation, produced the largest tomato yield, but the high labor costs reduced net return per ha. A standard weed control program of trifluralin plus plus cultivation and one hand hoeing resulted in an intermediate tomato crop and net return. The weed control program depending only on trifluralin and metribuzin produced the highest net profit and indicated that postplanting metribuzin treatments could substitute for cultivation and hand hoeing operations.

INTRODUCTION

Cultivation and hand hoeing have been employed for centuries to control weeds in various crops. When crops are grown in row culture, timely cultivation can be quite effective in controlling seedling weeds growing between the rows. Labor for hand weeding is no longer readily available and, with minimum wage laws now applying to agricultural workers, becomes an expensive operation when it is employed. For the past decade, the standard weed control practice for transplanted tomatoes (*Lycopersicon esculentum* Mill.) grown in the east and mid-western United States has involved the use of the herbicide trifluralin (*a,a,a*-trifluoro-2,6-dinitro-*N,N*-dipropyl-*p*-toluidine) as a preplanting treatment followed by one or two cultivations, with hand hoeing used on about 75% of the acreage. The ability to use metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one) as a postplanting treatment to control seedling weeds could eliminate the need to cultivate and hoe tomatoes. However, there has been some criticism that in an era of petroleum shortages, use of petroleum derived pesticides represents inefficient use of this limited resource. This trial was initiated to evaluate and compare four weed control systems involving mechanical methods, hand labor and herbicides.

MATERIALS AND METHODS

Four replicate, randomized block experiments were located near Napoleon, Ohio, in 1977 and 1978. The soil type for the 1977 trial was classified as a sandy clay with 2.3% organic matter and, in 1978, a sandy loam with 1.8% organic matter. Three-row plots 4.5 m wide by 6.1 m long were used in 1977, with four-row plots used in 1978. Four weed control systems were employed; mechanical cultivation, mechanical cultivation supplemented by hand hoeing, a "standard" program using trifluralin prior to planting followed by one or two cultivations and a chemical control program.

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Preplant herbicide treatments were applied May 10 in both years and incorporated 7 cm deep with a rototiller in 1977 and a double disc in 1978. Tomato transplants were set on May 12 each year using variety Campbell 37 in 1977 and Campbell 28 in 1978. Postplanting herbicide treatments were applied on June 3, 1977, to well established transplants having two to three flower clusters, while seedling weeds averaged 7 cm in height. In 1978, postplanting treatments were applied on June 5 to a well established crop and weeds only 2.5 cm tall. All herbicide treatments were applied with a bicycle plot sprayer delivering 308 L/ha at 2.1 cm^2 pressure. Plots receiving mechanical weed control treatments were cultivated three times; May 31, July 6 and July 27 in 1977; and June 5, June 15, and July 14, in 1978. Cultivator sweeps were angled to throw soil into the crop row in an attempt to smother seedling weeds. In 1977, only one hand hoeing on July 18 was required to supplement the cultivation treatment to obtain weed-free plots. In 1978, two hand hoeings were required in addition to two cultivations to achieve a relatively weed-free crop. These hoeings were carried out on June 15 and July 14 with weeding time recorded for each plot. Because of numerous weed escapes in 1978, the trifluralin plus cultivation treatment also required a supplemental hand hoeing on July 14 to provide an acceptable level of weed control. Weeds growing in the crop row in plots receiving only mechanical cultivation were allowed to grow and compete with the crop all season. Plots receiving only herbicide treatment were not cultivated or hoed and again weed escapes were permitted to compete with the crop throughout the season.

The weed population in 1977 was considered very light and consisted of common lambsquarters (*Chenopodium album* L.), smartweed (*Polygonum pensylvanicum* L.), velvetleaf (*Abutilon theophrasti* Medic.), and annual grasses including crabgrass (*Digitaria* sp) and barnyard grass (*Echinochloa crus-galli* (L.) Beauv.). In 1978, the weed infestation was moderate with lambsquarters, redroot pigweed (*Amaranthus retroflexus* L.), smartweed and black nightshade (*Solanum nigrum* L.) being the dominant broadleaf weeds, and giant foxtail (*Setaria faberi* Herm.) and crabgrass the dominant annual grass species.

Ripe tomato fruit were harvested by hand from the center row(s) of each plot on two dates each year; August 19 and 31 in 1977, and August 15 and September 7 in 1978.

RESULTS AND DISCUSSION

The weed density in the 1977 study was considered very light, averaging one broadleaf weed and 0.8 grasses per square m. This limited weed growth was thought to be associated with relatively dry weather conditions during May (4.7 cm of precipitation - most of which fell the first week of the month). In 1978, the weed population was considered moderate with six broadleaf weeds and 0.8 grasses per square m (precipitation in May of 1978 totaled 8.3 cm.). These weed populations were recorded as in-row weeds surviving in plots receiving the mechanical cultivation treatment.

In order to provide some economic cost analysis for the four weed control systems evaluated, a number of monetary values were assigned to the various operations as noted in the footnotes to Table 1. While costs and prices are variable items depending on the year, farmer, and location in the country, they are used here to illustrate relative differences in weed control costs and how this might affect a growers net return - assuming all other crop production costs are equal.

In 1977, under very light weed pressure, tomato yields were not significantly influenced by any of the weed control methods. In this situation, mechanical cultivation proved to be the least expensive treatment and provided the maximum return per ha, Table 1. This system did permit velvetleaf, smartweed, and lambsquarters as in-row escapes to go to seed and increase the potential weed population in the area for future years. Two cultivations plus one hand hoeing (averaging 17 hrs/ha) provided a relatively clean planting with only a few late germinating annual grass escapes and resulted in the maximum yield. The standard control program of trifluralin plus one cultivation permitted velvetleaf and smartweed escapes. While this was the second least expensive system used, it produced the lowest net return/ha. The three-way herbicide combination treatment was the most expensive method used in 1977, but did provide a weed-free planting throughout the growing season.

In 1978, the greater weed pressure produced quite different results to those obtained in 1977. Three mechanical cultivations left a sufficient in-row weed population to significantly reduce tomato yields by 41% of the other three methods studied, Table 2. Two cultivations plus the addition of 167 hrs/ha of hoeing labor produced the highest crop yield and the second highest net return. The standard weed control program of trifluralin plus cultivation was not satisfactory in 1978, and because of numerous weed escapes, supplemental hand hoeing was employed on July 14 involving 71 hrs/ha of labor. While this hoeing was beneficial in preventing weed escapes from going to seed, the timing was likely too late to stop competition from reducing crop yield. This illustrates the need to remove weeds early in the growing season, and is supported by the fact that the hoeing on June 15 (which entailed 133 hrs/ha) in the "cultivation plus hoeing" treatment produced 65 m tons/ha compared to 52 in the standard treatment.

Metribuzin combined with trifluralin preplanting and followed with a postplanting application on June 5 was the second least expensive treatment, produced a yield very similar to the cultivation plus hoeing treatment and resulted in the highest net return/ha. Black nightshade was not controlled by this treatment and some crabgrass and foxtail escapes were observed.

It is apparent that under very light weed pressure, differences between the four weed control systems were not significant and that if one only considered short term benefits and returns, mechanical cultivation would suffice. In the long run, permitting in-row weed escapes would eventually lead to increased weed problems in future years. The "standard" weed control program also was satisfactory under light weed pressure although weed species tolerant to trifluralin, such as velvetleaf and smartweed were evident. The 1978 trial, with more typical weed pressure, points out that dependence on mechanical cultivation alone, while the least expensive method, is not a practical option and that in-row weed escapes could not be tolerated if tomato growers were to operate successfully. In spite of high hand labor costs, the return on investment from this operation would be more than justified in terms of a growers net return. However, availability of this kind of agricultural labor is limited and likely to diminish in years ahead. Metribuzin used in conjunction with trifluralin offers an opportunity to eliminate the need for cultivation and hand labor to control weeds and in terms of input resources, may be the most efficient weed control system available for tomato production at this time. One of the weed species which could interfere with the success of the trifluralin/metribuzin program would be black nightshade. Where tolerant weed species exist, more attention needs to be devoted to their control by selecting appropriate weed control systems in production of other crops in the rotation.

Table 1. Comparison of four weed control systems for transplanted tomatoes at Napoleon, Ohio, in 1977.

Treatment	No. of operations or Rate kg/ha	Date	Weed control[a] cost/ha	Weed[b] escapes	Yield m ton/ha	Net return[c] per ha
Mechanical cultivation	3x	5/31,7/6,7/27	$37	VL, LQ, SW	64.1	$ 4,514
Mechanical cultivation + hand hoeing	2x 1x	5/31, 7/6, 7/18	69	few grasses	64.3	4,496
Trifluralin + cultivation	1.12 kg 1x	5/10 5/31	49	VL, SW	61.6	4,325
Trifluralin + pebulate + metribuzin	0.84 + 4.48 + 0.58	5/10 6/03	86	clean	63.8	4,444
LSD 5%					NSD	

Table 2. Comparison of four weed control systems for transplanted tomatoes at Napoleon, Ohio, in 1978.

Mechanical cultivation	3x	6/5, 15, 7/14	37	RRP, SW, LQ, NS, GF, CG	35.1	2,455
Cultivation + hand hoeing	2x 2x	6/5,6/15 6/15, 7/14	467	clean	65.6	4,183
Trifluralin + cultivation + hand hoeing	1.12 2x 1x	5/10 6/5, 6/15 7/14	239	few NS, LQ	52.2	3,467
Trifluralin + metribuzin + metribuzin	1.12 + 0.58 + 0.58	5/10 6/5	76	NS, CG GF	62.3	4,347
LSD 5%					19.0	

a Cost assumptions - cultivation $12.35/ha/operation; hand labor $ 2.65/hr.; metribuzin $17.30/ha ($14.00/lb ai); trifluralin $24.70/ha ($10/lb ai); pebulate $34.60/ha ($3.50/lb ai); herbicide appl. + incorporation $12.35/ha

b Weed escapes - VL = velvetleaf, LQ = lambsquarters, SW = smartweed, RRP = redroot pigweed, GF - giant foxtail, CG = crabgrass, NS = nightshade

c Crop valued at $71/m ton - Net return calculated as crop value minus weed control cost.

PERFORMANCE OF A CONTROLLED RELEASE STARCH FORMULATION OF EPTC

P. L. Minotti and R. D. Sweet[1/]

ABSTRACT

The relative performance of a starch encapsulated slow release granular formulation of EPTC (23.4 SX by Stauffer) was assessed in 12 various field experiments over the past two growing seasons. A consistent slight to moderate advantage for the SX granules over the 7E was evident against yellow nutsedge. No consistent advantage for either formulation surfaced in several experiments where redroot pigweed was the dominant weed, although the SX performed markedly better in an experiment where plots were deliberately irrigated to excess. Both formulations were extremely effective against millet and oats precluding meaningful comparison with these highly susceptible species. Both formulations generally benefited from incorporation but there were exceptions.

There was no suggestion of improved crop safety from the "slow release concept"; in fact there were instances where sweet corn and snap beans were injured more by the SX granule than a comparable rate of 7E.

In the greenhouse SX granules completely wiped out barnyard grass at rates where the 7E caused severe stunting and twisting and a 50% reduction in dry matter.

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Table 1. Relative performance of a starch encapsulated granular formulation of EPTC (23.4 SX) in several field experiments.

Results Book # & Description	Application		Rate	Mean Weed Rating[1]			Crop Injury[2]		
				7E	SX	Unt.	7E	SX	Unt.
57. 77 Nutsedge	4/28	PPI	4.0	6.2	8.0	4.5	-	-	-
		PRE	4.0	4.2	6.5	3.8	-	-	-
58. 77 Nutsedge	5/24	PPI	4.0	7.0	7.2	3.5	-	-	-
		PRE	4.0	5.8	6.8	3.4	-	-	-
39. 78 Nutsedge	4/28	PPI	3.0	6.3	6.6	5.1	-	-	-
		PRE	3.0	5.5	6.8	4.8	-	-	-
		PPI	4.0	6.5	6.8	5.1	-	-	-
		PRE	4.0	6.0	6.3	4.8	-	-	-
51. 78 Nutsedge[3]	6/23	PPI	3.0	4.2	4.7	1.8	-	-	-
		PRE	3.0	3.4	5.0	1.9	-	-	-
45. 77 Snap, Dry Bean	6/22	PPI	3.0	5.5	5.5	2.6	8.5,8.5	6.0,7.0	7.8,7.8
47. 77 Snap, Dry Bean	6/22	PRE	3.0	5.5	5.0	4.5	8.0,8.0	8.0,8.0	8.0,8.0
45.		PPI	4.0	5.0	6.5	2.6	8.5,8.5	6.0,7.0	7.8,7.8
47.		PRE	4.0	7.8	6.5	4.5	8.5,8.5	8.0,8.0	8.0,8.0
30. 78 Snap, Dry Bean	6/16	PPI	1.5	4.2	6.0	2.2	8.5,8.0	7.5,8.0	7.8,7.8
		PRE	1.5	4.2	4.2		8.0,7.5	8.0,8.0	
		PPI	3.0	6.5	6.0		7.0,7.5	8.0,7.0	
		PRE	3.0	5.0	5.0		8.0,8.0	7.5,7.5	
29. 78 Snap Beans[3] (excess H_2O)	6/22	PPI	3.0	3.7	5.5	2.3	9.0	9.0	9.0
		PRE	3.0	3.1	4.0	2.5	9.0	9.0	9.0
29. 78 Snap Beans[3] (normal H_2O)	6/22	PPI	3.0	2.8	4.4	1.0	9.0	9.0	9.0
		PRE	3.0	3.4	4.1	3.2	9.0	9.0	9.0
4. 78 Potatoes[2]	6/06	DPI	2.0	5.2	6.0	5.2	8.5	8.5	9.0
		DP	2.0	6.5	6.0		9.0	9.0	
		DPI	4.0	6.0	7.8		8.5	8.5	
		DP	4.0	8.2	7.5		8.0	6.5	
32. 77 Sweet Corn[4]	6/02	PPI	3.0	9.0	8.0	1.5	8.8	6.5	8.3
		PRE	3.0	7.0	8.0		8.5	7.5	
		PPI	4.0	8.5	8.2		8.5	5.0	
		PRE	4.0	8.7	7.5		8.3	8.5	
53. 78 Sweet Corn	6/06	PPI	2.0	7.2	7.2	5.4	8.0	7.2	7.8
		PRE	2.0	7.8	6.7		7.0	7.8	
		PPI	4.0	8.2	8.8		8.0	6.8	
		PRE	4.0	8.0	7.8		7.2	6.8	
52. 78 Sweet Corn[3]	7/13	PPI	2.0	6.7	6.5	5.7	7.5	5.7	9.0
		PRE	2.0	6.0	5.5	5.5	7.5	5.7	9.0
		PPI	4.0	6.7	7.3	5.7	5.7	4.5	9.0
		PRE	4.0	6.2	6.5	5.5	5.5	4.5	9.0

[1]Average over replications and rating times. Ratings are for redroot pigweed except for nutsedge plots. 1-9 system where 9=perfect control.

[2]Average over replications for earliest rating only. 9=perfect crop.

[3]These experiments replicated 6 times.

[4]EPTC+(6.7E) was the standard in this experiment only.

WEED CONTROL IN NARROW AND WIDE-ROW NAVY BEANS

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ABSTRACT

Several chemical weed control systems were investigated during 1977 and 1978 to determine the feasibility of utilizing narrow-row plantings with navy beans. The use of herbicide combinations involving two materials provided adequate season long weed control without the need for mechanical cultivation. This indicates that narrow-row culture, with respect to weed control, is a practical concept. Combinations involving three herbicides were not significantly better than two-way combinations under conditions of these trials. Bentazon applied postemergence with trifluralin or EPTC improved bean yields by 300 and 500 kg per ha in 1977 and 1978 respectively, compared to plots not receiving bentazon, more than enough to offset the cost of this treatment. Row spacings did not significantly influence the level of weed control attained with various herbicide treatments. Narrow-row spacings of 19 cm and 38 cm provided yield increases of 16 and 20 percent respectively, compared to conventional row spacing.

INTRODUCTION

Navy beans (Phaseolus vulgaris L.) are commonly grown as a row crop with row spacings of 71 cm to 106 cm apart. Considerable research with soybeans (Glycine max (L.) Merr.) has demonstrated that narrower rows (50 cm or less) outyielded wider rows of 75 cm or more, especially in the northern production areas of the United States (1, 2, 4). Numerous experiments conducted in Michigan (3) and New York[2/] indicate that a potential yield increase of 10 to 20% or more may be achieved with narrow-row plantings of dry beans over conventional spacings although the advantage may not be large every year. Narrow row planting, however, eliminates the ability to use mechanical cultivation to augment preplanting or preemergence herbicides in the weed control program. Thus, the threat of severe weed competition can be a limiting factor to a farmer considering adopting narrow-row culture for navy bean production. The registration of bentazon (3-isopropyl-1 H-2, 1, 3-benzothiadiazin-(4) 3 H-one 2,2-dioxide) for use on dry beans in 1977 provided a new herbicide tool which would permit postemergence control of many seedling broadleaf weeds and therefore, possibly replace the need for mechanical cultivation operations. This study was initiated to evaluate several chemical weed control systems using registered herbicides under conventional and narrow-row plantings.

MATERIALS AND METHODS

Field experiments were conducted on a sandy clay soil with 1.8% organic matter and a pH level of 5.7 in the area of Napoleon, Ohio, during 1977 and 1978. Treatments were replicated four times in a split-plot design with herbicide

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2/ Kueneman, E. A. 1978. Evaluation of the yield potential of growth habits of dry beans (Phaseolus vulgaris L.) and determination of plant types for high density plantings. PhD Thesis, Cornell University. Ithaca, NY. 221 p.

treatments as main plots and row spacings as sub-plots. Sub-plots were 1.5 m by 6.1 m in size with three row spacings; two-row plots 76 cm apart, three-row plots 38 cm apart, and five-row plots 19 cm apart. All herbicides were applied with a bicycle plot sprayer delivering 308 L/ha at 2.1 cm^2 pressure using compressed air as a propellant. Preplant treatments were incorporated immediately with a rotary powered tiller to a depth of 7 cm. Preplanting treatments were applied to a powdery dry soil on May 25, 1977, and to a moist soil on May 26, 1978. Preemergence applications were made June 10, 1977, to a moist soil surface (followed by 0.12 cm of precipitation in three days), and on June 1, 1978, to a dry soil surface (followed by 0.9 cm of precipitation within one week). Variety Sanilac navy beans were planted by hand using a cone type seeder on June 6 and May 31 in 1977 and 1978, respectively. The seeding rate was kept constant at 67 kg/ha or approximately 335,000 plants/ha, regardless of the row-spacing employed. Bentazon was applied to beans with two trifoliate leaves on June 29 in 1977, when broadleaf weed seedlings were 2 to 4 cm in height. In 1978, beans were at a similar stage of growth on June 22, but broadleaf weeds were larger, ranging from 5 to 7 cm in height. Plots were not cultivated or weeded with the exception of the "weeded controls" which were hoed twice during the early part of the season. Dominant broadleaf weeds present in both years were: common lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), smartweed (Polygonum pensylvanicum L.), black nightshade (Solanum nigrum L.) with crabgrass (Digitaria sanguinalis (L.) Scop.), and giant foxtail (Setaria faberi Herrm.) representing annual grasses. Weed control was assessed using a 0 to 10 visual rating system with 10 representing 100% control and 0 no control, with '8' considered necessary for commercial acceptance. Plots were harvested on September 7, 1977, and September 1, 1978. Beans were threshed and cleaned before yield weights were calculated and in 1978, bean seed moisture was measured and yields adjusted to 18% moisture.

RESULTS AND DISCUSSION

Weed Response

Weed populations in the test area were considered moderate to heavy resulting in 57% and 71% yield reductions in the unweeded control plots in 1977 and 1978, respectively. The weed control ratings reported in Table 1 are for July evaluations, but generally, there was only a slight deterioration in weed control levels by harvest for most treatments. Analysis of weed control ratings for a herbicide treatment by row spacing interaction was not significant and, therefore, means presented in Table 1 are for the three row spacings. Trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), EPTC (S-ethyl dipropylthiocarbamate) or their combination failed to provide satisfactory broadleaf weed control in 1977 and were borderline in July of 1978, Table 1, (but unacceptable by harvest - data not shown). The main weed escapes from these treatments were lambsquarters, smartweed and black nightshade. Combination treatments including chloramben (3-amino-2,5-dichlorobenzoic acid) preemergence or bentazon postemergence, improved the level of weed control significantly although nightshade escapes represent a potential problem.

Trifluralin alone in 1977 failed to hold crabgrass in check, indicating that the very dry soil conditions at application time adversely affected activity of this material. All other treatments were highly effective against annual grasses in both years.

Combination treatments with two or more herbicides generally improved the level of weed control over that obtained with a single compound; however, the advantage obtained with trifluralin plus EPTC was judged questionable based on these two trials. Trifluralin plus chloramben provided slightly better weed control than trifluralin plus EPTC while bentazon, postemergence with either trifluralin or EPTC were the most effective treatments. Combinations involving three herbicides were not considered necessary for commercially acceptable weed control.

Postemergence bentazon treatments, particularly with the narrow-row culture would be most effective if applied by airplane; however, the crop damage sustained by ground application equipment at early stages of growth may not be unreasonable considering the advantages gained in weed control.

Crop Response

The in-row bean population at harvest in 1977 averaged 3 cm between plants for the wide row spacing, 7.5 cm for the 38 cm spacing, and 16 cm for the 19 cm spacing. In 1978, final stands were somewhat thinner than in 1977 with in-row spacings of 5, 11, and 19 cm respectively for the 76, 38 and 19 cm row spacings.

Bean yields are summarized in Table 2 and represent the means of the three row spacings since "spacing by herbicide treatment" interactions were not significant. In 1977, all herbicide treatments resulted in yields comparable to the weeded control. This also was true in 1978 with three treatments involving bentazon with trifluralin or EPTC producing yields significantly higher than the weeded control plots. While bentazon is recognized as an expensive treatment, the data from these trials indicate that yield increase associated with its use provided 300 to 500 kg more beans/ha in 1977 and 1978, respectively, or enough to make the use of bentazon a good investment for navy bean growers.

Table 3 summarizes yield response for row spacings over two years by combining herbicide treatment effects and analyzing the yearly effect as a split-plot experiment. The data indicate that narrow rows - either 19 or 38 cm produce significantly greater yields than obtained with wide rows. This 16 to 20% yield response is similar to the potential expressed by Dr. Kueneman[2/] and reported from Michigan (3).

This study indicates that chemical weed control tools exist to eliminate the need for dependence on mechanical cultivation in the bean growers weed control program, and permit them to take advantage of the increased yields available with narrow row culture. There is need for further research to improve harvesting operations with narrow-row plantings by either modifying conventional bean pullers or in direct combining methods. In this regard, there may be a need for use of desicants to aid dry down of bean plants to facilitate harvesting of beans. Genetic improvement to provide varieties which set pods higher on the plant could aid in reducing harvest losses.

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Table 1. Effect of eight herbicide treatments of broadleaf and annual grasses in two trials conducted at Napoleon, Ohio, in 1977 and 1978.

			Weed control rating on a 0-10 scale			
			B.L.W.		Annual grasses	
Treatment	Rate kg/ha	Appl.	1977	1978	1977	1978
Weeded control	--	--	10.0	9.5	10.0	8.9
Unweeded control	--	--	0	0	0	0
Trifluralin	1.12	ppi	6.1	8.1	7	9.5
EPTC	3.3	ppi	6.5	8.0	10.0	9.5
Trifluralin + EPTC	(1.1 + 3.3)	ppi	7.5	8.1	9.7	10.0
Trifluralin+bentazon	1.1 ppi + 1.1 post		8.6	9.9	9.0	9.6
EPTC + bentazon	3.3 ppi + 1.1 post		8.9	9.7	9.5	9.8
Trifluralin + EPTC + bentazon	(1.1 + 3.3) ppi + 1.1 post		9.2	9.9	9.7	10.0
Trifluralin + chloramben	1.1 ppi + 3.3 pre		8.4	8.7	10.0	10.0
Trifluralin + chloramben + bentazon	1.1 ppi + 3.3 pre + 1.1 post		9.1	9.9	10.0	9.9
Bayes LSD 5%			1.6	0.8	1.9	1.1

Table 2. Effect of herbicide treatment on navy bean yields in two trials - 1977 and 1978.

Treatment	Rate kg/ha	Appl.	Yield kg/ha 1977		Yield kg/ha 1978	
Weeded control	--	--	1620 a[a]		2220 de	
Unweeded control	--	--	917 b		637 f	
Trifluralin	1.1	ppi	1272 ab		2123 de	
EPTC	3.3	ppi	1385 ab	1369 B	2263 cde	2115 B
Trifluralin + EPTC	(1.1 + 3.3)	ppi	1450 ab		1959 d	
Trifluralin + bentazon	1.1 ppi + 1.1 post		1646 a		2694 ab	
EPTC + bentazon	3.3 ppi + 1.1 post		1747 a	1691 A	2745 a	2693 A
Trifluralin + EPTC + bentazon	(1.1 + 3.3) ppi + 1.1 post		1680 a		2639 abc	
Trifluralin + chloramben	1 ppi + 3.3 pre		1742 a		2477 abcd	
Trifluralin + chloramben + bentazon	1 ppi + 3.3 pre + 1.1 post		1612 a		2317 bcde	

[a]Means in columns followed by a common letter are not significantly different at the 5.0% level - Duncan Multiple Range Test.

Table 3. Response of navy bean yields to three row spacings over a two-year period (combining herbicide treatment effects).

Row spacing in cm	1977	1978	Mean of spacings	% increase
19	1500	1935	1718 a	16
38	1251	2304	1778 a	20
76	1288	1669	1478 b	
Year Mean	1346 B	1969 A		

Note: Spacing x year interaction was not statistically significant by F test.

DINOSEB COMBINATIONS WITH TRIFLURALIN OR ALACHLOR FOR LIMA BEANS

C. E. Beste[1/]

ABSTRACT

In 1978, the combination of preemergence (pre) dinoseb at 1.5, 3.0 and 6.0 lb/A plus preplant incorporated (ppi) trifluralin at 0.5 and 1.0 lb/A did not significantly affect yields or maturity (as measured by a shear press) of baby lima beans (Phaseolus lunatus L. 'Bridgeton') in a Norfolk loamy sand with 0.7% organic matter. The combinations of ppi or pre alachlor at 1.5, 2.0 and 3.0 lb/A with pre dinoseb at 1.5, 3.0 and 6.0 lb/A did not significantly affect yields or maturity (as measured by a shear press) of 'Bridgeton' lima beans. The seeding depth was 1.5 inches and the rainfall during the first two weeks was 2.57 inches and the total rainfall plus irrigation was 14.83 inches. Alachlor, ppi, caused a delay of emergence; whereas, pre treatments did not affect emergence. Dinoseb at 1.5, 3.0 and 6.0 lb/A, pre, caused a 5, 10 and 33% delay of emergence, respectively. The combination of pre dinoseb at 6.0 lb/A plus ppi alachlor at 3.0 lb/A caused an 80% delay of emergence which was a synergistic interaction; however, an interaction did not occur with pre alachlor and dinoseb. Trifluralin caused a slight delay in emergence; however, no synergistic interactions with dinoseb occurred. Trifluralin and combinations of trifluralin plus dinoseb did not reduce early lima bean vigor. Alachlor, ppi and pre, caused an early vigor reduction; however, yields were not affected. No interaction in the combination of alachlor plus dinoseb appeared to occur on the early vigor of lima beans. Dinoseb controlled nightshade (Solanum scabrum Mill.) prior to tractor cultivation; but after cultivation, the control not satisfactory. Dinoseb was not effective on velvetleaf (Abutilon theophrasti Medic.) and morningglory (Ipomoea purpurea (L.) Roth and Ipomoea hederacea (L.) Jacq.). Alachlor, ppi, was more effective on velvetleaf than pre; however, pre treatments appeared to be more effective on nightshade than ppi. Nightshade control after cultivation was better with ppi than pre alachlor. Trifluralin provided suppression of morningglory and good control after cultivation. Trifluralin did not control nightshade and velvetleaf. Trifluralin plus dinoseb controlled nightshade but not morningglory and velvetleaf. Alachlor, ppi, plus dinoseb was effective on velvetleaf. Alachlor, ppi and pre, plus dinoseb was effective on nightshade, but not morningglory; however, morningglory control after cultivation was satisfactory. Goosegrass (Eleusine indica (L.) Gaertn.) and fall panicum (Panicum dichotomiflorum Michx.) control was satisfactory with alachlor and trifluralin but not with dinoseb. A single tractor cultivation reduced hoe time by 33% and a single tractor cultivation plus an effective herbicide reduced the hoe time by 88%. At the second hoeing, herbicides reduced the hoeing time by 89%.

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TOLERANCE OF SNAP AND DRY BEAN VARIETIES TO BENTAZON, METOLACHLOR AND PENDIMETHALIN[1/]

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ABSTRACT

Four varieties of snap beans, two green and two wax, treated with 0.75 or 1.0 lb/A of pendamethalin preplant incorporated showed no phyto injury or yield losses. Split applications of bentazon, 0.5 + 0.5 or 1.0 + 1.0 lb/A at the unifoliate stage and at the trifoliate stage caused burning of foliage and significantly reduced yields in three of the four varieties.

Three dry bean varieties were treated with 2 lbs/A of metolachlor preplant incorporated, preemergence, or at emergence, or with a total of 2 lbs/A of bentazon at two different timings. Although bentazon caused leaf scorching no herbicide treatment reduced yields. Differences were observed in the competitive ability of varieties against galinsoga.

INTRODUCTION

Bentazon [3-isoprophyl-1-H-2,1,3-benzothiadiazin-(4)3H-one 2,2-dioxide] received full label approval for use on snap beans for fresh market in the Fall of 1978. Results of a considerable amount of work on the use of bentazon in soybeans (Glycine max)(1,4) and on some of the selectivity mechanisms involved (2,3) have been published, but relatively little detailed information is available on the use of bentazon on snap (Phaseolus vulgaris, var. humilis) and dry beans (Phaseolus vulgaris). Our first experience with bentazon on dry and snap beans was in 1977. We observed leaf injury on both bean types and also noted very poor control of redroot pigweed (Amaranthus retroflexus). In 1978, spurred on because BASF was applying for a fresh market snap bean label, we decided to evaluate bentazon in some detail. Two other compounds which also have a potential for use in these two crops were included in these trials: pendimethalin [N-(1-ethylpropyl)-3-4-dimethyl-2,6-dinitrobenzamin] and metolachlor [2-chloro-N-(2-ethyl-6-methylphenol)-N-(2-methoxy-1-methylethyl)acetanide].

MATERIALS AND METHODS

Snap Beans

The experimental area chosen was an Eel Silt Loam with an organic matter content of three to four percent. The preplant incorporated treatments were applied on June 16 and worked in with a McKee cultivator with finger harrow.

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A COMPARISON OF SEVERAL HERBICIDE COMBINATIONS FOR WEED CONTROL IN KATAHDIN POTATOES

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ABSTRACT

Alachlor, linuron, metribuzin, EPTC, and pendimethalin were evaluated alone and as combination treatments for weed control in white potatoes in 1978 at Aroostook Farm, Presque Isle, Maine. None of the herbicides or combinations caused any prolonged crop injury. All herbicides and combinations provided good control of annual barnyard grass, mustard, and lambsquarters. Some low rates of alachlor plus linuron, pendimethalin alone, and the low rate of metribuzin followed by alachlor at layby were weak on early quackgrass control.

INTRODUCTION

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], EPTC [*S*-ethyl dipropylthiocarbamate], and pendimethalin [*N*-(ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] were compared for weed control in white potatoes *(Solanum tuberosum* L.'Katahdin'*)*. These combinations were applied as preemergence treatments, layby treatments, and some as shallow incorporated drag-off treatments. In all cases each herbicide was also applied alone and all treatments were compared with a check treatment and a standard of dinoseb [2-*sec*-butyl-4,6-dinitrophenol] plus dalapon [2, 2-dichloropropionic acid]. The purpose of the study was to determine the efficacy of the herbicides alone and in combination for control of mustard *(Brassica campestris* L.*)*, lambsquarters *(Chenopodium album* L.*)*, quackgrass *(Agropyron repens* L.*)*, and annual barnyard grass *(Echinochloa crusgalli* (L.) Beauv.*)*.

MATERIALS AND METHODS

All treatments were applied to a Caribou gravelly silt loam soil and under the temperature and moisture conditions listed at the bottom of Table 1. All herbicides were applied in 303 liters of water using 40 psi 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. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with 6 replicates for each treatment. Weed control and crop injury ratings were recorded on the dates

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listed in Table 1 and yields were taken on September 26, 1978. Rating system used was the "Cornell" system of 1 to 9. During July, weed counts were made and major species, as reported in Table 1, were identified in the "no treatment" plots.

RESULTS AND DISCUSSION

Practically all of the herbicides applied alone or in combination provided very good control of annual barnyard grass, lambsquarters, and mustard. The low rate of alachlor plus linuron (2.80 and 1.04 kg per hectare) applied preemergence was not particularly effective for early quackgrass control which was also true for pendimethalin alone preemergence, and for the split treatment of metribuzin preemergence followed by alachlor at lay-by. None of the treatments caused crop injury that was objectionable. No significant differences in yield were recorded, although numerically the "no treatment" or check yield was less than when herbicides were used.

Table 1. Effect of several herbicide treatment combinations on weed control and yield of Katahdin potatoes. Maine - 1978.

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	Crop Injury and Weed Control Ratings[2]														
		Crop injury			Quackgrass			Annual grass			Mustards			Lambsquarters		
		6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8
Check - no treatment	30.7	9.0		9.0	7.6		7.6	4.8		5.6	8.6		8.3	8.3		8.1
5.04 Dinoseb + 5.60 Dalapon (PE)	32.6	9.0		8.8	8.3		8.8	8.3		8.8	9.0		9.0	9.0		9.0
2.80 Alachlor + 1.04 Linuron (PE)[3]	33.0	8.5		8.1	7.5		8.5	9.0		9.0	9.0		9.0	9.0		9.0
4.48 Alachlor + 1.66 Linuron (PE)[3]	33.8	7.8		9.0	8.5		8.5	9.0		9.0	9.0		9.0	9.0		9.0
2.80 Alachlor + 1.04 Linuron (PE)[4]	33.9	8.6		9.0	8.5		8.8	9.0		9.0	9.0		9.0	9.0		9.0
4.48 Alachlor + 1.66 Linuron (PE)[4]	32.8	8.0		8.3	8.8		9.0	9.0		9.0	9.0		9.0	9.0		9.0
2.80 Alachlor + 0.53 Metribuzin (PE)[3]	33.2	8.5		8.6	8.5		9.0	9.0		9.0	9.0		9.0	9.0		9.0
2.80 Alachlor + 0.53 Metribuzin (PE)[4]	35.8	8.5		9.0	8.0		8.3	9.0		9.0	9.0		9.0	9.0		9.0
0.53 Metribuzin (PE)	32.7	8.8		8.8	8.1		8.5	9.0		9.0	9.0		9.0	9.0		9.0
1.04 Linuron (PE)	33.5	9.0		9.0	8.0		8.5	9.0		9.0	9.0		9.0	9.0		9.0
1.66 Linuron (PE)	33.0	9.0		9.0	8.1		8.6	9.0		9.0	9.0		9.0	9.0		9.0
0.56 Metribuzin (PE) + 1.68 Alachlor (LB)	34.5	9.0	9.0	8.8	7.8	8.6	8.6	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
0.56 Metribuzin (PE) + 0.28 Metribuzin (LB)	31.1	8.8	9.0	9.0	8.3	9.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
0.56 Metribuzin (PE) + 3.36 EPTC (LB)	35.1	8.8	9.0	8.8	8.3	8.3	8.3	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
1.68 Pendimethalin(PE)	34.8	9.0		9.0	7.8		8.6	8.1		9.0	9.0		8.8	9.0		9.0
1.68 Pendimethalin (DOI)	34.1	9.0		8.8	8.1		8.5	8.6		9.0	9.0		9.0	9.0		9.0
1.68 Pendimethalin + 3.36 EPTC (DOI)	34.8	8.6		9.0	8.5		8.6	9.0		9.0	9.0		9.0	9.0		9.0

Table 1 - continued

Treatments Kg A.I. per Hectare	Yield Mt/Ha	Crop Injury and Weed Control Ratings[2]														
		Crop injury			Quackgrass			Annual grass			Mustards			Lambsquarters		
		6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8
3.36 EPTC (DOI)	34.1	9.0		8.8	8.1		8.6	8.0		9.0	8.5		9.0	9.0		9.0
1.68 Pendimethalin + 0.56 Metribuzin (PE)	32.3	9.0		9.0	8.1		8.6	9.0		9.0	9.0		9.0	9.0		9.0
1.68 Pendimethalin + 1.12 Linuron (PE)	33.9	8.8		9.0	8.1		8.8	9.0		9.0	9.0		9.0	9.0		9.0
1.68 Pendimethalin (GC)	33.8	8.8		9.0	8.5		8.6	4.5		8.1	9.0		9.0	9.0		9.0
Bayes L.S.D. (0.05)	4.9															

[1]Planted - May 26; killed - September 12; harvested - September 26, 1978.

Preemergence and DOI treatments applied - June 5. Overcast. 18C. Soil - dry.
Ground crack treatments applied - June 16. Clear. 14C. Soil - moist.
Layby treatments applied - July 17. Overcast. 22C. Soil - moist.

[2]Rating code (Cornell). Weed rating: 1 = no control; 9 = complete absence of weeds.
Crop rating: 1 = all crops killed; 9 = no damage.

[3]Package mixture.

[4]Tank mixture.

Number and species of weeds per square foot (average of 6 replicates):

Agropyron repens	2.2
Echinochloa crusgalli	2.8
Brassica campestris	0.6
Chenopodium album	0.2

COMBINATIONS OF METOLACHLOR WITH METRIBUZIN, LINURON, DINOSEB, AND CHLORBROMURON FOR WEED CONTROL IN KATAHDIN POTATOES

H. J. Murphy and L. S. Morrow[1]

ABSTRACT

Metolachlor was evaluated alone and in combinations with metribuzin, linuron, dinoseb, and chlorbromuron for broad spectrum, full season weed control in Katahdin potatoes grown at Presque Isle, Maine in 1978. Excellent control of mustard, annual grass, and lambsquarters was obtained. No crop injury was found and yield differences were not significant. Data reported in Table 1 suggests that metolachlor could be used in combination with several other herbicides for weed control in white potatoes.

INTRODUCTION

Metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide] was evaluated for preemergence and drag-off treatments for weed control in potatoes *(Solanum tuberosum* L.'Katahdin'*)*. Since metolachlor is primarily a grass herbicide, various combinations with metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one], linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea], dinoseb [2-*sec*-4,6-dinitrophenol], and chlorbromuron [3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea] were also evaluated for broad spectrum and full season weed control in white potatoes. Predominate species of weeds in this study were quackgrass *(Agropyron repens* L.*)*, mustard *(Brassica campestris* L.*)*, lambsquarters *(Chenopodium album* L.*)*, and annual barnyard grass *(Echinochloa crusgalli* (L.) Beauv.*)*.

MATERIALS AND METHODS

Preplant incorporated treatments of R-12001 were applied to a very dry Caribou gravelly silt loam soil and incorporated either shallow (5 cm) or regular (8-10 cm) with an Ariens Rocket rototiller. All herbicides were applied in 303 liters of water using 40 psi 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. 337-4 tips. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with 6 replicates of each treatment. Weed control and crop injury ratings were made on two dates, as listed in Table 1, using the "Cornell" rating system of 1 to 9. During July, weed counts were made and species, as reported in Table 1, were identified in the "no treatment" plots.

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RESULTS AND DISCUSSION

Under the conditions of the study where the weed pressure was not very severe, metolachlor treatments alone gave satisfactory broad spectrum weed control when applied at preemergence or drag-off. The lower rate of 2.24 kg per hectare was equally as effective as the higher rate of 3.36 kg per hectare. The combinations of metribuzin, linuron, dinoseb, or chlorbromuron with metolachlor provided complete control of mustard, lambsquarters, and barnyard grass, but did not improve control of quackgrass. In this study, no significant crop injury or yield differences between herbicide treatments were found. It would appear from the data presented in Table 1 that drag-off treatments were as effective as preemergence treatments in this study.

Table 1. Effect of metolachlor in combination with metribuzin, linuron, dinoseb, and chlorbromuron on yield and weed control in Katahdin potatoes. Maine - 1978.

Treatments[1] Kg A.I. per Hectare		Yield Mt/Ha	Crop Injury and Weed Control Ratings[2]									
			Crop injury		Quackgrass		Annual grass		Mustards		Lambsquarters	
			6-23	8-8	6-23	8-8	6-23	8-8	6-23	8-8	6-23	8-8
	Check - no treatment	28.8	9.0	9.0	8.3	8.3	4.3	5.8	8.7	8.8	8.7	7.7
5.04	Dinoseb +											
5.60	Dalapon (PE)	29.9	9.0	9.0	8.8	9.0	8.8	8.8	9.0	9.0	9.0	9.0
2.24	Metolachlor (PE)	30.9	9.0	9.0	8.3	8.7	9.0	9.0	8.8	8.7	8.7	9.0
3.36	Metolachlor (PE)	30.0	9.0	8.8	8.5	8.7	9.0	9.0	9.0	9.0	9.0	8.8
2.24	Metolachlor (DO)	32.6	9.0	8.8	8.8	8.8	8.2	8.7	9.0	8.7	9.0	8.8
3.36	Metolachlor (DO)	30.5	9.0	9.0	8.3	8.3	8.8	9.0	8.8	8.7	9.0	8.8
2.24	Metolachlor +											
0.56	Metribuzin (PE)	30.7	9.0	9.0	8.6	8.8	9.0	9.0	9.0	9.0	9.0	9.0
2.80	Metolachlor +											
0.56	Metribuzin (PE)	32.7	9.0	9.0	8.3	8.5	9.0	8.8	9.0	9.0	9.0	9.0
3.36	Metolachlor +											
0.56	Metribuzin (PE)	33.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
2.24	Metolachlor +											
0.56	Metribuzin (DO)	32.3	9.0	9.0	8.2	8.5	8.7	9.0	9.0	8.8	8.8	9.0
2.80	Metolachlor +											
0.56	Metribuzin (DO)	31.5	9.0	9.0	7.8	8.5	8.8	9.0	9.0	9.0	9.0	9.0
3.36	Metolachlor +											
0.56	Metribuzin (DO)	31.2	9.0	9.0	8.2	9.0	8.8	9.0	9.0	9.0	9.0	9.0
2.24	Metolachlor +											
1.12	Linuron (PE)	31.0	9.0	8.8	8.3	8.5	9.0	9.0	9.0	9.0	9.0	9.0
2.80	Metolachlor +											
1.12	Linuron (PE)	30.9	9.0	9.0	8.7	8.8	9.0	9.0	9.0	9.0	9.0	9.0
3.36	Metolachlor +											
1.12	Linuron (PE)	31.5	8.8	9.0	8.3	8.5	9.0	9.0	9.0	9.0	9.0	9.0
2.24	Metolachlor +											
3.36	Dinoseb	29.6	9.0	9.0	8.2	8.7	9.0	9.0	9.0	9.0	9.0	9.0

Table 1 - continued

Treatments[1] Kg A.I. per Hectare		Yield Mt/Ha	Crop Injury and Weed Control Ratings[2]									
			Crop injury		Quackgrass		Annual grass		Mustards		Lambsquarters	
			6-23	8-8	6-23	8-8	6-23	8-8	6-23	8-8	6-23	8-8
2.80	Metolachlor +											
3.36	Dinoseb (PE)	31.8	9.0	9.0	8.3	8.7	9.0	9.0	9.0	9.0	9.0	9.0
2.24	Metolachlor +											
1.68	Chlorbromuron (PE)	31.1	9.0	9.0	8.5	8.8	9.0	9.0	9.0	9.0	9.0	9.0
2.80	Metolachlor +											
1.68	Chlorbromuron (PE)	30.6	9.0	9.0	8.2	8.5	9.0	9.0	9.0	9.0	9.0	9.0
3.36	Metolachlor +											
1.68	Chlorbromuron (PE)	32.3	9.0	8.8	8.8	8.8	9.0	9.0	9.0	9.0	9.0	9.0
	Bayes L.S.D. (0.05)	5.9										

[1]Planted - May 26; killed - September 12; harvested - September 29, 1978.

Drag-off (DO) treatments applied - June 6. Overcast. 15C. Soil - moist to dry.
Preemergence treatments applied - June 12. Overcast. 20C. Soil - moderately moist.

[2]Rating code (Cornell). Weed rating: 1 = no control; 9 = complete absence of weeds.
Crop rating: 1 = all crops killed; 9 = no damage.

Number and species of weeds per square foot (average of 6 replicates):

Agropyron repens	1.8
Echinochloa crusgalli	0.9
Brassica campestris	1.3
Chenopodium album	0.3

HERBICIDES FOR DODDER CONTROL IN POTATOES,

G.W. Selleck,[1] R.S. Greider[2] and J.F. Creighton[1]

ABSTRACT

Field dodder has become increasingly troublesome as a parasite of potatoes on Long Island. Germination of dodder seed occurred in late May on Long Island and continued until mid-July. When dodder is established early on potato foliage, tubers may fail to develop.

Several herbicides exhibited activity on dodder in potatoes during 1978. Two applications (preemergence and postemergence) of DCPA or alachlor or combinations of them provided complete control of dodder until mid-July.

Such an herbicide program with the use of an early maturing cultivar, such as Superior, may provide control until the vines are ready for desiccation. Failing that, a third application directed beneath the potato foliage may be necessary to maintain control until harvest.

INTRODUCTION

In recent years, the problem of field dodder (Cuscuta campestris Yunck) has become increasingly severe in Long Island potato fields. Native to the U.S., the weed is a notorious parasite on alfalfa (Medicago Sativa L.) (4), and infests considerable acreage of cropland in Eastern Canada (5). On Long Island dodder parasitizes potatoes (Solanum tuberosum L.) often spreading into fields from roadside infestations. Dodder flourishes on such plants as bindweeds (Convolvulus spp.), buckwheat (Polygonum spp.), goldenrods (Solidago spp.) and plantains (Plantago spp.). Infestations in field crops are not extensive on Long Island, but when present, expanding patches developing from seed each year can cause serious crop losses. The dense entanglement of threadlike stems in these patches results from rapid growth in mid-summer. This can kill potatoes completely, resulting in reduced tuber yields, and in some cases, complete loss. The only means of control has been to pull infested potato plants to isolate the dodder stems from the growing crop. The rapid development from flower to seed has recessitated burning of the stems to destroy the viable seed. These recommendations have usually not been followed on Long Island, resulting on larger infestations each year. A crop rotation including field rye Secale cereale L.) has been partially successful in limiting the spread of dodder, since it is unable to parasitize this crop.

Control is confounded by emergence of seedlings over several weeks during the growing season (3), and by longevity in soil which may last for several years (7).

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Chlorpropham (isopropyl m-chlorocarbamilate) has been recognized as a herbicide effective for the control of dodder (2, 6). Dawson (3) illustrated that a number of herbicide candidates were active against dodder in the greenhouse, including DCPA (dimethyl tetrachlorotorephthalate), as well as various carbamates and acetanilides. A field trial conducted on Long Island indicated that two applications of DCPA provided control of dodder in potatoes (8) which was attributed to preventing circumnutation of the dodder (1,8). A single application was reported not to be effective (8). It was the purpose of the present study to test further DCPA and other herbicide candidates to find a practical means of controlling dodder in potatoes.

MATERIAL AND METHODS

A field trial was conducted on a natural infestation of field dodder at Riverhead, New York on Haven Loam, containing less than 3% O.M. Potatoes var. Katahdin, were planted on conventionally tilled land on April 22 and treated May 20 with pre-emergence herbicides with a tractor mounted sprayer delivering 61 l/ha at 2.5 atm pressure on plots two rows wide and 30 m long. A one-row untreated check was established on both sides of the plots. Treatments included alachlor (2-chloro-2', 6'-diethyl-N-(methozymethyl) acetanilide) 2.2 kg/ha, DCPA, 11.1 kg/ha (pre + post-emergence) metribuzin (4 amino-6tert-butyl-3(methy/thio)-as-triazin-5(4H)-one) 1.1 kg/ha, alachlor 2.2 kg pre + DCPA 11.1/g post-emergence and alachlor 2.2 kg/ha pre + post. Post-emergence treatments on June 14th included metribuzin at .56 kg/ha and alachlor at 2.2 kg/ha to potatoes 20 to 25 cm tall and dodder which had emerged and entwined around barnyardgrass (Echinochloa crus-galli L.) and ladysthumb (Polygonum persicaria L.) Potatoes adjacent to the plots were treated with chlorbromuron (3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea) pre-emergence at 1.4kg/ha followed by EPTC (s-ethyl N-dipropylthiocarbamate at 4.4 kg/ha incorporated at layby. Dinoseb (2-sec-butyl-4,6-dinitrophenol) at 2.2 kg, the amine of 2,4-D (2,4 - dichlorophenoxyacetic acid) at 1.1 kg/ha and paraquat (1,1' dimethyl 4, 4' - bipyridiniom ion) at .56 kg/ha were applied July 13 to dodder in potatoes in the blossom stage with a CO_2 knapsack sprayer delivering 61 l/ha at 2.5 at pressure. Drag off and hilling were the only post-planting cultivation practices. Supplemental irrigation was supplied as needed.

RESULTS

Dodder germination was evident in untreated checks by May 27 but many failed to survive. By June 7 dodder had become established in some of the untreated checks and on June 14 was recorded at an average of 18.8 locations per untreated check, compared with 2 locations in the metribuzin treatment. None of the other treatments was infested. Untreated check plots were heavily infested with barnyardgrass and ladysthumb. Although dodder plants appeared to be only sustained by annual grasses such as barnyardgrass, they were nourished by ladysthumb. On June 27, following a post-treatment on potatoes (pre-to the dodder) of 2,4-D, DCPA and alachlor, dodder was present on an average of 2.2 locations per plot on metribuzin treatments, 1.0 locations on alachlor and metribuzin (pre + post) and 1.3 locations on Lasso + 2,4-D (pre + post). The remainder of the treatments were free of dodder. The single treatments of DCPA and alachlor preemergence maintained perfect dodder control until June 27 (Table 1).

The hilling operation on June 21 appeared to control small dodder plants on infested checks. Two applications of DCPA pre + post, alachlor pre + DCPA post, and alachlor pre + post were the only treatments which maintained perfect dodder control until July 11 (Table 1). Dodder infestations in check rows varied from 12 to 51 linear m/plot. None of the postemergence treatments including alachlor, metribuzin 2,4-D, dinoseb or paraquat was phytotoxic to dodder. Metribuzin was effective indirectly by killing the host, ladysthumb. The spread of established dodder was arrested only by paraquat at 0.56 kg/ha, which was more effective than dinoseb at 2.2 kg/ha through killing of potato foliage. However at this stage of vigorous vine growth, paraquat 1.12 kg/ha was necessary for complete vine kill. The 2,4-D treated potatoes were spindly, with a distinct reduction in leaf area. After July 7, invasion of dodder from untreated checks into treated plots was rapid, and by August 9, many of the treatments were badly infested. Hence, it is not certain whether two treatments of DCPA or alachlor will maintain control until harvest.

Potatoes infested with dodder by mid-June produced tuber weights from 0 to 203 g/hill on August 9, compared with 1006 g on dodder-free hills. Where dodder infestations did not become established until July, tuber weights ranged from 500 to 700 g/hill.

DISCUSSION

The impact of dodder on potato yields depends upon the earliness of dodder establishment in potatoes. In the present study, germination of dodder was recorded from May 27 to mid-July, and it is likely that germination extended beyond this period.

The location of dodder patches is determined by germination of the seed and its success in establishment on nearby vegetation, either potatoes or weeds. Dodder develops vigorously on potatoes or ladysthumb, but is able to survive on certain grasses such as barnyardgrass. Once established on a host plant the tangle of thread-like dodder stems expands and extends rapidly to adjacent foliage. In May in untreated checks, dodder seedlings which emerged equidistant between potato rows frequently failed to survive because they were unable to contact potato foliage 40 cm away. On the other hand, seedlings were able to survive on emerged seedlings of barnyardgrass and particularly lambsquarters (Chenopodium album L.) or ladysthumb until contact was made with potato foliage. When dodder seedlings emerged in the potato row or within 10 cm of it, stem elongation permitted contact and establishment. Once this occurred, the vegetative spread of dodder was rapid along the potato row and later between rows, as potato foliage formed a canopy. Hence the destructive capacity of dodder is attributable to rapid vegetative development. In closely-spaced host plants, the growth from a single dodder seed could parasitize an acre or more.

It is important to maintain good weed control in potatoes for efficient control of field dodder. The absence of weeds will prevent or delay establishment of dodder seedlings on host plants. Cultivation is of benefit here to control weeds between the rows, and where soil is deposited on the potato row, emerging seedlings are likely prevented from becoming established. These field trials suggest that herbicides, particularly alachlor and DCPA

may be practical for the control of dodder in potatoes. It appeared that these two herbicides resulted in decreased emergence of dodder seedlings and inhibited seedling elongation. This is contrary to earlier reports (1,7) which attributed the efficacy of DCPA entirely to inhibition of circumnutational movement. Other herbicides, such as EPTC and chlorbromuron also show activity. In fact any herbicide which controls host weeds delays establishment of the dodder. The problem lies in the extended period of dodder germination which is of longer duration than the residual effect of most herbicides.

It appears that alachlor or DCPA applied preemergence followed by another application of either herbicide at layby will prevent establishment of dodder at least until mid-July. It would be advisable to plant early-maturing potato cultivars such as Superior on dodder-infested fields. An application of a desiccant at the first sign of senescence, thus killing the vines as early as possible, may prevent late germinating dodder from flowering and setting seed. Failing that, a third application directed beneath the potato foliage may be necessary to maintain control until the vines are ready for desiccation.

Trials will be continued in 1979 to improve efficacy with a refinement of timing of application and the inclusion of other potentially active herbicide candidates.

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Table 1. Control of field dodder with herbicides in potatoes

Treatment kg/ha		Date 6/27 No/60m row	Date 6/27 % control	Date 7/11 Linear m/60m row	Date 7/11 % Control
1.	DCPA 11.1 pre	0	100	7.8	75
	Untreated	12	-	30.6	-
2.	DCPA 11.1 pre + post	0	100	0	100
	Untreated	4.6	-	21	-
3.	Metribuzin 1.1 pre	2.2	48	9.6	44
	Untreated	4.2	-	17.1	-
4.	Alachlor 2.2 pre	0	100	1.8	93
	Untreated	10.8	-	24.9	-
5.	Alachlor 2.2 pre + metribuzin .56 post	1	75	5.1	83
	Untreated	4.0	-	29.7	-
6.	Alachlor 2.2 pre + 2,4-D 1.1 post	1.3	86	0.9	92
	Untreated	9.3	-	10.8	-
7.	Alachlor 2.2 pre + DCPA 11.1 post	0	100	0	100
	Untreated	12.4	-	15	-
8.	Alachlor 2.2 pre + post	0	100	0	100
	Untreated	25.2	-	22.8	-
9.	Metribuzin .56 post	27	0	38.7	27
	Check	25.2	-	46.2	-
10.	Alachlor 2.2 post	5	80	11.4	66
	Check	25.2	-	33.3	-
11.	Chlorbromuron 1.8 pre + EPTC 4.4 post-inc.	-	-	7.8	62
	Check	-	-	20.1	-

EFFECT OF SEVERAL HERBICIDES APPLIED AT DIFFERENT TIME SEQUENCES ON YIELD AND WEED CONTROL IN WHITE POTATOES MAINE - 1978

L. S. Morrow and H. J. Murphy[1]

ABSTRACT

Comparisons of cyanazine, metribuzin, linuron, diclofop, and EPTC applied alone and in combinations were evaluated for weed control, crop injury, and effect on yield of Katahdin potatoes at Aroostook Farm, Presque Isle, Maine. All herbicides and treatments provided excellent control of mustard, lambsquarters, and annual barnyard grass. Quackgrass control, however, was weak early in the season but improved for most treatments as the season progressed. Crop injury of any prolonged nature was not experienced. Yield of potato tubers was significantly better for all treatments when compared to the untreated check.

INTRODUCTION

Several herbicides including cyanazine (2[[4-chloro-6(ethylamino)-*s*-triazin-2-yl]amino]-2-methyl propionitrile), EPTC [*S*-ethyl dipropylthiocarbamate], linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea], metribuzin [4-amino-6-*tert*-butyl-3(methylthio)-*as*-triazin-5(4*H*)-one], and diclofop [2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid] were applied as preemergence and layby treatments to compare efficacy for weed control in white potatoes *(Solanum tuberosum* L. 'Katahdin'*)*. These herbicides were compared as single and combination treatments and at different rates. Wettable powders and liquid formulations of cyanazine and two proprietary products of metribuzin were also compared. The four predominate weed species in this study were mustard *(Brassica campestris* L.*)*, lambsquarters *(Chenopodium album* L.*)*, quackgrass *(Agropyron repens* L.*)*, and annual barnyard grass *(Echinochloa crusgalli* (L.) Beauv.*)*

MATERIALS AND METHODS

All treatments were applied to a Caribou gravelly silt loam soil and under the temperature and moisture conditions listed at the bottom of Table 1. All herbicides were applied in 303 liters of water using 40 psi 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. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with 6 replicates for each treatment. Weed control and crop injury ratings were recorded on the dates

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listed in Table 1 and yields were taken on September 26, 1978. Rating system used was the "Cornell" system of 1 to 9. During July, weed counts were made and major species, as reported in Table 1, were identified in the "no treatment" plots.

RESULTS AND DISCUSSION

Cyanazine, metribuzin, linuron, and diclofop applied as preemergence treatments all provided good control of mustard, lambsquarters, and annual barnyard grass. Combinations of cyanazine(PE) plus EPTC(PPI), cyanazine plus linuron(PE), and cyanazine plus lasso(PE), metribuzin(PE) plus metribuzin(LB), linuron plus diclofop(PE), metribuzin plus EPTC(PPI) all gave good control of mustard, lambsquarters, and annual barnyard grass. All treatments in this study were weak on control of quackgrass early in the season, but most treatments except linuron(PE), metribuzin applied PE, diclofop(PE and LB), and metribuzin(PE) plus diclofop(LB) improved in quackgrass control ratings late in the season. Comparisons of liquid versus wettable powder formulations did not show any significant differences in weed control ratings. Crop injury ratings appeared to increase slightly as the season progressed which could have been due to the very dry growing conditions rather than to herbicidal treatments. All herbicide treatments appeared to improve yield of potatoes as compared to "no treatment" plots which could have been due to competition of weeds with the potatoes for moisture under the dry growing conditions.

Table 1. Effect of several herbicides applied at different time sequences on yield and weed control in white potatoes. Maine - 1978

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	Crop Injury and Weed Control Ratings[2]														
		Crop injury			Quackgrass			Annual grass			Mustards			Lambsquarters		
		6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8
Check - no treatment	23.8	9.0		9.0	5.8		7.5	3.8		5.7	6.5		7.7	4.5		4.0
5.04 Dinoseb + 5.60 Dalapon (PE)	36.8	9.0		8.5	6.7		7.8	8.8		9.0	9.0		9.0	9.0		9.0
3.58 Cyanazine (PE)[3]	35.3	8.5		8.5	6.5		8.2	9.0		8.8	9.0		9.0	9.0		9.0
3.58 Cyanazine (PE)[4]	35.0	9.0		8.5	6.3		8.2	8.8		9.0	9.0		9.0	9.0		9.0
3.36 EPTC (PPI) + 3.58 Cyanazine (PE)[3]	34.2	9.0		8.5	7.0		8.7	9.0		9.0	9.0		9.0	9.0		9.0
3.36 EPTC (PPI) + 3.58 Cyanazine (PE)[4]	35.0	8.7		8.3	7.5		8.7	9.0		9.0	9.0		9.0	9.0		9.0
3.58 Cyanazine + 0.56 Linuron (PE)	33.2	9.0		8.3	6.2		7.8	8.0		8.8	8.8		8.8	9.0		8.8
3.58 Cyanazine + 2.24 Lasso (PE)	35.8	9.0		8.7	6.2		8.3	9.0		9.0	8.5		8.8	9.0		8.7
0.28 Metribuzin (PE)[5]	33.2	9.0		8.7	6.0		7.3	8.8		9.0	8.8		8.8	9.0		9.0
0.28 Metribuzin (PE) + 0.56 Metribuzin (LB)[5]	34.2	9.0	8.8	8.7	6.3	8.2	7.8	8.5	8.8	9.0	9.0	9.0	9.0	9.0	9.0	8.8
0.28 Metribuzin (PE) + 0.56 Metribuzin (LB)[6]	34.1	9.0	8.7	8.3	6.7	7.7	8.2	8.2	9.0	8.8	8.8	9.0	9.0	9.0	9.0	9.0
0.28 Metribuzin (PE) + 0.56 Metribuzin (LB)[7]	33.4	8.8	9.0	8.5	6.0	8.5	8.7	7.8	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
1.12 Linuron + 1.12 Diclofop (PE)	33.9	9.0		8.3	6.0		7.5	9.0		9.0	9.0		9.0	9.0		9.0
1.12 Linuron (PE) + 1.12 Diclofop (LB)	37.8	8.8	9.0	8.5	6.7	8.3	8.7	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	8.8
0.56 Metribuzin + 1.12 Diclofop (PE)	35.7	9.0		8.7	6.3		7.7	9.0		9.0	9.0		9.0	9.0		9.0
0.56 Metribuzin (PE) + 1.12 Diclofop (LB)	33.8	8.8	8.8	8.7	6.2	8.0	7.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
0.56 Metribuzin (PE)	34.9	9.0		8.5	6.2		7.5	9.0		9.0	9.0		9.0	9.0		8.8

Table 1 - continued

Treatments[1] Kg A.I. per Hectare	Yield Mt/Ha	Crop Injury and Weed Control Ratings[2]														
		Crop injury			Quackgrass			Annual grass			Mustards			Lambsquarters		
		6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8	6-27	7-25	8-8
4.48 EPTC + 0.28 Metribuzin (PPI)	36.3	9.0		8.2	6.7		9.0	8.5		9.0	8.7		9.0	8.5		9.0
6.72 EPTC + 0.56 Metribuzin (PPI)	35.6	9.0		8.8	7.7		8.5	8.5		9.0	8.8		9.0	8.8		9.0
4.48 EPTC (PPI)	35.3	8.8		8.3	6.8		8.7	8.0		9.0	7.2		8.5	7.8		9.0
6.72 EPTC (PPI)	36.0	9.0		8.7	7.5		9.0	8.3		9.0	7.8		9.0	8.7		8.8
Bayes L.S.D. (0.05)	4.3															

[1]Planted - May 26; killed - September 12; harvested - September 26, 1978.

Preplant treatments applied - May 23. Sunny. 17C. Soil - dry.
Preemergence treatments applied - May 30. Partly cloudy. 27C. Soil - slightly damp.
Layby treatments applied - July 17. Overcast. 22C. Soil - moist.

[2]Rating code (Cornell). Weed rating: 1 = no control; 9 = complete absence of weeds.
crop rating: 1 = all crops killed; 9 = no crop damage.

[3]Bladex 80WP

[4]Bladex 4L

[5]Sencor 50W

[6]Sencor 4L

[7]Lexone 4L

Number and species of weeds per square foot (average of 6 replicates):

Agropyron repens	1.9	*Brassica campestris*	1.2
Echinochloa crusgalli	2.6	*Chenopodium album*	1.8

RELATIONSHIPS BETWEEN CERTAIN HERBICIDES AND SYSTEMIC INSECTICIDES

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

ABSTRACT

Relationships between the preemergence herbicides linuron, dinoseb, and alachlor and the systemic insecticides carbofuran, phorate, aldicarb, and thiofanox were studied for effects on growth and yields of two varieties of potatoes during the years 1976 through 1978. Insecticides were applied in the furrow with the seedpiece at planting and herbicides were applied after drag-off but prior to potato emergence. To prevent weeds and insects from influencing results potatoes were cultivated as needed and sprayed with foliar insecticides. Results varied with years and variety but indicated that certain combinations of insecticides with herbicides could cause extensive injury and yield reductions to both the 'Pungo' and 'Superior' varieties. In general, potato injury was greater when herbicide treatments included dinoseb and alachlor when compared with linuron. With reference to insecticides, potato yields were higher with aldicarb, carbofuran, and thiofanox than with phorate.

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AN EVALUATION OF R-40244 ALONE AND IN COMBINATION WITH EPTC FOR WEED CONTROL IN KATAHDIN POTATOES

H. J. Murphy and L. S. Morrow[1]

ABSTRACT

Various treatments of experimental herbicide R-40244 were evaluated to determine a rate and method of application for use in weed control in white potatoes grown at Aroostook Farm, Presque Isle, Maine. R-40244 has good potential for control of mustards and lambsquarters, and has some activity on grasses when applied preemergence or preplant incorporated. In combination with EPTC good broad spectrum weed control in potatoes was obtained.

INTRODUCTION

Experimental herbicide R-40244 [1-(*m*-trifluoromethylphenyl)-3-chloro-4-chloromethyl-2-pyrrolidone] was evaluated at three rates for preplant incorporated, preemergence, ground crack, and early post treatments for weed control in potatoes *(Solanum tuberosum* L. 'Katahdin'*)*. In addition, two treatment combinations of R-40244 and EPTC [*S*-ethyl dipropylthiocarbamate] were included to determine if R-40244 needed additional assistance from EPTC for grass control. Weed populations of mustard *(Brassica campestris* L.*)*, lambsquarters *(Chenopodium album* L.*)*, and annual barnyard grass *(Echinochloa crusgalli* (L.) Beauv.*)* were very high in this study but quackgrass *(Agropyron repens* L.*)* was relatively low, as reported in Table 1.

MATERIALS AND METHODS

Preplant incorporated treatments of R-40244 and EPTC were applied to a very dry Caribou gravelly silt loam and incorporated either shallow (5 cm) or regular (8-10 cm) with an Ariens Rocket rototiller. All herbicides were applied in 303 liters of water using 40 psi 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. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with 6 replicates of each treatment. Weed control and crop injury ratings were made on two dates, as listed in Table 1, using the "Cornell" rating system of 1 to 9. During July, weed counts were made and species, as reported in Table 1, were identified in the "no treatment" plots.

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RESULTS AND DISCUSSION

Data presented in Table 1 indicate that all treatments with R-40244 alone and in combination with EPTC provided good control of mustard and lambsquarters. Preplant incorporated treatment with R-40244 alone gave poor early control of grasses but came on later to provide fair control except for the 0.28 kg per hectare rate. About the same effect was noted for treatments with R-40244 applied at ground crack of the potatoes. Early post treatments with R-40244 gave poor control of quackgrass and very poor control of barnyard grass. The combination of EPTC(PPI) followed by R-40244 as a preemergence treatment appeared to have a good potential for full season broad spectrum weed control in potatoes. Crop injury data presented in Table 1 suggests that R-40244 caused considerable injury when applied as an early post treatment and the injury was sufficient to cause a significant reduction in yield. From the data presented in Table 1, it appears that R-40244 has a potential for broadleaf weed control but should be used in combination with EPTC, if severe grass infestations are present.

Table 1. Effect of R-40244 applied at four time intervals and in combination with EPTC on yield and weed control in Katahdin potatoes. Maine - 1978.

Kg A.I. per Hectare	Treatments[1]	Yield Mt/Ha	Crop Injury and Weed Control Ratings[1]									
			Crop injury		Quackgrass		Annual grass		Mustards		Lambsquarters	
			6-27	8-8	6-27	8-8	6-27	8-8	6-27	8-8	6-27	8-8
	Check - no treatment	25.5	8.8	9.0	7.0	7.6	4.3	6.3	6.5	6.6	7.5	7.3
5.04	Dinoseb +											
5.60	Dalapon (PE)	35.8	9.0	8.8	7.2	8.3	7.5	9.0	9.0	9.0	9.0	9.0
0.28	R-40244 (PPI)	34.1	8.6	8.8	7.1	8.8	4.6	6.6	7.5	8.8	8.3	9.0
0.56	R-40244 (PPI)	29.4	8.6	8.6	6.8	8.5	5.6	8.3	8.2	9.0	8.6	9.0
1.12	R-40244 (PPI)	31.9	7.6	8.1	6.6	8.1	6.2	8.5	8.8	9.0	9.0	9.0
0.28	R-40244 (PE)	37.7	9.0	8.6	6.3	8.5	8.6	8.8	9.0	8.6	9.0	9.0
0.56	R-40244 (PE)	35.7	8.5	8.6	7.0	8.2	8.8	9.0	9.0	9.0	9.0	9.0
1.12	R-40244 (PE)	34.5	6.6	8.6	7.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0
0.28	R-40244 (GC)	35.3	7.3	8.3	7.2	8.0	4.8	7.8	9.0	9.0	9.0	9.0
0.56	R-40244 (GC)	34.5	7.3	8.5	7.3	8.3	5.8	8.5	9.0	9.0	9.0	9.0
1.12	R-40244 (GC)	35.7	5.0	8.5	6.5	7.8	6.2	9.0	9.0	9.0	9.0	9.0
0.28	R-40244 (EP)	25.0	3.5	8.6	6.5	8.1	4.1	3.4	6.6	9.0	8.6	9.0
0.56	R-40244 (EP)	25.2	3.5	8.0	7.1	7.5	4.1	5.1	6.6	9.0	8.5	9.0
3.36	EPTC (PPI)	30.4	9.0	9.0	8.0	9.0	7.1	9.0	5.6	8.5	8.8	9.0
3.36	EPTC +											
0.56	R-40244 (PPI)	34.9	7.6	8.8	8.5	9.0	7.8	9.0	8.3	9.0	9.0	9.0
3.36	EPTC (PPI) +											
0.56	R-40244 (PE)	36.6	8.5	8.8	7.3	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	Bayes L.S.D. (0.05)	4.7										

Table 1 - continued

[1]Planted - May 26; killed - September 13; harvested - September 25, 1978.

PPI treatments applied - May 23. Sunny. 16C. Soil - dry. Wind 10-15 mph.
PE treatments applied - May 30. Partly cloudy. Soil - damp. 26C. Wind 3-5 mph.
GC (ground crack) treatments applied - June 16. 14C. Soil - moist. Wind 0-2 mph.
EP (early post) treatments applied - June 23. Partly cloudy. 20C. Soil - moist. Wind 6-7 mph.

[2]Rating code (Cornell). Weed rating: 1 = no control; 9 = complete absence of weeds.
Crop rating: 1 = all crops killed; 9 = no crop damage.

Number and species of weeds per square foot (average of 6 replicates):

Brassica campestris	8.6
Chenopodium album	7.2
Echinochloa crusgalli	10.4
Agropyron repens	2.6

HERBICIDES -- A VALUABLE TOOL

John B. Middleton 1/

Pennsylvania Electric Company (Penelec), which covers 39% of the geographical land area of the state of Pennsylvania, has been using herbicides advantageously since 1951. Herbicides, used properly, are superior to any mechanized method of managing right-of-way for undesirable species. Herbicides do a great job. With mechanical and particularly with hand labor, it is practically impossible to do a comparable job either environmentally or economically.

Modern equipment has made herbicide application even much more favorable. Presently, herbicides are being applied in Penelec with four-wheel drive equipment, back-pack knapsack, timberjacks, and other advanced methods which are particularly adaptable to selective basal.

Selective basal is the prime technique of treatment on Penelec rights-of-way. The advantages are obvious, particularly in removing the undesirable timber type species and retaining the smaller trees, large shrubs, small shrubs, herbaceous plants, perennial plants, brambles, and weeds. When the undesirable species are removed, the favorable, smaller type vegetation becomes competition for the sprouting, suckering or seeding into the right of way. We have portions of right-of-way in Penelec that have gone for at least 25 years without any need for repeat treatment. Retreatment is not needed because of the competition from the low growing materials. However, it takes a professional or trained eye to recognize the true value of competition from desirable species.

In Penelec, over 90% of the treatment is by selectivity. There are only rare exceptions when it may be necessary to use a waterborne stem foliage application or helicopter. These are mainly, too great a population of stems on an area, extreme inaccessability of an area, areas that are very infrequently seen by humans, or species that do not respond properly to selective basal. The prices for quality herbicides that are used in the power utility industry have skyrocketed due to the inflation rate in this country, and so have prices for manpower and mechanical equipment. Herbicides used properly far out-strip any other way that is known to manage rights of way at the present time.

Professional care must be exercised in using this tool, since misuse of the herbicide technique can be destructive to the environment and to the people who are using it. In Penelec, we pride ourselves with having a good right of way management plan using herbicides. Unfortunately, some users of herbicides use them unwisely. Since Penelec is a major user in Pennsylvania, we sometimes get blamed for the misuse that is done by other groups and contractor applicators.

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This misuse has led to a multitude of regulations on herbicide use. Often misuse is a result of attempting to economize and save dollars. However, if unwise use continues, it will actually cost all of us more in the long run. The result will be even more stringent and costly regulations by the State of Pennsylvania. I personally feel these excessive regulations are imminently close. If care and proper use are not improved, we are going to be told what to do and how to do it instead of being able to use our initiative. The herbicide is and should be used as a tool for the betterment of both the environment and the user.

A PRESSURE INJECTOR FOR HERBICIDAL CONTROL OF POTENTIAL DANGER TREES

J. P. Sterrett[1/]

ABSTRACT

A syringe-type pressure injector was used to introduce herbicides into the vascular system of several species of trees. The injector consisted of a modified 11-inch, Vise-Grip locking pliers with a tapered stainless steel injector barrel and a disposable syringe. Forty-five days after injection, the combination of picloram (4-amino-3,5,6-trichloropicolinic acid) + 2,4-D [(2,4-dichlorophenoxy)acetic acid] or triclopyr [[(3,5,6-trichloro-2-pyridinyl) oxy]acetic acid] killed from 60 to 90% of the tops of the deciduous hardwoods averaging about 15 cm in diam near the soil line. On ash and elm, two injection sites per tree were as effective 10 months after treatment as were 3 or 4 injection sites. The injection equipment, which included the syringe injector, cordless electric drill, and herbicide container, can be conveniently carried in a small canvas bag by one person for use on trees potentially damaging to electrical conductors.

INTRODUCTION

Many species of trees that border power line rights-of-way have the potential of growing into danger trees; i.e., trees that could damage electrical conductors. It is desirable to remove or kill these trees before they become a threat to the conductors. Cut-surface treatments with tree injectors and hatchets have been used effectively for years by foresters to remove undesirable tree species (5, 6, 7). Much of the herbicide solution introduced through cut-surfaces is not absorbed due to overflow or is washed out by rain, which wastes and reduces the effectiveness of the herbicide, contaminates the soil, and sometimes damages desirable plants. Chemicals injected directly into the vascular system should be absorbed and translocated more effectively. Pressure-type injection systems for growth retardants, insecticides, and fungicides are presently in use but are cumbersome or not practical in rough terrain (1, 3, 4). The objective of this study was to develop and evaluate a hand-syringe method of pressure injection of herbicides into the vascular system of trees that can be conveniently carried over rough terrain.

METHODS AND MATERIALS

The syringe-type pressure injector used in this study is a larger version of the miniature pressure injector described in a study by Sterrett and Creager (8). It consists of a modified 11-inch, Vise-Grip "C"-clamp with a tapered stainless steel injector barrel and disposable syringe designed to inject solutions into the vascular system of tree trunks (Figure 1). Two,

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Figure 1. The syringe pressure injector wedged into hole drilled in a white ash tree.

three, or four 3.9-mm diam holes were drilled into the trunk with a cordless electric drill. The holes started about 10 cm above ground level and were spaced about 5 cm apart in a vertical direction. They were drilled equidistant around the trunk circumference and entered the sapwood at a 45° angle to the trunk diam to a depth of about 9 cm in a manner similar to those described by Brown et al. (1). The tapered injector barrel was inserted into each hole and wedged in place by closure of the Vise-Grip locking pliers.

A pre-filled 5-ml polypropylene syringe was then inserted into a Luer-Lok connector and the liquid herbicide forced into the hole by hand. A herbicide formulation with known activity (picloram + 2,4-D) was used to validate the method, and the efficacy of a new herbicide (triclopyr) was determined. The species injected, which averaged about 15 cm diam in the treatment zone, were Chinese elm (Ulmus parvifolia Jacq.), white ash (Fraxinus americana L.), and pin oak (Quercus palustris Muenchh.). A total volume of 6 ml was used per tree regardless of the number of holes drilled. Treatments were conducted in late July 1977 and the percentage of tops killed was determined in September 1977 and June 1978. The percentage of dead tops was estimated visually by 2 persons on a scale of 0 (none) to 10 (100%). Treatments were replicated 5 times (1 tree per treatment) and analyzed with Duncan's multiple range test and the rank sum test (2).

RESULTS AND DISCUSSION

The combination of 32 g/L picloram + 120 g/L 2,4-D and both levels of triclopyr (180 and 360 g/L) killed at least 90% of the tops of the Chinese elm, 70% of the white ash, and 60% of the pin oak by September 1977 (45 days after injection) (Tables 1, 2 & 3). With white ash and pin oak, maximum top kill did not occur until the following growing season in June 1978. The maximum kill of Chinese elm occurred by September 1977. With the exception of triclopyr on pin oak, treatments involving 2 injection sites were as effective with all herbicide levels as those involving 3 or 4 injection sites. Apparently, most of the lateral translocation between the drilled holes occurred sometime well after injection because a cursory study with red dye during injection indicated more upward and downward than lateral movement. Some regrowth (less than 3%) was evident in June 1978 on Chinese elm branches. No regrowth was observed on white ash or pin oak.

Top kill from the syringe injector was as effective (from 88 to 100%) and occurred as quickly as from the commercial cut-surface-type injectors and hatchets (3, 4, 5). No evidence of herbicide wash-out was observed on vegetation adjacent to the treated trees. Since only one total volume per tree was used throughout the study (6 ml), future experiments should include a larger range of volumes, especially if 2 injection sites are used on larger trees; e.g., higher volumes with lower concentrations may be necessary to kill trees larger than 15 cm in diam.

The syringe injector is designed for trunks ranging from 3.6 to 18 cm in diam. Most machine shops should be able to build the injector at low cost based on the specifications in this study and in the publication describing the mini-injector (8). The injection equipment, which includes the syringe injector, cordless electric drill, and herbicide container, weighs about 3 kg and is small enough to be carried comfortably in a canvas bag by one person. Injection time per hole took from 3 to 10 sec for 3 ml of solution depending on species. Solutions can usually be forced into diffuse-porous species faster than into ring-porous species.

Table 1. Dead tops of Chinese elm trees after injection with herbicides in July 1977 with a syringe pressure injector.

Injection sites (No.)	Volume/injection site (ml)	Dead tops (%)[a] Sept '77	June '78
	Picloram (32 g/L) + 2,4-D (120 g/L)		
2	3	96a	100a*
3	2	94a	96a
4	1 1/2	98a	100a
	Triclopyr (360 g/L)		
2	3	94a	92a
3	2	90a	94a
4	1 1/2	98a	100a
	Triclopyr (180 g/L)		
2	3	92a	96a
3	2	94a	94a
4	1 1/2	90a	92a

[a]Any two treatments in a column not having the same letter are significantly different at the 5% level using Duncan's multiple range test. The asterisk indicates a significant difference within treatments at the 5% level between September and June using the rank sum test. Trunk diam was about 15 cm.

Table 2. Dead tops of white ash trees after injection with herbicides in July 1977 with a syringe pressure injector.

Injection sites (No.)	Volume/injection site (ml)	Dead tops (%)[a] Sept '77	June '78
	Picloram (32 g/L) + 2,4-D (120 g/L)		
2	3	76ab	100a*
3	2	72a	98a*
4	1 1/2	96ab	100a
	Triclopyr (360 g/L)		
2	3	94ab	100a*
3	2	100b	100a
4	1 1/2	98ab	100a
	Triclopyr (180 g/L)		
2	3	90ab	100a*
3	2	86ab	100a
4	1 1/2	94ab	100a*

[a]Any two treatments in a column not having the same letter are significantly different at the 5% level using Duncan's multiple range test. The asterisk indicates a significant difference within treatments at the 5% level between September and June using the rank sum test. Trunk diam was about 15 cm.

Table 3. Dead tops of pin oak trees after injection with herbicides in July 1977 with a syringe pressure injector.

Injection sites (No.)	Volume/injection site (ml)	Dead tops (%)[a] Sept '77	June '78
	Picloram (32 g/L) + 2,4-D (120 g/L)		
2	3	60a	98bc*
3	2	82ab	100c*
4	1 1/2	84b	100c*
	Triclopyr (360 g/L)		
2	3	64ab	90ab*
3	2	82ab	98bc*
4	1 1/2	86b	98bc*
	Triclopyr (180 g/L)		
2	3	76ab	88a
3	2	80ab	92abc
4	1 1/2	80ab	96abc*

[a]Any two treatments in a column not having the same letter are significantly different at the 5% level using Duncan's multiple range test. The asterisk indicates a significant difference within treatments at the 5% level between September and June using the rank sum test. Trunk diam was about 15 cm.

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CHEMICAL CONTROL OF MULTIFLORA ROSE

J. F. Ahrens 1/

ABSTRACT

Basal, foliar and soil treatments for the control of multiflora rose (Rosa multiflora L.) were applied in 1977 at two locations and evaluated during 1977 and 1978. Effective treatments included a dormant basal spray of 2,4-D + 2,4,5-T at 7.5 + 7.5 lb ae/100 gal diesel oil, and foliar sprays in June during late bloom with 2,4,5-T or dichlorprop at 6 lb ae/100 gal, dicamba + 2,4-D at 1.25 + 2.5 lb ae/100 gal, or triclopyr at 1.5 lb ae/100 gal. Foliar sprays of glyphosate at 1.5 or 3 lb ae/100 gal in June or August, foliar sprays of fosamine at 9 or 12 lb ai/100 gal in August, and soil applications of picloram pellets at 4 lb ae/A, also were very effective. Soil applications of dicamba did not give satisfactory control during the two seasons.

INTRODUCTION

Multiflora rose (Rosa multiflora L.) that spreads from former wildlife plantings and "living fences" for livestock, has become a serious pest in rough pastures and abandoned farmlands. The current standard chemical control of multiflora rose in pastures is pelleted picloram (4-amino-3,5,6-trichloropicolinic acid). Shortcomings of picloram include the requirements for special training of users to avoid contamination of water supplies and injury to desirable trees or crop plants, and restrictions on use of manure from treated areas. For these reasons there are many pasture and non-crop areas where picloram cannot currently be used to control multiflora rose.

Foliar sprays of the herbicides 2,4,5-T ((2,4,5-trichlorophenoxy)acetic acid) and mixtures of 2,4,5-T and 2,4-D ((2,4-dichlorophenoxy)acetic acid) are reported to control multiflora rose (2). Both are currently available for pasture uses. Glyphosate (N-(phosphonomethyl)glycine) was reported effective against multiflora rose, especially when surfactant was added to foliar sprays (1). Herbicides such as dichlorprop (2-(2,4-dichlorophenoxy)propionic acid), dicamba (3,6-dichloro-o-anisic acid), mixtures of dicamba and 2,4-D (3), and fosamine ((aminocarbonyl)phosphonic acid) (4), control certain woody plants and might control multiflora rose.

The purpose of this work was to investigate alternative herbicides for controlling multiflora rose. We also compared formulations of picloram to determine whether rose control could be achieved with lower dosages.

MATERIALS AND METHODS

Trials were conducted in 1977 and 1978 in two abandoned pastures in Bloomfield, CT where extensive multiflora rose infestations were present. Unit clumps of multiflora rose ranging in crown diameter from 5 to 25 ft were marked for treatment.

1/ The Connecticut Agricultural Experiment Station, Valley Laboratory, Windsor, CT.

At Site A, the soil type was a Narragansett silt loam. A dormant basal spray was applied on April 29, 1977 on nine rose clumps. Foliar and soil treatments were applied June 16 to 20, 1977 during late bloom, each on four or five individual clumps scattered over the two acre site. The soil treatments of picloram and dicamba were applied on June 16 and 17. Foliar sprays of dichlorprop, 2,4,5-T and triclopyr (3,5,6-trichloro-2-pyridinyl)oxy)acetic acid) were applied on June 16. Light rain lasting 15 min followed 1.5 hr after the June 17 foliar application of dicamba plus 2,4-D, and 0.6 in of rain fell the next day. Fosamine and glyphosate were applied on June 20 under sunny skies and at 85°F, but a light rain of 0.14 in fell 4 to 5 hr after the last application. Rainfall was normal in July (3.2 in) and 7/10 normal in August, 1977 (2.4 in).

At Site B, the soil type was a Wethersfield stony loam. Each treatment was applied on at least four clumps of multiflora rose. The soil treatments were applied on August 24, 1977 and 0.3 in rain fell that night. The foliar sprays were applied on August 25, 1977 on dry foliage under sunny skies at 70°F. The next rain fell on August 30. September, 1977, received over twice normal rainfall (8.6 in). Additional soil treatments on May 22, 1978 received over 1 in of rain in the next seven days.

The basal spray at Site A was applied with a low pressure knapsack sprayer, using a diesel oil carrier. The lower 18 in of each clump was thoroughly sprayed to rundown around the root collar, using about 1 pt of solution per clump. The soil treatments at both locations were based on the crown area of each rose clump. Pellet (P) or granular (G) treatments were weighed and spread by hand close to and around the rose stems. Dicamba liquid was diluted 10 times and applied to the root zone with a "SPOT GUN"1/. The foliar sprays were applied with a knapsack sprayer and adjustable nozzle operating at 25 to 35 psi. The foliage was sprayed to thoroughly wet, with little runoff. The surfactant X-77 was added at 0.25% v/v to sprays of glyphosate and fosamine. The percentage foliage kill of each clump was estimated at intervals following treatment during 1977 and 1978.

RESULTS AND DISCUSSION

Data on foliage kill at the two locations are given in Tables 1 and 2. Incomplete data were obtained from some treatments at Site B because of unplanned bulldozing on the site that removed many dead or dying rose clumps. Lower foliage kill estimates for later periods indicate that regrowth had occurred, or to some extent, the variability in visual estimates at different times. Regrowth in most cases arose from treated stems and not from roots. Eighty percent or better control by the end of the second season was considered acceptable. We expect that many of these plants will die by the third season.

The dormant basal spray of 2,4-D + 2,4,5-T gave almost total kill of rose clumps with sparse regrowth on only four of nine treated. Foliar sprays of 2,4,5-T, dichlorprop, triclopyr, and the dicamba plus 2,4-D combinations all gave essentially complete defoliation within a month, but allowed some regrowth the second year, especially following the August applications. The June

1/ Dale Alley Co., St. Joseph, MO.

treatments of 2,4,5-T, dichlorprop, and dicamba plus 2,4-D were more effective than the August treatments at Site B. These results might be expected because of decreased growth and thicker cuticles in August. The dicamba + 2,4-D treatments at the two sites also differed slightly in dosage and formulation.

By contrast, fosamine at 9 lb/100 gal was more effective in August at Site B than at 12 lb/A in June at Site A. These results agree with findings of Zoebisch et al. who reported that late season applications of fosamine were most effective in woody plant control. Effects of August applications were not observed until the following spring. Fosamine at 6 lb/100 gal gave poor control at both locations.

Glyphosate, while more rapid than fosamine, killed more slowly than other foliar sprays, but at either 1.5 or 3 lb/100 gal, gave almost complete control of multiflora rose by the end of the second season. Seven of eight clumps treated with the lower rate at both locations showed no regrowth. Grasses grew well under the sunny edges of several glyphosate treated plots, indicating that the spray on the rose overstory did not penetrate to the ground in phytotoxic amounts. None of the other treatments seriously affected perennial grasses under or around the treated roses.

Foliar kill with picloram pellets was slow to develop at both locations, except following the May application at Site B where the roses were in an actively growing prebloom stage. Although the 5 and 10% pellets were equally effective it appears that 4 lb/A is required for consistent control.

Soil applications of granular or liquid dicamba at 8 lb/A tended to be more effective than pelleted dicamba, but neither gave satisfactory control of multiflora rose over the two seasons. The rose plants showed tip dieback and growth reduction, but rarely severe defoliation.

These trials indicate that there are several potential herbicides for controlling multiflora rose. Basal sprays of 2,4-D plus 2,4,5-T, and foliar sprays of 2,4,5-T, dichlorprop, fosamine, glyphosate, triclopyr, and dicamba plus 2,4-D all gave high levels of control at one or both locations, but some may require reapplication to control regrowth in well established stands. A third season will be required to fully evaluate plant kill.

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TABLE 1. Average percentage foliage kill of multiflora rose at Site A.

Herbicide, formulation & date	Rate	7/26/77	9/21/77	5/18/78	9/11/78
Dormant basal spray 4/29/77	lb/100 gal oil				
2,4-D+2,4,5-T butoxyethanol esters	7.5 + 7.5	97	90	99	99
Foliar sprays 6/16 to 6/20/77	lb/100 gal water				
2,4,5-T butoxyethanol ester	6 ae	99	100	95	89
dichlorprop butoxyethanol ester	6 ae	100	100	98	96
triclopyr, triethylamine	.75 ae	100	100	96	79
	1.5 ae	100	99	93	94
fosamine, ammonium+X-77	6 ai	3	25	65	56
	12 ai	1	25	73	63
glyphosate, isopropylamine+ X-77	1.5 ae	8	81	99	96
	3.0 ae	11	91	98	95
dicamba, dimethylamine+ 2,4-D, butoxyethanol ester	1.25 ae+ 2.5 ae	99	99	99	87
Soil applications 6/16 to 6/17/77	lb/A				
picloram, K salt, 10P	2 ae	44	82	80	71
	4 ae	58	92	90	89
5P	2 ae	74	90	81	72
	4 ae	62	87	91	80
dicamba, 10P	4 ae	5	29	32	24
	8 ae	9	55	33	43
dicamba, 5G	4 ae	6	22	34	32
	8 ae	12	84	60	63
dicamba, dimethylamine 4S	4 ae	10	56	52	37
	8 ae	21	78	82	68
L.S.D. p = .05					22
.01					30

TABLE 2. Average percentage foliage kill of multiflora rose at Site B.

Herbicide, formulation & Date	Rate	9/19/77	6/28/78	9/11/78
Foliar sprays 8/24/77	lb/100 gal water			
2,4,5-T, butoxyethanol ester	6 ae	100	62	62
dichlorprop, butoxyethanol ester	6 ae	100	47	63
triclopyr, triethylamine	.75 ae	100	-	-
fosamine, ammonium+X-77	6 ai	7	33	48
	9 ai	10	99	99
	12 ai	9	95	100
glyphosate, isopropylamine+ X-77	1.5 ae	71	100	100
	3 ae	85	100	100
dicamba + 2,4-D, dimethylamines	1+3 ae	100	71	68
Soil applications 8/24/77	lb/A			
picloram, K salt 10P	2 ae	59	55	59
	4 ae	78	-	-
picloram, K salt 5P	2 ae	70	62	60
	4 ae	54	100	85
dicamba, 10P	4 ae	8	45	53
	8 ae	10	36	37
dicamba, dimethylamine 4 WS	8 ae	16	26	34
Soil applications 5/22/78	lb/A			
picloram, K salt 10P	4 ae	-	100	97
dicamba 5G	8 ae	-	24	30
	10 ae	-	36	50
dicamba, dimethylamine 4 WS	8 ae	-	54	76
	10 ae	-	36	57

CONVERTING LOW-GRADE OAK-HICKORY FORESTS TO JAPANESE LARCH WITH PELLETED TEBUTHIURON

R. D. Shipman[1/]

ABSTRACT

One-year-old nursery grown seedlings of Japanese larch were effectively released from the overstory competition of a mixed upland oak-hickory forest with soil-applied pelleted tebuthiuron. After three growing seasons, height and diameter growth of Japanese larch treated with two 10 gm pellets per spot in a 12 by 12 foot grid pattern, was nearly double that of one 10 gm pellet placed per spot at the same spacing and concentration. The percent crown reduction of seven major competing overstory and three understory woody plants increased directly with increased numbers of pellets applied. Visual toxicity symptoms to Japanese larch seedlings underplanted at a 6 by 6 foot spacing following tebuthiuron treatment was negligible.

INTRODUCTION

In addition to the most commonly used liquid herbicides such as 2,4,5,-T, soil-applied herbicides offer the forest manager a versatile, safe, and easily applied method of controlling unwanted low-quality woody plants and brush that compete with the growth of more desirable tree species (1,2,3,4,5,6,7). Pellets, beads or granules are especially useful for the small woodlot owner because of their economies in application equipment and labor. Costs of these herbicides are high, although in the future they may become comparable to other methods of controlling woody plants that require costly oil or other petroleum products often added as carriers. They are especially useful in areas inaccessible to heavy equipment and are easily applied with aircraft.

MATERIALS AND METHODS

In April, 1975 two adjacent 0.1 acre square blocks were established in a mixed upland oak forest stand approximately 55-60 years of age and dominated by a white oak (*Quercus alba* L.) and hickory (*Carya* spp.) overstory and a hophornbeam [(*Ostrya virginiana* (Mill.) K. Koch)], and shadbush [(*Amelanchier canadensis* (L.) Med.)] understory. The soil is a Weikert clay loam and the slope is approximately 15 percent. The experimental site is located on the Stone Valley Experimental Forest in Huntingdon County, Pennsylvania.

Tebuthiuron N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea pellets* were applied at rates of one and two 10 gm pellets (1.65 gms ai per pellet) on the soil surface at each corner of a 12 by 12 foot grid pattern on May 8, 1975. The pellets were crushed by stepping on

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* Trade name "Spike."

them and covering with a thin layer of soil. They were applied approximately one month following a 6 by 6 foot spaced underplanting of Japanese larch (Larix leptolepis, Sieb. and Zucc.). Planting was completed during the period April 12-17, 1975. Survival counts and percent crown reduction inventories were taken in April 1976, November 1977, and July 1978 respectively (Tables 1 and 2).

RESULTS AND DISCUSSION

Table 1 - Survival differences between the one and two pellet per spot rates of application for the planted Japanese larch remained essentially the same for the first two growing seasons; however, at the termination of the third year, survival at the two pellet rate dropped to 77 percent. The higher rate of two pellets per spot showed a significantly greater height growth (88 inches, or about 2.5 feet per year) than the lower rate of one pellet per spot (49 inches) after three growing seasons. This exceedingly rapid increase in height growth of larch can be attributed mainly to its highly intolerant or light demanding characteristics and immediate release brought about by doubling the rate of application which drastically reduced the overstory crown competition. Also, prior studies have shown that Japanese larch despite annual browsing by the white-tailed deer, is not significantly reduced in height or diameter growth. It is one of few species planted in the Northeast which is essentially "deer proof" (6).

Table 2 - Tebuthiuron pellets applied at the two pellets per spot rate was nearly twice the amount of crown reduction compared to the one pellet per spot rate after three growing seasons. Satisfactory crown reduction at the two pellet rate was obtained for both white oak and hickory, or 87 and 76 percent respectively by 1978; at the lower one pellet per spot rate, white oak and hickory produced 50 and 52 percent crown reductions respectively. Too few of the remaining species were available to make valid comparisons according to rate of application and crown reduction response. However, all species are listed in Table 2 showing the susceptibility and crown reduction of all species treated.

Pelleted tebuthiuron appears to control a broad range of woody species characteristic of low-grade oak-hickory forest stands in central Pennsylvania when applied according to soil and site conditions as described in this investigation. Furthermore, Japanese larch (essentially a "deer proof" species) survived and grew exceptionally well with no observable herbicide damage, even at the higher rate of tebuthiuron applied. Thus, along with several other urea and non-urea type herbicides, it appears that pelleted formulations, despite their current high cost, may be safely used to increase growth and upgrade the quality of oak-hickory forests and may eventually become competitive with other less expensive herbicides.

Table 1. Survival and average height growth of underplanted Japanese larch by herbicide treatment.

Block	Pellets per spot 1/	Rate lb/A	Number Seedlings Planted 2/	Species	April 1976 Survival (percent)	April 1976 Height (inches)	November 1977 Survival (percent)	November 1977 Height (inches)	July 1978 Survival (percent)	July 1978 Height (inches)
1	one	1.1	87	Japanese larch	92	25	92	38	90	49
2	two	2.2	83	Japanese larch	93	36	93	64	77	88

1/ Ten-gram tebuthiuron pellet (1.65 gms ai) applied on soil surface at each corner of a 12 by 12 foot grid on May 8, 1975.

2/ One-year-old seedlings planted beneath hardwood overstory at 6 by 6 foot spacing during April 12-17, 1975.

Table 2. Susceptibility of competing hardwood species by rate of application.

Block	Pellets per spot 1/	Rate lb/A	Species	Average Diameter (inches)	Number of Trees	Percent Crown Reduction 1976	1977	1978
1	one	1.1	White oak	6.7	18	27	41	50
			Hickory	3.7	7	27	46	52
			Red maple	1.8	6	0	0	0
			Scarlet oak	12.4	4	14	48	67
			Dogwood	2.4	2	0	0	0
			Black oak	6.3	1	10	100	100
			Red oak	12.9	1	0	0	0
			Hornbeam	1.6	1	0	0	5
			Sugar maple	3.5	1	5	15	20
			Shadbush	2.8	1	0	20	20
							Means:	
				Total:	42	8	28	31
2	two	2.2	White oak	7.3	36	68	35	87
			Hickory	2.6	7	45	82	76
			Shadbush	2.0	4	20	40	41
			Hornbeam	2.0	2	60	63	55
			Red maple	1.5	1	40	70	75
			Red oak	10.0	1	20	50	30
							Means:	
				Total:	51	42	57	61

1/ Ten-gram tebuthiuron pellet (1.65 gms ai) applied on soil surface at each corner of a 12 by 12 foot grid on May 8, 1975.

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CONTROL OF YELLOW NUTSEDGE IN NURSERY PLANTINGS

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ABSTRACT

Preemergence and postemergence herbicides were applied during 1977 and 1978 in nursery stock infested with dense stands of yellow nutsedge (Cyperus esculentus L.). Bentazon at 1 or 2 lb/A in August gave excellent control of mature nutsedge with injury to Juniperus horizontalis plumosa and no injury to Taxus cuspidata densiformas, but June applications on younger nutsedge gave no control. Repeating the applications in July and adding a surfactant gave fair control in August and good to excellent control in September. RH-6201 at 0.5 and 1 lb/A in June and July gave similar results.

Followed by subnormal precipitation, preemergence applications in late March of dichlobenil, napropamide, oxyfluorfen, oxadiazon, and R-40244 gave little or no control of nutsedge, whereas alachlor at 6 lb/A plus simazine at 1.5 or 3 lb/A gave fair control.

June applications of metolachlor at 6 or 8 lb/A following weeding gave fair control of nutsedge. Good to excellent control without injury to Taxus was obtained with subsequent applications in July of bentazon at 1 lb/A plus surfactant.

INTRODUCTION

Yellow nutsedge (Cyperus esculentus L.) can become a serious competitor in nurseries, to the extent of either forcing land out of production or requiring expensive preplant fumigation. Nutsedge tubers are abundant in former haylands and are also brought into nurseries on planting stock. Yellow nutsedge is resistant to several of the commonly used nursery herbicides (1) which allows it to thrive when other weeds are controlled.

Earlier we reported that applications in late fall of dichlobenil (2,6-= dichlorobenzonitrile) and napropamide (2-(α-naphthoxy)-N,N-diethylpropionamide) controlled nutsedge (1). Others have reported control of nutsedge with preplant or preemergence applications of alachlor (2-chloro-2',6-diethyl-N-= (methoxymethyl)acetanilide), metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-= (2-methoxy-1-methylethyl)acetamide), and postemergence applications of bentazon (3-isopropyl-1H-2,1,3-benzothiadiazin(4)3H-one 2,2-dioxide) in annual crops (2,4,5) or turfgrass (3).

MATERIALS AND METHODS

Trials were conducted at a commercial nursery in Waterford, CT during 1977 and 1978. Sprays were applied with a calibrated knapsack sprayer delivering 50 gal/A, and granules were applied with a calibrated auger-feed applicator or weighed out for plots and applied by hand.

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1977 - Andorra junipers (Juniperus horizontalis plumosa) were planted in April, 1977 into beds four ft wide in a fine sandy loam soil. The plants were spaced at 8 by 8 in. Sprays of bentazon were applied on August 24, 1977 in a three ft swath centered on five ft plots across the beds. The nutsedge was mature and 12 to 16 in tall. The treatments were replicated four times in a randomized block design.

Also, on August 24, 1977, single rows of established Taxus cuspidata densiformas, 250 ft long, were sprayed overhead with bentazon at 1 or 2 lb/A. The plants were spaced 1 ft apart in rows 3 ft wide. Untreated rows were left on either side. The nutsedge here was 8 to 24 in tall and dense, but both the yews and the nutsedge were thoroughly sprayed. The temperature was 78°F and overcast, and the soil was wet. No rain fell until August 30. Control of nutsedge and plant injury were evaluated on September 20, 1977 and during 1978.

1978 - Three trials were conducted on silt loam soils infested with yellow nutsedge tubers or plants. In the first, we applied herbicides on 6 by 13 ft plots of established Taxus cuspidata densiformas on March 31, 1978, before any nutsedge had emerged. Each plot of Taxus contained about 50 plants, and because of spacing could not be mechanically cultivated. The treatments were replicated four times in randomized complete blocks. The temperature was 55°F at treatment. No appreciable rain fell for 19 days, and rainfall in April was less than half of normal (1.6 in), but above normal in May (4.4 in). Control of nutsedge and injury was evaluated on June 7 when the untreated nutsedge was 4 to 8 in tall.

In the second trial, treatments were applied on June 15, 1978, on an adjacent area in the same field, where the nutsedge was overtopping the yews (4-8 in). The treatments were replicated three times on plots 6 by 16 ft. The temperature was 70°F at treatment and no rain fell for four days. Rainfall during the month following treatment was about 0.7 normal. Metolachlor plus simazine (2-chloro-4,6-bis(ethylamino-s-triazine) was applied on plots that were first hoed and hand weeded to remove the nutsedge plants, whereas bentazon and RH-6201 (Sodium 5-/2-chloro-4-(trifluoromethyl)-phenoxy/-2-nitrobenzoate) were applied over the established stand. The control plots also were hoed and weeded. On July 20, we evaluated control of nutsedge and reapplied bentazon and RH-6201, adding the surfactant X-77 at 0.5% v/v to the sprays. The nutsedge then was 16 to 24 in tall and formed a dense canopy over the yews, and the temperature was 82°F. No rain fell for three days and only 0.5 in fell in the week following treatment.

To obtain more information on the tolerance of other established nursery stock to bentazon, RH-6201, and glyphosate (N-(phosphonomethyl)glycine), on June 23, 1978 we applied sprays of these herbicides over 20 ft single row plots. RH-6201 was applied at 0.5 and 1 lb/A over Canadian hemlock (Tsuga canadensis), Hetz juniper (Juniperus chinensis glauca hetzi), and arborvitae (Thuja occidentalis boothi). Glyphosate was applied at 1.3 and 2 lb/A ai over Hetz juniper and arborvitae, and bentazon was applied at 1 and 2 lb/A over Canadian hemlock.

In all tests, control of yellow nutsedge and injury to plants were visually rated on a 0 to 10 scale, with 0 = no control or injury, and 10 = 100% control or dead plants.

RESULTS AND DISCUSSION

In the 1977 trials bentazon applied in August gave 95% control of mature nutsedge at 1 lb/A, and complete control at 2 lb/A with no injury to Taxus cuspidata densiformas. However, injury on Andorra junipers was moderate at 1 lb/A and severe at 2 lb/A. Control of nutsedge was good to excellent in 1978 from these applications, without further treatment, perhaps because the soil was not disturbed.

As shown in Table 1, the only plots treated in March, 1978, that showed any appreciable control of nutsedge were those treated with alachlor at 6 lb plus simazine at 1.5 or 3 lb/A. Because of the dense stands of nutsedge even these treatments were unsatisfactory. Lack of control in this test undoubtedly was affected by low rainfall following application. Granular R-40244 (1-(m-trifluoromethylphenyl)-3-chloro-4-chloromethyl-2-pyrrolidone) was the only herbicide to injure the yews. Other treatments that did not control nutsedge included granular dichlobenil at 6 lb/A, napropamide wettable powder or granules at 4 or 8 lb/A, oxadiazon (2-tert-butyl-4(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,-4-oxadiazolin-5-one) at 4 or 8 lb/A, and granular oxyfluorfen (2-chloro-1-(3-ethoxy-4-nitropenoxy)-4-(trifluoromethyl)benzine) at 2, 4 or 8 lb/A.

The June, 1978 application of bentazon and RH-6201 on 4 to 8 in nutsedge gave no control within a month (Table 2). This was in sharp contrast to our results with bentazon in August, 1977. We considered that perhaps a surfactant was needed and added it to the July sprays. Results in August from these treatments were better than in July, but still not satisfactory, except where bentazon plus surfactant followed the June application of metolachlor at 6 or 8 lb/A. By September, however, the nutsedge retreated in July with bentazon at 2 lb/A or RH-6201 at 1 lb/A was almost completely dead. No injury to the yews was observed from these treatments.

In the unreplicated plots treated with bentazon, RH-6201, and glyphosate on June 23, both bentazon and RH-6201 injured Canadian hemlocks (Table 3). RH-6201 at 0.5 or 1 lb/A did not injure Hetz juniper or arborvitae, whereas glyphosate at 1 or 1.5 lb/A caused moderate to severe injury on both. In other studies in Windsor, CT, we obtained no injury with bentazon at 1 or 2 lb/A on white pine (Pinus strobus) or Taxus cuspidata, but we also obtained severe injury on Andorra juniper and Forsythia intermedia.

In nursery stock with severe infestations of yellow nutsedge it is apparent that more work is needed to find acceptable controls. Fall or winter applications of dichlobenil probably would be more effective (1), but these also have been known to fail with inadequate precipitation following application. Cultivation also might have improved results with the preemergence herbicides in late March, but is not possible in bedded nursery stock. Preemergence treatments with alachlor or metolachlor inhibit nutsedge for a time, but must either be reapplied or followed by suitable postemergence treatments. Bentazon or RH-6201 offer hope for postemergence control of nutsedge in certain ornamental cultivars such as yews and white pine in the case of bentazon, and yews and possibly juniper and arborvitae in the case of RH-6201. Our results with bentazon agree with findings of Jagschitz (3) who obtained better control of nutsedge with bentazon in July than in June. Glyphosate could be useful in

directed applications, but other application methods would have to be developed for low growing nursery stock.

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TABLE 1. Effect of preemergence treatments applied 3/31/78 on control of yellow nutsedge and injury to Taxus.

Herbicide	Rate, ai lb/A	Control 1/ 6/7/78	Injury 2/ 6/7/78
untreated	0	0	0
dichlobenil, 4 G	6	1	0
napropamide, 50 W	4	1.5	0
	8	1.5	0
napropamide, 10 G	4	3.8	0
	8	3.5	0
R-4C244, 2 G	2	3.0	1.8
	4	3.5	3.0
oxadiazon, 4 G	4	2.0	0
	8	1.3	0
alachlor, 4 EC + simazine, 80 W	6+1.5	7	0
	6+3.0	6.9	0
oxyfluorfen, 2 G	2	0	0
	4	0	0
	8	0	0

1/ 0 = no control, 10 = 100% control
2/ 0 = no injury, 10 = dead plants.

TABLE 2. Control of yellow nutsedge[1/] with bentazon, RH-6201, and metolachlor applied 6/15/78, and with bentazon and RH-6201 reapplied on 7/21/78.

First Treatment 6/15/78		Second Treatment 7/20/78				
Herbicide	lb/A	Herbicide	lb/A	7/20	8/24	9/19
untreated		untreated		0	0	0
RH-6201, 2L	0.5	RH-6201 +	.5	0	5.0	8.2
	1.0	X-77	1.0	0	6.2	9.6
bentazon 4L	1.0	bentazon +	1.0	0	7.2	8.2
	2.0	X-77	2.0	0	7.8	9.6
metolachlor EC+	4+1.5	bentazon +	1.0	5.7	8.3	8.0
simazine WP	6+1.5	X-77	1.0	7.3	8.8	9.3
	8+1.5		1.0	7.3	9.0	9.5
L.S.D. p = .05					1.2	N.S.

1/ 0 = no control, 10 = 100% control.

TABLE 3. Injury to nursery stock and control of yellow nutsedge with sprays on June 23, 1978 in unreplicated single plots.

Herbicide	Rate, ai lb/A	Injury-July 20[1/] Hetz juniper	Arborvitae	Canadian hemlock	Nutsedge control July 20
untreated		0	0	0	0
RH-6201, 2L	.5	0	0	1	5
	1.0	0	0	2	8
bentazon, 4L	1.0	0	-	3	-
	2.0	0	-	5	-
glyphosate,	1.0 ae	3	2	-	9.5
isopropylamine salt	1.5 ae	4	5	-	9.5

1/ 0 = no injury, 10 = dead plants.

METOLACHLOR AND ALACHLOR FOR WEED CONTROL IN ESTABLISHING WOODY NURSERY STOCK

J. Ray Frank and J. A. King[1/]

ABSTRACT

A field experiment was conducted to test the effectiveness 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] alone or in combination with simazine [2-chloro-4,6-bis-(ethylamino)-s-triazine] for weed control in the establishment of four species of woody nursery stock.

Metolachlor and alachlor alone gave short-term control of annual weeds. Combinations with simazine lengthened the period of effective weed control.

Follow-up treatments of glyphosate [N-(phosphonomethyl)glycine] and paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) were applied to control the perennial weed population. Glyphosate was more effective than paraquat in controlling weeds over a 45-day evaluation period.

INTRODUCTION

Alachlor has been reported to provide effective early season weed control alone or in combination with simazine in some woody nursery growing areas of the northeastern United States (1, 3, 4). Metolachlor, a closely related compound has also been reported to be effective for early season weed control (2, 5). An experiment was conducted to compare alachlor and metolachlor for early season control of annual weeds when used alone or in combination with simazine.

MATERIALS AND METHODS

A split plot design was used with 30 main plots arranged in a randomized complete block with subplots randomized within each main plot. Main plots were 13.4 m by 3.6 m with three subplots each 3.6 m by 3.6 m. A 1.2 m by 3.6 m buffer zone separated each subplot. Each subplot contained four plants of each of four woody nursery species in a continuous row on 1.2 m centers. The woody plants included: Dwarf Japanese yew (*Taxus cuspidata* 'compacta'), Hershey red azalea (*Rhododendron sp.* Hershey red), Boxleaf Japanese holly (*Ilex crenata* 'convexa'), and Andorra juniper (*Juniperus horizontalis* plumosa).

Main plot treatments were: untreated control, alachlor at 2.2 and 4.5 kg/ha, metolachlor at 2.2 and 4.5 kg/ha, simazine at 2.2 kg/ha, metolachlor at 2.2 and 4.5 kg/ha + simazine at 2.2 kg/ha, and alachlor at

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2.2 kg/ha and 4.5 kg/ha + simazine 2.2 kg/ha. Each treatment was replicated three times.

The field, which is a Duffield silt loam, was cultivated on April 14 and again on April 24. The woody plants were planted between May 25 to May 30 and watered immediately after planting. The metolachlor, alachlor and simazine treatments were applied on May 31 and June 2 preemergence to weed growth.

Subplot spray treatments with glyphosate at 4.5 kg/ha or paraquat at 1.1 kg/ha were applied on June 20 to perennial weeds which dominated the plots after the reduction of the annual weed population.

All applications were made with a tractor-mounted boom sprayer, using Spraying Systems T-Jet nozzles (8003)[2] at a volume of 280.6 L/ha at 2.5 kg/cm^2. Applications were made between the hours of 0715 to 0930 with a wind speed of 0 to 4.8 kmh. Plants were covered with pots during all applications to prevent contact injury.

Three people independently visually rated each subplot for an estimate of percentage weed cover every week from June 13 to August 2. The three percentages were averaged. Data were transformed to degrees by the arcsine transformation and analysis of variance and Duncan's multiple range test were run on the transformed data. Mean arcsine values were then transformed back to percentages.

The weeds in each plot were identified and recorded during June, July, and August.

RESULTS AND DISCUSSION

Eleven days after the first application, only the alachlor (4.5 kg/ha)-simazine (2.2 kg/ha) combination had a lower percent weed cover than the untreated control plots (Table 1). After 26 days, none of the treatments was effective in controlling the percent weed cover.

The follow-up treatment with paraquat or glyphosate was effective throughout the experiment (Table 2). Paraquat gave rapid knockdown but after 24 days, glyphosate treatments were more effective than paraquat.

There was no observable interaction between the preemergence treatments and the postemergence treatments with paraquat or glyphosate. When paraquat or glyphosate was used as a follow-up treatment, the percentage weed cover was the same as that observed in plots with a preemergence treatment. Individual weed species were identified in each plot 11 and 26 days after the preemergence treatment to determine which species were controlled.

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[2]Spraying Systems Co., Wheaton, IL 60187.

Table 1. Effect of alachlor, metolachlor, simazine and combinations on the percent weed cover 11 days after treatment

Treatment	% Weed cover
Untreated control	25.78ab[a]
Alachlor 2.2 kg/ha	28.52a
Alachlor 4.5 kg/ha	24.56abc
Simazine 2.2 kg/ha	27.34ab
Metolachlor 2.2 kg/ha	31.54a
Metolachlor 4.5 kg/ha	32.22a
Metolachlor 2.2 kg/ha + Simazine 2.2 kg/ha	28.51a
Metolachlor 4.5 kg/ha + Simazine 2.2 kg/ha	22.38abc
Alachlor 2.2 kg/ha + Simazine 2.2 kg/ha	17.72bc
Alachlor 4.5 kg/ha + Simazine 2.2 kg/ha	15.95c

[a]Analysis of variance and Duncan's multiple range test at 5% level. Figures followed by common letters are not significantly different.

Table 2. Effect of glyphosate or paraquat on percent weed cover

Postemergence application	Days after treatment				
	8	24	31	38	45
Untreated control	46.92a[a]	58.88a	61.83a	65.69a	65.54a
Glyphosate 4.5 kg/ha	18.46b	21.48c	29.84c	35.51c	39.15c
Paraquat 1.1 kg/ha	14.28c	26.95b	36.75b	43.40b	46.60b

[a]Analysis of variance and Duncan's multiple range test at 5% level. Figures followed by common letters are not significantly different.

Annuals including Virginia copperleaf (*Acalypha virginica* L.), redroot pigweed (*Amaranthus retroflexus* L.), velvetleaf (*Abutilon theophrasti* Medic.), prickly sida (*Sida spinosa* L.), spotted spurge (*Euphorbia maculata* L.), field brome (*Bromus arvensis* L.), giant foxtail (*Setaria faberi* Herrm.), and large crabgrass [*Digitaria sanguinalis* (L.) Scop.] were controlled by all treatments. Alachlor appeared to be more effective than metolachlor in controlling yellow woodsorrel (*Oxalis stricta* L.), carpetweed (*Mollugo verticillata* L.), yellow toadflax (*Linaria vulgaris* Hill.). Common ragweed (*Ambrosia artemisiifolia* L.) was controlled by all treatments except simazine or metolachlor alone.

Perennials such as hedge bindweed (Convolvulus sepium L.) and horsenettle (Solanum carolinense L.) were not controlled by metolachlor, alachlor or simazine applications when used alone or in combination. Broadleaf dock (Rumex obtusifolius L.) was controlled by metolachlor or simazine alone or when used in combination. Alachlor and simazine combinations were also effective against broadleaf dock, whereas alachlor alone was not. Canada thistle [Cirsium arvense (L.) Scop.] was killed with simazine at 2.2 kg/ha, while chicory (Cichorium intybus L.) was controlled with 4.5 kg/ha of alachlor, 4.5 kg/ha metolachlor and 4.5 kg/ha alachlor + simazine at 2.2 kg/ha.

Alachlor and metolachlor appear to provide temporary control of annual weeds under conditions of high weed pressure. Simazine in combination with alachlor or metolachlor lengthened the period of control of annual weeds with some effect on perennial weeds. No crop injury was observed as the result of preemergence treatment with metolachlor, alachlor, simazine alone or in combination. One or more follow-up treatments of paraquat or glyphosate would be required for season-long weed control under the test conditions.

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THE USE OF TEBUTHIURON NEAR TREES

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ABSTRACT

Tebuthiuron is a very effective long lasting soil sterilant. It is very useful along curbstones, around lighting poles and along fences. This was used along a fence adjacent to an experimental ground cover planting in 1976. The other side of the fence was turf and about 15 feet away a row of Norway maple (Acer platanoides). There resulted a clear, weed-free band under the fence with no injury to the nearby ground covers and to the turf. After a few weeks the side of the trees toward the fence defoliated and some branches eventually died. Other trees in the area were normal.

This year treatments around lighting poles and between curbstones and parking lot pavement produced similar results. In the fall the maples started to grow a new set of leaves. Similar trees away from the treated area did not die back prematurely.

A test is being carried out on well established large London plane trees (Platanus acerifolia) in a somewhat abandoned nursery area to determine how close to the tree applications of tebuthiuron can be safely applied. It was applied around the base of a tree and to 5 x 15 ft areas 5-10 feet, 10-15 feet and 15-20 feet from the base of the tree at 10 lb/A.

Observations on October 2 showed complete defoliation but some new leaves starting where the basal spray had been used. The other trees showed no injury. The treated areas were bare of vegetation from the treatment.

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CHEMICAL WEED CONTROL IN BROADLEAF EVERGREEN LINERS

C. Haramaki and L. Kuhns[1]

ABSTRACT

Alachlor, napropamide, oryzalin, oxadiazon, prometryn, simazine, and USB 3153 were sprayed on newly planted liners of common boxwood, cranberry cotoneaster, glossy abelia, inkberry, and Laland firethorn at 1, 2, 4 and 8 pounds active ingredient per acre. Excellent weed control was obtained by all rates of oryzalin, oxadiazon, prometryn, simazine, and USB 3153 and alachlor at 2, 4, and 8 pounds. Napropamide provided satisfactory weed control only at the 8 pound rate. The herbicides other than prometryn and simazine caused little or no injury to the plants. Prometryn at 4 and 8 pounds injured common boxwood and at 2, 4, and 8 pounds injured inkberry. Simazine injured common boxwood at all rates, inkberry at 2, 4, and 8 pounds, glossy abelia at 4 and 8 pounds, and Laland pyracantha at 8 pounds.

INTRODUCTION

The most efficient way to control weeds in a nursery is to eliminate the weeds and weed seeds prior to planting the nursery crop, then suppressing future weed growth with preemergence herbicides. Many nurseries do not schedule sufficient time between harvesting one crop and planting another to properly clean up weed problems with non-selective herbicides and instead a common practice is to apply an herbicide shortly after planting. For most herbicides currently available for use on nursery crops, the plants must be well established prior to application to minimize injury. Some herbicides recently cleared for use on nursery stock, and some experimental herbicides appear to be less injurious to ornamental plants while providing excellent weed control. The objectives of this experiment were to evaluate the weed control provided by these herbicides and to determine their phytotoxicity, if any, to recently planted broadleaved evergreen liners.

METHODS AND MATERIALS

The experiment was conducted at The Pennsylvania State University Agricultural Research Center at Rock Springs. The Hagerstown silt loam soil was double disced, spring tooth harrowed, smoothed with a Levy Roterria during the period of June 28-30, 1978. Four liners of common boxwood (Buxus sempervirens L.), cranberry cotoneaster (Cotoneaster apiculata Rehd.), Glossy abelia (Abelia grandiflora Rehd.) inkberry (Ilex glabra Gray), and Laland firethorn (Pyracantha coccinea lalandi Roem.) were planted in each of ninety plots on July 6, 1978. The weather was clear and sunny with the temperatures in the mid 80's. One inch of water applied by sprinkler irrigation immediately after planting.

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Table 1. Effect of Postplant Applications of Pre-emergent Sprays on Weed Growth, Twelve Weeks after Application, 1978.

Chemical	Rate	Grasses	Broad-leaves	Canada Thistle	Overall	Overall minus Canada Thistle
Check		2.00	3.66	1.00	6.66	5.66
Alachlor	1#/A	0	4.00	0.33	4.33	4.00
	2#/A	0	1.33	1.33	2.66	1.33
	4#/A	0	0.33	1.33	1.66	0.33
	8#/A	0	0	0	0	0
Napropamide	1#/A	0.33	5.00	2.66	8.00	5.33
	2#/A	0.33	3.66	2.33	6.33	4.00
	4#/A	0.33	4.33	2.33	7.00	4.66
	8#/A	0	2.00	2.66	4.66	2.00
Oryzalin	1#/A	0	1.00	3.66	4.66	1.00
	2#/A	0	1.33	3.66	5.00	1.33
	4#/A	0	0.33	3.00	3.33	0.33
	8#/A	0	0	2.66	2.66	0
Oxadiazon	1#/A	0	0.66	0.33	1.00	0.66
	2#/A	0.66	0.66	0.66	2.00	1.33
	4#/A	0	0.33	0.33	0.66	0.33
	8#/A	0.33	0	0.66	1.00	0.33
Prometryn	1#/A	0	0.33	2.00	2.33	0.33
	2#/A	0	0	0.33	0.33	0
	4#/A	0	0	0.33	0.33	0
	8#/A	0	0	0	0	0
Simazine	1#/A	0	0	1.00	1.00	0
	2#/A	0	0	0.33	0.33	0
	4#/A	0	0	0.33	0.33	0
	8#/A	0	0	0	0	0
USB-3153	1#/A	0	1.00	5.00	6.00	1.00
	2#/A	0	1.00	3.66	4.66	1.00
	4#/A	0.33	0	2.00	2.33	0.33
	8#/A	0	0	4.33	4.33	0

0 = no weeds, 10 = 100% weed coverage.

On July 11, 1978 the herbicides were applied to the ninety square foot plots with a CO_2 pressured sprayer at 20 psi in the equivalent of 40 gallons per acre using LP8002 nozzles with 50 mesh screens. The herbicides alachlor (2-chloro- 2', 6'-diethyl-N- (methoxoymethyl) acetanilide), napropamide (2,(α-naphthoxy)-N, N-diethylpropionamide), oryzalin (3, 5-dinitro-N^4, N^4-dipropylsulfanilamide) oxadiazon (2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazalin-5-one D, prometryn (2,4-BIS (isopropylamino)-6-(methylthio) -S-triazine), simazine (2-chloro-4,6-bis (ethylamino)-S-triazine), and USB-3153 (N^3, N^3-di-n-propyl-2,4-dinitro-6-trifluoromethyl-m-phenylenediamine) were applied at the rates of 1, 2, 4, and 8 pounds of active ingredient per acre. The weather at the time of application was sunny with a few scattered clouds and the soil moisture was at field capacity. Wind speed varied from 5-15 mph and the temperatures at the beginning and end of application period were as follows: air, 65° and 78°; soil surface, 68° and 81°; soil 2 inches below the surface, 63° and 79°. All of the herbicide treatments were replicated three times and there were six untreated control plots. The plants were sprinkle irrigated throughout the summer. On October 5, 1978 the plots were examined for weed growth and crop injury.

RESULTS AND DISCUSSION

The predominant weeds in the control plots in decreasing order of frequency were: common ragweed (*Ambrosia artemisiifolia* L.), common lambsquarter (*Chenopodium album* L.), witchgrass (*Panicum capillare* L.), redroot pigweed (*Amaranthus retroflexus* L.), and Canada thistle (*Cirsium arvense* Scop.) Canada thistle will be eliminated in our discussion of weed growth (Table 1) because it was not evenly distributed throughout the test area and it was not controlled by any of the herbicides being evaluated.

Alachlor treatments gave excellent control of grasses at all rates, acceptable control of broadleaved weeds at 2 pounds per acre and excellent broadleaf control at 4 and 8 pounds per acre. Inkberry liners sprayed with alachlor showed some chlorosis at low application rates and some marginal necrosis at the higher rates. The other plant species exhibited little or no injury. Napropamide gave excellent control of grasses but poor control of broadleaved weeds at all rates except 8 pounds per acre. This poor broadleaf weed control is most likely due to the higher temperatures during and following treatment. The liners exhibited little or no injury and had good growth. Oryzalin treatments gave good to excellent weed control of both grasses and broadleaved weeds. There was little or no injury on the liners. Plots treated with oxadiazon had good to excellent weed control and resulted in little or no injury to the plants. The only indication of injury was the shoot tips and margins of the new leaves of inkberry which were reddish. Excellent weed control of both grasses and broadleaved weeds was observed in all plots treated with prometryn. The common boxwood liners had some chlorosis at the 4 pound per acre rate and chlorosis and necrosis at the 8 pound per acre rate. Inkberry liners exhibited some interveinal chlorosis at the lower rates and extensive chlorosis at the higher rates. The other liners exhibited little or no injury. Simazine treated plots had excellent weed control at all rates of application. Common boxwood exhibited some chlorosis at the 1 pound per acre rate and severe necrosis at the 2, 4, and 8 pound per acre rate. Inkberry had some chlorosis at the 2 pound per acre rate and extensive chlorosis and necrosis at the 4 and 8 pound per acre rate. Laland pyracantha and glossy abelia liners had some chlorosis at the 4 and 8 pound per acre rate. Cranberry cotoneaster exhibited little or no injury at all

Table 2. Effect of Postplant Application of Pre-emergent Sprays on Broadleaf Evergreen Liners, Twelve Weeks After Application, 1978.

Chemical	Rate	Common Boxwood	Inkberry	Laland Pyracantha	Cranberry Cotoneaster	Glossy Abelia
Check		0.08	0.50	0.21	1.13	0.13
Alachlor	1#/A	0	1.66	0.75	0.42	0
	2#/A	0.17	1.58	0.42	0.25	0.17
	4#/A	0	1.33	0.75	0.42	0.08
	8#/A	0.25	1.42	1.17	0.92	0.75
Napropamide	1#/A	0.42	0.33	0.83	0.67	0
	2#/A	0	0.50	0.08	0.17	0.17
	4#/A	0	1.08	1.00	1.08	0.50
	8#/A	0	0.58	1.33	0.58	0.08
Oryzalin	1#/A	0.50	1.00	0.42	0.33	0.17
	2#/A	0.08	1.00	0.25	1.17	0.50
	4#/A	0.33	1.25	0.42	0.42	0.17
	8#/A	0.25	0.92	0.50	1.75	0.08
Oxadiazon	1#/A	0	1.25	0.66	0.75	0
	2#/A	0.50	0.75	0.25	0.25	0.08
	4#/A	0.17	1.75	0.08	0.66	0.08
	8#/A	0.33	0.81	0.33	1.00	0
Prometryn	1#/A	0.17	1.50	0	0.33	0
	2#/A	1.42	2.42	0.08	0.17	0.17
	4#/A	2.25	3.42	0.33	1.08	0.17
	8#/A	3.83	3.50	0.42	0.83	0.75
Simazine	1#/A	2.33	1.08	1.58	0.33	0.66
	2#/A	4.00	2.08	1.00	0.33	0.75
	4#/A	4.75	3.25	1.92	0.92	2.33
	8#/A	4.75	3.83	2.66	1.58	2.33
USB-3153	1#/A	0.08	1.00	0.50	0.42	0.42
	2#/A	0.25	0.83	0.08	0.58	0
	4#/A	0.08	1.33	0	0	0.50
	8#/A	0.58	1.16	0	0.83	0.08

0 = no injury; 5 = dead.

rates of application. USB 3153 treatments gave good to excellent weed control at all rates of application and caused little or no injury to liners. Common boxwood was tolerant to all rates of application of alachlor napropamide, oryzalin, oxadiazon, and USB 3153 and the 1 and 2 pound rates of prometryn. Moderate to severe injury was found on the boxwoods treated with prometryn at 4 and 8 pounds per acre and simazine at all rates of application. Inkberry tolerated sprays of alachlor, napropamide, oryzalin, oxadiazon and USB 3153 at all concentrations and prometryn and simazine at 1 pound per acre. Interveinal and severe chlorosis was observed on inkberry treated with prometryn and simazine at 2, 4, and 8 pounds per acre. Laland pyracantha was tolerant to all herbicide applications except simazine at 4 and 8 pounds per acre, which caused some chlorosis to occur. Cranberry cotoneaster tolerated all rates of application of the herbicides used. Glossy abelia grew well in all of the plots except those treated with simazine at 4 and 8 pounds per acre where chlorosis on the older leaves was evident.

EVALUATION OF HERBICIDES ON SIX SPECIES OF CONTAINER-GROWN WOODY ORNAMENTALS

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ABSTRACT

During the 1977 growing season six species of container-grown nursery stock were selected for the evaluation of weed control and phytotoxicity when treated with five herbicides at four application rates. Uniform liners of bearberry cotoneaster, wintercreeper euonymus, boxleaf Japanese holly, Andorra juniper, glossy privet and Wyatti pyracantha were planted in a media of equal parts by volume of sand and Canadian sphagnum peat moss in 3.8 L black plastic containers. The plants were potted during late May and June and the herbicides were applied the third week of June 1977. Oryzalin in a 75% wettable powder formulation was applied as a foliage spray with a tractor-mounted field sprayer. All other chemicals were applied to the soil surface as granular formulations using a calibrated vial to measure predetermined volumes of the granules which were then applied to individual containers by hand broadcasting. The napropamide granular formulation used for these experiments differed from the proposed commercial formulation. Seeds of bittercress (Cardamine hirsuta L.), large crabgrass [Digitaria sanguinalis (L.) Scop.], and oxalis (Oxalis sp.) were broadcast over the container one day after herbicide application. During the period of the experiment 29 other weed species were found; primarily from the planting media and secondarily from deposition by wind. The effects of the herbicides on weeds and nursery stock were evaluated monthly. The weed control ratings were based on a scale of 0 to 10 (representing no weed control to total weed control). The effects of the herbicides on the nursery stock were also visually evaluated monthly using the scale: 0 to 3, no reduction or limited injury; 4 to 10, undesirable injury; 10, kill. The final evaluation was conducted in October 1977.

Table 1 is a summary of the number of months 75% weed control was obtained for six species of nursery stock. The best chemicals for 4 months control of weeds without damage to the plants appeared to be oxadiazon 2% followed by oxadiazon 5% and oryzalin. Oryzalin provided weed control for 1 to 2 months which was significantly different from the control. Napropamide after 1 month was generally not significantly different from the untreated plants in the control of weeds. Alachlor provided weed control for 1 month which was significantly different from the control, but weeds began to emerge after this period. Periodic monthly applications of both alachlor and oryzalin would be necessary to have continued weed control. After 4 months no treatment exceeded the 0 to 3 rating for plant damage.

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Table 1. The number of months 75% weed control was obtained for six species of nursery stock.

Formulation	Rate[a] kg/ha	Coto-neaster	Euonymus	Holly	Juniper	Privet	Pyra-cantha
Napropamide 10% G	22.4	<1	<1	<1	1	1	1
	44.8	1	1	<1	1	1	1
	89.6	2	1	<1	2	1	3
	179.2	3	1	<1	2	2	3
Alachlor 15% G	11.2	1	1	<1	1	1	1
	22.4	1	1	1	1	1	1
	44.8	1	1	1	1	1	1
	89.7	1	1	1	1	1	1
Oxadiazon 2% G	112.0	4+	2	2	2	3	3
	224.0	4+	3	2	3	3	4+
	448.0	4+	3	3	3	4+	4+
	896.0	4+	4+	4+	4+	4+	4+
Oxadiazon 5% G	44.8	3	2	2	2	3	3
	89.6	4+	3	2	3	4+	4+
	179.2	4+	3	2	3	3	4+
	358.4	4+	3	3	4+	4+	4+
Oryzalin 75% WP	1.1	1	1	1	1	2	1
	2.2	1	1	1	2	1	3
	4.5	3	1	2	2	3	3
	9.0	4+	3	2	3	3	3

[a]kg/ha of the formulated product.

NURSERY WEED CONTROL ON LONG ISLAND

Thomas Corell[1/]

The exceptional growing conditions found on Long Island favor the production of woody plants. The growing season is long, soil is a well drained sandy loam and ample water of excellent quality is available from deep wells and summer rainfall. The majority of days are clear but extremely high temperatures are prevented by the cooling on-shore breezes. Taking advantage of this environment and a rapidly expanding population a strong nursery industry developed.

The industry presently consists of over 200 growers who account for over half of New York's nursery stock production. There are numerous backyard type growers as well as many in the 40 to 100 acre category and a few nurseries greater than 100 acres. In recent years the trend has been away from field production for some crops. Today, container production accounts for a good percentage of smaller-size azaleas, junipers, and rhododendrons. Larger shrubs and shade trees are generally still field grown as are most of the yews, hemlocks and other narrow leaved evergreens. The industry amounts to about 12 million dollars a year at wholesale.

In spite of the ideal environment, the grower's worst problem is still weeds. The major perennial weeds are Canada thistle (*Cirsium arvense* (L.) Scop.), field bindweed (*Convolvulus arvensis* L.), quackgrass (*Agropyron repens* (L.) Beauv.), mugwort (*Artemesia vulgaris* L.) and yellow nutsedge (*Cyperus esculentus* L.). Other weeds include groundsel (*Senecio vulgaris* L.), yellow woodsorrel (*Oxalis stricta* L.), marestail (*Conza canadensis*), common chickweed (*Stellaria media* (L.) Cyrillo), barnyardgrass (*Echinschloa crusgalli* L. Beauv.), crabgrass (*Digiteria sp.* Heist.), fall panicum (*Panicum dichotomiflorum* Michx.) and common purslane (*Portulaca oleracea* L.).

Considerable labor and energy are expended hoeing, mechanically cultivating, hand pulling or chemically controlling weeds. Competition from weeds decreases saleability of nursery stock by lowering the grade, and by competing with the crop for nutrients and moisture.

We in extension will custom design a weed control program to suit a grower's needs. Generally any such plan starts with a survey to determine what weeds are present. Assuming perennials are a major part of the problem, as is usually the case, we suggest a grower to try preplant applications (usually 2 treatments at 10 to 14 day intervals) of glyphosate (N-(phosphonomethyl) glycine) in the late summer or early fall of the year prior to planting. With land free of perennial weeds the grower prepares the land and plants his crop. After planting, the ground is smoothed to even the surface, and preemergence herbicides are applied. Water from rain or irrigation amounting to 1/2 to 1" should then be applied. Preemergence herbicides are generally applied in granular form, but sprays are also used. A combination of two herbicides usually gives a broader spectrum of control with less possible

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crop damage than a single material. The expected residual weed control of an application will be from 8 to 10 weeks. After that time, growers are encouraged to sweep through the area to pull out all existing weeds, lightly cultivate to loosen up the soil and spot treat with glyphosate to eliminate perennial weeds. This should be an easy operation in most situations. A follow up treatment of preemergence herbicide is then applied and watered in. It is desirable to use a different herbicide at this time to avoid allowing a few weeds that might escape the first treatment to take over.

In the field these two treatments will generally suffice. Container growers will need to make a third treatment if they expect to remain weed free. The treatments most commonly used are a combination of 1 lb simazine (2-chloro-4, 6-bis(ethylamino)-s-triazine) per acre in combination with one of the following: oxadiazon (tert-butyl-4-(2,4-dichloro-5-isopropoxyphenl)- Δ^2-1,3,4-oxadiazolon-5-one) 2 lb/A, oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide) 2 lb/A, dephenamid (N,N-dimethyl-2,2-diphenylacetamide) 4 lb/A, trifluralin (a,a,atrifloro-2,6-dinitro-N,N-dipropyl-p-toluidine), DCPA (dimethyl tetrachloroterephthalate) 10 lb/A and experimentally alachlor (2-Chloro-2'-6'-diethylN-(methoxymethyl)-acetanilide) 4 lb/A or napropamide (2-(a-Naphthoxy)-N,N-diethylpropionamide) 4lb/A. Growers who use this program are experiencing decreased labor costs and improved plant quality.

This information is disseminated to growers through a monthly newsletter, leaflets, evening meetings, experimental demonstration plots at nurseries and personal visits. Growers are often reluctant to start a herbicide program, but by treating a little at a time they become convinced that herbicides can work for them. One grower reported an 80% reduction in the labor expense of weeding by hand and rototiller as compared to the chemical program outlined above.

GLYPHOSATE AS A PREPLANT TREATMENT FOR NURSERY LINERS AND GLADIOLUS

Arthur Bing[1/]

ABSTRACT

Field plots were treated with glyphosate at 2, 4, 8 and 16 lb/A in late May before planting nursery liners and gladiolus cormels at Farmingdale and Ithaca, New York. Visual ratings of nursery liners and corm yield of gladiolus showed no adverse effect from the glyphosate treatments.

INTRODUCTION

In nurseries, crops grow in the same area for several years which can allow perennial weeds to become a serious problem. During the later stages of growth, the plant spread can make cultivation or other weed control measures very difficult, thereby favoring perennial weeds especially if an extended period of time is used to remove the entire crop before fitting the land for a new planting. If perennial weeds do become established, it is safer and more efficient to remove them before planting the new crop.

In past experiments on Long Island and by Ahrens in Connecticut (1) applications of glyphosate (N-(phosphonomethyl)glycine) to perennial weeds have given good to excellent control. Nursery liners planted 5-10 days later in the treated area grew normally. This is a very promising weed control method that also has been tried on a limited acreage in commercial nurseries. This report covers the 1978 tests at Farmingdale and Ithaca, New York.

MATERIALS AND METHODS

The area in Farmingdale was previously part of an apple orchard that was covered with a heavy sod. Before the experiment was started the area was plowed, disked and planted with a rye cover crop which was 6-8 inches tall on May 30 when the glyphosate treatments were applied with a hand-pumped sprayer to 18 x 20 ft plots replicated 4 times. The treatments were 0, 4, 8 and 16 lb/A active glyphosate at Farmingdale and 0, 2, 4 and 8 lb/A at Ithaca.

The land was rototilled on June 5 using a Howard Rotovator behind a tractor. On June 5 and 6 nursery plants and gladiolus cormels were planted in rows 3 ft apart. The plants were set 2 ft apart in each of 2 rows per plot. Four plants of each of 2 cultivars were set in each row. One row of each plot had a planting of gladiolus cormels. They were scattered in a trench 2 inches deep by 6 inches wide by 14 ft long and then covered. Plots were separated by an 8 ft alley.

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At Ithaca heavily grass covered field plots were sprayed on May 25, rototilled May 30 and planted May 30 and 31. The plot design was the same as at Farmingdale.

The liners planted at Farmingdale (F) and Ithaca (I) were as follows: Green Island holly (Ilex crenata) (F), Hicks yew (Taxus media Hicksii) (F), Azalea (Rhododendron obtusum) (F), Japanese andromeda (Pieris japonica (F), Rhododendron (R. Roseum elegans) (I), Oak (Quercus sp.) (I), Red stemmed dogwood (Cornus stolonifera) (F) (I), Japanese black pine (Pinus thunbergii) (F), White pine (Pinus strobus) (I), cranberry viburnum (Viburnum opulus) (F) (I), English ivy (Hedera helix) (F) (I), Golden bells (Forsythia intermedia) (F) (I), California privet (Ligustrum ovalifolium) (F), Amur privet (Ligustrum amurense) (I), Flowering dogwood (Cornus Florida) (I), Andorre juniper (Juniperus horizontalis plumosus) (I), and multiflora rose (Rosa multiflora) (I). The gladiolus cormels were variety T590 in lots of 1000 determined by weight.

After a cultivation on June 14, the entire area was treated on June 19 with 1 lb/A simazine (2-chloro-4,6-bis(ethylamino)-s-triazine) 5G and 4 lb/A alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide) 15G. The area over the gladiolus received a lighter application because of the sensitivity of cormels to these compounds. The few weeds that started growing were removed by hand pulling or the use of a scuffle hoe during the entire summer.

On October 13 at Farmingdale and November 1 at Ithaca the gladiolus plants were dug, tops removed and each lot of corms and attached cormels put into an individual tray. After a curing period, the corms were cleaned and the corms and cormels weighed. On October 16 at Ithaca and October 25 at Farmingdale each nursery plant was rated as to its growth using 10 for best growth, 7 fair growth down to 1 for a dead or missing plant.

RESULTS AND DISCUSSION

The growth ratings of the nursery liners are in Table 1. Each number is the average of 4 replicates of 4 plants. At Farmingdale, California privet and at Ithaca white pine and multiflora rose did poorly in all plots so were not included in the table. There were no consistent reductions in yield from any rate of glyphosate on any of the plants tested.

The gladiolus grew very well in spite of the late planting date. There were no visible effects on the plants at Farmingdale or Ithaca. The combined weights of all sizes of corms from the 4 replicated plots were averaged and are presented in Table 2. There was no reduction in yield from the glyphosate treatments. At Farmingdale corm production increased as the rates of glyphosate increased.

ACKNOWLEDGEMENTS

The experiment at Ithaca was supervised by Mr. Howard Pidduck. Some plant materials were furnished by the Ornamental Horticulture Dept, SUNY, Farmingdale and the New York State Dept. of Environmental Conservation.

Table 1. The effect of preplant applications of glyphosate on the growth of nursery liners. The field at Farmingdale (F) was treated on May 30, rototilled June 5, planted June 5 and 6 and observed October 25. At Ithaca (I) the field was treated May 25, rototilled May 30 and planted May 30 and 31 and observed October 16.

Plant treated	Location	Hand-weeded	Growth index Glyphosate (lb/A) 2	4	8	16
Holly, Green Island	F	9	-	10	9	10
Yew, Hicks	F	9	-	8	9	9
Azalea	F	10	-	10	10	10
Andromeda	F	6	-	8	7	6
Dogwood, redstemmed	F	6	-	7	5	8
	I	6	8	4	8	-
Pine, black	F	4	-	5	6	4
Viburnum, cranberry	F	9	-	6	8	9
	I	8	8	9	8	-
English ivy	F	7	-	6	8	8
	I	8	9	9	9	-
Forsythia	F	9	-	7	6	8
	I	10	10	10	9	-
Privet, Amur	I	9	9	9	8	-
Rhododendron	I	6	8	6	7	-
Juniper	I	9	9	9	9	-
Oak	I	8	9	8	8	-

Table 2. The effect of preplant applications of glyphosate on the growth from gladiolus cormels variety T590. The field was treated May 25 at Ithaca and May 30 at Farmingdale, planted May 30 at Ithaca and June 6 at Farmingdale, and dug November 1 at Ithaca and October 13 at Farmingdale.

Treatment Material	Lb/A	Yield in grams from 1000 cormels Farmingdale	Ithaca
Hand weeded		1464	839
Glyphosate	2	-	832
	4	1514	791
4 lb/gal	8	1598	773
	16	1665	-

LITERATURE CITED

1. Ahrens, J. F. 1974. Preplant herbicides for control of quackgrass on ornamentals. Proc. Northeast Weed Sci. Soc. 28: 372-78.

GLYPHOSATE INJURY AS THE RESULT OF PREPLANT TREATMENT

Andrew G. Hilen, Arthur Bing, George L. Good 1/

ABSTRACT

Glyphosate is an effective postemergence, nonselective herbicide with systemic properties ideally suited for preplant control of certain noxious perennial weeds. Laboratory and field experiments were conducted to evaluate and characterize phytotoxicity caused by glyphosate to several woody plant species when applied as a preplant treatment to infestations of quackgrass. One to three year old dormant and nondormant species of viburnum, privet, yew, forsythia, plum, cherry and apple were used as test plants. Various rates and time intervals between application and tillage were evaluated. Root induced toxicity symptoms were sporadic and infrequent which suggest that symptomology varied according to plant species, state of active growth and treatments used.

INTRODUCTION

Because of its effectiveness as a preplant postemergence herbicide, glyphosate, [N-(phosphonomethyl) glycine], could gain widespread use in commercial ornamental plant nurseries for controlling quackgrass, [*Agropyron repens* (L.) Beauvois], prior to crop establishment. Nursery stock producers will, undoubtedly, observe abnormalities in their crops caused by factors unrelated to preplant applications of glyphosate. The chemical, however, because it is an herbicide, will be suspect in those cases where it is used even though there is insufficient evidence to support glyphosate induced abnormalities. Unfortunately, injury induced by root applications of glyphosate to woody ornamentals has not been adequately characterized. Producers, therefore, have no standards by which to separate plant injury caused by factors unrelated to glyphosate from injury actually induced by the chemical itself. Consequently, greenhouse and field experiments were conducted to characterize injury caused by root applications of glyphosate to woody ornamental plants. The results would aid producers in the elimination of glyphosate as a possible factor in those cases where the herbicide is not involved.

MATERIALS AND METHODS

Experiment 1

An initial greenhouse experiment was designed to characterize plant injury caused by root applications of glyphosate without the mitigating effect of soil. Dormant one year old rooted cuttings of Showy Border Forsythia

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(Forsythia x intermedia Zabel), Amur Privet (Ligustrum amurense Carriere), Ibolium Privet (Ligustrum x ibolium E. F. Coe), Apple (Malus sp.), Mahaleb Cherry (Prunus mahaleb L.), Common Plum (Prunus domestica L.), Japanese Yew (Taxus cuspidata Siebold & Zucc.), and Double File Viburnum (Viburnum plicatum var. tomentosum), were grown in aerated, full-strength Hoagland's solution to which rates eqivalent to 1, 1.12, 2.24, 4.49 and 8.98 kg ai/ha of the isopropylamine salt of glyphosate were added. Each treatment consisted of four replications of five plants each. Growth of treated plants was evaluated one, two and four weeks after the initiation of treatments.

Experiment 2

A second greenhouse experiment was also designed to characterize injury induced by root applied glyphosate. The chemical, however, was applied to quackgrass which was subsequently chopped and incorporated into a clay loam field soil. This mixture was then used as a growing medium for the same plant species used in Experiment 1. Quackgrass rhizomes were propagated in 15.2 cm plastic pots using a clay loam field soil as the growing medium. Weed plants were grown under artificial light at minimum 21°C day and 18°C night temperatures until the plants were approximately 20 cm in height (4 to 5 leaf stage). The pots were then segregated and the quackgrass sprayed with glyphosate at rates equivalent to 0, 2.24, 4.49, and 8.98 kg ai/ha. A 7.5 l Chapin hand-pressurized sprayer was used to make the proper application of glyphosate. At intervals of 0, 1 and 3 days after treatment, the quackgrass was removed from the containers, separated from the soil medium, and both rhizomes and above ground plant parts were chopped into 2 cm lengths. The cut quackgrass was then incorporated into the untreated soil initially used as the propagating medium. The composite mixture was used as the growing medium for the experimental plants. After potting, the plants were placed in a greenhouse at minimum 21°C day and 18°C night temperatures. Each treatment consisted of three replications of one plant each. Plant growth was evaluated one, two and four weeks after repotting.

Experiment 3

To assess glyphosate injury from preplant treatments of quackgrass in the field, a series of field plots were established at two sites in New York State including a commercial nursery in Dansville, New York and Cornell University, Ithaca, New York. At both locations, the experimental plots were situated in heavily infested areas of quackgrass. In the commercial nursery, 2 m x 7 m plots were treated with glyphosate at rates of 0, 2.24, 4.49 and 8.98 kg ai/ha. The herbicide spray was applied with a 7.5 l Chapin hand-pressurized applicator and permitted to dry afterwhich the treated quackgrass was immediately tilled into the soil. The one and three day interval treatments were not included in this particular test. Rooted cuttings of ibolium privet, apple, mahaleb cherry and plum were then planted directly into the prepared beds. Each treatment consisted of twelve replications of four plants each. Plant growth was evaluated one and two months after treatment.

The identical procedures were used in experiments conducted at Ithaca except that time intervals of one and three days between spray application and planting were included. Also, actively growing plants of snowy border forsythia, amur privet, japanese yew and double file viburnum were used. Each

treatment consisted of twelve replications of four plants each. Ratings on injury response were recorded at one, two and four weeks after planting.

In a final field experiment at Ithaca designed to assess injury induced by high application rates of glyphosate, plots were treated at 16.83 and 33.66 kg ai/ha. At zero, one and three day intervals, plots were tilled and immediately planted with dormant and actively growing showy border forsythia, double file virburnum and amur privet plants. Treatments consisted of three replications of one plant each. Plant response was evaluated at one, two and four week intervals.

RESULTS AND DISCUSSION

Experiment 1

Application of glyphosate at different rates to dormant woody plants placed in solution culture resulted in substantial phytotoxicity to both roots and stems. Test plants exhibited different morphological symptoms. Viburnum showed the greatest injury to roots and stems. Roots were severly discolored, necrotic and lacking in new growth. Microscopic examination of secondary roots revealed pronounced necrosis in root cortical cells, while the conducting tissue remained substantially intact and viable. Bud expansion and leaf development on shoots were totally inhibited. Approximately 90% of all buds failed to break and all plants died after four weeks.

Treatments on amur privet and ibolium privet resulted in visible suppression of bud break and root growth. All buds at the 4.49 and 8.98 kg ai/ha rate failed to break and the plants eventually died. Plants treated at 1.12 and 2.24 kg ai/ha exhibited bud break, but subsequent shoot elongation was very restricted. Where bud expansion was noted, leaves were deformed and remained in compact clusters around the nodal area. The root systems of many privet plants except those treated at 1.12 kg ai/ha, were discolored with some necrosis in the root cortical area. Pronounced suppression of root development was noticed on several plants treated at 2.24 kg ai/ha resulting in compact and stunted secondary feeder roots which resulted in a dense cluster of roots around the base of the stem. However, no necrosis or discoloration was observed on these stunted roots.

Showy border forsythia responded to all glyphosate treatments in a slightly different manner from privet and viburnum plants. Only the buds located near the shoot terminal exhibited activity and the shoots which developed were stunted with the leaves deformed resulting in clusters around the stem. Several plants treated with high rates of glyphosate (8.98 kg ai/ha) died after four weeks. Forsythia root systems were extensive, however, exposure to varying glyphosate rates induced a necrosis at the root apices. The remainder of the root system exhibited minor discoloration. Microscopic examination revealed all root tissues intact.

Japanese yew was extremely slow in responding to glyphosate treatments. Toxicity symptoms became evident six to eight weeks after treatment. At this time, necrosis of some leaves and stems was observed. Very little, if any,

new growth was noted. Root systems appeared normal throughout, but little new growth was observed.

Apple, mahaleb cherry and plum were similar in their response to root applied glyphosate treatments. Bud development was restricted resulting in compact clusters of stunted and deformed leaves around the nodal area. A pronounced chlorosis was associated with the deformities. Root development was also affected as many plants in this family exhibited the same stunting and clustering described in privet. High rates resulted in total inhibition of root growth and the eventual death of the plant.

Experiment 2

Tables I and II show the growth response of several woody plants grown in soil to which glyphosate treated quackgrass was incorporated. Table I shows the survival rate of the test plants. Plum and mahaleb cherry failed to regenerate new roots and a high mortality of these plants was noted particularly at the higher application rates. However, privet and apple were able to regenerate roots in the presence of glyphosate which accounted for higher survival rates. At rates of 2.24, 4.49 and 8.98 kg ai/ha there was some glyphosate induced deformity and growth inhibition to expanding buds of surviving plants as illustrated by Table II. Approximately twenty-five percent of surviving plants in all species and treatments exhibited similar responses as described in Experiment 1. However, only at extremely high rates (16.83 kg ai/ha) did viburnum, amur privet, forsythia and japanese yew exhibit significant injury response as described in Experiment 1. Apparently, the mitigating effects of the clay loam soil used in this experiment accounted for the substantial reduction of injury to roots and shoots.

Experiment 3

Tables III and IV present a synopsis of growth responses of plants treated in Dansville, N.Y., including the survival rate of the test plants and the injury response of surviving plants, respectively. Table III shows that control plants as well as treated plants exhibited high mortality rates. The high mortality noted could have been caused by drought conditions which existed two to three weeks after planting, and to the general quality or viability of the test plants themselves at the time of planting. Regardless of the aforementioned possibilities, the immediate presence of glyphosate in the close proximity of the root zone cannot be discounted as a contributing factor. Table IV shows, of the plants which survived, approximately 22% of all species in all treatments exhibited glyphosate injury as distinguished by deformed and stunted leaves at nodal areas. Despite the relative infrequency of such symptomology, it was evident that such effects were truly glyphosate induced due to their conformity to those responses categorized in Experiment 1.

In similar field studies in Ithaca, N.Y., with actively growing forsythia, amur privet, viburnum and japanese yew, no noticeable effects in any treatments were noted. Viburnum, however, proved reasonably sensitive with pronounced abscission of older leaves and stunting of young expanding leaves. Roots of affected plants exhibited discoloration but not to the degree obtained in Experiment 1.

Because of the infrequency of response at rates previously used in Experiments III and IV, plants were subjected to excessive rates using the same techniques as before. The objective of this approach was to see if the frequency of symptoms could be increased throughout the test plots. Actively growing forsythia and viburnum and dormant amur privet, forsythia and viburnum were used. Actively growing viburnum was the most severly affected at both rates (16.83 and 33.66 kg ai/ha) and at all three time intervals between application and tillage. Moderate to severe defoliation, inhibited leaf development and root discoloration were evident. Conversely growing forsythia plants did not exhibit any injury as the result of these excessive treatments. Dormant amur privet, forsythia and viburnum were extremely sensitive to excessive rates of glyphosate. All plants in all treatments exhibited restricted shoot growth and the characteristic stunted, deformed, and clustered growth at nodal areas noted in earlier experiments.

SUMMARY

In the experiments discussed in this report, glyphosate was used in ways inconsistent with the manufacturer's recommendations. The objectives, however, were to induce glyphosate injury to selected woody ornamental plants in order to characterize the specific nature of that injury. Phytotoxicity was noted and documented on those plants included in the study. The nature of the phytotoxicity noted depended on the state of plant growth. Dormant plants exhibited deformed leaves, stunted shoot growth and discoloration of roots. Actively growing plants, namely viburnum, exhibited a defoliation response to root applied glyphosate. Frequency and the degree of injury, however, was dependent upon the presence or absence of soil as a growing medium, type of treated plant, rate of application and the time interval between application and tillage. It is apparent, therefore, that an interaction of factors was significant in terms of producing meaningful injury in the field. Producers who use the chemical and who have cause to suspect glyphosate injury can utilize the results of this report to substantiate or refute their suspicions. Abnormalities other than those identified in this report would require further investigation for elucidation of their causes.

Table I. The survival of test plants grown in a medium composed of glyphosate-treated quackgrass clippings incorporated into clay loam field soil.

Plant Survival After Four Weeks a/

Rate of glyphosate kg ai/ka	Privet			Apple			Plum			Cherry		
	Days between application and tillage											
	0	1	3	0	1	3	0	1	3	0	1	3
0	0	1	0	0	1	1	1	0	1	2	1	0
2.24	0	0	1	0	0	1	2	3	0	0	3	1
4.49	0	0	0	1	0	0	3	0	3	3	1	1
8.98	0	0	0	0	0	0	3	3	3	3	2	3

a/ data represents number of plants dead after four weeks out of a total of 3 plants per treatment.

Table II: Number of live plants which showed glyphosate induced injury after four weeks in growing medium consisting of treated quackgrass incorporated into clay loam field soil.

Plants Showing Glyphosate Injury After Four Weeks

Rate of glyphosate kg ai/ha	Privet			Apple			Plum			Cherry		
	Days between application and tillage											
	0	1	3	0	1	3	0	1	3	0	1	3
0	0	0	0	0	0	0	0	0	0	0	0	0
2.24	0	0	1	0	1	0	1	0	1	0	0	2
4.49	0	1	0	1	3	0	1 a/	2	1 a/	0	2	2
8.98	2	0	1	1	1	1	1 a/	0	1 a/	1 a/	2 a/	1 a/

a/ showed glyphosate injury after 2 weeks but eventually died.

Table III: Survival of test plants grown in field plot experiment, Dansville, N.Y. in Summer 1978. Dormant plants placed in glyphosate treated quackgrass plus soil.

Plant Survival After Two Months a/

Rate of Glyphosate b/ kg ai/ha	Privet	Apple	Plum	Cherry
0	0	3	9	9
2.24	0	8	10	6
4.49	2	6	2	12
8.98	0	3	1	11

a/ number of dead plants out of a total of twelve plants per treatment.
b/ there was no time interval between spray application, tillage and planting.

Table IV: Number of live plants which showed glyphosate induced injury after two months in treated quackgrass plots at Dansville, N.Y., Summer 1978.

Plants Showing Glyphosate Injury

Rate of glyphosate kg ai/ha	Privet	Apple	Plum	Cherry
0	0	0	0	0
2.24	0	5 a/	3 a/	2
4.49	1	5	1	2 a/
8.98	0	4	0	2 a/

a/ total includes plants which showed initial glyphosate injury but subsequently died after four weeks.

AN EVALUATION OF GLYPHOSATE USED ON SHADE TREES AND EVERGREEN LINERS

C. Haramaki and L. Kuhns[1]

ABSTRACT

After two growing seasons honeylocust, pin oak, red maple, red oak, and sugar maple trees continued to show little or no difference in growth due to glyphosate and simazine applications. Applications of glyphosate alone severely reduced weed populations especially grasses. These sprayed areas were soon infested with other broadleaf weeds such as purslane speedwell which were not originally present. Established liners of red bearberry, Japanese holly, Blueberry juniper and Savin juniper showed little or no increase in damage three months after spraying with glyphosate.

INTRODUCTION

Glyphosate is a post-emergence, translocated herbicide with a low danger of toxicity to humans and no residual effects in the soil. It has the potential to be an outstanding herbicide for use in nursery and landscape plantings and will undoubtedly be in use in the near future. Before it can be used safely though, effective application rates and phytotoxicity to commonly grown ornamental plants must be determined. The objectives of this experiment were to evaluate the weed control provided by a range of application rates and to determine if any of the rates were toxic to liners of some commonly grown shade trees or evergreens.

METHODS AND MATERIALS

The part of the study including shade trees was conducted at the nursery of the State Correctional Institution at Rockview, Bellefonte, Pennsylvania. In June, 1977 established plantings of honeylocust (Gleditsia triacanthos L.), pin oak (Quercus palustris Muenchh), red maple (Acer rubrum L.), red oak (Quercus rubra Duroi), and sugar maple (Acer saccharum Marsh.) were sprayed with glyphosate (N-(phosphonomethyl) glycine) alone at 1, 2, and 4 pounds per acre or a mixture of glyphosate and simazine (2-chloro-4,6-bis (ethylamino)-S-triazine) at 0+2, 2+2, and 4+2 pounds per acre (1). There were 3 or 4 trees per plot and each treatment was replicated 3 times for each species.

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At the end of the first growing season no leaf, twig, bark, or trunk growth differences were observed between the untreated controls and any herbicide treatments on any of the trees. Diameter measurements were recorded in September, 1977 and November, 1978 and growth increases were determined for each species and treatment to determine if there were any latent effects of the herbicide on tree growth.

A heavily weed-infested established planting of red bearberry (Arcostaphylos uva-ursi Spreng), convexleaf Japanese holly (Ilex crenata convexa Thunb.), Bluerug juniper (Juniperus horizontalis wiltoni Moench), and Savin juniper (Juniperus sabina L.), located at The Pennsylvania State University Agricultural Research Center at Rock Springs, was used for the remainder of the study. Two days prior to spraying the planting was mowed to a height of six inches to allow penetration of the herbicide to the plants. On July 11, 1978 glyphosate was applied to the 270 square foot plots at 1, 2, 4, and 8 pounds per acre with a CO_2 pressurized broadcast sprayer using 20 psi at the rate of 40 gallons per acre through LP 8002 nozzles fitted with 50 mesh screens. The weather was sunny with a few clouds and a 5-mile per hour wind. Temperatures were 78°F for the air, 81°F at the soil surface, and 79°F two inches below the surface. Treatments and controls were replicated 4 times. Weed and crop injury ratings were recorded the day before spraying and 3 months after spraying. Crop injury ratings were required at the beginning of the study because of damage incurred during mowing.

RESULTS AND DISCUSSION

Examination of the leaves, twigs, and trunks of the shade trees in the summer and fall of the second growing season after application of the glyphosate and simazine did not reveal any differences between treatments. Measurement of the increase in trunk diameters showed the herbicide treatments had little or no effect on trunk growth (Table 1).

Table 1. Trunk Diameter Growth in Inches During Second Growing Season after Treatment, 1978.

Treatment		Honey Locust	Pin Oak	Red Maple	Red Oak	Sugar Maple	Mean
Check		0.29	0.38	0.35	0.34	0.25	0.32
Glyphosate	1#/A	0.36	0.31	0.25	0.42	0.28	0.32
Glyphosate	2#/A	0.42	0.39	0.29	0.31	0.18	0.32
Glyphosate	4#/A	0.39	0.39	0.42	0.28	0.41	0.38
Simazine	2#/A	0.21	0.44	0.30	0.43	0.29	0.33
Glyphosate + Simazine	1#/A 2#/A	0.33	0.50	0.33	0.33	0.25	0.35
Glyphosate + Simazine	2#/A 2#/A	0.50	0.35	0.38	0.31	0.23	0.35
Glyphosate + Simazine	4#/A 2#/A	0.33	0.25	0.27	0.69	0.32	0.37

Table 2. Effect of broadcast sprays of glyphosate on established weeds three months after application, 1978.

Rate of Application	Grasses Oct. 11	Broadleaves Oct. 11	Overall Oct. 11
Check	3.50	4.33	7.83
1/2#/A	1.08	4.31	5.42
1#/A	1.25	4.75	6.00
2#/A	1.08	4.25	5.33
4#/A	0.58	4.83	5.42

0 = no weeds; 10 = 100% weed coverage.

At the time of glyphosate application the planting of evergreen liners was infested with the following weeds, in decreasing order of frequency: yellow foxtail (Setaria lutescens Hubb.), green foxtail (Setaria virdis Beauv.) common dandelion (Taraxacum officinale Weber), witchgrass (Panicum capillare L.), common ragweed (Ambrosia artemisifolia L.), yellow woodsorrel (Oxalis stricta L.), annual fleabane (Erigeron annuus Pers.), and Canada thistle (Circium arvense Scop.). One month after treatment weed control was excellent in the plots treated with 2 and 4 pounds of glyphosate per acre. But the plots were reinfested with weeds and after 3 months the weed population had changed so that the following weeds were present, in decreasing order of frequency: purslane speedwell (Veronica peregrina L.), redroot pigweed (Amaranthus retroflexus L.), common yarrow (Achillea millefolium L.), common lambsquarters (Chenopodium alba L.), common dandelion, thymeleaf sandwort (Arenaria serpyllifolia L.), and witchgrass. After 3 months the grass population remained low, but the broadleaved weed population was high again (Table 2) mainly because the treated plots were covered with small purslane speedwell seedlings. This demonstrates the importance of combining a pre-emergence herbicide with post emergence herbicides if lont-term control is desired.

The Japanese holly and Savin juniper liners were injured by the mowing prior to the glyphosate application, with the edges of the leaves becoming necrotic. Because of its low growth habit red bearberry, Bluerug juniper received little or no mower injury. Three months after treatment there was a very small increase in the injury ratings of the bearberry, holly, and Bluerug juniper (Table 3), indicating the glyphosate treatments were slightly phytotoxic to those varieties. The Savin junipers grew out of the mower injury and had a reduced injury rating, suggesting it is tolerant of glyphosate at the rates used.

Considering the value of glyphosate in eliminating hard to control weeds from existing nursery and landscape plantings, the limited amount of phytotoxicity observed is well within tolerable limits.

Table 3. Effect of broadcast sprays of glyphosate on established evergreen liners, three months after application, 1978.

Rate of Application	Bearberry		Japanese Holly		Bluerug Juniper		Savin Juniper	
	7/10	10/11	7/10	10/11	7/10	10/11	7/10	10/11
Check	2.18	1.97	2.05	1.93	0.54	1.25	1.58	1.42
1/2#/A	1.72	2.19	1.84	1.86	0.50	1.00	1.75	1.27
1#/A	2.18	2.64	0.88	1.67	0.46	0.98	1.42	1.17
2#/A	2.40	2.44	1.83	2.28	0.48	1.00	1.44	1.25
4#/A	1.61	2.36	1.82	2.43	0.33	0.75	1.69	1.46

0 = no injury; 5 = Dead.

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APPLICATION OF GLYPHOSATE TO THE STEMS OF SYCAMORE TREES

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ABSTRACT

Glyphosate has been used experimentally as a directed spray to kill perennial weeds in tree plantings for several years. There have been many reports of its safe use, although sprays on newly cut surfaces or sufficient foliage of basal sprouts can cause injury. A New York State extension agent reported to the authors that there may have been injury to sycamore (London plane) trees (Platanus acerifolia) by a spray of glyphosate on the bark.

On July 26 in a nursery area with London plane trees 2-8 inches in diameter, just exfoliating bark and full of weeds, sprays of glyphosate were made at 2, 4 and 8 lb/A on 10 x 15 ft plots each including several trees. The weeds and the tree trunks from soil level to 4 feet above were thoroughly wetted.

Observations on October 2 showed no injury to bark or foliage of any of the treated trees. The weeds were mostly dead.

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HERBICIDES FOR GROUND COVER PLANTINGS

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ABSTRACT

Newly planted ground covers of myrtle (Vinca minor L.), pachysandra (Pachysandra terminalis), English ivy (Hedera helix L.'Thorndale'), and wintercreeper (Euonymus fortunei 'Sarcoxie') were treated with preemergence and postemergence herbicides that were reapplied the following spring. Five hand weedings in the untreated plots over the two seasons required an estimated 1373 man hours of labor per acre. The preemergence treatments reduced hand weeding by over 90% the first year and 85% the second.

Simazine WP at 1.5 lb/A the first year and 2 lb/A the second did not seriously injure any of the ground covers, but double rates excessively injured pachysandra and wintercreeper. Granular napropamide at 4 or 8 lb/A caused no injury the first year, but at 8 lb/A the second year, injured myrtle and pachysandra. Oryzalin WP at 1.5 lb/A reduced the vigor of myrtle during the first year, but when reapplied at 2 lb/A did not cause serious injury during the second year. Double rates excessively injured myrtle and pachysandra. A combination of simazine and oryzalin at .75 + 1.5 lb/A the first year followed by 1+2 lb/A the second, caused more injury to myrtle and pachysandra than either herbicide alone.

INTRODUCTION

During the first two years of establishment, weeds in ground covers are very competitive and must be removed manually. Several herbicides have been evaluated for use in ground covers (5,6,7). English ivy, pachysandra, myrtle and wintercreeper are among the most popular ground covers in New England, because of their hardiness and handsome foliage. Simazine (2,chloro-4,6-bis-=ethylamino-s-triazine) has been used at low rates with little or no injury in all of these except certain cultivars of Euonymus (5,6,7), but sometimes other herbicides are desired for greater safety around turfgrass areas, more effective control of annual grasses, or to remove established weeds that escape. Oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide), napropamide (2-(α-naph=thoxy)-N,N-diethylpropionamide), and asulam (methyl sulfanilycarbamate) have proven useful in ornamental nurseries, but have not been widely tested in these ground covers (1,2). Tolerance of English ivy and Euonymus for napropamide and asulam has been reported (1,3,4).

The purpose of this experiment was to evaluate tolerance of the ground covers for oryzalin, napropamide, and asulam over the first two years of establishment. We also attempted to obtain information on labor requirements for hand weeding of ground covers.

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MATERIALS AND METHODS

Plants of four ground covers were transplanted into 6 ft x 10 ft plots in prepared Merrimac sandy loam soil in Windsor, CT between June 24 and July 1, 1977. The plots were arranged in randomized complete blocks with four replicates and 10 plots per replicate. The plants and numbers per plot included: eight or nine rooted cuttings of pachysandra, three or four separations of myrtle, and three rooted cuttings each of English ivy (Hedera helix L.'Thorndale'), and wintercreeper (Euonymus fortunei 'Sarcoxie'). Untreated border areas separated the plots.

On July 7, 1977, simazine, oryzalin and asulam were applied, alone or in combination, using a knapsack sprayer calibrated to deliver 36 gal/A. Sprays of asulam and oryzalin on the same plots were applied separately. Granular napropamide was applied with a calibrated auger-feed applicator. Plots except those receiving asulam were hand tilled and weeded before treatment. The asulam plots contained crabgrasses (Digitaria spp.) 1/2-3 in, purslane (Portulaca oleracea L.) 1/2 in, and carpetweed (Mollugo verticillata L.) 1/2 in. A light rain fell during the night of July 7 and the plots were irrigated 1/2 in on July 11, 1977, and occasionally during the 1977 season. On July 18, 1977 and again in June, 1978, we applied a 12-8-8 fertilizer at 330 lb/A, followed by 1 in of irrigation.

Visual weed control and injury ratings were made in August and September, 1977 on a scale of 0 to 10, with 0 being no control or injury and 10 being complete control or all plants dead. At each date, weeding times also were taken in 5 sq ft areas of each plot and then all weeds were removed from the plots. Vigor of myrtle and English ivy was rated visually in December, 1977.

On April 20, 1978, all herbicides were reapplied. Rosettes of horseweed (Erigeron canadensis L.) were present in many plots at retreatment, and mouseear chickweed (Cerastium vulgatum L.) was emerging in plots previously treated with asulam. Ratings of weed control and injury were made in June, July, and October, 1978, and weeding times were obtained on whole plots in June and July. In October, 1978, we counted the surviving plants and visually rated the vigor of each plant. English ivy suffered severe winter injury and could not be evaluated in 1978.

RESULTS AND DISCUSSION

Not counting the initial weeding on July 7, 1977, two handweedings in untreated plots required the equivalent of 526 man hours of labor per acre during 1977 (Table 1) and 697 man hours in 1978 (Table 2). To this we can add the estimated time for another required weeding in October, 1978. Based on the weeding times required for September, 1977, this could equal another 150 man hours per acre. Thus, over the two year span, a total of 1373 man hours of labor per acre were required to weed the untreated ground covers. At $3 per hour, the weeding cost would be $4119 per acre for the 2 years, or an average of $2059 per acre per year.

Weeds in the untreated plots greatly reduced the vigor of ground cover plants. Plants injured by herbicides early in the season often were more vigorous than untreated plants in the fall.

The preemergence treatments reduced hand weeding by over 90% in 1977, and 85% in 1978. Asulam alone controlled seedling crabgrass and horseweed, but did not control carpetweed, purslane and mouseear chickweed, or provide residual control. Therefore, asulam alone did not greatly reduce total weed populations and weeding times. Combining asulam with oryzalin killed established carpetweed, gave residual control, and greatly reduced weeding times.

Asulam at 4.5 lb/A in 1977 caused tolerable injury to myrtle and English ivy and no injury to pachysandra or wintercreeper. A few shoot tips of myrtle and English ivy were killed, but regrowth was normal. Injury in 1978 was tolerable on all plants. Asulam at 3 lb/A plus oryzalin at 1.5 lb/A, like oryzalin alone, significantly reduced the vigor of myrtle during the first year. The second application of asulam at 3 lb/A + oryzalin at 2 lb/A, caused greater mortality in pachysandra and more injury in myrtle than asulam or oryzalin alone.

Simazine gave excellent weed control and did not injure English ivy or myrtle, but caused chlorosis on leaf edges of pachysandra and wintercreeper. Injury to both from simazine at 4 lb/A was unacceptable during the second season, but injury at 2 lb/A was temporary. Vigor ratings of plants in plots treated with the low rates of simazine were in all cases higher than in control plots.

Oryzalin at 1.5 gave excellent control of weeds in 1977, but significantly reduced the vigor of myrtle. These effects were not evident at the end of 1978 when vigor of the myrtle with oryzalin at 2 lb/A was better than in control plots. At 3 lb/A in 1977, followed by 4 lb/A in 1978, oryzalin controlled most weeds except dandelion (Taraxacum officinale Weber), and yellow rocket (Barbarea vulgaris R.Br.), but caused stem girdling on pachysandra and excessive injury to myrtle.

Simazine at .75 lb/A plus oryzalin at 1.5 lb/A, like oryzalin alone, injured myrtle the first year. When reapplied a second year at 1 + 2 lb/A, this combination injured myrtle more than did oryzalin or simazine alone at similar rates and increased the mortality of pachysandra.

Napropamide at 4 lb/A failed to control horseweed and dandelion, but reduced weeding times by about 90% and caused no significant injury over the two year period. At 8 lb/A, napropamide gave improved weed control, but also injured myrtle excessively and reduced the stand of pachysandra during the second season.

This experiment indicates that low dosages of simazine or napropamide can effectively reduce weeding with small effects on the four ground cover plantings, but that double rates can cause excessive injury. Myrtle appears sensitive to oryzalin in the planting year, but wintercreeper, English ivy, and pachysandra all appear tolerant of oryzalin at 1.5 lb/A. Asulam also can be a useful tool to control certain established weeds, but preemergence herbicides that are used in combination with asulam must be evaluated further. In practice, asulam would probably be used to remove weeds that escape a preemergence treatment and plant injury might be less than where two herbicides are applied at the same time.

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Table 1. Weed control one and two months after treatment in 1977.

Treatment, rate, lb/A ai		Weed control ratings 0-10: crabgrass 8/14	crabgrass 9/14	carpetweed 8/4	carpetweed 9/14	purslane 8/4	purslane 9/14	All weeds 9/14	Weeding times in seconds 1/: 8/4	Weeding times in seconds 1/: 9/15
untreated		0	0	0	0	0	0	0	160.5 2/	57.5 3/
Preemergence treatments										
simazine WP	1.5	9.5	9.8	10	10	10	10	9.7	0	0.5
	3.0	9.9	9.9	10	10	10	10	9.9	1.5	0.0
oryzalin WP	1.5	8.6	9.9	9.8	10	9.8	9.1	9.1	9.6	3.0
	3.0	9.1	9.9	10	10	9.9	9.4	9.6	3.0	1.3
napropamide 10G	4.0	8.9	9.8	9.4	9.5	9.5	8.9	9.2	9.6	3.8
	8.0	9.6	9.8	9.9	9.5	9.6	8.6	9.1	5.0	4.8
simazine+ oryzalin	.75+ 1.5	9.8	9.8	10	10	10	10	9.7	2.5	1.5
Postemergence treatments										
asulam	4.5	10	6.3	0	2.5	2.8	0	0	222.0	47.5
asulam+ oryzalin	3.0+ 1.5	9.9	9.9	9.9	10	3.8	5.8	7.9	31.0	11.5

1/ Average time for one person to pull weeds in a 1 x 5 ft area (5 sq ft) in each plot.
2/ Equivalent to 387 man hours per acre.
3/ Equivalent to 139 man hours per acre.

Table 2. Effects of herbicides on injury and vigor ratings in 1977.

Treatment, rate, lb/A, ai		Injury ratings 1/: Pachysandra 8/4	Pachysandra 9/14	Vinca 8/4	Vinca 9/14	Euonymus 8/4	Euonymus 9/14	Hedera 8/4	Hedera 9/14	Vigor ratings 0-10 2/ 12/2: Vinca	Vigor ratings 0-10 2/ 12/2: Ivy
untreated		0	0	0	0	0	0	0	0	8.8	8.8
Preemergence treatments											
simazine WP	1.5	1.3	1.0	0	0	2.8	0.5	0	0	7.8	8.5
	3.0	2.0	1.5	0	0	3.8	2.0	0.3	0	8.0	8.8
oryzalin WP	1.5	0	0	0	0.3	0	0	0	0	6.5	9.0
	3.0	0	0	0.5	0.5	0	0	0	0	6.3	8.5
napropamide 10G	4.0	0	0	0	0	0	0	0	0	9.0	8.3
	8.0	0.3	0.5	0	0.3	0	0	0	0	8.3	9.0
simazine+ oryzalin	.75+ 1.5	0.3	0.3	1.0	1.0	0.8	0	0	0	4.5	8.8
Postemergence treatments											
asulam	4.5	0	0	0.8	2.0	0	0	1.3	0	9.0	8.5
asulam+ oryzalin	3.0+ 1.5	0.3	0.3	1.5	3.3	0.3	0.8	0.5	0.3	4.5	8.3
L.S.D. p = .05										2.1	NS
p = .01										2.8	

1/ 0 = no injury, 10 = dead plants.
2/ 0 = dead plants, 10 = most vigorous.

Table 3. Effects of herbicides on weed control and weeding times during 1978.

Herbicide	Rate, ai lb/A '77	Rate, ai lb/A '78	Ratings[1/] 6/16 All weeds	Horse-weed	mouse-ear	Crab-grass	% Reduction in weeding time 6/18	7/31	Rating[1/] all weeds 10/6
untreated			0	0	0	0	0[2/]	0[3/]	0
simazine WP	1.5	2.0	9.6	10.0	10.0	10.0	98.1	96.4	8.9
	3.0	4.0	9.9	10.0	10.0	10.0	99.9	99.9	9.6
oryzalin WP	1.5	2.0	7.5	7.1	9.8	10.0	87.1	84.6	6.5
	3.0	4.0	9.4	9.5	10.0	10.0	96.6	93.9	8.8
napropamide,G	4.0	4.0	7.5	4.8	10.0	10.0	89.8	87.0	7.0
	8.0	8.0	9.0	8.4	10.0	10.0	95.8	94.8	8.8
simazine+ oryzalin	.75+ 1.5	1.0+ 2.0	9.5	9.8	10.0	10.0	96.6	95.1	9.4
asulam	4.5	4.5	6.5	10.0	5.0	9.9	55.8	0	0
asulam+ oryzalin	3.0+ 1.5	3.0+ 2.0	9.7	10.0	10.0	10.0	98.6	94.6	7.8

1/ 0 = no control, 10 = 100% control.
2/ Weeding time in controls averaged 26.34 min per plot or 319 man hours per acre.
3/ Weeding time in controls averaged 31.85 min per plot or 378 man hours per acre.

Table 4. Effects of herbicides on injury[1/], survival[2/], and vigor[3/] of ground covers-1978.

Herbicide	Rate, ai, lb/A '77	Rate, ai, lb/A '78	Pachysandra 7/10 injury	Pachysandra 10/6 No. live	Pachysandra vigor	Vinca 7/10 injury	Vinca 10/6 No. live	Vinca vigor	Euonymus 7/10 injury	Euonymus 10/6 No. live	Euonymus vigor
untreated			0.5	6.3	6.3	2.3	3.8	5.5	0.8	3.0	5.5
simazine, WP	1.5	2.0	3.0	6.5	8.8	2.8	3.5	7.5	2.8	3.0	6.5
	2.0	4.0	5.8	4.5	6.0	1.0	4.0	10.0	3.8	3.0	6.8
oryzalin, WP	1.5	2.0	0.3	6.5	9.5	3.8	3.8	6.5	0.3	3.0	7.5
	3.0	4.0	5.3	3.0	7.8	5.3	3.3	4.8	1.0	2.8	8.3
napropamide,G	4.0	4.0	1.8	5.0	8.5	2.5	3.5	7.5	0.8	2.8	7.3
	8.0	8.0	4.0	3.5	8.5	4.0	2.8	6.0	0.8	3.0	7.5
simazine+ oryzalin	0.75 1.5	1.0+ 2.0	2.3	4.3	8.8	5.0	2.5	6.8	0.5	3.0	9.8
asulam	4.5	4.5	1.0	7.8	6.0	1.5	4.0	6.8	1.8	3.0	5.5
asulam+ oryzalin	3.0+ 1.5	3.0+ 2.0	3.8	4.0	7.0	6.3	2.3	6.8	1.3	3.0	9.0
L.S.D. p = .05				1.9	1.8			NS			2.1

1/ 0 = no injury, 10 = all plants dead.
2/ Maximum number of surviving plants for pachysandra - 8.8, vinca - 4, euonymus - 3.
3/ 0 = dead plants, 10 = most vigorous.

HERBICIDE COMBINATIONS FOR USE IN ESTABLISHING AND MAINTAINING WOODY NURSERY PLANTS

J. Ray Frank and J. A. King[1/]

ABSTRACT

Field experiments were conducted during 1976, 1977, and 1978 to develop a program for full season weed control in newly planted and established woody nurseries.

Early season applications of alachlor and alachlor-simazine combinations were followed by a directed spray application of glyphosate or paraquat. Treatments included alachlor as an emulsifiable concentrate or granular formulation at 3.4, 4.5, and 6.7 kg/ha. Alachlor EC at 3.4 and 4.5 kg/ha was also used in combination with simazine at 2.2 kg/ha. The alachlor-simazine combination was used alone; followed by a glyphosate treatment within 7 days at 2.2, 4.5, 5.6, 9.0 kg/ha; or paraquat at 0.56, 1.1, 2.2 kg/ha. Woody plants included for these tests were: Hicks yew, dwarf Japanese yew, boxleaf Japanese holly, Heller's Japanese holly, Kurume azalea Hershey Red, and Andorra juniper.

During 1976 all compounds were applied late in the growing season. The weed cover at 25 days (8/6) was reduced 17% in plots treated with alachlor granular at 6.7 kg/ha (Table 1). The alachlor-simazine combination followed by glyphosate at 4.5 or 5.6 kg/ha reduced the weed cover by 44% after 90 days (10/12).

A reduction in weed cover of 73% was observed 42 days (6/27) after the 1977 application of the alachlor-simazine combination with a follow-up treatment of glyphosate at 4.5 or 9.0 kg/ha. Glyphosate alone at the same rates reduced the weed cover by 55 and 50%, respectively. The reduction in weed cover at 75 days (7/25) in plots treated with alachlor and simazine with a following glyphosate treatment at all rates was between 30 and 35% while no significant reduction in weed cover was observed in plots treated with glyphosate alone. At 100 days (9/2) the alachlor-simazine combination with glyphosate at 4.5 kg/ha was the most effective treatment with a weed cover reduction of nearly 20%.

During 1978 the alachlor-simazine combination with glyphosate as a follow-up treatment reduced the weed cover from 85 to 90% after 10 days (6/26). The weed cover for the same plots observed after 50 days (7/21) was 57 to 62% and 25 to 30% of the control after 80 days (8/18). This study indicates that an alachlor-simazine (4.5 + 2.2 kg/ha) application with glyphosate at each rate will provide significant reduction of weed cover for up to 80 days.

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Table 1. Effect of alachlor, simazine, glyphosate, and paraquat on % weed cover in woody nursery plantings.[a]

Treatment (kg/ha)	1976			1977			1978		
	7/20	8/6	10/12	6/27	7/25	9/2	6/26	7/21	8/18
Untreated control	72	84	93	88	86	89	96	99	98
Alachlor EC 3.4	35*	85	93	62	81	86	39*	69*	89*
Alachlor EC 4.5	26*	80	89	66	70	74*	48*	73*	83*
Alachlor EC 6.7	46*	78	86	64	70	80	27*	67*	81*
Alachlor gran. 3.4	50	80	90	69	74	81	52*	75*	86*
Alachlor gran. 4.5	70	87	83	61	68*	75	41*	76*	89*
Alachlor gran. 6.7	44*	67*	85	54	68*	73*	32*	65*	80*
Alachlor 3.4 + simazine 2.2	43*	80	89	63	70	76	19*	63*	82*
Alachlor 4.5 + simazine 2.2	58	74	85	66	68*	79	13*	55*	80*
Alachlor 3.4 + simazine 2.2 + glyphosate 2.2	38*	67*	65*	20*	48*	90	7*	37*	66*
Alachlor 3.4 + simazine 2.2 + glyphosate 4.5	40*	44*	49*	15*	50*	70*	10*	42*	67*
Alachlor 3.4 + simazine 2.2 + glyphosate 5.6 (9.0)[b]	40*	66*	49*	15*	57*	77	8*	40*	71*
Alachlor 3.4 + simazine 2.2 + paraquat 0.56	33*	54*	74*	52*	67*	82	15*	52*	75*
Alachlor 3.4 + simazine 2.2 + paraquat 1.1	27*	63*	73*	52*	67*	79	14*	50*	69*
Alachlor 3.4 + simazine 2.2 + paraquat 2.2	24*	51*	68*	51*	65*	82	15*	62*	79*
Glyphosate 2.2	45*	49*	81*	50*	77	85	83*	95	99
Glyphosate 4.5	18*	31*	73*	33*	78	88	77*	96	99
Glyphosate 5.6 (9.0)[b]	36*	27*	72*	38*	71	80	81*	96	99
Paraquat 0.56	61	81	86	83	80	85	82*	98	96
Paraquat 1.1	36*	80	89	81	87	94	78*	94	96
Paraquat 2.2	35*	58*	87	77	82	89	84*	95	98

[a]Herbicide application dates: 1) July 13, August 4, 1976; 2) May 16, 1977; and 3) June 5-7, June 15 & 16, 1978.
[b]5.6 kg/ha rate used in 1976; 9.0 kg/ha used in 1977, 1978.
*Indicates significance within columns when compared to control at the 5% level using the Duncan multiple range test.

THE EFFECT OF PREEMERGENCE POSTPLANT TREATMENTS OF ALACHLOR, NAPROPAMIDE, OXADIAZON, OXYFLUORFEN AND PRODIAMINE ON GLADIOLUS

Arthur Bing[1/]

ABSTRACT

Napropamide up to 16 lb/A and prodiamine at 2 and 4 lb/A were safe on gladiolus. Oxadiazon and oxyfluorfen caused leaf burn and greatly reduced the production of gladiolus corms from cormels. Alachlor reduced corm production from cormels and reduced cut flower yield from small corms.

INTRODUCTION

Gladiolus for cut flowers are grown commercially from corms. Corms for cut flower production are replenished by growing new corms from cormels, which are the small structures that are attached to the corm and harvested with them.

Weed competition reduces production of cut flowers and corms. Sensitivity to herbicidal treatments is greater in a planting of cormels than of corms. Cormels are planted 2-3 inches deep and corms 4-6 inches. Since foliage from cormels emerges later and is smaller than foliage from corms, it is affected more by weed competition.

The normal procedure is to plant gladiolus corms or cormels in a shallow trench, then cover with a hill of soil over the row. Before emergence, the hill is raked or harrowed nearly level and preemergence herbicides applied. Once flower spikes appear, it is too late to cultivate. The last herbicidal treatment should be made before "spiking".

In addition to seedling weeds, nutsedge is a major problem in gladiolus. Nutsedge nutlets are similar in size to gladiolus cormels and are easily harvested and planted with them.

In previously reported experiments, Bing (2) (3) found napropamide (2-(α-naphthoxy)-N,N-diethylpropionamide) fairly effective against seedling weeds and safe on cormel plantings. Ahrens (1) found napropamide at 3 lb/A to be safe to use in cormel plantings and to give about one month control of yellow nutsedge. At 6 lb/A control was effective for about two months, but in one trial was injurious to a planting of cormels of variety White Friendship. Alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide) (4 lb/A) gives some control of nutsedge but Bing (3) reported injury to cormels at higher rates. In Florida where nutsedge is a costly problem, alachlor is used occasionally on plantings of large flowering size corms. Oxadiazon (2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one), prodiamine (N^3,N^3-Di-n-propyl-2,4-dinitro-6-trifluoromethyl-m-phenylenediamine) and oxyfluorfen (2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene)

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have been fairly effective herbicides on nursery plants in containers and in the field, and they may be useful on gladiolus. There is considerable interest in safer more efficient preemergence herbicides, especially ones that show activity against yellow nutsedge.

MATERIALS AND METHODS

Each of the 40 herbicidal plots consisted of four 10-ft rows 3 ft apart, 8 ft was planted and 2 ft not planted. The first row in each plot was planted with 50 small (3/8-1/2 inch diameter) gladiolus corms variety T950 on May 10. On May 12 the second row was planted with 1000 cormels (determined by weight) variety Pink Romance. The third and fourth row was planted with cormels (1000) of varieties T210 and Cardinal, respectively, on May 20. Corms were planted about 3 inches deep in a staggered row and covered with excess soil formed into a hill. Cormels were scattered on the bottom of a trench 2 inches deep and 6 inches wide and covered the same as the corms. Early germinated weeds were killed when the plots were raked nearly level on May 30.

Preemergence treatments were applied on May 31 to each 120 sq ft plot (10 ft along the row and across all 4 rows 8 ft planted, 2 ft not planted). Granules were applied with a Harbor applicator and sprays with a handpumped pressure sprayer with a Tee Jet 65004 nozzle. There were 4 replicates of untreated, handweeded and napropamide treatments but only two of alachlor, oxadiazon, oxyfluorfen and prodiamine treatments. The handweeded plots were weeded and scuffle hoed nearly weekly from time of treatment to early September.

Observations on foliar injury were made on June 14. Weed control was evaluated by visual observations on July 18 using a rating scale of 10 for excellent control, 6-7 fair control to 1 for full of weeds. Ratings were made for overall weed control, control of grassy weeds, non-grassy weeds and for specific weeds that were prevalent: crabgrass (*Digitaria* sp.), yellow foxtail (*Setaria lutescens* (Weigel) Hubb.), common groundsel (*Senecio vulgaris* L.), common purslane (*Portulaca oleracea* L.), redroot pigweed (*Amaranthus retroflexus* L.), common lambsquarters (*Chenopodium album* L.) and common ragweed (*Ambrosia artemisiifolia* L.).

Cut flowers were harvested from the row of T590 corms from August 9 to September 11. Only the number of spikes were recorded. The plants of Pink Romance were dug September 20-22, tops removed and the corms and cormels that clung to the corms from each lot were put in separate screen bottomed trays. Varieties T210, Cardinal and T590 corms were harvested by October 5. All corms were washed and dried after digging and then stored at 75-85 °F until cleaned. The cleaned corms were graded according to size and weighed. Cormels also were weighed after debris and stones were removed.

RESULTS AND DISCUSSION

The weed control ratings in Table 1 show that napropamide was only partially effective against redrood pigweed at 2 and 4 lb/A only fair for

foxtail and groundsel. The other treatments were good to nearly excellent. There was severe leaf burn on the young foliage in some plots. Ratings of the damage were made on June 14 (Table 2) using a scale of 1 for no injury to 5 for severe injury. Pink Romance showed a slight tip burn in all plots. Oxadiazon and oxyfluorfen caused severe foliar burn from which the plants never recovered as shown by the low corm yield (Table 3).

Cut flower and corm yields from the small T590 corms are presented in Table 3. The most noticeable yield reduction in weight (560 g) and number of flowers cut (24) was from the 8 lb rate of alachlor.

The corm yield from the 3 varieties of cormels are also in Table 3. Letting the weeds grow until mid-July greatly reduced the yield of all varieties. Oxadiazon greatly reduced corm yield in all 3 varieties with Pink Romance going from 820 g in the handweeded down to 80 g and 114 g at the 2 and 4 lb rates. Alachlor reduced yield but to a lesser degree. Oxyfluorfen reduced the yield of Cardinal to 784 g and 27 g at the 2 and 4 lb rates, respectively. Napropamide caused no reduction in yield, which agrees with results in previous years (2) (3). Napropamide may be useful in gladiolus weed control but oxadiazon and oxyfluorfen are too phytotoxic.

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Table 1. Post plant preemergence weed control in gladiolus corms and cormels planted May 10-22, treated May 31 and rated on July 18, 1978 at Farmingdale, New York.

Treatment			Weed control ratings[a]									
Material	Rate ai/A	No. of replicates	General	Grasses	Non-grasses	Crabgrass	Foxtail	Groundsel	Purslane	Redroot	Lambsquarters	Ragweed
Untreated		4	2	4	3	5	6	9	9	4	6	9
Hand weeded		4	10	10	10	10	10	10	10	10	10	10
Napropamide 50WP	2	4	4	9	4	10	9	9	10	6	9	8
	4	4	6	9	6	10	10	10	10	6	9	8
	8	4	7	10	7	10	10	9	10	7	10	8
	16	4	8	10	8	10	10	10	10	8	10	8
Oxadiazon 2G	4	2	8	9	8	10	8	10	10	10	10	10
	8	2	9	10	9	10	10	10	10	10	10	10
Prodiamine 2G	2	2	6	7	6	9	8	8	10	10	9	10
	4	2	7	7	7	10	7	6	10	10	10	10
Alachlor 15G	4	2	8	10	8	10	10	10	10	10	10	8
	8	2	8	10	8	10	10	10	10	10	10	10
Oxyfluorfen 2G	2	2	8	8	9	8	10	10	10	10	9	10
	4	2	9	9	9	8	10	10	10	10	10	9

(a) Ratings are the average of replicates.
Ratings are 1 = full of weeds to 10 = no weeds.

Table 2. Leaf injury on gladiolus planted May 10 & 23 treated May 31 and observed June 14, 1978 at Farmingdale, New York.

Treatment			Degree of leaf burning[a]			
			Corms	Cormels		
Material	Rate ai/A	Replicates	T590	Pink Romance	T210	Cardinal
Untreated		4	1	2	1	1
Handweeded		4	1	2	1	1
Napropamide 50WP	2	4	1	2	1	1
	4	4	1	2	1	1
	8	4	1	2	1	1
	16	4	1	2	1	1
Oxadiazon 2G	4	2	3	5	5	3
	8	2	2	5	5	4
Prodiamine 2G	2	2	1	2	1	1
	4	2	1	2	1	1
Alachlor 15G	4	2	1	2	1	1
	8	2	1	2	1	1
Oxyfluorfen 2G	2	2	1	4	3	3
	4	2	4	5	5	5

(a) Ratings are the average of 4 replicates: 1 = none, 2 = none to slight, 3 = slight to some, 4 = some to severe, 5 = severe.

Table 3. The yield from corms and cormels planted May 10-20, treated preemergence May 31, cut flowers harvested August 9 - September 11 and corms dug September 20 to October 5, 1978 at Farmingdale, New York.

Treatment			Corm yield in grams from 1000 cormels			Yield from 50 corms variety T590		
Material	Rate ai/A	Replicates	Pink Romance	T 210	Cardinal	No. of cut flowers	No. of Corms	Wt of corms in grams
Untreated		4	485[a]	471	1110	28	41	684
Handweeded		4	820	1320[c]	2045	34	41	1186
Napropamide 50WP	2	4	790	868	1573	36	44	1113
	4	4	853	882	1941	36	43	1190
	8	4	899	1043	2308	48	44	1278
	16	4	940	1016	3131	38	44	1260
Oxadiazon 2G	4	2	80	354	624	36	47	1166
	8	2	114	238	233	37	45	1204
Prodiamine 2G	2	2	579	904	2335	34	50	1245
	4	2	677	1129	2038	39	41	1337
Alachlor 15G	4	2	390[b]	1171	833	37	46	1145
	8	2	268	253	1435	24	38	560
Oxyfluorfen 2G	2	2	49	164	784	30	43	1139
	4	2	5	277	27	30	39	1068

(a) average of replicates
(b) 1 replicate
(c) 3 replicates

CRABGRASS CONTROL WITH SINGLE AND SPLIT APPLICATIONS OF PREEMERGENCE HERBICIDES

T. L. Watschke, J. M. Duich, and M. S. Welterlen 1/

ABSTRACT

Seven herbicides were applied May 9, 1978, to Kentucky bluegrass and creeping red fescue turfs to determine their control of smooth crabgrass. The materials used were DCPA (75W and 5G), prosulfalin (50W), siduron (50W), bensulide (4EC and 3.6G), benefin (2.5G), butralin (2G), and pendimethalin (10G). Prosulfalin, DCPA, and siduron were also applied in split applications. With 90% control being used as an acceptable level of control, all treatments except the split application of siduron (8.96 + 6.72 kg/ha) and benefin (2.24 kg/ha) provided acceptable control in Kentucky bluegrass. In creeping red fescue, all materials gave an acceptable level of control. None of the treatments injured bluegrass, however, injury was noted on creeping red fescue. All formulations of DCPA injured red fescue, however the split application (8.4 + 5.6 kg/ha) of the 75W formulation caused less injury than the single application at 11.76 kg/ha. Injury from the granular formulation was not changed by making a split application.

INTRODUCTION

Preemergent control of smooth crabgrass Digitaria ischaemum (Schreb.) Muhl. has been shown to be virtually complete with a number of commercially available materials (1, 2, 3, 4, 5). Efficacy may vary for different formulations of the same chemical and injury to desired species may also be effected. Efficacy of experimental materials must be continually compared to commercially available standards as an aid in the formulation of future recommendations.

Lawn service firms have an interest in the effects of split applications of preemergence herbicides from the standpoint of reduced injury (especially for DCPA) and improved season long control.

The purpose of this research was to compare the efficacy and phytotoxicity of three experimental herbicides with four commercially available materials. Split applications of one experimental and two commercial materials were included as a comparison with single applications.

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MATERIALS AND METHODS

This research was conducted at The Joseph Valentine Turfgrass Research Center, The Pennsylvania State University. A twelve year-old-stand of Kentucky bluegrass (Poa pratensis L.) and a stand of creeping red fescue (Festuca rubra) the same age were treated on May 9, 1978 with seven herbicides. On June 9, 1978, a second application of four of the herbicides was made. The turf was maintained at a 3.2 cm cutting height and sufficient rainfall occurred to eliminate any need for supplemental irrigation. Significant germination did not occur until May 23, but was followed by more germination early in June. The crabgrass stand was variable across the test site ranging from nearly 100% to 35%. The experiment was designed with two replications of each treatment on each grass with an untreated control plot adjacent to each treatment. This design facilitated rating and eliminated the problem caused by the variable crabgrass stand.

Sprayed materials were applied to 0.9 by 7.3 m plots with a hand held boom sprayer, calibrated to deliver 709 L/ha. Granular formulations were applied to 1.2 by 1.8 m plots with a shaker bottle.

The materials used were; DCPA (dimethyl tetrachloroterephthalate) 5G and 75W, butralin [4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzamine] 2.3G, prosulfalin (N-[[4-(dipropylamino)-3,5-dinitrophenyl]sulfonyl]-S,S-dimethylsulfilimine) 50W, bensulide (0,0-diisopropylphosphorodithioate S-ester with N-(2-mercaptoethyl)benzenesulfonamide) 3.6G and 4EC, benefin (N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine) 2.5G, pendimethalin N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine, siduron 1-(2-methylcyclohexyl)-3-phenylurea. Application rates and dates appear in Table 1. Control and injury were rated on August 17, 1978.

RESULTS AND DISCUSSION

Both the single and split applications of prosulfalin gave excellent control of smooth crabgrass without injury to the desired turf (Table 1). The split application decreased the injury that has previously been reported on Kentucky bluegrass (1, 2, 5). Also, by making the second application within a month of the first, the level of control is comparable to a single application.

All formulations and applications of DCPA provided excellent control. All DCPA treatments injured creeping red fescue, however, the split application (8.4 + 5.6 kg/ha) of the 75W formulation caused less injury than the single application at 11.76 kg/ha. Injury from the granular formulation was not changed by making a split application.

A split application of siduron on bluegrass resulted in a less than satisfactory control. A single application at the recommended rate (13.44 kg/ha) however did provide acceptable control on both turfgrasses. Possibly the initial rate of the split application should have been higher, but only for application to bluegrass as the crabgrass control was 95% in creeping red fescue turf.

All formulations and rates of bensulide provided excellent control in both turfgrasses without injury in excess of five percent. The 8.4 kg/ha rate appeared sufficient for control from both formulations.

Benefin gave slightly less than acceptable control of crabgrass in Kentucky bluegrass, but was satisfactory in creeping red fescue (93%). However, injury to creeping red fescue was similar to that observed for the granular formulation of DCPA.

Butralin has consistently provided excellent crabgrass control in both turfgrasses (3, 4, 5) and continued to do so in 1978. No injury was noted on either bluegrass or creeping red fescue. At last report, the commercial marketing of this promising experimental material is still a remote possibility (6).

Pendimethalin, which is commercially labeled for agronomic crops showed excellent efficacy at both rates (2.24 and 3.36 kg/ha), without injury to either turfgrass. These low rates require a more dilute formulation than a 10G for proper distribution of particles.

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Table 1. Control and injury ratings for preemergence herbicides applied to Kentucky bluegrass and creeping red fescue for the control of smooth crabgrass. Herbicides were applied May 9, with some reapplications on June 9, 1978. Ratings were taken August 17, 1978.

Treatment	Formulation	Application Date	Rate kg/ha	% Crabgrass Control		% Injury*	
				KBG	CRF	KBG	CRF
Prosulfalin	50W	5/9 + 6/9	1.68 + 1.68	99	99	0	0
Prosulfalin	50W	5/9	2.8	96	97	0	0
DCPA	75W	5/9 + 6/9	8.4 + 5.6	97	99	0	15
DCPA	75W	5/9	11.76	97	99	0	23
DCPA	5G	5/9 + 6/9	8/4 + 5/6	95	95	0	15
DCPA	5G	5/9	11.76	98	97	0	13
Siduron	50W	5/9 + 6/0	8.96 + 6.72	80	95	0	SL
Siduron	50W	5/9	13.44	93	96	0	SL
Bensulide	4EC	5/9	8.4	95	95	0	SL
Bensulide	4EC	5/9	11.2	97	97	0	SL
Bensulide	3.6G	5/9	8.4	97	93	0	5
Bensulide	3.6G	5/9	11.2	99	98	0	0
Benefin	2.5G	5/9	2.24	88	93	0	13
Butralin	2G	5/9	4.48	98	90	0	0
Pendimethalin	10G	5/9	2.24	98	98	0	0
Pendimethalin	10G	5/9	3.36	99	97	0	0

*Injury refers to discoloration and/or thinning.

POSTEMERGENCE HERBICIDES FOR CRABGRASS AND NUTSEDGE CONTROL IN TURFGRASS [1/]

John A. Jagschitz [2/]

ABSTRACT

Tests were conducted to evaluate herbicides for postemergence control of smooth crabgrass and yellow nutsedge in Kentucky bluegrass turf. The effect of treatment date, number of treatments and time interval between treatments was also investigated. Effectiveness of treatments was based on weed control and degree of injury to turfgrass. Excellent crabgrass control with but slight grass injury was provided by certain 2 or 3 application treatments of DSMA and MSMA. A time interval greater than 2-weeks between applications resulted in poor control. Results were unsatisfactory using HOE-22870 and HOE-23408. Control of nutsedge was provided by certain treatments with bentazon, DSMA and MSMA. Less herbicide was required with treatments made in July than in June. Kentucky bluegrass was more tolerant to bentazon than methanearsonates. Spray mixtures of bentazon with either bromoxynil or DSMA were not antagonistic.

INTRODUCTION

Two troublesome weeds in turfgrass areas are smooth crabgrass [*Digitaria ischaemum* (Schreb.) Muhl.] and yellow nutsedge (*Cyperus esculentus* L.). Postemergence treatments with methanearsonates for selective control of these two weeds often cause some turfgrass injury and usually require two or more applications for effective results (1,2,3,4,5). To find more effective and safer control measures two tests were conducted in 1978. One test evaluated several formulations of methanearsonates (DSMA and MSMA) and two promising new herbicides, HOE-22870 and HOE-23408 (2,3,5) for crabgrass control. This test also included a study of the effect of number of treatments and time interval between treatments.

The second test was designed to evaluate herbicides for nutsedge control. Methanearsonate formulations and treatment times were compared with other promising materials. Bentazon [3-isopropyl-1*H*2,1,3-benzothiadiazin-(4) 3*H*-one 2,2-dioxide], a newer herbicide, has shown promise for selective nutsedge control (1,3,4). To find the most effective use of bentazon it was applied at three rates with several treatments and time intervals between treatments. It has been suggested that nutsedge is easier to control with midsummer rather than late spring treatments (4). Late June and late July treatments were compared. Spray compatability of bentazon with methanearsonates and bromoxynil (3,5-dibromo-4-hydroxybenzonitrile) was also studied.

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MATERIALS AND METHODS

The crabgrass test was conducted in 1978 on a practice football field at the University of Rhode Island. The turf was several years old and contained predominately Kentucky bluegrass (Poa pratensis L.). It was mowed at a height of about 1.5 inches and was watered when required to avert drought. At the time of the first treatment (July 12) crabgrass plants were in the 2 to 7 tiller stage. The herbicides, rates, treatment dates, treatment number and time interval between treatments are shown in Table 1. The granular (gran) material was applied by hand and the other herbicides were applied as sprays at the rate of 50 gallons of water per acre.

The nutsedge test was initiated in 1978 at a local sod farm (Kingston Turf Farm, West Kingston, R.I.). The turf was Kentucky bluegrass seeded the previous fall and maintained at a height of 2 inches. At the start of treatments (June 30) grass was tillering and grass cover was about 43%. Nutsedge plants had up to 15 blades with some plants sending out rhizomes. At this time about 44% of the total plants evident at the end of the test (August 28) had emerged. About 98% emergence took place by the second date treatments were started (July 21). The herbicides, rates, dates treatments started, number of treatments and time interval between treatments are shown in Table 2. All treatments were applied as sprays at the rate of 50 gallons of water per acre.

In both the crabgrass and nutsedge test the plot size was 4 by 5 feet with each treatment replicated three times. 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. Crabgrass control was determined on August 18 by comparing the crabgrass cover in each plot to that of untreated check plots (80% cover). Nutsedge control was based on plant counts in 15.75 sq ft of each plot at the start of the test (June 30) and at the conclusion of the test (August 28). Control was determined by comparing the initial and final counts adjusted to the changes in the untreated plots.

RESULTS AND DISCUSSION

Crabgrass control

The results with herbicides applied in 1978 for postemergence control of smooth crabgrass in Kentucky bluegrass are shown in Table 1. Excellent control (90-100%) with no objectionable grass injury (less than 2.0) was obtained with the following minimum treatments: three applications of granular DSMA (3 lb) and spray MSMA (1.5 lb) at 1-week intervals and two applications of spray DSMA (3.6 lb) at 1 and 2-week intervals. A third application of spray DSMA provided 3 to 9% additional control for a total of 99%. Objectional injury (2.3) from the three applications spaced 2-weeks apart was thought to be caused by temperatures near 90°F following the 3rd application. This was the only treatment applied this late in the test.

TABLE 1. Crabgrass control and turfgrass injury from various herbicides, rates, treatment number and time interval applied in 1978 to a football field containing chiefly Kentucky bluegrass.

Herbicide	Rate lb ai/A	Treatment Number	Treatment Interval in weeks	Percent Crabgrass Control[a]	Maximum Turfgrass Injury[b]
DSMA (gran)	3.0	3	1	99	1.1
DSMA	3.6	2	1	90	0.8
DSMA	3.6	2	2	96	0.7
DSMA	3.6	2	3	55	0.5
DSMA	3.6	3	1	99	1.4
DSMA	3.6	3	2	99	2.3
DSMA (201)	3.6	3	1	99	0.7
DSMA (301)	3.6	3	1	99	1.1
DSMA (401)	3.6	3	1	99	1.4
DSMA (501)	3.6	3	1	99	1.1
DSMA (601)	3.6	3	1	99	1.3
MSMA	1.5	2	1	88	0.9
MSMA	1.5	3	1	99	1.2
MSMA	2.0	3	1	99	1.0
HOE-22870	6.0	2	1	38	0.7
HOE-23408	1.0	1	0	22	0.2
HOE-23408	1.0	2	1	11	0.4
HOE-23408	2.0	1	0	25	1.0
HOE-23408	2.0	2	1	50	1.5
HOE-23408	4.0	1	0	31	2.7
HOE-23408	4.0	2	1	69	2.9
DSMA	3.6	3[c]	1	99	1.2
Bentazon	1.0	3[c]	1	0	0.0
DSMA + Bentazon	3.6+1.0	3[c]	1	98	1.5

a control based on 80% crabgrass cover in untreated plots on August 18.

b scale 0 - 10 (10 = brown) July through August.

c treatments started July 19, others July 12.

A time interval greater than 2-weeks between applications resulted in poor crabgrass control. Control from two applications of DSMA (3.6 lb) spaced 1 or 2-weeks apart was 90 to 96% while only 55% when spaced 3-weeks apart. Possibly crabgrass had a chance to recover during this lengthy time period. This could account for poor results in previous research (5) where the time interval approached 3-weeks.

The five spray formulations of DSMA (201, 301, etc) provided results similar to the standard material used in the rest of this test. Poor crabgrass control and/or objectionable turfgrass injury resulted through the use of bentazon, HOE-22870 and HOE-23408. In previous tests (2,4) HOE-22870 performed satisfactorily. The formulation of HOE-22870 used in this test was 5-years old and may have been the cause of the poor results. The spray mixture of DSMA plus bentazon was as effective as the DSMA alone. If desirable these two herbicides might possibly be tank mixed without the bentazon interfering with the action of DSMA on crabgrass.

Nutsedge control

The data from the postemergence nutsedge test are presented in Table 2. None of the bentazon treatments caused objectionable turfgrass injury. Single applications of bentazon at rates of .5, .75 and 1 lb were more effective when applied on July 21 compared to June 30. This supports earlier research (4) which showed less herbicide was required for control as the season progressed from late spring to midsummer. This same trend was also true for the single DSMA and MSMA treatments. The presence of nutsedge at the time of treatment could account for better results from later treatment. On the early treatment date (June 30) only 44% of the total population evident in August was present while on July 21 (later treatment date) 98% of the population was present. It is also possible that nutsedge is more susceptible to herbicides in the later season because in earlier research (4) maximum emergence had occurred prior to the time of early treatment.

A single, late application of bentazon at .75 or 1 lb or two applications, early or late, of .5, .75 or 1 lb at a 1-week interval provided 95% nutsedge control or better. The effect of varying the time interval from 1 to 4-weeks between applications was variable and inconclusive. Interpretation is difficult because better control could be due to late use as concluded earlier in this paper. Only obtaining 81% control from two applications of .5 lb at a 2-week interval might have been due to rainfall starting about 12 hours after the 2nd treatment.

Excellent nutsedge control was obtained from the following methanearsonate treatments: a single (3.6 lb) or double (1.8 lb) late application of DSMA, a single, late application of MSMA (1.5 lb) and two applications (early or late) of DSMA (3.6 lb). However, most treatments caused objectionable turfgrass injury. Greater grass injury following the late treatments was probably due to 90°F temperatures following treatment. The five formulations of DSMA (201, 301, etc) provided results very similar to the standard material.

TABLE 2. Effect of herbicides, rates and treatment number, time interval and dates on nutsedge control and turfgrass injury when applied to developing Kentucky bluegrass sod in 1978.

Herbicide	Rate lb ai/A	Treatment Number	Treatment Interval in weeks	Percent Nutsedge Control[a] (treatment started) June 30	Percent Nutsedge Control[a] (treatment started) July 21	Maximum Turfgrass Injury[b] (treatment started) June 30	Maximum Turfgrass Injury[b] (treatment started) July 21
Bentazon	.5	1	0	55	83	0.2	0.0
Bentazon	.5	2	1	99	97	0.2	0.2
Bentazon	.5	2	2	81	-	0.1	-
Bentazon	.5	2	3	95	-	0.1	-
Bentazon	.5	2	4	87	-	0.3	-
Bentazon	.5	3	1	99	-	0.0	-
Bentazon	.75	1	0	64	95	0.1	0.0
Bentazon	.75	2	1	98	99	0.3	0.0
Bentazon	.75	3	1	99	-	0.0	-
Bentazon	1.0	1	0	85	96	0.0	0.4
Bentazon	1.0	2	1	99	99	0.1	0.2
Bentazon	1.0	2	2	99	-	0.2	-
Bentazon	1.0	2	3	99	-	0.3	-
Bentazon	1.0	2	4	96	-	0.0	-
Bentazon	1.0	3	1	100	-	1.9	-
DSMA	3.6	1	0	62	99	0.5	3.3
DSMA	3.6	2	1	99	100	2.1	3.5
DSMA (201	3.6	2	1	100	-	1.9	-
DSMA (301)	3.6	2	1	99	-	2.3	-
DSMA (401)	3.6	2	1	99	-	2.6	-
DSMA (501)	3.6	2	1	100	-	2.2	-
DSMA (601)	3.6	2	1	99	-	1.7	-
MSMA	1.5	1	0	60	94	0.4	1.9
MSMA	1.5	2	1	100	99	2.5	3.1
Bromoxynil	.25	1	0	0	-	0.0	-
Bromoxynil	.5	1	0	14	-	0.0	-
Bromoxynil + Dicamba	.5+.125	1	0	9	-	0.2	-
Bromoxynil + Bentazon	.5+1.0	1	0	90	-	0.2	-
DSMA	1.8	2	1	-	99	-	1.1
DSMA + Bentazon	1.8+.5	2	1	-	99	-	0.6
DSMA + Bentazon	3.6+1.0	2	1	-	100	-	3.0

a based on plant counts June 28 and August 28. Untreated plots averaged 11.5 nutsedge plants per sq. ft.

b scale 0 to 10 (10 = brown) maximum through August.

Bromoxynil and dicamba (3,6-dichloro-o-anisic acid) did not control nutsedge. The addition of bentazon to bromoxynil resulted in excellent control as did the combination of bentazon with DSMA. It appears that bentazon could be tank mixed with bromoxynil and DSMA when desirable for broad spectrum weed control without antagonistic effects.

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The Effect of Soil Fertility Levels on Dandelion and Crabgrass Encroachment of Merion Kentucky Bluegrass

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ABSTRACT

Little information is presently available on the relationships among weed encroachment into turfgrass, soil fertility levels, and limestone, P, and K applications. A field study was conducted on Hagerstown clay loam (fine, mixed, mesic typic Hapludalf) to determine the effects of limestone applications (0 and 54 kg/100 m^2), P applications (0, 0.85, 1.7, 3.4, and 6.8 kg P/100 m^2), and K applications (0, 1.45, 2.9, and 5.8 kg K/100 m^2) on soil nutrient levels and on the performance of Merion Kentucky bluegrass turf. Spring greening, clipping yield, tiller density, and encroachment of dandelion and crabgrass into the turf were used to assess performance.

Limestone applications decreased soil acidity 0.8 pH unit and increased Ca 2.0 meq/100 g soil over unlimed plots. Available soil P and K ranged from 6 to 76 ppm and from 0.08 to 0.16 meq/100 g soil, respectively. Spring greening (April 13, 1975) was greatest at the three highest P rates, while no greening had occurred at the 0 P rate. Clipping yields were greater for unlimed turf, and tended to increase with increasing P and K rates. Tiller density tended to increase with K rates.

Crabgrass encroachment was significantly affected by P application, with a greater amount of crabgrass in 0 P plots than in turf fertilized at the higher rates. Dandelion encroachment was greater in the turf receiving limestone applications and tended to decrease with increasing P rates. Encroachment appeared to be related to competition rather than the nutritional requirements of the weeds since encroachment tended to decrease as the turfgrass clipping yields increased.

INTRODUCTION

Much information is available on the effect of nitrogen nutrition on weed encroachment into turfgrass areas. However, limited information is available on the relationship among encroachment of weeds into turf, soil fertility levels, and limestone, P, and K applications. Greenfield (1) classified some turf weeds into acid or alkaline preferring categories,

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indicating that soil reaction may play a role in the encroachment of specific weed species into turf. He also stated that white clover (Trifolium repens) is favored by a high soil P level. Westover (9) stated that liming of turfgrass creates a favorable condition for growth of clovers and some weeds, particularily crabgrass (Digitaria spp.). Monteith and Bengtson (4) found that the addition of lime to Kentucky bluegrass (Poa pratensis L.) did increase clover, but decreased crabgrass. They also found that phosphorus applications decreased crabgrass whereas potassium applications increased crabgrass. Welton and Carrol (8) stated that dandelions (Taraxacum officinale) are sensitive to high soil acidity. In their work dandelion populations in Kentucky bluegrass turf decreased when soil acidity had been increased by the addition of aluminum sulfate to the soil. Multiple ammonium sulfate applications to Kentucky bluegrass turf also lowered the pH and decreased the number of dandelions; however, they attributed the control by ammonium sulfate to repeated defoliation by the fertilizer salts rather than soil acidity. Non-acid-forming nitrogen fertilizers also controlled dandelions. Waddington et al. (5) found that annual bluegrass (Poa annua L.) invasion into creeping bentgrass (Agrostis palustris Huds.) turf was favored by P and K fertilization. Phosphorus applications were also found to increase annual bluegrass invasion of bentgrass turf by Goss et al. (2).

Objectives of this research were to study the relationships among turfgrass response, soil fertility levels, and limestone, P, and K applications. Crabgrass and dandelion encroachment into the turf, clipping yields, tiller density, and spring greening were used to evaluate performance.

MATERIALS AND METHODS

In September, 1969, a soil fertility test area was established on Hagerstown clay loam (fine, mixed, mesic Typic Hapludalf) at University Park, Pa. The area was seeded to 'Merion' Kentucky bluegrass.

Limestone, P, and K were applied in a split-split-block design with three replications. Main plots (3.66 by 7.62 m) consisted of limestone treatments, subplots of P treatments, and sub-subplots of K treatments. Rates were as follows: 0 and 54 kg limestone/100 m^2 in the seedbed (designated as L_1 and L_2 respectively); 0, 0.85, 1.7, 3.4, and 6.8 kg P/100 m^2 (P_1, P_2, P_3, P_4 and P_5 respectively) as normal superphosphate with P_3, P_4, and P_5 in the seedbed and P_2 applied to established turf (May, 1970); and a total of 0, 1.45, 2.9, and 5.8 kg K/100 m^2 (K_1, K_2, K_3 and K_4 respectively) as KCl applied to established turf over the period 1970-1973. Limestone and P applied prior to seeding were incorporated to a soil depth of approximately 10 cm. Nitrogen fertilization with ureaform averaged 2.5 kg N/100 m^2 annually through the spring of 1975, after which no further N was applied.

The turf was mowed one or two times weekly at a height of 3 cm. The last herbicidal weed control applications for crabgrass and broadleaved weeds were made in May, 1972 and October, 1975, respectively. Complete control of the respective weeds was achieved. Natural encroachment of crabgrass and dandelion occurred after the last herbicidal applications for their control were made.

In May, 1978, all plots were sampled at a depth of 0 to 5 cm to determine soil test values. The pH was determined using a 1:1 soil water paste, the phosphorus was extracted with Bray P1 solution, and K, Ca, and Mg were extracted with neutral, 1 N NH_4OAc (3).

Spring greening, clipping weights, and tiller density were used as measures of turfgrass response to fertility treatments. In mid-April, 1975, initial spring greening of the turf was rated on a scale of 0 to 5 (0 = no greening; 5 = complete greening). Fresh clipping yields, representing 4-weeks growth, were taken from 3.1 m^2 and tiller density counts were made on each plot in May, 1978. Tiller density was obtained by counting tillers in three 1.3 cm by 7.6 cm samples taken with a profile sampler.

The percent crabgrass per plot was visually rated in October, 1975, and dandelions per plot were counted in May, 1978.

Data were analyzed using analysis of variance, and means were compared using Duncan's L.S.D. test with K = 100 (6).

RESULTS AND DISCUSSION

Limestone, P, and K applications significantly affected soil test values (Table 1). Soil pH was 0.8 pH unit higher and soil Ca was 2.0 meq/100 g soil higher on plots which had received limestone applications. Soil P ranged from 6 ppm in plots where no P was applied to 76 ppm at the 6.8 kg P rate. Soil K ranged from 0.08 meq/100 g soil in plots receiving no K applications to 0.16 meq/100 g soil at the highest K rate.

Spring greening (Table 2), an indication of early spring growth, was significantly affected by P applications. On April 13, 1975, turf which had not received P applications showed no sign of greening and was still straw colored. Slight greening occurred on turf fertilized at the 0.85 kg P rate, whereas greater but not complete greening occurred on turf fertilized at the three highest P rates. Similar spring response was also observed in previous years. It thus appears that increased soil P levels above 6 ppm resulted in earlier initiation of spring growth.

Clipping yields (Table 3) were significantly affected by limestone, P, and K applications. Yields were greater for turf which had not received limestone applications, and tended to increase with increasing rates of P and K. Yields for turf fertilized at the two highest P rates were significantly greater than for turf receiving no P, and yields for turf fertilized at the highest P rate were also significantly greater than for the 0.85 kg P rate. Turf fertilized with the highest K rate outyielded turf receiving 0 or 1.45 kg K. These results support earlier information from this experiment reported by Watschke et al. (7) on the effect of P on clipping yield; however, they had found no significant effect of limestone or K on clipping yield.

Tiller density (Table 3) was significantly affected only by K applications, being greater for turf fertilized at the two highest K rates than for turf receiving no K.

Crabgrass encroachment (Table 2) was significantly affected by P applications but not by limestone or K applications. The amount of crabgrass was greater in turf receiving no P than in turf receiving P applications. There were no significant differences among plots that had been fertilized with P. Although it could not be determined whether the increased crabgrass in turf receiving no P was due to decreased competition or other reasons, it would appear that decreased competition was an important factor. Later initiation of spring growth, as evidenced by delayed spring greening, and a slower growth rate, as evidenced by lower clipping yield, on the turf which had not received P applications would indicate that crabgrass encroachment in these plots was enhanced by decreased competition.

Phosphorus and limestone applications significantly affected dandelion encroachment (Table 3). As the P rate increased, the number of dandelions per plot tended to decrease. Dandelion encroachment was significantly greater in turf receiving no P than in turf fertilized at the two highest P rates. As was the case with crabgrass, the dandelion encroachment appeared to be related to increased competitiveness of the turf due to increased growth with increasing P rates. The effect of limestone applications on dandelion encroachment was more pronounced than was the effect of P applications. Approximately 2½ times as many dandelions were found in turf which had limestone incorporated in the seedbed. Once again, it could not be determined from this experiment whether the decreased dandelion encroachment in unlimed turf was due to a nutritional requirement of the dandelion or due to competition. However, since dandelion encroachment tended to increase as clipping yields of the turf decreased due to either P or limestone treatments, competition probably was the major factor involved. Also, as tiller density was not significantly affected by limestone or P applications, competitiveness of the turf in this experiment appeared to be influenced more by growth rate than by turf density.

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Table 1. The effect of limestone, P, and K applications on soil test results.

Rates	Soil Test Values				
	pH	P	K	Mg	Ca
		-ppm-		meq/100g soil	
Lime					
L_1	5.6b†	30a	0.10a	0.5a	4.1b
L_2	6.4a	28a	0.12a	0.5a	6.1a
P					
P_1	5.9a	6d	0.11a	0.6a	4.8a
P_2	6.0a	10d	0.11a	0.6a	5.0a
P_3	6.0a	19c	0.12a	0.6a	4.9a
P_4	6.1a	33b	0.10a	0.5a	5.2a
P_5	6.0a	76a	0.11a	0.5a	5.4a
K					
K_1	6.1a	30a	0.08c	0.6a	5.3a
K_2	6.0a	29a	0.09c	0.6a	5.2a
K_3	6.0a	30a	0.11b	0.5a	4.9a
K_4	6.0a	28a	0.16a	0.5a	5.0a

† Means for lime, P, and K treatments followed by the same letter are not significantly different.

Table 2. The effect of P applications on spring greening and crabgrass encroachment of Merion Kentucky bluegrass.

P-rate	Spring greening†	Crabgrass encroachment
		%
P_1	0.0c‡	26a
P_2	1.0b	12b
P_3	3.0a	5b
P_4	3.0a	5b
P_5	3.0a	7b

† Scale: 0-5, with 0 equal to no greening and 5 equal to complete greening.

‡ Means in each column followed by the same letter are not significantly different.

Table 3. The effect of limestone, P, and K applications on clipping yield, tiller density, and dandelion encroachment of Merion Kentucky bluegrass.

Rates	Clipping Yield	Tiller Density	Dandelions
	g/m^2	$tillers/dm^2$	$plants/m^2$
Lime			
L_1	130a†	182a	4.6b
L_2	110b	153a	12.3a
P			
P_1	108c	172a	10.9a
P_2	111bc	175a	8.7ab
P_3	124abc	163a	9.2ab
P_4	126ab	159a	7.3b
P_5	132a	169a	6.0b
K			
K_1	116b	153b	7.8a
K_2	115b	162ab	7.6a
K_3	123ab	179a	8.3a
K_4	126a	177a	10.0a

† Means for lime, P, and K treatments followed by the same letter are not significantly different.

Veronica Control in Turf

T. L. Watschke 1/

ABSTRACT

DCPA, ACR 1255 (Ro7-6145 + MCPP + 2,4-D), and 2,4-D + MCPP + dicamba were applied to a mixed turfgrass - Veronica filiformis stand to assess control and turfgrass injury. Both rates of DCPA (8.9 and 17.4 kg/ha) and ACR 1255 (5.9 + 1.7 + 0.8 and 7.8 + 2.2 + 1.1 kg/ha) provided excellent control. Turf injury from both rates of the ACR 1255 was severe, but recovery was rapid leaving turf treated with this chemical combination weed free and attractive. Good control from a single application of 2,4-D + MCPP + dicamba lasted only slightly more than a month. Approximately three-and-one-half months after initial treatment, plots that received two applications of 2,4-D + MCPP + dicamba had only 38 percent control. The low rate of DCPA was also applied twice which provided control comparable to a single application at twice the rate. DCPA provided excellent veronica control without turfgrass injury.

INTRODUCTION

Veronica filiformis (hereafter called veronica) is frequently found in lawns, parks, cemeteries, and golf courses in Pennsylvania. Because 2,4-D has not provided good control of veronica, but has eliminated competition from other weeds, most turf specialist recognize veronica as an increasingly serious weed problem. The severity of the problem is most frequently the greatest on home lawns.

Although often used as a rock garden plant, veronica is considered a weed in turf because of its rapid spread and textural incompatability with turfgrasses. Chemical control has been attempted for over 20 years (1, 2, 3, 4, 5). In early studies 2,4-D and 2,4,5-T showed little control, while endothal provided control, but at high rates caused severe turfgrass injury (2, 4). More recently wettable and flowable formulations of DCPA and an experimental growth regulator (Ro7-6145) have provided excellent control (1, 3, 5).

The objectives of this research were to compare the effectiveness of DCPA 75W, Ro7-6145 + MCPP + 2,4-D, and 2,4-D + MCPP + dicamba in controlling Veronica filiformis.

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MATERIALS AND METHODS

On May 25, 1978, application of three herbicides was made to 0.9 by 3.6 m plots (composed of veronica and turfgrasses) using a hand held boom-type plot sprayer which delivered 709 L/ha. The site had a variable veronica infestation (from 30 to 95 percent). Therefore, the experiment was designed to that adjacent to each treated plot was an untreated plot to facilitate rating. The base turf population was a mixture of rough bluegrass (*Poa trivialis* L.), creeping red fescue (*Festuca rubra*), and creeping bentgrass (*Agrostis palustris*, Huds) and was located on the campus of The Pennsylvania State University, University Park, Pennsylvania.

The herbicides used were; 1) a mixture of 2,4-D ((2,4-dichlorophenoxy) acetic acid), MCPP (2-[(4-chloro-o-tolyl)oxy]propionic acid), and dicamba (3,6-dichloro-o-anisic acid), 2) ACR-1255, a mixture of Ro7-6145 (unknown), 2,4-D, and MCPP, and 3) DCPA (dimethyltetrachloroterephthalate). On June 23, 1978, a second application of the 2,4-D + MCPP + dicamba mixture and the low rate of DCPA was applied.

Control was rated four times during the season and injury was rated twice. No significant precipitation occurred within 48 hours of treatment and no supplemental irrigation was applied during the season. Treatments were replicated three times.

RESULTS AND DISCUSSION

Control ratings taken June 11, (17 days after treatment) showed that veronica was controlled fastest and most completely with both rates of DCPA and the high rate of ACR 1255 (Table 1). Control from the lower rate of ACR 1255 was comparable to the 2,4-D + MCPP + dicamba treatment.

By June 20, all treatments had controlled veronica better than 85 percent. Very little difference in control was observed between the two DCPA rates. In this test, the 8.9 kg/ha rate of DCPA was sufficient for control.

On August 2, both rates of ACR 1255 and DCPA controlled veronica better than either a single or double application of the 2,4-D + MCPP + dicamba mixture. The double application of the 2,4-D + MCPP + dicamba mixture however controlled the veronica twice as effectively as the single application (60 versus 30 percent).

On September 12, the control rating for the single application of the 2,4-D + MCPP + dicamba mixture was only 12 percent. The double application rating was down from 60 percent on August 2 to 38 percent. Reinfestation by veronica into turf treated with 2,4-D, silvex, and dicamba has been reported previously (1). Apparently, translocation of these materials throughout the veronica was not extensive, as reinfestation appeared to come from buds breaking on existing stolons. Both rates of ACR 1255 controlled veronica throughout the experiment as did both rates of DCPA. It is not known whether the low rate of DCPA would have maintained the level of control shown on June 20 throughout the test period if it had not been reapplied on June 23. Control

of veronica by DCPA shown here is similar to that reported previously (3, 5).

Injury from both applications of ACR 1255 was quite severe (Table 2). All turf species in the sward were slightly discolored, however, ACR 1255 discolored the veronica extensively. Consequently, the overall color of plots containing high percentages of veronica was rated as being very yellow. This discoloration occurred quite rapidly (3 to 4 days). By August 2, the turf in plots treated with ACR 1255 had completely recovered. Clover (*Trifolium repens*) and other scattered broadleaf weeds were also controlled by the application of ACR 1255. Applications of Ro7-6145 (one of the components of ACR 1255 by itself for veronica control have been shown to cause turf injury (3). None of the other chemical treatments caused a color loss.

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Table 1. Veronica control ratings for plots treated with herbicides on May 28 and June 23, 1978.

Treatments	Application Dates	Rate (kg/ha)	Date of Observation 6/11	6/20	8/2	9/12
			%			
2,4-D+MCPP+dicamba	5/25	1.2+0.6+0.1	56	86	30	12
2,4-D+MCPP+dicamba	5/25+6/23	1.2+0.6+0.1	56	89	60	38
ACR 1255(Ro7-6145+MCPP+2,4-D)	5/25	5.9+1.7+0.8	51	93	94	86
ACR 1255 (Ro7-6145+MCPP+2,4-D)	5/25	7.8+2.2+1.1	76	97	94	92
DCPA 75W	5/25+6/23	8.9	81	97	95	98
DCPA 75W	5/25	17.9	79	98	98	97

Table 2. Color ratings for a veronica-turf sward treated with herbicides for veronica control on May 25, 1978.

Treatments	Application Dates	Rate (kg/ha)	Observation Date 6/11	8/2
2,4-D+MCPP+dicamba	5/25	1.2+0.6+0.1	9[a]	9
2,4-D+MCPP+dicamba	5/25+6/23	1.2+0.6+0.1	8	9
ACR 1255 (Ro7-6145+MCPP+2,4-D)	5/25	5.9+1.7+0.8	4	9
ACR 1255 (Ro7-6145+MCPP+2,4-D)	5/25	7.8+2.2+1.1	3	9
DCPA 75W	5/25+6/23	9.0	9	9
DCPA 75W	5/25	17.9	9	9
Check			9	9

[a]Color Rating Scale; 1 = yellow, 9 = dark green.

CONTROLLING *VERONICA FILIFORMIS*

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ABSTRACT

Eight herbicides were evaluated for control of creeping speedwell (*Veronica filiformis* Smith) in established turfgrass. Selective control was provided by both ACR 1255 applied at or after flowering and DCPA applied at the time of flowering at a rate of 11.2 kg/ha. DCPA at 11.2 kg/ha, dicamba, a mecoprop and 2,4-D mixture, silvex, and 2,4-D applications after flowering and a 2,4-D, silvex, and dicamba mixture applied at or after flowering provided less adequate control. Bentazon was not effective in providing control. ACR 1255, the mecoprop and 2,4-D mixture, and the 2,4-D, silvex and dicamba mixture were the only treatments evaluated that induced temporary discoloration of turfgrass after application.

INTRODUCTION

Creeping speedwell, a perennial broadleaf plant, is one of several Veronica species considered to be weeds in turfgrass areas throughout the Northeast. Noted for its small blue and white flower, creeping speedwell was introduced into the United States as a rock garden plant in the early 1930's. Subsequent escape into nearby lawns has provided continuous problems in turf maintenance. Reproductively sterile, creeping speedwell spreads by low lying prostrate stems and produces dense stands, even in well established turfgrass. From experiments designed to evaluate chemical control measures, Jagshitz (1955) reported that endothall (3,6-endoxohexa hydrophthalic acid) at 0.85 kg/ha provided control. In a subsequent report, Mower (1959) demonstrated that endothall at 1.1 kg/ha controlled creeping speedwell, but higher rates resulted in turf discoloration. Shauer (1968) reported excellent control and no turf discoloration using DCPA (dimethyl tetrachloroterephalate) at 13.5 kg/ha. In a more recent investigation, Kaufman (1976) also reported that DCPA at 13.5 kg/ha exhibited good control five weeks after application and that R 07-6145 2,3:4,6 Bis-O- ([1-methylethylidene]-α-L-xylo-2-Hexulofuranosonic acid) at 9 kg/ha gave effective control, but turfgrass discoloration was observed. The purpose of this study was to investigate further rates and timing of DCPA treatments and to evaluate several other herbicides for their effectiveness in controlling creeping speedwell and potential for turfgrass discoloration.

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MATERIALS AND METHODS

A series of 3.3m by 3.3m plots were established at Cornell University, Ithaca, New York, in a mixed turfgrass area containing Kentucky bluegrass (*Poa pratensis* L.), perennial ryegrass (*Lolium perenne* L.) and red fescue (*Festuca rubra* L.), heavily infested with mature stands of creeping speedwell. All chemicals in this investigation were sprayed by a hand operated sprayer having an approximate delivery of 467 liters per hectar at 25psi. Continuous passes were made over the plots to provide uniform coverage. Plots and respective treatments were randomly selected. Plots with less than 70% creeping speedwell were not treated. Evaluation of control and discoloration were rated from 0 to 10, with 0 equalling no control and 10 equalling complete control; 0 equalling no discoloration and 10 equalling severe discoloration.

On April 18, 1978, a series of plots containing five replications of DCPA at the rate of 11.2 kg/ha were treated. Identical treatments were made on the 18th of each succeeding month through October.

A second series of plots were treated between May 18, 1978 and May 23, 1978. Five replications of DCPA; bentazon [3-isopropyl-1H-2,13 benzothiadiazin-4 (3H)-one 2,2-dioxide]; and a 2,4-D (butoxyethanol ester of 2,4-diclorophenoxy acid), silvex (butoxyethanol ester of 2,4,5-trichlorophenoxyacetic acid) and dicamba (2-methoxy-3,6-diclorobenzoic acid) mixture at four different rates (see Table 2) were applied. ACR 1255, a mixture of diethylanolamine salts of 2,4-D (2,4-diclorophenoxy acetic acid), mecoprop [2-(2-methyl-4 chlorophenoxy)-proprionic acid] and dikegulac (2,3:4,6-di-O-isopropylidiene 2 keto-2-gluonic acid) at three different rates (see Table 2) also was applied.

A third series of plots containing three replications at four different rates of DCPA; bentazon; 2,4-D, silvex, and dicamba mixture; three replications of three different rates of ACR 1255 and five replications at one rate of dicamba; mecoprop and 2,4-D; silvex; and 2,4-D were applied between June 11, 1978 and June 14, 1978 (for rates see Table 3).

RESULTS AND DISCUSSION

Bentazon had no visible effect on creeping speedwell in either May or June. Dicamba, mecoprop and 2,4-D combination, silvex, and 2,4-D exhibited fair control of creeping speedwell in evaluations made two months after application (see Table 3). October ratings indicate that some creeping speedwell recovery did occur. The results indicate that further experiments varying the rates of the above mentioned herbicides should be conducted to see if greater control can be obtained. The mecoprop and 2,4-D mixture induced temporary discoloration.

DCPA at 11.2 kg/ha to 44.8 kg/ha, when applied during peak flowering (mid May in central New York) provided effective control (see Table 2). DCPA at 11.2 kg/ha and 22.4 kg/ha exhibited less adequate control if applied after flowering. At 44.8 kg/ha, DCPA continued to show effective control even after peak flowering (see Table 3). The monthly applications (see Table 1) of DCPA at 11.2 kg/ha show no control in April and excellent control

in May during peak flowering. Control afterward decreased when stands of the weed lost growth vigor as the summer season approached. Late August and September treatments exhibited better control as creeping speedwell growth became more vigorous, resulting from cooler, moist fall weather. DCPA caused no discoloration in the mixed turfgrass.

The 2,4-D, silvex, and dicamba mixture gave poor control in the May series of plots (see Table 2). However, control ratings of June plots improved (see Table 3). A hard rain 8 hours after the June application may have had an effect on the variations of the reported results. Considerable discoloration was observed in turfgrass several days after applications at all rates of the herbicide in both series of plots. Discoloration was no longer noticeable 6 weeks after applications.

ACR 1255 at 11.2 kg/ha and 22.4 kg/ha provided excellent control, and ACR 1255 at 5.6 kg/ha gave fair control in both May and June plot series (see Tables 2 and 3). Severe discoloration of turf was notable in plots treated at 11.2 kg/ha and 22.4 kg/ha five days after treatment. Within one month, discoloration was no longer evident. Treatments of ACR 1255 at 5.6 kg/ha caused less discoloration. After three weeks no discoloration was evident. From these results one can conclude that the toxic effects of ACR 1255 can be reduced yet good control maintained by lower rates. Dikegulac a growth retardant is the ingredient for the discoloration of grasses noted by treatments of ACR 1255.

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Table 1: Control of Creeping Speedwell from Monthly Application of DCPA WP at 11.2 kg/ha.

Month	Control of creeping speedwell six weeks after application*	October 27*
April	0	0
May	10	10
June	7	7
July	7	7
August	7.8	7.5
September	8.5	8.5
October	**	0
Check	0	0

* observation dates.
** no results available.

Table 2: The Effects of May 18 to May 23, 1978, Treatments for Creeping Speedwell Control.

Chemical	Formulation	AI/Hectare	Control* (10 = excellent) (0 = no control)			Turfgrass Discoloration (10 = severe discoloration) (0 = no discoloration)			
			July 7	Aug. 4	Oct.27	June 7	July 7	Aug. 4	Oct. 27
ACR 1255	WS	5.6 kg	7.2	8.3	4.8	4	0	0	0
		11.2 kg	9.1	9.2	8.2	8	0	0	0
		22.4 kg	9.9	9.9	9.5	9	0	0	0
Bentazon	EC	0.5 kg	0	0	0	0	0	0	0
		1.12 kg	0	0	0	0	0	0	0
		2.24 kg	0	0	0	0	0	0	0
		4.49 kg	0	0	0	0	0	0	0
DCPA	WP	5.6 kg	4.4	4.0	4.0	0	0	0	0
		11.2 kg	8.2	8.4	8.0	0	0	0	0
		22.4 kg	9.6	9.0	9.0	0	0	0	0
		44.8 kg	9.9	9.2	9.5	0	0	0	0
2,4-D + Silvex + dicamba	EC	0.28 kg	3.2	3.0	2.5	4	0	0	0
		0.56 kg	3.8	3.7	2.8	5	0	0	0
		1.12 kg	3.8	3.8	3	9	3	0	0
		2.24 kg	4.0	3.8	3	9	3	0	0
Check			0	0	0	0	0	0	0

* observation dates.

Table 3: The Effects of June 11 to June 14, 1978 Treatments for Creeping Speedwell Control.

Common Name	Formulation	AI/Hectare	Control* (10 = excellent) (0 = no control)		Turfgrass Discoloration* (10 = severe) (0 = no discoloration)		
			Aug. 4	Oct. 27	July 1	Aug. 4	Oct. 27
ACR 1255	WS	5.6 kg	6.8	6.5	5	0	0
		11.2 kg	9.1	9.0	8	0	0
		22.4 kg	9.5	9.4	9	0	0
Bentazon	EC	0.51 kg	0	0	0	0	0
		1.12 kg	0	0	0	0	0
		2.24 kg	0	0	0	0	0
		4.49 kg	0	0	0	0	0
DCPA	WP	5.6 kg	4.0	4.0	0	0	0
		11.2 kg	6.0	5.5	0	0	0
		22.4 kg	6.8	5.9	0	0	0
		44.8 kg	9.6	9.0	0	0	0
Dicamba	EC	0.26 kg	6.0	4.6	0	0	0
Mecoprop + 2,4-D	EC	1.56 kg	6.7	5.9	7	0	0
Silvex	EC	0.84 kg	6.0	5.5	0	0	0
2,4-D	WS	1.12 kg	6.6	5.4	0	0	0
2,4-D, mecoprop, and dicamba	EC	.28 kg	5.5	5.0	5	0	0
		.56 kg	6.6	5.8	7	0	0
		1.12 kg	7.5	6.0	8	0	0
		2.24 kg	7.8	7.0	9	0	0
Check			0	0	0	0	0

* observation data.

CRABGRASS CONTROL IN TURFGRASS USING PREEMERGENT HERBICIDES AND SURFACTANTS[1/]

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ABSTRACT

Experiments were conducted on established turfgrass to evaluate preemergent control of smooth crabgrass [Digitaria ischaemum (Shreb.) Muhl.]. Tests were initiated to show the effects of standard and experimental herbicides, various formulations, time of application, surfactant effects and mechanical spreader applications of siduron. Results were based on percent crabgrass control and degree of injury to turfgrass. Certain rates, formulations and dates of treatment with bensulide, butralin, DCPA, oxadiazon, prosulfalin and siduron provided excellent results. Benefin and the experimental materials HOE-22870, HOE-23408, M-4212 and R-40244 provided less favorable results. Siduron exhibited poor control (less than 70%) when applied in March but excellent control (90-100%) was observed when applied in May. Benefin and butralin caused more turf injury when applied in May while oxadiazon caused more injury when applied in March. All four formulations of bensulide provided similar results. The wettable powder formulation of DCPA tended to cause more injury to fescue turf and better control than the granular formulation. The 5% formulation of oxadiazon did not provide as good crabgrass control as the 2% formulation. Granular formulations of siduron exhibited considerable differences in control whether applied by hand or mechanical spreader. Surfactants showed no control of crabgrass and a tendency for some surfactants, when combined with DCPA, to increase turf injury.

INTRODUCTION

The selective control of crabgrass can be attained in turfgrass areas with the use of preemergent herbicides (1,2,3,6). Experimental herbicides are continually being introduced to supplement the standard choices for crabgrass control. The following studies evaluate standard and some newer preemergent herbicides.

Effectiveness of preemergent herbicides may depend upon the time of application (2,4,6). Tests were conducted to show the response of preemergent herbicides applied in late March compared to the usual application date in early May.

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It has been shown that different formulations of the same preemergent herbicide vary in effectiveness. Examples of this are phytotoxicity to red fescue (Festuca rubra L.) caused by DCPA in spray formulations rather than granular formulations (1,6), and varying control with different granular formulations of siduron (1,3). Various formulations of several herbicides were compared in the March and May tests.

In our tests, granular formulations are hand applied to experimental plots. However, granular formulations of siduron were compared using a mechanical drop spreader.

The potential for surfactants to reduce weed populations has been suggested (5). Two experiments were conducted using surfactants for preemergent crabgrass control as well as to determine their effect on herbicidal action of DCPA.

MATERIALS AND METHODS

All tests were undertaken in 1978 at the Rhode Island Agricultural Experimental Station. Experiments were conducted on turf containing predominantly red fescue with some Kentucky bluegrass (Poa pratensis L.). Turf maintenance consisted of mowing at a one inch height. Irrigation was employed to ensure crabgrass germination and to prevent drought.

Herbicides for the early test comparing application dates were applied on March 24. Herbicides in other tests were applied on May 8-12 with the exception of DCPA in the surfactant tests which was applied on May 26. Selected May treatments received a second application on July 3. The surfactants were applied on April 21, May 5, 19 and June 5 in one test and May 26 in the second test.

The surfactant Surf-Side-80 contained 40% Triton X-100 (Octyl phenol) and 40% Hercules AR-150 (polyethylene glycol esters of resin). Surf-Side 7, 12 and 21 contain GAF (various molar counts of nonylphenoxpoly ethanol). Plot size in the March and May application comparison test and the surfactant tests were 4 by 5 ft with each treatment replicated three times. Treatments for the mechanical drop spreader applied herbicide study were applied to 2 by 25 ft plots which were replicated five times. Spray herbicide formulations were applied in 86 gal of water per acre. Surfactants were applied by spray in 10 or 30 gal of water per 1000 square feet. All spray applications were applied with the aid of a CO_2 pressurized sprayer. Visual estimates of turfgrass injury were made periodically using a 0-10 evaluation scale with 0 indicating no injury and 10 exhibiting brown or dead turf. Percent crabgrass control for all studies was determined on August 21-22, 1978. Determinations for crabgrass control were made by comparing crabgrass cover in each plot with that of the check plots.

RESULTS AND DISCUSSION

The results of the late March versus early May application of pre-emergent herbicides are listed on Table 1. Prosulfalin and the four formulations of bensulide provided excellent crabgrass control (90-100% control) and no objectionable turfgrass injury (less than 2.0). Treatments of benefin provided poor (less than 70%) to fair control (less than 80%) and tended to cause more turf injury when applied in May. Conversely, the 2.0% granular formulations of oxadiazon provided excellent control but caused more injury on the March applied treatments. The 5.0% formulations of oxadiazon exhibited less crabgrass control possible due to an insufficient number of particles to cover the test plot. Similar results were found in previous research (3). Butralin provided excellent control but caused objectionable turf injury when applied in May. The wettable powder formulation of DCPA provided more turf injury, especially to red fescue, than the granular material, however, control was excellent. Results with granular formulations of DCPA proved to be variable. A granular and wettable powder formulation of siduron showed excellent control in the May treatments but poor control in the March treatments. Poor control in the March treatments may be due to the low residual activity of siduron.

Initial crabgrass emergence occurred during mid-June. In control plots a total of 604 plants per square foot were estimated to have emerged by August 11 with 87% of this total occurring by July 20, 1978.

Granular formulations of siduron exhibited considerable differences in control with different formulations. This collaborates results of earlier tests (1,3) that some granular formulations of siduron gave poor control. Spreader applied formulations of siduron gave similar variability (Table 3). Data was not consistent enough to show that materials applied by spreader performed better than when applied by hand to smaller plots.

The experimental herbicides M-4214 and R-40244 provided poor control and objectionable turf injury. HOE-22870 and HOE-23408 also resulted in poor control, however, higher application rates could be investigated as there was no objectionable turf injury at this rate.

In the surfactant studies (Table 2), Surf-Side-80 treatments applied five times prior to crabgrass emergence showed little promise for crabgrass control as did Surf-Side 7, 12 and 21 which were applied only once. Surfactants did not appear to enhance the results obtained with DCPA. Surf-Side-7 and 21 appeared to increase the level of injury to the turfgrass when combined with DCPA.

Table 1. Turfgrass injury and crabgrass control from preemergence herbicides applied on either March 24 or May 8-12, 1978.

Herbicide	Granular or Spray	Rate lb ai/A	Maximum Turfgrass Injury[a]		Percent Crabgrass Control	
			March Test	May Test	March Test	May Test
Benefin	G (2.5%)	2	1.3	1.9	54	56
Benefin	G (2.5%)	3	1.9	3.0	73	63
Bensulide	G (3.6%)	7.5	0.4	0.6	99	99
Bensulide	G (3.6%)	7.5-7.5[b]	---	0.3	--	99
Bensulide	G (3.6%)	10	0.3	0.5	99	100
Bensulide	G (7.0%)	7.5	---	0.4	--	98
Bensulide	G (7.0%)	7.5	---	0.6	--	98
Bensulide	G (7.0%)	10	---	0.3	--	99
Bensulide	G (12.5%)	7.5	---	0.7	--	98
Bensulide	G (12.5%)	7.5-7.5	---	0.7	--	99
Bensulide	G (12.5%)	10	---	0.8	--	99
Bensulide	S	7.5	0.8	0.6	96	99
Bensulide	S	7.5-7.5	---	0.5	--	100
Bensulide	S	10	1.2	0.0	99	99
Butralin	G (2.3%)	4	1.0	3.0	90	98
DCPA	G (5.0%)	7.5	0.2	1.0	89	67
DCPA	G (5.0%)	10	2.3	1.0	90	87
DCPA	S (WP)	7.5	2.3	3.1	98	99
DCPA	S (WP)	10	2.8	3.6	99	100
Oxadiazon	G (2.0%)	3	2.9	0.4	92	92
Oxadiazon	G (2.0%)	4	3.3	1.3	96	97
Oxadiazon	G (5.0%)	3	---	0.9	--	63
Oxadiazon	G (5.0%)	4	---	0.3	--	87
Prosulfalin	S (WP)	1.5	0.2	0.7	95	99
Prosulfalin	S (WP)	1.5-1.5	---	0.8	--	100
Prosulfalin	S (WP)	2	1.0	1.3	98	99
Prosulfalin	S (WP)	3	---	1.7	--	99
Siduron	S (WP)	10	0.8	0.0	33	91
Siduron	G (2.3%)	10	---	0.5	--	11
Siduron	G (2.65%)	10	---	0.0	--	47
Siduron	G (3.1%)	10	---	0.0	--	91
Siduron	G (3.57%)	10	0.0	0.7	58	92
Siduron	G (4.57%)	10	---	0.4	--	62
Siduron	G (4.6%)	10	---	0.2	--	66
Siduron	G (4.7%)	10	---	0.9	--	73
Siduron	G (4.7%)	10	---	0.4	--	56
Siduron	G (5.76%)	10	---	0.5	--	68
Siduron	G (7.66%)	10	---	0.3	--	80
HOE-22870	G (2.5%)	6	---	0.3	--	26
HOE-22870	S	6	---	0.0	--	20
HOE-23408	S	1	---	0.1	--	15
HOE-23408	S	2	---	0.6	--	43
HOE-23408	S	4	---	1.2	--	76
M-4212	S	3	---	8.3	--	79
R-40244	S (EC)	1	---	5.0	--	13
R-40244	S (EC)	2	---	6.2	--	52
R-40244	G (2.0%)	2	---	4.8	--	54

Crabgrass cover in check plots averaged 65%.

[a] Scale 0 to 10 (10 = brown) from May through August.

[b] A second application on July 3, 1978.

Table 2. Effect of surfactants on crabgrass control with and without DCPA in 1978.

Treatment [a]	Surfactant Conc. oz./1000ft^2	DCPA (lb ai/A) 5/26	Percent Crabgrass Control 8/21	Maximum Turfgrass Injury [b] 7/26
Applied 4/21, 5/5, 5/19, 6/5 10 gal. spray/1000ft^2				
None	0	0	0	0.4
None	0	4	85	1.8
Surf-Side 80	5	0	0	0.5
Surf-Side 80	5	4	80	2.4
Surf-Side 80	10	0	2	0.7
Surf-Side 80	10	4	89	2.6
Applied 5/26 30 gal. spray/1000ft^2				
Surf-Side 7	10	4	74	3.1
Surf-Side 7	30	4	77	2.8
Surf-Side 12	10	4	90	1.9
Surf-Side 12	30	4	85	2.3
Surf-side 21	10	4	84	3.0
Surf-side 21	30	4	79	3.5
None	0	4	89	2.3
None	0	0	0	0.5

Crabgrass cover in check plots averaged 65-70%.

[a]Chemical constitutents of coded surfactants are listed under methods and materials.

[b]Scale 0-10 (10 = Brown).

Table 3. Control of crabgrass with various siduron granular formulations using a spreader on May 10-12, 1978.

Siduron Formulation (%)	Rate lb ai/A	Percent Crabgrass Control August 22, 1978
2.3	9.7	27
2.65	9.1	83
3.57	9.0	81
4.57	10.8	47
4.6	10.7	57
4.7	10.2	54
4.7	11.5	80
5.76	10.5	84
7.66	10.3	68

Crabgrass cover in check plots averaged 80%.

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Growth Retardation of Merion and Pennstar Kentucky Bluegrasses

T. L. Watschke 1/

ABSTRACT

Mefluidide, DS-31247, DS-35245, and MBR 18337 were applied to Merion and Pennstar Kentucky bluegrasses to evaluate growth retardation and injury. Turf treated with the high rate of KS-31247 (4.48 kg/ha), mefluidide, and both rates of MBR 18337 had less growth (based on height and weight measurements) than turf treated with the low rate (2.24 kg/ha) of KS-31247, both rates of DS-35245, or that which was untreated. Mefluidide caused more phytotoxicity than the other treatments. The low rate of KS-35245 had caused a slight growth stimulation by the first growth assessment date (27 days after treatment). All treatments had a greater percentage growth suppression when measured 27 days following treatment than when measured 80 days following treatment.

INTRODUCTION

Growth retarding chemicals have received continued evaluation on several cool season turfgrasses in recent years (1, 2, 3, 4, 5, 6, 7, 8). Each year more experimental materials require testing. The potential sites of use for these materials range from roadsides to home lawns. Previous studies have shown that rates effective in suppressing growth caused undesirable discoloration particularly to species used on home lawns (3, 6, 7, 8).

The objective of this study was to compare the growth retardation and phytotoxicity of three experimental chemicals with a commercially available material applied to 'Merion' and 'Pennstar' Kentucky bluegrasses (*Poa pratensis* L.).

MATERIALS AND METHODS

On June 14, 1978, three experimental and one commercially available growth retarding chemical were applied to 11-year-old stands of Merion and Pennstar Kentucky bluegrasses at The Joseph Valentine Turfgrass Research Center, The Pennsylvania State University. The materials were; DS-31247 (undisclosed), DS-35245 (undisclosed), MBR 18337 (undisclosed), and mefluidide N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide. The materials were applied to 0.9 by 1.8 m plots with a handheld boom type sprayer with three replications of each treatment on each bluegrass.

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Color was rated twice during the experimental period on a scale of 0-10; 0 equivalent to yellow, and 10 equivalent to dark green. After 26 days height was measured at three locations per plot height was measured at three locations per plot using a graduated metal rod with a flat base (9.6 cm^2). The rod was inserted through a circular rigid paper disc (182 cm^2) which was vertically movable. The disc was allowed to slide down the rod until it was resting on top of the leaf canopy and height was then read directly from the rod.

Two days after heights were measured, fresh weight yields were taken using a rotary mower. The mower was set at 5.0 cm height and the harvested swath measured 157 by 51 cm.

On September 1, 1978, height was again measured as previously described on both the turf that had been clipped 50 days prior and that which was allowed to grow the entire 80 day period.

RESULTS AND DISCUSSION

Color ratings were taken twice after treatment to assess the magnitude and longevity of phytotoxic effects (Table 1). On July 13, approximately one month after treatment, both bluegrasses were injured more by mefluidide treatment than by any other. Very little injury was noted for either DS-31247 or DS-35245. The high rate (0.28 kg/ha) of MBR 18337 caused slightly more injury than the low rate. By September 1, color ratings for all treated turf were nearly the same as for untreated. There was also a tendency for most treated turf to be slightly greener than the check. This response to growth regulators has been noted previously (5, 6, 7).

Height measurements taken 27 days following treatment showed that mefluidide, the high rate of KS-31247, and both rates of MBR 18337 had suppressed vertical shoot growth (Table 2). The growth of both bluegrasses was retarded similarly by each chemical treatment. The low rate of KS-35245 (2.24 kg/ha) caused a slight growth stimulation of both bluegrasses after 26 days, while the high rate (4.48 kg/ha) did not appear to restrict growth when compared to the check. Higher rates of this material may be necessary to cause growth suppression.

Two days after height was measured (29 days after treatment) fresh weight yields were taken. Weights paralleled the results recorded for heights (Tables 2 and 3). Mefluidide, the high rate of DS-31247, and both rates of MBR 18337 caused the largest reduction in clipping yields. The slightly higher height measured for both bluegrasses treated with the low rate of DS-35245 was reflected in more clipping weight compared to untreated turf. Yields of Merion and Pennstar were affected approximately the same by both rates of DS-31247 and DS-35245. However, Merion clipping weights were reduced more than that for Pennstar when treated with mefluidide (89 and 80 percent respectively). This trend was more dramatic when they were treated with MBR 18337. At the low rate, Merion growth was reduced 73 percent while Pennstar was reduced only 27 percent. At the high rate, Merion growth was reduced 83 percent, and Pennstar 69 percent. Apparently, the high rate of MBR 18337 will be necessary to negate any varietal differences in growth suppression.

Height measurements were again made 80 days after treatment on both unclipped turf and also on the turf that had been mowed for clipping yields (51 days of regrowth). After 80 days, the difference in height between turf treated with mefluidide, the high rate of DS-31247, and both rates of MBR 18337 and the check was not as great as when measured after 27 days (Table 4). For example, Merion treated with mefluidide was 46 percent shorter than check after 26 days, but was only 10 percent shorter after 80 days. Heights measured on turf that had been mowed for clipping yields (51 days earlier) showed that there was a tendency for treated turf to grow faster than untreated. Mefluidide treated turf, in particular, grew faster than the check. This may have been the result of a response by the turf to the chemical treatment, or the result of slight scalping which occurred on untreated turf. However, after 51 days there was no evidence of the slight scalping.

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Table 1. The effect of growth regulators applied June 14, 1978, on the color of Merion and Pennstar Kentucky bluegrass.

Material	Rate (kg/ha)	Observation Date 7/13/78 Merion	7/13/78 Pennstar	9/1/78 Merion	9/1/78 Pennstar
DS-31247	2.24	9.0[a]	8.7	9.3	9.3
DS-31247	4.48	8.0	8.0	10.0	10.0
DS-35245	2.24	9.0	9.0	9.0	9.0
DS-35245	4.48	9.0	9.0	8.7	8.7
Mefluidide 2S	0.42	6.3	7.3	9.0	9.0
MBR 18337 2EC	0.14	8.7	9.0	9.0	9.0
MBR 18337 2EC	0.28	7.7	8.0	9.5	9.5
Check	0.00	9.0	9.0	8.0	9.0

[a]Color rating; 0 = yellow, 10 = dark green.

Table 2. The height of Merion and Pennstar Kentucky bluegrasses 27 days after treatment with growth regulators.

Material	Rate kg/ha	Merion	Pennstar
DS-31247	2.24	8.1	7.6
DS-31247	4.48	6.5	6.5
DS-35245	2.24	11.2	12.1
DS-35245	4.48	9.3	10.9
Mefluidide 2S	0.42	5.1	5.7
MBR 18337 2EC	0.14	6.4	7.2
MBR 18337 2EC	0.28	5.9	6.1
Check	0.00	9.7	10.2

Table 3. The effect of growth regulators applied June 14, 1978, on the fresh weight yield of Merion and Pennstar Kentucky bluegrasses 28 days later.

Material	Rate kg/ha	Weight (g)	
		Merion	Pennstar
DS-31247	2.24	187	193
DS-31247	4.48	126	140
DS-35245	2.24	348	346
DS-35245	4.48	209	346
Mefluidide 2S	0.42	37	68
MBR 18337 2EC	0.14	89	254
MBR 18337	0.28	55	107
Check	0.00	325	350

Table 4. The effect of growth regulators on the height of Merion and Pennstar Kentucky bluegrasses 80 days after treatment (unclipped) and also 51 days after clipping (which occurred 29 days after treatment).

Materials	Rate (kg/ha)	Height (cm) of unclipped		Height of clipped	
		Merion	Pennstar	Merion	Pennstar
DS-31247	2.24	17.1	17.7	12.9	13.1
DS-31247	4.48	17.1	15.9	11.4	11.7
DS-35245	2.24	20.2	19.2	14.2	14.1
DS-35245	4.48	18.9	18.7	12.4	11.9
Mefluidide 2S	0.42	18.5	16.0	15.3	15.0
MBR 18337 2EC	0.14	18.7	17.2	13.4	14.1
MBR 18337 2EC	0.28	20.7	19.3	16.4	16.1
Check	0.00	20.6	20.2	11.5	11.5

ANNUAL BLUEGRASS CONTROL IN KENTUCKY BLUEGRASS TURF WITH HERBICIDES 1/

John A. Jagschitz 2/

ABSTRACT

Preemergence and postemergence herbicides were evaluated for the control of annual bluegrass in Kentucky bluegrass lawn areas. Effectiveness of treatments was based on degree of turf discoloration and changes in annual and Kentucky bluegrass cover. After four years use of preemergence herbicides, none of which caused objectionable discoloration, the most effective material was bensulide (91% control) followed by butralin (85%), prosulfalin (83%), benefin (59%), H-22234 (37%), DCPA (36%), oxadiazon (29%) and siduron (19%). With most postemergence herbicide treatments there was a decrease in annual bluegrass and an increase in Kentucky bluegrass. However, the elimination of annual bluegrass usually resulted in overall turf discoloration and thin, open turf. The most promising treatments were diuron at .5 lb, endothall spray at 2 lb, endothall granular at 6 lb, linuron granular at 3 lb and terbacil at .25 lb. Higher rates of diuron and terbacil caused a decrease in both annual and Kentucky bluegrass while the use of MH + CF was ineffective. A good approach to the control of annual bluegrass would be to use repeated postemergent herbicide treatments at low rates coupled with techniques to increase Kentucky bluegrass cover.

INTRODUCTION

The selective control of annual bluegrass (*Poa annua* L.) in turfgrass has been the goal of many turfgrass managers and researchers. The use of preemergence herbicides for killing seedlings following germination has been partially successful (1,3). Another approach has been to chemically inhibit seed production and reduce the potential for new annual bluegrass plants (3,5). Recent emphasis has been on the use of postemergence herbicides for control (2,4,5). To examine further the use of preemergence herbicides a four year study was done to evaluate some of the standard and newer materials. Postemergent studies were performed in each of 1976, 1977 and 1978 to evaluate several herbicides for the selective control of annual bluegrass in Kentucky bluegrass (*Poa pratensis* L.) turf.

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MATERIALS AND METHODS

All tests were conducted at the Turf Research Farm at the R.I. Agricultural Experiment Station. The preemergence annual bluegrass test was conducted on an old Kentucky bluegrass lawn area containing some annual bluegrass. Turf maintenance consisted of mowing at a 1.5 inch height and use of irrigation after each herbicide application and when needed to prevent drought. Treatments were started on September 5, 1975 with applications made between April 9 to 15 and August 11 to September 9 in 1976, 1977 and 1978. The herbicides, rates, and dates of application are shown in Table 1. Plot size was 4 by 4 feet with four replications. Granular materials were applied by hand and spray materials were applied at the rate of 218 gallons per acre. Visual estimates of grass discoloration were made periodically on a scale of 0 to 10 with 10 being brown turf. A reading of 2.0 might be considered objectionable. Each year estimates of annual bluegrass cover were made and percent control was determined by comparing treated to untreated plots.

The three postemergence tests were on Kentucky bluegrass lawn areas containing annual bluegrass. The areas were maintained at a height of 1.5 inches and irrigated when necessary to prevent drought. The herbicides, rates and dates of application are presented in Tables 2, 3 and 4. Plot size varied from 4 by 4 feet to 8 by 8 feet with three to six replicates. Granular materials were applied by spreader in the 1977 test and by hand in the 1978 test. Other materials were as sprays using water at the rate of 86 gallons per acre in 1976 and 1978 and at the rate of 172 gallons in 1977. The herbicides in the 1977 test and those as indicated in Table 4 of the 1978 test were watered in after application. Visual estimates of grass discoloration were made periodically as described earlier. Estimates of annual and Kentucky bluegrass cover in each plot were recorded on the dates as indicated in the tables. Percent change in grass cover was calculated by comparing cover at the time of treatment to that at the later date.

RESULTS AND DISCUSSION

Preemergence control

The results of four years use of preemergence herbicides for annual bluegrass control in a Kentucky bluegrass lawn are presented in Table 1. At no time during the test was the discoloration of the turf at an objectionable level (2.0 or greater). Bensulide was the most effective of the eight herbicides. Control in the 2nd, 3rd and 4th year was 81%, 96% and 91%, respectively. Butralin and prosulfalin provided control in the 80 percent range by the 3rd and 4th year. The other materials, benefin, DCPA, H-22234, oxadiazon and siduron, provided less than 68% control.

Postemergence control

The herbicide rates and results obtained from the 1976 trial are presented in Table 2. Annual bluegrass decreased in turf areas treated with linuron in August and by November there was an increase in the Kentucky bluegrass stand. During this transition period there was objectionable turf discoloration from

TABLE 1. Percent annual bluegrass cover and control from preemergent type herbicides applied for four years to lawn turf containing annual and Kentucky bluegrass

Herbicide	Rate lb ai/A 1975 Sept	1976-77-78 April	1976-77-78 Aug to Sept	Annual bluegrass Percent cover May 1976	Aug 1976	June 1977	May 1978	Oct 1978	Percent control Aug 1976	June 1977	Oct 1978
Benefin (gran)	2	1	2	14	24	4	18	16	35	68	59
Bensulide	15	5 *	12.5*	2	7	1	4	4	81	96	91
Butralin (gran)	5	2.5	5	4	16	3	6	6	58	80	85
DCPA	12	6	12	22	28	10	25	29	34	49	36
H-22234	2	2	4 **	31	37	12	22	38	31	36	16
H-22234	4	4	4	12	26	5	11	33	39	58	37
Oxadiazon (gran)	3	1.5	3	21	31	6	17	31	26	54	29
Prosulfalin	2	1	2	9	14	2	6	7	62	86	83
Siduron	15	10	15	36	34	9	32	38	28	33	19
Checks	-	-	-	30	37	12	26	39	--	--	--

* 6.25 & 12.5 lb in 1977, 7.5 & 10 lb in 1978.

** 2 lb in 1977, 1978

TABLE 2. Annual and Kentucky bluegrass cover in a mixed turf after postemergent treatment with linuron in 1976.

Herbicide Aug 13	Rate lb ai/A	Percent cover Nov 4 Annual bluegrass	Kentucky bluegrass
Linuron	2.25	21	65
Linuron	4.5	7	68
Linuron	9.0	1	54
Linuron	13.5	1	49
Check	-	58	40

TABLE 3. Influence of postemergent treatment with diuron and linuron in 1977 on a mixed stand of annual and 'Baron' Kentucky bluegrass

Herbicide * Aug 5	Rate lb ai/A	Annual bluegrass Percent cover Aug 5	Oct 13	Percent change	Kentucky bluegrass Percent cover Aug 5	Oct 13	Percent change
Diuron	3.0	46	0	- 100	26	1	- 96
Linuron	2.25	40	16	- 60	30	52	+ 73
Linuron	3.0	36	6	- 83	27	50	+ 85
Linuron (gran)	4.2	41	16	- 61	30	42	+ 40
Check	-	33	43	+ 30	34	40	+ 18

* Watered in after treatment

all treatments. Although there was some discoloration to Kentucky bluegrass, especially at rates of 4.5 lb and above, most of it was attributed to injured and dead annual bluegrass. In a separate test, on the same date, in a pure stand of Kentucky bluegrass, the maximum discoloration from rates of 2.25, 4.5, 9.0 and 13.5 lbs was 0.8, 2.2, 4.5 and 5.5, respectively.

Although there was an increase in Kentucky bluegrass in treated areas the plots lacked complete cover or density due to the loss of annual bluegrass. Thin turf stands and objectionable discolored turf might be avoided by starting treatment before annual bluegrass constitutes more than 15 to 20 percent of the turf or gradually removing the annual bluegrass with repeated herbicide treatments for several seasons. To make the annual bluegrass eradication program successful (1) Kentucky bluegrass density should be encouraged by proper management, fertilization and reseeding, (2) new annual bluegrass plants from seed should be prevented by the use of preemergence herbicides and (3) the effect <u>any</u> herbicide may have on the establishment and spread of Kentucky bluegrass, especially from seed, should be considered.

The data from the use of diuron and linuron in 1977 in a mixed turf stand are presented in Table 3. As in the 1976 test at the completion of the study there was less annual bluegrass and more Kentucky bluegrass in areas treated with linuron. The spray application of linuron at the 2.25 lb rate and the granular application at the 4.2 lb rate performed about the same. Diuron applied at the rate of 3 lbs almost completely eliminated both bluegrass species. Injury and death of the annual bluegrass, as in the 1976 test, contributed to overall turf discoloration and thin turf stands. There is again the need to encourage the growth and spread of Kentucky bluegrass or for the gradual removal of annual bluegrass so that total turf density is not decreased, especially when annual bluegrass cover is high.

The effect of 18 herbicide treatments applied twice in 1978 to a mixed stand of annual and Kentucky bluegrass are presented in Table 4. All treatments except granular linuron and MH + CF produced objectionable discoloration sometime during the test. Endothall, endothall + DSMA and terbacil provided discoloration from both the May and August applications. The latter two caused more injury from the August treatment while endothall alone caused more injury when applied in May. The granular formulation of endothall used at three times the rate of the spray formulation caused less turf discoloration. Diuron and linuron produced no objectionable discoloration from the May application. There was a trend for the watered in linuron spray not to discolor Kentucky bluegrass or discourage its growth compared to not watering it in. It rained 2 days after the May treatment and not for 10 days after the August treatment.

The 1 lb rate of diuron and the .5, 1.0 and 1.5 lb rates of terbacil caused a decrease in both annual and Kentucky bluegrass. The reduction in total grass cover from these four treatments ranged from 39 to 76 percent. Ten other treatments resulted in an increase in total grass cover (up to 41%). The spray linuron treatment at the 3 lb rate showed a 5% decrease in total cover. There was no change in annual bluegrass cover from May to October using the two rates of MH + CF or granular linuron at the 2.25 lb rate. The other 15 treatments provided a reduction in annual bluegrass ranging from

TABLE 4. Effect of postemergent herbicide applications in 1978 on the population of annual bluegrass and Kentucky bluegrass in a mixed turf.

Herbicide	Rate lb ai/A May & Aug 22 18	Annual bluegrass Percent cover May 22	July 14	Oct 5	% change May to Oct	Kentucky bluegrass Percent cover May 22	July 14	Oct 5	% change May to Oct
Diuron	.5 *	23	18	3	- 87	60	76	88	+ 47
Diuron	1.0 *	23	8	0	- 100	53	71	36	- 52
Endothall	1	25	14	18	- 28	44	73	78	+ 77
Endothall	2	19	3	4	- 79	43	71	83	+ 93
Endothall (gran)	6	16	7	4	- 75	50	79	89	+ 78
Endothall (gran)	8	29	13	21	- 28	58	73	77	+ 33
Endothall + DSMA	1 + 5	22	19	16	- 27	54	68	74	+ 44
Linuron	2.25	24	21	2	- 92	51	69	77	+ 51
Linuron	2.25 *	19	15	2	- 89	57	79	94	+ 65
Linuron	3 *	21	15	1	- 95	55	76	71	+ 29
Linuron (gran)	2.25 *	20	20	20	0	61	76	78	+ 28
Linuron (gran)	3 *	31	23	14	- 55	47	73	71	+ 51
MH + CF	1 + .5	35	39	35	0	41	53	56	+ 37
MH + CF	1.5 + .75	21	23	21	0	68	75	77	+ 13
Terbacil	.25	31	17	11	- 65	45	62	76	+ 69
Terbacil	.5	22	8	0	- 100	55	62	38	- 31
Terbacil	1.0	16	2	0	- 100	63	40	3	- 95
Terbacil	1.5	22	1	0	- 100	50	10	1	- 98
Check	-	30	32	46	+ 53	55	66	53	- 4
Check	-	26	29	34	+ 31	45	62	64	+ 42

* Watered in after treatment

27 to 100 percent. Areas treated with 11 of these materials had more Kentucky bluegrass cover (28 to 93 percent).

Based on the least discoloration, the greatest reduction in annual bluegrass and the best increase in Kentucky bluegrass and total grass cover the following postemergence treatments appeared the most promising: diuron at .5 lb, endothall spray at 2 lb, endothall granular at 6 lb, linuron spray at 2.25 lb, linuron granular at 3 lb and terbacil at .25 lb. Possibly the best technique would be to use repeated low rates of these materials for the gradual removal of annual bluegrass coupled with techniques to encourage Kentucky bluegrass growth.

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EFFECT OF BROADLEAVED WEED CONTROL HERBICIDES ON TURFGRASS RENOVATION OVERSEEDING[1/]

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ABSTRACT

Renovation of heavily used athletic fields must often be done during the short period from May to September. When herbicides useage is included in the program to control summer annual weeds seeding has often been delayed. Experiments were run during 1977 and 1978 to determine whether the delay between herbicide application and seeding could be eliminated by seeding with a grassland-type seeder rather than by normal broadcast seeding. Combinations of several standard turf herbicides were applied to areas to be renovated prior to, at the time of and on seedling turf. Results indicated that it was safe to apply these herbicides before or just after seeding but not for some weeks following germination.

INTRODUCTION

Annual renovation of heavily used grassed football, soccer and certain other athletic fields is nearly always a requirement. School and municipal athletic fields generally receive heavy use during the fall and spring seasons. Frequently, the only time they are not in use is during summer months. It is only during the short period from May through August that many of these fields are out of play and can be renovated.

Throughout the Northeast it is common that Knotweed (Polygonum aviculare L.), and possibly other lawn weeds, may be present in abundance by the time late spring renovations are to be initiated. It is often necessary to eliminate Knotweed, in particular, if a successful reseeding is to be accomplished. Although there are a number of herbicides or combinations available for Knotweed and general broadleaved weed control in turf (3, 4) general label directions suggest delaying seeding for several weeks after herbicide application. Herbicide application following seeding has also been discouraged because of potential injury to germinating seed or to seedlings (1, 2). These herbicide recommendations relate to the standard practice of surface scarification of damaged turf areas and subsequent broadcast distribution of seed. With this method of renovation most of the seed remains on or near the soil surface.

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In recent years a grassland-type slicer-seeder (Jacobsen seeder) has become a commonplace implement for turf renovation. When properly used this machine slices grooves through the turf and into the soil where seed is deposited below the soil surface. Since most of the seed is placed beneath the soil surface it was thought that perhaps herbicides could safely be applied just before or just after seeding and thus save time during the very short period available for these renovations. A pilot study in 1976 indicated such a possibility (5). Trials were carried out during 1977 and 1978 for the purpose of determining whether potential herbicides could be safely used just before or after renovation seeding.

MATERIALS AND METHODS

The initial 1977 trial was established on a nearly bare high school football field in North Kingstown, R.I. Initial herbicide applications to plots were made on April 26 and seedings were made with a Jacobsen tractor mounted seeder (Model 548-100) on May 13. A 50-50 mixture of improved varieties of Kentucky bluegrass (*Poa pratensis* L.) and perennial ryegrass (*Lolium perenne* L.) was used. Seeding was done twice over at right angles to each other. Herbicides were applied to additional plots immediately after seeding. Plot size was 6 by 15 feet and treatments were in triplicate. Herbicides were applied in water with a CO_2 pressurized sprayer at the rate of 50 gpa. An application of Siduron [1-(2-methylcyclohexyl)-3-phenylurea] in granular form was applied to the entire field on May 15. This treatment failed to provide crabgrass control. Several applications of methane-arsonates were applied later in the season in an effort to reduce a heavy crabgrass stand. Estimates of grass cover and weed population were taken 17 weeks after seeding.

A second trial was established at the turfgrass research farm of the R.I. Agricultural Experiment Station in May and June, 1977. A series of herbicides were applied two weeks before, at seeding and three weeks after seeding Kentucky bluegrass with a Jacobsen seeder (Model 524-100). Plot size was 4 by 4 feet, treatments were in triplicate and materials were applied in water with a CO_2 pressurized sprayer at 50 gpa. Turf stand estimates were taken seven weeks after seeding.

Two studies were made during 1978 for the purpose of observing the effect of herbicides on turf establishment following renovations. The first trial was located on a newly seeded lawn on the university grounds. A broadcast seeding utilizing a mixture of Kentucky bluegrass, red fescue (*Festuca rubra* L.) and perennial ryegrass was made in late April. Prior to emergence several herbicide combinations were applied for the purpose of observing their effect on establishment. Materials were applied as in the previous tests at the rate of 86 gpa, plot size was 4.5 by 4.5 feet and treatments were in triplicate. Estimates of percent grass cover were made at 8, 14 and 26 weeks after treatment.

A second 1978 trial was seeded on a local sod farm with a Jacobsen seeder (Model 524-100) on April 28 and several herbicides and combinations were applied the same day, after seeding, and again on June 2 - five weeks after seeding. Materials were applied in water, as in previous tests, at the rate of 86 gpa. Plot size was 4.5 by 4.5 feet and treatments were triplicated. The seeded grass was "Baron" Kentucky bluegrass and the seeder was run in one direction only. An estimate of turf stand was made 14 and 26 weeks after chemical treatment. All tests in both seasons were irrigated as needed to assure germination and subsequent growth.

RESULTS AND DISCUSSION

The herbicide treatments and data obtained from the 1977 study on the high school football field are presented in Table 1. The test was initiated as early in the season as the field was free from use and the last stand estimates were taken just prior to the time the field was again to be used. Stand estimates taken just before seeding show that the field was nearly devoid of turf (less than 6%). Knotweed seed had already germinated and seedling plants were present when the first herbicide applications were made.

When comparing the September turf stands it is obvious that there is little difference whether herbicides were applied 17 days prior to seeding or on the day of seeding. Grass stands on all treated plots ranged from 62 to 76 percent. On the untreated plots the stand averaged only 12 percent. Knotweed control appeared slightly better on those plots treated on the earlier date but in both cases the stand was thinned sufficiently to permit good turf seed germination and stand development. No single herbicide combination proved superior.

Results of the second 1977 trial also demonstrated that herbicide application could safely be made the day of seeding as well as two weeks prior. The herbicides included are listed in Table 2 along with the estimated percent turf stand taken seven weeks after seeding. Where the herbicides were applied to seedling turf some stand reduction generally resulted. This occurred with all combinations of systemic materials used for broadleaved weed control.

The results of the 1978 trial on a campus lawn in which herbicides were applied to a newly seeded lawn after broadcast seeding but before germination are presented in Table 3. Siduron had no adverse effect on turf stand and the systemics only slightly reduced stand as seen at all reading dates. Seedling counts of each species in the seed mixture were made 14 weeks after treatment. Kentucky bluegrass and perennial ryegrass seedlings showed no reduction over the check but the red fescue stand was slightly reduced. It is possible that the slight reduction in stand at each interval reflected this loss.

This trial was somewhat unlike a routine renovation in that the soil surface was friable at seeding and the seed could more readily be mixed into and covered by soil.

The treatments and results of the second 1978 trial, located on a sod farm near the University, are shown in Table 4. As was the case in earlier trials no turfgrass injury or stand reduction was detected when any of the herbicides were applied just after seeding. Considerable stand reduction occurred when herbicides were applied to young turf five weeks after seeding.

Based on test results during 1977 and 1978 it appears completely safe to apply standard broadleaved turf herbicides prior to or just after renovation seeding, when seeding is done with a implement such as the Jacobsen seeder. Not having to delay seeding following herbicide application will allow added weeks for better establishment of renovated turf.

Table 1. Effect of herbicides applied before and at seeding with a Jacobsen seeder on grass stand and Knotweed stand at the North Kingstown High School football field in 1977.

Herbicide Treatment	Rate (lb ai/A)	Percent Stand 17 weeks after seeding (Sept.) Grass	Knotweed
17 days before seeding			
2,4-D+dicamba	1+.25	62	6
2,4-D+mecoprop	1+1	70	18
2,4-D+silvex	1+.5	75	8
2,4-D+silvex+dicamba	1+.5+.125	74	3
2,4-D+mecoprop+dicamba	1+.5+.125	72	9
2,4-D+mecoprop+dicamba+DSMA	1+.5+.125+4	62	12
At seeding (May 13, 1974)			
2,4-D+dicamba	1+.25	67	10
2,4-D+mecoprop	1+1	68	20
2,4-D+silvex	1+.5	62	16
2,4-D+silvex+dicamba	1+.5+.125	62	13
2,4-D+mecoprop+dicamba	1+.5+.125	67	8
2,4-D+mecoprop+dicamba+DSMA	1+.5+.125+4	76	13
Check		12	81

Table 2. Effect of herbicides on Kentucky bluegrass seeding made with Jacobsen seeder - June 9, 1977.

Herbicide		% Ky. Bluegrass Stand-7 wk after seeding Herbicide related to seeding: 2 weeks before	at seeding	3 weeks* after
Siduron	10	28	36	24
2,4-D+silvex+dicamba	1+.5+.125	37	23	9
2,4-D+silvex+dicamba+siduron	1+.5+.125+10	--	36	18
2,4-D+silvex+dicamba+siduron+DSMA	1+.5+.125+10+4	--	35	13
2,4-D+mecoprop+dicamba	1+.5+.125	34	27	19
2,4-D+mecoprop+dicamba+siduron	1+.5+.125+10	--	30	18
2,4-D+mecoprop+dicamba+siduron+DSMA	1+.5+.125+10+4	--	30	19
Siduron+DSMA	10+4	--	29	32
DSMA	4	--	30	26
Check		26	26	26

*Seedlings with an average of 3 blades.

Table 3. Effect of herbicides on grass stand when applied after a broadcast seeding in 1978.

Herbicide Treatment	Rate lbs/A	Percent Grass Stand After Treatment		
		8 weeks	14 weeks	26 weeks
After broadcast seeding and before emergence (April 25)				
2,4-D+dicamba+siduron	1+.25+10	48	54	62
2,4-D+mecoprop+siduron	1+1+10	51	57	66
2,4-D+silvex+siduron	1+.5+10	46	48	66
Siduron	10	58	60	72
Checks	----	65	56	73

Table 4. Effect of herbicides on "Baron" Kentucky bluegrass when applied at seeding (Jacobsen Seeder) and on seedling turf in 1978.

Herbicide Treatment	Rate lbs/A	Percent Grass Stand		
		In Seeded rows 8 weeks after seeding	In whole plots after seeding 14 weeks	26 weeks
At Seeding (April 28)				
2,4-D+dicamba	1+.25	55	44	89
2,4-D+mecoprop	1+1	64	58	84
2,4-D+silvex	1+.5	47	41	74
2,4-D+silvex+dicamba+siduron+DSMA	1+.5+25+10+4	63	48	77
Siduron	10	64	49	79
DSMA	4	71	53	82
5 weeks after seeding (June 2)*				
2,4-D+dicamba	1+.25	33	28	65
2,4-D+mecoprop	1+1	16	17	50
2,4-D+silvex	1+.5	24	22	64
Checks	----	55	45	74

*Seedlings averaged 4 blades per plant on this date.

Some stand reduction may be expected if herbicides are applied on broadcast seeded renovations. Seedling loss and stand reduction may result when applying systemic herbicides to seedling turf.

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Effects of Mefluidide and MH on Tall Fescue.

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ABSTRACT

Mefluidide (granular and liquid formulations) and MH were applied to tall fescue to evaluate growth retardation and injury. All treated turf was shorter than untreated with the high rate of the granular and liquid mefluidide causing more retardation than MH. All treatments caused color losses, with the liquid formulation of mefluidide causing the most discoloration. The granular formulation of mefluidide caused less discoloration than the liquid, even when applied at a high rate. Fresh weight yields taken approximately four weeks after treatment revealed that the high rate of the granular and liquid mefluidide caused the most retardation. Density (based on tiller counts) measured nine months after treatment was not appreciably affected by application of mefluidide, however MH caused approximately a 20 percent reduction in tiller number.

INTRODUCTION

Testing of growth regulators on several turfgrass species has continued at several locations in the recent past (1, 2, 3, 4, 5, 6, 7, 8). Mefluidide N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide has been reported to have good retarding capability at low rates, but with some phytotoxicity (3, 4, 5, 6, 7, 8).

The objectives of this research were; 1) to compare the retarding capabilities of mefluidide and MH (1,2-dihydro-3,6-pyridazinedione), and 2) to determine whether the phytotoxicity of mefluidide would be lessened by application of a granular form to tall fescue (*Festuca arundinacea* Schreb.).

MATERIALS AND METHODS

In 1976, two growth regulators were applied to a six-year-old stand of Kentucky 31 tall fescue at The Joseph Valentine Turfgrass Research Center, The Pennsylvania State University. The two chemicals used were mefluidide and MH. Sprayed formulations were applied with a hand held boom sprayer and the granular formulation of mefluidide (0.25G) was applied with a drop-type spreader. All plots were 0.9 by 3.7 m with three replications per treatment. No irrigation or fungicides were applied during the test. Color was rated three times after application. Height was measured the same day color was

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rated. Five locations per plot were measured for height using a graduated metal rod with a flat base (9.6 cm^2) which kept the rod flush with the soil surface. The rod was inserted through a circular rigid paper disc (182 cm^2) which was vertically movable. The disc was allowed to slide down the rod until it was resting on top of the leaf canopy and height was then read from the rod. Clippings from a 51 cm x 3 m swath made with a rotary mower set a 5 cm height were collected and weighed (fresh) on August 10. Density was measured by counting tillers in three sod plugs (81 cm^2) per plot taken May 10, 1977.

RESULTS AND DISCUSSION

Color ratings were taken to assess the degree and longevity of phytotoxic effects to tall fescue (Table 1). All treatments reduced color with the EC formulation of mefluidide causing the most severe and long lasting discoloration. The low rate (0.56 kg/ha) of the granular mefluidide formulation caused the least injury. Mefluidide has been previously shown to injure tall fescue more than MH (5). Formulation as a granule appeared to effectively reduce the phytotoxicity, even at a higher rate (1.12 kg/ha compared to 0.28 kg/ha for the liquid). By August 24 (approximately, six weeks after treatment) all turf but that treated with liquid mefluidide had improved color (equivalent to the non treated turf).

All treated turf was considerably shorter than the check on July 27. Height of turf treated at the low rate of granular mefluidide and MH was comparable throughout the treatment period (Table 2). Turf treated at the high rate of the granular and the liquid formulation of mefluidide caused more retardation than MH on all three measurement dates. From July 27 to August 24 height increases for all treated turf were greater than for non treated turf. Apparently, most of the retarding affect occurred from the application date to July 27.

Fresh weight yields reflected the differences seen for heights (Table 3). The high rate of granular mefluidide and the liquid formulation caused more growth reduction than the low rate of the granular and MH. All treatments caused considerably lower foliage yields than the check. These weights were taken approximately four weeks after application which has been shown to be the expected duration of growth suppression when these materials are applied at the rates used here (6, 7). Consequently, it was assumed that these weights reflected maximum differences in growth suppression.

It has been shown that mefluidide had a slight effect on density of Kentucky bluegrass (*Poa pratensis* L.) (8). Approximately nine months after application of the materials in this test, density measurements did not reflect any thinning (Table 3). The density of turf treated with MH was reduced approximately 20 percent over untreated turf. The previous report of density decreases from mefluidide applications was for turf that had received more than one application during the season. Reapplication of growth regulators to obtain season long growth suppresion may not be advisable.

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Table 1. Color ratings of tall fescue treated with mefluidide and MH on July 8 and 9, 1976.

Material	Application Dates and rates (kg/ha) (7/8)	(7/9)	Observation Dates 7/27	8/5	8/24
Mefluidide 0.25G	0.56		8.3[a]	8.0	9.0
Mefluidide 0.25G	1.12		8.3	7.3	9.0
Mefluidide 4EC		0.28	8.0	7.0	7.0
MH 3EC		2.24	9.0	7.6	8.0
Check	0.00		9.0	9.0	9.0

[a]Color rating; 0-10, 0 = yellow, 10 = dark green.

Table 2. Height measurements of tall fescue treated with mefluidide and MH on July 8 and 9, 1976.

Material	Application Dates and Rates (kg/ha) (7/8)	(7/9)	Measurement Dates 7/27	8/5	8/24
			cm		
Mefluidide 0.25G	0.56		7.9[a]	9.1	9.9
Mefluidide 0.25G	1.12		7.2	7.6	8.9
Mefluidide 4EC		0.28	7.0	7.5	9.3
MH 3EC		2.24	8.2	9.3	10.4
Check	0.00		12.0	12.2	13.4

[a]Height of turf at application was approximately 5 cm.

Table 3. The effect of mefluidide and MH on weight (taken August 10, 1976) and density (tiller counts made 5/10/77) of tall fescue.

Material	Application Dates and Rates (kg/ha) (7/8)	(7/9)	Weight (g)	Tiller Counts
Mefluidide 0.25G	0.56		119	51
Mefluidide 0.25G	1.12		73	54
Mefluidide 4EC		0.28	40	47
MH 3EC		2.24	159	43
Check	0.00		437	52

USE OF ORGANIC SOLVENTS IN THE SCREENING OF HERBICIDES AND GROWTH REGULATORS 1/

Robert M. Devlin, Marian J. Kisiel and
Andrzej S. Kostusiak 2/

ABSTRACT

The organic solvents petroleum ether, chloroform, ethyl ether and acetone were tested for their influence on the germination and seedling growth of wheat (*Triticum aestivum* L. 'Mericopa') and corn (*Zea mays* L. Merit). The purpose of the testing was to determine if the solvents could be used as carriers for water insoluble herbicides or growth regulators when screening of these compounds becomes necessary as part of their commercial development. Petroleum ether, ethyl ether, and acetone did not appreciably affect growth and thus can be used as carrier solvents for screening purposes.

INTRODUCTION

The screening of new herbicides and growth regulators is an important part of their development for commercial use by the agricultural chemical industry. Often the chemicals to be screened are not soluble in water and are thus hard to work with and test on living plants. In this study we have shown that a number of parameters of plant growth are not affected by certain organic

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solvents and that these solvents can be used to introduce water insoluble herbicides or growth regulators to the plant.

MATERIALS AND METHODS

Corn and wheat seeds were soaked for 0, 6, 12, 18, and 24 h in petroleum ether, chloroform, ethyl ether, and acetone. After soaking the seeds were placed on paper towels and allowed to dry for 2 hr under a fume hood. The seeds were then sown in styrofoam pots containing pre-wet vermiculite and placed in a Percival growth chamber (Model E-540) where constant conditions of light (white, 10.8 klux, 18 h light and 6 h dark) and temperature (25 1°C) were maintained. Eight high-output fluorescent lamps (F48T 12-CW-HO) and four 60-W incandescent light bulbs provided the light source. After 8 days of growth seedlings were collected and root and shoot lengths measured. Dry weight of shoot tissue was also determined.

For germination tests, treated (as described above) seeds were placed in petri dishes containing 3 pads of filter paper (Whatman No. 1) and 10 ml of water for wheat seeds and 40 ml of water for corn seeds. Each petri dish held 50 seeds and one of the pads of filter paper was used to cover the seeds. This, in turn, was covered by the glass top of the petri dish. Constant conditions were maintained by allowing the seeds to germinate in a growth chamber. After 72 h germination was recorded.

All experiments, including the seedling growth tests as well as the germination tests, were replicated 4 times.

RESULTS

Shoot and root lengths of both corn and wheat were not affected by petroleum ether even when soaked for 24 h (Tables 1 & 2). Decreases in corn shoot dry weight were observed but these were slight and erratic. Shoot dry weight of wheat was not influenced by petroleum ether (Table 2).

Shoot length, root length, and shoot dry weight were all reduced for corn seeds soaked in chloroform for 12, 18, and 24 h (Table 1). Wheat seeds were less sensitive to chloroform. For example, root length was not reduced even after the seeds were soaked for 24 h and shoot length was only reduced after 18 and 24 h treatments with the solvent (Table 2).

Similarly, shoot dry weight of wheat seedlings was significantly reduced after 18 and 24 h exposures to chloroform (Table 2).

Shoot length, root length, and shoot dry weight for both corn and wheat were not influenced by ethyl ether treatments (Tables 1 & 2).

Corn shoot length was significantly reduced when the seeds were soaked for 24 h in acetone (Table 1). However, significant reductions in root length and shoot dry weight of corn were observed for all exposures to acetone (Table 1). In contrast, shoot length, root length, and shoot dry weight of wheat were not affected by acetone (Table 2).

Petroleum ether and ethyl ether had only a slight effect on the germination of corn seeds. For example, the germination of seeds soaked for 24 h in petroleum ether or ethyl ether was reduced 6% and 7% respectively (Table 3). Germination of corn seeds was considerably reduced by chloroform, a 73% reduction being observed for those seeds soaked for 18 h in the solvent (Table 3). Acetone also inhibited germination of corn seeds but only after prolonged exposure to the solvent (Table 3).

Germination of wheat seeds responded to petroleum ether in much the same manner as corn seeds. In contrast, however, ethyl ether dramatically reduced germination of wheat seeds (Table 4). For example, a 12 h soaking of corn seeds in ethyl ether only reduced germination by 4.5%, but the same exposure time for wheat seeds reduced germination by 64%. As it did with corn seeds, chloroform inhibited wheat seed germination (Table 4). Germination was only slightly affected by acetone (Table 4).

DISCUSSION

Previous studies (1,2,3,4,5) using organic solvents as a convenient way to carry relatively water-insoluble compounds into the seed, primarily described the influence these compounds had on germination. In this study not only were the effects of different solvents on germination determined but also the effects of the solvents on seedling growth. It is apparent that Petroleum ether, ethyl ether, and acetone do not appreciably affect growth. It is thus possible that these solvents could be used as a way to carry water-insoluble herbicides or growth regulators into a seed for screening purposes. That is, the effect of the compound being screened on the growth of the plant could be

determined without fear of contaminating influences from the solvent.

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Table 1. Influence of four organic solvents on the shoot length, root length, and shoot dry weight of corn. Shoot and root lengths are given in mm and dry weight in mg.

Soaking Time (h)		Petroleum Ether			Chloroform			Ethyl Ether			Acetone		
		Shoot (mm)	Root (mm)	Dry (wgt)	Shoot (mm)	Root (mm)	Dry (wgt)	Shoot (mm)	Root (mm)	Dry (wgt)	Shoot (mm)	Root (mm)	Dry (wgt)
0		89	150	264	96	172	264	93	170	251	92	190	244
6		86	148	245	96	136	260	94	145	262	86	153	217
12		89	151	240	85	145	218	93	140	261	86	148	213
18		94	157	257	89	141	215	94	149	251	83	137	197
24		86	147	235	83	138	175	94	152	260	78	151	190
LSD	5%	8	23	21	9	11	34	3	22	28	10	24	18
	1%	12	32	29	12	15	46	4	31	39	13	34	24

Table 2. Influence of four organic solvents on the shoot length, root length, and shoot dry weight of wheat. Shoot and root lengths are given in mm and dry weight in mg.

Soaking Time (h)		Petroleum Ether			Chloroform			Ethyl Ether			Acetone		
		Shoot (mm)	Root (mm)	Dry (wgt)	Shoot (mm)	Root (mm)	Dry (wgt)	Shoot (mm)	Root (mm)	Dry (wgt)	Shoot (mm)	Root (mm)	Dry (wgt)
0		157	168	144	145	156	124	153	162	135	158	154	135
6		150	174	140	145	164	125	148	173	122	163	162	144
12		149	165	138	144	163	126	145	170	125	157	163	140
18		156	164	141	134	165	101	151	171	130	156	152	136
24		155	167	147	130	163	108	143	169	121	154	158	133
LSD	5%	9	16	13	10	10	16	11	24	18	8	11	12
	1%	12	22	18	13	13	22	15	34	25	11	15	17

Table 3. Effect of four organic solvents on the germination of corn seeds.

Soaking Time (h)	Petroleum Ether	Chloroform	Ethyl Ether	Acetone
0	99.0	99.5	99.5	99.0
6	98.0	72.0	97.0	95.0
12	95.5	46.0	95.0	86.5
18	95.0	27.0	95.0	71.0
24	93.5	29.0	93.0	44.0
LSD 5%	3.4	11.1	2.0	5.7
1%	4.7	15.3	2.8	7.9

Table 4. Effect of four organic solvents on the germination of wheat seeds.

Soaking Time (h)	Petroleum Ether	Chloroform	Ethyl Ether	Acetone
0	95.0	92.0	94.5	92.0
6	94.0	84.0	74.5	94.5
12	95.0	41.0	33.5	91.5
18	89.0	23.0	23.5	90.0
24	89.0	15.5	20.5	83.0
LSD 5%	5.1	12.0	6.8	4.7
1%	7.1	16.6	9.3	6.5

Control of Fall Panicum Seed Dormancy by Light

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ABSTRACT

Laboratory studies have shown that seeds of fall panicum (*Panicum dichotomiflorum* Michx.) have an intense dormancy, which is difficult to overcome by pretreatment of the dry seeds with an accelerated after-ripening. A more effective pretreatment is a 35°C dark imbibition for a week. In either case, activation of phytochrome by red radiation is required for germination. The red-induced germination is completely reversible by far-red radiation; direct evidence for phytochrome control. A further requirement for germination is an alternating temperature. The results suggest a multiple form of dormancy. The initial form does not allow a response to light and is overcome by imbibition at a high temperature. The residual dormancy is controlled by phytochrome.

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THE ALLELOPATHIC EFFECTS OF DECAYING QUACKGRASS (*Agropyron repens* L.) RESIDUES

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ABSTRACT

Experiments were conducted to study the effect of incubation temperature (5°, 10°, 20° and 30°C) on the phytotoxic activity of decaying quackgrass leaves and rhizomes that were incubated for 0, 1, 2, 4 and 6 weeks. Alfalfa seeds were germinated for 96 hours in water, water extracts of control soils, and water extracts of soil with quackgrass rhizomes or leaves. The data showed that dried quackgrass rhizomes and leaves contained water soluble toxins that inhibited the growth and germination of alfalfa. There is a strong interaction of incubation time and temperature on the development of additional toxins by decomposing quackgrass. High incubation temperature, 30°C, accelerated toxin formation and ultimate decay. Intermediate temperature, 20°C, delayed toxin formation and decay. Low incubation temperatures, 5°C and 10°C, prevented formation of additional toxin. In all extracts of quackgrass and soil that had been incubated for 6 weeks alfalfa germination equaled that in water.

Treatment of quackgrass with herbicide glyphosate in the greenhouse did not influence the toxicity of decaying quackgrass leaves. The highest toxic effect was noted after one week of decay on the soil surface.

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WEED CONTROL AND PHYTOTOXICITY WITH HERBICIDES IN FIVE TOMATO VARIETIES

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ABSTRACT

Two experiments were conducted on a Haven loam soil at the Long Island Horticultural Research Farm to evaluate the efficacy of selected herbicides on weeds present and also to look for phytotoxic effects on five varieties of tomatoes (Lycopersicon esculentum Mill.).

Preemergence treatments of napropramide, metribuzin, trifluralin, or diphenamid resulted in effective control of barnyardgrass (Eschinochloa crus-gali (L.) Beauv.) and purslane (Portulaca oleracea L.) at the first assessment date, June 15. By mid-June, postemergence treatments of metribuzin were required to control both of these weed species. Napropramide provided good control of fall panicum (Panicum dichotomiflorum Michx.) and crabgrass (Digitaria sanguinalis (L.) Scop.) but was inadequate on purslane at the June 28 assessment. The addition of metribuzin post provided excellent control of the weeds present but was visibly phytotoxic to the varieties Jet Star, Red Pak, and Ramapo. There is also evidence that napropramide slightly depressed the early yield of Ramapo although the differences in yield were not significant. From these experiments, it is evident that metribuzin rates above 0.28 K/ha may cause injury to a number of tomato varieties.

INTRODUCTION

In preliminary experiments, some phytotoxic effects have been noticed resulting from treatments of metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5 4*H*)-one) post emergence to a number of tomato varieties. The present experiments were conducted to determine if these treatments had significant effects on yields of the varieties Early Girl, Better Boy, Ramapo, Red Pak, and Jet Star. Metribuzin shows a great deal of potential as a tomato herbicide because it can be used postemergence and has broad spectrum activity, particularly for some of our problem weeds (1,2). If growers are to use this material commercially, they must be aware of the phytotoxic effects particularly if it is related to variety.

MATERIALS AND METHODS

The tomato varieties Jet Star, Red Pak, Ramapo, Early Girl, and Better Boy were seeded in flats in a greenhouse on April 17 and transplanted to the field on May 30. Preemergence treatments were applied on May 29, using a tractor-mounted sprayer delivering 61 l/ha at 2.4 atm. Each plot was represented by four plants with one meter between plants. Treatments were replicated four times with a 1.5 m check between treatments.

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In the first experiment napropramide (2-(*a*-naphthoxy)-*N*,*N*-diethylpropionamide) at 1.12 kg/ha and metribuzin at 0.56 kg/ha were applied prior to transplanting. A metribuzin treatment was followed by a post treatment of 0.28 kg/ha metribuzin.

In the second experiment, the variety Jet Star was used with the materials trifluralin (*a*,*a*,*a*-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine) at 0.56 kg; napropramide at 1.12 kg; metribuzin at 0.28 kg and 0.56 kg/ha; and diphenamid (*N*,*N*-dimethyl-2,2-diphenylacetamide) at 2.24 kg/ha applied preemergence. The trifluralin treatment was followed by a metribuzin treatment at 0.28 K/ha on June 12, and the napropamide and diphenamid treatments were followed by the same rate of metribuzin on June 20. The trifluralin treatment required a second application of metribuzin on June 30.

Ratings were made for the control of barnyardgrass and purslane on June 15 and June 28. Ratings for fall panicum and crabgrass were made on June 28. Phytotoxicity ratings were also made on June 15. Harvest data included fruit counts and weight of ripe, marketable fruit.

RESULTS AND DISCUSSION

As indicated in Tables 1 and 3, all of the treatments were effective for the control of barnyardgrass and purslane at the June 15 assessment. Trifluralin required an early postemergence treatment of metribuzin. Napropamide and diphenamid required the same postemergence treatment on June 20 to control emerging weeds. On the June 28 assessment, napropamide at 1.12 kg/ha maintained control of fall panicum and crabgrass, but was marginal on purslane. The application of metribuzin at 0.28 kg/ha postemergence provided excellent control of those weeds present where preemergence materials were becoming less effective.

Metribuzin at 0.56 kg/ha was visibly phytotoxic to all of the varieties tested and depressed or delayed yields of Jet Star, Red Pak, and Ramapo. Napropamide also depressed yields of Ramapo. However, the differences in yields were not statistically significant. Harvest data was taken only during the month of August and discontinued early, which would be at a disadvantage to the mid- and late-season varieties, particularly Ramapo.

From these experiments, it appears that a dosage of 0.56 K/ha metribuzin pre- or postemergence could readily cause phytotoxic symptoms on a number of varieties and that growers need to be aware of this. The lower rate (0.28 K/ha) of metribuzin caused less injury and provided excellent weed control.

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Table 1. Percent weed control with herbicides in tomatoes.

Chemical	Rate K/ha	Timing	Weed Control Ratings					
			Barnyard grass		Purslane		Fall Panicum	Crabgrass
			6/15	6/26	6/15	6/26	6/28	6/28
napropamide	1.12	pre	84	77	63	64	95	89
metribuzin	0.56	pre	99	96	99	97	95	98
metribuzin + metribuzin	0.56 0.28	pre post	98	96	99	99	98	99
Check[1/]			10	4	13	4	2	3

[1/] Number indicates weed density per 0.3 m^2.

Table 2. Percent phytotoxicity with herbicides and yields[1/] of four tomato varieties.

Chemical	Rate K/ha	Timing	Early Girl Phyto	Early Girl # fruit	Early Girl Wt.	Better Boy Phyto	Better Boy # fruit	Better Boy Wt.	Ramapo Phyto	Ramapo # fruit	Ramapo Wt.	Red Pak Phyto	Red Pak # fruit	Red Pak Wt.
napropamide	1.12	pre	0	315	31.8	5	42	10.4	5	33	5.0	0	108	17.7
metribuzin	0.56	pre	27	210	20.9	5	70	10.9	27	36	5.0	15	65	12.3
metribuzin + metribuzin	0.56 0.28	pre post	5	316	32.7	12	45	8.2	35	22	3.2	5	79	15.0
Check			0	155	20.9	0	57	10.4	0	51	9.5	0	103	20.9

[1/] Yields indicated by number and weight in kilograms of marketable fruit per plot.

Table 3. Percent weed control and phytotoxicity and marketable yields of Jet Star tomatoes.

Chemical	Rate kg/ha	Timing	Weed Control Ratings: Barnyardgrass 6/15	Barnyardgrass 6/28	Purslane 6/15	Purslane 6/28	Fall Panicum 6/28	Crabgrass 6/28	Phyto 6/15	Yield/plot # fruit	Yield/plot kg
trifluralin + metribuzin	0.56 1.12	pre post	87	96	99	99	99	94	0	94	17.3
napropamide + metribuzin	1.12 0.28	pre post	93	98	98	99	99	99	5	110	19.5
metribuzin + metribuzin	0.28 0.28	pre post	99	96	98	99	99	97	5	136	22.7
metribuzin + metribuzin	0.56 0.28	pre post	95	94	96	90		93	12	82	14.5
diphenamid + metribuzin	2.24 0.28	pre post	94	98	97	99	99	98	0	134	20.0
Check[1/]			9	3	6	6	0	2	0	122	20.9

[1/] number indicates weed density per 0.3 m^2.

RESPONSE OF WOODY SPECIES TO GLYPHOSATE IN NORTHEASTERN STATES

L. B. Lynn, R. A. Rogers and J. C. Graham [1/]

ABSTRACT

Glyphosate was evaluated in the northeastern states for control of berries (Rubus spp.), honeysuckle (Lonceria spp.), maples (Acer spp.), oaks (Quercus spp.), multiflora rose (Rosa multiflora), poison ivy (Rhus radicans), trumpet creeper (Campsis radicans), sumac (Rhus glabra), and Japanese bamboo (Polygonum cuspidatum) in numerous situations.

The optimum growth stages for maximum results were characterized by physiological development and time of year. While all listed species had developed enough physiologically to respond to summer applications, several species were much more responsive to fall applications. Reduced or less than desirable control could be attributed to certain environmental and/or physiological stresses. Rates required for control ranged from 1 - 2% vol/vol solution. The importance of complete spray coverage is explained. General responses of the listed species to both summer and fall applications are described.

INTRODUCTION

Glyphosate [N - (phosphonomethyl) glycine], a nonselective postemergence herbicide, introduced in 1971 has demonstrated excellent activity on a diverse group of herbaceous annual and perennial weeds. Numerous investigators have observed glyphosate on woody species.

Varying degrees of success with glyphosate on woody species have lead to questions concerning rates, application dates, and the physiological maturity of the weed in question. In response to these questions and inquiries on woody brush control specifics this paper summarizes over ninety locations in ten northeastern states from 1973-1978.

MATERIALS AND METHODS

The woody/brush species discussed in this paper were growing in numerous situations (Table 1). Experiments are summarized from glyphosate applications made with aerial and mostly handgun/wand devices.

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Spray volume was normally high, except for aerial applications. The spray volume varied by species, location and vegetation density and was not an area function. With the hand-gun/wand devices, spray volume was calibrated to achieve the desired concentration at incipient drip, i.e. spray to wet.

Rates of glyphosate ranged from 1% - 2% solution based on volume/volume formulated product. Treatment dates ranged from the time of initial leaf development (early spring) until almost complete defoliation (late fall).

Evaluations were based on the Cornell rating system and reported as % control for a specific number of days after treatment (DAT).

Table 1. Type of Evaluation sites for Glyphosate on Woody/Brush Species in the Northeast.

Species	Industrial	Forest	Nursery	Grapes	Orchard	Railroad	Fencerow	Ditchbank
Berries (*Rubus* spp.)	x	x	x	x	x	x	x	
Honeysuckle (*Lonceria* spp.)	x						x	x
Maples (*Acer* spp.)	x	x	x					
Oaks (*Quercus* spp.)	x	x	x					
Multiflora Rose (*Rosa* multiflora)	x						x	
Poison Ivy (*Rhus radicans*)	x	x	x	x	x	x		
Trumpet Creeper (*Campsis radicans*)			x	x				
Sumac (*Rhus glabra*)	x			x	x			
Japanese Bamboo (*Polygonum cuspidatum*)	x						x	x

RESULTS AND DISCUSSION

Successful control of the woody species listed in Table 1 with glyphosate was dependent upon the following factors:

1. Physiological stage of growth (leaf maturity)
2. Lack of environmental/physiological stress
3. Proper rate
4. Uniform spray coverage

Physiological Stage of Growth

As with herbaceous species, maximum glyphosate activity on woody species is achieved when plants are at the proper stage of growth. Based on experiments summarized in this report, herbicidal activity was noted for most species with the presence of any leaf tissue. However each species had an optimum time for application to achieve commercially acceptable control. Application times and subsequent plant responses are characterized in Table 2.

Physiological/Environmental Stress

Reduced or less than desirable results with glyphosate on woody species has been noted in several trials. Investigation of parameters affecting these experiments revealed one or more of the following factors involved:

- Drought stress
- Temperature extremes (brush not actively growing)
- Insect damage i.e. beetle defoliation of multiflora rose
- Disease stress

These factors are not unique to woody plants, as they often account for less than desirable control with glyphosate on annual and herbaceous perennial weeds. Seemingly differential herbicidal responses, which are not due to improper rates, can often be explained by these factors.

Table 2. Characteristic Response of Woody Species to Glyphosate

	Time of Glyphosate Applications		
	SPRING	SUMMER	FALL
Plant Leaf Tissue Stage	Mostly Juvenile Less than 50% Leaf Maturity	50-75% Leaves Fully Mature	Most Leaves Mature; Minimal Senescence Occuring
Type of Response	Knock-down of many species, but no long term control.	Commercial control of most species.	Best control of most species as long as leaf tissue present.
Rate Response	Increase rate only speeds up knock-down time.	Increase rates provide symptoms faster and longer duration of control.	Increased rates provide symptoms faster and maximum duration of control.
Physiological Explanation	Insufficient tissue to afford significant translocation to roots.	Mature leaves afford sufficient translocation to roots and rhizome systems.	Mature senescencing leaves translocating rapidly to root and rhizome systems.
Suggested Use	Not recommended.	Recommended.	Best Recommendation.

Proper Rates

As with all herbicides, the proper rate is mandatory to achieve commercial control. A summary of the numerous experments reviewed, indicated that a rate range of 1.0 to 2.0% solution provided control of all the species listed. Variations in response were associated with the time of application (Table 3). The effects of increased rates are outlined in Table 2. However the effects of physiological/environmental stress can be neutralized (up to a certain degree) by increased rates.

Uniform Spray Coverage

Complete spray solution coverage of the foliage of target species is second only to the physiological stage of growth in influencing maximum brush control with glyphosate. The desired coverage can be achieved by incipient drip (spray to wet) applications. With certain woody species the degree of control can be closely correlated with the uniformity of spray coverage. The proliferous growing Japanese bamboo, for instance, readily shows reduced control from less than total spray coverage. Another example of this effect is with Rubus spp., in that less than complete coverage will be reflected as regrowth the following season. Incomplete spray coverage, as with other factors discussed, can account for excessive regeneration the following season. These observations emphasize the importance of the "spray to wet" statement by the manufacturer of glyphosate.

Summary

Control of several woody brush species was demonstrated in several northeastern states. Successful control of berries (Rubus spp.), oaks (Quercus spp.), multiflora rose (Rosa multiflora), poison ivy (Rhus radicans), trumpet creeper (Campsis radicans), sumac (Rhus glabra) and Japanese bamboo (Polygonum cuspidatum) could be attributed to several factors. There is a characteristic seasonal response of woody species to glyphosate that is affected by the stage of growth. Rates required for control of these species generally fell within the range of 1.0% to 2.0% solution. The significance of uniform spray coverage is important to all species, however mandatory with several species. The differential herbicide response was related to time of application (maturity of leaf) rather than rates.

With brush it is extremely important for maximum effectiveness of glyphosate to (1) insure the proper stage of growth (appropriate time of application), (2) treat actively growing plant, (3) apply the proper rate and (4) provide uniform spray coverage.

Table 3. Response of Several Woody Species to Glyphosate

Species	Time of Application	Days After Treatment (DAT) 0-25	20-100	100-200	300-400
		% Control			
Berries (Rubus spp.)	Summer	70-80	85-95	90-100	80-100
	Fall	-	60-75	98-100	90-100
Honey-suckle	Summer	20-40	50-80	80-95	-
	Fall	*	*	*	-
Maples/ Oaks	Summer	-	75-100	100	-
	Fall	*	*	*	*
Multiflora Rose	Summer	80-98	60-100	80-100	100
	Fall	25-30	-	85-100	100
Poison Ivy	Summer	45-55	80-98	98-100	70-90
	Fall	-	75-100	98-100	80-100
Trumpet Creeper	Summer	-	75-98	90-100	-
	Fall	*	*	*	*
Sumac	Summer	70-75	80-100	100	100
	Fall	*	*	*	*
Japanese Bamboo	Summer	70-75	80-100	100	100
	Fall	*	*	*	*

- Data Not Available
* Fall applications limited by deciduous nature of species

Decline in the % control with some species, i.e. berries and poison ivy, was due to reinfestation.

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EFFECT OF GLYPHOSATE ON THE ACTIVITY OF CYANAZINE IN SIMULTANEOUS APPLICATION

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ABSTRACT

Laboratory experiments showed that cyanazine was significantly 'decomposed' in the presence of glyphosate. Precise chemical reactions were unknown, so the term 'decomposition' was used to indicate loss of cyanazine as detected by the pyridine-alkali colorimetric test. This apparent 'decomposition' of cyanazine occurred only when it was air-dried in the presence of glyphosate, and the amount of 'decomposition' increased with the time these herbicides were in contact. Significant 'decomposition' occurred after 1-day and 2-day time periods.

This same trend was indicated when a mixture of cyanazine + glyphosate was applied to soil at 1.12 and 2.24 kg/ha rates, respectively. This mixture was applied preemergent to annual grasses under greenhouse conditions and allowed to persist on the soil surface for 5 days before being leached in with water. A field trial conducted in 1978 indicated that slightly better, but not significantly better, annual grass control was obtained when the mixture of cyanazine + glyphosate was immediately leached in, rather than remaining on the soil surface for a 2-day period. This mixture was applied preemergence to the annual grasses.

Other field and greenhouse trials indicated no loss in cyanazine activity when tank mixed with glyphosate, applied preemergence at label rates and leached in within a day by rainfall or surface watering.

In a subsequent greenhouse experiment, it was determined that distilled or 'hard' water (30.5 ppm Ca and 16.5 ppm Mg) used as herbicide carriers, had no effect on the activity of cyanazine when applied preemergence with glyphosate.

The effects of ultraviolet light on the weed control activity of a cyanazine + glyphosate mixture were evaluated in two growth chamber experiments. Ultraviolet light was produced by a metal halide lamp at an intensity of 300 and 100 microwatts/square cm in the 2200 to 2800 and 3000 to 4000 angstrom wavelength ranges, respectively. The mixture was irradiated after being applied preemergence to annual grasses at rates of 1.12 and 2.24 kg/ha. It was concluded that 160 minutes of irradiation did not affect weed control by cyanazine.

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