ANNUAL WEED CONTROL IN FIELD CORN[1/]

Joans Vengris[2/]

ABSTRACT

Two silage corn (Zea mays L. Agway 390X) experiments were conducted in fields infested with fall panicum (Panicum dichotomiflorium Michx.), crabgrass (Digitaria spp.), redroot pigweed (Amaranthus retroflexus L.) and lambsquarters (Chenopodium sp.). Butylate (S-ethyl diisobuthylthio-carbamate) and EPTC+R-25788 (S'-ethyl dipropylthiocarbamate + R-25788 antidote) preplant incorporated applications provided excellent grassy weed control. Practical fall panicum and crabgrass control was obtained by various combination treatments which included alachlor [2-chloro-2',6'-diethyl-N-(methoxy-methyl) acetanilide], procyazine [2-[(4-chloro-6-(cyclopropylamino)-1,3,5-triazine-2-yl] amino)-2-methylpropanenitrile], atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazone], penoxalin [N-(l-ethylopropyl)-3,4-dimethyl-2,6-dinitrobenzamine], bifenox [methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate], metolachlor [2-chloro-N-(2-ethyl-6-methyl-phenyl)-N-(methoxy-l-methylethyl) acetamide] or Vel 5026[3] herbicides. Vel 5026 at 0.25 lb/A or procyazine at lower than 2,4 lb/A rates did not control grassy weeds satisfactorily. Atrazine + simazine [2-chloro-4,6-bis(ethylamino)-s-triazine] probably because of dry weather conditions was poor on grassy weed control in 1976. Metolachlor at 2 lb/A and butylate at 4 lb/A did not provide needed broadleaf weed control. Both years bifenox temporarily injured the corn. Silage corn yields were increased over untreated checks in both years by all treatments used.

INTRODUCTION

The main objective of our 1975 and 1976 trials was to determine the effectiveness and practicability of some of the promising new herbicides or herbicides combinations which would give better and more practical annual weed control in field corn in Massachusetts.

MATERIALS and METHODS

The experiments were conducted at the South Deerfield experimental farm on a fine sandy loam with good drainage. A randomized block design with four replicates in the 1975 trials and with three replicates in the 1976 trials was used. Each plot consisted of four rows 25 ft. long. In both years fall panicum and crabgrass were dominant weeds and together represented over 75 percent of the total weed population. The rest of the weed population consisted of redroot pigweed, lambsquarters and yellow foxtail [Setaria lutescens (Weigel) Hubb.].

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3/ Velsicol Chem. Co. experimental compound; chemistry not disclosed.

In both years the seedbed was prepared two days before field corn planting on May 28. A list of treatments and their application dates are presented in the tables below. Preplant treatments were, after application, immediately mixed into the soil by rototilling. All herbicide rates presented in the tables are expressed in pounds of acid equivalent or active ingredient per acre. In both years rainy weather conditions within three days after application of preemergent treatments created good conditions for herbicidal action.

The effects of different treatments on weeds and corn were observed throughout the growing season. Weed stands in all plots were surveyed three times during the growing season, 4 weeks, 7 weeks after corn emergence and at harvesting time and average weed stands were recorded. In 1975 and 1976 corn was harvested on October first and September eighth, respectively.

RESULTS and DISCUSSION

1975 Trials.

Weed control as well as silage corn yield results are recorded in Table 1. The best grassy weed control was obtained by EPTC+R-25788 and butylate + bifenox treatments. Fall panicum and crabgrass were eliminated almost completely the whole growing season. Procyazine alone at 2.4 lb/A or lower rates was least effective in weedy grass control. Procyazine at 3.2 lb/A or in combination with atrazine or metolachlor was as effective as accepted standard alachlor + atrazine treatment.

With the exception of metalachlor 2 lb/A rate broadleaf weeds were completely eliminated by all treatments used.

All herbicides or their combinations used in these trials significantly controlled weeds and increased silage corn yields compared with weedy checks. Corn was injured by bifenox treatments only. Injury marks were observable for about 6 weeks. The corn treated with bifenox had whitish lesions on its leaves. Later these injury marks disappeared completely.

1976 Trials.

All treatments significantly controlled grassy weeds present (Table 2). Practical grassy weed control was obtained by various combination treatments which included alachlor, procyazine, atrazine, metolachlor, penoxaline, bifenox or Vel 5026 herbicides. Penoxaline alone at 1.5 lb/A provided as good grassy weed control as cyanazine or procyazine at 2.4 lb/A rate. Flowable formulations of bifenox or alachlor were as effective as wettable powder of bifenox or liquid formulation of alachlor. It is interesting to note that atrazine + simazine combination provided poorer grassy weed control than expected. Apparently dry weather conditions during the first part of the growing season was responsible for this. In the whole experiment the worst grassy weed control was produced by Vel 5026, a new herbicide. This herbicide in combination with alachlor is rather promising.

Thinly scattered broadleaf weeds were satisfactorily controlled by all treatments except butylate.

All herbicides or their combinations used significantly increased silage corn yields compared with weedy checks. Due to the dry 1976 early summer period, competition for water apparently was strong and corn yields of untreated checks compared with treatments were much more decreased than in 1975 tests (Table 1). Again this year slight corn injury was observed by bifenox treatments. This injury did not affect corn yields significantly.

Table 1. Effect of herbicidal treatments on annual weed control and yields of silage corn.

Treatments	Date of Application	Weed stands Check = 100 GW	Weed stands Check = 100 BW	Yields Check = 100
1. Check		100	100	100
2. Check, clean		0	0	133
3. Atrazine + simazine, 1 + 2 lb/A, Pre	5/29	8	0	123
4. Atrazine + alachlor, 1 + 2 lb/A, Pre	5/29	18	0	123
5. Eradicane, 4 lb/A, PP1	5/28	2	0	127
6. Procyazine, 2 lb/A, Pre	5/29	28	+[a]	119
7. Procyazine, 2.4 lb/A, Pre	5/29	20	0	118
8. Procyazine, 3.2 lb/A, Pre	5/29	12	0	125
9. Cyanazine, 2.4 lb/A, Pre	5/29	17	+	129
10. Procyazine + Dual, 1.5 + 1.5 lb/A, Pre	5/29	20	0	125
11. Procyazine + Dual, 2 + 2 lb/A, Pre	5/29	10	0	122
12. Procyazine + alachlor, 1.5 + 1.5 lb/A, Pre	5/29	10	0	126
13. Procyazine + alachlor, 2 + 2 lb/A, Pre	5/29	10	0	121
14. Procyazine + atrazine 3:1, 2 lb/A, Pre	5/30	18	0	123
15. Procyazine + atrazine 3:1, 3.2 lb/A, Pre	5/30	15	0	116
16. Dual, 2 lb/A, Pre	5/30	8	17	117
17. Alachlor + bifenox, 2 + 1.5 lb/A, Pre	5/30	12	0	111
18. Butylate + bifenox, 4 + 1.5 lb/A, PPi + Pre	5/28 + 5/30	+	0	117
19. Cyanazine + atrazine, 2:1, 3 lb/A, Pre	5/30	14	0	123
LSD at 5%		6		12

[a] Negligible amounts.

Table 2. Effect of herbicidal treatments on annual weed control and yields of silage corn 1976.

Treatments	Date of Application	Weed stands Check = 100 GW	Weed stands Check = 100 BW	Yields Check = 100
1. Check		100	100	100
2. Check, clean		0	0	186
3. Atrazine + alachlor, 1 + 2 lb/A, Pre	6/1	3	+[a]	179
4. Atrazine + alachlor flow., 1 + 2 lb/A, Pre	6/1	4	0	180
5. Atrazine + simazine, 1 + 2 lb/A, Pre	6/1	20	+	170
6. Procyazine, 2.4 lb/A, Pre	6/1	12	2	188
7. Procyazine + Dual[x)], 1.25 + 1.25 lb/A, Pre	6/1	5	+	184
8. Procyazine + Dual, 1.5 + 1.5 lb/A, Pre	6/1	4	2	176
9. Procyazine + alachlor, 1.2 + 2 lb/A, Pre	6/1	1	+	178
10. Dual + atrazine, 1.25 + 1 lb/A, Pre	6/1	10	0	174
11. Dual + atrazine, 2 + 1 lb/A, Pre	6/1	9	0	176
12. Vel 5026 + alachlor, .25 + 2 lb/A, Pre	6/1	2	+	174
13. Vel 5026 + alachlor, .125 + 2 lb/A, Pre	6/1	3	1	177
14. Vel 5026, .25 lb/A, Pre	6/1	32	+	172
15. Penoxalin, 1.5 lb/A, Pre	6/1	12	+	176
16. Penoxalin + atrazine, 1.5 + 1 lb/A, Pre	6/1	5	+	174
17. Butylate, 4 lb/A, PPI	5/27	+	27	183
18. Cyanazine, 2.4 lb/A, Pre	6/2	14	3	184
19. Bifenox + alachlor, 1.5 + 2 lb/A, Pre	6/2	5	+	179
20. Bifenox flow. + alachlor, 1.5 + 2 lb/A, Pre	6/2	3	0	174
21. Bifenox + Dual, 1.5 + 2 lb/A, Pre	6/2	7	+	172
22. Bifenox flow. + Dual, 1.5 + 2 lb/A, Pre	6/2	5	+	177
LSD at 5%		6		24

[a] Negligible amounts.

PENOXALIN ALONE AND IN COMBINATION WITH ATRAZINE, CYANAZINE, AND RH 5205 FOR WEED CONTROL IN CORN

R. D. Ilnicki and Ratemo Michieka[1]

ABSTRACT

Penoxalin in combination with atrazine improved the control of velvetleaf and the control of lambsquarters and redroot pigweed was only slightly better than the control produced by either herbicide applied alone.

Penoxalin in combination with cyanazine greatly improved the control of lambsquarters, velvetleaf, and fall panicum with no appreciable increase in the control of redroot pigweed.

RH 5205 by itself was very effective on redroot pigweed but did not adequately control fall panicum, velvetleaf, or lambsquarters. Combinations with penoxalin produced marked improvement of lambsquarters and velvetleaf but did not improve the control of redroot pigweed or fall panicum over that produced by either herbicide applied alone.

INTRODUCTION

The use of the two triazine herbicides, atrazine and cyanazine for weed control in corn is well known. Cyanazine, the newer of the two, is not as long-lasting in the soil as atrazine, a herbicide that has been used for many years.

A recently developed herbicide, penoxalin, of the dinitroaniline family,has shown promise for weed control in corn. Unlike most of the dinitroanilines, there is no need to soil-incorporate it for use in corn. Moreover, if soil-incorporated injury to corn is imminent without that much improvement in weed control. Penoxalin, which is very effective on annual grassy weeds and many broadleaf weeds fails to adequately control common ragweed (Ambrosia artemesiifolia L.).

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More recently, RH 5205, an experimental herbicide showing promise for use in corn, was made available to weed researchers. Michieka et al. (1) observed this compound to be effective on broadleaf weeds found in corn but ineffective on fall panicum (Panicum dichotomiflorum Michx).

It was the objective of this study to determine if penoxalin could be effectively used in corn to effect broad spectrum weed control when combined with atrazine, cyanazine, or RH 5205 without producing any injury.

MATERIALS AND METHODS

Midstates 869 field corn was planted on May 4, 1976, in Sassafras loam soil in 30-inch rows at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey. Immediately after planting plots 10' wide (4 rows) x 18' long were established to receive preemergence applications of herbicides and herbicide combinations. All herbicide applications were made using a hand-operated backpack CO_2-propelled experimental plot sprayer on May 5 in 40 gpa with water the carrier. All herbicide treatments included in the study are presented in Table 1. Chemical identities of the herbicides are found in the Appendix.

Throughout the course of the investigation, observations were made on crop injury and weed control using the scale 0 to 10 where 0 = no effect on stand or vigor of plants and 10 = complete control or 100% elimination of stand.

The experimental area was infested with lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), velvetleaf (Abutilon theophrasti Medic.), and fall panicum (Panicum dichltomiflorum Michx.). Other annual broadleaf weeds were also present but these were sparsely distributed and estimates of their control was not possible.

RESULTS AND DISCUSSION

Weed control data, recorded at time of maximum performance of the herbicides, on July 12, are summarized in Table 1. Included, also, are the responses of corn to the various herbicides and herbicide combinations. From this table it can be seen that corn was not seriously affected by any of the herbicide treatments.

Some interesting comments can be made about weed control. Penoxalin, which is reported to be effective on velvetleaf, did not produce good control of this weed. Atrazine, on the other hand, produced good control of velvetleaf, but was ineffective on fall panicum, a well-established fact. Combinations of penoxalin and atrazine improved the control of fall panicum greatly but only slightly the control of velvetleaf. Control of lambsquarters and redroot pigweed by either herbicide alone was comparable with only slight improvement in control when combined.

Cyanazine was very effective on redroot pigweed but only fair to good on lambsquarters, velvetleaf, and fall panicum. Combining penoxalin with cyanazine effected a great improvement in the control of lambsquarters, velvetleaf, and fall panicum but with no appreciable increase in the control of redroot pigweed.

RH 5205, by itself, did not produce much control of fall panicum, only fair control of velvetleaf, and poor to fair control of lambsquarters. It was very effective, however, on redroot pigweed Combinations of RH 5205 with penoxalin gave marked improvement in the control of lambsquarters and velvetleaf. The combination did not improve the control of redroot pigweed or fall panicum over that produced by either herbicide applied alone.

LITERATURE CITED

(1) Michieka, R. W., R. D. Ilnicki, and J. Somody. 1976. The Response of corn and annual weeds to some new herbicides used alone and in combination with atrazine or alachlor. Proc. NEWSS 30:46-47.

APPENDIX

Common Name	Chemical Name
atrazine	2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine
cyanazine	2-[[-4-chloro-6-(ethylamino)-s-triazin-z-yl] amino]-2-methyl-propionitrile
penoxalin	N-(2-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine
RH 5205	chemistry not disclosed

Table 1. The response of corn and some annual weeds to penoxalin, atrazine, cyanazine, and RH 5205 and combinations of penoxalin with atrazine, cyanazine, and RH 5205.

Herbicide	Rate, lb/A	Response (Stand)[1]				
		Corn	Lambsquarters	Redroot Pigweed	Velvetleaf	Fall Panicum
penoxalin	3/4	0.0	8.3	9.7	4.0	9.0
	1	0.7	8.3	10.0	6.3	9.7
atrazine	1 1/2	0.7	10.0	10.0	8.7	2.3
	2	0.0	10.0	10.0	9.7	2.7
cyanazine	2	0.7	7.3	9.0	7.0	7.3
	2 1/2	0.3	9.3	10.0	7.3	8.0
RH 5205	1/8	0.3	3.7	10.0	7.3	3.5
	1/4	0.3	8.0	10.0	8.7	5.3
penoxalin + atrazine	3/4 + 1 1/2	0.7	9.7	10.0	5.7	9.0
	1 + 1 1/2	0.3	10.0	10.0	7.7	9.0
penoxalin + cyanazine	3/4 + 2	0.3	9.7	9.3	8.7	10.0
	1 + 2	0.0	9.7	9.7	9.0	9.7
penoxalin + RH 5205	3/4 + 1/8	0.3	8.9	10.0	9.3	8.0
	1 + 1/8	0.0	9.0	9.7	9.3	9.0

[1]Based on scale 0 to 10, where 0 = no control or reduction in stand and 10 = complete control or elimination of stand.

OPTIONS FOR QUACKGRASS CONTROL IN NO-TILLAGE SILAGE CORN

R. A. Peters[1/]

ABSTRACT

Glyphosate (N-(phosphonomethyl)glycine), atrazine (2-chloro-4-ethylamino)-6-(isopropylamino)-s-triazine), simazine (2-chloro-4,6-bis(ethylamino)-s-triazine) and paraquat (1,1'-dimethyl-4,4' bipyridinium ion) were applied on quackgrass (Agropyron repens (L.) Beauv.) in November 1975 and in April and May 1976. Silage corn (Zea mays L. var XL 315A) was planted on both no-tillage plots and plots plowed after treatment.

In general the most effective quackgrass topkill from glyphosate was obtained from May applications when the grass was 1½-2 feet tall. The atrazine treatments, alone or with paraquat, were most effective, however, if applied in November or April before rapid growth occurred. Quackgrass control with few exceptions was good on treated plots subsequently plowed.

Corn yields were greater in the plowed than in the no-tillage plots following all three dates of treatment. This was related in part to decreased stands in the no-tillage plots and in Stage A and B to greater competition from crabgrass.

Rhizome samples removed in November 1976 from the May treated plots indicated little difference in weight but a significant difference in regrowth potential with only 10% of buds sprouting in the glyphosate plots compared to 40% in the atrazine plots.

INTRODUCTION

Quackgrass continues to be a widespread weed in corn fields in the Northeast. The trend toward no cultivation following planting of conventional corn and the total lack of soil manipulation in no-tillage corn results in little, if any, disturbance of quackgrass rhizomes.

MATERIALS AND METHODS

The experiment was initiated in the fall of 1975 in a field which had been in no-tillage corn in 1974 but idle in 1975. The soil type is a Paxton fine sandy loam. The predominate weed at the time of treatment was quackgrass. Dandelion was also fairly abundant.

The herbicides used were atrazine, princep, paraquat and glyphosate alone and in combination. All rates are given in terms of active ingredient per acre except for glyphosate which is given in terms of acid equivalent per acre.

Based on soil tests, 2T of lime was applied on April 27, 1976. 700 lb/A of 15-15-15 fertilizer was applied on May 5, 1976. On May 25, 1976 all plowed strips were disked. Corn was planted on May 27, 1976 in 30 inch rows with a Bridger No-tillage planter. Because of a general invasion of crabgrass in many of the plots an application of alachlor (2 lb ai/A) was applied on June 1. The warm spring resulted in the 2-3 leaf stage by this date.

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Table 1. gives the details of when treatments were made. On each treatment date herbicides were applied on two strips. One strip was plowed as indicated in the table but the other was untouched prior to corn planting (no-tillage).

Table 1. Summary of timing of herbicide and plowing treatments.

	Stage A	Stage B	Stage C
Date of herbicide treatment	Nov 7, 1975	April 20, 1976	May 22, 1976
Stage of growth of quackgrass	6 inch in hgt 4 leaf stage	6 inch in hgt 4 leaf stage	18-24 inch in hgt boot stage
Weather on day of spraying	41° F min 60° F max	60° F min 90° F max	42° F min 70° F max
Date of plowing conventional strip	Nov 27, 1975	April 23, 1976	May 25, 1976

RESULTS AND DISCUSSION

Quackgrass control

No-tillage - In terms of quackgrass topgrowth as rated in November 1976, the glyphosate treatments at the 1½ and 2 lb rate were effective at all stages of growth (Table 2). The 1 lb rate was weak in the November and April treatments. The triazines were more variable. Applications of 4 lb of atrazine were quite effective if applied in November or May but marginal when applied in April. Simazine gave less than 50% control when applied in November or May. The combination of atrazine 2 lb + simazine 2 lb/A was intermediate in effectiveness between atrazine and simazine. If paraquat ½ lb was added to atrazine none of the applications compared with the high rate, 4 lb, of atrazine alone. Paraquat + atrazine was most effective in April when the grass was actively growing. The combination of paraquat ½ and simazine 2 lb had very little effect in the fall application but was as effective as simazine at 4 lb when applied in April or May.

Plowed - Plowing combined with chemical treatment increased the control of some of the marginal treatments especially with the fall treatments. With the glyphosate treatments or the 4 lb rate of atrazine, there was no marked increase in control in topgrowth from plowing.

Corn yields

No-tillage - The mean silage corn yields of the November treated plots were only 2/3 of the yields in the April and May treated plots. The only treatments as effective as the April and May treatments were the glyphosate + atrazine treatments and the 4 lb rate of simazine. The latter resulted in poor yields in all three stages which was probably related to the depressed stands associated with this treatment. The lower yields in the Stage A plots treated with glyphosate could be related to the poor crabgrass control. By the time of the June 1 application of alachlor the crabgrass was so large the kill was quite limited. The same relationship can be seen to a lesser extent in Stage B. The May glyphosate treatment applied after germination killed most of the crabgrass. No explanation can be given for the very poor yields with glyphosate 1½ lb in November. Poor crabgrass control in the Stage A plots treated with atrazine alone or in combination may have been a factor in the reduced yields.

In comparing the April and May treatment dates in terms of yield the glyphosate applied when the quackgrass was only 6 inches tall in April was less effective than when applied in May on quackgrass 18-24 inches in height. The converse was

Table 2. Quackgrass Control and Corn Yields Following Applications of Glyphosate With and Without Atrazine and Atrazine and Simazine With and Without Paraquat.

Herbicide	lb/A ae or ai	No-Tillage Control Rating[1] (0-10) Quackgrass	No-Tillage Control Rating[1] (0-10) Crabgrass	Silage Yields T/A[2]	Stand Plants/A[3]	No-Tillage Control Rating[1] (0-10) Quackgrass	No-Tillage Control Rating[1] (0-10) Crabgrass	Silage Yields T/A[2]	Stand Plants/A[3]
				November 1975 Treatment (Stage A)					
Glyphosate	1	6.3	2.0	8.2	31.2	7.3	8.3	21.1	28.1
Glyphosate	1½	8.0	3.7	14.7	20.3	10.0	9.7	24.7	29.5
Glyphosate	2	9.7	3.7	2.8	18.4	8.3	9.3	26.9	27.1
Paraquat + atrazine	½ + 2	6.3	4.7	14.3	21.8	8.3	9.3	21.1	28.1
Paraquat + simazine	½ + 2	1.7	8.3	6.0	18.9	7.3	9.3	25.7	30.4
Glyphosate + atrazine	1 + 2	8.3	4.0	21.8	30.5	9.0	10.0	26.4	31.5
Atrazine + simazine	2 + 2	6.7	3.7	9.8	26.1	8.0	8.0	23.8	29.0
Atrazine	4	9.0	1.3	11.8	26.7	10.0	10.0	24.7	26.6
Simazine	4	4.7	5.7	8.9	18.4	8.3	10.0	19.2	25.1
Control		0.7	9.3	0.5	10.6	3.7	8.3	14.9	21.3
Mean		6.1	4.6	9.9	22.3	8.0	9.2	22.9	27.6
				April 1976 Treatment (Stage B)					
Glyphosate	1	5.7	4.7	17.8	24.7	6.7	10.0	24.2	30.5
Glyphosate	1½	8.7	2.0	13.2	22.3	7.7	9.7	21.6	24.2
Glyphosate	2	9.3	6.7	20.2	26.1	7.0	9.0	24.0	25.6
Paraquat + atrazine	½ + 2	7.0	8.0	16.3	23.2	8.3	9.7	22.3	28.1
Paraquat + simazine	½ + 2	8.0	7.7	9.6	23.2	7.0	9.0	20.2	23.7
Glyphosate + atrazine	1 + 2	6.7	7.3	19.7	23.2	8.3	9.7	22.3	28.1
Atrazine + simazine	2 + 2	9.3	7.7	15.6	23.2	7.7	9.7	22.1	27.6
Atrazine	4	9.7	8.0	19.2	23.7	9.0	9.7	24.2	30.0
Simazine	4	8.3	7.7	11.0	19.8	6.3	9.7	22.6	29.0
Control		1.7	8.3	0.7	10.6	7.0	8.3	19.7	25.1
Mean		7.4	6.8	14.3	21.9	7.5	9.5	22.3	27.3
				May 1976 Treatment (Stage C)					
Glyphosate	1	10.0	7.7	19.0	28.1	8.3	9.3	25.9	31.9
Glyphosate	1½	9.7	7.3	22.1	28.1	9.0	9.7	22.8	27.1
Glyphosate	2	10.0	6.0	24.7	26.1	9.3	9.0	21.4	24.9
Paraquat + atrazine	½ + 2	4.7	8.6	10.6	19.3	5.0	9.7	21.1	25.2
Paraquat + simazine	½ + 2	5.7	10.0	15.8	25.0	5.7	9.7	16.1	21.3
Glyphosate + atrazine	1 + 2	8.3	8.3	23.5	31.9	8.3	9.7	26.6	32.4
Atrazine + simazine	2 + 2	6.0	7.7	10.8	20.3	6.7	8.3	19.2	25.6
Atrazine	4	7.0	7.0	14.2	23.2	8.3	9.3	25.7	30.0
Simazine	4	5.0	6.3	7.9	15.0	6.3	10.0	22.1	29.0
Control		1.3	8.6	0.5	8.7	2.7	8.6	16.9	17.9
Mean		6.8	7.8	14.9	22.6	7.0	9.3	21.8	26.9

[1] 0 - No control; 10 - Complete kill [2] Tons/A on 30% dry matter basis [3] X 1000

true when simazine and atrazine were used alone or in combination. The triazines need to be applied before rapid growth of quackgrass for adequate control.

No-tillage versus plowed plots - The mean yields of silage corn were lower in all three stages in the no-tillage plots than in the plowed plots; 43.0% in Stage A, 64.1% in Stage B and 68.3% in Stage C.

Part of this differential could be attributed to the lower stands in many of the no-tillage plots. The lowest stands were usually associated with treatments giving the poorest quackgrass control. In those treated plots which were given a quackgrass control rating of 5 or less the stand was 75% or less of the plowed plots. The one exception was the paraquat + simazine treatment applied in May. In the no-tillage plots receiving no herbicide treatment stand was less than half of the plowed non-treated plots. The much lower relative yields in Stage A no-tillage plots could also be related in part to the limited crabgrass control.

Table 3. Effect of herbicide treatment in May on quackgrass rhizome weight and regrowth potential in November.

Herbicide	lb/A ae or ai	Rhizome fresh wgt gm/sq ft	Shoot No. per 20 nodes	Shoot hgt cm
Glyphosate	1	10.3	3	24.0
Glyphosate	2	4.0	4	28.5
Atrazine	4	6.3	17.5	27.3
Control		28.5	46.0	23.3

Treatment effects on rhizomes

In November 1976, rhizome samples were removed from selected plots to determine the long term effects of treatment. The data in Table 3 indicates that the fresh weight of rhizomes was decreased by glyphosate and atrazine to about the same degree. The significant difference was in the number of buds which regenerated after the rhizomes were cut into 3 node sections and potted in the greenhouse. The shoot number from either 1 or 2 lb rate of glyphosate was only 10% of the control as compared to 40% in the atrazine plots. Judging by the regrowth, if a bud is capable of growing after treatment the shoot growth will be normal.

WEED CONTROL IN CORN WITH VEL 5052 AND BUTHIAZOLE (VEL 5026) APPLIED ALONE, IN COMBINATION, AND IN COMBINATION WITH ATRAZINE OR ALACHLOR

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

ABSTRACT

Two new herbicides, VEL 5052 and VEL 5026, were evaluated for weed control in corn. VEL 5052 was not effective on lambsquarters or common ragweed. Buthiazole (VEL 5026) was very effective on fall panicum. Combinations of VEL 5052 with buthiazole or atrazine effected excellent control of many annual weeds. Similarly, combinations of buthiazole with alachlor produced excellent control of many weeds.

INTRODUCTION

Two experimental herbicides having some potential for use in corn were recently released. One, an acetanilide, from preliminary studies is considered effective on annual grasses; the other, buthiazole (VEL 5026), a heterocyclic nitrogen compound has produced excellent results for industrial and non-cropland use. The latter, considered marginal for use in corn, has produced some injury when applied at rates sufficiently high to effect adequate broadleaf and grassy weed control. From preliminary work done at this station, it was felt that buthiazole might fit into a weed control program in corn if low rates were used and if it were combined with other herbicides already being used or considered for use in corn. It was with this objective in mind that this study was undertaken.

MATERIALS AND METHODS

Midstates 869 field corn was planted on April 28, 1976, in Sassafras loam soil at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey, in 30-inch rows. Following planting plots 10' wide (4 rows) x 18' long were established to receive preemergence applications of herbicides

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and herbicide combinations. All herbicide applications were made using a hand-operated CO_2-propelled plot sprayer on April 30, two days after planting. Sprays were applied in water carrier at 40 gpa. The experimental design was a complete randomized block with 3 replications.

The herbicide treatments included in this study are presented in Table 1. Chemical identities and the formulations used are presented in the Appendix.

During the course of the investigation, periodic observations were made on crop injury and weed control. In rating, a scale of 0 to 10 was used where 0 = no effect on stand or vigor and 10 = complete control or 100% elimination of stand. Weeds in the experimental area included lambsquarters (_Chenopodium album_ L.), redroot pigweed (_Amaranthus retroflexus_ L.), common ragweed (_Ambrosia artemisiifolia_ L.), large crabgrass (_Digitaria sanguinalis_ (L.) Scop.), and fall panicum (_Panicum dichotomiflorum_ Michx).

RESULTS AND DISCUSSION

Weed control data and corn response data are presented in Table 1. These data are from ratings made on July 6, when it was estimated that the maximum effects of the herbicides were being produced. Blanks in the table indicate the absence of weeds in these plots or treatments or that the intensity of the weed population was such that accurate estimates of control were not possible.

One interesting fact is immediately evident from this table. No herbicide or herbicide combination produced any injury to corn. Another observation worthy of note that both VEL 5052 and alachlor were ineffective on lambsquarters or common ragweed but very effective on the grasses - typical of acetanilide herbicides.

Buthiazole was only effective on redroot pigweed at the rates studied but produced good to excellent control of fall panicum and lambsquarters, respectively, at the higher rate.

Atrazine, as expected, did not control fall panicum but did produce very good to excellent control of the broadleaf weeds.

Combinations of VEL 5052 with buthiazole or atrazine produced very good to excellent control of all weeds in the experiment.

Buthiazole in combination with alachlor produced excellent control of redroot pigweed, common ragweed, large crabgrass, and fall panicum but only very good control of lambsquarters; however, the degree of control of lambsquarters was better from the combination than that effected by the herbicides applied alone.

Yields of harvested grain were significantly reduced by all rates of VEL 5052 and the lowest rate of alachlor. These reductions were not from injury produced by the herbicides but from the heavy infestation of lambsquarters in the experimental area. Had the corn been given a lay-by cultivation the reductions in yield would not have been as great as they were.

Table 1. The response of corn and some annual weeds to VEL 5052 and buthiazole (VEL 5026) applied alone, in combination, and in combination with atrazine or alachlor.

Herbicide	Rate, lb/A	Plant Responses[1] Corn	Lambsquarters	Redroot Pigweed	Ragweed	Crabgrass	Fall Panicum
VEL 5052	1 1/2	0.0	0.3	10.0	0.0	10.0	10.0
	2	0.0	0.0	10.0	0.0	10.0	9.7
	2 1/2	0.0	0.0	-	5.0	-	9.7
buthiazole	3/8	0.0	6.3	9.5	5.0	5.0	1.0
	3/4	0.0	9.7	10.0	-	3.0	8.0
atrazine	1 1/2	0.0	9.7	-	10.0	-	0.0
	2	0.0	10.0	10.0	-	9.0	0.0
alachlor	1 1/2	0.0	2.0	10.0	0.0	10.0	10.0
	2	0.0	6.3	10.0	0.0	10.0	10.0
	2 1/2	0.0	4.7	10.0	-	10.0	8.3
VEL 5052 + buthiazole	2 + 3/8	0.0	9.3	10.0	-	10.0	9.3
VEL 5052 + atrazine	2 + 1	0.0	10.0	10.0	-	10.0	9.0
buthiazole + alachlor	1/4 + 1 1/2	0.0	8.7	10.0	-	-	9.7
	3/8 + 1 1/2	0.0	8.3	10.0	-	10.0	8.3
	1/2 + 1 1/2	0.0	8.3	10.0	-	-	10.0
	1/4 + 2	0.0	9.0	10.0	-	-	10.0
	3/8 + 2	0.0	9.3	-	10.0	-	9.7
	1/2 + 2	0.0	9.7	10.0	10.0	-	9.7

[1]Based on a scale of 0 to 10, where 0 = no effect on stand or vigor and 10 = complete control or elimination of stand.

APPENDIX

Common Name	Chemical Name
alachlor	2-chloro-2',6'-diethyl-N-(methoxy=methyl) acetanilide
atrazine	2-chloro-4-(ethylamino)-6-(iso=propylamino)-s-triazine
buthiazole (VEL 5026)	3- 5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl -4-hydroxy-1-methyl-2-imidazolidinone
VEL 5052	N-chloroacetyl-2,6-dimethylanilino-acetaldehydeethyleneacetal

NUTSEDGE CONTROL IN NO-TILLAGE CORN WITH AND WITHOUT A CROWNVETCH COVER CROP

N. L. Hartwig[1/]

Abstract

Competition from crownvetch (Coronilla varia), when used as a living mulch for no-tillage corn (Zea mays), significantly reduced the growth of yellow nutsedge as long as herbicide suppression was not too great. When crownvetch was severely suppressed with atrazine + simazine + dicamba applied postemergence the yellow nutsedge grew better in the suppressed crownvetch than in the absence of crownvetch. Herbicide mixtures of atrazine + simazine and atrazine + cyanazine gave sufficient weed control and crownvetch suppression to produce maximum yields of 113.5 to 156.9 bu/A both with and without crownvetch. The addition of paraquat to either of these mixtures did not improve weed control or corn yields. Atrazine + penoxalin significantly reduced corn stands (17%) and yields. The addition of paraquat to atrazine and penoxalin reduced corn stands 30 to 34% with an even greater loss in yields.

Introduction

The use of crownvetch as a perennial "living mulch" for no-tillage corn is a proven possibility (1,2,3,4). It provides all of the desirable characteristics of a dead mulch such as reduced soil erosion, reduced rain water runoff, increased infiltration and reduced surface soil evaporation losses without the need for reestablishing a cover crop each year. The possible contribution to weed control by competition from the crownvetch is another advantage of a "living mulch" which was established in this research.

Methods and Materials

The crownvetch cover crop was seeded on July 20, 1973 on a Hagerstown silt loam soil containing 10% sand, 67% silt, 20% clay and 2.5% organic matter. The area was limed to a pH of 7.0 before seeding the crownvetch and it has been limed since to maintain a pH of 7.0.

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On May 6, 1976, Pioneer 3780 (100 day) corn was planted to a stand of about 27,000 plants per acre with a 6-row no-tillage corn planter. Fertilizer was applied according to soil test. In 1976, the following fertilizer equivalent was broadcast before corn planting; 0 lb/A N, 200 lb/A P_2O_5 and 160 lb/A K_2O. Two hundred lb/A of 10-30-10 fertilizer was applied in the row at planting time. An additional 150 lb/A of nitrogen was applied as ammonia in late June. I would never do this again since the crownvetch had made considerable growth by this time and it kept balling up in front of the injection knives and lifting them out of the ground. Sidedressing nitrogen at this time, I feel, is alright but it will have to be applied in some other form. Application of at least 100 lb/A of nitrogen at planting time also helps suppress the crownvetch.

Preemergence treatments were applied 8 days after planting on May 14 and postemergence treatments were applied on June 16 when the corn was 6 to 8 inches tall. These same basic herbicide treatments had been applied to these same plots in 1975 and the area had been planted to no-tillage corn. All treatments were applied with a small plot sprayer in 20 gallons of water per acre with an 80015 LP nozzle at 12 psi. There was sufficient moisture following all treatments to activate the herbicide and promote good crop growth.

All plots received Sutan$^+$ + atrazine 18-6·G equivalent to 5.25 lb/A of butylate and 1.75 lb/A of atrazine in a 7 inch band over the row applied in front of the fluted coulter at planting time. It did not appear that this treatment controlled any weeds or suppressed the crownvetch. Furadan was applied at 1 lb ai/A in a 7 inch band over the row in back of the planter for insect control.

Plots consisted of 5 rows of corn planted in 30 inch rows, 20 feet long. Experimental design was a randomized complete block replicated 3 times. Corn stands,height and yields were taken from the center 3 rows. Yellow nutsedge and crownvetch cover crop yields were measured by harvesting an 18 inch swath, the length of the plot and to one side of the center row with a rotary mower in September.

Results and Discussion

The control of yellow nutsedge was significantly improved by the presence of crownvetch for all herbicide treatments except atrazine + simazine applied preemergence or post with dicamba, treatments 1 and 3, Table 1. When dicamba was used postemergence with atrazine and simazine (treatment 3) the crownvetch was 96% suppressed, more than any other herbicide treatment, which allowed the yellow nutsedge to come on strong in this treatment.

Crownvetch recovery growth was excellent following all herbicide treatments except atrazine + simazine + dicamba applied postemergence. Although there was no significant reduction in corn yields due to the presence of crownvetch, the trend would indicate that crownvetch was competing with and reducing the yield of corn. The addition of paraquat to atrazine + simazine or atrazine + cyanazine contributed nothing to improved yellow nutsedge control, crownvetch suppression or increased corn yields.

The corn stand was very good with only a 5% stand loss when atrazine + simazine was used in the absence of crownvetch which increased to a 10% stand loss in the presence of crownvetch. Corn stands were reduced only 5 to 10% from atrazine + cyanazine treatments both with and without crownvetch. When penoxalin was added to the mixture the corn stand loss was increased to 17% (treatment 6) and with paraquat the stand loss was 30 to 34% (treatment 7). These were both significant decreases in stand from the stand for the best treatments and also resulted in significant reductions in corn yields except where atrazine + penoxalin was used in the absence of crownvetch. It is possible that the seed is not covered as well for no-tillage corn and the seed is not protected by sufficient soil to prevent injury from penoxalin but this does not explain why the stand loss is greater when paraquat is added to the mixture. Other research has shown that penoxalin can be safely used on no-tillage corn when applications are made at least three weeks ahead of planting.

Although the presence of crownvetch appears to cause a 10 to 15% reduction in corn yields on level ground, it is hoped that the value of a crownvetch cover for control of soil erosion on sloping ground and its possible use for pasture or silage after corn harvest in the fall or the control of weeds by competition from the crownvetch will more than offset the corn yield losses.

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Table 1. Yellow nutsedge control, crownvetch suppression and corn stand, height and grain yield following various herbicide treatments in the presence and absence of crownvetch cover for no-tillage corn.

No.	Treatment and Rate (lb ai/A)		Sod Cover[a]	Yellow Nutsedge Control %	Yellow Nutsedge Dry Wt. lb/A	Crownvetch Control %	Crownvetch Dry Wt. lb/A	Corn Stand plants/A	Corn Ht. cm	Corn Yield bu/A[b]
1	atrazine 1 +	Pre	+CV	97[c]	56 defg[d]	66	540 b	23813 ab	160 abc	127.3 abc
	simazine 1		-CV	88	136 abcd	--	--	25458 a	177 a	156.9 a
2	atrazine 1 +	+ paraquat .25 Pre	+CV	100	0 g	73	775 a	23522 ab	163 ab	130.1 abc
	simazine 1		-CV	87	84 cdef	--	--	25458 a	163 ab	144.1 ab
3	atrazine 1 +	+ dicamba .25 Post	+CV	95	167 ab	96	137 c	24635 ab	128 ef	117.5 bcd
	simazine 1		-CV	91	135 abcd	--	--	24683 ab	139 cdef	107.8 cde
4	atrazine 1 +	Pre	+CV	98	24 fg	60	803 a	24394 ab	138 def	113.5 bcde
	cyanazine 1		-CV	87	126 abcd	--	--	24878 ab	177 a	141.3 ab
5	atrazine 1 +	+ paraquat .25 Pre	+CV	96	22 fg	71	532 b	25652 a	163 ab	122.3 bc
	cyanazine 1		-CV	83	178 a	--	--	23426 ab	157 abcd	112.7 bcde
6	atrazine 1 +	Pre	+CV	97	24 fg	68	688 ab	22458 b	150 bcde	105.3 cde
	penoxalin 1.5		-CV	83	115 abcde	--	--	22458 b	162 abc	126.7 abc
7	atrazine 1 +	+ paraquat .25 Pre	+CV	96	38 efg	56	852 a	19360 c	142 cdef	89.7 de
	penoxalin 1.5		-CV	68	157 abc	--	--	17714 c	138 def	84.7 e
Average over all herbicide treatments			+CV	97	47	70	618	23405 ns	149 ns	115.1 ns
			-CV	84	133	--	--	23439 ns	159 ns	124.9 ns

[a] CV = crownvetch

[b] Corn yields are bushels of shelled corn containing 15.5% moisture.

[c] All values are an average of 3 replications.

[d] Those values followed by the same letter are not significantly different according to Duncan's modified least significant difference test.

RESIDUAL HERBICIDES ON NO-TILLAGE CORN IN A RYE COVER CROP[1]

J. V. Parochetti and A. W. Bell[2]

Abstract. Effects of combinations of residual herbicides and paraquat (1,1'-dimethyl-4,4'-bipyridinium, chloride) or glyphosate [N-(phosphonomethyl)glycine] were evaluated for three years in no-tillage corn (Zea mays L.) grown in a rye (Secale cereale L.) cover crop. Paraquat affected a more rapid necrosis of the rye cover than glyphosate even though corn yields were similar. Fall panicum (Panicum dicotomiflorum Michx.) was the predominant weed in each year with generally over 90% control achieved by combinations containing simazine [2-chloro-4,6-bis=(ethylamino)-s-triazine] ; cyanazine [2-[[4-chloro-6-(ethylamino)-s-triazin-2-yl] amino] -2-methylpropionitrile] was almost as effective. The degree of fall panicum control was highly related to corn yields.

INTRODUCTION

No-tillage corn has become an increasingly popular method of producing corn in the western counties of Maryland. Approximately 60% of the acreage is planted by the no-tillage method; a rye cover crop is often present at planting time. Parochetti (1,2) has reported on the effectiveness of a number of residual herbicides for annual weed control in a rye cover crop. Paraquat is the only foliar herbicide currently registered for use in combination with residual herbicides; however glyphosate has been used to kill the existing vegetative cover crop for no-tillage production (2,3,4,5,6,7). The purpose of this research was to evaluate glyphosate and paraquat in combination with various residual herbicides over a three year period.

MATERIALS and METHODS

Experiments using residual herbicides on no-tillage corn were conducted in 1974, 1975 and 1976 at the Plant Research Farm, Fairland, Maryland. The

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[1]Scientific Article No.A2268 and Contribution No.5264 of the Maryland Agr. Exp. Sta., College Park, MD.

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soil was a Beltsville silt loam (Typic Fragiudults; Fine loamy mixed mesic) with approximately 2% organic matter. Corn was planted in a rye cover crop each year. A randomized complete block with four replications design was used. Herbicides were applied at 30 gpa with a sprayer designed for experimental work. Treatments are listed in Tables 1, 2 and 3. Plot size was 10 by 30 feet with '3369A' corn ('3334A' in 1975) planted in 30 inch rows.

Planting dates were as follows: 23 April, 1974, 9 May, 1975 and 26 April, 1976. Herbicides were applied within three days of planting.

Rye necrosis ratings were taken in 1974 and 1976 using a percentage of the dead foliage while weed control observations in all three years were made by the European rating scale. Approximate percent of control are included in Tables 1, 2 and 3. These ratings exhibited significant differences and were analysed with the Bayes LSD at the 5% level of probability.

RESULTS and DISCUSSION

1974. Treatments containing glyphosate were found to affect significantly less rye necrosis 16 days after treatment than applications using paraquat (Table 2). Glyphosate was most active alone with almost as much as 20% reduction necrosis when residual herbicides were added. Paraquat effectiveness was variable ranging from a low of 75% necrosis in combination with simazine plus cyanazine to 90% when applied with atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-*s*-triazine].

Fall Panicum control in no-tillage corn was ineffective with paraquat plus atrazine. Either simazine or cyanazine in combination with paraquat successfully controlled this weed. With glyphosate as the foliar herbicide, control of fall panicum with residual herbicides was not as effective as with paraquat plus effective residual herbicides. Corn yields in 1974 reflected the degree of fall panicum control; initial rye crop necrosis seemed of little importance to corn grain yields.

1975. This year a moist spring produced considerable infestations of yellow nutsedge (*Cyperus esculentus* L.). Outstanding control of this weed was difficult to obtain though many combinations did affect adequate suppression (Table 2). Treatments with simazine produced the best results in control of fallpanicum and seasonal residual effect was good. Metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide] at 2.25 lb/A plus paraquat affected only 85% control of fall panicum; combinations with R 3140 [2-chloro-4-(ethyloxalyl)ethylamino-6-isopropylamino-*s*-triazine] did not affect adequate control of fall panicum. Yields again reflected control of this weed, for example being 77.4 bu/A in the alachlor [2-chloro-2',6'-diethyl-N-(methoxy=methyl)acetanilide] plus simazine plus paraquat treatment with better than 99% control) versus 17.9 bu/A for paraquat alone.

1976. By the third week after application necrosis of the rye cover was high with an unusual exception of paraquat in combination with atrazine plus simazine. This is possibly attributable to poor spray coverage. Glyphosate again did not affect rapid initial necrosis when compared to paraquat. A heavy fall panicum infestation appeared by August and was effectively controlled only by paraquat with penoxalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] plus atrazine, penoxalin plus simazine and atrazine and simazine.

Yields were notably low in 1976, moisture stress probably being the major cause of these low yields.

A review of the three years of no-tillage data reveals that fall panicum is a critical weed in yield reduction. Seasonal control of this weed is of far greater importance than the effectiveness of control of the annual rye cover crop by foliar herbicides.

ACKNOWLEDGEMENTS

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Table 1. The effect of paraquat or glyphosate alone or in combination with several residual herbicides on weed control and corn yields under no-tillage production in a rye cover crop, 1974.

	lb/A	May 10 Rye Necrosis (%)	August 30 Fall Panicum (Rating)[a] (%)[b]	October 11 Corn Yield (Bu/A)
1. Control	----	0	6.5 (70)	40.5
2. Paraquat	.25	90	4.3 (89)	85.4
+ Atrazine	2.5			
3. Paraquat	.25	79	2.3 (97)	101.3
+ Simazine	2.5			
4. Paraquat	.25	88	1.8 (98)	108.0
+ Cyanazine	2.5			
5. Paraquat	.25	85	1.3 (99)	106.5
+ Atrazine	1.25			
+ Simazine	1.25			
6. Paraquat	.25	88	3.5 (93)	67
+ Atrazine	1.25			
+ Cyanazine	1.25			
7. Paraquat	.25	75	1.8 (98)	97.6
+ Simazine	1.25			
+ Cyanazine	1.25			
8. Glyphosate	.5	74	7.8 (42)	34.3
9. Glyphosate	.5	60	1.8 (98)	135.5
+ Atrazine	1.25			
+ Simazine	1.25			
10. Glyphosate	.5	61	3.8 (91)	97.6
+ Atrazine	1.25			
+ Alachlor	2.5			
11. Glyphosate	.5	55	3.8 (91)	104.2
+ Cyanazine	1.25			
+ Alachlor	2.5			
12. Glyphosate	.5	54	4.0 (90)	55.4
+ Simazine	1.25			
+ Alachlor	2.5			
13. Glyphosate	.5	56	5.3 (83)	81.3
+ Alachlor	2.5			
Bayes $LSD_{0.05}$		8	2.6	48.4

[a]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%.

[b]The % is an approximation.

Table 2. The effect of paraquat or glyphosate alone or in combination with several residual herbicides on weed control and corn yields under no-tillage production in a rye cover crop, 1975.

		June 18			July 16	
	Rate (lb/A)	Yellow Nutsedge (Rating)[a] (%)[b]	Fall Panicum (Rating)[a] (%)[b]	Corn Injury (Rating)[a] (%)[b]	Fall Panicum (Rating)[a] (%)[b]	Corn Yields (Bu/A)
1. paraquat	0.25	7.3 (56)	8.3 (23)	1.0 (0)	8.3 (23)	17.9
2. glyphosate	0.5	6.5 (70)	7.8 (42)	1.0 (0)	7.3 (56)	19.5
3. atrazine + simazine + paraquat	1.25 +1.25 +0.25	5.3 (83)	2.0 (98)	1.0 (0)	2.3 (97)	66.3
4. alachlor + atrazine + paraquat	2.5 +1.25 +0.25	3.5 (93)	2.5 (96)	1.0 (0)	3.3 (94)	67.1
5. alachlor + simazine + paraquat	2.5 +1.25 +0.25	3.3 (94)	1.3 (99)	1.0 (0)	1.5 (99)	77.4
6. alachlor + atrazine + glyphosate	2.5 +1.25 +0.5	4.8 (86)	3.8 (91)	1.3 (1.2)	3.3 (94)	44.6
7. alachlor + simazine +glyphosate	2.5 +1.25 +0.5	5.8 (77)	1.5 (99)	1.0 (0)	2.0 (98)	72.9
8. atrazine + cyanazine + paraquat	1.25 +1.5 +0.25	4.8 (86)	2.8 (96)	1.0 (0)	2.5 (96)	61.8
9. simazine + cyanazine + paraquat	1.25 +1.5 +0.25	2.8 (96)	2.0 (98)	1.0 (0)	2.5 (96)	62.8
10. atrazine + metolachlor + paraquat	1.5 +1.5 +0.5	4.3 (89)	2.8 (96)	1.0 (0)	2.8 (96)	76.8
11. atrazine + metolachlor + paraquat	2.25 +2.25 +0.75	3.5 (93)	2.5 (96)	1.0 (0)	3.8 (91)	80.9
12. simazine + metolachlor + paraquat	1.5 +1.5 +0.5	4.0 (90)	2.5 (96)	1.0 (0)	3.5 (93)	74.2
13. simazine + metolachlor + paraquat	2.25 +2.25 +0.75	4.5 (88)	1.8 (98)	1.0 (0)	1.5 (99)	87.9
14. metolachlor + paraquat	1.5 +0.5	3.3 (94)	4.0 (90)	1.0 (0)	2.8 (96)	61.7
15. metolachlor + paraquat	2.25 +0.75	3.0 (95)	4.5 (88)	1.0 (0)	5.0 (85)	42.3
16. R3140 + paraquat	1.5 +0.25	4.3 (89)	6.8 (67)	1.0 (0)	7.0 (65)	46.0
17. R3140 + paraquat	3 +0.25	6.0 (75)	5.3 (83)	1.0 (0)	4.3 (89)	49.4
18. R3140 + paraquat	4 +0.25	3.0 (95)	4.8 (86)	1.3 (1.2)	5.0 (85)	51.1
19. R3140 + simazine + paraquat	1.5 +1.25 +0.25	5.0 (85)	6.0 (75)	1.0 (0)	5.5 (80)	45.8
Bayes LSD .05		NS	1.3	NS	2.0	28.1

[a]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%.

[b]The % is an approximation.

Table 3. The effect of paraquat or glyphosate in combination with several residual herbicides on weed control and corn yields under no-tillage production in a rye cover crop, 1976.

Treatment	Rate lb/A	May 19 Cover Kill (%)	August 12 Fall Panicum (Rating)[a] (%)[b]	October 14 Corn Yields (Bu/A)
1. Paraquat	0.25	80	5.3 (83)	9.8
2. Paraquat	0.25	86	5.0 (85)	16.6
+ penoxalin	+2.0			
3. Paraquat	0.25	91	4.0 (90)	31.1
+ penoxalin	+1.5			
4. Paraquat	0.25	84	2.8 (96)	68.5
+ penoxalin	+1.5			
+ atrazine	+1.25			
5. Paraquat	0.25	96	2.0 (98)	49.4
+ penoxalin	+1.5			
+ simazine	+1.25			
6. Paraquat	+2.5	89	5.8 (77)	49.4
+ atrazine				
7. Paraquat	0.25	61	2.3 (97)	46.3
+ atrazine	+1.25			
+ simazine	+1.25			
8. Paraquat	0.25	93	3.3 (94)	47.9
+ cyanazine	+2.5			
9. Paraquat	0.25	90	3.5 (93)	74.4
+ atrazine	+1.25			
+ cyanazine	+1.5			
10. Paraquat	0.25	89	7.0 (65)	16.4
+ metolachlor	+2.0			
11. Paraquat	0.25	90	7.0 (65)	45.5
+ metolachlor	+1.5			
+ atrazine	+1.25			
12. Paraquat	0.25	93	4.0 (90)	98.8
+ metolachlor	+1.5			
+ simazine	+1.25			
13. Paraquat	0.25	90	5.8 (77)	49.6
+ metolachlor	+1.5			
+ procyazine	+2.0			
14. Paraquat	0.25	83	5.0 (85)	22.7
+ metolachlor	+1.5			
15. Paraquat	0.25	93	6.5 (70)	61.8
+ atrazine	+1.25			
+ alachlor	+2.5			
16. Paraquat	0.25	88	7.5 (52)	47.0
+ metolachlor	+2.5			
17. Paraquat	0.25	83	5.8 (77)	37.5
+ alachlor	+2.5			
18. Glyphosate	0.5	76	4.0 (90)	90.0
+ atrazine	+1.25			
+ simazine	+1.25			
Bayes LSD_{05}		18.6	2.4	34.7

[a]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%.

[b]The % is an approximation.

HERBICIDE PERFORMANCE IN NO-TILLAGE CORN

F.J. Webb[1]

ABSTRACT

Several herbicide combinations were evaluated as to their performance in a no-tillage corn culture, utilizing corn stalk and soybean stubble residue. A 30% liquid nitrogen solution was used as the chemical carrier in this study. Glyphosate at 1.5 lbs/A and Paraquat at .25 lbs/A were both satisfactory for vegetative kill. Both dessicants were much improved on broadleaf weed control with the addition of 2,4-D ester at .25 lbs/A.

The most outstanding herbicide combinations for residual weed control were combinations of Atrazine at 1.25 lbs/A and Simazine at 1.25 lbs/A or Cyanazine at 2.0 lbs/A or Alachlor at 2.0 lbs/A.

The Alachlor performance was better in the soybean stubble than in the corn stalk residue, possibly because there was less debris on the soil surface in the soybean area and less chemical was tied up.

In the event of delayed application of the foliar dessicant after planting for no-tillage corn, Paraquat has been used at the very early spike stage with essentially no lasting damage. Glyphosate was found to be very injurious to corn in the early spike stage at 0.5 lbs/A and above. At the 0.5 lbs/A rate the corn grew out of the chlorosis; however, at the higher rates the corn remained chlorotec for a long period and some corn plants died at the 2.0 lbs/A rate.

INTRODUCTION

No-tillage corn (Zea mays L.) production is quickly being accepted throughout the Delmarva Peninsula. Satisfactory weed control by both the knock-down and residual chemicals is the greatest problem still facing the producer. Paraquat (1,1'-dimethyl 4,4' bipyridinium chloride) has performed reasonably well in most instances for vegetative kill. However, since most of the no-tillage corn is planted in old crop residue, higher populations of both broadleaf and grass weeds are encountered than where a cover crop is utilized. This means that the dessicant material must be effective on a greater number of species and a greater population of weeds. The summer annuals can also occur at greater populations in most instances.

This study was initiated to evaluate several dessicant materials alone and in combination with a phenoxy for vegetative burn down and to evaluate residual materials alone and in combination for broadleaf and grass weed control.

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MATERIALS AND METHODS

This study was located at the University of Delaware Substation, Georgetown at two plot locations. One location was utilizing a Woodstown Sandy Loam soil with a cover of corn stalk residue from the previous crop.

The second location was an Elkton Sandy Loam soil utilizing the residue from last years full season soybeans (Glycine max L.). The corn residue was disked in the fall immediately after harvest. The soybean residue stood undisturbed.

The corn residue area was planted on May 12, 1976 and the soybean residue area on May 20, 1976.

Both tests utilized a complete randomized block statistical design, with four replications. The Woodstown Sandy Loam soil was infested with Common Lambsquarters (Chenopodium album L.), Redroot Pigweed (Amaranthus retroflexus L.), Common Ragweed (Ambrosia artemesiifolia), Pennsylvania Smartweed (Polygonum pensylvanicum), Wild Vetch (Vicia cracca L.), and Fall Panicum (Panicum dichotomiflorum michx.).

The Elkton Sandy Loam had the same broadleaf weed spectrum except for the absence of Pennsylvania Smartweed, and Wild Vetch but included a heavy population of Horseweed (Erigeron canadensia L.) which is very common in this cover situation.

The plots were sprayed the day following planting with a CO_2 pressured plot sprayer. The plots were 6 rows by 25 feet long with the four center rows treated. All spray treatments combining several chemicals were tank mixed together and applied with a single spraying. All treatments were mixed in 30% liquid nitrogen to supply 97.5 lbs of nitrogen per acre (30 gal/A). This method of application was used to directly simulate a normal application method used by most producers.

Treatments 33, 34, and 35 were delayed until just at hypocotol cracking, approximately five days. These treatments were studied to evaluate the effects of glyphosate (N-(phosphonomethyl) glycine) on emerging corn. Producers are sometimes delayed, for a number of reasons, with their chemical application until early emergence. Paraquat has been used in this situation with little or no lasting crop injury.

The Woodstown Sandy Loam plot was rated for vegetative kill on May 26, 1976 and the Elkton Sandy Loam area on June 15, 1976.

The residual chemical weed control ratings were made on July 26, 1976 with ratings made for broadleaf weeds and for grassy weeds.

The ester form of 2,4-D was used to facilitate mixing with the 30% liquid nitrogen.

RESULTS AND DISCUSSION

The foliar dessicant, Paraquat and Glyphosate were both improved with the addition of 2,4-D on broadleaf weed kill (Table 1). In the soybean stubble, especially, where the horseweed was present, the addition of 2,4-D improved the activity of Glyphosate and of Paraquat. The 2,4-D seemed to have the least effect in the treatments containing Atrazine and Cyanazine. Treatments containing these materials tend to give greater contact activity when applied in liquid nitrogen.

Glyphosate at 0.5 and 1.0 lbs/A was unsatisfactory, but at 1.5 lbs/A and above gave satisfactory vegetative kill. Paraquat at .13 lbs/A was unsatisfactory to give good burn down. The .25 lbs/A was satisfactory with the .50 lbs/A having the best activity.

Alachlor gave satisfactory grass control at 2.5 lbs/A in combination with Atrazine or Cyanazine. In the corn stalk plot where the fall panicum was the heaviest, Alachlor rates below 2.5 lbs/A gave unsatisfactory control.

Cyanazine gave excellent fall panicum and broadleaf weed control at 2.0 lbs/A and above in combination with Atrazine and Alachlor. It was noted in the soybean stubble plot that Cyanazine at 2.0, 2.5 and 3.5 lbs/A produced temporary chlorosis in the young corn. The soil contained about .9% organic matter which probably explains this early injury. The corn stalk plot contained 1.8% organic matter and showed no signs of injury even at the higher rates of Cyanazine. The data shows a yield reduction at the 3.5 lbs/A rate of Cyanazine. This reduction in yield was consistent at both locations.

The yields vary greatly but generally are lower with the poorer overall weed control ratings.

The delayed applications of Glyphosate produced chlorosis in the young corn.

This chlorosis increased as the rate increased. At the 2.0 lbs/A rate permanent damage was evident. This shows that delayed applications of Glyphosate can be injurious to corn if the spike is emerged.

Table 1

HERBICIDE EFFECTIVENESS FOR NO-TILLAGE CORN
APPLIED IN 30% LIQUID NITROGEN 1/

Treatment	Rate lb/A a.i.	Yield Bu/A	Burn Down Rating 3/	Broad Leaf Weeds 3/	Grassy Weeds 3/
1. Check plot (no treatment)		24.2	0.3	1.9	1.0
2. Glyphosate	0.5	37.7	4.6	4.1	2.6
3. Glyphosate	1.0	43.4	6.7	4.9	4.6
4. Glyphosate	1.5	81.4	8.1	6.0	5.1
5. Glyphosate	2.0	55.3	8.5	7.7	5.9
6. Glyphosate + Atrazine + Alachlor	1.0 + 1.25 + 2.0	66.0	8.5	8.8	7.9
7. Glyphosate + Atrazine + Alachlor	1.5 + 1.25 + 2.5	77.9	9.4	9.5	8.4
8. Glyphosate + Atrazine + Alachlor	1.5 + 1.25 + 2.0	72.9	9.3	9.3	8.9
9. Glyphosate + Atrazine + Alachlor (Flowable combination)	1.5 + 1.0 + 2.0	71.6	8.9	9.4	8.6
10. Glyphosate + Atrazine + Alachlor	1.5 + 1.0 + 2.0	71.4	9.0	9.0	8.4
11. Glyphosate + Atrazine + Cyanazine	1.5 + 1.25 + 1.5	78.6	9.9	5.4	7.7
12. Glyphosate + Atrazine + Cyanazine	1.5 + 1.25 + 2.5	70.0	9.7	5.4	9.4
13. Glyphosate + Atrazine + Cyanazine	1.5 + 1.25 + 3.5	63.8	9.9	9.7	8.7
14. Glyphosate + Atrazine + Simazine	1.0 + 1.25 + 1.25	66.5	8.4	8.9	8.7
15. Glyphosate + Atrazine + Simazine	1.5 + 1.25 + 1.25	61.2	9.1	9.5	8.7
16. Glyphosate + Alachlor + Simazine	1.5 + 2.5 + 1.25	67.4	9.3	8.9	8.9
17. Paraquat 2/ + Atrazine + Simazine	.13 + 1.25 + 1.25	64.2	7.4	8.7	8.8
18. Paraquat + Atrazine + Simazine	.25 + 1.25 _ 1.25	52.9	8.4	9.4	7.9
19. Paraquat + Atrazine + Simazine	.50 + 1.25 ∓ 1.25	62.7	9.3	9.4	8.7
20. Paraquat + Atrazine + Simazine + 2,4-D	.25 + 1.25 + 1.25 + .13	71.9	8.8	8.7	8.8
21. Paraquat + Atrazine + Simazine + 2,4-D	.25 + 1.25 + 1.25 + .25	60.4	9.4	9.4	8.3
22. Glyphosate + Atrazine + Simazine + 2,4-D	1.0 + 1.25 + 1.25 + .25	73.9	9.7	9.4	8.4
23. Glyphosate + Atrazine + Simazine + 2,4-D	1.5 + 1.25 + 1.25 + .25	70.8	9.9	9.0	8.9
24. Paraquat + Atrazine + Cyanazine	.25 + 1.25 + 1.5	67.9	10.0	9.6	8.5
25. Paraquat + Atrazine + Cyanazine	.25 + 1.25 + 2.0	75.9	9.8	9.9	8.9
26. Paraquat + Atrazine + Cyanazine	.25 + 1.25 + 2.5	76.4	9.7	9.9	9.7
27. Paraquat + Atrazine + Cyanazine + 2,4-D	.25 + 1.25 + 2.0 + .25	78.7	9.7	9.9	9.3
28. Paraquat + Alachlor + Cyanazine	.25 + 1.5 + 2.0	66.3	9.3	8.5	8.4
29. Paraquat + Alachlor + Cyanazine	.25 + 2.0 + 2.0	76.8	8.8	9.3	9.2
30. Paraquat + Alachlor + Cyanazine + 2,4-D	.25 + 2.0 + 2.0 + .25	73.4	9.3	9.4	9.0
31. Glyphosate + Atrazine + Simazine + SRC 101	1.0 + 1.0 + 1.0 + 0.5	70.4	8.1	7.8	7.8
32. Paraquat + + Atrazine + Simazine + SRC 101	.13 + 1.0 + 1.0 + 0.6	77.7	7.8	8.3	8.4
33. Glyphosate) delayed application	1.0	42.6	7.2	5.7	7.0
34. Glyphosate) until near emergence	1.5	49.5	7.4	6.4	5.2
35. Glyphosate)	2.0	56.8	8.9	6.4	5.5

1/ Figures given are the average of two locations in 1976
2/ All treatments containing Paraquat have 2 pts/100 gal - Ortho X77 surfactant
3/ Weed Control Ratings: 0 - No Control
10 - 100% Control

HERBICIDE COMBINATIONS FOR SOY, SNAP AND KIDNEY BEANS IN NEW YORK

George H. Bayer [1]

ABSTRACT

Seventy three single and combination herbicide treatments were evaluated on soybeans (Soja Max. Traverse), snapbeans (Phaseolus vulgaris Provider) and kidney beans (Phasealus vulgaris Dark Red) at Fabius, New York in 1976.

The kidney beans were the most sensitive of the three crops to herbicide injury. Soybeans were the least sensitive. Weed species which were evaluated included: common ragweed (Ambrosia artemisiifolia L.), common lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.) and green foxtail [Setaria viridis (L.) Beauv.]

The treatments which provided 90% or better control with each of the four weed species included: the preemergence treatment of profluralin [N-(cyclopropylmethyl)-a,a,a-trifluoro-2,6-dinitro-N-propyl-p-toluidine] at 2 lbs/A plus metribuzin [4-amino-6-tert-butyl-3-(methylthio-as-triazine-5 (4H)one] at .38 lbs/A; trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) applied preplant soil incorporated at 1 lb/A plus bentazon [3-isopropyl-1H-2,1,3-benzothiadiazin-(4) 3H-one 2,2-dioxide] at .75 lbs/A applied postemergence; FMC 30371 (chemistry unknown) at 2.5 lbs/A plus metribuzin at .38 lbs/A both applied preemergence; a single herbicide treatment of SN 40321 [3-ethoxycarbonylaminophenyl-N-(4-fluorophenyl)-carbamate] at 1.5 lbs/A; alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] at 1.5 lbs/A plus metribuzin at .38 lbs/A both applied preemergence; trifluralin preplant incorporated at 1 lb/A followed by desmedipham [ethyl m-hydroxycarbanilate carbanilate (ester)] at 1 lb/A postemergence and the three herbicide treatment of penoxalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine)] at .75 lb/A plus EPTC (S-ethyl dipropylthiocarbamate) at 3 lbs/A both incorporated followed by dinoseb (2-sec-butyl-4,6-dinitrophenol) at 4.5 lbs/A applied preemergence.

INTRODUCTION

Although there is not a large acreage of soybeans in New York, red kidney and snap beans are important crops with large acreages. This experiment was designed to screen the many commercial and experimental materials suggested for at least one of these crop species.

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MATERIALS AND METHODS

The soil in the experimental area is a Genesee Alluvial fan with a pH of 6.3 and 4.9% o.m. The design was a randomized complete block with four replications. Plot size was 6 ft by 20 ft. The treatments were applied with a hand carried CO_2 sprayer at 40 psi and a spray volume of 72 gal/A. Preplant incorporated treatments were applied on June 8. One row each of the beans was planted and preemergence treatments were applied on June 9. At-cracking materials were sprayed on June 16, and post treatments (except number 63) were applied on June 24 when the beans were in the two leaf stage, green foxtail was in the 2 to 3 leaf and broadleaf weeds in the 3 to 4 leaf stage. Treatment number 63 was applied on July 1 when the beans were in the 4 to 6 leaf stage and broadleaf weeds in the 3 to 4 leaf stage.

Weed control and crop ratings were made on July 7 on the basis of 1 to 10; where 0 = no effect and 10 = complete death of the crop or weed.

RESULTS AND DISCUSSION

The kidney beans were the most sensitive of the three crops to herbicide injury. Soybeans were the least sensitive (see Table 1).

Common ragweed was the weed most difficult to control followed by common lambsquarters, redroot pigweed and green foxtail.

Combinations that provided fair ragweed control included linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea] or chlorbromuron [3-(4-bromo-3-chlorophenyl)-1-methylurea] and very good with metribuzin combinations. Metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide], EPTC, alachlor, chloramben (3-amino-2,5-dichlorobenzoic acid), dinoseb, profluralin and RH 2512 [2-chloro-1-(4-nitrophenoxy)-4-trifluoromethyl benzene] did not control common ragweed.

Common lambsquarters control was poor with metolachlor, dinoseb and EPTC.

Almost all treatments gave good to excellent control of redroot pigweed and green foxtail except dinoseb.

THREE BEAN HERBICIDE TEST
FABIUS, NEW YORK
1976

Trt. No.	Chemical & Formulation	Timing	Rate ai/A	Crop Injury Soy	Snap	Kidney	Weed Control G Fox	Rd Pig	Lamqua	Cm Rag
1.	profluralin + linuron	PPI+Pre	1.0+.75	0	2.0	1.8	9.5	10.0	10.0	7.3
2.	profluralin + metribuzin	PPI+Pre	.75+.38	0	5.5	5.0	9.3	10.0	9.8	7.3
3.	profluralin + metribuzin	PPI+Pre	1.0+0.5	0	5.8	4.8	9.8	10.0	9.8	8.5
4.	profluralin + chlorbromuron	PPI+Pre	1.0+1.0	0	2.0	1.5	9.3	9.5	10.0	6.5
5.	profluralin + chlorbromuron	PPI+Pre	1.0+1.5	0	5.8	4.0	9.8	9.8	10.0	7.8
6.	metolachlor + linuron	Pre	2.0+.75	0	3.0	2.0	10.0	10.0	9.8	8.0
7.	metolachlor + metribuzin	Pre	2.0+.38	.8	8.3	6.8	10.0	9.8	10.0	9.0
8.	metolachlor + chlorbromuron	Pre	2.0+1.0	0	2.5	1.8	10.0	10.0	10.0	5.5
9.	metolachlor	Pre	2.0	0	.5	1.0	9.8	9.3	2.5	1.8
10.	chlorbromuron	Pre	2.0	0	6.5	3.0	7.5	9.8	9.8	7.0
11.	metolachlor + metribuzin	Pre	1.5+.38	0	6.0	4.5	9.8	10.0	10.0	8.3
12.	metolachlor + linuron	Pre	1.5+1.0	0	4.8	3.8	10.0	10.0	10.0	8.3
13.	Hercules 26910 + linuron	Pre	1.5+1.0	.5	5.3	3.5	10.0	10.0	10.0	8.3
14.	Antor 22234 + linuron	Pre	1.5+1.0	.3	6.0	2.3	9.5	10.0	10.0	8.3
15.	chloramben + alachlor	Pre	1.5+1.5	.8	.8	.5	9.8	10.0	6.7	3.5
16.	chloramben + alachlor	Pre	2.0+2.0	0	3.0	2.3	9.8	9.5	8.5	5.3
17.	chloramben + metribuzin	Pre	2.0+.38	.3	5.5	5.5	9.5	9.5	9.3	8.0
18.	butralin + EPTC	PPI	2.0+3.0	1.8	1.8	2.0	10.0	9.3	7.5	4.8
19.	butralin + metribuzin	PPI+Pre	2.0+.38	0	7.8	6.8	10.0	10.0	9.8	8.8
20.	butralin + metribuzin	PPI	2.0+.38	0	7.0	5.3	9.8	10.0	10.0	8.8
21.	butralin + chloramben	PPI+Pre	2.0+2.0	0	3.5	2.0	10.0	10.0	10.0	3.8
22.	trifluralin + chloramben	PPI+Pre	1.0+2.0	.3	1.0	.8	10.0	10.0	9.8	1.0
23.	butralin + linuron	PPI+Pre	2.0+1.0	.5	4.0	3.8	9.5	10.0	10.0	8.5
24.	butralin + linuron	PPI	2.0+1.0	0	1.8	1.3	8.3	9.0	9.3	7.5
25.	penoxalin + linuron	PPI	1.0+1.0	0	1.8	1.5	9.0	9.0	9.8	7.3
26.	penoxalin + metribuzin	PPI	1.0+.38	0	5.3	4.0	10.0	10.0	10.0	8.8
27.	penoxalin + linuron	PPI+Pre	1.0+.38	0	3.3	2.8	9.0	9.0	9.8	6.3
28.	penoxalin + metribuzin	PPI+Pre	1.0+.38	0	6.0	5.0	9.3	9.5	9.3	7.3
29.	penoxalin + metribuzin	PPI+Pre	1.0+.38	.3	6.0	4.8	10.0	9.8	9.8	8.0
30.	penoxalin + EPTC + dinoseb	PPI+PPI +Pre	.75+3.0 +4.5	1.5	1.0	1.3	10.0	9.8	9.5	9.0
31.	penoxalin + EPTC	PPI	.75+3.0	1.8	1.5	1.3	9.8	8.3	9.5	6.5
32.	trifluralin + EPTC + dinoseb	PPI+PPI +Pre	0.5+3.0 +4.5	1.8	.8	1.3	10.0	8.0	8.0	7.8
33.	trifluralin + EPTC	PPI	0.5+3.0	.3	1.5	1.5	9.8	8.5	7.3	5.5

THREE BEAN HERBICIDE TEST - 1976

Trt. No.	Chemical & Formulation	Timing	Rate ai/A	Crop Injury			Weed Control			
				Soy	Snap	Kidney	G Fox	Rd Pig	Lamqua	Cm Rag
34.	dinoseb	Pre	4.5	0	0	0	0	1.8	6.0	3.3
35.	dinoseb	at cracking	3.0	.5	2.5	2.5	2.0	5.5	5.3	6.3
36.	trifluralin + bentazon	PPI+Post	1.0+.75	.3	1.3	.8	9.3	10.0	10.0	9.5
37.	profluralin + bentazon	PPI+Post	1.0+.75	0	.5	1.3	8.5	9.5	9.5	8.8
38.	alachlor + linuron	Pre	1.5+1.0	.5	6.8	2.5	10.0	10.0	10.0	8.3
39.	FMC 25213 + metribuzin	Pre	1.0+.38	0	4.7	4.0	9.7	10.0	9.7	8.3
40.	FMC 30371 + metribuzin	Pre	1.5+.38	.5	5.5	5.0	10.0	10.0	10.0	8.3
41.	FMC 30371 + metribuzin	Pre	2.5+.38	.5	5.5	4.5	10.0	10.0	10.0	9.3
42.	HOE 23408 + linuron	Pre	1.25+1.0	0	5.3	2.5	9.3	9.5	10.0	8.3
43.	SN 40321	(weeds 1-2") Post	1.0	0	2.5	1.8	7.8	9.5	9.5	8.8
44.	SN 40321	(weeds 1-2") Post	1.5	1.0	3.3	2.3	9.0	9.0	9.3	9.5
45.	EPTC	PPI	3.0	.5	0	0	9.3	7.8	5.8	4.5
46.	EPTC + trifluralin	PPI	3.0+0.5	.7	1.0	2.0	7.3	6.7	7.0	5.7
47.	EPTC + alachlor	PPI+Pre	3.0+1.5	1.8	.8	.8	9.5	8.8	8.5	7.3
48.	butralin + linuron	Pre	2.0+1.0	0	3.0	2.0	9.3	10.0	10.0	7.8
49.	penoxalin + linuron	Pre	1.0+1.0	0	5.0	2.0	9.0	10.0	10.0	9.3
50.	vernolate + profluralin	PPI	2.5+1.5	0	.3	1.8	9.3	9.8	9.0	3.0
51.	profluralin	PPI	.75	0	1.0	1.0	8.3	6.5	6.3	5.3
52.	profluralin	PPI	1.0	0	1.0	2.0	9.0	8.3	7.7	3.7
53.	GCP 5544 + metribuzin	Pre	2.5+.38	0	6.0	6.0	10.0	10.0	9.8	8.5
54.	GCP 5544 + metribuzin	Pre	3.5+.38	.3	6.5	5.8	10.0	10.0	10.0	8.0
55.	alachlor + metribuzin	Pre	1.5+.38	.8	7.5	7.0	10.0	10.0	10.0	9.0
56.	alachlor + dinoseb	Pre	1.5+4.0	0	1.3	1.3	9.3	8.5	6.0	5.5
57.	RH 2915 + alachlor	Pre	.12+1.5	.8	5.5	3.8	10.0	10.0	6.8	6.3
58.	RH 2915 + alachlor	Pre	.25+1.5	1.3	8.3	5.5	9.8	10.0	10.0	6.5
59.	RH 2512	Pre	1.0	.3	9.8	9.8	9.8	10.0	7.8	2.5
60.	RH 2512 + alachlor	Pre	1.0+1.5	.5	9.0	8.8	10.0	10.0	8.8	6.0
61.	RH 8817	PPI	1.0	0	2.8	2.0	9.5	9.8	8.8	8.3
62.	RH 8817	PPI	.5+.5	0	2.3	2.3	9.5	9.0	8.8	7.3
63.	trifluralin + desmedipham	PPI+Post	1.0+1.0	2.0	4.3	4.0	9.8	9.8	9.8	9.8

THREE BEAN HERBICIDE TEST - 1976

Trt. NO.	Chemical & Formulation	Timing	Rate ai/A	Crop Injury Soy	Snap	Kidney	Weed Control G Fox	Rd Pig	Lamqua	Cm Rag
64.	FMC 25213 + metribuzin	Pre	1.0+.38	.8	3.8	3.0	10.0	10.0	10.0	7.5
65.	FMC 30371	Pre	1.5	0	4.0	4.0	8.8	7.8	7.8	5.3
66.	FMC 30371 + linuron	Pre	1.5+1.0	.5	3.3	3.5	9.8	10.0	10.0	8.8
67.	Ortho 19790 + linuron	Pre	1.5+1.0	.3	6.5	2.8	9.8	10.0	10.0	8.8
68.	dinoseb + naptalam + alachlor	cracking	1.0+2.0+ 1.5	1.3	3.3	3.3	10.0	10.0	10.0	8.8
69.	oryzalin + linuron	Pre	1.5+1.0	1.0	2.8	1.3	10.0	10.0	10.0	8.0
70.	metribuzin + HOE 23408	Pre+EPo	.38+1.25	0	6.5	5.3	10.0	10.0	9.5	8.5
71.	metribuzin + (HOE 23408 + Oil Concentrate)*	Pre+ Post	.38+ .50	.3	4.0	2.3	9.8	8.3	8.8	7.0
72.	metribuzin + (HOE 23408 + Oil Concentrate)*	Pre+ Post	.38+ 1.0	.5	7.0	6.0	10.0	10.0	10.0	8.8
73.	Check									
74.	Check									
75.	Check									
76.	Check									
77.	Check									
78.	Check									
79.	penoxalin + metribuzin	Pre	1.0+.38	0	7.0	4.3	9.8	9.8	10.0	8.5

*Oil Concentrate = Booster Plus E 1:60 v/v

Weed and Soybean Responses to Oxadiazon[1/]

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

ABSTRACT

Oxadiazon (2-*tert*-butyl-4- [2,4-dichloro-5-isopropoxyphenyl] -Δ^2-1, 3,4-oxadiazolin-5-one) was evaluated for five years as a preemergence herbicide for soybeans. Control of lambsquarters (*Chenopodium album* L.) was excellent and control of three species of annual grass was good although 1 lb/A oxadiazon produced an average 16% initial reduction in soybean growth. Combinations of oxadiazon with alachlor (2-chloro-2^1,6^1-diethyl-N- [methoxy= methyl] acetanilide) or trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) resulted in improved control of annual grasses and in some instances produced less soybean injury than higher rates of oxadiazon alone; a combination of oxadiazon with linuron (3- [3,4-dichlorophenyl] -1-methoxy-1-methylurea) failed to provide satisfactory control of annual grasses. Soybeans recovered from initial injury and produced good yields in all instances.

INTRODUCTION

Oxadiazon has been researched in several areas of the United States during the past few years for weed control in soybeans. Control of many small-seeded annual broadleaf weeds and grasses has been good while control of jimsonweed (*Datura stramonium* L.) and annual morningglories (*Ipomoea* spp.) has been variable (5,6,10). Injury to soybeans has frequently occurred with the extent varying from initial stunting and cupping of the unifoliate, first, and second trifoliate leaves followed by rapid recovery (4,5,10) to more severe responses expressed as stand reduction and eventual yield reduction (1,3). Huntoon and Gagnon (6) indicated that the effectiveness of oxadiazon is better when applications are made to moist soil rather than to extremely dry soil. Hogue and Kirby (5) reported injury to soybeans was greatest when excessive rainfall occurred after application. However, a review of other literature indicates no consistent pattern of soybean response to oxadiazon based on moisture at the time of application or rainfall following applications (2,7,8,9).

The research reported herein was conducted to determine the efficacy of oxadiazon alone and in certain herbicide combinations, for weed control in soybeans in eastern Virginia. Of special interest was the effect of soil moisture at the time of application and shortly thereafter on soybean injury.

1/ Contribution from the Plant Physiology Department, Virginia Truck and Ornamentals Research Station. Paper No. 165, Journal Series. Approved for publication November 4, 1976.
2/ Plant Physiologist and Agricultural Research Technician, respectively, Virginia Truck and Ornamentals Research Station, Painter, VA 23420.

MATERIALS AND METHODS

Research was conducted from 1972 to 1976 at the Virginia Truck and Ornamentals Research Station, Painter. Soil type was a Sassafras sandy loam with a pH varying from 5.5 at the beginning of the period to about 6.3 in 1976, organic matter content was 1.25 to 1.5 and phosphorus and potassium tested high. Plots measuring 6.7 ft x 20 ft (2 rows wide) were prepared in the spring to receive herbicide treatments by mold-board plowing and tilling two or three times with a double disc. Where trifluralin was applied prior to planting, incorporation to a depth of 3 to 4 inches was done immediately with a tractor-powered rotary tiller. Soybeans were planted in late May or early June and preemergence herbicides were applied within 2 days of planting using hand-carried plot sprayers. The source of pressure was propane. All treatments were replicated three or four times. Soybean varieties, dates of planting and herbicide application, soil moisture conditions and days until initial rainfall after application and amount are presented in Table 1.

Table 1. Soybean varieties, dates of planting and herbicide application, soil moisture conditions, and initial rainfall and amounts received after planting in oxadiazon studies from 1972 through 1976.

Year	Variety	Date Planted	Date Treated	Soil Moisture	Days until initial rainfall and amount	
1972	Bragg	June 2	June 2	Dry	5	0.47 in
1973	Bragg	May 18	May 18	Moist	0	0.11 in
1974	Essex	June 6	June 7	Wet	0-2	0.31 in
1975	Essex	May 19	May 19	Moist	8	0.56 in
1976	Forrest	May 25	May 27	Dry	2-3	0.53 in

Soybean injury and weed control evaluations were made at the times indicated in Tables 2 through 4. Following initial ratings, soybeans were cultivated so that final control evaluations and yields would be similar to those obtained by most commercial growers who follow conventional tillage practices. Weed species predominant during the years were lambsquarters, jimsonweed, large crabgrass (*Digitaria sanguinalis* (L.) Scop.), fall panicum (*Panicum dichotomiflorum* Michx.) and barnyardgrass (*Echinochloa crusgalli* (L.) Beauv). To determine yields, soybeans were harvested by hand and threshed in a stationary plot thresher. Yields were analyzed statistically by standard analysis of variance and means were compared using Duncan's new multiple range test.

RESULTS AND DISCUSSION

Soybean response, yields, and weed control are presented in Tables 2, 3, and 4. It is evident that soybeans were injured by oxadiazon. The extent of soybean response to the herbicide varied with oxadiazon rate and with the year in which the study was conducted but averaged 16% from 1 lb/A oxadiazon when recorded 2.5 to 3 weeks after application. Formulation did not significantly affect soybean response to oxadiazon. Preemergence combinations of oxadiazon with alachlor and split applications of trifluralin incorporated prior to planting followed by preemergence applications of oxadiazon after planting resulted in injury that increased more with increases in the rate of oxadiazon than with increases in the rates of either alachlor or trifluralin in 1974 and 1975; no significant differences existed among chemical treatments in 1976 although all caused some injury when compared with the check. The combination of oxadiazon with linuron was researched in 1976 only but did not result in injury that differed significantly from linuron or oxadiazon applied alone.

Soil moisture at application varied from dry to wet during the 5 years of the study and although heavy rains were not received, a small amount of rain was recorded within 8 days following application. For this reason, in each year of the study soil moisture was high although not excessive at some time during the period of soybean germination and emergence. It is concluded from these studies, that under conditions of good soil moisture such as those described, oxadiazon can be expected to produce initial crop injury.

Control of lambsquarters with oxadiazon was good each year with rates as low as 0.75 lb/A but control of annual grasses was not consistent, especially at lower rates. Grass control was improved with alachlor and the preplant incorporated application of trifluralin. The combination of linuron with oxadiazon did not provide satisfactory control of annual grass.

Jimsonweed was present in the study in 1976 only and the population was low. Although activity was observed against jimsonweed, sufficient variability existed among the data to indicate control was not consistent.

Cultivation had little effect on control as evidenced by the fact that late-season ratings differed little from initial ratings. One possible exception might be in 1976 where control of annual grass was better in late summer than 8 weeks after application.

Yields of soybeans treated with oxadiazon were excellent. Soybean growth reductions were not reflected in lower yields from rates as high as 3 and 4 lb/A. These results indicate a good margin of safety exists in spite of the large amounts of initial injury involved. It should be kept in mind, however, that soybeans in these studies were planted early in the season and had time to recover from injury. Frequently in Virginia, soybeans are planted as a second crop following snap beans or small grains. Under these cultural practices, sufficient time for recovery from injury might not exist and yields may be reduced.

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Table 2. Effects of oxadiazon on soybean growth, lambsquarters and fall panicum control, and soybean yields in 1972, 1973 and 1974.[1/]

			Soybean growth reduction		Weed control[2/]				
					5-6 wk		15 wk		
		Rate,	2.5 wk	5-6 wk	LQ	FP	LQ	FP	Yield,
Year	Herbicide	(lb/A)	(%)	(%)	(%)	(%)	(%)	(%)	(bu/A)
1972	Oxadiazon	1	35 b	4 a	99	99			45.8 a
		1.5	60 c	8 a	100	99			44.5 a
		3	83 d	35 b	100	100			41.5 a
	Check (hoed)		6 a	4 a	100	100			44.5 a
	Check (weedy)		2 a	2 a	0	0			25.0 b
1973	Oxadiazon	.75	5 a	5 ab	100	100	100	99	33.3 a
		1	11 a	7 ab	100	100	100	98	35.7 a
		1.5	12 a	7 ab	100	98	100	97	34.5 a
		2	26 b	11 b	100	100	100	100	34.5 a
		4	48 c	23 c	100	100	100	100	32.7 a
	Linuron + alachlor	.5 + 1.5	6 a	4 a	100	100	100	100	35.7 a
	Check (weedy)		0	0	27	0	0	0	21.8 b
1974	Oxadiazon[3/]	1		1 a	100	92	100	97	42.4 a
		1.5		16 ab	100	94	100	97	43.0 a
		2		26 bc	100	96	100	96	41.7 a
	Oxadiazon[3/]	1		8 a	100	99	100	96	43.0 a
		2		32 c	100	96	100	98	40.5 a
	Oxadiazon + alachlor	1 + 1		1 a	100	99	100	98	45.4 a
	Linuron + alachlor	.5 + 1		3 a	100	98	100	98	44.2 a
	Check (weedy)			0	0	0	0	0	23.6 b

1/ Means within columns within years followed by the same letter do not differ at the 5% level of significance according to Duncan's new multiple range test.

2/ LQ=lambsquarters and FP=fall panicum. Soybeans were cultivated after the 5 to 6 week evaluations were made.

3/ Comparisons between 3 rates of the standard 2 lb/gallon emulsifiable concentrate formulation and 2 rates of a 3 lb/gallon flowable formulation. All other treatments used the standard 2 lb/gallon emulsifiable concentrate.

Table 3. Effect of oxadiazon on soybean growth 3, 5 and 10 weeks after application, lambsquarters and crabgrass control 5 and 10 weeks after application and soybean yield in 1975. 1/ 2/

		Soybean growth reduction			Weed control 3/				
					LQ	CG	LQ	CG	
Herbicide	Rate, (lb/A)	3 wk (%)	5 wk (%)	10 wk (%)	5 wk (%)	5 wk (%)	10 wk (%)	10 wk (%)	Yield, (bu/A)
Oxadiazon	1	12 ab	10 ab	7 a	98	96	100	93	36.3 b-d
	1.5	27 b	20 cd	10 a	95	95	99	95	40.5 a-d
Alachlor	1.5	3 a	3 a	5 a	33	97	70	93	36.3 b-d
	2	5 a	5 a	10 a	55	100	80	92	35.1 cd
Oxadiazon + alachlor	1 + 1	22 b	17 bc	8 a	100	100	99	97	40.5 a-d
	1 + 1.5	22 b	22 cde	5 a	98	100	100	98	41.1 a-d
	1.5 + 1	47 c	30 e	10 a	100	100	100	97	42.4 a-c
	1.5 + 1.5	50 c	23 cde	6 a	100	99	99	99	41.8 a-c
Trifluralin	.5	3 a	8 a	10 a	55	91	83	88	33.9 d
Trifluralin + oxadiazon	.5 + 1	13 ab	5 a	0	99	100	99	100	44.8 a
	.5 + 1.5	47 c	27 de	11 a	100	100	100	100	43.6 ab
	.5 + 3	68 d	53 f	25 c	100	100	100	100	43.0 ab
	1 + 1	25 b	23 cde	8 a	100	100	99	100	39.9 a-d
	1 + 1.5	47 c	25 cde	13 ab	100	100	100	100	43.0 ab
	1 + 3	77 d	53 f	20 bc	100	100	100	100	38.7 a-d
Check		0	0	0	0	0	0	0	19.4 e

1/ Trifluralin was applied prior to planting and incorporated.

2/ Means within columns followed by the same letter do not differ at the 5% level of significance according to Duncan's new multiple range test.

3/ Soybeans were cultivated after the 5-week evaluations were made. LQ = lambsquarters and CG = large crabgrass.

Table 4. Effect of oxadiazon on soybean growth 3 weeks after application, lambsquarters, jimsonweed, crabgrass and barnyardgrass control 8 and 12 weeks after application, and soybean yields in 1976[1/]

Herbicide	Rate, (lb/A)	Soybean growth reduction 3 wk (%)	Weed Control[2/] LQ 8 wk (%)	JW 8 wk (%)	CG 8 wk (%)	JW 12 wk (%)	CG 12 wk (%)	BY 12 wk (%)	Yield (bu/A)
Oxadiazon	1	7 a	99	87	70	92	82	91	30.9 ab
	1.5	15 a	100	98	82	97	87	97	32.1 ab
Linuron	.75	12 a	100	98	80	97	70	80	31.5 ab
Oxadiazon + linuron	1 + .5	10 a	100	94	83	78	85	91	30.3 b
Oxadiazon + alachlor	1 + 1.5	15 a	100	98	98	97	98	98	30.9 ab
Linuron + alachlor	.5 + 1.5	13 a	100	86	99	98	96	99	33.9 a
Check		0	0	0	0	0	0	0	23.0 c

1/ Means within columns followed by the same letter do not differ at the 5% level of significance according to Duncan's new multiple range test.

2/ Soybeans were cultivated after the 8-week evaluations were made. LQ = lambsquarters, JW = jimsonweed, CG = large crabgrass and BY = barnyardgrass.

ORYZALIN APPLIED OVERTOP WHEAT FOR WEED CONTROL IN SOYBEANS PLANTED IN THE STUBBLE FOLLOWING WHEAT HARVEST

L. B. Lynn, M. L. Jones, W. E. Rogers, G. J. Shoop[1/]

ABSTRACT

Results have shown that oryzalin may be applied as an overtop spray on wheat and still provide acceptable weed control in a succeeding no-till planted soybean crop. At herbicidally efficacious rates 1 - 1.5 lb/A, oryzalin caused no adverse effects to wheat when applied at the jointing stage of development and only slight effects when applied to fully tillered wheat. While other chemicals are used after soybeans are planted, OTS applications of oryzalin reduces the dependence on a contact herbicide to provide both grass and broadleaf weed control in no-till soybeans. Based on these and other trials in the Eastern United States, Eli Lilly and Company expects an EPA experimental permit label for this use of oryzalin in 1977.

INTRODUCTION

No-till farming has increased substantially in recent years to allow more intensive utilization of land. A no-till practice of particular interest is soybeans following small grain because it permits harvesting two crops from the same land in a single year. Continued success and expansion of no-till soybeans is dependent on development of a more consistent weed control program.

Currently, most no-till growers spray the small grain stubble with a contact herbicide to kill existing weeds plus residual herbicides for grass and broadleaf weed control. These herbicides are normally tank-mixed and applied either just before or, more frequently, just after planting soybeans. Historically, erratic weed control has often occurred due to difficulties in getting complete spray coverage in the small grain residue and inconsistent kill of existing weeds by contact herbicides.

Oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide), (Elanco Products Company) has been evaluated by Lilly scientists and several universities in a new concept for double cropped soybeans. Oryzalin was applied as an overtop spray (OTS) to wheat in different growth stages followed by no-till planted soybeans. The theory of this concept is that oryzalin applied in this manner is not injurious to fully tillered wheat and that the early application allows good chemical distribution before soybeans are planted. Because oryzalin controls

1/ Lilly Research Laboratories, Greenfield, Indiana

early germinating annual grasses and small seeded broadleaf weeds, there is less dependence on the contact herbicide as the only means of controlling early germinating species. The residual properties of oryzalin provide season long control of these species. Application of a contact herbicide and a residual broadleaf weed herbicide preemergence to the soybeans following grain harvest was made to aid in the control of broadleaf weeds resistant to oryzalin.

MATERIALS AND METHODS

Field trials were conducted in 1975 and 1976 in Illinois, Indiana, Kentucky and Maryland to determine the crop tolerance of wheat to OTS applications of oryzalin and to evaluate the control of annual grasses and broadleaf weeds in the no-till soybeans which followed. OTS applications of oryzalin were made to wheat at the fully tillered and jointing stages of wheat growth at rates of 1, 1.25, 1.5, 2, 2.5 3 and 4 lb/A irrespective of soil type. Experiments were conducted on the following soil types: silt loam, silty clay loam and loam.

In initial trials applications to the wheat were made with hand held CO_2 pressurized sprayers while all later trials were made with tractor mounted sprayers equipped with PTO roller pumps. Application rates varied from 18 to 40 gallons per acre.

In trials where no-till soybeans were planted following wheat harvest, tank-mix applications of paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) plus linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea] or metribuzin [3-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)one] were applied preemergence (PRE) to aid in the control of broadleaf weeds resistant to oryzalin. The soybeans were planted with no-till planters within two days of wheat harvest.

RESULTS AND DISCUSSION

Wheat Response

A summary of the wheat response to oryzalin from three experiments in 1975 and three experiments in 1976 are shown in Tables 1 and 2. At the fully tillered stage of growth only slight crop injury was observed at rates up to 3 lb/A. When applied at the jointing stage no crop injury was observed up to 3 lb/A with only slight crop injury at 4 lb/A. Slight root injury was observed when treatments were made to fully tillered wheat. When applied to jointing wheat no root injury was observed up to 3 lb/A. Crop yields were generally less than non-treated plots when the treatments were applied to fully tillered wheat; however, when applied to jointing wheat, yields were in most cases greater than non-treated plots.

Small grains, including wheat, are frequently used as a bioassay species for dinitroaniline herbicides. Oryzalin affects root development of small grains and has little or no effect on shoots.[1/] These properties of oryzalin help to explain why it works in this concept. When oryzalin is applied overtop the wheat some of the chemical reaches the soil surface immediately, but the majority is washed off as the season progresses. Slight root injury was observed when oryzalin was applied prior to jointing because new roots are developing near the soil surface where they may come in contact with oryzalin. Less root injury occurred when OTS applications were made to jointing wheat because new root growth is largely below the oryzalin zone.

Herbicidal Efficacy and Soybean Response

Weed control and soybean response are presented only from experiments where oryzalin was applied OTS at jointing stage of growth and where soybeans were planted into the wheat stubble after wheat harvest. Results are summarized for one trial in 1975 and three trials in 1976.

Table 3 summarizes the herbicidal efficacy of oryzalin applied OTS in the soybeans planted into wheat stubble. Late season weed control results are reported for giant foxtail (*Setaria italica*), volunteer wheat (*Triticum* spp.), spotted spurge (*Euphorbia maculata*), common ragweed (*Ambrosia artemisiifolia*), and cocklebur (*Xanthium pensylvanicum*). Giant foxtail control was acceptable with oryzalin treatments applied OTS alone 1.25 - 3 lb/A and with all combinations OTS + PRE treatments of oryzalin plus linuron or metribuzin. While OTS treatments of oryzalin alone provided 46-85% control of volunteer wheat, all combinations OTS + PRE provided excellent control (95-100%). Spotted spurge was easily controlled by all OTS applications of oryzalin (95-100%). Cocklebur and common ragweed were at best only slightly inhibited by oryzalin OTS alone but preemergence treatment of linuron or metribuzin resulted in good to excellent control of these species (60-100%). Volunteer wheat, foxtail, and common ragweed control from 1976 experiments are comparable to 1975 results (Table 4).

Crop injury, when it occurred, in both years was only slight. Yields of soybeans for all treatments in both years was higher than non-treated areas (Tables 3 and 4).

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Herbicidal efficacy with OTS applications of oryzalin was greatest on species which were known to be susceptible to the chemical. Weed control results confirm the theory that the OTS applications are not tied up on wheat leaves, therefore, this method of application is equally efficacious to PRE applications of oryzalin to the wheat stubble. Resistant species were not effectively controlled by oryzalin alone; however, even without chemicals to control these species the oryzalin OTS treatments alone provided yields higher than non-treated plots simply due to reduced competition.

Table 1. Crop injury, root injury, lodging and yield when oryzalin was applied as an overtop spray (OTS) to wheat at the fully tillered and jointing stage of development in 1975[1/].

Crop Stage	Oryzalin Rate (lb/A)	Crop[2/] Injury Early	Crop[2/] Injury Late	Root[3/] Injury	Percent Crop Lodging	Yield (Percent of Control)
Fully Tillered	1	0	0	0	0	91
	1.25	0	0.1	0.1	0	94
	1.5	0	0	0.3	0	95
	2	0.5	1	1	0	90
	3	1	1.2	2	0	92
	4	-	-	2.5	0	86
	Control	0	0	0	0	100
Jointing	1	0	0	0	0	95
	1.25	0	0	0	0	97
	1.5	0	0	0	0	103
	2	0	0	0	0	104
	3	0	0	0.3	0	108
	4	0	0.2	0.3	0	101
	Control	0	0	0	0	100

1/ Data average of three trials.

2/ Crop injury rating: 0 = no injury, 1-3 = slight, 4-6 = moderate, 7-9 = severe, 10 = death.

3/ Root injury rating: 0 = no injury, 1-3 = slight, 4-6 = moderate, 7-9 = severe, 10 = complete inhibition of root system.

Table 2. Crop injury, root injury, lodging, and yield when oryzalin was applied as an overtop spray (OTS) to wheat at the jointing stage of development in 1976.[1]

Crop Stage	Oryzalin Rate (lb/A)	Crop[2] Injury	Root[3] Injury	Percent[4] Crop Lodging	Yield (Percent of Control)
Jointing	1	0	0	0.3	105
	1.25	0	0	0.3	109
	2.5	0	0	0.3	111
	0	0	0	0	100

1/ Data average of three trials

2/ Crop injury rating: 0 = no injury, 1-3 = slight, 4-6 = moderate, 7-9 = severe, 10 = death.

3/ Root injury rating: 0 = no injury, 1-3 % slight, 4-6 = moderate, 7-9 = severe, 10 = complete inhibition of root system.

4/ Crop Lodging Rating: 0 = no lodging, 10 = 100% lodging.

Table 3. Herbicidal efficacy, crop tolerance and yield when oryzalin was applied as an overtop spray (OTS) on wheat and followed by linuron plus paraquat, metribuzin plus paraquat or paraquat on no-till soybeans in 1975.

				Percent Weed Control - Late Season[4]					
Treatment[1]	Rate(s) (lb/A)	Type[2] Application	Crop[3] Injury	Giant Foxtail	Volunteer Wheat	Spotted Spurge	Common Ragweed	Cocklebur	Soybean Yield (Percent of Control)
Oryzalin	1	OTS	0	67	46	95	0	0	110
Oryzalin	1.25	OTS	0	80	63	97	6	0	118
Oryzalin + linuron	1 + 0.75	OTS + PRE	0	90	93	99	97	60	127
Oryzalin + linuron	1.25 + 0.75	OTS + PRE	0	92	93	97	100	85	147
Oryzalin + metribuzin	1 + 0.33	OTS +	0	88	90	100	99	93	122
Oryzalin + metribuzin	1.25 + 0.33	OTS + PRE	0	92	96	98	93	95	131
Control	0	-	0	0 (1)[5]	0 (5)	0 (1)	0 (6)	0 (1)	100

1/ Paraquat 2CL included in all treatments.

2/ OTS = Overtop spray; PRE = preemergence after wheat harvest prior to soybean emergence.

3/ Crop injury: 0 = no injury; 1-3 = slight; 4-6 = moderate; 7-9 = severe; 10 = death.

4/ Weed control: 0 = no weed control; 100 = 100% weed control.

5/ Numbers in parenthesis are the number of weeds per square foot in control plots.

Table 4. Herbicidal efficacy, crop tolerance, and yield when oryzalin was applied as an overtop spray (OTS) on wheat and followed by linuron plus paraquat or metribuzin plus paraquat on no-till soybeans in 1976.1/

				Percent Weed Control - Late Season5/			
Treatment2/	Rate(s) (lb/A)	Type3/ Appli-cation	Crop4/ Injury	Giant Foxtail	Volunteer Wheat	Common Ragweed	Yield (Percent of Control)
Oryzalin + linuron	1 + 0.75	OTS + PRE	0	96	78	100	170
Oryzalin + linuron	1.25 + 0.75	OTS + PRE	0	100	80	100	95
Oryzalin + linuron	2.5 + 0.75	OTS + PRE	0	100	85	100	150
Oryzalin + metribuzin	1 + 0.33	OTS + PRE	0	100	80	100	-
Oryzalin + metribuzin	1.25 + 0.33	OTS + PRE	0	100	85	100	-
Oryzalin + metribuzin	2.5 + 0.33	OTS + PRE	0	100	90	100	-
Control	-	-	0	0 (>1)6/	0 (20)	0 (1)	100

1/ Data for oryzalin + linuron from one trial and oryzalin + metribuzin from a second trial.

2/ Paraquat 2CL included in all treatments.

3/ OTS = overtop spray, PRE = preemergence after wheat harvest prior to soybean emergence.

4/ Weed control: 0 = no weed control, 100 = 100% weed control.

5/ Crop injury: 0 = no injury, 1-3 = slight, 4-6 = moderate, 7-9 = severe, 10 = death.

6/ Numbers in parenthesis are the number of weeds per square foot in control plots.

HERBICIDES FOR NO-TILLAGE DOUBLE CROPPED SOYBEANS[1]

J. V. Parochetti [2]

Abstract. Weed control in double cropped soybeans (Glycine max L.) following barley (Hordeum vulgare L.) was evaluated in field studies conducted from 1974 to 1976. Best control of weeds present after barley harvest occurred with herbicide combination containing the foliar active herbicide paraquat (1,1'-dimethyl-4,4'-bipyridium,chloride) or glyphosate (N-phosphonomethyl)glycine). Weeds present after barley harvest were horseweed (Conyza candensis (L.) Cronq.), common ragweed (Ambrosia artemisiifolia L.), fall panicum (Panicum dichotomifolium Michx.) and Pennsylvania smartweed (Polygonum pensylvanicum L.). Best control of weeds emergin after soybean planting occurred with a combination of a foliar herbicide plus residual herbicides. When comparing treatments with only the foliar active herbicides versus treatments with only the residual herbicides, soybean yields were higher with the latter. Soybean injury occurred in some years from metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)one), oryzalin (3,5=dinitro-N4-dipropylsul-fanilanide), nitrofluorfen(2-chloro-1-(4-nitrophenoxy)-trifluoromethyl)benzene), and oxyfluorfen(2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4=(trifluoromethyl)benzene), but where there was adequate weed control, yields were not reduced.

INTRODUCTION

The practice of no-tillage doubled cropped soybeans is relatively new, being first introduced in the late 1960's. On the Delmarva peninsula about one-third of the approximately 500,000 acres of soybeans are planted by this method. Early research with various herbicides has been conducted at the Maryland Agricultural Experiment Station(3). Parochetti(3) in a 4 year study noted two types of weeds in this cropping system; weeds that emerged and were present at barley harvest and weeds that germinated after soybean planting. A combination of a foliar active herbicide (either paraquat or glyphosate) plus soil residual herbicides was the most effective in providing season long weed control. More recently Ilnicki et al.(2) have reported on similar results.

With the advent of several newer residual herbicides, the present study was conducted to evaluate paraquat or glyphosate alone and in combination with these and registered residual herbicides.

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MATERIAL AND METHODS

Four field experiments were conducted at the Poplar Hill Research Farm, Salisbury, Maryland from 1974 to 1976 to evaluate herbicides for no-tillage soybeans planted in a barley stubble. Barley was harvested about June 10 of each year; stubble height was 8 to 10 inches. Soybeans were planted in 20 inch row spacing. Individual plots were 10 by 20 feet. All experiments were arranged in a randomized complete block design with four replications. Herbicides were applied with water at 30 gpa with an experimental sprayer. Treatments are listed in Tables 1-4. The experimental site was on a Mattapeake silt loam(Typic Hapludult; Fine silty, mixed, mesic) with 1.5% organic matter.

A visual rating system was used to evaluate crop injury and the effectiveness of the weed control attained as previously described(1).

In 1974, both experiments were planted with 'Williams' soybeans on 10 June, followed the same day by herbicide applications. Rainfall occurring 2 weeks after herbicide treatment was: 0.11 inches on 14 June, 0.24 inches on 22 June and 0.21 inches on 29 June.

In 1975, one experiment was planted with 'York' soybeans on 17 June with herbicides treatments applied the same day. Rainfall occurring 4 weeks after herbicide treatment was: 20 June, 0.19 inches; 5 July, 0.33 inches; 6 July, 1.30 inches, 10 July, 0.30 inches; 11 July, 0.45 inches; 12 July, 2.01 inches; 14 July, 0.94 inches; 15 July, 2.75 inches; 16 July, 0.48 inches; and 17 July, 1.43 inches.

In 1976, one experiment was planted with 'Essex' soybeans on 9 June and treated with herbicides on the same day. Rainfall occurring 2 weeks was: 17 June, 0.60 inches and 21 June, 0.24 inches.

RESULTS AND DISCUSSION

When no-tillage, double-cropped soybeans are planted in a barley stubble there are two types of weed problems at planting time. One type is weeds that are present in the barley stubble. Since no over-all tillage of the land is made, weeds that germinate in the barley crop are present after grain harvest. It is important that these emerged weeds (a) not be cut off too near the ground (thus eliminating green foliage necessary for effectiveness of the foliar active herbicides) and (b) that the amount of straw going on the emerged weeds be as sparse as possible (so as not to prevent the contact of the foliar herbicides). For these reasons barley stubble height should be between 8 to 10 inches. The second type of weeds are those that emerge after planting soybeans.

Control of weeds emerged in barley stubble. Weeds that were present after barley harvest varied from year to year.

In 1974 these weeds were fall panicum, Pennsylvania smartweed, common ragweed, and horseweed; they were effectively (95%) controlled with a combination of residual herbicides plus either paraquat or glyphosate (Table 1 and 2). Interestingly, control of Pennsylvania smartweed decreased to unacceptable levels (85% in Table 1 and 79% in Table 2) with paraquat alone on August 2; however glyphosate alone effected excellent (100% in Table 1) control of Pennsylvania smartweed.

In 1975, these weeds were horseweed and common ragweed; they were effectively (95%) controlled with a combination of residual herbicides plus either paraquat or glyphosate (Table 3).

In 1975, the emerged weed population present after barley harvest was sparse and no control ratings were taken.

Control of weeds emerging after soybean planting. The predominant annual weed species germinating after soybean planting was giant green foxtail (*Setaria viridis* var. _major_ (Gaud.) Posp.).

In 1974, excellent control (91%) of giant green foxtail resulted from all treatment combinations except methazole (2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione) plus paraquat; paraquat and glyphosate applied singularly affected poor (53%) to fair (86%) control of giant green foxtail (Tables 1 and 2).

In 1975, control of giant green foxtail was not as effective as in 1974 with paraquat or glyphosate plus a residual herbicide (Table 3 vs. Tables 1 and 2). On August 2, most treatments affected greater than 89% control of giant green foxtail except glyphosate, paraquat, or metribuzin applied alone and paraquat plus alachlor plus linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea] or paraquat plus alachlor plus metribuzin (Table 3).

In 1976, control of giant green foxtail was the more variable than in previous years. Of the three years, 1976 had the longest period (8 days) of no rainfall after herbicide application. The most effective treatments were paraquat plus oryzalin (0.5 + 1.5 lb/A, respectively) and paraquat plus penoxalin [_N_-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] plus linuron (0.5 + 1.5 + 0.5 lb/A, respectively). These treatments were statistically better than the control, paraquat, glyphosate, and the combinations of paraquat plus linuron plus alachlor, paraquat plus metolachlor [2-chloro-_N_-(2-ethyl-6-methylphenyl)-_N_-(2-methoxy-1-methylethyl)acetamide], and paraquat plus oxyfluorfen (0.5 + 0.25 lb/A, respectively) (Table 4).

Soybean injury and yields. In 1974 treatments containing metribuzin at 0.375 lb/A and oxadiazon [2-_tert_-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)- -1,3,4-oxadiazolin-5-one] caused significant early injury which decreased as the season advanced (Table 1). In 1975, when comparing soybean injury data to glyphosate alone, either early (July 7) or late (August 6), treatments containing oryzalin including the four way combination with paraquat plus naptalam [_N_-1-naphthylphthalamic acid) plus dinoseb [2-_sec_-butyl-4,6-dinitrophenol] caused significant soybean injury; however soybean yields were not statistically reduced (Table 3). In 1976, no soybean yield reduction was noted; however combinations containing metribuzin at 0.375 lb/A and oxyfluorfen at 0.5 lb/A caused significant soybean injury. Interestingly, oryzalin did not cause significant soybean injury; this might be due to the lack of rainfall until 8 days after herbicide treatment. Soybeans had emerged within 5 days.

With regards to soybean yields, uncontrolled weeds reduced yield much more than the effect of herbicide injury on the soybeans. Of particular interest is the good control of weeds present after barley harvest (Table 3). In contrast, higher soybean yields (although not always statistically significant each year) resulted from treatments containing only paraquat or glyphosate and no residual herbicide. Competition from weeds present at barley harvest is apparently more severe than the competion from later germinating weeds.

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Table 1. The effect of several herbicides on weeds which are emerged and on subsequently germinating weeds at planting time in no-tillage, doubled cropped soybeans sown in a barley stubble, 1974.

		Emerged at Planting						Emerged after Planting			
		June 25			August 2			August 2	June 25	August 2	October 2
Treatment	Rate (lb/A)	Fall Panicum (Rating)[a] (%)[b]	Pennsylvania Smartweed (Rating)[a] (%)[b]	Common Ragweed (Rating)[a] (%)[b]	Pennsylvania Smartweed (Rating)[a] (%)[b]	Common Ragweed (Rating)[a] (%)[b]	Horseweed (Rating)[a] (%)[b]	Giant green Foxtail (Rating)[a] (%)[b]	Soybean Injury (Rating)[a] (%)[b]	Soybean Injury (Rating)[a] (%)[b]	Soybean Yield (Bu/A)
1. Control	---	9.0 (0)	9.0 (0)	9.0 (0)	7.0 (65)	7.0 (65)	7.0 (65)				
2. Paraquat	.5	1.0 (100)	3.0 (95)	1.3 (99)	5.0 (85)	1.8 (98)	1.00 (100)	7.0 (65)	1.0 (0)	1.0 (0)	19.2
3. Paraquat	.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	7.8 (41)	1.0 (0)	1.0 (0)	34.0
+ linuron	1.0							2.5 (96)	1.0 (0)	1.5 (1.5)	36.7
4. Paraquat	.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ alachlor	1.5							2.8 (96)	1.0 (0)	1.0 (0)	42.3
+ linuron	1.0										
5. Paraquat	.5	1.0 (100)	1.3 (99)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ nitrofluorfen	1.0							1.0 (100)	1.0 (0)	1.0 (0)	38.7
6. Paraquat	.5	1.0 (100)	1.0 (100)	1.3 (99)	1.0 (100)	1.0 (100)					
+ nitrofluorfen	.75							1.0 (100)	1.0 (0)	1.5 (1.5)	38.4
+ alachlor	1.5										
7. Paraquat	.5	1.0 (100)	1.0 (100)	1.0 (100)	2.0 (98)	1.8 (98)	1.3 (99)				
+ oxyfluorfen	.38							1.8 (98)	1.0 (0)	1.0 (0)	36.5
8. Paraquat	.5	1.0 (100)	1.0 (100)	1.3 (99)	1.0 (100)	1.0 (100)	1.3 (99)				
+ oxyfluorfen	.38							1.0 (100)	1.0 (0)	1.0 (0)	41.1
+ alachlor	1.5										
9. Glyphosate	1.0	1.0 (100)	1.3 (99)	1.0 (100)	1.0 (100)	1.3 (99)	1.0 (100)				
10. Glyphosate	1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	4.8 (86)	1.0 (0)	1.0 (0)	36.5
+ linuron	1.0							1.5 (99)	1.0 (0)	1.0 (0)	38.3
11. Glyphosate	1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ alachlor	1.5							1.3 (99)	1.0 (0)	1.0 (0)	39.7
+ linuron	.5										
12. Glyphosate	1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ alachlor	1.5							1.8 (98)	2.0 (2.5)	1.0 (0)	38.9
+ metribuzin	.375										
13. Glyphosate	1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.3 (99)	1.3 (99)				
+ alachlor	3.0							1.3 (99)	3.0 (5.0)	2.8 (4.4)	36.1
+ metribuzin	.75										
14. Glyphosate	1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ alachlor	1.5							1.5 (99)	1.0 (0)	1.0 (0)	37.6
+ chlorbromuron[c]	1.0										
15. Paraquat	0.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ chlorbromuron[c]	1.5							2.0 (98)	1.0 (0)	1.0 (0)	41.3
16. Paraquat	.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ alachlor	1.5							1.5 (99)	1.3 (1.2)	1.0 (0)	35.0
+chlorbromuron[c]	1.0										
17. Paraquat	.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ CGA 17020[d]	.75							1.8 (98)	1.0 (0)	1.5 (1.5)	40.4
+ chlorbromuron[c]	1.0										
18. Paraquat	.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.3 (99)				
+ metolachlor	1.5							1.0 (100)	1.0 (0)	1.0 (0)	38.0
+ chlorbromuron[c]	1.0										
19. Glyphosate	1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ chlorbromuron[c]	1.5							1.5 (99)	1.0 (0)	1.0 (0)	37.5
20. Paraquat	.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ oxydiazon	1.5							1.0 (100)	4.8 (14)	1.0 (0)	42.2
21. Paraquat	0.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ oxydiazon	3.0							1.0 (100)	6.5 (30)	1.0 (0)	39.5
22. Paraquat	0.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)				
+ oxydiazon	1.5							1.0 (100)	3.8 (8.6)	1.0 (0)	40.8
+ alachlor	1.5										
Bayes LSD 0.05		0	.4	.2	1.4	1.2	1.1	1.9	0.6	0.8	5.5

[a]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%.

[b]The % is an approximation.

[c]Chemistry for chlorbronuron is 3-(4-bromo-3-chlorphenyl)-1-methoxy-1-methylurea.

[d]The chemistry for CGA17020 is not known.

Table 2. The effect of several herbicides on weeds which are emerged and on subsequently germinating weeds at planting time in no-tillage, doubled cropped soybeans sown in a barley stubble, 1974.

		Emerged at Planting						Emerged Planting		
		June 25			August 2			August 2	June 25	October 15
Treatment	Rate (lb/A)	Fall Panicum (Rating)[a] (%)[b]	Pennsylvania Smartweed (Rating)[a] (%)[b]	Common Ragweed (Rating)[a] (%)[b]	Pennsylvania Smartweed (Rating)[a] (%)[b]	Common Ragweed (Rating)[a] (%)[b]	Horseweed (Rating)[a] (%)[b]	Giant Green Foxtail (Rating)[a] (%)[b]	Soybean Injury (Rating)[a] (%)[b]	Soybean Yield (Bu/A)
1. Control	---	9.0 (0)	9.0 (0)	9.0 (0)	9.0 (0)	9.0 (0)	7.0 (65)	9.0 (0)	1.0 (0)	16.8
2. Paraquat	.5	1.0 (100)	1.3 (99)	1.0 (100)	5.5 (79)	1.8 (98)	1.0 (100)	7.5 (53)	1.0 (0)	35.1
3. Paraquat + methazole	.5 .25	1.0 (100)	2.5 (96)	1.0 (100)	6.8 (67)	1.5 (99)	1.3 (99)	5.5 (79)	1.0 (0)	31.3
4. Paraquat + methazole	.5 .5	1.0 (100)	1.3 (99)	1.0 (100)	2.5 (96)	1.0 (100)	1.0 (100)	6.8 (67)	1.0 (0)	33.4
5. Paraquat + methazole	.5 1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	2.0 (95)	1.0 (100)	5.8 (77)	1.0 (0)	31.3
6. Paraquat + methazole	.5 1.5	1.0 (100)	1.3 (99)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	4.3 (89)	1.0 (0)	35.5
7. Paraquat + linuron	.5 1.0	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	3.8 (91)	1.0 (0)	36.7
Bayes LSD 0.05		0	.7	0	1.2	.8	1.6	1.6	N.S.	3.4

[a]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%.

[b]The % is an approximation.

Table 3. The effect of several herbicides on weeds which are emerged and on subsequently germinating weeds at planting time in no-tillage, doubled cropped soybeans sown in a barley stubble, 1975.

		Emerged at Planting				Emerged after Planting				
		July 7		August 6		July 7	August 6	July 7	August 6	
Treatment	lb/A	Horseweed (Rating)[a](%)[b]	Common Ragweed (Rating)[a](%)[b]	Horseweed (Rating)[a](%)[b]	Common Ragweed (Rating)[a](%)[b]	Giant Green Foxtail (Rating)[a](%)[b]	Giant Green Foxtail (Rating)[a](%)[b]	Soybean Injury (Rating)[a](%)[b]	Soybean Injury (Rating)[a](%)[b]	Soybean Yields (Bu/A)
1. Paraquat	0.5	1.0 (100)	1.5 (99)	1.0 (100)	1.8 (98)	8.0 (33)	8.5 (20)	1.8 (2.1)	1.5 (1.5)	17.3
2. Glyphosate	1.0	3.0 (95)	3.3 (94)	2.3 (97)	3.5 (93)	7.3 (59)	8.5 (20)	2.5 (35)	1.8 (2.1)	15.4
3. Paraquat	0.5	1.8 (98)	1.0 (100)	1.8 (98)	1.0 (100)	5.0 (85)	6.5 (70)	3.0 (5.0)	1.5 (1.5)	20.5
+ Alachlor	+1.5									
+ Linuron	+0.5									
4. Glyphosate	1.0	1.3 (99)	1.3 (99)	1.3 (99)	2.8 (96)	4.8 (86)	4.5 (88)	3/0 (5.0)	1.5 (1.5)	24.7
+ Alachlor	+1.5									
+ Linuron	+0.5									
5. Paraquat	0.5	1.0 (100)	1.0 (100)	1.5 (99)	1.0 (100)	4.5 (88)	4.3 (89)	2.3 (3.0)	1.3 (1.3)	22.4
+ Metolachlor	+2.0									
+ Chlorbromuron	+0.75									
6. Paraquat	0.5	1.8 (98)	1.0 (100)	1.8 (98)	1.0 (100)	2.8 (96)	3.5 (93)	3.5 (7.0)	1.8 (2.1)	23.6
+ Metachlor	+2.5									
+ Chlorbromuron	+1.0									
7. Paraquat	0.5	1.0 (100)	1.0 (100)	1.0 (100)	1.5 (99)	3.3 (94)	3.8 (91)	2.3 (3.0)	1.3 (1.2)	21.3
+ Metolachlor	+2.0									
+ Metribuzin	+ .375									
8. Paraquat	0.5	1.0 (100)	1.0 (100)	1.5 (99)	1.0 (100)	4.0 (90)	4.3 (89)	2.3 (3.0)	1.3 (1.2)	26.4
+ Melachlor	+2.5									
+ Metribuzin	+ .375									
9. Paraquat	0.5	2.0 (98)	1.0 (100)	1.3 (99)	1.3 (99)	3.3 (94)	4.5 (88)	2.8 (4.4)	1.8 (2.1)	20.9
+ Metalachlor	+2.0									
+ Linuron	+0.5									
10. Paraquat	0.5	1.0 (100)	1.0 (100)	1.0 (100)	1.3 (99)	3.8 (91)	3.3 (94)	1.5 (1.5)	1.3 (1.2)	26.5
+ Metolachlor	+2.5									
+ Linuron	+0.75									
11. Paraquat	0.5	2.0 (98)	1.0 (100)	3.0 (95)	1.5 (99)	2.5 (96)	4.3 (89)	2.5 (3.5)	2.0 (2.5)	27.0
+ Nitrofluorfen	+1.0									
12. Paraquat	0.5	1.3 (99)	1.0 (100)	2.8 (96)	1.3 (99)	3.8 (91)	4.3 (89)	2.5 (3.5)	1.5 (1.5)	25.0
+ Oxyfluorfen	+ .375									
13. Oxyfluorfen	0.375	9.0 (0)	7.3 (60)	8.3 (26)	4.5 (88)	5.0 (85)	4.0 (90)	2.5 (3.5)	1.0 (0)	11.2
14. Metribuzin	0.5	5.8 (76)	7.5 (53)	4.8 (87)	7.3 (59)	5.0 (85)	6.5 (70)	3.3 (6.0)	1.8 (2.1)	14.2
15. Paraquat	0.5	1.0 (100)	1.0 (100)	1.8 (98)	1.3 (99)	4.5 (88)	5.3 (83)	2.8 (4.4)	1.5 (1.5)	22.5
+ Metribuzin	+ .375									
16. Paraquat	0.5	1.0 (100)	1.0 (100)	1.3 (99)	1.0 (100)	2.8 (96)	5.8 (77)	2.3 (3.0)	1.3 (1.2)	20.3
+ Alachlor	+1.5									
+ Metribuzin	+0.375									
17. Paraquat	0.5	1.0 (100)	1.0 (100)	1.0 (100)	1.0 (100)	2.5 (96)	3.0 (95)	4.3 (11)	3.5 (7.0)	23.0
+ Oryzalin	+1.3									
+ Metribuzin	+0,375									
18. Paraquat	0.5	1.0 (100)	1.0 (100)	1.3 (99)	1.0 (100)	2.0 (98)	2.8 (96)	4.5 (13)	4.0 (10)	24.5
+ Oryzalin	+2.6									
+ Metribuzin	+0.75									
19. Paraquat	0.5	1.0 (100)	1.0 (100)	1.5 (99)	1.0 (100)	2.8 (96)	4.3 (89)	4.3 (11)	3.5 (7.0)	26.6
+ Linuron	+0.5									
+ Oryzalin	+1.3									
20. Paraquat	0.5	2.0 (98)	1.0 (100)	1.8 (98)	1.0 (100)	2.3 (97)	2.5 (96)	4.5 (13)	4.0 (10)	18.5
+ Linuron	+1.0									
+ Oryzalin	+2.6									
21. Paraquat	0.5	1.5 (99)	1.0 (100)	2.0 (98)	1.3 (99)	2.0 (98)	3.8 (91)	4.5 (13)	3.0 (5.0)	19.3
+ Naptalan	+3.0									
+ Dinoseb	+1.5									
+Oryzalin	+1.3									
22. Paraquat	0.5	2.5 (96)	1.0 (100)	2.3 (97)	1.3 (99)	2.5 (96)	3.5 (93)	6.8 (35)	5.0 (15)	20.0
+ Naptalan	+6.0									
+ Dinoseb	+3.0									
+ Oryzalin	+2.6									
Bayes LSD		1.6	.9	1.5	1.2	1.7	1.3	1.1	1.2	8.6

[a]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%.

[b]The % is an approximation.

[c] Chemistry does not appear in the text and is 3-(4-bromo-3-chloropenyl)-1-methoxy-1-methylurea

d Chemistry not released

Table 4. The effect of several herbicides on weeds which are emerged and on subsequently germinating weeds at planting time in no-tillage, doubled cropped soybeans sown in a barley stubble, 1976.

		Emerged after Planting			
		June 22	August 26	August 26	
Treatment	Rate (lb/A)	Soybean Emergence Reduction (Rating)[a] (%)[b]	Soybean Injury (Rating)[a] (%)[b]	Giant Green Foxtail (Rating)[a] (%)[b]	Soybean Yield (Bu/A)
1. Control	--	1.8 (2.0)	1.0 (0)	7.0 (65)	33.2
2. Paraquat	0.5	2.0 (2.5)	1.3 (1.3)	5.0 (85)	48.6
3. Glyphosate	1.0	1.8 (2.0)	1.0 (0)	7.0 (65)	40.5
4. Paraquat + linuron + alachlor	0.5 +0.5 +1.5	1.5 (1.5)	1.0 (0)	4.7 (86)	44.8
5. Paraquat + metalachlor + linuron	0.5 +1.5 +0.5	3.5 (7.0)	1.3 (13)	6.0 (75)	44.5
6. Paraquat + metalachlor + metribuzin	0.5 +1.5 +0.375	2.5 (3.5)	6.5 (29)	3.0 (95)	44.5
7. Paraquat + oryzalin	0.5 +0.75	1.5 (1.5)	2.5 (3.5)	4.3 (89)	42.8
8. Paraquat + oryzalin	0.5 +1.0	1.0 (0)	1.0 (0)	3.0 (95)	48.9
9. Paraquat + oryzalin	0.5 +1.5	1.3 (1.3)	1.0 (0)	2.0 (98)	45.4
10. Paraquat + oryzalin + linuron	0.5 1.0 1.0	1.5 (1.5)	1.0 (0)	3.3 (94)	51.7
11. Paraquat + penoxalin	0.5 +1.5	2.8 (4.4)	1.0 (0)	3.7 (91)	41.7
12. Paraquat + penoxalin + linuron	0.5 +1.0 +0.5	2.0 (2.5)	1.0 (0)	2.7 (96)	46.9
13. Paraquat + penoxalin + linuron	0.5 +1.5 +0.5	2.3 (3.0)	1.0 (0)	2.0 (98)	47.9
14. Glyphosate + linuron + alachlor	1.0 +0.5 +1.5	2.0 (2.5)	1.0 (0)	4.0 (90)	43.1
15. Paraquat + oxyfluorfen	0.5 +0.25	2.3 (3.0)	1.5 (1.5)	5.7 (77)	44.7
16. Paraquat + oxyfluorfen	0.5 +0.5	2.3 (3.0)	2.8 (4.4)	2.7 (96)	47.7
17. Paraquat + alachlor + metribuzin	0.5 +1.5 +0.375	3.3 (6.0)	5.5 (19)	4.3 (89)	43.8
18. Glyphosate + alachlor + metribuzin	1.0 +1.5 +0.375	3.8 (8.6)	5.3 (17)	3.0 (95)	47.1
Bayes LSD_{05}	--	NS	1.5	2.5	9.2

[a]European rating used; for crop injury 1=0%, 2=2.5%, 3=5%, 4=10%, 5=15%, 6=25%, 7=33%, 8=7 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%.

[b]The % is an approximation.

WEED CONTROL IN DOUBLE-CROP SOYBEANS WITH HERBICIDES APPLIED ALONE AND IN COMBINATION WITH PARAQUAT OR GLYPHOSATE

Ratemo Michieka, Richard D. Ilnicki, and James R. Justin[1/]

ABSTRACT

A number of herbicides and herbicide combinations were evaluated for weed control and crop tolerance in no-till soybeans following wheat harvest. Paraquat and glyphosate were the only herbicides that effected good weed control when applied alone but control was not long-lived.

Paraquat and metribuzin did reduce stand of soybeans but this did not prove serious. Had these two herbicides been applied prior to planting this effect on soybeans, probably would not have been expressed.

Alachlor and penoxalin did not adequately control fall panicum in this cropping situation. In conventional tillage these herbicides are generally effective on this species.

Penoxalin or linuron in combination with glyphosate or paraquat improved control of many weed species over that of penoxalin and linuron applied alone; however, combinations of the two with either of the contact herbicides (3-way combinations) did not improve the degree of control effected by the single herbicides applied with paraquat or glyphosate.

Combinations of RH 2915 and alachlor did not improve weed control over that produced by either herbicide applied alone; considerable improvement resulted when glyphosate or paraquat were added to the combination.

INTRODUCTION

The planting of soybeans in stubble following small grain harvest continues to grow in popularity here in the Northeast

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as well as in other parts of this nation. The availability of quick knockdown foliar-active herbicides such as glyphosate and paraquat, and a good arsenal of soil-applied residual herbicides have made this concept possible. Almost as important as good herbicides is the availability of planters capable of placing seeds at proper germinating depths with little or no tillage.

It was reported by Ilnicki *et al.* (1) that combinations of alachlor plus linuron and alachlor plus metribuzin in combination with paraquat or glyphosate were promising combinations for weed control in double-crop soybeans. It was the objective of this study to further explore the use of these herbicides in this cultural practice as well as to evaluate some new herbicides.

MATERIALS AND METHODS

Soybeans (var. Williams) were planted with a 3-row, no-till planter, equipped with a fluted coulter, in Freehold loam soil on July 15, 1976, on a site previously cropped to winter wheat. Immediately after planting, plots 7½' (3 rows) wide x 19' long were established to receive herbicide treatments. The experimental design was a complete randomized block with 4 replications. All herbicide treatments were applied as sprays at 40 gpa with a CO_2-propelled backpack sprayer equipped with a 4-nozzle boom on June 16, one day after soybean planting.

The experimental area was primarily infested with common ragweed (*Ambrosia artemisiifolia* L.) and fall panicum (*Panicum dichotomiflorum* Michx.). Other annual weeds were also present but these were sparsely distributed and accurate measures of their control were not possible. Weed control ratings were made on August 17, one month after planting and herbicide applications, using the scale 0 to 10, where 0 = no control or crop injury and 10 = complete weed control or 100% reduction in crop stand.

At the time of herbicide application, some small weed seedlings were present in the experimental area. All herbicides used alone and in the various combinations are presented in Table 1 through Table 4. Complete chemical identities of the herbicides used are presented in the Appendix.

RESULTS AND DISCUSSION

Weed control results and soybean responses of the herbicides applied alone are presented in Table 1. Notwithstanding that it was known that some of the herbicides applied singly would not effect complete control of weeds, it was necessary to establish just what weeds would be controlled when used alone. From this table, several points are obvious. Only paraquat and glyphosate applied alone effected good control of all weeds. This was due to their contact type of action on the already germinated weeds. Later in the season, but not recorded here, plots so treated became weedy because residual herbicides were not included as mixtures. Paraquat did reduce stand of soybeans at the higher rate but this did not prove serious. Evident, too, is the reduction in stand of soybeans by metribuzin. Had this herbicide been applied prior to planting, this response would probably not have been produced. Metribuzin did effect fair control of ragweed and fall panicum at the higher rate but this was not sufficient. Linuron and RH 2915 at the higher rates were effective on ragweed but these failed to adequately control fall panicum. In conventional tillage, alachlor and penoxalin control fall panicum at the rates used here but in this study these herbicides were ineffective on this species.

Crop and weed responses of penoxalin and linuron in combination with paraquat or glyphosate and combinations of penoxalin plus linuron in combination with either glyphosate or paraquat are summarized in Table 2. Several points are worthy of comment. Control was improved greatly when these residual herbicides were combined with these contact herbicides. There was no great difference in the degree of control of linuron combined with either paraquat or glyphosate; however, the penoxalin-glyphosate combination was slightly better than the penoxalin-paraquat combination. There seemed to be no advantage in weed control by combining penoxalin and linuron together along with paraquat or glyphosate over the single herbicides combined with paraquat or glyphosate. As a matter of fact, control was only comparable or slightly less from the 3-way combinations than from the 2-way combinations.

In conventional tillage, combinations of alachlor with linuron and alachlor with metribuzin have proved successful. In this study, these combinations were not evaluated alone but in combination with glyphosate or paraquat. From Table 3 where these are presented, it is obvious that these 3-way combinations effected good weed control with no injury to soybeans. These combinations with either paraquat or glyphosate were comparable with glyphosate, perhaps, being slightly better.

In Table 4 are summarized weed control and crop response data for RH 2915 in combination with alachlor and these two herbicides together in combination with paraquat or glyphosate. From this table, it can be seen that the degree of weed control from the two residual herbicides was not very good and not much different from the degree of control effected by either herbicide alone (Table 1). Considerable improvement resulted when the combination was added to glyphosate or paraquat with slightly better control of fall panicum from the glyphosate addition.

Table 1. Crop and weed response to herbicides applied alone in no-tillage, double-crop soybeans.

Herbicide	Rate, lb/A	Soybeans Stand[1]	Soybeans Vigor[1]	Weed Control[1] Ragweed	Weed Control[1] Fall Panicum
penoxalin	1	1.0	0.9	3.8	2.3
	2	0.9	1.0	2.8	5.0
linuron	1/2	0.8	0.4	6.1	2.4
	1	0.6	0.4	9.9	5.0
alachlor	2	0.9	0.5	5.5	4.5
	2 1/2	0.3	0.9	3.5	3.3
paraquat	1/2	0.6	0.3	7.0	9.6
	1	1.4	0.4	9.0	9.5
glyphosate	1 1/2	0.6	0.5	9.8	9.8
	2	0.4	0.5	7.8	7.7
metribuzin	3/8	1.3	0.6	5.4	4.6
	3/4	1.5	0.8	7.3	7.3
RH 2915	1/4	0.5	0.3	6.4	3.5
	1/2	0.4	0.5	7.0	4.8

[1]Based on a scale of 0 to 10, where 0 = no effect on stand or vigor and 10 = complete control or elimination of stand.

Table 2. Crop and weed responses to penoxalin and linuron in combination with paraquat or glyphosate and combinations of penoxalin and linuron with paraquat or glyphosate in no-tillage, double-crop soybeans.

		Soybeans		Weed Control[1]	
Herbicide	Rate, lb/A	Stand[1]	Vigor[1]	Ragweed	Fall Panicum
penoxalin + paraquat	1 + 1/2	0.9	0.3	8.4	9.3
	1 1/2 + 1/2	0.6	0.4	8.6	9.0
penoxalin + glyphosate	1 + 1 1/2	0.1	0.3	9.5	9.6
	1 + 2	1.3	0.5	10.0	9.9
linuron + paraquat	1/2 + 1/2	0.5	0.3	10.0	9.7
linuron + glyphosate	1/2 + 1 1/2	0.5	0.5	10.0	10.0
	1/2 + 2	0.3	0.3	9.9	9.8
penoxalin + linuron + paraquat	1 + 1/2 + 1/2	0.4	5.0	8.5	9.0
penoxalin + linuron + glyphosate	1 + 1/2 + 1 1/2	0.8	0.4	9.9	10.0
	1 + 1/2 + 2	0.4	0.4	8.8	9.5

[1]Based on a scale of 0 to 10, where 0 = no effect on stand or vigor and 10 = complete control or elimination of stand.

Table 3. Crop and weed responses of alachlor plus linuron and alachlor plus metribuzin in combination with paraquat or glyphosate in no-tillage, double-crop soybeans.

Herbicide	Rate, lb/A	Soybeans		Weed Control[1]	
		Stand[1]	Vigor[1]	Ragweed	Fall Panicum
alachlor + linuron + paraquat	2 + 1/2 + 1/2	0.4	0.4	9.9	9.6
alachlor + linuron + glyphosate	2 + 1/2 + 1 1/2	0.4	0.4	9.6	10.0
	2 + 1/2 + 2	0.3	0.4	10.0	9.9
alachlor + metribuzin + paraquat	2 + 3/8 + 1/2	0.6	0.5	9.9	9.0
alachlor + metribuzin + glyphosate	2 + 3/8 + 1 1/2	0.6	0.4	9.6	9.9
	2 + 3/8 + 2	0.8	0.4	9.8	10.0

[1]Based on a scale of 0 to 10, where 0 = no effect on stand or vigor and 10 = complete control or elimination of stand.

Table 4. Crop and weed response of RH 2915 in combination with alachlor and RH 2915 plus alachlor in combination with paraquat or glyphosate in no-tillage, double-crop soybeans.

Herbicide	Rate, lb/A	Soybeans Stand[1]	Soybeans Vigor[1]	Weed Control[1] Ragweed	Weed Control[1] Fall Panicum
RH 2915 + alachlor	1/8 + 1 1/2	0.4	0.5	5.0	1.3
	1/8 + 2	0.9	0.8	6.3	3.0
	1/8 + 2 1/2	0.6	0.4	6.0	2.0
	1/4 + 1 1/2	0.0	0.5	2.3	2.3
	1/4 + 2	0.4	0.3	4.1	1.4
	1/4 + 2 1/2	0.4	0.5	3.0	0.4
RH 2915 + alachlor	1/8 + 2 + 1/2	0.3	0.3	9.4	8.9
+ paraquat	1/4 + 2 + 1/2	0.4	0.5	9.9	9.9
RH 2915 + alachlor	1/4 + 2 + 1 1/2	0.3	0.5	9.3	10.0
+ glyphosate	1/4 + 2 + 2	0.4	0.3	9.9	10.0

[1]Based on a scale of 0 to 10, where 0 = no effect on stand or vigor and 10 = complete control or elimination of stand.

LITERATURE CITED

1. Ilnicki, R. D., J. R. Justin, and R. W. Michieka. 1976. Combinations of herbicides with paraquat or glyphosate for weed control in double-crop soybeans. Proc. NEWSS 30:23-24.

APPENDIX

Common Name	
penoxalin, ec	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine
linuron, wp	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea
alachlor, ec	2-chloro-2',6'-diethyl-N-(methoxy=methyl) acetanilide
paraquat, s	1,1'-dimethyl-4,4'-bipyridinium ion
glyphosate, s	N-(phosphonomethyl) glycine
metribuzin, wp	4-amino-6-tert-butyl-3-(methylthio)-as-triazine-S(4H)one
RH 2915, ec	2-chloro-1-(3-ethoxy-4-nitrophenyl)-4-trifluromethyl benzene

Activity of Penoxalin in Soybeans[1/]

H. P. Wilson, T. E. Hines and J. E. Dunton, Jr.[2/]

ABSTRACT

Penoxalin (N-[1-ethylpropyl] -3,4 dimethyl-2,6-dinitrobenzenamine) was studied for 4 years as a herbicide for soybeans grown on Coastal Plain soils. Applications prior to planting and incorporated provided better control than preemergence applications. Delayed incorporation of preemergence applications did not consistently result in satisfactory control. Of the weed species studied, penoxalin controlled large crabgrass (Digitaria sanguinalis L. Scop.) and fall panicum (Panicum dichotomiflorum Michx.) better than it controlled lambsquarters (Chenopodium album L.); penoxalin had little effect against jimsonweed (Datura stramonium L.). Preemergence combinations of penoxalin with linuron (3 [3,4-dichlorophenyl] 1-methoxy-1-methylurea), dinoseb (2-sec-butyl-4,6-dinitrophenol), or metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4H)one were less effective than combinations of alachlor (2-chloro-2^1,6-diethyl-N- [methoxymethyl] acetanilide) with linuron. Soybeans were injured by 1 1/2 lb/A and 2 lb/A rates of penoxalin applied prior to planting and incorporated.

INTRODUCTION

Dinitroaniline herbicides have been used extensively for weed control in soybeans since the introduction of trifluralin (a,a,a-trifluoro-2, 6-dinitro-N, N-dipropyl-p-toluidine). With some exceptions, these herbicides are most effective incorporated into the soil shortly after application and provide better control of annual grasses than of most species of broadleaf weeds. One of the most recently discovered dinitroaniline herbicides is penoxalin. Initial studies (3) indicate penoxalin has given good control of certain annual grasses and some broadleaf weeds when applied either preplant incorporated or preemergence. Control of broadleaf weeds has not been consistent, indicating a need to combine penoxalin with other herbicides so that broad-spectrum weed control can be obtained. Soybean injury was reported to occur from high rates of penoxalin but was confined mostly to preemergence applications. In other studies (1,2) it was found that delays of incorporation up to 9 days after penoxalin application resulted in excellent control of annual grasses and some broadleaf weeds. In contrast, Parochetti and Burt (4) reported that a 7-day delay of incorporation of penoxalin resulted in less control than was obtained when penoxalin was incorporated within one day of application.

The following studies were conducted to evaluate penoxalin for weed control in soybeans grown on Coastal Plain soils. Of primary concern was the margin of

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safety to soybeans, the effect of incorporation on weed control, and the potential of combining penoxalin with other herbicides.

MATERIALS AND METHODS

Research was conducted on a Sassafras sandy loam soil with a pH averaging 6.0 and an organic matter content of approximately 1.5%. Herbicides were applied to a well prepared seed-bed prior to planting and incorporated immediately or were applied preemergence within one day of planting. Incorporation prior to planting was with a tractor-driven rotary tiller to a depth of 1 to 2 in for penoxalin and 3 to 4 in for trifluralin. A rotary hoe was used to incorporate penoxalin to a depth of 1/2 in where preemergence applications were incorporated after planting. Plot size was 6.7 ft by 20 ft (2 rows wide) with three replications; an untreated guard row was maintained between plots to permit better estimates of weed species and populations present. Soybeans were planted between mid-May and early June using the variety Bragg in 1972, Essex in 1974 and 1975, and Forrest in 1976.

Soybean injury and weed control were rated 3 to 6 weeks after planting and all plots were cultivated to simulate commercial production practices for conventionally-tilled soybeans. Late-season weed control was evaluated in August and soybeans were harvested to permit yield determinations. Yield data were analyzed statistically and the means compared using Duncan's new multiple range test.

RESULTS AND DISCUSSION

Weed control and soybean injury and yields obtained during the four years of the study are presented in Tables 1 through 4.

Soybeans were injured by the 2 lb/A rate of penoxalin in 1972 and were slow to outgrow the injury since growth reduction was more evident 6 weeks after planting than 3 weeks after planting. Control of lambsquarters and fall panicum with penoxalin was comparable to that provided by trifluralin and soybeans produced good yields at all rates, indicating that early-season injury was outgrown.

In 1974, soybeans were injured slightly from low rates of penoxalin incorporated or from any of the combinations with metribuzin but soybean growth was reduced more from 1 1/2 lb/A penoxalin applied preplant incorporated and from 3/4 lb/A trifluralin. Control of fall panicum was good in all instances where penoxalin was applied preplant incorporated but diminished when applied preemergence with metribuzin. Lambsquarters control with penoxalin applied preplant incorporated increased with penoxalin rate and with the addition of metribuzin. The highest yielding soybeans were those treated with linuron plus alachlor but the only ones yielding significantly less were those treated with the highest rate of penoxalin indicating the possibility that initial injury resulted in a yield reduction.

Soybeans were slow to recover from injury in 1975 as they were in 1973. This was especially evident with penoxalin at 1 1/2 lb/A when, even at harvest-time, soybeans were lodging and exhibited much stem brittleness near the soil surface. This is contrary to reports indicating similar responses from preemergence but not from preplant incorporated applications (3). In the studies reported herein, stem brittleness did not occur at the lower rates of penoxalin alone or in combinations with other herbicides.

Weed control with penoxalin in 1975 was not as good as in previous years with even 1 1/2 lb/A preplant incorporated failing to provide complete control of crabgrass. Shallow incorporation of preemergence applications 0 and 1 day after treatment were less effective than preplant incorporated applications or incorporation 10 days after application. Preemergence applications of penoxalin with linuron provided weed control which compared favorably with that obtained from the combination of alachlor with linuron but the combination with dinoseb or bentazon (3-isopropyl-1_H_-2,1,3-benzothiadiazin- [4] 3_H_-one 2,2-dioxide) postemergence failed to provide satisfactory control of crabgrass. Cultivation generally had little effect on the relative differences among treatments in weed control as evidenced by the late ratings. Yields in 1975 were related to treatments producing good weed control and little crop injury with highest yields being produced by penoxalin at 3/4 lb/A preplant incorporated or preemergence followed by shallow incorporation 10 days later, by trifluralin and by combinations of penoxalin or alachlor with linuron.

All applications of penoxalin were safe to soybeans in 1976. Control, especially of lambsquarters was better from 3/4 lb/A penoxalin preplant incorporated than from 1 lb/A applied preemergence but neither application method controlled jimsonweed. Formulation had little effect on control resulting from preplant incorporated applications. Shallow incorporation one week after preemergence application of penoxalin failed to control lambsquarters although crabgrass control was good. The preemergence application of penoxalin with linuron was less effective than the combination of alachlor with linuron while the split application of penoxalin preemergence followed by bentazon postemergence provided excellent control of jimsonweed but did not provide satisfactory control of lambsquarters. Cultivation after initial weed control ratings generally improved control, especially of lambsquarters and crabgrass. Soybean yields in 1976 were highest where overall control of broadleaf weeds and grasses was best and weed-crop competition was minimal.

These studies indicate that penoxalin is most effective when applied preplant incorporated and that, of the weed species studied, provides best control of annual grasses. Excessive rates can cause injury to soybeans that may eventually be reflected as yield reductions. Of the preemergence applications of penoxalin evaluated, the most effective was the combination with linuron. However, even when combined with linuron, preemergence applications were less effective than alachlor with linuron.

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ACKNOWLEDGEMENTS

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Table 1. Weed control, soybean growth, and yields with penoxalin and trifluralin applied preplant incorporated in 1972.

Herbicide	Rate, (lb/A)	Soybean growth reduction 3 wk (%)	6 wk (%)	Weed control[2] LQ (%)	FP (%)	Yield[3] (bu/A)
Penoxalin	3/4	2	2	98	98	41.1 a
	1	4	3	94	98	41.1 a
	2	7	17	98	100	39.3 a
Trifluralin	3/4	2	2	98	98	41.1 a
Check (hoed)		0	0	33	33	25.4 bc
Check (weedy)		0	0	0	0	23.6 bc

1/ Penoxalin was incorporated 1 to 2 in and trifluralin was incorporated 3 to 4 in.

2/ LQ=lambsquarters, FP=fall panicum. Rated 5 weeks after application.

3/ Means followed by the same letter are not different at the 5% level of significance according to Duncan's new multiple range test.

Table 2. Weed control, soybean growth, and yields in penoxalin studies in 1974.

Herbicide	Application method[1/]	Rate, (lb/A)	Soybean growth reduction 5 wk (%)	Weed control [2/] 5 wk LQ (%)	5 wk FP (%)	12 wk LQ (%)	12 wk FP (%)	Yield[3/] (bu/A)
Penoxalin	Ppi	1/2	7	86	99	95	95	43.0 abcd
	Ppi	3/4	5	90	97	97	97	43.6 abcd
	Ppi	1 1/2	15	99	99	100	97	40.5 bcde
Penoxalin + metribuzin	Ppi Pre	1/2 + 1/4	5	99	98	100	94	44.2 abcd
		3/4 + 1/4	8	99	100	100	100	45.4 abcd
Penoxalin + metribuzin	Pre Pre	1/2 + 1/4	6	92	92	98	88	43.0 abcd
Penoxalin + metribuzin	Ppi Ppi	1/2 + 1/4	0	100	98	100	95	44.2 abcd
Trifluralin	Ppi	3/4	12	94	94	100	94	45.4 abc
Linuron + alachlor	Pre Pre	1/2 + 1	10	96	99	98	98	46.6 a
Check (weedy)			0	0	0	0	0	17.5 f

1/ Ppi=preplant incorporated and Pre=preemergence. Penoxalin was incorporated to a depth of 1 to 2 in and trifluralin was incorporated to a depth of 3 to 4 in.

2/ LQ=lambsquarters, FP=fall panicum. Soybeans were cultivated after the 5-week evaluations were made.

3/ Means followed by the same letter are not different at the 5% level of significance according to Duncan's new multiple range test.

Table 3. Weed control, soybean growth, and yields in penoxalin studies in 1975.

Herbicide	Application method[1/]	Rate, (lb/A)	Soybean growth reduction 3 wks (%)	Soybean growth reduction 10 wks (%)	Weed control[2/] 5 wk LQ (%)	Weed control 5 wk CG (%)	Weed control 10 wk LQ (%)	Weed control 10 wk CG (%)	Yield[3/] (bu/A)
Penoxalin	Ppi	1/2	3	2	78	86	73	67	27.8 c
		3/4	5	10	85	89	85	90	32.1 abc
		1 1/2	17	28	93	93	90	84	24.8 c
Penoxalin	Pre	1/2	2	5	42	80	77	67	26.6 c
Penoxalin	Pre Inc	3/4	5	5	75	80	81	65	27.2 c
	Pre Inc 1	3/4	0	2	70	80	86	50	29.7 bc
	Pre Inc 10	3/4	3	9	93	96	93	90	31.5 abc
Penoxalin + linuron	Pre	1/2 + 1/2	8	3	100	95	100	95	38.7 ab
Penoxalin + dinoseb	Pre	1/2 + 3	3	8	92	72	98	70	26.6 c
Penoxalin + bentazon	Pre Post	1/2 + 3/4	5	0	77	85	84	77	29.0 c
Trifluralin	Ppi	1/2	10	3	88	100	89	96	31.5 abc
Linuron + alachlor	Pre	1/2 + 1 1/2	3	0	100	100	98	95	40.5 a
Check (weedy)			0	0	0	0	0	0	12.7 d

1/ Ppi=preplant incorporated, Pre Inc=preemergence incorporated 1/2 in, Pre Inc 1= preemergence incorporated 1/2 in 1 day after application, Pre Inc 10=preemergence incorporated 1/2 in 10 days after application. Preplant incorporation was to a depth of 1 to 2 in for penoxalin and 3 to 4 inches for trifluralin.

2/ LQ=lambsquarters and CG=large crabgrass. Soybeans were cultivated after the 5-week evaluations were made.

3/ Means followed by the same letter are not different at the 5% level of significance according to Duncan's new multiple range test.

Table 4. Weed control, soybean growth and yields in penoxalin studies in 1976

Herbicide[1/]	Application method[2/]	Rate, (lb/A)	Soybean growth reduction 3 wk (%)	Weed control[3/] 5 wk LQ (%)	5 wk JW (%)	5 wk CG (%)	12 wk LQ (%)	12 wk JW (%)	12 wk CG (%)	Yield[4/] (bu/A)
Penoxalin	Ppi	3/4	5	87	68	92	90	35	98	27.9 b
Penoxalin	Ppi	3/4	3	87	62	95	92	20	100	26.0 bc
Penoxalin	Pre	1	7	52	37	85	65	35	98	26.7 bc
Penoxalin	Pre Inc 8	3/4	0	58	28	70	71	20	92	23.6 c
Penoxalin + linuron	Pre	3/4 + 1/2	2	85	43	78	86	13	100	27.9 b
Penoxalin + bentazon	Pre Post	3/4 + 3/4	0	60	100	75	62	100	92	36.4 a
Linuron + alachlor	Pre Pre	1/2 + 1 1/2	0	98	72	93	96	15	100	33.3 a
Check			7	0	0	0	0	0	0	11.5 d

1/ All treatments utilized the 4E formulation of penoxalin except the second treatment which utilized the 75W formulation.

2/ Ppi=preplant incorporated, Pre Inc=preemergence incorporated 8 days after application. Preplant incorporation was to a depth of 1 to 2 in for penoxalin.

3/ LQ=lambsquarters, JW=jimsonweed and CG=large crabgrass. Soybeans were cultivated after the 5-week evaluations were made.

4/ Means followed by the same letter are not different at the 5% level of significance according to Duncan's new multiple range test.

ORYZALIN TANK-MIX COMBINATIONS FOR WEED CONTROL IN SOYBEANS PLANTED IN SMALL GRAIN STUBBLE

W. E. Rogers, S. Addink, and G. J. Shoop[1/]

ABSTRACT

Tank-mix combinations of oryzalin + linuron + paraquat and oryzalin + metribuzin + paraquat were surface applied as preemergence treatments for weed control in no-till soybeans. Results are presented from three representative experiments, one each located in Maryland, Illinois and Kentucky. Rates applied were 1 lb/A for oryzalin, 0.75 lb/A for linuron and 0.33 lb/A for metribuzin. Paraquat was used at 0.25 lb/A in the Maryland and Kentucky experiments and 0.5 lb/A in Illinois. Commercially acceptable control of giant foxtail, green foxtail, crabgrass, fall panicum, redroot pigweed, pennsylvania smartweed, ladysthumb, velvetleaf and common ragweed was obtained. Partial control of volunteer wheat, ivyleaf morningglory, and horseweed was obtained. Weed control was roughly equivalent to that obtained with alachlor + linuron + paraquat and superior to paraquat used alone. Soybeans demonstrated adequate tolerance to all treatments.

INTRODUCTION

One of the principal keys to successful no-till soybean culture is adequate weed control. Oryzalin, 3,5-dinitro-N^4,N^4-dipropylsulfanilamide, Elanco Products Company, is a selective preemergence herbicide for the control of annual grasses and certain broadleaf weeds in conventional soybeans (*Glycine max*). Tank-mix combinations with linuron, 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea and metribuzin, 4-amino-6-*tert*-butyl-3-methylthio)-*as*-triazin-5(4H)one have provided improved broadleaf weed control in conventional soybeans over that provided by oryzalin alone. These combinations were evaluated to determine efficacy and crop tolerance for weed control in no-till soybeans planted in small grain stubble. Paraquat, 1,1'-dimethyl-4,4'-bipyridiniumion[as dichloride salts] was used in the tank-mix combinations for kill of established weeds.

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METHODS AND MATERIALS

Experiments were established in Maryland, Illinois and Kentucky during 1974 and 1975 on silt loam soils with organic matter content of 2.1 to 2.9 percent. Treatments were applied to non-replicated 0.5 acre plots.

Applications were made with standard commercial tractor-mounted spray booms using volumes of 20 to 40 gallons per acre. The tank-mix combinations of oryzalin + linuron and oryzalin + metribuzin were applied at rates of 1.0 + 0.75 and 1.0 + 0.33 lb/A. Tank-mix combinations included paraquat 2CL at 0.25 lb/A in Maryland and Kentucky and 0.5 lb/A in Illinois for contact kill of emerged weeds. Soybean varieties included in these experiments were York, Cutler 71 and Hood using a seeding rate of 90 lb/A at a planting depth of 1.0 to 1.5 inches.

Treatments were surface applied over existing weeds within 48 hours after planting and before soybean emergence. Commercial no-till planters were used to plant directly into wheat stubble and no subsequent cultivation or postemergence application of herbicides were made.

Weed control ratings by species, crop tolerance observations and yield data were recorded. A 0 to 10 rating scale was used for weed control where 0 equals no weed control and 10 equals 100 percent weed control. Crop and root injury ratings of 0 to 10 were used: 0 equals no injury and a rating of 10 equals death of the crop.

RESULTS AND DISCUSSION

A. Maryland; Herbicidal Efficacy: On a silt loam soil near Cambridge, Maryland (Table 1), oryzalin + linuron + paraquat at 1.0 + 0.75 + 0.25 lb/A and oryzalin + metribuzin + paraquat at 1.0 + 0.33 + 0.25 lb/A provided good (90 percent) control of crabgrass (*Digitaria adscendens*), green foxtail (*Setaria viridis*), fall panicum (*Panicum dichotomiflorum*), redroot pigweed (*Amaranthus retroflexus*) and velvetleaf (*Abutilon theophrasti*). These combinations provided only slightly better control (67-70 percent) of ivyleaf morning-glory (*Ipomoea hederacea*) than paraquat alone (63 percent). Oryzalin combinations provided slightly better control of crabgrass and green foxtail than the reference combination with alachlor but the overall herbicidal efficacy was similar.

Crop Response: The herbicide combinations applied in this experiment did not reduce crop yield and did not result in any form of crop injury.

B. _Illinois; Herbicidal Efficacy_: At this location near Keenes, Illinois oryzalin combinations provided excellent control (93-97 percent) of giant foxtail (_Setaria faberi_), ladysthumb (_Polygonum persicaria_), volunteer wheat (_Triticum aestivum_) and ivyleaf morningglory (Table 2).

Crop Response: Slight injury was observed as slight stunting. This injury had little apparent effect on the soybeans since plots treated with the oryzalin combinations had higher yields than the plot treated with paraquat alone. The untreated control was not harvested at this location, due to weeds.

C. _Kentucky; Herbicidal Efficacy_: Oryzalin + linuron + paraquat at the Kentucky location provided fair (65 and 75 percent) control of giant foxtail and Pennsylvania smartweed (_Polygonum pensylvanicum_); good (80 and 90 percent) control of redroot pigweed and common ragweed (_Ambrosia artemisiifolia_); and poor control (20 and 40 percent) of volunteer wheat and horseweed (_Erigeron canadensis_) (Table 3). Oryzalin + metribuzin + paraquat provided fair to good (70 to 90 percent) control of all weeds. Alachlor + linuron + paraquat provided poor (0 and 50 percent) control of volunteer wheat and horseweed; and good to excellent (90 to 100 percent) control of other weeds.

Crop Response: The herbicide combinations did not cause crop or root injury and did not result in any reduction in yield when compared to the control.

These results are representative of experiments conducted in the major no-till soybean areas of the country where rainfall following treatment has been adequate to move oryzalin into the weed seed germination zone. Injury to germinating soybeans may result if herbicides come in direct contact with the seed due to inadequate closing of the furrow during planting.

Table 1. Herbicidal efficacy, crop tolerance, and yield when oryzalin tank-mix combinations were applied preemergence to no-till soybeans in Maryland.

Treatment	Rate (lb/A)	Crop[a] Injury Rating	Percent Weed Control: Crab-grass	Green Foxtail	Fall Panicum	Redroot Pigweed	Velvet-leaf	Ivyleaf morning-glory	Crop Yield[b] % of Control
Oryzalin + Linuron + Paraquat	1 + 0.75 + 0.25	0	90	90	90	90	90	67	96
Oryzalin + Metribuzin + Paraquat	1 + 0.33 + 0.25	0	90	90	90	90	90	70	96
Alachlor + Linuron + Paraquat	2.5 + 0.75 + 0.25	0	80	76	93	90	83	67	100
Paraquat	0.25	0	70	70	70	67	70	63	98
Control	0	0	0 (2.5)[c]	0 (2)	0 (1)	0 (<1)	0 (<1)	0 (<1)	100

a/ Crop injury rating: 0 = no injury and 10 = dead plants.

b/ Crop yield was determined by harvest with commercial equipment, then converted to percent of control for comparison.

c/ Numbers in parenthesis are the number of weeds per square foot in control plots.

Table 2. Herbicidal efficacy, crop tolerance, and yield when oryzalin tank-mix combinations were applied preemergence to no-till soybeans in Illinois

Treatment	Rate (lb/A)	Crop Injury Rating[a/] 4 weeks	14 weeks	Percent Weed Control: Giant Fox-tail	Ladys-thumb	Volunteer Wheat	Ivyleaf Morning-glory	Crop Yield[b/] % of Control
Oryzalin + Linuron + Paraquat	1 + 0.75 + 0.5	0.3	0.7	93	95	95	93	155
Oryzalin + Metribuzin + Paraquat	1 + 0.33 + 0.5	1.0	1.7	96	96	97	95	145
Paraquat	0.5	0	0	58	77	70	67	100
Control	0	0	0	0 (1)[c/]	0 (0.5)	0 (5)	0 (0.7)	--[d/]

a/ Crop injury rating: 0 = no injury; 10 = dead plants.

b/ Crop yield was determined by harvest with commercial equipment, then converted to percent of control for comparison.

c/ Numbers in parenthesis are the number of weeds per square foot in control plots.

d/ Untreated control was not harvested.

Table 3. Herbicidal efficacy, crop tolerance, and yield when oryzalin tank-mix combinations were applied preemergence to no-till soybeans in Kentucky.

Treatment	Rate (lb/A)	Crop[a/] Injury Rating	Root[a/] Injury Rating	Percent Weed Control: Giant Fox-tail	Pennsyl-vania Smart-weed	Red-root Pig-weed	Horse-weed	Common Ragweed	Volunteer Wheat	Yield[b/] % of Control
Oryzalin + Linuron + Paraquat	1 + 0.75 + 0.25	0	0	65	75	80	40	90	20	170
Oryzalin + Metribuzin + Paraquat	1 + 0.33 + 0.25	0	0	90	80	90	80	80	70	105
Alachlor + Linuron + Paraquat	2.5 + 0.75 + 0.25	0	0	95	90	95	50	100	0	131
Control	0	0	0	0 (1)[c/]	0 (7)	0 (<1)	0 (<1)	0 (0.5)	0 (11)	100

a/ Crop and root injury ratings: 0 = no injury and 10 = dead plants.

b/ Crop yield was determined by harvest with commercial equipment, then converted to percent of control for comparison.

c/ Numbers in parenthesis are the number of weeds per square foot in control plots.

Preemergence and Postemergence Activity of HOE-23408 in Soybeans

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

ABSTRACT

Research was conducted during 1974, 1975, and 1976 to determine the preemergence and postemergence activity of HOE-23408 (methyl 2- [4-(2,4-dichlorophenoxy)phenoxy] propanoate) for weed control in soybeans. Applications were made at a delivery rate of 41 gpa using small plot equipment with propane as the source of pressure. Plots measured 6.7' by 20' (2 rows wide); treatments were replicated 3 to 4 times. In 1974 preemergence applications of HOE-23408 at 1 1/2 to 3 lb/A provided season-long control of fall panicum (Panicum dichotomiflorum Michx) but failed to control lambsquarters (Chenopodium album L.). Postemergence applications to fall panicum measuring 1 to 2 in in height also provided excellent control at rates between 1/2 and 2 lb/A. A combination of HOE-23408 at 1 lb/A with chloroxuron (3- [p-(p-chlorophenoxy)phenyl] -1,1-dimethylurea) at 1 1/2 lb/A controlled lambsquarters and fall panicum while a combination of HOE-23408 + bentazon (3-isopropyl-1H-2,1,3-benzothiadiazin-(4) 3H-one 2,2-dioxide) at 1 + 3/4 lb/A respectively resulted in less fall panicum control than HOE-23408 alone. In 1975, postemergence applications of HOE-23408 were made to fall panicum measuring 1 to 5 in in height and control averaged only 55% for rates of 1 1/2 to 3 lbs/A with little difference existing between rates. Combinations of HOE-23408 with chloroxuron at 1 1/2 lb/A each provided 77% control of fall panicum while combinations of HOE-23408 (3 lb/A) with bentazon (3/4 lb/A) provided only 35% control of fall panicum. Highest soybean yields were obtained from treatments providing best control. Studies in 1976 showed that lovegrass (Eragrostis pilosa L.) and bullgrass (Paspalum Boscianum Fluegge) were more susceptible to postemergence applications of HOE-23408 than was large crabgrass (Digitaria sanguinalis L.). The differences in susceptibility of these species to HOE-23408 increased rapidly as stage of growth increased. A combination of HOE-23408 + chloroxuron provided slightly better control of large crabgrass than a combination of HOE-23408 + bentazon. Extensive injury to soybeans resulted from combinations of HOE-23408 with dinoseb (2-sec-butyl-4,6-dinitrophenol) or with dinoseb + naptalam (N-1-naphthylphthalamic acid) applied at the "cracking" stage of soybean growth. Preemergence applications of HOE-23408 with linuron (3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea) or metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one) provided excellent control of crabgrass and bullgrass.

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CONTROL OF JIMSONWEED IN SOYBEANS WITH TIMED POSTEMERGENCE BENTAZON APPLICATIONS

J. V. Parochetti and J. R. Brow[1]

ABSTRACT

Timely postemergence applications of bentazon [3-isopropyl-1 H-2,1,3-benzothiadiazin-(4)3H-one 2,2-dioxide] have resulted in excellent control of jimsonweed [*Datura stramonium* L.] in soybeans [*Glycine max*. L.]. Bentazon applied as late as the 5 to 6 leaf stage of jimsonweed (approximately 4 weeks after soybean emergence) effected greater than 98% control of jimsonweed. Later treatments (beyond 6 weeks after crop emergence) resulted in significantly poorer jimsonweed control in two experiments. Injury to soybeans was minimal with early postemergence treatments applied at the 3 to 5 trifoliate leaf stage (approximately 3 to 4 weeks after crop emergence). Soybean yields were not reduced significantly when bentazon applications were made by the 1 to 3 trifoliate leaf stage (approximately 3 weeks after soybean emergence). Yields were significantly reduced by jimsonweed competition when bentazon was applied later than 3 weeks after soybean emergence.

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RESPONSE OF KENAF TO SOME PREEMERGENCE HERBICIDES

R. W. Michieka, R. D. Ilnicki, J. R. Justin, and J. Zublena[1]

ABSTRACT

Some representative herbicides from the acetanilide, dinitroaniline, N-phenylurea, diphenylether, and as-triazine families were surveyed for possible use as preemergence herbicides on kenaf. The acetanilide herbicides, alachlor and propachlor, were the safest. The dinitroaniline herbicides studied were the next safest with penoxalin safer than oryzalin.

As a family, the N-phenylureas were injurious to kenaf. Chlorbromuron and linuron were more severe on crop stand and vigor than fluometuron and metabromuron, but the latter two still produced significant injury.

Fluorodifen was safe on kenaf at rates not affecting good weed control. Increasing the rate to improve weed control injury on kenaf resulted.

Metribuzin, an asymmetric herbicide, was not considered safe at all for this crop.

INTRODUCTION

Some interest has developed in kenaf (*Hibiscus cannabinus* L.) as a source of bast fibers for the manufacture of fine quality papers. Some research was conducted on this plant during World War II as a possible jute substitute.

Not much work has been done on kenaf with regard to weed control from herbicides or how herbicides might fit into the culture of this crop. It was the objective of this study to ascertain what preemergence herbicides might be used successfully to control weeds without producing any serious injury. Some

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representatives of the following herbicide families were selected: acetanilides, dinitroanilines, N-phenylureas, diphenylethers, and an as-triazine.

MATERIALS AND METHODS

Kenaf (var. 2032) was planted after complete seedbed preparation on June 17, 1976, in a Freehold loam soil at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey, with a tractor-drawn drill with 9-inch spacings between rows. Following planting,plots 3' (4-rows) wide x 20' long were established to receive preemergence applications of herbicides. All herbicide applications were made preemergence using a hand-operated CO_2-propelled plot sprayer on the same day of planting. A complete randomized block design was used with 3 replications. The herbicide treatments included in the study are presented in Table 1. Chemical identities and the formulations used are presented in the Appendix.

The experimental area was infested with the following weeds: redroot pigweed (*Amaranthus retroflexus* L.), common ragweed (*Ambrosia artemasiifolia* L.), and fall panicum (*Panicum dichotomiflorum* Michx.)

Throughout the investigation periodic observations were made on crop injury and weed control. A rating scale of 0 to 10 was used where 0 = no effect on stand or vigor and 10 = complete control or 100% elimination of stand.

RESULTS AND DISCUSSION

In Table 1 are summarized the responses of kenaf to the various herbicide treatments and weed control. The data presented here were taken on July 30 some 6 weeks after planting and herbicide application.

From this table it can be seen that of the herbicide families studied, the acetanilide herbicides were the safest. Some injury to stand and vigor of kenaf was produced from the highest rate of alachlor but it was felt this would not be reflected in yield.

Some injury to kenaf was realized from the dinitroanilines but only from oryzalin. Penoxalin was safe to use on this crop.

As a family, the N-phenylureas were injurious to this crop. Chlorbromuron and linuron produced serious injury and at the highest rate of each almost completely eliminated the kenaf. Less injury, but still serious injury, was produced by fluometuron and metobromuron.

Fluorodifen, a diphenylether herbicide, effected some injury to kenaf but only at the highest rate evaluated. The two lower rates were considered as safe rates.

Metribuzin, an asymmetric triazine, was very injurious to kenaf and probably could not be worked into a weed control program.

With regard to weed control, all herbicides produced some degree of weed control on the weeds present in the study. Some specific comments can be made, however. Penoxalin and fluorodifen were only slightly effective on pigweed; alachlor, fluorodifen, penoxalin, and oryzalin produced poor to good control of common ragweed; and chlorbromuron, fluorodifen and oryzalin were only fair on fall panicum.

Table 1. The effects of some preemergence herbicides on weed control and kenaf responses

Herbicide	Rate, lb/A	Kenaf Stand[1]	Kenaf Vigor[1]	Weed Control[1] Pigweed	Weed Control[1] Ragweed	Weed Control[1] Fall Panicum
alachlor	2	0.0	0.3	8.0	4.0	8.3
	3	0.3	0.7	9.3	5.0	9.3
	4	1.0	1.7	10.0	5.0	10.0
propachlor	4	0.3	0.2	8.0	4.0	9.7
	5	0.3	0.8	8.0	5.7	10.0
	6	0.3	0.7	6.0	6.0	10.0
oryzalin	1 1/2	0.3	3.3	5.3	7.0	5.3
	2	1.2	2.0	9.0	8.3	6.0
	3	4.7	2.3	9.7	7.7	7.7
penoxalin	3/4	0.3	0.5	4.0	6.7	8.3
	1	0.0	0.7	6.0	9.0	10.0
	1 1/2	0.0	0.3	9.0	10.0	8.7
chlorbromuron	1	2.7	3.7	9.3	8.0	2.3
	2	8.3	6.0	10.0	8.7	5.0
	3	9.8	7.3	10.0	8.3	6.3
fluometuron	2	2.0	1.0	8.0	9.0	8.3
	3	1.7	2.3	9.3	10.0	9.3
	4	2.3	4.3	10.0	10.0	10.0
linuron	3/4	3.8	3.3	10.0	7.3	8.3
	1	5.2	4.0	9.7	8.3	5.7
	1 1/2	8.7	6.0	10.0	10.0	8.0
metobromuron	2	2.3	3.3	10.0	9.3	6.7
	2 1/2	1.8	2.5	10.0	10.0	10.0
	3	2.3	4.7	10.0	10.0	10.0
fluorodifen	2	0.8	3.0	6.7	3.7	5.0
	3	0.2	4.0	7.3	4.0	3.3
	4	1.7	2.3	8.0	8.3	6.3
metribuzin	3/8	7.3	2.7	6.3	10.0	10.0
	3/4	7.0	6.7	10.0	10.0	10.0
	1	6.7	6.7	10.0	10.0	10.0

[1]Based on a scale of 0 to 10, where 0 = no effect on stand or vigor and 10 = complete control or elimination of stand.

APPENDIX

Common Name	Chemical Name
Acetanilides	
alachlor, ec	2-chloro-2',6'-diethyl-N-(methoxy=methyl) acetanilide
propachlor, wp	2-chloro-N-isopropylacetanilide
Dinitroanilines	
oryzalin, wp	3,5-dinitro-N^4,N^4-dipropylsulfanil-amide
penoxalin, ec	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine
N-phenylureas	
chlorbromuron, wp	3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea
fluometuron, wp	1,1-dimethyl-3-(α,α,α-trifluoro-m-tolyl)urea
linuron, wp	3-(3,4-dichlorophenyl)-1-methoxy-1-methyl-urea
metabromuron, wp	3-(p-bromophenyl)-1-methoxy-1-methylurea
Diphenylether	
fluorodifen	p-nitrophenyl (α,α,α-trifluoro-2-nitro-p-tolyl ether
as-Triazine	
metribuzin	4-amino-6-tert-butyl-3-(methylthio) as-triazine-S(4H)one

FALL APPLICATIONS OF GLYPHOSATE FOR QUACKGRASS CONTROL[1]

William B. Duke and Julian F. Hunt[2]

Field studies were conducted in 1975 and 1976 at Etna, New York to examine the overall effects of glyphosate on quackgrass regrowth following application at several different dates in the fall. Glyphosate at 2.2 kg/ha were applied every two weeks from September 15 to November 15, 1975 and compared to an application made on May 15, 1976. These treatments were repeated at Etna on a second site in the fall of 1976. The only changes in the second study were that glyphosate applications were begun on September 1. The experiments were set up as a factorial with pared comparisons between checks and treatments for each date. All treatments were replicated four times.

Quackgrass regrowth in July 1976 following glyphosate applications in early to mid-September 1975 was greater than that which occurred following applications made in mid-October to mid-November 1975. Late fall applications (mid-November) were as effective as early spring (mid-May) treatments.

In the second study initiated in the fall of 1976, subsamples of intact rhizome systems with attached plants were taken from treated and untreated plots ten to fourteen days after glyphosate applications. The rhizome system was mapped and all rhizomes were cut into individual nodes. The single nodes were planted in peat in the greenhouse and viability was determined after 30 days. In general glyphosate was found to translocate throughout old and new rhizomes. Lack of translocation into buds was observed following rainfall and when temperatures were less than 45°F for the period between application and sampling. Data will be taken in the summer of 1976 to correlate activity with the translocation information.

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[2] Assoc. Prof. and Experimentalist, respectively, Dept. of Agron., Cornell Univ., Ithaca, NY 14853.

POLYETHYLENE BOTTLES FOR CO_2 SPRAYERS

John A. Grande[1/]

Abstract

Various plastic resin containers were evaluated for their ability to be adapted to a CO_2 pressurized small plot sprayer. The containers were evaluated by the following criteria: burst pressure, burst characteristics, chemical resistance, and economy. A 1000 ml linear polyethylene container was successfully evaluated by the above criteria. Burst pressure was in excess of 8.78 kg/cm^2. The container was operated continuously at pressures up to 4.92 kg/cm^2, which allowed for a high degree of flexibility in nozzle performance, i.e. GPM, spacing, height and GPA. The burst characteristic of the container was a longitudinal rupture along one side. No fragmentation occurred. Chemical resistance was tested by allowing twenty undiluted emulsifiable concentrate herbicides to remain in the container for 72 hours. The containers were then evaluated for chemical resistance by visual inspection and for loss of wall rigidity by pressurizing them to 4.92 kg/cm^2. The only change noted in the containers was a slight permanent stain from trifluralin. The container is easily adaptable to CO_2 pressurized sprayers with common tools and a minor expense.

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THE EFFECTS OF SOME DINITROANILINE HERBICIDE ON KENAF

R. D. Ilnicki, J. R. Justin, and R. W. Michieka[1/]

ABSTRACT

A number of dinitroaniline herbicides were evaluated for weed control and crop tolerance in kenaf. All were soil-incorporated prior to planting. Of the herbicides studied, no herbicide had any serious effect on kenaf. Butralin, ethalfluralin, nitralin, oryzalin, profluralin, and USB 3153 had any effect on the vigor or growth of the crop. Penoxalin, at all rates studied, and only the high rates of dinitramine, trifluralin, and trifluralin reduced the vigor of the crop but this was a short-lived response.

All herbicides were effective on fall panicum and redroot pigweed. Excellent control of common ragweed was produced by oryzalin and profluralin, by high rates of ethalfluralin and USB 3153, and by the highest rate of nitralin and butralin. Dinitramine, fluchloralin, penoxalin, and trifluralin were not too effective, at any rate, on this species.

INTRODUCTION

Kenaf (Hibiscus cannabinus L.) has been studied for nearly 20 years in the south as a possible substitute for wood pulp. Over the past decade, it has been investigated at least three times in New Jersey for various uses. In 1975, a study was begun to determine the usefulness of kenaf bast fibers for the manufacture of fine quality papers.

From preliminary studies conducted at this station and elsewhere, it was found that trifluralin may have a place in its culture for the control of many annual weeds. Since there are a number of herbicides available to weed scientists that are similar in chemical structure to trifluralin, it was felt that a study to

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determine the effects of other dinitroaniline herbicides on kenaf was in order. It was with this objective in mind that this study was undertaken.

MATERIALS AND METHODS

Kenaf (var. 2032) was planted, after complete seedbed preparation, on June 17, 1976, in a Freehold loam soil at the Adelphia Research Center, New Jersey Agricultural Experiment Station with a tractor-drawn drill with 9-inch spacings between drill bands. Prior to planting plots 3' (4 rows) wide x 20' long were established to receive the herbicide treatments. A complete randomized block design with 3 replications was used. All herbicide treatments were applied as 40 gpa with water as the carrier. Immediately after planting, all treated plots were mechanically soil-incorporated to a depth of 3 inches with a tractor-drawn tilrovator. After the incorporation operation, plots were relocated and planting followed.

The experimental area was primarily infested with redroot pigweed (*Amaranthus retroflexus* L.), common ragweed (*Ambrosia artemisiifolia* L.) and fall panicum (*Panicum dichotomiflorum* Michx.).

Weed control and crop injury were rated using the scale 0 to 10, where 0 = no control or crop injury and 10 = complete control or 100% reduction in crop stand or vigor. Ratings were made on July 30. The herbicide treatments investigated are presented in Table 1. The chemical names and formulations of herbicides investigated are presented in the Appendix.

RESULTS AND DISCUSSION

The effects of the dinitroaniline herbicides on kenaf and on weed control are summarized in Table 1. From this table it can be seen that no herbicide or herbicide treatment (rate) had any effect on stand of kenaf. However, several herbicide treatments did affect the vigor of crop. Butralin, ethalfluralin, nitralin, oryzalin, profluralin, and USB 3153 had no effect on the vigor or growth of kenaf. Penoxalin, at all rates investigated, reduced the vigor of the crop. Only the two higher rates of dinitramine and trifluralin and only the highest rate of fluchloralin reduced the vigor of the crop. These reductions in vigor were short-lived and ultimately this temporary effect was later outgrown.

With regard to weed control, one interesting point is obvious. All dinitroaniline herbicides evaluated were effective on fall panicum with no difference between them. There were differences in the degree of broadleaf weed control, however. Common redroot pigweed was more easily controlled than common ragweed. Excellent control of ragweed at all rates evaluated was obtained by oryzalin and profluralin. Slightly less but still excellent control was obtained by the two higher rates of ethalfluralin and USB 3153 and good to excellent control only by the highest rate of nitralin and butralin. Control of redroot pigweed was complete by all herbicides. Excellent control was obtained by the highest rates of all herbicides studied. Lower rates of all herbicides effected good control of this species with the exception of oryzalin. Control of fall panicum at the lowest rate of herbicide was poor.

Kenaf was not harvested for yield. It was felt that no herbicide had any detrimental effects on this crop _per se_. Any difference in yield would be due to weed control alone.

Table 1. The effects of some dinitroaniline herbicides on weed control and kenaf responses.

		Kenaf		Weed Control[1]		
Herbicide	Rate, lb/A	Stand[1]	Vigor[1]	Pigweed	Ragweed	Fall Panicum
butralin	1	0.0	0.7	9.7	6.7	10.0
	1 1/2	0.0	0.0	8.7	6.7	9.3
	2	0.0	0.2	10.0	8.3	10.0
dinitramine	1/3	0.0	0.0	9.3	5.7	10.0
	1/2	0.0	1.0	9.7	6.3	10.0
	2/3	0.0	1.0	10.0	5.3	10.0
ethalfluralin	3/4	0.0	0.0	9.3	6.7	10.0
	1	0.2	0.0	8.7	9.3	10.0
	1 1/2	0.2	0.0	10.0	10.0	10.0
fluchloralin	1/2	0.0	0.2	8.0	4.7	10.0
	3/4	0.0	0.8	9.8	5.0	10.0
	1	0.7	1.2	9.0	6.7	10.0
nitralin	3/4	0.7	0.7	9.0	5.0	10.0
	1	0.0	0.7	10.0	6.3	10.0
	1 1/2	0.0	0.0	9.3	9.7	10.0
oryzalin	3/4	0.0	0.0	3.3	10.0	10.0
	1	0.0	0.3	10.0	10.0	10.0
	1 1/2	0.0	0.3	10.0	10.0	10.0
penoxalin	3/4	0.0	1.0	10.0	3.3	10.0
	1	0.0	1.2	9.5	2.7	10.0
	1 1/2	0.0	1.2	10.0	6.3	10.0
profluralin	1/2	0.0	0.0	8.0	10.0	10.0
	1	0.0	0.2	8.8	10.0	10.0
	1 1/2	0.0	0.3	9.7	9.8	10.0
trifluralin	3/4	0.8	0.7	10.0	0.0	9.3
	1	0.0	1.0	9.5	0.0	10.0
	1 1/2	0.0	1.0	9.0	6.3	10.0
USB 3153	1/3	0.0	0.5	7.7	0.5	10.0
	1/2	0.3	0.3	9.2	9.3	10.0
	2/3	0.2	0.3	10.0	9.7	10.0

[1]Based on a scale of 0 to 10, where 0 = no effect on stand or vigor and 10 = complete control or elimination of stand.

APPENDIX

Common Name	
butralin, ec	4-(1,1-dimethylethyl)-N-(1-methyl=propyl)-2,6-dinitro-benzenamine
dinitramine, ec	N^4,N^4-diethyl-α,α,α-trifluoro-3,5-dinitrotoluene-2,4-diamine
ethalfluralin, ec	N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine
fluchloralin, ec	N-(2-chloroethyl)-2,6-dinitro-N-propyl-4-(trifluoromethyl)aniline
nitralin, wp	4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline
oryzalin, wp	3,5-dinitro-N^4,N^4-dipropylsulfanilamide
penoxalin, ec	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine
profluralin, ec	N-(cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine
trifluralin, ec	α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine
USB 3153, wp	chemistry not disclosed

EFFECT OF GLYPHOSATE APPLICATIONS ON HEDGE BINDWEED

W. L. Kline and G. W. Selleck[1]

ABSTRACT

Glyphosate [N-(phosphonomethyl) glycine] at 4 lbs/A alone, plus 1% Mon 0011 and Nalco was applied to hedge bindweed (Convolvulus sepium L.) at different stages of plant growth. Leaf chlorosis was visible three days after application and within 21 days 95 to 97% control was achieved. After six weeks, regrowth from underground parts reduced control to 50% on pre-flowering, 70-75% on flowering and to 90-95% on late or post flowering treatments. There was no visible difference to hedge bindweed between Glyphosate at 4 lbs/A alone or with any of the additives, either in initial activity or the extent of regrowth. All plots were retreated twice at various stages of the plants. The first re-treatment controlled regrowth for a month at 4 stages: 4" tall, 6" tall, 10" tall, 20" tall and bloom. Subsequent regrowth from these treatments differed little in density. The second re-treatment gave a 70 to 85% control on foliage, but the rhizomes revealed only superficial root necrosis.

Jack pine (Pinus rigida Mill.) which was in some of the plots showed only superficial burning of the needles with one application of Glyphosate.

[1] Graduate Student and Professor, L.I. Vegetable Research Farm, respectively, Department of Vegetable Crops, Cornell University, Ithaca, New York.

ANNUAL WEED CONTROL IN ALFALFA NEW SEEDINGS[1/]

Jonas Vengris[2/]

ABSTRACT

Two field experiments were conducted in studying annual weed control in establishing alfalfa (Medicago sativa L. Saranac) seedings. In experimental areas fall panicum (Panicum dichotomiflorum Michx.) was dominant weedy grass. Dinoseb (2-sec-butyl-4,6-dinitrophenol), metolachlor [2-chloro-N-(2-ethyl-6-methyl-phenyl)-N-(methoxy-1-methylethyl) acetamide] and methazole [2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione] treatments significantly thinned out alfalfa seedings. Benefin [N-butyl-N-ethyl-a,a,a-trifluoro-2,6-dinitro-p-toluidine], EPTC (S-ethyl dipropylthiocarbamate), profluralin [N-(cyclopropylmethyl)-a,a,a-trifluoro-2,6-dinitro-N-propyl-p-toluidine] and butralin [4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzamine] were outstanding treatments in grassy weed control. Vel 5052 [2-chloro-N-(2,6-dimethyl phenyl)-N[(l,3-dioxolan-2-yl) methyl] acetamide)] herbicide did a good job in controlling fall panicum and other grassy weeds but it was poor in broadleaf weed control. Following the year after seeding, alfalfa yields of untreated checks and of the best herbicidal treatments were comparable. The values of herbicidal treatments in establishing alfalfa seedings in most cases should be measured by both the improved quality and quantity of hay produced in the year of seeding.

INTRODUCTION

In recent years fall panicum and crabgrass (Digitaria spp.)became most troublesome annual weedy grasses in corn, forage seedings and other crops in the Northeast. The main objective of this study was to investigate under field conditions the effectiveness of available herbicides and their combinations in controlling these weedy grasses in establishing alfalfa seedings.

MATERIALS and METHODS

The experiments were conducted at the South Deerfield experimental farm on a fine sandy loam that was made up of 1.1% organic matter and was moderately well drained. A randomized block design with four replicates in the 1975 trials and with three replicates in the 1976 trials was used. Plot size 8 by 30 ft. was used. Fall panicum was the dominant weed in both experiments. The rest of the weed population consisted of crabgrass, witchgrass (Panicum capillare L.), redroot pigweed (Amaranthus retroflexus L.) and lambsquarters (Chenopodium sp.). Common purslane (Portulaca oleracea L.) was present in the 1975 trials only.

1/ Paper No. 2088, Massachusetts Agr. Exp. Sta., Univ. of Massachusetts at Amherst. This research is supported from Exp. Sta. Hatch Project No. 375.

2/ Prof., Department of Plant and Soil Science, Univ. of Massachusetts, Amherst, Ma. 01003.

In both years the seedbed was prepared one to two days before alfalfa seeding. In 1975 on May 23 and in 1976 on May 25 alfalfa was seeded with a Brillion seeder at the rate of 16 lb/A. A list of treatments and their application dates are presented in the tables. Preplant treatments were, after application, immediately mixed into the soil by rototilling three inches deep. Alfalfa and weed seedlings were about 2 to 3 inches tall when postemergence treatments were applies. Alfalfa was in a 3 true leaf stage of growth. All herbicide rates presented in the tables are expressed in pounds of acid equivalents or active ingredients per acre.

The effectiveness of the herbicides used in controlling weeds was closely observed throughout the growing season. Two weeks after application of postemergence treatments, alfalfa seedling number per sq. ft. was recorded. At early blooming the alfalfa of the 1975 seeding was harvested twice the first year and twice the following year. For the 1976 seedings only first year yield data was presented. Yields were determined by harvesting a 3 ft. strip in the middle of each plot. Immediately after harvestings, species separation analyses were done to determine alfalfa and weed yields. Some specifics concerning procedures will be given when discussing results of the separate experiments.

RESULTS and DISCUSSION

1975 trials.

Dinoseb methazole and metolachlor treatments significantly thinned out alfalfa seedlings (Table 1). Metolachlor pre-emergence applications were more injurious to alfalfa than preplant incorporated treatments. Alfalfa was stunted and injured by methazole and metolachlor treatments.

Benefin, EPTC and profluralin eliminated fall panicum almost completely in the first cutting. Some weedy grasses escaped metolachlor and methazole applications and, due to the lack of competition, developed lush growth in the aftermath (Table 1). Dinoseb killed broadleaf weed seedlings and thinned out alfalfa, thus creating excellent conditions for fall panicum and other grassy weeds to grow. Metolachlor was rather weak in controlling broadleaf weeds. Also, it is interesting to note that EPTC was weaker for broadleaf weed control than benefin or profluralin.

The highest yields of alfalfa were producted by benefin, EPTC and profluralin treatments. Dinoseb, methazole and higher rates of metolachlor decreased alfalfa yields compared with untreated checks.

In the aftermath fall panicum was the dominant weed. Other weedy grasses or broadleaf weeds were scarce and insignificant. Regrowth of alfalfa was poor. Fall panicum strongly competed with thinned out alfalfa stands in metolachlor, lower rates of methazole, dinoseb and 2,4-DB[4-(2,4-dichlorophenoxy) butyric acid] treatments. Again, benefin, EPTC and profluralin produced the highest alfalfa yields. Aftermath yields were much lower than those of the first cutting.

Alfalfa stands were surveyed the following year. Alfalfa stands of untreated checks as well as all treatments were clean from weeds. Methazole plots showed some injury marks; alfalfa was thinned out and somewhat stunted. Alfalfa was cut at an early bloom stage of growth on June 15 and again on July 20 (Table 1). Alfalfa yields were decreased by dinoseb and higher rates of methazole. It is interesting to note that yields of checks, 2,4-DB and even metolachlor were comparable with the best herbicidal treatments. Thus, the values of the herbicidal treatments in establishing alfalfa seedings in most cases should be measured by both the improved quality and quantity of hay produced in the year of seeding.

1976 trials.

Methazole at higher rates than 0.75 lb/A and dinoseb thinned out alfalfa stands considerably (Table 2). All treatments but 2,4-DB and dinoseb significantly controlled weedy grasses. Fall panicum was the dominant grassy weed and made up over 90 percent of all weeds present. New Vel 5052 herbicide did an excellent job in controlling fall panicum. This herbicide was relatively poor on annual broadleaf weed control.

Alfalfa yields of the first cutting were increased over the untreated checks by all treatments except dinoseb and methazole 1.5 lb/A and 2,4-DB. Regrowth of alfalfa was good and apparently suppressed the regrowth of fall panicum and other weeds. With the exception of 2,4-DB, dinoseb and untreated checks, second cutting alfalfa yields of all treatments were comparable and did not differ appreciably.

Table 1. The effect of herbicidal treatments on annual weed control in new alfalfa seeding 1975.

Treatments	Date of Application	No. of alfalfa seedlings Sq. ft. on 7/2/75	Dry Matter Yields lb/90 sq. ft. plot[1)] First Cutting 7/23/75 Fall Panicum	Other GW	BW	Alfalfa	Second cutting 9/15/75 Fall Panicum	Alfalfa	6/15/76 Alfalfa	7/20/76 Alfalfa
1. Check		42	3.52 b	1.90	1.59	2.34 cd	2.09 d	1.69 bc	7.70 ab	5.71 abc
2. Benefin, 1.2 lb/A, PP1	5/22	47	0	0	0	6.60 a	0.29 f	3.10 a	8.60 a	6.52 a
3. EPTC, 4 lb/A, PP1	5/22	43	0	0	0.32	6.08 a	0.07 f	3.54 a	7.88 ab	6.30 ab
4. Profluralin, 1 lb/A, PP1	5/22	49	0	0	0	6.60 a	0.03 f	3.10 a	8.03 ab	6.09 ab
5. Profluralin + 2,4-DB, 1 + 1.5 lb/A, PP1 + Post	5/22 + 6/17	40	0	0	0	6.22 a	0.09 f	2.96 a	8.10 ab	6.24 ab
6. Metolachlor, 2 lb/A, PP1	5/22	38	0.29 c	0	0.94	2.37 cd	2.47 d	1.57 bcd	7.22 abc	5.81 abc
7. Metolachlor, 3 lb/A, PP1	5/22	28	0.06 c	0	0.83	1.39 ef	3.54 c	1.34 cdef	8.00 ab	6.45 a
8. Metolachlor, 2 lb/A, Pre	5/23	23	0.35 c	0.07	0.67	3.07 c	4.07 b	1.03 def	8.52 a	5.54 abc
9. Metolachlor, 3 lb/A, Pre	5/23	23	0.11 c	0.05	0.06	1.78 def	4.64 a	1.89 bc	7.48 ab	5.32 bc
10. Methazole, 2 lb/A, Pre	5/23	18	0.12 c	0.02	0.04	2.03 de	3.53 c	1.41 cde	7.05 abc	4.84 c
11. Methazole, 3 lb/A, Pre	5/23	7	0.12 c	0.05	0	0.46 gh	1.07 e	0.81 f	6.02 c	3.74 d
12. Metazole, 4 lb./A, Pre	5/23	7	+[a]	0	0	0.23 h	0.09 f	0.96 ef	3.20 d	2.11 e
13. Dinoseb, 1 lb/A, Post	6/17	8	5.37 a	1.34	0	1.19 fg	3.06 c	0.96 ef	6.58 c	3.71 d
14. 2,4-DB, 1.5 lb/A, Post	6/17	42	3.16 b	1.27	0	4.01 b	2.17 d	1.45 bcde	7.82 ab	5.47 abc

1) Means not followed by the same letter are significantly different at the 5% level using Duncan's Multiple Range Test.
a) Negligible amounts.

Table 2. The effect of herbicidal treatments on annual weed control in new alfalfa seeding 1976.

Treatments	Date of Application	No. of alfalfa seedlings Sq. ft. on 6/26/76	Dry Matter yields lb./90 sq. ft.[1] First Cutting 7/20/76			Second Cutting 9/14/76		
			GW	BW	Alfalfa	GW	BW	Alfalfa
1. Check		61	5.61 c	5.17	1.98 gh	1.33 b	0.23	1.73 c
2. Benefin, 12 lb/A, PPI	5/24	57	0.13 ef	0.66	5.84 abc	0.19 g	0	5.81 a
3. EPTC, 4 lb/A, PPI	5/24	62	0.19 ef	0.25	5.77 abc	0.25 g	+	5.46 ab
4. Profluralin, 1 lb/A, PPI	5/24	61	0.28 e	0.08	6.27 ab	0.52 f	+	5.13 ab
5. Profluralin + 2,4-DB, 1 + 1 lb/A, PPI + Post	5/24 + 6/15	65	0.34 e	+[a]	6.39 a	0.40 fg	0	5.59 ab
6. Butralin, 1.5 lb/A, PPI	5/24	66	0.37 e	0.22	6.88 a	0.89 cd	+	4.94 b
7. Butralin + 2,4-DB, 1.5 + 1 lb/A, PPI + Post	5/24 + 6/15	54	0.36 e	0	6.92 a	0.77 de	0	5.12 ab
8. Methazole, 0.75 lb/A, Pre	5/26	61	0.68 d	+	6.08 ab	1.03 c	0	4.96 b
9. Methazole, 1.0 lb/A, Pre	5/26	33	0.33 e	0	4.50 de	0.60 ef	0	5.30 ab
10. Methazole, 1.5 lb/A, Pre	5/26	13	0.16 ef	0.09	1.90 gh	0.35 fg	+	4.94 b
11. Benefin + methazole, 1 + 1 lb/A, PPI + Pre	5/24 + 5/26	36	+	0	4.68 cd	0.17 g	0	5.59 ab
12. EPTC + methazole, 3 + 1 lb/A, PPI + Pre	5/24 + 5/26	22	0.04 f	+	3.25 f	0.17 g	0	5.17 ab
13. Vel 5052, 2 lb/A, Pre	5/26	58	0.07 f	1.81	5.36 cd	0.26 g	+	4.94 b
14. Vel 5052, 3 lb/A, Pre	5/26	64	+	1.11	5.81 abc	0.25 g	+	5.36 ab
15. Vel 5052 + methazole, 2 + 1 lb/A, Pre	5/26	21	0.18 ef	0	3.34 ef	+	0	5.52 ab
16. Dinoseb, 1 lb/A, Post	6/15	14	9.58 a	1.46	1.09 h	1.44 b	+	1.00 d
17. 2,4-DB, 1 lb/A, Post	6/15	57	8.34 b	0	2.71 fg	2.17 a	0	2.31 c

1) Means not followed by the same letter are significantly different at the 5% level using Duncan's Multiple Range Test.

a) Negligible amounts.

MANAGING ALFALFA PRODUCTION WITH METRIBUZIN

G. P. Pagano, R. H. Ackerman, E. A. Cunningham and P. M. Grehlinger[1]

ABSTRACT

The presence of weeds in established alfalfa effect both hay quality and stand life. Metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4H)one) has been field tested in alfalfa growing regions of the Northeast to determine weed control, optimum rates, yield and protein changes resulting from its application.

Metribuzin at rates of 0.28 kg/ha controlled common chickweed (*Stellaria media*) and yellow rocket (*Barbarea vulgaris*). Metribuzin at 0.56 kg/ha gave control of henbit (*Lamium amplexicaule*), mustard (*Brassica* sp.), pigweed (*Amaranthus* sp.), red deadnettle (*Lamium purpurcum*), shepherdspurse (*Capsella bursa-pastoris*) and sweet vernalgrass (*Anthoxanthum odoratum*). At least 0.84 kg/ha were required to control ragweed (Ambrosia ortemisiifolia) white cockle (Lynchnis alba) and give partial control of dandelion (*Taraxacum officinale*). Grasses such as barnyardgrass (*Echinochloa crusgalli*) and quackgrass (*Agropyron repens*) require 1.13 kg/ha metribuzin for suppression.

Both reductions and increases in total yield (alfalfa plus weeds) were noted after metribuzin applications. In areas where weed pressure was severe total yields were decreased, however total protein was increased following treatment. In fields with high alfalfa populations the control of broadleaf with metribuzin increased total yields and protein per hectare.

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EFFECTS OF SEVERAL ADJUVANTS ON PREEMERGENCE AND POSTEMERGENCE HERBICIDES IN 1976[1]

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Abstract. Seven field experiments were conducted at three locations in Maryland and Virginia in 1976 to evaluate several herbicides with and without surfactants. All treatments were applied in water. Several surfactants greatly enhanced foliar necrosis of rye (Secale cereale L.) by paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) whereas several others were not as effective but better than paraquat with no surfactant. The addition of surfactants to preemergence herbicides generally did not enhance either initial or residual weed control nor reduce crop phytotoxicity from the herbicides.

INTRODUCTION

Surfactants are exempt from Environmental Protection Agency (EPA) registration because they are defined as a non-pesticide. As a consequence surfactants packaged separately from a pesticide can be marketed for use with pesticides without EPA registration and without providing efficacy data.

A review article on the nature and mode of action of surfactants has been published (1). The addition of surfactants to increase the activity of postemergence herbicides has been known since the introduction of the phenoxy herbicides. Surfactants are usually added by the manufacturers of pesticides to provide formulations suitable for field use. The addition of extra surfactants by the user to preemergence herbicides has been advocated by surfactant manufacturers, but little efficacy data are available.

This research was conducted to determine if several commercially available surfactants are beneficial both for foliar and soil application with several herbicides.

PROCEDURE, RESULTS, and DISCUSSION

Seven field experiments were conducted at three locations in 1976 in Maryland and Virginia evaluating several herbicides with and without surfactants. All treatments were applied with water as the liquid carrier.

Locations of the field experiments were the Vegetable Research Farm, Salisbury, MD (hereafter referred to as Site 1), the Virginia Truck and Ornamentals Research Station, Painter, VA (hereafter referred to as Site 2), and the Poplar Hill Research Farm, Salisbury, MD (hereafter referred to as Site 3). The soil at Site 1 was Norfolk sandy loam; at Site 2, Sassafras sandy loam; and at Site 3, Galestown sandy loam.

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[1]Joint contribution of the Deps. of Agron. and Hort., Maryland Agri. Exp. Sta., Scientific Article No.A2271 and Contribution No. 5267, and the Plant Physiol. Dep., Virginia Truck and Ornamentals Res. Sta., Paper No. 167, Journal Series.

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The trade name, source of material and principle functioning agents of surfactants used in the field research is listed in Table 1.

Experiments I and II were conducted to evaluate the effects of several surfactants with paraquat using rye foliar necrosis as the basis of measurement of herbicide activity. Experiment I was located at Site I and Experiment II was located at Site 2. Rye was seeded in the fall of 1975. In Experiment I rye was 12 inches in height when treated on March 8 in a volume of 34.7 gpa; there was only one replication. Plot size was 5 by 60 feet. In Experiment II rye varied from 8 to 24 inches in height when treated on March 18 in a volume of 40.6 gpa; there were 4 replications. Plot size was 6.7 by 20 feet. Paraquat plus the following surfactants effected rapid rye necrosis: X-77, Amway All-Purpose Spray Adjuvant, and Bestline LC (Tables 2 and 3). Less effective were SRC 101, WEX and BIO-88.

Experiments III through VII were conducted to evaluate the effects of surfactants on the preemergence activity of residual herbicides.

Experiment III was a no-tillage sweet corn (*Zea mays* L. var. *saccharatum*) study conducted at Site 1 to evaluate SRC 101 with atrazine [2-chloro-4-(ethylamino)-6-(isopropyl amino)-*s*-triazine] and alachlor [2-chloro-2',6'-diethyl-*N*-(methoxymethyl) acetanilide] to determine if SRC 101 extended residual weed control. Rye was the cover crop and was 18 to 24 inches in height when treated on March 26 with paraquat plus X-77. Plot size was 9 by 25 feet and there were 4 replications. The residual herbicides and an additional application of paraquat were applied on May 5 at a volume of 32 gpa. Early weed control was 95 to 100% for all species and all treatments; there was no corn injury (data not shown). Residual weed control on August 1 was similar for all treatments (Table 4).

Experiment IV was conducted at Site 2 on 'Pungo' potatoes (*Solanum tuberosum* L.) to evaluate three surfactants with linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea]. Plot size was 5 by 25 feet (2 rows wide with three replications). Potatoes were planted on March 12 with herbicides applied after drag-off on April 7 in a volume of 55 gpa. The first rainfall event after herbicide treatment was on April 25 and was 0.10 inches. Preemergence applications of WEX, AL 411F and SRC 101 did not improve control or yields resulting from linuron alone (Table 5).

Experiment V was conducted at Site 2 on 'Forrest' soybeans (*Glycine max* L.) to evaluate two different herbicide combinations with and without AL 411F. Plot size was 5 by 20 feet containing 2 rows; there were 3 replications. Soybeans were planted on May 25; preemergence herbicides were applied on May 27 and "at cracking" treatments were applied on June 2. Rainfall, shortly after herbicide application occurred on May 29 (0.53 inches) and June 3 (0.13 inches). The addition of AL 411F to either alachlor plus metribuzin [4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one] or alachlor plus dinoseb (2-*sec*-butyl-4,6-dinitrophenol) plus naptalam (*N*-1-naphthylphthalamic acid) increased soybean injury when observed early (data not shown). With reference to weed control, little differences were observed between the herbicide combinations with or without AL 411F (Table 6).

Experiment VI was conducted at Site 2 on 'Pioneer 3369A' field corn (*Zea mays* L. var. *indentata*) to evaluate several surfactants with preemergence herbicides in corn. Plot size was 6.7 by 20 feet containing 2 rows; there were 3 replications. Corn was planted on April 19, and herbicides were applied on April 21 in a volume of 41 gpa. The rainfall events 2 weeks after herbicide treatment were: April 25, 0.10 inches and May 3, 0.13 inches. Some variability existed in the data. However, it would appear that adjuvants had no effect on weed control or corn yields (Table 7). The one possible exception might be the addition of AL 411F to atrazine where it seems that control of large crabgrass (*Digitaria sanguinalis* (L.) Scop.) was improved over that obtained with atrazine alone. Since this would still not be a satisfactory treatment commercially, limited benefit resulted from the use of adjuvants with these preemergence herbicide applications.

Experiment VII was conducted at Site 3 on 'Essex' soybeans using metribuzin at various rates alone and with SRC 101 to determine if SRC 101 slowly released metribuzin, thus minimizing phytoxicity to soybeans. Plot size was 10 by 20 feet with 4 rows and was replicated four times. Soybeans were planted on June 9, and herbicides were applied the same day. The addition of SRC 101 to metribuzin was found to have no significant effect on weed control or soybean injury (Table 8). Injury was progressively more severe with increasing rates of metribuzin.

LITERATURE CITED

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ACKNOWLEDGEMENTS

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TABLE 1. Trade name, source of material, and principle functioning agents of surfactants used in the field research in 1976.

TRADE NAME OR CODE	SOURCE	PRINCIPLE FUNCTIONING AGENTS
X-77	Chevron Chemical Co.	Alkylarylpolyoxethylene glycols, fatty acids and isopropanol
SRC 101	Scientific Research Corp. Alva, OK	Alkylene ether sulfate aromatic sulfonate and polyhydric alcohol phenyl acrolein and aliphatic solvents
Amway All Purpose Spray Adjuvant	Amway, Inc., Ada, MI	Alkylpolyethoxylated alcohol
WEX	Conklin Co., Inc., Shakopee, MN	propylene glycol, dimethylpolysiloxane, ethoxylated alcohols
BIO-88	Kalo Laboratories, Inc.,	alkylpolyethoxy ethanol, free fatty acids and isopropanol
Bestline LC	Bestline Products, Inc. Chicago, IL	linear alkylsulfonate, lauric superamide
AL 411F (Agway's Booster Plus E or Helena's Agrodex)	ICI United States	A mixture of 100% viscosity paroffinic oil (83%) and polyoxyethylene sorbitan fatty acid ester (17%)

Table 2. The effect of paraquat alone and with the surfactants SRC 101 and X-77 on rye necrosis, Site 1, 1976.

	Treatment	Herbicide Rate (lb/A)	Adjuvant Conc. (% V/V)	Foliar Necrosis Mar 11 (%)	Mar 14 (%)	Mar 19 (%)	Apr 1 (%)
1.	Paraquat	0.25	----	55	10	30	25
2.	Paraquat + X-77	0.25 + ----	---- 0.125[d/]	90	90	98	90
3.	Paraquat + SRC 101	0.25 + ----	---- 0.036[a/]	50	20	60	70
4.	Paraquat + SRC 101	0.25 + ----	---- 0.063[b/]	50	25	60	55
5.	Paraquat + SRC 101	0.25 + ----	---- 0.125[c/]	60	30	75	70

[a/] 1 gallon SRC 101 per 20 lb active ingredient herbicide.

[b/] 1 gallon SRC 101 per 11.5 lb active ingredient herbicide.

[c/] 1 gallon SRC 101 per 6.5 lb active ingredient herbicide

[d/] 16 oz/100 gallon solution

Table 3. The effect of paraquat alone and with the surfactants X-77, Amway Spray Adjuvant, WEX, B10-88, and Bestline on rye necrosis, Site 2, 1976.

Treatment	Herbicide Rate (lb/A)	Adjuvant Conc. (% V:V)	Rye Necrosis 4 DAT[a] (%)
Paraquat	0.5	0	55c
Paraquat + X-77	0.5	0.125[b]	89 a
Paraquat + Amway[c]	0.5	0.11[c]	90 a
Paraquat + Amway[c]	0.5	0.14[c]	87 ab
Paraquat + Amway[c]	0.5	0.28[c]	90 a
Paraquat + WEX	0.5	0.05[d]	67 d
Paraquat + WEX	0.5	0.10[d]	82 bc
Paraquat + B10-88	0.5	0.125[b]	81 c
Paraquat + Bestline LC	0.5	0.28[e]	85 abc
Check	---	---	0 f

a/ DAT= Days after treatment, means followed by the same letter are not significantly different at the 5% level according to Duncan's new multiple range test.
b/ X-77 and B10-88 were applied at 1 pt/100 gal.
c/ Amway all purpose spray adjuvant was applied at 2/5, 1/2 and 1 pt/A for 0.11, 0.14 and 0.28% V:V, respectively.
d/ WEX was applied at 1/2 and 1 pt/125 gal for 0.05 and 0.10% V:V, respectively.
e/ Bestline LC surfactant was applied at 1 pt/A.

Table 4. The effect of residual herbicides and paraquat plus X-77 with and without SRC 101 on full season weed control in no-tillage sweet corn, Site 1, 1976.

Treatment	Herbicide Rate (lb/A)	Adjunct Conc. (% V:V)	Weed Control August 1 Large Crabgrass (%)	Purslane[e] (%)	Sweet Corn Yield (ton/A)
Atrazine	1.0		7.9	8.2	5.11 a
+ Alachlor	+1.0				
+ Paraquat	+0.375				
+ X-77		0.125[a]			
Atrazine	1.0		7.8	8.2	4.45 a
+ Alachlor	+1.0				
+ Paraquat	+0.375				
+ X-77		0.125[a]			
+ SRC 101		0.364[b]			
Atrazine	1.22		7.8	8.2	4.39 a
+ Alachlor	+1.22				
+ Paraquat	+0.45				
+ X-77		0.343[c]			
+ SRC 101		0.158[d]			

a/ Contains X077 at 16 oz/1000 gallons spray solution.
b/ Contains SRC 101 at 1 gallon/20 lb a.i. herbicide.
c/ Contains X-77 at 19.4 oz/100 gallons spray solution.
d/ Contains SRC 101 at 0.77 gallons/20 lb a. i. herbicide.
e/ *Portulaca oleracea* L.
f/ Means followed by the same letter are not significantly different at the 5% level according to Duncan's new multiple range test.

Table 5. The effect of linuron alone and with several surfactants on weed control in potatoes, Site 2, 1976.

Treatment	Herbicide Rate (lb/A)	Adjuvant (% V:V)	Common Lambsquarter[d/] May 6 %	Common Lambsquarter[d/] July 8 %	Potato Yields July 14 (cwt/A)
Control		-	0	0	56.5 c[e/]
Linuron	0.75	-	70	53	88.2 ab
Linuron +WEX	0.75	0.10[a/]	67	63	90.5 ab
Linuron + AL411F	0.75	0.10[b/]	63	53	65.5 bc
Linuron +SRC-101	0.75	0.09[c/]	58	57	82.4 abc

[a/] This is equivalent to 1 pt/125 gallons.

[b/] This is equivalent to 1 pt/A and is commercially available as Agway's Booster Plus E or Helena's Agrodex.

[c/] This is equivalent to 1 gal SCR 101/ 20 lb a.i. linuron.

[d/] Chenopodium album L.

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

Table 6. The effect of herbicide combinations with and without surfactant on soybean injury and weed control, Site 2, 1976.

Treatment	Herbicide Rate (lb/A)	Time of Application	Adjunct Conc. (% V:V)	Soybean June 14 Stand (%)	Soybean June 14 Vigor Reduction (%)	Weed Control July 29 Common Lambsquarter (%)	Weed Control July 29 Jimsonweed[b/] (%)	Weed Control July 29 Large Crabgrass (%)
1. Alachlor	1.0	at cracking	----	13	28	99	98	88
+ Dinoseb	+1.5							
+ Naptalam	+0.75							
2. Alachlor	1.0	at cracking	0.6[a/]	12	27	100	92	91
+ Dinoseb	+1.5							
+ Naptalam	+0.75							
+ AL411F								
3. Alachlor	1.5	pre	----	8	10	100	87	100
+ Metribuzin	+0.25							
4. Alachlor	1.5	pre	0.6[a/]	9	10	100	91	99
+ Metribuzin	+0.25							
+ AL411F								

a/This concentration is 1/3 gallon per acre and commercially available as Agway's Booster Plus E on Helena's Agrodex.

[b/] Datura stramonium L.

Table 7. The effect of several preemergence herbicides with and without surfactants on weed control in corn, Site 2, 1976.

Treatment	Herbicide Rate (lb/A)	Conc. Adjunct (%V:V)	Common Lambsquarter (%)	Large Crabgrass (%)	Fall[e] Panicum (%)	Corn Yield 26 Aug. (Bu/A)
control	-	-	0	0	0	8.3
atrazine	1.0	-	99	75	94	65.5b
alachlor	1.5	-	57	99	100	29.1c
atrazine + AL-411F	1.0	0.73	100	88	96	86.3ab
alachlor + AL-411F	1.5	0.73	46	99	100	13.5c
atrazine + alachlor	0.5 +0.75	-	95	94	98	72.3ab
atrazine + alachlor	1.0 +1.5	-	100	98	100	75.4ab
atrazine + alachlor + AL-411F[a]	0.5 +0.75 -	0.75	99	85	99	87.4ab
atrazine + alachlor + AL-411F	1.0 +1.5 +0.75	0.75	100	99	100	95.7ab
atrazine + alachlor + Amway[b]	0.5 +0.75 -	0.34	97	94	99	82.7ab
atrazine + alachlor + Amway[b]	1.0 +1.5 -	0.34	99	98	100	90.0 ab
atrazine + alachlor + WEX[c]	0.5 +0.75 -	0.10	99	94	99	103.5a
atrazine + alachor + WEX	1.0 +1.5 -	0.10	100	98	99	81.6ab
atrazine + alachlor + SRC 101[d]	0.5 +0.75 -	0.15	96	99	99	96.7ab
atrazine + alachlor + SRC 101	1.0 +1.5 -	0.30	95	100	100	96.2ab

[a] AL-411F is commercially available as Booster Plus and Agrodex and is applied at 1/3 gpa.
[b] Amway All Purpose Spray Adjuvants is a non-ionic surfactant applied at 1 pt/A.
[c] WEX is applied at 1 pt/125 gal solution.
[d] SRC 101 is applied at 1 gal/20 lb a.i. total herbicide.
[e] *Panicum dichotomiflorum* Michx.
[f] Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Table 8. The effect of preemergence applications of metribuzin alone and with SRC 101 on weed control and soybean yields, Site 3, 1976.

Treatment	Herbicide Rate (lb/A)	Adjuvant Conc. (% V:V)	Morningglory July 6 (Rating)[a] (%)[b]	Morningglory August 4 (Rating)[a] (%)[b]	Soybean Necrosis July 6 (Rating)[a] (%)[b]	Soybean Necrosis August 4 (Rating)[a] (%)[b]
1. Control	---	---	8.8 (10)	5.0 (85)	1.0 (0)	3.0 (5)
2. Metribuzin	.25	---	4.3 (89)	5.0 (85)	4.3 (11)	3.0 (5)
3. Metribuzin + SRC 101[c/]	.25	0.04	7.0 (65)	6.8 (67)	4.5 (12)	2.8 (4)
4. Metribuzin	.5	---	6.0 (75)	7.8 (40)	6.5 (30)	4.3 (11)
5. Metribuzin + SRC 101	.5	0.08	5.3 (83)	6.3 (73)	6.5 (30)	4.3 (11)
6. Metribuzin	1.0	---	4.3 (89)	6.8 (67)	7.8 (60)	6.8 (33)
7. Metribuzin + SRC 101	1.0	0.17	4.5 (88)	6.3 (73)	8.0 (68)	6.3 (28)
8. Metribuzin	2.0	---	2.0 (98)	3.0 (95)	8.8 (90)	8.5 (80)
9. Metribuzin + SRC 101	2.0	0.33	3.3 (94)	5.0 (85)	8.8 (90)	8.5 (80)
10. Metribuzin	4.0	---	1.8 (98)	1.3 (99)	9.0 (100)	9.0 (100)
11. Metribuzin + SRC 101	4.0	0.67	1.0 (100)	1.3 (99)	9.0 (100)	9.0 (100)
Bayes $LSD_{.05}$			2.0	2.9	0.6	1.6

[a]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%, 8=33%, 9=0%.

[b]The % is an approximation.

[c]Adjuvant was used at the rate of 1 gallon SRC 101 per 20 pounds a.i. herbicide.

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UPTAKE AND SOIL ACTIVITY OF HOE 23408[1/]

M. Schluter and W.Duke[2/]

Establishing alfalfa in conjunction with a companion crop can result in stand failures and poor alfalfa yields the seeding year, due to the strong competition by the companion crop. Alfalfa seeded without a companion crop is easier to manage and has a higher crude protein content. Due to these findings, there is an increasing trend toward clear seeding alfalfa, and this has required seeking new methods of weed control. One major problem in clear seeded alfalfa is annual grass weeds such as crabgrass (*Digitaria* spp.), foxtail (*Setaria* spp.) and barnyardgrass [*Echinochloa crusgalli* (L.) Beauv.] that enter the new establishment. Few products are currently available for annual grass control in clear seeded alfalfa other than EPTC (*S*-ethyl dipropylthiocarbamate) and benefin (*N*-butyl-*N*-ethyl-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine) whose uses are restricted to preplant applications that must be incorporated.

Research was conducted to investigate the potential for using HOE 23408 (methyl 2-[4-(2,4-dichlorophenoxy)phenoxy]propanote) in seedling alfalfa for annual grass control. The focus was on several environmental factors that affected activity. Leaching studies have indicated HOE does not readily move in the soil more than 1 cm. HOE applied preemergence at rates of 1 and 2 lb/A on soils that varied from .6 to 6.0% organic matter showed decreased control of barnyardgrass and large crabgrass [*Digitaria sanguinalis* (L.) Scop.] as the organic matter level increased. Postemergence applications of HOE in these same soils when the grasses were at the 2 to 3 leaf stage showed no difference in control. This was in agreement with data indicating that plant shoots are primarily responsible for the uptake of HOE when the chemical was applied postemergence. When 3/4 inch of simulated rainfall was applied immediately after a preemergence application of HOE, activity was greater than when no rainfall was applied after spray treatment.

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WEED CONTROL WITH AC 92,553[1/] IN CORN

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(ABSTRACT)

AC 92,553 ([N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine]) was applied by farmers on 4-10 acre plots of corn in New York, Pennsylvania, Maryland and Virginia in 1976 under an American Cyanamid Company sponsored Market Development Program. The weed control performance of AC 92,553 was compared with performance of their standard herbicide and untreated check areas.

AC 92,553 applied alone as a preemergence application controlled lambsquarters (*Chenopodium album* L.), velvetleaf (*Abutilon theophrasti* Medic.), redroot pigweed (*Amaranthus retroflexus* L.) and smartweed (*Polygonum pensylvanicum* L.). Grasses controlled by AC 92,553 were green foxtail (*Setaria viridis* L.), giant foxtail (*Setaria faberii* L.), yellow foxtail (*Setaria lutescens* Weigel) and fall panicum (*Panicum dichotomiflorum* Michx.).

When combined with atrazine or cyanazine, control of common ragweed (*Ambrosia artemisiifolia* L.) was reported.

If escapes of weeds such as velvetleaf or the foxtail spp. did occur, the weeds root systems were stunted by the AC 92,553 treatment reducing the competition provided by the weeds.

1/ PROWL® herbicide

2/ American Cyanamid Company, Princeton, New Jersey 08540.

EPTC + R-25788 MOVEMENT IN MARYLAND SOILS

C.A. Buzio and G.W. Burt[1]

ABSTRACT

Injury to corn (Zea mays L.) treated with EPTC (S-ethyl dipropylthiocar= bamate) + R-25788 (N,N-diallyl-2,2-dichloroacetamide) has been observed on occasion under field conditions. A possible reason for this is thought to be a different rate of leaching for the two chemicals in the soil. In this study, four Maryland soils (Galestown sand, Monmouth sandy loam, Beltsville silt loam, Manor gravelly loam) were tested for EPTC + R-25788 movement upon leaching.

Plastic columns 9.2 cm in diam. were filled with 8 cm of soil, and a 2 cm band of soil treated with 0.3 mmoles of EPTC + R-25788 (ratio 12:1) was placed on top. The columns were then leached with water and eight leachate fractions (200 ml each) were collected and partitioned in benzene for further gas chromatographic analysis.

It was found that for all four soils EPTC leached slower than R-25788; the ratio of these two in the leachate fractions changed from low (as all the R-25788 was leaching out) to high in the later fractions, when most R-25788 was already gone. The mobility of the two chemicals decreased in soils higher in organic matter and clay and lower in sand contents.

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SOIL pH AND TRIAZINE ACTIVITY IN NO-TILLAGE CORN AS AFFECTED BY NITROGEN AND LIME APPLICATIONS

M. G. Schnappinger, C. P. Trapp, J. M. Boyd, and S. W. Pruss

Abstract

The pH of the surface soil (0 to 1.2 cm) was reduced significantly throughout the growing season as a result of preplant or preemergence applications of nitrogen solution (33%N) to no-tillage corn (*Zea mays* L.). Less significant reductions in pH were noted in the subsurface soil (1.2 to 7.6 cm). Application of $NaNO_3$ had little effect on soil pH. Lime applied to the soil surface prior to planting neutralized the acidity produced by nitrification, thereby maintaining a neutral pH regardless of nitrogen application timing. Atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-*s*-triazine] and simazine [2-chloro-4,6-bis(ethylamino)-*s*-triazine] applied at 1.68 plus 1.68 kg/ha gave excellent weed control except where soils were most acid. Results of this study indicate that the acidifying reaction of nitrogen fertilizers on soil in continuous no-tillage corn may be responsible for the failure of some herbicides to provide acceptable weed control.

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QUANTIFICATION OF s-TRIAZINE LOSSES IN SURFACE RUNOFF: A SUMMARY

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ABSTRACT

A series of experiments was conducted over six years (1967 through 1972) using field erosion plots of 14% slope to evaluate runoff losses of chloro-s-triazines applied preemergent to conventionally planted corn (Zea mays, L.) and a methoxy-s-triazine applied as a dormant spray to alfalfa (Medicago sativa, L.). Runoff losses of atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine), GS13529 (2-chloro-4-ethylamino-6-tert-butylamino-s-triazine) and GS14254 (2-sec-butylamino-4-ethylamino-6-methoxy-s-triazine) were related to the amount, frequency and intensity of rainfall, rate of herbicide application, proximity of erosion events to the spray-date and herbicide solubility and dissipation rate in soil. Total losses of chloro-s-triazines in runoff water and soil sediment ranged from 2.5 to 5.0% of that applied (2.2 kg ai/ha). Range of loss at the 4.5 kg ai/ha rate was 2.2 to 5.7%. Considering the nature of the experimental site and the soil and crop management practices imposed on the slope, these losses were considered to be minor. However, soil and water losses were significant in these studies and emphasized the need for strict adherence to conservation measures on sloping cropland to control the loss of these entities as well as entrained agricultural chemicals. Results of an experiment conducted in 1972, the year of hurricane 'Agnes', showed that minimal incorporation of atrazine into the soil surface reduced losses significantly without an apparent reduction in weed control. Inclusion of an "oat-strip" at slope-base adjacent to the corn reduced losses recorded for the 2.2 and 4.5 kg ai/ha preemergent rates (3.5 and 1.2%), where oats were not seeded, by 91 and 66%, respectively, with no significant damage to the oat crop. Total losses of the methoxy-s-triazine from alfalfa were negligible, amounting to 0.02 and 0.03% of that applied (2.2 and 4.5 kg ai/ha) in 1971.

INTRODUCTION

Wise pesticide use has increased the production of food, feed and fiber in the U.S. markedly over the last three decades and has given the American consumer the quantity and quality of foodstuffs and a pleasingly aesthetic environment that make his life more fruitful and enjoyable. Despite these beneficial effects from pesticides, certain segments of society have stated that widespread pesticide usage has created havoc with our environment. Over the last 10 years herbicides have been implicated more strongly in

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discussions on potential non-point source discharge of agricultural chemicals as ultimate contaminants in non-treated areas. The transport vehicles involved in this discharge from treated land are surface runoff or vertical displacement through the soil by leaching with subsequent contact and distribution of the herbicide in or on adjacent land, impounded bodies of water, stream courses or ground-water supplies. Projections on "area yield" of herbicides and potential stream loadings in watershed areas encompassing a large acreage of agricultural land have been postulated without consideration of herbicide reaction and detoxication in soil commensurate with application rate and soil and crop management practices employed on the agricultural landscape. On the other hand, during this same span of time, little information had been published by agronomists and soil scientists on the ultimate fate of herbicides in soils particularly from the standpoint of characterizing the "runoff process" and the potential for downslope movement of herbicide residues in surface water and entrained sediment during specific erosion events induced by natural precipitation. Consequently, we began a series of studies at Penn State to collect some data in this area and it is my intention to summarize our findings in this paper, primarily confining my discussion to the first years data of each of four separate studies initiated in 1967, 1970, 1971, and 1972.

METHODS AND MATERIALS

Runoff studies were conducted on a Hagerstown silty clay loam of 14% slope using a set of field erosion plots. Plot-tiers were divided one from the other by steel barriers extending approximately 30 cm above and below the soil surface throughout the plot length. At slope-base, each tier was fitted with a trough and chute assembly which facilitated the transport of runoff water and entrained sediment into an enclosed collection facility where initial sampling of water and sediment phases was undertaken. Field sampling and laboratory processing of samples, including segregation of water and soil and residue analysis, are outlined in two published reports (1, 3). In each study where corn was planted conventionally (1967, 1970) and no conservation measures were used to reduce surface runoff, the site was managed to maximize the potential for herbicide loss at each rate applied. Corn rows were planted parallel to the slope using a moderate plant population (48,000 plants/ha). The soil surface was smoothed prior to planting to provide a surface for uniform erodibility and herbicides were applied at replicated, preemergent rates. Consequently, the site was "open-ended" since no physical impedance to downslope movement of water occurred from the top of each plot-tier to its base. These conditions established a high potential for herbicide loss in the erosive process. In 1967, atrazine was applied at seven rates (0, 0.6, 1.1, 2.2, 4.5, 6.7, 9.0 kg ai/ha) bracketing the recommended rate (2.2 kg/ha) for surface application to Pennsylvania soils. In 1970, atrazine and a related chloro-s-triazine, GS13529, were applied at two rates, 2.2 and 4.5 kg ai/ha. Control plots were also included. In addition, several of the plot-tiers were planted to alfalfa and in March, 1971, GS14254, a methoxy-s-triazine, was applied at the same two rates to the dormant crop and losses of this compound were subsequently determined throughout the growing season.

In 1972, several different treatments were introduced into the experimental design to study whether a slight incorporation of atrazine into the soil surface and seeding an "oat-strip" at slope-base (lower 10 m) abutting the corn crop would reduce loss of the parent compound. Also we were interested in evaluating whether water-transported residue contacting and reacting with soil in this untreated section would have any toxic effects on the oat crop. Atrazine was applied preemergent to corn at 2.2 and 4.5 kg ai/ha. Stripped and non-stripped tiers were included at each rate. These treatment combinations were repeated again except that atrazine was applied and incorporated into the soil surface (3 cm) before seeding.

In all studies, soil cores were collected periodically at specific depths from the surface to 24 cm to assay the rate of dissipation, movement and recalcitrant properties of the herbicides in this soil.

RESULTS AND DISCUSSION

Each yearly study involving the chloro-s-triazines was characterized by above average rainfall for the growing season and a different distribution each year. Rainfall was sufficient to induce 9, 13 and 12 erosion events during 1967, 1970 and 1972, respectively. In 1967 the first runoff collection (June 12) was made 23 days after atrazine application and the majority of the erosion events (5) occurred in July. In 1970, five erosion events were recorded within the first month following herbicide treatment and the first collection of runoff was sampled on May 25, six days after spraying. Rainfall associated with hurricane "Agnes" was responsible for inducing five erosion events during June, 1972 and the first collection was received on May 30, 8 days after spraying. The first erosion event is singled-out in the above discussion since its proximity to application date was found to be a significant parameter in determining the concentrations of herbicide in water and sediment phases. Other parameters which proved to be significant in regulating the concentration of herbicide in these two phases and ultimately the total amounts lost were: amount, frequency and intensity of rainfall, rate of herbicide applied, herbicide solubility and rate of herbicide dissipation in soil.

In general, concentrations of herbicide in runoff water increased with increasing application rate, were highest during the first erosion event and declined at a moderate rate with each successive collection throughout the growing season. Atrazine (solubility = 33 ppm) concentrations in runoff water collected from the first erosion event in 1967 at the 2.2 and 4.5 kg/ha rates were 0.8 and 2.0 ppm, respectively. In 1970, comparative concentrations were 2.3 and 4.5 ppm. Sediment concentrations in 1967 were 1.4 and 2.8 ppm; in 1970, 0.1 and 12.0 ppm, for the respective rates. Concentrations of GS13529 (solubility = 8.5 ppm) in the first collection of runoff water in 1970 were 0.8 and 1.8 ppm at the same two rates, respectively; in sediment, the concentrations were 0.3 and 32 ppm. These results illustrated that levels of chloro-triazines in the respective substrates increased with increasing rate of application and were greater the closer the storm event occurred to the spray date. Higher concentrations were detected in sediment in each study regardless of the chemical configuration of the herbicide, but it was clear from the data that the levels of an herbicide in water varied directly with its solubility, whereas levels detected in sediment varied inversely with solubility.

Total losses of atrazine in runoff water and soil sediment in 1967 and 1970 were 2.5 and 5.0% at the recommended application rate (2.2 kg/ha). Thus, the "area yield" was 0.06 and 0.11 kg/ha for each of the years. Amounts lost at the 4.5 kg/ha rate were 0.05 and 0.32 kg/ha. The total amounts of GS13529 lost in 1970 were 0.11 and 0.26 kg/ha at these two rates. More total herbicide was lost in runoff water than in soil sediment and amounts increased in general with increasing application rate. Despite the higher total amounts transported in surface water, more GS13529 was carried downslope in sediment than atrazine, illustrating again the solubility effect. Total herbicide losses were not considered excessive in light of the nature of the experimental site and soil and crop management practices employed during these studies. Whether concentrations and total amounts of herbicides in "surface flow" would ever exceed those reported here would depend on storm intensities and their proximity to application date. Higher concentrations would be conceivable if an intense storm induced erosion immediately following application. However, so many controlling variables exist between herbicide, soil, plant and climate that coupled with considerations of reaction and detoxication in soils, accurate predictions on surface loss become nearly impossible. The percent total losses reported in these studies seem to agree with those reported elsewhere, where losses of triazines in surface flow were evaluated under natural climatic conditions or where simulated rainfall of controlled rate was applied to different soil types. Therefore, the ranges reported herein might be considered average levels for a humid, temperate region.

The low "area yield" of atrazine to the erosive action of rainfall was largely due to the moderate rate of dissipation of this compound in soil over the different growing seasons. Analysis of soil cores collected from each plot showed that the majority of the atrazine applied at the recommended level reacted in the plow-layer and dissipated on the average 60 to 70% one month after spraying. By the end of the growing season, 90% dissipation was achieved. GS13529 was more residual earlier, exhibiting a 40% dissipation level after one month, but a comparable level to that of atrazine by the end of the growing season.

Although herbicide losses were low, soil and water losses were significant and demonstrated the need for sound conservation practices to combat erosion. In 1967, water lost to runoff ranged from 0.2 to 5.3 cm over the treatment sequence, a loss of 0.7 to 19.3% of the total rainfall recorded for the nine runoff-producing rains. Soil loss over this spectrum ranged from 0.4 to 21 t/ha (2). In 1970, runoff losses during one particular erosion event ranged from 17% of the incident rainfall for the check plot to 68% at the low rate of atrazine. Moreover, 10 t/ha of soil was lost at the low rate.

Losses of GS14254 from alfalfa sod were negligible. Little runoff and no sediment was collected. Concentrations of herbicide in runoff were very low despite the high solubility of this compound (620 ppm). Highest levels detected were 0.28 and 0.48 ppm at the two rates. These levels were detected in snow-melt, 11 days after treatment. Total losses were 0.02 and 0.03% of that applied. This methoxy-s-triazine was more recalcitrant than the chloro-s-triazines since only 71 and 68% of the applied amounts had dissipated by November, 1971.

Total loss of atrazine in 1972 in the combined substrates at the 2.2 kg/ha rate was intermediate (3.5%) between that found in 1967 and 1970. Inclusion of an "oat-strip" at the slope-base and slight incorporation of atrazine into the soil surface had a marked effect on total losses at this rate. "Stripping" reduced atrazine losses by 91%. Where atrazine was disked into the surface and no "oat-block" was included at slope-base, total loss was 0.94%. Therefore, incorporation alone had a significant effect on attenuating downslope movement of atrazine in runoff. Adding at "oat-strip" at the slope-base in conjunction with incorporation reduced losses by 65%. Interestingly enough, where atrazine was incorporated after spraying there appeared to be no significant reduction in weed control compared to the pre-emergent treated plots. Likewise, atrazine moving across and reacting with soil in this non-treated segment of the plot-tier did not have any adverse effects on the growth of this atrazine sensitive crop. Some atrazine toxicity symptoms were detected on oats growing at the border of the two plantings, but damage was chiefly limited to this small area. Since residues in runoff were lower where oats were planted, this buffer area had a "diluting or attenuating" effect on atrazine moving as dissolved molecules in water, adsorbed molecules on sediment or suspended, unreacted particles in the water phase.

This synopsis of results from several runoff studies conducted in years of different rainfall spectra during the growing seasons of corn and alfalfa makes it clear that where wisely used, recommended dosages of an herbicide are applied to the landscape, the potential "area yield" of herbicide in an average season as a result of surface runoff is low. Where sound soil and crop management practices are used, potential 'loading of streams and impounded bodies of water or contamination of adjacent non-treated lands will be minimal or of minor consequence. In light of past and current speculations and charges on non-point sources of pollution, it seems imperative from an agronomic, environmental, economic and aesthetic viewpoint that conservation measures be emphasized and their use encouraged to a greater degree than exists today on the agricultural landscape.

LITERATURE CITED

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THE EFFECTS OF SIMAZINE TREATMENTS ON THE BENTHIC FAUNA OF MORIANE LAKE, MADISON COUNTY, NEW YORK

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ABSTRACT

The CIBA-Geigy Chemical Company treated Moriane Lake, Madison Co., N. Y. with Simazine (Princep 80W®, or Aquazine 80N®) [2-chloro-1,6-bis (ethylamino)-s-triazine] to control undesirable blue-green algal populations in 1974 and 1975. I was to determine the effects of these treatments on the benthic fauna. The lake is not completely satisfactory for this type of analysis because typical benthic communities are not present, possibly because of previous applications of copper sulphate ($CuSO_4$) and Diquat (1,1'-ethylene-2,2'-depyridylium dibromide). Simazine applications theoretically equalling concentrations of 0.25 and 0.5 ppmw after dispursal throughout the epilimnion did not have an important effect on profundal arthropod (Chironomidae) biomass. However, applications of 0.5 ppmw (after dispursal throughout the epilimnion) did have debilitating effects on littoral molluscs. Populations of arthropod and mollusk species that normally reproduce throughout the summer tended to recover by the spring following treatment. Simazine applications of 0.5 ppmw had severely debilitating effects on sublittoral populations of the viviparus snail, Viviparus georgianus (Lea), killing all immature individuals. At concentrations of 0.25 ppmw populations were not as affected because newly born snails did not sustain high mortality. Short term toxicity tests conducted in the laboratory resulted in no mortality to mollusks in concentrations of Simazine up to 5.0 ppmw. It is hypothesized that synergestic reactions with substrate or dying algal cells were responsible for in situ mortality of benthos.

INTRODUCTION

In 1974 and 1975 CIBA-Geigy applied Simazine to Moraine Lake (Madison Reservoir), Madison Co., N. Y., to determine its action as an algacide in dimictic lakes. The herbicide was applied over littoral areas in such a way that concentrations of 0.5 ppmw (1974) and 0.25 ppmw (1975) were theoretically attained throughout the epilimnion, due to diffusion and mixing, after several hours. It was my responsibility to evaluate these applications on the benthic fauna.

Lake Moriane has a surface area of approximately 94 ha with a maximum depth of 13 m. A rather high shore development combined with a diversity of substrate types indicates a potentially high diversity of littoral, benthic organisms despite an advanced trophic condition. The lake drains south via the Chenango River into the North Branch of the Susquehanna. Chemical characteristics during 1974 were recorded by Oglesby (3). They are typical of local dimictic lakes of this morphology, with the exception of rather high concentrations of phosphorus.

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The benthic fauna (Table 1) is unique for several reasons. Many of the mollusks present are normally not encountered in the Susquehanna drainage basin, but are common in the Oswego watershed. They apparently were given access to Moriane Lake when the Chemung Canal was joined to the Erie Canal during the middle 1800's. Atypically, the littoral biomass was made up almost entirely (96%) of Mollusca (Fig. 1). The profundal areas average 90% Arthropoda (Fig. 2). The more normal situation in these types of waters is illustrated by Otsego Lake (Fig. 3 and 4) where the littoral biomass is about equally divided between the Arthropoda and Mollusca, and the profundal biomass is dominated by Annelids. The relationship between total benthic biomass and depth in Moriane Lake appears typical for lakes with high hypolimnion oxygen deficits (Table 2).

On 22 July 1974 the development of a bloom of blue-green algae had reached the point where a quantity of Simazine, equivalent to a concentration of 0.5 ppmw throughout the epilimnion waters, was applied. The following year, conditions were appropriate for application on 17 July. At that time the equivalent of 0.25 ppmw Simazine throughout the epilimnion was applied. The latter concentration was utilized because damage had occurred to rooted aquatic plants (predominately eel grass [*Vallisneria americana*, Michx.]) after the 1974 treatment.

Changes in water quality correlated with the application of Simazine included an increase of the pigment phaeophytin in the bottom waters which was attributed to the decomposition of algal cells (3). This indicates the presence of other metabolytes of decomposing blue-green algae which are potentially toxic to many benthic organisms.

METHODS OF STUDY

On the date of first application of Simazine (22 July 74) collections were made in 6 locations throughout the lake (Fig. 5). 1: The control; in an area separated by a causeway, north of the main basin of the Lake, where no algacide was applied. In that area a profundal sample was collected at about 5 m in depth using an ekman dredge. 2: Three profundal ekman samples at stations #1, #3, and #6 (8m, 5m, and 15m in depth respectively); in the main basin. 3: A 1/2 m^2 littoral sample at Sunny Point; in 0.5 m of water on a rocky shore, and lastly 4: a 1/2 m^2 sub-littoral collection of *V. georgianus* (4.5 m) taken by divers between Snake Island and the eastern shore. Sampling was repeated in each area on 25 July 74, 8 Aug 74, 13 Sept 74, 21 Oct 74, and 6 June 75.

The control and all 3 profundal samples were treated in the following manner; 1. The substrate was removed from the dredge and placed into a plastic tub. 2. Approximately eight L of 70% ethyl alcohol were added to bottom materials to fix any included organisms. 3. Ten ml of rose-bengal dissolved in 95% ethyl alcohol was added to stain any organisms present. 4. The sample was then mixed to form a slurry and placed in sealed, labelled containers for transportation back to the laboratory. 5. Immediately upon return to the laboratory the contents of the containers were diluted with an equal volume of 70% ethyl alcohol for long term fixation.

TABLE 1. Taxa collected in Moriane Lake.

PHYLUM	CLASS	LOWEST TAXA DETERMINED	COMMON NAME
Arthropoda	Crustacea	Astacidae	crayfish
"	"	Ostracoda	seed shrimp
"	"	Gammaridae	scuds
"	"	*Hyalella*	"
"	"	*Asellus*	aquatic sow bugs
"	Hydracarina	Hydracarina	water mites
"	Insecta	Ceratopogonidae	punkies
"	"	Chironomidae	midges
"	"	*Chaoborus*	phantom midges
"	"	Hydroptilidae	caddis flies
"	"	*Polycentropus*	" "
"	"	*Helichus*	beetles
"	"	*Caenis*	may flies
"	"	Chloroterpes	" "
"	"	*Stenonema*	" "
"	"	*Tetragoneura*	dragon flies
"	"	Coenagrionidae	damsel flies
"	"	Plecoptera	stone flies
"	"	*Sialis*	alder flies
Annelida	Oligochaeta	Oligochaeta	aquatic earthworms
"	Hirudinea	*Helobdella*	leeches
Mollusca	Bivalvia	*Pisidium*	finger-nail clams
"	Gastropoda	*Physa*	bladder snails
"	"	*Helisoma*	rams-horn snails
"	"	*Gyraulus*	" " "
"	"	*Amnicola*	hydrobiied snails
"	"	*Viviparus*	viviparus snails
"	"	*Goniobasis*	unicorn snails
Platyhelminthes	Turbellaria	Planaridae	flatworms
Nematoda		Nematoda	roundworms
Coelenterata	Hydrozoa	*Hydra*	hydra
Ectoprocta		Ectoprocta	bryozoa

TABLE 2. Pretreatment benthic biomass at selected depths in Moriane Lake.

Depth	Biomass (g/m^2)
0	90.96
5 m	5.53
8 m	4.83
15 m	5.32

Figure 1. Composition of pretreatment littoral benthic biomass in Moriane Lake.

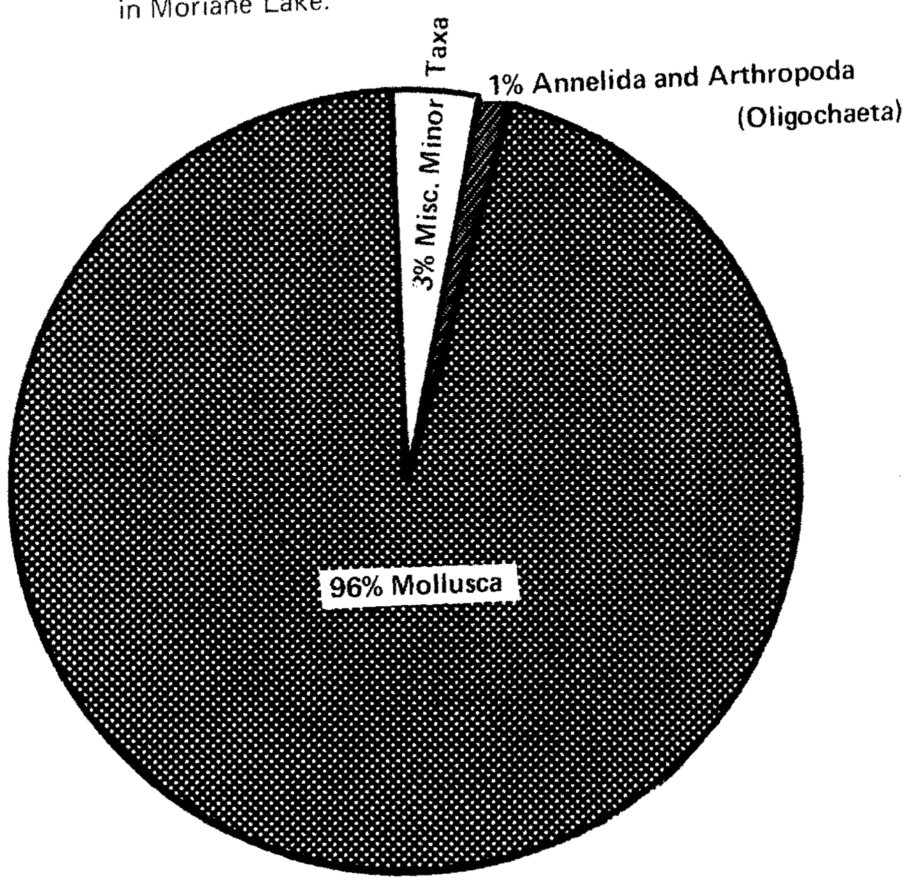


Figure 2. Composition of pretreatment profundal benthic biomass in Moriane Lake.

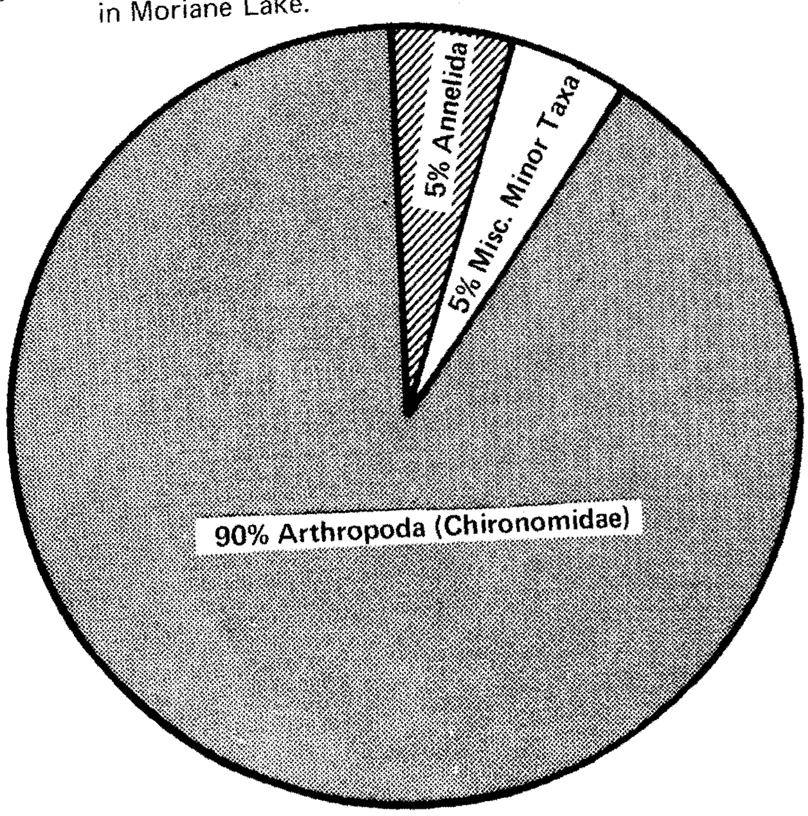


Figure 3. Composition of littoral benthic biomass in Otsego Lake.

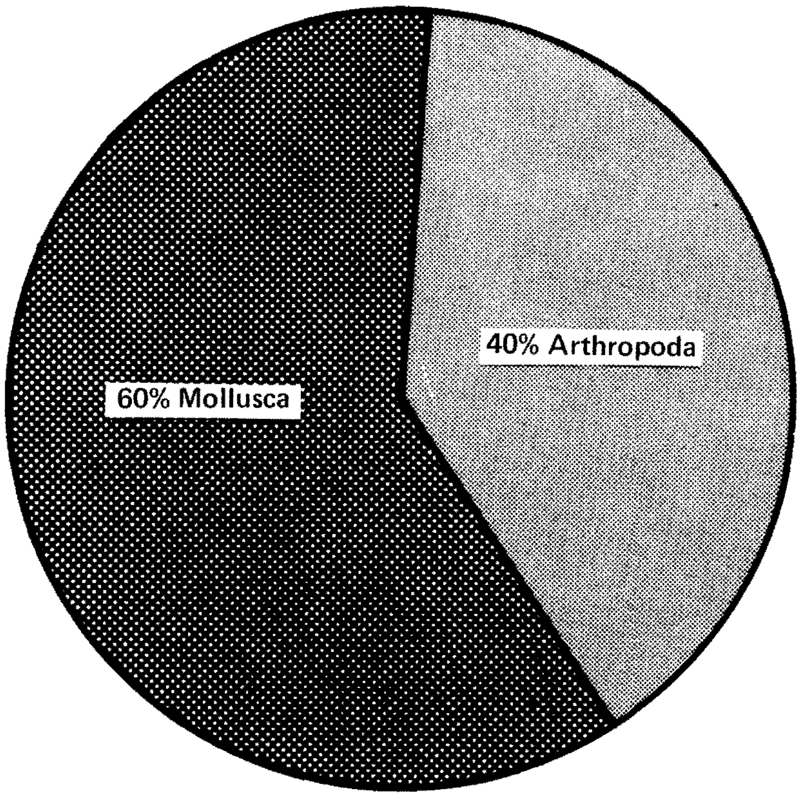
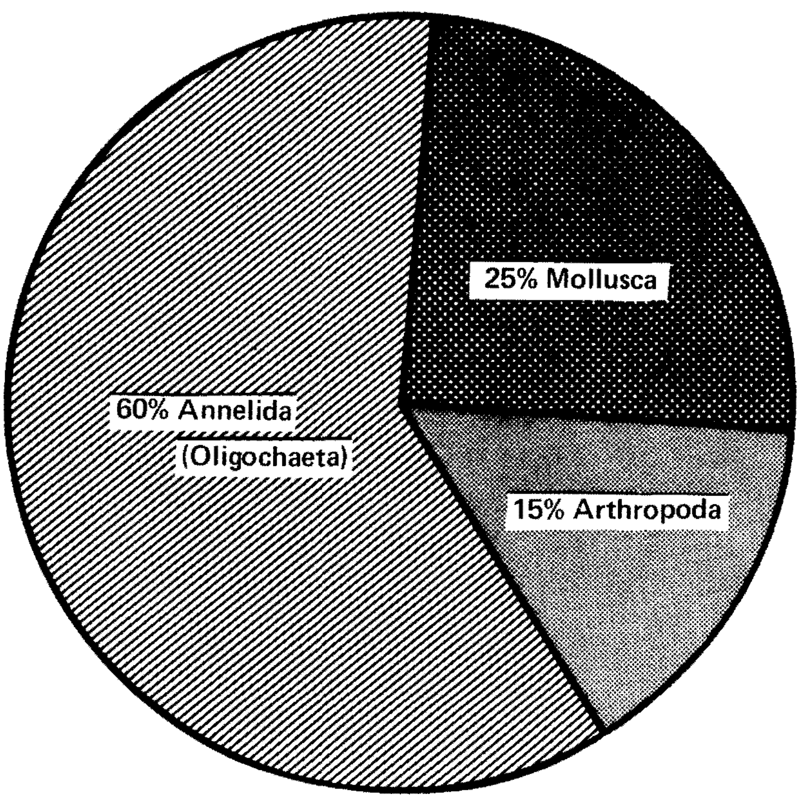
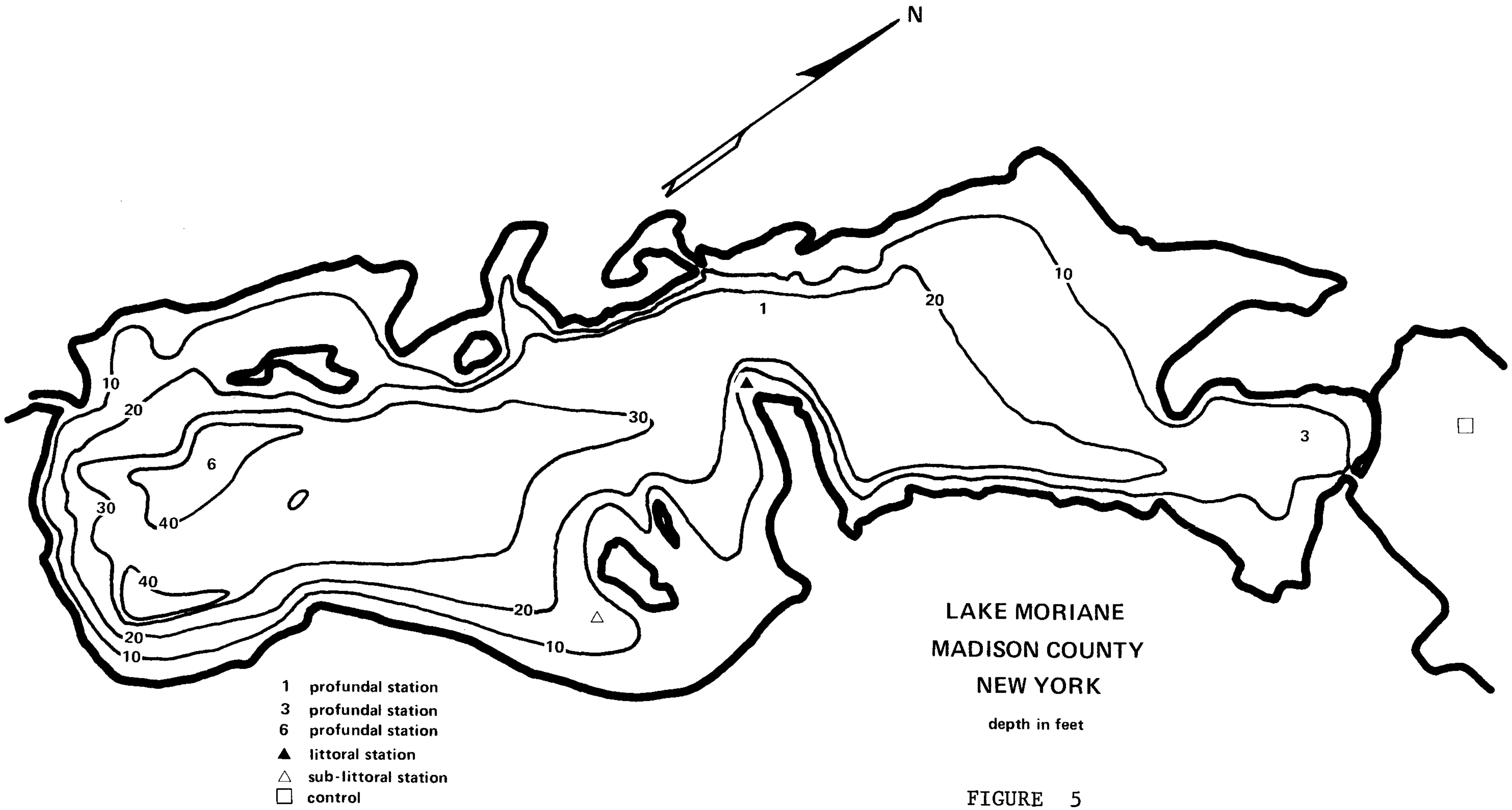


Figure 4. Composition of profundal benthic biomass in Otsego Lake.




N
10
20
1
10
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6
40
30
40
20
10
20
10
3
LAKE MORIANE
MADISON COUNTY
NEW YORK
depth in feet
1 profundal station
3 profundal station
6 profundal station
▲ littoral station
△ sub-littoral station
□ control

FIGURE 5

The 1/2 m^2 littoral sample was taken by inserting a galvanized, sheet metal frame into the substrate. All surficial rocks and sediments were removed by hand and placed in a plastic tub. About eight L of 70% ethyl alcohol and 10 ml of the rose-bengal solution were added. Back at the laboratory all rocks larger than 2 cm in diameter were scraped to remove aufwuchs and placed in sealed bottles for future processing. The 1/2 m^2 sub-littoral sample of Viviparus was collected by a diver who placed the 1/2 m^2 frame on the substrate in the collection area. All specimens of Viviparus were individually picked from the bottom enclosed by the frame, placed in a specimen container and brought to the surface. The container was then filled with 95% ethyl alcohol, labelled and returned to the laboratory.

On 17 July 75, the date of the second application of Simazine, samples were taken as in 1974, except that only one profundal sample (#3) was collected to reduce expenses. Further sampling, in like manner, took place on 17 July 75, 21 July 75, 8 Aug 75, 15 Sept 75 and 24 Oct 75.

Samples taken both years were processed identically in the laboratory. A small amount of substrate (about five ml) was placed in a white enamel pan. The pan was then flooded with a sugar-water solution (1). The organisms, less dense than the solution and stained red by the rose-bengal, would then float to the surface, be grasped by forceps or collected by pipette and placed in vials. They were then determined to the lowest taxa economically feasible and weighed by traditional methods. Short term toxicity tests in the laboratory were conducted using standard methods.

RESULTS

Tables 3 and 4 indicate the biomass (wet wt./m^2) in the control area during 1974 and 1975. The Chironomidae were the most common organisms. They became less abundant in 1975 as compared with 1974. That apparent trend is not evident in Tables 5 and 6, representing profundal station 1 during those two years, but may be indicated in Tables 7 and 8, representing profundal stations 3 and 6 during 1974. If the control has any validity, it would appear that the total profundal biomass, made up of 95% Chironomidae (Fig. 5) was not affected by Simazine.

However, there are obvious alterations in the littoral community (Table 9, 10). In 1974 there was a decline in total littoral biomass from 22 July to 25 July of more than 60%. Although many organisms were effected, the greatest impact was on the unicorn snail Goniobasis livescens (Menke), a prosobranch that composed 96% of the biomass in the sample area.

By spring of 1975 the population had recovered, due in large part to late summer reproduction. The application of 0.25 ppmw on 17 July 75 resulted in the reduction of total littoral biomass by 25%. By autumn 1975 the total littoral biomass was approximately 75% of the pretreatment biomass in July 1974.

TABLE 3. Control (Profundal) gms/m^2.

Taxa	7/22/74	7/25/74	8/8/74	9/13/74	10/21/74
Hydra	.0077	-	-	-	-
Bryozoa	-	.0096	-	-	-
Planariidae	-	-	-	-	.0192
Oligochaeta	.4481	.1058	.0538	.0096	.9519
Helobdella	.0519	.9423	-	.0250	.1827
Ostracoda	.0019	.0096	.0173	.0346	-
Chironomidae	8.2404	6.6423	8.2403	2.2481	1.0481
Chaoborus	.3077	.1923	.1212	.8077	1.3750
Ceratopogonidae	-	.0192	.0269	.0250	-
Pisidium	-	.5769	-	-	-
Misc.	.3731	-	.0019	.1058	-
Total	9.437	8.537	7.459	3.465	3.865

TABLE 4. Control (Profundal) gms/m^2.

Taxa	6/6/75	7/17/75	7/21/75	8/8/75	9/15/75	10/24/75
Hydra	.0058	-	-	-	-	.0019
Bryozoa	.0077	.0019	-	-	-	.0192
Nematoda	.0019	-	.0115	.0019	.0019	.0154
Oligochaeta	.0769	.0019	.2154	.0596	.1231	.0885
Helobdella	-	.0538	-	.1058	-	-
Ostracoda	.0019	.0038	.0135	.0462	.2250	.3365
Asellus	-	.0019	-	.0519	-	-
Hyalella	.0038	-	-	-	-	-
Hydracarina	.0019	-	.0019	-	.0019	.0135
Caenis	-	.1096	-	.1423	-	-
Tetragoneuria	-	2.9058	-	-	-	-
Hydroptilidae	-	.0079	-	-	-	-
Chaoborus	.1635	.0731	.1788	.4404	.5558	.3827
Chironomidae	2.9060	.0481	.3673	.1654	1.8380	.3135
Ceratopogonidae	.1808	-	.0077	.0154	.1269	.2250
Physa	-	-	-	.0212	-	-
Planorbidae	-	-	-	.0385	-	-
Pisidium	-	-	-	.1154	.0635	.0865
Misc.	-	-	.0096	.0077	.0288	.0308
Total	3.3502	3.2078	.8057	1.2136	2.9649	1.5135

TABLE 5. Station #1 (Profundal) gms/m^2

Taxa	7/22/74	7/25/74	8/8/74	9/13/74	10/21/74
Oligochaeta	.0865	.1385	.1115	.1615	.4423
Hirudinea	-	1.1077	.7808	.7231	.3635
Hydracarina	-	.0058	-	.0058	.0096
Ostracoda	.0019	.0038	.0173	.0057	-
Chironomidae	3.8650	10.7461	5.0346	2.9462	5.0385
<u>Chaoborus</u>	.7231	1.3231	.3115	.8500	.3385
Nematoda	.0135	-	-	-	-
Total	4.6900	13.3250	6.2557	4.6923	6.1924

TABLE 6. Station #1 (Profundal) gms/m^2.

Taxa	6/6/75	7/17/75	7/21/75	8/8/75	9/15/75	10/21/75
Hydra	-	.0635	.0019	-	-	-
Bryozoa	-	.0019	-	-	-	.1462
Nematoda	-	.0038	.0019	.0019	.0231	.0096
Oligochaeta	.2827	.4115	.4173	.2154	.2038	.4577
Hirudinea	.1885	-	-	-	-	-
Ostracoda	-	-	.0019	.0615	.0231	.0577
Hyalella	-	-	-	.0077	-	-
Hydracarina	.0058	-	-	.0038	.0154	.0096
Baetidae	-	-	-	.0654	-	-
Hydroptilidae	-	-	-	-	.0077	-
Leptoceridae	-	-	-	-	-	.0038
Chaoborus	.3712	.6519	.1923	.2000	.1692	.1096
Chironomidae	10.3630	13.3340	13.8730	8.6346	.0808	5.2308
Ceratopogonidae	.0096	-	-	.0231	.0038	.0577
Misc.	.1769	.0269	.0808	.0115	-	-
Total	11.3977	14.5035	14.5691	9.2249	.5269	6.0827

TABLE 7. Station #3 (Profundal) gms/m^2.

Taxa	7/22/74	7/25/74	8/8/74	9/13/74	10/21/74
Oligochaeta	.1077	.1923	.0077	.0500	.0712
Hirudinea	.2038	.1884	.2481	.0462	-
Pisidium	-	.3462	.3462	.2865	.0404
Hydracarina	-	.0019	.0096	-	.0019
Amphipoda	.0077	-	-	.0058	-
Ostracoda	-	.0058	-	.0019	-
Asellus	-	.2192	-	-	-
Chironomidae	5.1442	2.1115	2.3923	3.7904	2.9019
Chaoborus	.0327	.0808	.0038	.5923	.3250
Ceratopogonidae	.0346	-	-	-	-
Sialis	-	-	.2750	-	-
Misc.	.0058	.0019	.0577	.0038	.0269
Total	5.5365	3.1480	3.3402	4.7769	3.3673

TABLE 8. Section #6 (Profundal) gms/m^2.

Taxa	7/22/74	7/25/74	8/8/74	9/13/74	10/21/74
Oligochaeta	.0462	-	.0038	-	.0019
Hirudinea	.1981	.0615	-	.0808	-
Nematoda	.0019	-	-	-	-
Ostracoda	.0115	.0288	.0019	-	-
Chironomidae	2.1346	.3827	.4212	.0212	.3635
Chaoborus	2.2962	1.2500	1.8038	.9904	8.4212
Stenonema	-	-	-	-	.2096
Misc.	.2269	.0077	.0058	.0096	-
Total	4.9154	1.7307	2.2365	1.1020	8.9943

TABLE 9. Littoral Station - Sunny Point gms/m^2.

Taxa	7/22/74	7/25/74	8/8/74	9/13/74	10/21/74
Hydra	-	-	-	.0160	.0324
Planariidae	.1956	-	-	.0560	-
Oligochaeta	.6564	.2764	.6372	2.4740	.3364
Hirudinea	.0020	-	-	.6840	.0239
Goniobasis	85.4204	20.5168	44.3172	52.3720	69.1356
Viviparus	1.5896	-	-	1.4696	-
Amnicola	.5012	-	-	.4604	.4703
Physa	-	-	-	.4456	.1044
Gyraulus	.0800	-	-	-	.0304
Pisidium	.0536	-	-	.0280	.0444
Hydracarina	.0024	-	-	.0004	.0004
Astacidae	-	-	-	-	2.0140
Hyalella	.0392	.0068	.0180	.0004	.0004
Chironomidae	2.2940	3.5280	2.6704	.5400	1.0744
Ceratopogonidae	-	-	.0012	.0020	.0008
Plecoptera	-	-	-	-	.0004
Baetidae	-	-	-	.0052	-
Chloroterpes	.0720	.0128	-	-	-
Heptageniidae	.0016	.0076	.0060	-	-
Stenonema	.0420	-	-	.0480	-
Trichoptera	-	-	.0024	-	.0016
Helichus	.0160	-	-	-	-
Dryopidae	-	-	.0244	-	-
Misc.	.0032	-	-	.0128	.0380
Total	90.9690	24.4640	47.6840	58.7160	73.3700

TABLE 10. Littoral Station - Sunny Point gms/m^2.

Taxa	6/6/75	7/17/75	7/21/75	8/8/75	9/15/75	10/24/75 high H_2O
Hydra	.0308	.0148	.0036	.0060	.0096	.0800
Planorbidae	.0008	.0048	.0196	.0172	.0092	.2784
Bryozoa	-	-	-	-	-	.0192
Nematoda	-	.0004	-	-	-	.0008
Oligochaeta	3.2592	4.6976	2.7744	1.2220	2.6800	.7196
Hirudinea	.2160	2.0748	.8580	.9360	-	.0664
Physa	2.8604	.4460	-	.1664	.1924	.0292
Helisoma	-	1.7440	-	-	-	-
Gyraulus	.0584	-	-	-	-	-
Viviparus	3.0432	3.5156	11.1508	.6708	1.1860	-
Goniobasis	119.8100	110.5680	72.9140	60.3160	65.7890	18.2670
Amnicola	-	-	-	.0156	-	-
Pisidium	.3792	.0848	.0256	.0580	.1824	.0024
Hyalella	.0040	.0012	.0200	.0172	.0004	.0048
Gammaridae	-	.0016	-	-	-	-
Ostracoda	-	.0008	-	.0008	.0016	.0008
Hydracarina	-	.0012	.0008	.0008	.0004	.0068
Heptageniidae	.0004	.2368	-	.0052	-	-
Baetidae	.5152	.0896	.1012	-	-	-
Coenagrionidae	.1152	-	-	-	-	-
Sialis	-	.0112	-	-	-	-
Polycentropus	-	-	-	.0028	-	-
Hydroptilidae	-	-	.0056	-	.0020	-
Leptoceridae	-	.0008	.0048	.0012	-	.0028
Chaoborus	.1635	.0012	-	-	-	.0200
Chironomidae	2.9060	6.1884	4.7296	4.8160	.1404	.0576
Ceratopogonidae	.1808	-	.0004	-	-	-
Misc.	.0600	.2356	.1692	.0068	.0116	.0156
Total	130.8600	129.9400	92.7800	68.2600	70.2000	19.5700

The sublittoral community of *V. georgianus* was almost eliminated after the 1974 application of Simazine (Table 11). Adults aborted young and all individuals were very lethargic 2 days after treatment. It appeared that 100% of the immature specimens were killed. As is typical of this species no further reproduction took place during the summer. The 1975 application of 0.25 ppmw did not result in high mortality and by autumn the population had increased beyond its 1974 pretreatment density.

Tables 12 and 13 summarize total benthic biomass throughout the lake, including the control, during the period of study.

DISCUSSION

The unusual distribution of faunal elements in Moriane Lake results because of the essential lack of entire taxa; Arthropod groups in the littoral areas and Annelids in the profundal substrates. This may be the result of previous pesticide treatments. According to Kastens (2), 1 gal. of Diquat/surface acre (1 L/ha) were used to treat the lake in 1972 and 1973. During the same period a total of 2,157 lbs. (*ca* 10 x 10^5g) of copper sulfate were applied. The absence of these taxa is unfortunate because it is impossible to ascertain the effects of the Simazine application on groups that were missing before the experiment was initiated.

Despite high mortality in the lake, preliminary data from short-term toxicity tests on *Goniobasis* and *Viviparus* in the laboratory indicate that neither genera are adversely affected by Simazine concentrations up to 5 ppmw. It is hypothesized that herbicide-substrate interactions occured in both habitats that had negative effects on these populations.

It is also possible that the littoral populations of *Goniobasis* were sensitive to synergestic effects of the Simazine application in Moriane Lake because of their total dependence for food on a 1-3 mm thick layer of blue-green benthic, encrusting algae that covers the cobbles that make up the substrate in the littoral environment. As this flora decomposes, organic compounds are released that are potentially toxic to snails. The sublittoral *Viviparus* population may also have been severely stressed by synergestic effects as dying algal cells rained into this environment from the epilimnion waters and then were ingested.

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ACKNOWLEDGEMENT

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TABLE 11. Sublittoral census of Viviparus georgianus in Moriane Lake.

Date	Individuals/m^2
7/22/74 (treatment)	72
7/25/74	24
8/8/74	8
9/13/74	8
10/21/74	-No Data-
6/6/75	-No Data-
7/17/75 (treatment)	32
7/21/75	24
8/8/75	24
9/15/75	84
10/24/75	-No Data-

TABLE 12. Total Biomass, 1974 gms/m^2.

Station	7/22/74	7/25/74	8/8/74	9/13/74	10/21/74
Control	9.437	8.537	7.459	3.465	3.865
Profundal #1	4.838	13.327	6.304	4.700	6.192
#3	5.537	3.148	3.402	4.787	3.521
#6	5.327	1.785	2.238	1.150	8.996
Littoral	90.969	24.464	47.684	58.716	73.370

TABLE 13. Total Biomass, 1975 gms/m^2.

Station	6/6/75	7/17/75	7/21/75	8/8/75	9/15/75	10/24/75
Control	3.350	3.208	.806	1.214	2.965	1.514
Profundal #1	11.398	14.504	14.569	9.225	.527	6.083
Littoral	130.857	129.940	92.777	68.258	70.205	invalid data high water 19.572

COMPETITION BETWEEN CORN AND CRABGRASS AND CORN AND LAMBSQUARTERS AS INFLUENCED BY N AND K LEVELS AND SPACINGS

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ABSTRACT

A field experiment was designed to study competition between field corn (*Zea mays* L.) and large crabgrass (*Digitaria sanguinalis* L. Scop.) and common lambsquarters (*Chenopodium album* L.). Corn and weeds were grown both alone and in association at a constant level of applied phosphorus and varying levels of applied nitrogen and potassium. 150 lb/A P_2O_5 (46% superphosphate) was applied to all plots, N (ammonium nitrate) at 50, 100, or 200 lb/A and K_2O (muriate of potash) was applied at 60 or 240 lb/A to individual plots. Five corn rows, 36 inches apart, were planted in all corn and corn plus weed plots. In combination plots weed seeds were planted at corn seeding within the second corn row or between the third and fourth and fourth and fifth corn rows to study the effects of spacing on competition.

Increasing levels of either N and K generally increased the early growth of the corn to a greater degree than that of the weed species although high K appeared to have a greater effect on early corn growth than high N levels. Earlier increases in growth gave the corn a competitive advantage over the weeds which was reflected in higher corn yields from combination plots receiving more K and N fertilizer. An increase in N levels was more effective in raising corn yields at lower than at high K. Increasing N levels from 50 to 100 lb/A produced greater yield increases than did an N increase from 100 to 200 lb/A. Where corn was growing in association with lambsquarters planted within the corn row it was found that increasing N at high K actually depressed corn yields. At 240 lb/A K there was a 10% reduction in corn yield as nitrogen levels were increased from 50 to 100 lb/A and a 20% additional yield reduction when nitrogen levels were increased from 100 to 200 lb/A. These reductions were accompanied by a 25% and 45% increase in lambsquarters yield, respectively compared to the 50 lb/A rate. In plots where weeds were growing alone nitrogen also increased weed yield to a greater degree at high K than at low K. At 240 lb/A K yields of crabgrass and lambsquarters were increased by averages of 25% and 3% respectively when N levels were increased from 50 to 200 lb/A, while at 60 lb/A K yields of both species peaked at 100 lb/A N.

Lambsquarters and crabgrass yields were at least twice as high when they were grown between the corn rows than when grown within the row but the consequence in corn yield differed between the two species. Overall corn yields were reduced to a greater degree by the presence of lambsquarters within the row than between rows, while crabgrass produced similar reductions in the between row spacing at the high potassium level. The former effect could be attributed to increased competition during early growth and the latter effect might be due to the ability of crabgrass to tiller profusely and root at the nodes, thus producing a denser and more extended root system than that of the lambsquarters.

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DIFFERENTIAL RESPONSE OF TOMATO AND LAMBSQUARTER TO POTASSIUM LEVEL

Peter L. Minotti[1]

ABSTRACT

The response of lambsquarter (*Chenopodium album* L.) and tomato (*Lycopersicon esculentum* Mill. cv. New Yorker) was characterized when the two species were grown at various levels of K in sand culture under "Metalarc" lights in the greenhouse. Lambsquarter required greater amounts of K for optimum growth. The critical K concentration (that giving approximately 90% of maximum growth) of either the nutrient media or plant shoots was twice as high for lambsquarter. At all 5 K levels employed, lambsquarter shoots contained a greater percentage of dry matter and a greater K concn in that dry matter than did tomato shoots. Total plant accumulation of K per unit of root mass was higher for lambsquarter at low to moderate K levels but equal for the species at high K levels. Lambsquarter contained more K and N per unit of fresh weight and also more Ca and Mg at the lower to moderate K levels. At high levels of K lambsquarter contained less Ca and Mg because these cations were more severely depressed by K uptake in lambsquarter. Both species contained similar amounts of P per unit of fresh weight although the P concn of dry matter was noticeably higher for tomato, particularly in regard to roots.

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DIFFERENTIAL RESPONSE OF TOMATO AND LAMBSQUARTER TO P LEVELS AND N SOURCE[1]

David H. Picha and P. L. Minotti[2]

ABSTRACT

The early growth response of tomato (Lycopersicon esculentum Mill. cv. Jetstar) and lambsquarter (Chenopodium album L.) was characterized when the two species were grown alone and in competition at various levels of P and at varying ratios of NO_3^--N:NH_4^+-N (total media N level constant) under "Metalarc" lights in the greenhouse.

Tomato required higher amounts of P for optimum growth than did lambsquarter and the concn of P in tomato dry matter was greater. When the species were grown together in competition the ratio of lambsquarter weight to tomato weight increased with decreasing P concn of the media. Root:shoot ratios were higher for lambsquarter and this ratio increased with decreasing P.

Growth of both species were severely depressed by exclusively NH_4^+-N but lambsquarter was markedly more tolerant to increasing NH_4^+:NO_3^- ratios. Thus, when the species were grown together the ratio of lambsquarter to tomato increased as a greater proportion of the total N was supplied in the NH_4^+ form. On a dry matter basis total N concn of shoots was higher for lambsquarter while N concn of roots was higher for tomato. Increased proportions of NH_4^+-N increased the N concn of tomato roots and shoots and markedly decreased the percentage of tissue N in the NO_3^--N form. Although increasing ratios of NH_4^+:NO_3^- also increased the N concn of lambsquarter shoots the reduction in tissue NO_3^- by NH_4^+ was much less pronounced suggesting that at least part of lambsquarter's superior tolerance to NH_4^+ may reside in its capacity to still absorb appreciable NO_3^- in the presence of relatively high NH_4^+ concentrations.

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THE EFFECT OF LIGHT ON GALINSOGA CILIATA ACHENE GERMINATION

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ABSTRACT

Galinsoga ciliata (Raf.) Blake achenes were tested to determine if there is a light requirement for germination. The achenes were collected on three dates in Willington, Connecticut and stored in the dark. Germination tests were conducted in a controlled environment chamber. In the light the germination range was 94-98% compared to 1-15% germination in the dark. This shows a positive germination response in the light.

INTRODUCTION

Galinsoga ciliata (Raf.) Blake is a difficult weed to control in some crops; particularly onions, cole crops and tomatoes. It is resistant to most of the herbicides that are registered for use on these crops (1). The achenes germinate continuously over many months usually from April through October, varying yearly with weather. More detailed study of environmental effects will aid in its control.

Prior research has been inconclusive with respect to the effect of light on germination of Galinsoga ciliata achenes. If achenes were placed on the soil surface in the dark, and the pots remained in the dark, no germination was observed. If the pots were moved to the light after imbibition some germination occurred. When germinated in petri dishes it was found that achenes in the same seedlot varied in their light requirement. Germination in the dark was often equal to the germination in the light, and in some seed batches there was better germination (1,2).

Tests were conducted at the University of Connecticut Plant-Water Relation Laboratory in North Coventry, Connecticut during September and October, 1976. The objective of these experiments was to determine the effect of light on the germination of Galinsoga ciliata achenes.

MATERIALS AND METHODS

Three germination tests were run with a different batch of achenes used in each test.

The achenes were collected on 8/3/76, 9/20/76 and 9/13/76 for use in Test I, II and III, respectively. The achenes were collected from mature seed heads.

The achenes in Test I and III were placed in light exclusive envelopes and stored at room temperature. The achenes in Test II were freshly harvested, air dried in fluorescent light for 5 days and then tested.

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The three tests were initiated on three different dates. Test I was initiated on 9/13/76 and ran for 17 days. Test II was initiated on 9/24/76 and ran for 20 days. Test III was initiated on 10/9/76 and ran for 14 days.

The germination tests were carried out in 9 cm plastic petri dishes. Four pieces of Whatman No. 2 filter paper and 10 ml of distilled water were placed in each dish. One hundred achenes were placed on the moist paper and the petri dishes placed in the appropriate light treatment. Treatments were replicated four times.

The procedure for the germination tests was identical in the three tests. Seed exposed to light during germination was placed in a growth chamber maintaining a temperature of 29.0 $\pm$ 2°C, a relative humidity of 70 $\pm$ 5%, the light source was fluorescent with radiant energy of 1.8×10^4 ergs $cm^{-2}sec^{-1}$. Seed to be germinated in the dark were placed in a wooden box which was enclosed in a black cloth bag (a portable film developing bag) which was then placed in the same growth chamber. The temperature in the dark chamber was approximately 2°C higher than in the light chamber.

Germination counts were first made after two days and then every two or three days. Counting was done by removing the dishes from the chamber and counting germination on a laboratory table. Achenes that germinated and produced cotyledons were counted and removed from the dish then the dishes were replaced in the appropriate light or dark treatments.

TABLE I. The effect of light on germination of Galinsoga ciliata achenes.

Test	Treatment	%Germination	Date Collected	Storage Condition	Germination Test started
I	Light	94	8/3/76	Dark	9/13/76
	Dark	15	"	Dark	"
II	Light	98	9/20/76	Light	9/24/76
	Dark	3	"	Light	"
III	Light	98	9/13/76	Dark	10/9/76
	Dark	1	"	Dark	"

RESULTS AND DISCUSSION

The data from these tests show Galinsoga ciliata achenes have a light requirement for germination.

The achenes from Test I, collected 8/3/76 had 94% germination in the light and 15% germination in the dark (Table I). There was significantly better germination in the light (1% level of probability). This test had the highest germination in the dark of the three tests (Table I). One possible explanation for better dark germination could be that they were exposed to longer day lengths or higher light intensity on the plant prior to harvesting.

The achenes from Test II, collected 9/29/76 germinated significantly (1% level of probability) better in the light (98%) as compared to the dark (3%) (Table I). These seed were freshly harvested, air dried in light for 5 days and then tested. The achene readily germinated in the light even considering the late harvest date.

Test III repeated the results found in the first two tests. The achenes germinated significantly better in the light than in the dark. In the light 98% of the achenes germinated and 1% in the dark.

The data found in these experiments is not in line with the previous research dealing with light response of Galinsoga ciliata achenes during germination. In the previous research in petri dishes the achenes germinated equally or better in the dark as compared to the light (1,2). The data in these experiments indicated a light requirement for the germination of the achenes was involved.

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MODIFICATION OF PLANT RESPONSE TO TEMPERATURE STRESS WITH A SUBSTITUTED PYRIDAZINONE

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ABSTRACT

BASF 13-338 [4-chloro-(dimethylamino)-2-phenyl-3(2*H*)-pyridazinone] inhibits the formation of linolenic acid in the polar lipids of plant membranes. BASF 13-338 also blocks the low temperature induced increase in linolenic acid associated with cold hardening. Reduced levels of membrane linolenate are marked by alteration of resistance to both heat and cold. Combination of BASF 13-338 and low temperature resulted in effective control of chickweed (*Stellaria media*). Corn (*Zea mays* L.) and sorghum (*Sorghum bicolor* (L.) Moench) showed resistance to high temperature damage as a result of treatment with BASF 13-338. A definite role for membrane linolenate in plant response to temperature stress has been established.

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ABSTRACT

RIGHTS-OF-WAY VEGETATION - COASTAL PLAIN OF SOUTH CAROLINA

Richard Stalter 1/

The vegetation on rights-of-way in three counties in southeastern South Carolina; Jasper, Beaufort, and Hampton, were sampled by the line intercept method. Five 100 foot line transects were established on rights-of-way perpendicular to the adjacent land and the species intercepted were recorded.

Study sites in each county were chosen according to soil association, and frequency data (percent lines intercepted) for each species on each soil association were tabulated. A similarity index, $S = \frac{2C}{A+B}$, was used to compare the vegetation of all soil associations. With the exception of three salt marsh areas, the similarity index for species occupying each soil association was low (>.50).

The herbaceous species with the highest frequency values occupying most study sites included *Andropogon virginicus*, *Panicum* spp., and *Ambrosia artemisiifolia*. *Quercus virginiana*, *Quercus laurifolia*, and *Liquidambar styraciflua* were the most commonly encountered arborescent species, while the shrub species were poorly represented by *Rubus* spp. and *Ilex glabra*. Differences in the age of each study area, proximity to various seed sources, previous use of the land, differences in soil moisture conditions, local edaphic conditions, and sampling techniques might account for the low similarity values.

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WEEDS OF THE WORLD. IIc., THE WEEDS OF THE EASTERN MEDITERRANEAN COUNTRIES - 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 551 species and varieties providing the species and family names, life span and other biological data. Crop associations, distribution for certain regions, bibliographies and illustrations were also included.

INTRODUCTION

The area under consideration here includes Turkey, Syria, Lebanon, Cyprus, Israel, the Sinai Peninsula, Jordan, Iraq, Iran, Saudi Arabia and the remainder of the Arabian Peninsula. However specific weed studies were available for only a few of these areas. A factor common to much of this area observed by Boyko (2) is the strong influence of man, dating back for thousands of years. Highly developed and organized states appeared and disappeared in this area during the course of the centuries. Overpopulation occurred from time to time, with its plant ecological consequences: deforestation, overgrazing and erosion, with all their accompanying effects on soil, moisture conditions and vegetation. The studies of Delebes (4) also may be helpful here. Turrill's (18) comments on ruderals and on human influences are most appropriate here.

The largest area in this region under review is Saudi Arabia with an area of approximately 865,000 square miles. No specific studies on weeds were utilized from Saudi Arabia. A weed survey of this area has been recently published by Parker (17).

Iran has an area of approximately 636,000 square miles. No specific weed records from Iran have been included here. However, there exists a thesis by Habibollak Sabeti, "Les plantes adventices de l'Iran," which has not been available for study. Iraq has an area of 168,928 square miles. The weed records for Iraq included here have come from a list of 70 weeds from a publication of Ali Al-Rawi which was translated by Falah A. El-Naib - a student of Dr. Nicholas Polunin formerly

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of the staff at the College of Arts and Science in Bagdad. A small list of weeds was also utilized from a publication of Guest in 1929. The weeds of Lebanon (3,950 square miles) have been studied by Edgecombe (5). The list comprises 341 species representing 46 plant families. English and Arabic common names are provided wherever possible. The weed information provided in this work has not been included in the present study. Arabic, Armenian and Turkish plant names are listed in the work of Bedevian (1).

Turkey is the third largest of the countries considered in the general area here under review. Turkey has an area of 300,948 square miles. The weed records for Turkey have come from two detailed studies: that of N. Göksel (6) concerning the weed seed contaminants of Turkish grains, and the extensive study of K. Meyer (15).

Israel has an area of 7,992 square miles. The weed records of this area were obtained from the publications of Nadel (16) covering the weeds of the Jaffa region, and that of Zohary (21) covering the weeds of Palestine. No specific weed publications have been noted for the remaining areas in this general region. However, aspects of phytogeography together with a considerable reference list may be found in the same UNESCO publication in which the study of Boyoko (2) appears. The *Flora Palestina* when completed will include about 2,400 species (24). Publications of the *Israeli Weed Control Conference* are also helpful (8). The other publications of Dr. M. Zohary listed should also be consulted.

DISCUSSION AND SUMMARY

Reference may be made here to Turrill's 1929 study on the Balkan Peninsula, an area also of great antiquity, long heavily populated and intensively farmed (18). He included 6,530 species of flowering plants of which 567 species were considered weeds (8.7 per cent of the total flora). The four families most plentifully represented were: Compositae (100 spp.), Gramineae (99), Umbelliferae (82), and Cruciferae (65).

This Balkan weed flora comprised 407 annuals, 39 biennials, and 121 perennials; while the ruderal flora consisted of 172 annuals, 39 biennials, and 77 perennials. The 61 species of the 17 genera of the Chenopodiaceae were particularly noted. Turrill noted that the main halophytic invasion had been one of Central Asian species via South Russia into the Dobruja. He also noted that the Mediterranean is given as the most important single geographical source of the weed-aliens of the seaport area of Montpellier in France (Thellung, 1912, *see*, 9), 416 species having this origin. Thus anthropic factors have a great influence on the origin and evolution of weeds and weed associations (*see* Häflinger et al. (7) for related European studies).

The total number of species and varieties listed as weeds or ruderals in the present checklist totals 551. If this total should represent 10 per cent of the entire vascular flora, then the vascular flora for this region could comprise some 5,510 species and varieties.

Plant families represented by large numbers of species and varieties include: Leguminosae, 94 (24 genera); Compositae, 53 (30 genera); Gramineae, 85 (36 genera); and Cruciferae, 49 (32 genera). In addition, the Chenopodiaceae included five genera with 13 species; nine species are listed for the Euphorbiaceae.

The weeds included in the checklist show a particularly high representation of members (spp. and vars.) of the Leguminosae: *Lathyrus* (11 spp.); *Medicago* (14 spp.); *Trifolium* (26 spp.); *Vicia* (24 spp.) and *Trigonella* (8 spp.). Also in this family are the following genera with somewhat smaller numbers of species: *Alhagi*, *Astragalus*, *Cicer*, *Coronilla*, *Galega*, *Glycyrrhiza*, *Lens*, *Lotus*, *Melilotus*, *Mimosa*, *Onobrychis*, *Ononis*, *Ornithopus*, *Pisum*, *Prosopis*, and *Scorpiurus*.

Undoubtedly large numbers of these are deep-rooted perennials capable of surviving during periods of aridity so common to this area. Likewise many of these species, or near relatives perhaps, have been cultivated or otherwise used by man throughout many ages. Furthermore, these all presumably fix nitrogen by means of root nodules and thus have ready sources of nitrates available even in areas of low soil fertility.

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GROWTH REGULATOR EFFECTS ON WILD OAT SEED PRODUCTION, DEHISCENCE, AND DORMANCY

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ABSTRACT

We initiated studies to determine if foliar application of test chemicals could either increase the germination of newly dispersed seeds or reduce seed shedding of wild oats (*Avena fatua* L.) in a manner similar to the use of growth regulators in preventing preharvest drop of various fruits. Plants were thinned to one plant/pot and grown in the greenhouse for 3 to 4 wk, transferred to growth chambers for ca 1 month, and returned to the greenhouse prior to heading. NAA (1-naphthaleneacetic acid), the dimethylamine salt of 2,4-D [(2,4-dichlorophenoxy)acetic acid], or the triethylamine salt of 2,4,5-T [(2,4,5-trichlorophenoxy)acetic acid] was applied at different stages of growth. Seeds were collected from individual plants at weekly intervals over the harvest period and nonshed seeds were removed from the panicles at the final harvest. Number, weight, and germinability of collected seeds were some of the variables assessed.

Seeds collected from plants treated preheading with 0, 80, or 100 g/ha of NAA were dormant from the first 6 weekly collections. Germination gradually increased over the next 7 wks reaching a high of 83% at the last harvest. A statistically significant increase in germination was observed at the 11th harvest for the high level of NAA. Enhancement of germination by 100 g/ha continued for most subsequent harvests, but the increases were not significant. Shoot elongation was also found to be significantly enhanced at several harvests. For both control and treated plants, ca 55% of the seeds were shed and ca 45% were retained in the panicles. Total number of seeds produced by treated plants was greater than the controls but the increases were not significant. However, when seed production was examined on the basis of seed color, the 100 g/ha level was found to have caused a significant (P = 0.06) 80% increase in total number of dark seeds and a four-fold increase in number of nonshed dark seeds (P = 0.03).

Seeds from plants treated at preheading with 50 to 1600 g/ha of 2,4,5-T exhibited germination responses similar to those observed with NAA. In general, germination was not influenced by treatment but length of shoots was increased by increasing levels of herbicide. Total number of seeds produced was inhibited ca 22% by 800 or 1600 g/ha of 2,4,5-T.

Seed production from oats, treated when 50% of the plants were at anthesis, was reduced 46% by 1 kg/ha of 2,4-D. Germination was enhanced by the 2,4-D treatment in the seeds collected from the early harvest when seeds are normally dormant, but was not affected in later harvests when all seeds were germinating in the range of 80 to 97%. Seeds from plants treated 1 wk later exhibited the same general responses, but inhibition of viable seed production dropped from 46% to 36%.

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A SIMPLE AND RAPID BIOASSAY FOR EVALUATING CHEMICAL STRUCTURE-BIOLOGICAL ACTIVITY RELATIONSHIPS

Werner J. Meudt 1/

Abstract

The relationship between structure and biological activity of chlorophenoxyacetic- and benzoic-acids was determined with a newly-developed bean first internode assay.

Bean internode sections were each treated with 10 nanomoles of mono, di, and trichloro-phenoxy- or benzoic-acids. The "hormone" response of each was determined 2 hours after chemical treatment.

The greatest biological activity of chlorobenzoic acids is associated with a chlorine substitution at the ortho position plus a second chlorine para to the ortho positioned chlorine (2,5-; 2,3,6-). 4-chlorobenzoic acids are inactive (4-; 2,4-; 2,4,6-; 2,3,4-). The activity of phenoxyacetic acids is greatest when they contain at least one unsubstituted ortho ring position and a second unsubstituted position in the benzene ring para to it (2,5-; 3,6-). Even though both biologically active chlorobenzoic- and chlorophenoxy-acetic acids give similar physiological responses, the differences in structural requirements suggest differences in their metabolic reactions.

It is conjectured that the biological activity of chlorobenzoic acids depends upon the ease at which the ortho chlorine can be substituted by a nucleophilic substituent.

The biological activity of chlorophenoxyacetic acids, on the other hand, might depend upon the ease of oxidation-reduction of the unsubstituted ring positions.

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DETECTION OF ROOT-ABSORBED GROWTH REGULATORS WITH CALIFORNIA PRIVET

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ABSTRACT

A rapid method for the discovery and evaluation of plant growth regulators on woody plants was developed, using California privet (*Ligustrum ovalifolium* L.) and root-absorbed growth inhibitors. Experiments were conducted involving hydroponics and soil-drench techniques and ancymidol (α-cyclopropyl-α-(4-methoxyphenyl)-5-pyrimidinemethanol) to develop and validate the methods.

To determine the range of concentrations necessary to retard growth of privet sprouts, 2½-year-old plants were grown and treated in nutrient culture under controlled environmental conditions. The plants were decapitated, and the stump sprouts pruned to a single stem which was treated with ancymidol in the emulsifiable concentrate form (EL-531 E. C.), at levels ranging from 0.125 to 16.0 ppm. All treatments inhibited growth, but the lowest significant inhibition occurred with 0.25 ppm ancymidol in 7 days.

Two age-groups of privet (3 months and 4 years old) were compared for effectiveness of ancymidol in soil-drench experiments. Both groups were grown in a controlled environment and each plant was pruned to a single stem. Soil-drench applications of the emulsifiable concentrate of ancymidol ranged from 4 to 64 ppm. All treatments inhibited growth, but the 3-month plants were inhibited longer than the 4-year-old plants. At rates ranging from 32 to 64 ppm both young and old plants were significantly inhibited for 18 weeks; however, at 16 ppm the young plants were inhibited for 18 weeks while the old plants were inhibited for only 12 weeks.

An additional experiment was performed using 2-year-old privet to compare the effects of the emulsifiable concentrate with the water-soluble form of ancymidol. This experiment not only indicated that the water-soluble formulation of ancymidol is as effective as a soil drench as the emulsifiable concentrate, but confirmed the results of the first soil-drench experiment.

The hydroponic method for testing root-absorbed plant growth regulators gave an indication of activity in very low dosages, but was time consuming to set up and maintain. The soil-drench method using privet plants from 3 months to 2 years old gave fast and effective indication of activity response, but a higher dose level was required than in hydroponics. Experiments with other known plant growth regulators are in progress and eventually unknown chemicals will be tested to further validate the methodology.

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TECHNIQUES FOR DETECTING AND EVALUATING TOBACCO AXILLARY BUD INHIBITING CHEMICALS

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Abstract

New, effective chemicals for the inhibition of axillary bud (sucker) growth on tobacco (Nicotiana tabacum L.) have been sought since the late 1940's. It is estimated that U.S. tobacco producers spend nearly 20 million dollars annually for chemicals to control sucker growth. The late Paul C. Marth of this Laboratory first described a rapid greenhouse method for evaluating chemicals to control sucker growth using the small-leaf type tobacco, Xanthi-nc. According to Marth (Marth, P. C. and J. W. Mitchell. 1964. J. Agr. Food Chem. 12:61-64.) Xanthi-nc tobacco is a hybrid of N. glutinosa L. and N. tabacum cv. Xanthi (a Turkish type) developed at the University of California. These plants require less greenhouse bench space and the turnover time to produce them is shorter compared to commercial tobacco cultivars. We have utilized Marth's general procedure since the early 1960's and have made modifications and alterations which make the procedure quite versatile. The Xanthi-nc plants are grown in sterilized soil in a greenhouse at about 80° F under natural daylight. The seeds germinate within 7 days and seedlings 2.5 to 4 cm tall are ready to be transplanted into 5 cm (thumb) pots approximately 4 to 5 weeks after seeding. The seedlings become established in these small pots and the entire soil ball is transferred to 10.5 cm clay pots after about 2 weeks. The plants grow 2 to 3 weeks in the 10 cm pots until they are 15 to 20 cm tall and ready for treatment. The length of time from sowing the seed until plants are ready for treatment is 60 to 70 days depending upon season of year and greenhouse conditions. Seed is sown at weekly intervals so plants are available all year.

Chemicals to be evaluated can be applied in several ways to terminal or sucker buds or both. After terminal buds are removed, suckers develop rapidly so that treatment effects can be evaluated within 2 weeks. The extent of growth of the terminal portions of intact plants can also be evaluated within 2 weeks. Chemicals can be mixed with a carrier such as lanolin as described by Marth and applied to the buds in specific amounts. Emulsions of the chemical, usually diluted with water and a surfactant as well as organic solvents when necessary, can be applied as droplets to buds or as overall sprays to the entire plant.

Bud growth inhibition on Xanthi-nc tobacco plants has been successfully used to evaluate chemicals with contact and systemic modes of action, to study structure-activity relationships among related chemicals, and to monitor biological activity for the isolation and characterization of components from natural products. In addition to evaluations of bud growth (number, length, weight), overall size of the plant, leaf area, and formative effects can be used to evaluate the effects of applied chemicals.

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SCREENING OF NONANAL AND RELATED VOLATILE SPORE STIMULATORS FOR ACTIVITY ON EIGHT SPECIES OF WEED SEEDS

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ABSTRACT

Naturally-occurring organic volatiles, previously found to stimulate germination of uredospores, aeciospores, conidia, teleutospores, and pollen (*Pinus* sp.) were studied in relation to their effects on germination and subsequent radicle growth of eight weed species.

Weed seeds were placed on moist filter paper in petri dishes in 10 L desiccators. The chemical to be tested was placed on a supported Whatman #1 filter paper disc and sealed in the desiccators for 3 days. Liquid volumes of 0.01, 0.1, and 1.0 ml chemical were placed on the filter paper to provide a range of concentrations. Weed species used were: redroot pigweed (*Amaranthus retroflexus*), jimsonweed (*Datura stramonium*), giant foxtail (*Setaria faberii*), wild mustard (*Brassica kaber*), johnsongrass (*Sorghum halepense*), curly dock (*Rumex crispus*), Pennsylvania smartweed (*Polygonum pensylvanicum*), and velvetleaf (*Abutilon theophrasti*). Visual observations were made at three and ten days.

The spore-germination stimulators had varied effects on the germination of the weed seeds. In general, the highest concentration (1 ml) completely inhibited germination under both dark and light conditions. Formative effects such as lack of root hairs, negative geotropism, swelling of the radicle at the zone of elongation and seed-coat splitting as a result of increased imbibition were noted. Swelling of the radicle was most pronounced with nonanol on smartweed, curly dock, and jimsonweed. Seed-coat splitting was noted particularly with nonanal on smartweed. Additional studies have shown that nonanal-induced swelling in smartweed seeds is concentration-dependent over log dilutions from 10 to 0.01% as determined by soaking the seeds in the solutions for 16 hr and observing the splitting of seed coats over a 35-day period.

Although the objective of this screening program is to find stimulators of weed seed germination, it is believed that the formative effects produced by some of these chemicals may have practical application in the control of weed seed populations.

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THE INFLUENCE OF GROWTH REGULATORS ON THE ABSORPTION OF MINERAL ELEMENTS

by

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ABSTRACT

The influence of GA (gibberellic acid), 2,4-D (2,4-dichlorophenoxyacetic acid), and SADH (succinic acid-2,2-dimethylhydrazide) on the uptake of N, P, and K by wheat (Triticum vulgare L. 'Mericopa') and soybean (Glycine hispida L. 'York') was investigated. Uptake of K by wheat was accelerated by GA and the uptake of N and P by wheat and soybean was enhanced by 2,4-D. Both GA and 2,4-D interfered with the translocation of N,P, and K. SADH did not enhance the uptake of N, P, and K but did stimulate the translocation of P and K in the plant.

INTRODUCTION

The transport of nutrients and metabolites in the growing plant and, particularly, to the developing seed and ripening fruit, are to a great extent under the direction of plant growth regulators. Early investigators demonstrated that the movement of soluble carbohydrates, nitrogenous compounds, and ions to certain areas of the plant was enhanced when those areas were treated with indole-3-acetic acid (IAA). However, this enhancement extended over a prolonged period of time and no attempt was made to distinguish whether the influence of IAA was due to a stimulation of growth or to a direct effect of the growth regulator on the transport mechanisms. More recent experiments have demonstrated that growth regulator-directed uptake and transport of nutrients, metabolites and even materials foreign to the plant can occur in plants within a relatively short period of time following application of the growth regulator (1,2,5,6,10).

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In the present paper the influence of 2,4-D, GA, and SADH on the uptake of N,P, and K was studied. All three of these growth regulators are used in modern agriculture.

METHODS AND MATERIALS

Newly germinated wheat seeds were placed on wire screens supported by small beakers so that their root systems grew down into inorganic nutrient media (Hoagland No. 1--¼ strength) contained by the beakers. Each beaker contained 10 wheat seedlings, the ten plants being tested and analyzed as one unit. Constant conditions of light (white, 10.8 Klux, and continuous) and temperature ($25 \pm 1^{\circ}C$) were maintained in a Percival growth chamber (Model E-540). The plants were transferred to fresh aerated medium every 2 days. After 7 days of growth the plants were transferred to beakers containing inorganic media (Hoagland No. 1--full strength) and different concentrations of the growth regulators, 2,4-D, GA, and SADH. The plants were allowed to grow under these circumstances for another 72 h.

Soybean seeds were planted in clay pots containing vermiculite and grown in a growth chamber as described above for 14 days. The vermiculite at the start of the experiment was thoroughly soaked with water. Thereafter the plants were treated daily with 100 ml of inorganic nutrient solution (Hoagland No. 1--¼ strength). Fourteen-day-old soybean plants of similar size were then transferred to wide-mouth 250 ml erlenmeyer flasks that held 150 ml of aerated inorganic nutrient solution (Hoagland No. 1--full strength) and different concentrations of the growth regulators, 2,4-D, GA and SADH. Each flask contained one plant held in place with a cotton plug. The flasks were placed in the growth chamber for 72 h under 10.8 Klex of continuous white light and $25 \pm 1^{\circ}C$. Eight high-output fluorescent lamps (F48T 12-CW-HO) and four 60-W incandescent light bulbs provided the light source. In all wheat and soybean experiments the pH of the inorganic nutrient media was adjusted to 6.8 ± 0.2.

After exposure to the growth regulators, wheat and soybean plants were cut into small pieces and dried at $45^{\circ}C$ for 48 h in preparation for N, P, and K analyses. Before being analyzed the dried plant tissue was ground into a fine powder by a Wiley mill. The samples were analyzed for N by semi-micro Kjeldahl (3), for P by phosphomolybdate colorimetry (7), and for K by flame photometry. All experiments were replicated 3 times and the data were analyzed by analysis of variance.

RESULTS

NITROGEN. Treatment of wheat and soybean with GA had only a negligible effect on the uptake of N (Tables 1 and 2). With wheat, GA was slightly stimulatory at 0.03 and 0.3 uM and inhibitory at 30,300, and 1500 uM. When wheat shoots and roots were analyzed separately it was found that shoot absorption of N was inhibited and root absorption stimulated by all concentrations of GA tested (Table 1). This difference between shoot and root uptake was not observed in soybean treated with GA (Table 2).

The absorption of N by wheat and soybean was stimulated by 2,4-D, maximum effect in wheat occurring at 0.5 uM and in soybean at 0.25 and 25 uM 2,4-D (Tables 3 and 4). A 10% increase in N absorption by wheat shoots was observed at 0.5 uM and an 18% increase in root absorption at 2.5 uM 2,4-D (Table 3). Maximum stimulatory influence in soybean shoots occurred at 25 uM (19%) and in roots at 0.25 uM (22%) (Table 4). In most instances where root uptake was stimulated shoot uptake was inhibited, suggesting some interference with the translocation of N from root to shoot. This was also true for GA-treated wheat plants.

The growth retardant SADH had little or no effect over a wide concentration range on N uptake by wheat and soybean (Tables 5 and 6).

PHOSPHORUS. As with nitrogen, GA had only a negligible effect on the absorption of P by wheat and soybean (Tables 1 and 2). A decrease in soybean shoot uptake compared with slight stimulatory effects of GA on root uptake suggests that the growth regulator may inhibit translocation of P (Table 2).

Phosphorus uptake by wheat and soybean was stimulated by 2,4-D (Tables 3 and 4). The peak stimulatory effect in wheat (19%) occurred at 0.5 uM and in soybean (13%) at 0.25 uM 2,4-D. Analyses of wheat shoots and roots separately showed enhanced shoot uptake at 0.25 and 0.5 uM 2,4-D. However, enhanced root uptake in wheat was demonstrated in all 2,4-D tests (Table 3). In soybean 0.25 uM 2,4-D caused a 15% increase in shoot absorption and at 2.5 uM a 28% increase in root absorption of P (Table 4). At the higher concentrations of 2,4-D used, translocation of P from root to shoot in wheat was inhibited (Table 3) and in soybean was stimulated (Table 4).

Low concentrations of SADH (0.062 to 31 uM) did not influence wheat absorption of P while higher concentrations (62 to 6200 uM) caused slight inhibition (Table 5). Separate analyses of wheat shoots and roots for P showed consistent SADH acceleration of shoot uptake and inhibition of root uptake (Table 5). This suggests that SADH accelerated the translocation of P from root to shoot.

Soybean absorption of P was not influenced to any extent by SADH (Table 6). A slight stimulation at 0.62 uM and a slight inhibition at 3100 and 6200 uM SADH was observed. With the exception of high concentrations (620 to 6200 uM), analysis of soybean plant parts showed very little SADH-caused differences between root and shoot absorption of P.

POTASSIUM. The absorption of K by wheat was stimulated by the higher concentrations of GA (30 to 1500 uM) used in this study. Peak stimulation (33%) occurred at 1500 uM (Table 1). Shoot uptake of K at 1500 uM GA was increased 14% and root uptake 67%. Unlike wheat soybean absorption of K was relatively unaffected by GA (Table 2).

When the entire wheat plant was analyzed very little influence of 2,4-D on the uptake of K could be observed (Table 3). However, separate analyses of shoots and roots revealed some inhibition of shoot uptake and considerable stimulation of root uptake of K (Table 3). As with N and P, it appears that the higher concentrations of 2,4-D (2.5 to 25 uM) interfered with the translocation of K from root to shoot.

Some small stimulation of K uptake in 2,4-D treated soybean plants was observed (Table 4). However, stimulation was erratic and no concentration effect could be observed. These same observations were made for shoot and root absorption under the influence of 2,4-D. Considerable inhibition of root uptake, however, was caused by 25 and 50 uM 2,4-D (24% and 35%, respectively).

Potassium absorption by wheat was inhibited by SADH over a wide concentration range (3.1 to 6200 uM) (Table 5). With the exception of those plants treated with 6200 uM, shoot absorption was relatively unaffected by SADH. However, since the amount of K in the root was considerably less in SADH-treated wheat plants it appears that the translocation of K from the root to the shoot was accelerated (Table 5).

Potassium uptake by SADH-treated soybean plants was somewhat erratic. Peak stimulation (12%) was observed in plants treated with 310 uM SADH (Table 6). Peak shoot absorption of K (15%) occurred at 31 and 310 uM SADH and peak root absorption (20%) at 6200 uM.

DISCUSSION

In this study GA accelerated the uptake of K by wheat and 2,4-D enhanced the uptake of N and P by both wheat and soybean. However, both GA and 2,4-D interfered with the movement of N, P, and K from the root to the shoot. This was inferred by stimulation of root uptake coupled with either a "no effect" or an inhibition of shoot uptake. Although SADH did not stimulate the uptake of N, P, or K, it did stimulate translocation of P and K from the root to the shoot.

In at least two studies (9,11) the translocation of the mineral elements Ca and Fe in bean was accelerated by SADH. El-Fouly et al. (8) showed that the growth retardant 2-chloroethyltrimethylammonium chloride (CCC) accelerates the translocation of P from the roots to the aerial parts of cotton plants. In addition, Kannan and Mathew (9) demonstrated that the growth retardant 4-hydroxyl-5-isopropyl-2-methylphenyltrimethylammonium chloride (AMO-1618) stimulates basipetal transport of Fe in bean.

Cooke (4) showed that when the foliage of bean plants is treated with 2,4-D there is a considerable initial enhancement of the uptake of K, Cl, Ca, and S from soil to which these mineral elements had been added. After a short period of time, however, 2,4-D caused an inhibition of mineral uptake.

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Table 1. Influence of GA on the uptake of N, P, and K by wheat. Mineral nutrients are recorded in mg/g dry weight.

	Nitrogen			Phosphorus			Potassium		
GA (uM)	Plant	Shoot	Root	Plant	Shoot	Root	Plant	Shoot	Root
0	25.5	28.7	22.3	5.7	5.8	5.6	7.5	9.2	5.7
0.03	27.0	28.4	25.6	5.9	6.2	5.6	7.5	9.1	5.9
0.3	26.6	27.4	25.7	5.9	6.0	5.7	7.8	9.6	6.0
3	25.6	25.9	25.2	5.8	5.8	5.8	7.6	9.2	5.9
30	23.9	24.4	23.3	5.9	5.8	6.0	8.2	9.7	6.6
300	23.3	23.2	23.3	5.8	5.7	5.9	8.7	10.1	7.3
1500	22.5	22.6	22.4	5.8	5.6	6.0	10.0	10.5	9.5
LSD, 0.01	1.6	2.1	1.5	0.4	0.4	0.5	0.6	0.6	0.5
0.05	1.1	1.5	1.1	0.3	0.3	0.4	0.4	0.4	0.3

Table 2. Influence of GA on the uptake of N, P, and K by soybean. Mineral nutrients are recorded in mg/g dry weight.

	Nitrogen			Phosphorus			Potassium		
GA (uM)	Plant	Shoot	Root	Plant	Shoot	Root	Plant	Shoot	Root
0	38.2	37.2	40.0	5.1	4.7	6.1	6.9	7.5	5.7
0.03	37.8	36.6	40.1	4.8	4.3	5.8	6.8	7.4	5.7
0.15	36.1	34.9	38.5	4.8	4.2	5.9	6.8	7.3	5.8
0.3	36.1	33.9	40.4	5.1	4.5	6.1	6.8	7.3	6.0
1.5	37.1	36.0	39.5	5.1	4.4	6.4	6.8	7.2	6.0
3	36.6	35.8	38.2	5.1	4.5	6.4	6.9	7.3	6.0
15	36.8	34.9	40.6	5.1	4.4	6.6	7.0	7.3	6.4
30	38.3	36.8	41.5	5.2	4.7	6.2	6.7	7.4	5.4
150	36.0	35.1	37.8	4.9	4.3	6.0	6.7	7.3	5.4
300	36.9	36.7	37.3	5.1	4.6	6.2	7.1	7.7	5.9
1500	33.9	34.5	32.7	5.1	4.6	6.1	7.2	8.2	5.3
LSD, 0.01	0.8	0.8	2.4	0.3	0.5	0.6	0.2	0.4	0.4
0.05	0.6	0.6	1.8	0.2	0.4	0.4	0.1	0.3	0.3

Table 3. Influence of 2,4-D on the uptake of N, P, and K by wheat. Mineral nutrients are recorded in mg/g dry weight.

	Nitrogen			Phosphorus			Potassium		
2,4-D (uM)	Plant	Shoot	Root	Plant	Shoot	Root	Plant	Shoot	Root
0	24.5	26.6	22.4	4.2	4.0	4.3	3.9	5.1	2.6
0.05	25.3	27.7	22.9	4.3	4.0	4.6	3.9	5.1	2.6
0.25	26.6	29.2	23.9	4.5	4.3	4.6	3.9	5.1	2.6
0.5	27.3	29.3	25.3	5.0	5.0	4.9	4.1	5.2	2.9
2.5	26.0	25.5	26.4	4.5	3.9	5.0	4.0	4.6	3.3
5	24.1	23.9	24.2	4.4	3.6	5.1	3.8	4.2	3.4
25	23.3	21.2	25.4	4.2	3.2	5.1	4.1	3.6	4.5
LSD, 0.01	1.6	1.6	3.0	0.3	0.3	0.6	0.2	0.3	0.2
0.05	1.2	1.1	2.2	0.2	0.2	0.4	0.1	0.2	0.1

Table 4. Influence of 2,4-D on the uptake of N, P, and K by soybean. Mineral nutrients are recorded in mg/g dry weight.

	Nitrogen			Phosphorus			Potassium		
2,4-D (uM)	Plant	Shoot	Root	Plant	Shoot	Root	Plant	Shoot	Root
0	37.5	35.6	41.4	4.6	4.6	4.7	6.5	7.3	4.9
0.05	40.2	36.8	47.0	4.8	4.8	5.0	6.8	7.5	5.3
0.25	43.3	39.8	50.3	5.2	5.3	5.0	7.1	8.0	5.4
0.5	41.9	38.6	48.3	5.1	4.9	5.6	6.9	7.7	5.4
2.5	41.5	37.7	49.1	4.9	4.4	6.0	7.0	7.8	5.4
5	42.5	40.7	46.0	4.6	4.6	4.6	6.6	7.5	4.9
25	43.4	42.3	45.8	4.9	5.1	4.5	6.8	8.3	3.7
50	41.4	40.6	42.8	4.6	5.0	3.9	6.4	8.0	3.2
LSD, 0.01	2.0	1.6	2.6	0.3	0.4	0.3	0.5	0.2	0.6
0.05	1.4	1.1	1.9	0.2	0.3	0.2	0.4	0.1	0.4

Table 5. Influence of SADH on the uptake of N, P, and K by wheat. Mineral nutrients are recorded in mg/g dry weight.

	Nitrogen			Phosphorus			Potassium		
SADH (uM)	Plant	Shoot	Root	Plant	Shoot	Root	Plant	Shoot	Root
0	35.8	39.9	31.6	6.4	5.2	7.6	10.4	11.6	9.2
0.062	36.5	43.1	29.9	6.6	5.6	7.5	10.2	11.2	9.1
0.31	35.9	41.7	30.1	6.3	5.6	7.0	10.1	11.4	8.7
0.62	37.0	42.6	31.3	6.7	6.2	7.2	10.8	12.5	9.1
3.1	34.9	41.1	28.7	6.4	5.9	6.8	9.7	12.0	7.3
6.2	35.6	40.3	30.9	6.2	6.0	6.4	9.4	11.7	7.0
31	35.1	41.6	28.6	6.2	5.9	6.4	9.5	11.8	7.1
62	34.1	40.2	28.0	5.9	5.5	6.3	9.2	10.9	7.4
310	36.1	39.8	32.3	6.1	5.5	6.7	9.1	11.3	6.9
620	36.4	42.2	30.5	6.0	5.8	6.2	9.0	11.6	6.4
3100	35.2	38.3	32.0	6.1	5.7	6.4	8.9	10.7	7.1
6200	31.5	34.7	28.3	5.9	5.4	6.4	8.1	9.3	6.9
LSD, 0.01	1.6	1.3	2.3	0.7	0.5	1.1	0.2	0.4	0.5
0.05	1.2	1.0	1.7	0.5	0.4	0.8	0.1	0.3	0.4

Table 6. Influence of SADH on the uptake of N, P, and K by soybean. Mineral nutrients are recorded in mg/g dry weight.

	Nitrogen			Phosphorus			Potassium		
SADH (uM)	Plant	Shoot	Root	Plant	Shoot	Root	Plant	Shoot	Root
0	30.1	29.8	30.8	4.0	3.5	5.1	7.3	6.6	8.5
0.062	29.0	29.2	28.7	4.0	3.4	5.1	7.5	7.2	8.1
0.31	30.3	30.3	30.4	4.1	3.5	5.1	7.4	7.3	7.7
0.62	30.4	30.0	31.4	4.3	3.7	5.4	7.8	7.6	8.4
3.1	30.9	30.6	31.5	4.1	3.5	5.3	7.7	7.4	8.2
6.2	30.6	30.3	31.1	4.1	3.5	5.3	7.8	7.3	8.8
31	30.9	30.6	31.5	4.1	3.4	5.4	8.1	7.7	8.8
62	29.6	28.8	31.4	4.0	3.4	5.4	7.8	7.1	9.1
310	31.3	31.6	30.7	4.1	3.5	5.4	8.2	7.7	9.2
620	29.5	29.7	29.3	4.0	3.3	5.4	7.9	7.5	8.7
3100	30.3	29.8	31.3	3.8	3.0	5.4	7.6	7.0	8.9
6200	31.8	30.7	33.9	3.8	3.2	5.2	7.8	6.6	10.2
LSD, 0.01	0.6	1.1	1.6	0.6	0.7	0.5	0.5	0.6	1.7
0.05	0.8	0.8	1.2	0.5	0.5	0.4	0.4	0.5	1.3

RESPONSES OF SWEET AND FIELD CORN
TO TREATMENTS WITH DINOSEB

M. Abdel-Rahman 1/ and D. L. Bailey 2/

ABSTRACT

Five experiments were conducted at the Agway Farm Research Center in Fabius, New York, during 1976 to evaluate the effects of dinoseb (2-sec-butyl-4,6-dinitrophenol) treatments on growth and yield of five sweet and field corn (*Zea mays* L.) cultivars. Two sweet corn, 'Butter Corn' and 'Butter and Sugar', and three field corn, 'Agway 151S', 'Michigan 280' and 'Agway 590X', cultivars were planted on May 24, 1976, and were used in these tests. Plants were thinned to a population of one plant of sweet corn every 8 inches and 23-24,000 field corn per acre. Treatments were applied at either four or two weeks before tasseling as foliar sprays in 40 GPA at 100 psi and consisted of 5 or 10 gram ai/A equivalent of dinoseb (1/2 or 1 pint dinoseb + surfactant mixture). Evaluations were made on plant growth, plant height, length of tassels, date of tasseling, silage yield and grain yield.

Dinoseb treatments resulted in earlier tasseling, reduced plant height, reduced length of tassels and increased yield of treated sweet corn plants. Similar effects were observed on treated field corn plants. Results and discussion will be presented at the meeting.

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EFFECTS OF DINOSEB AS A GROWTH REGULANT ON FIELD CORN

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ABSTRACT

Experiments were conducted at Mr. Walter Schiff's farming operation, Dover, Delaware to determine the effects of foliar applications of dinoseb (2-sec-Butyl-4,6-dinitrophenol) on the yield of field corn (Zea mays L. vars.) Late Schiff, DeKalb XL64, Pioneer Brand (R) hybrids 3535 and 3368. Topical applications of 4.3, 5, 10 and 15 gms (ai/A) were applied when the unemerged tassel lengths of the hybrids ranged from one to six inches in length. The dinoseb at 10 gms (ai/A) gave a 6.8% increase in corn yields across all hybrids over the untreated check; however, this increase was not statistically significant at the 10% level. The 10 gm rate did significantly increase (10% level) corn yields of DeKalb XL64 and Pioneer Brand (R) hybrid 3535 by 9.9% and 8.9% respectively. The 4.3, 5 and 15 gm rates showed consistent trends in increasing yields ranging from 2.1% to 2.8% across the average of all hybrids; however, this was not statistically significant.

The ear tip fill seemed to provide an answer for the increased yields. The tip fill increased from the check with 5.6 ears complete, out of 14 counted, to the highest at the 10 gm (ai/A) rate of 9.2 filled or a 64% increase.

INTRODUCTION

Topical application of dinoseb in corn for increased grain yields has been studied for a number of years. Studies reported from New York and Indiana (1) (2) show varied responses from corn due to rate of chemical applied and hybrid variability. This study was initiated to evaluate several identified rates and how they affect different corn hybrids under Delaware conditions.

MATERIALS AND METHODS

The experiment was conducted at Mr. Walter Schiff's farming operation at Dover, Delaware during the growing season of 1976. The planting was made on April 27, 1976, utilizing a split plot design with four replications. The main effect was five treatments, 4.3, 5, 10 and 15 gms (ai/A) of dinoseb and an untreated check. The 4.3 gm rate resulted from utilizing a commercially prepared foliar spray, Spark (R)2/ at the recommended rate of application

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2/ Trademark of Helena Chemical Company.

(1 pint/A). The 5, 10 and 15 gm rates were mixed from Premerge.[3/] A non-ionic adjuvant[4/] used at the rate of 1 pt/100 gal on all dinoseb treatments, except the Spark (R) formulation which contained its own adjuvant. The split was across four different hybrids, Late Schiff[5/], DeKalb XL64, Pioneer Brand (R) hybrid 3535 and 3368, all commercially planted at 19,000 seeds per acre. The final stand was approximately 18,400 and uniform between hybrids.

Plot size was .24 of an acre each treatment being three rows wide.

Treatments were applied on June 25, 1976, broadcast with a hi boy sprayer calibrated to deliver 11.1 gallons of solution per acre at 60 psi.

On the treatment date the average tassel length for Late Schiff, DeKalb XL64, Pioneer Brand (R) hybrid 3535 and 3368 were 1.9, 5.8, 1.6, and 0.9 inches respectively. The hybrids as given above tasseled on July 20, July 10, July 18, and July 22, 1976, respectively. On October 4, 1976 ear tip fill ratings were made. Fourteen ears from each plot were examined and rated as complete or incomplete. On October 7 and 8, 1976 grain yields were taken, percent grain moisture, and percent broken stalks were measured.

RESULTS AND DISCUSSION

All the dinoseb treatments gave increased corn yields, over the check, across all hybrids except Pioneer Brand (R) 3368; which responded only to the 5 and 10 gm rates. Several of these increases were statistically significant (Table 1).

The 10 gm level produced the largest increased yield over the untreated check across all hybrids with a 9.9% for DeKalb XL64 and a 8.9% for Pioneer Brand (R) 3535. These hybrid increases were statistically significant at the 10% level.

The 4.3, 5 and 15 gm rates increased yields over the check, but all yielded lower than the 10 gm rate. This indicates that under this set of growing conditions and hybrids that 10 gms of dinoseb was the most desirable. This is further emphasized because there were no significant interactions between rates and hybrids. However, hybrids varied some in their total yield response to the application of 10 gms of dinoseb.

The ear tip fill data indicates that the application of dinoseb is helping to complete ear fill, thus resulting in increased yields. Ear tip fill was increased an average of 64% with the application of 10 gms of dinoseb per acre across all hybrids. Hybrids varied with the different rates, but all responded with better ear tip fill.

3/ Dinitro Weed Killer, Dow Chemical Company
4/ X77 Spreader-Ortho, Division of Chevron Chemical Company
5/ Mr. Walter Schiff produces some of his corn hybrids and this name was assigned this hybrid for identification.

The tassel length at application time could not be correlated with a given response across hybrids. From this work it appears that application during tassel length of one to six inches is satisfactory. Proper time of application for each hybrid may vary, but this information could not be determined from this study.

There was no correlation between dinoseb treatments and broken stalks in this study.

The growing conditions throughout the season were excellent. Severe stress conditions may alter the results of this one year study. These results are in agreement with those obtained by M. Abdel-Rahman et al (1) and indicate that dinoseb can be used as a growth stimulant to corn to obtain 5 to 10% yield increases in Delaware.

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Table 1: Effect of dinoseb treatments on different corn hybrid yields and ear tip till.

	L. Schiff		DeKalb XL64		Pioneer Brand Hybrid 3535		Pioneer Brand Hybrid 3368			
	Grain Yield1/	Ear Tip Fill2/	Grain Yield	Ear Tip Fill	Grain Yield	Ear Tip Fill	Grain Yield	Ear Tip Fill	Average Grain Yield	Average Ear Tip Fill
4.3 gms (Spark)3/	128.9	7.4	129.2	8.2	140.6	7.5	132.5	10.1	132.8	8.3
Dinoseb 5 gms	119.1	6.3	130.6	6.6	140.7	9.1	139.0	11.2	132.4	8.3
Dinoseb 10 gms	129.2	8.5	134.0	8.9	147.5	10.6	143.2	8.8	138.4	9.2
Dinoseb 15 gms	128.3	8.2	130.9	6.4	140.7	7.2	133.6	12.0	133.3	8.4
Untreated Check	126.4	4.1	121.9	4.2	135.4	5.3	134.9	9.0	129.6	5.6
LSD .10%	N.S.		9.7		7.5		N.S.			

1/ Adjusted to 15.5% grain moisture content.

2/ Ear tip fill was determined by absolute numbers (counting 14 ears per treatment and determining either filled or not filled). The numbers given are averages of filled ears out of 14.

3/ Trademark of Helena Chemical Company.

PREVENTION OF LODGING IN CEREALS WITH ETHEPHON

Robert C. de Wilde and Armin H. Furrer [1/]

ABSTRACT

Ethephon [(2-chloroethyl)phosphonic acid] was applied at 0.22 to 0.45 kg/ha to winter wheat (Triticum aestivum L. 'Yorkstar') after pollination, when 5 to 10% of the grain heads were emerging from the sheath. The treatments reduced straw height 17 to 27 cm and decreased lodging tendency 30 to 75% without affecting yields. Ethephon can be useful in emergency to reduce excessive plant growth because the late stage at which it should be applied allows ample opportunity to assess fields and decide whether lodging might occur.

INTRODUCTION

Heavy rates of nitrogen are desirable for maximum yields of wheat, oats, barley and rye. In areas where soil moisture does not limit production, this fertilization often produces tall straw which lodges easily. Lodged cereal crops can be smothered by late germinating weeds and are difficult to pick up with a combine. Grain from lodged crops can be lost as a result of germination on the ground, or involve the farmer in additional drying costs. Underseeded legumes also can be smothered by lodged grain.

Although plant breeders have developed lodge-resistant varieties by genetically reducing straw length, plant regulator formulations of chlormequat have been utilized effectively in Europe for greater control of lodging in wheat and oats (3).

Research in Europe, Great Britain, Korea, and the United States has shown that ethephon will promote tillering, increase yield, decrease straw height, and reduce lodging percentage or severity when applied at 0.5 to 2 kg/ha from the end of tillering to the beginning of stem extension (1,4,5,6). Yield increases of 5 to 30% were recorded in association with increased tillering and antilodging.

Generally, the greatest reduction in lodging is associated with straw shortening following ethephon treatments applied after the beginning of stem extension. Ethephon applied during the early, mid and late boot stages has produced male sterility in wheat (7). Although the ovary remains receptive, limited pollen availability can result in less seedhead development and lower yields.

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The object of the present experiments was to determine whether ethephon applied after pollination when 5 to 10% of the grain heads have emerged from the sheath will reduce lodging without decreasing yield.

MATERIALS AND METHODS

A randomized block experiment with four replications was planted to 'Yorkstar' winter wheat on September 22, 1975, near Poplar Ridge, New York. Plot size was 1.8 by 6 m. Four treatments -- ethephon at 0.22 and 0.45 kg/ha (0.25 and 0.5 lb/A) alone and with an oil/surfactant adjuvant at 1.12 l/ha (1 pt/A) -- were applied June 2, 1976, when 5 to 10% of grain heads were emerging from the sheath. Total spray volume was 56 l/ha (5 gal/A), simulating aerial application.

The experimental area received 180 kg/ha (200 lb/A) of 10-20-10 fertilizer broadcast and incorporated before planting. A topdress application of 81 kg/ha (90 lb/A) of 34-0-0 fertilizer was made on May 14, 1976. The central portion of each plot was evaluated July 20 for lodging and yield. Lodging was measured visually as a percentage of stems and heads flat upon the ground. Lodging tendency was measured as a percentage estimate of the number of stems leaning 30 to 45 degrees off perpendicular. Data was subjected to standard analysis of variance techniques.

RESULTS AND DISCUSSION

All ethephon rates significantly reduced straw height, characterized by a two-fold average reduction in straw length between the flag leaf and the base of the head.

Grain weight per 100 heads at 10% moisture showed that treatments had no effect on yield.

Although some lodging was apparent outside the experimental area, no true lodging occurred in any plot. However, it was apparent that the straw and grain heads were more erect in all ethephon treatments than in the control plots. Measurement of lodging tendency shows that wheat treated with the 0.45 kg/ha ethephon rate will resist lodging. The oil/surfactant adjuvant improved efficiency of the 0.22 kg/ha ethephon rate with respect to straw shortening and reduced lodging tendency.

Table 1. Effect of ethephon rate on height, yield and lodging of 'Yorkstar' wheat.

Character	Ethephon rates kg/ha					LSD	
	0	0.22	0.45	0.22 + S*	0.45 + S*	1%	5%
Height, cm ground to base of head	104	87	77	85	81	5.6	4.0
Length, cm flag leaf to base of head	22	13	8	10	9	2.4	1.7
Kernel weight, g/100 heads	113	118	117	119	119	NS	NS
Lodging %	0	0	0	0	0	NS	NS
Lodging tendency %	80	50	5	30	5	24.1	17.2

* S = oil/surfactant adjuvant

The present study indicates that when applied as the grain heads are emerging from the sheath ethephon can significantly reduce wheat height and lodging without affecting yield.

Similar results have been obtained with ethephon applied to barley and rice (2).

Ethephon can be particularly useful on an emergency basis to reduce plant height under conditions where excessive growth and subsequent lodging are expected. Since the benefit is obtained from application at a late growth stage, before deciding to use ethephon a farmer could observe his fields and speculate on whether lodging might be expected.

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PHYSIOLOGICAL EFFECTS OF ETHEPHON ON PLANT HEIGHT, LODGING AND YIELD OF WHEAT, BARLEY AND OATS

Mohamed Abdel-Rahman 1/

ABSTRACT

Four tests were conducted at the Agway Farm Research Center in Fabius, New York, to evaluate the effects of ethephon (2-chloroethyl phosphonic acid) on lodging and yield of cereal grains. Winter wheat (Triticum aestivum L. 'York Star'), Spring wheat (Triticum aestivum L. 'Neapewa'), barley (Hordeum vulgare L. 'Erie') and oats (Avena sativa L. 'Orbit'), were planted on May 15, 1976. Chemical treatments were applied at the early boot stage using a pressurized hand sprayer in 10 GPA and 30 psi. Evaluations were made on plant height, spike length, spike weight and yield.

Ethephon treatments reduced plant height, decreased or prevented lodging and had no significant effect on hand harvested yield. The 2 pt/A rate of ethephon was significantly more effective than the 1 pt/A rate; however, the addition of Glyodin at 1 pt/A or Booster plus E at 1 pt/A as adjuvants, increased the activity of 1 pt/A of ethephon significantly and results were similar to the 2 pts/A.

The use of ethephon to control and prevent lodging may result in yield increases of machine harvested grains and may allow more use of fertilizer to increase yield of cereal crops.

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EFFECT OF SEVERAL HERBICIDES APPLIED PREEMERGENCE, AT DRAG-OFF AND LAYBY ON WEED CONTROL IN WHITE POTATOES

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ABSTRACT

During 1976, metolachlor (2-chloro-*N*-(2-ethyl-6-methylphenyl-*N*-(2-methoxy-1-methylethyl-acetamide), dinitramine (N^4,N^4-diethyl-α,α,α-trifluoro-3,5-dinitrotoluene-2,4-diamine), penoxalin (*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine), dibutalin (*N*-*sec*-Butyl-4-*tert*-butyl-2,6-dinitroaniline), and trifluralin (α,α,α-trifluoro-2,6-dinitro-*N*,*N*-dipropyl-*p*-toluidine) in various combinations with metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4*H*)-one) were tested for weed control in potatoes (*Solanum tuberosum*) in Maine. With the exception of drag-off treatments with dinitramine, USB-3153, and trifluralin, and layby treatments with penoxalin, all herbicides and combinations provided acceptable control of mustard (*Brassica campestris*), lambsquarters (*Chenopodium album*) and spurry (*Spergula arvensis*).

Quackgrass (*Agropyron repens*) and annual barnyard grass (*Echinochloa crusgalli*) were also satisfactorily controlled by all herbicides and combinations used in this study.

INTRODUCTION

Several new and labeled herbicides were evaluated during 1976 for weed control in white potatoes. Differential rates of the newer herbicides were applied as preplant, preemergence, and post emergence treatments using several combinations to gain broad spectrum weed control.

MATERIALS AND METHODS

Preplant incorporated treatments of dibutalin and EPTC were applied to a very dry Caribou gravelly silt loam soil on June 7. Preemergence treatments were applied on June 16 to a block of Katahdin potatoes planted on June 7. Weather on June 16 was hot, hazy, and 80F. with soil very moist. Drag-off treatments of experimental compound USB-3153 and trifluralin were applied June 12. Soil conditions were moist, weather was clear and sunny with an air temperature of 59F. Layby treatments were applied July 22, when the potato plants were 10 to 12 inches in height. Soil conditions were very wet. The weather was partly cloudy and 63F.

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All herbicides were applied in 80 gallons of water using 40 psi pressure. A compressed air sprayer equipped with a two-nozzle brush type hand boom was used. Nozzle type was Delavan raindrop type with No. 3374-3 tips. Plot size was single 20 foot rows arranged in a randomized block design with six replicates of each treatment. Weed control ratings were made on three dates as listed in Table 1 using a rating code of 1 to 10. Samples were saved at harvest time for storage studies during 1976-77 and emergence tests during the 1977 growing season. During July, weed counts were made and species identified in the 'no treatment' plots.

RESULTS AND DISCUSSION

Data presented in Table 1 indicate that metolachlor applied preemergence and penoxalin applied at layby did not provide satisfactory control of broadleaved weeds. None of the drag-off treatments with dinitramine, USB-3153, and trifluralin controlled broadleaved weeds. The 0.5-lb. rate of USB-3153 and 0.75-lb. rate of trifluralin applied at drag-off did not give satisfactory control of quackgrass. All herbicides in this test at the rates and methods applied gave excellent full season control of annual barnyard grass, although there was some evidence that drag-off treatments with dinitramine, USB-3153, and trifluralin were starting to allow new grass seedlings to break though on August 27.

Table 1. Effect of several herbicides applied preplant, preemergence, at drag-off, and layby on weed control and yield of Katahdin potatoes. Maine - 1976.

Treatments[1] Pounds of Active Material per Acre	Yield Cwt./A.	Weed Control Ratings[2]								
		Broadleaved			Quackgrass			Annual grass		
		7-7	7-28	8-27	7-7	7-28	8-27	7-7	7-28	8-27
Untreated check, PE	241	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2.5 lbs. Metolachlor, PE	206	4.0	6.7	6.7	6.3	8.7	8.0	6.7	10.0	9.7
2.0 lbs. Chlorbromuron, PE	268	10.0	10.0	8.7	6.0	8.0	7.0	10.0	10.0	10.0
1.0 lb. Linuron, PE	250	9.7	10.0	9.7	6.0	9.0	8.0	10.0	10.0	10.0
2.5 lbs. Alachlor, PE	274	6.7	7.3	8.3	4.7	8.3	7.7	10.0	9.7	10.0
1.5 lbs. Metolachlor plus 0.375 lb. Metribuzin, PE	310	10.0	9.7	10.0	6.3	8.3	7.7	10.0	10.0	10.0
2.0 lbs. Metolachlor plus 0.50 lb. Metribuzin, PE	288	8.0	10.0	10.0	6.7	8.0	8.3	10.0	10.0	10.0
2.0 lbs. Metolachlor plus 0.75 lb. Linuron, PE	291	10.0	10.0	9.7	6.7	9.0	8.0	10.0	10.0	10.0
2.5 lbs. Metolachlor plus 1.00 lb. Linuron, PE	266	10.0	10.0	9.7	7.3	9.3	8.3	10.0	10.0	10.0
1.5 lbs. Metolachlor plus 1.00 lb. Chlorbromuron, PE	258	10.0	10.0	9.7	6.7	8.7	9.3	10.0	10.0	10.0
2.0 lbs. Alachlor plus 0.50 lb. Metribuzin, PE	280	10.0	10.0	9.7	6.3	9.3	8.7	10.0	10.0	10.0
2.0 lbs. Alachlor plus 1.00 lb. Linuron, PE	290	9.7	10.0	9.3	6.0	8.0	8.0	8.0	10.0	10.0
2.0 lbs. Alachlor plus 1.00 lb. Chlorbromuron, PE	309	10.0	10.0	10.0	6.0	8.0	7.3	10.0	10.0	10.0
0.5 lb. Dinitramine, Drag-off	279	2.7	3.7	6.0	3.7	8.0	7.3	10.0	10.0	9.7
1.0 lb. Dinitramine, Drag-off	288	3.3	3.0	6.3	5.0	8.7	7.3	9.7	10.0	9.0
0.5 lb. USB-3153, Drag-off	207	2.7	3.7	5.7	3.7	7.7	6.3	10.0	10.0	9.3
1.0 lb. USB-3153, Drag-off	227	2.0	2.3	5.7	4.0	8.3	7.7	10.0	10.0	9.0
2.0 lbs. Dibutalin, PPI plus 1.0 lb. Linuron, PE	241	10.0	9.7	9.0	6.3	8.0	8.7	10.0	9.7	10.0
2.0 lbs. Dibutalin plus 1.0 lb. Linuron, PE	249	10.0	9.7	8.7	5.3	8.0	7.0	10.0	10.0	10.0

. . . . Continued . . . .

Table 1 - Continued.

Pounds of	Treatments[1] Active Material per Acre	Yield Cwt./A.	Weed Control Ratings[2] Broadleaved 7-7	Broadleaved 7-28	Broadleaved 8-27	Quackgrass 7-7	Quackgrass 7-28	Quackgrass 8-27	Annual grass 7-7	Annual grass 7-28	Annual grass 8-27
2.0 lbs.	Dibutalin, PE	279	7.7	9.0	10.0	4.0	8.3	7.7	10.0	10.0	10.0
4.5 lbs.	Dinoseb plus 5.0 lbs. Dalapon, PE	283	8.0	10.0	9.7	5.3	8.7	8.3	10.0	10.0	10.0
0.75 lb.	Trifluralin, Drag-off	248	2.3	3.0	4.0	3.3	8.3	6.7	10.0	10.0	9.7
1.0 lb.	Trifluralin, Drag-off	247	3.0	4.3	6.3	4.3	7.0	7.0	10.0	9.3	9.0
0.5 lb.	Metribuzin plus 0.75 lb. Trifluralin, LB	287	1.0	5.2	9.7	1.0	8.7	8.7	1.0	8.8	10.0
0.5 lb.	Metribuzin plus 1.00 lb. Trifluralin, LB	336	1.0	5.6	10.0	1.0	8.7	8.3	1.0	10.0	10.0
0.5 lb.	Metribuzin, PE plus 6.0 lbs. EPTC, PPI	309	10.0	10.0	9.7	6.3	8.3	8.0	10.0	10.0	10.0
1.0 lb.	Penoxalin, PE	296	6.0	9.0	9.3	3.7	8.0	7.7	10.0	10.0	10.0
1.5 lbs.	Penoxalin, PE	306	7.3	9.3	7.7	4.0	7.7	7.7	10.0	10.0	9.0
1.0 lb.	Penoxalin plus 0.25 lb. Metribuzin, PE	320	8.7	9.3	8.7	4.7	8.0	7.7	10.0	10.0	10.0
1.0 lb.	Penoxalin plus 0.50 lb. Metribuzin, PE	312	10.0	10.0	9.7	6.3	8.3	8.3	10.0	10.0	10.0
1.0 lb.	Penoxalin plus 2.5 lbs. EPTC, LB	182	1.0	3.3	4.7	1.0	4.7	7.3	1.0	10.0	9.3
1.0 lb.	Penoxalin, LB	190	1.0	5.0	4.3	1.0	7.3	7.3	1.0	10.0	9.7
	Bayes L.S.D. (0.05)	87									

[1]Planted - June 7; killed - September 10; harvested - September 20, 1976.

[2]Rating code: 1 = no control; 7 = acceptable control; 10 = excellent weed control.

Number and species of weeds per square foot: (average 12 reps.)

Brassica campestris - 6.0	Agropyron repens - 4.8	Spergula arvensis - 1.0
Chenopodium album - 0.9	Echinochloa crusgalli - 1.6	

HERBICIDES FOR CONTROL OF YELLOW NUTSEDGE IN POTATOES

G. W. Selleck, L. E. Weber and Wm. J. Sanok[1/]

ABSTRACT

CGA 24705 (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide) at 2 to 3 lb/A, FMC 25213 (r-2-ethyl-5-methyl-c-5-(2-methylbenzyloxy)-1,3-dioxane or FMC 30371 (r-2-isopropyl-5-methyl-c-5-(2-methylbenzyloxy)-1,3-dioxane at 2 and 3 lb/A preemergence incorporated, and alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide at 2-4 lb/A or H 26910 (N-sec-butyl-2',6'-dinitro-3,4-xylidine at 3-4 lb/A preemergence controlled yellow nutsedge (*Cyperus esculentus* L.) 75% or better in Abnaki potatoes for nearly three months after application. CGA 24705 and the FMC compounds appeared to be slightly less effective applied preemergence than soil-incorporated. CGA 24705 and alachlor caused slight, temporary acetanilide phytotoxic symptoms on the leaves of white potato (*Solanum tuberosum* L.). Potato yield increases were statistically significant at the five percent level, L.S.D. test with alachlor at 2 lb, EPTC (S-ethyl dipropylthiocarbamate) at 6 lb, FMC 25213 at 2 lb and H 26910 at 3 and 4 lb/A. Favorable moisture conditions in spring, and friable, medium-textured soils typical of Long Island, contribute to improved efficacy of acetanilides and other herbicides which require moisture for optimum performance.

INTRODUCTION

Yellow nutsedge is believed to infest approximately 15,000 of the 26,000 acres planted to potatoes on Long Island, and adversely affects either yield or quality on approximately 10,000 acres (2). The larger, faster-growing rhizomes of yellow nutsedge on Long Island (1) seem to confirm observations that the weed has a greater impact on potato yield and quality than the yellow nutsedge in upstate New York. Spring rains are typical of the area, and irrigation water one-inch weekly is used to complement natural precipitation when needed. This provides a favorable moisture regime for the growth of nutsedge. Yellow nutsedge continues to be a serious problem despite commercial use of EPTC for several years.

It is the purpose of this study to identify and develop additional outstanding herbicides for selective control of yellow nutsedge in potatoes on Long Island.

MATERIALS AND METHODS

Nine herbicides were applied alone and in combination for a total of 30 treatments in a dense stand of yellow nutsedge in the Abnaki variety of white potatoes (*Solanum tuberosum* L.). Applications were made with a tractor-mounted sprayer delivering 43 gpa at 35 psi on quadruplicated plots

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1.7 x 9 m on sandy to gravelly loam soil (containing 2% or less organic matter) near Riverhead, N. Y. Preemergence applications were made 5/14, post- 6/3 and layby applications 6/10. Certain treatments were soil incorporated immediately after application with a finger-weeder to a depth of 2 to 3 in. Tillage in all cases was limited to soil preparation, drag-off, and a single hilling operation.

RESULTS AND DISCUSSION

Several herbicides controlled yellow nutsedge, with CGA 24705 at 2 to 3 lb/A pre-soil-incorporated maintaining 80% control or better for nearly 3 months. Alachlor at 2 to 4 lb/A, H 26910 3 to 4 lb/A preemergence, and FMC 25213 or 30371 at 3 lb/A incorporated also performed well (Table 1). CGA 24075 and the FMC products appeared to be slightly less effective applied preemergence than soil-incorporated. The treatments alachlor + linuron (2 + 0.75 and 2.5 + 0.75 lb/A) were also effective for nutsedge control. Alachlor and CGA 24075 caused slight temporary acetanilide symptoms. Potato yields were significantly increased at the five percent level, L.S.D. test with alachlor at 2 lb, EPTC at 6 lb, FMC 25213 at 2 lb and H 26910 at 3 and 4 lb/A.

Alachlor and CGA 24075 have performed satisfactorily on Long Island for yellow nutsedge control (2) contrary to results in upstate New York where alachlor, particularly, has been inconsistent (3). The medium-to-coarse-textured soils on Long Island usually provide an excellent seedbed, and this, coupled with favorable moisture at planting and emergence of potatoes, contribute to the efficacy of these herbicides for the control of nutsedge. Hence acetanilides are expected to perform more consistently for nutsedge control on Long Island than in areas where cloddy seedbeds or a lack of spring moisture is not an unusual occurrence.

ACKNOWLEDGMENTS

Financial support, either in the form of grant-in-aid or commercial product, is gratefully acknowledged from six chemical suppliers (Table 2).

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Table 1. Nutsedge control,[2/] phytotoxicity[1/] and yields in potatoes

Herbicide	Rate lb/A	Timing	Phyto.[1/]	Av. control 6/2	Av. control 6/22	Av. control 8/25	Yield cwt/A
Alachlor	2	pre-	1	8.5	8.6	7.3	281[3/]
Alachlor	3	pre-	1.3	6.6	7.8	7.9	255
Alachlor	4	pre-	2	7.9	8.3	8.2	262
Alachlor	2						
+ linuron	.75	pre-	1.5	8.1	7.5	7.3	244
Alachlor	2.5						
+ linuron	.75	pre-	1.3	6.8	8.2	7.3	246
Alachlor	3	pre-					
+ EPTC	4	layby inc.	1	7.1	7.1	5.4	257
EPTC	4	pre-inc.	.6	3.3	4.8	2.5	261
EPTC	6	pre-inc.	1	3.9	2.0	1.3	275[3/]
FMC 30371	2	pre-inc.	1	6.3	6.3	5.3	249
FMC 30371	3	pre-inc.	1	5.0	6.5	7.8	267
FMC 25213	2	pre-inc.	.8	4.5	6.3	6.6	276[3/]
FMC 25213	3	pre-inc.	.8	7.6	8.5	8.6	248
FMC 25213	2	pre-	1	3.9	5.9	6.5	295[3/]
FMC 25213	3	pre-	1.3	8.3	6.4	6.8	264
H 26910	2	pre-	1	5.3	7.3	6.1	244
H 26910	3	pre-	1	7.1	8.4	6.5	274[3/]
H 26910	4	pre-	1.5	7.3	7.8	7.5	280[3/]
CGA 24075	2	pre-	1.3	7.4	6.8	6.9	260
CGA 24075	2.5	pre-	1	6.6	7.8	7.4	269
CGA 24075	3	pre-	1	6.8	7.9	8.0	268
CGA 24075	2	pre-inc.	.8	6.5	7.8	8.0	269
CGA 24075	2.5	pre-inc.	1.3	6.8	7.6	8.1	249
CGA 24075	3	pre-inc.	1	7.3	8.6	8.8	242
Alachlor	2						
+ metribuzin	.5	pre-	1.3	5.9	6.8	7.0	252
Metribuzin	1	pre-	.8	6.4	6.3	7.4	236
Metribuzin	2	pre-	1	4.0	5.0	5.1	256
Metribuzin	.5	post-	1	0	4.3	1.3	254
Napropamide	3	pre-	1	3.0	3.3	2.0	244
Untreated check[3/]			.3	av. density 252 shoots per sq m			264
Untreated check[3/]			.5	av. density 198 shoots per sq m			254

1/ 0 = no injury, 10 = complete kill

2/ 0 = no control, 10 = complete kill

3/ Yield increase over check significant at 5% level L.S.D.

Table 2. Herbicides and formulations

Common name	Chemical name	Formulation	Supplier
Alachlor	2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide	4 lb/gal E.C.	Monsanto Co.
CGA 24705	2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide	6 lb/gal E.C.	Ciba-Geigy Corp.
EPTC	S-ethyl dipropylthiocarbamate	7 lb/gal E.C.	Stauffer Chem. Co.
FMC 25213	r-2-ethyl-5-methyl-c-5-(2-methylbenzyloxy)-1,3-dioxane	4 lb/gal E.C.	FMC Corp.
FMC 30371	r-2-isopropyl-5-(2-methylbenzyloxy)-1,3-dioxane	4 lb/gal E.C.	FMC Corp.
Linuron	(3-(3,4-dichlorophenyl)-1 methoxy-1-methylurea)	50% W.P.	Dupont Co.
Metribuzin	4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)one (4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one)	50% W.P.	Chemagro Div. Dupont Co.
Napropamide	2(a-naphthoxy)-N,N-diethylproprionamide	2 lb/gal E.C.	Stauffer Chem. Co.

RESPONSE OF POTATOES TO ALACHLOR AND METRIBUZIN[1]

C. P. Yip, D. T. Warholic, G. W. Selleck, and R. D. Sweet[2]

ABSTRACT

Excellent broadleaved weed control without reduction in potato (Solanum tuberosum L.) yields was obtained with combinations of alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] and metribuzin [4-amino-6-tert-butyl-3(methylthio)-as-triazin-4(4H)one]. Application of alachlor alone or in combination with metribuzin in the 'at crack' stage stunted potatoes initially, but they recovered with no adverse effects on total yield. At two locations, there was no difference in weed control or crop response between tank and prepackage mixes of alachlor and metribuzin applied delayed preemergence.

INTRODUCTION

Potato (Solanum tuberosum L.) growers in New York State, especially on Long Island where barnyardgrass (Echinochloa crusgalli L.) is a problem, have a need for a herbicide to control annual grasses. Linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea] and metribuzin provide excellent control of annual broadleaved weeds, but are weak on grasses. Metribuzin has the advantage in that it can be applied postemergence at low rates in single or multiple applications to potatoes without causing any yield reduction (6, 7). EPTC (S-ethyl dipropylthiocarbamate) gives good control of annual grasses and yellow nutsedge (Cyperus esculentus L.). However, for best results it needs to be incorporated when the soil is dry. Furthermore, due to its high solubility, EPTC soon loses effectiveness with high rainfall or repeated irrigation. Consequently, there is a need for a long lasting grass herbicide that can be applied preemergence or delayed preemergence and incorporated. Recent investigations have shown that alachlor at 2 to 4 lbs/A applied preemergence gave excellent control of annual grasses (1, 2, 3). Alachlor at 4 lbs/A caused temporary stunting of potatoes (5). When applied at emergence, 2 lbs/A of alachlor also stunted potatoes (4).

The objectives of this study were to evaluate the effects of alachlor and metribuzin on weeds and potato yields, where applied at two timings singly and in combination; to compare the effects of tank and prepackage mixes of alachlor and metribuzin on weeds and potatoes.

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MATERIALS AND METHODS

Three experiments were conducted, two at Freeville, NY, and one at Riverhead, Long Island. Potatoes (cv. Katahdin) were planted on a Howard gravelly loam at Freeville on May 25, 1976. Prior to planting 800 lbs/A of 13-13-13 fertilizer was broadcast and plowed down in mid-April. An additional 1250 lbs/A of 12-24-12 fertilizer was banded at planting. Seed pieces were spaced 9 inches apart. Plots consisted of two 34 inch rows, 20 feet long. A randomized complete block design with three replications was utilized.

On June 8, just prior to herbicide application, the entire experimental area was dragged off with a finger weeder. Certain treatments listed in Table 1 were then applied and incorporated (DPI) to a depth of 1 to 2 inches with a finger weeder. Plots were restaked and delayed preemergence treatments (DP) applied. Chemicals were also applied to some plots on June 15 when the potatoes were emerging or 'at crack' stage. All spray materials were applied with a hand operated CO_2 pressurized sprayer which delivered 45 gals/A at 35 lbs/in^2.

Potatoes were not cultivated or hilled. Weeds present were predominantly redroot pigweed (*Amaranthus retroflexus* L.) and common lambsquarter (*Chenopodium album* L.). Visual ratings of weed and potato response to treatments were obtained on July 1. Potatoes were harvested in early October approximately 2 weeks after the application of paraquat (1,1'-dimethyl-4,4'-bipyridium ion) at 0.5 lb/A as a vinekiller. Total yields were obtained.

Two additional experiments, one at Freeville and another at Riverhead, Long Island were conducted to compare the effects of tank and prepackage mixes of alachlor and metribuzin on potatoes. Experimental methods for the experiment at Freeville are similar to those described above. On Long Island, Katahdin potatoes were planted on a Haven loam soil in quadruplicated plots, two rows wide by 30 ft. long on April 23, 1976. Herbicides listed in Table 3 were applied with a tractor-mounted sprayer delivering 100 gals/A at 40 lbs/in^2 on May 11. Formulation of prepackage mix of alachlor and metribuzin was 3.2 + 0.6 E.C., respectively.

RESULTS AND DISCUSSION

Redroot pigweed and lambsquarter stands were moderate. As shown in Table 1, alachlor and metribuzin when applied alone or in combination provided good control of both weed species. Delayed preemergence incorporated application of both chemicals caused little injury to potatoes, whereas the 'at crack' application stunted the potatoes initially, but they recovered. Potato tuber yields were not reduced by any of the treatments (Table 1).

There was no significant difference between tank and prepackage mixes of alachlor and metribuzin in terms of weed control and crop response (Tables 2 and 3). The low yields in plots receiving a tank mix of alachlor and metribuzin at 2 plus 0.375 lb/A, respectively, was unexplainable (Table 3). Excellent barnyardgrass control was obtained with either formulation (Table 3).

Table 1. Influence of alachlor and metribuzin, applied delayed pre incorporated and 'at crack' on weeds and potatoes.

Chemical	Timing[1]	Rate (lb/A ai)	Visual Ratings By Species[2] Pigweed 7/1	Lambs-quarter 7/1	Potato 7/1	Total Potato Yield[3] (cwt/A)
alachlor	DPI	1.0	8.0	8.3	8.7	457
alachlor	DPI	2.0	9.0	8.3	8.7	476
metribuzin	DPI	0.25	8.0	8.7	8.3	486
metribuzin	DPI	0.75	9.0	9.0	8.7	474
alachlor + metribuzin	DPI	1.0+0.25	8.0	9.0	8.7	453
alachlor + metribuzin	DPI	1.0+0.75	8.0	8.0	8.0	468
alachlor + metribuzin	DPI	2.0+0.25	9.0	9.0	8.3	466
alachlor + metribuzin	DPI	2.0+0.75	9.0	9.0	8.3	407
alachlor	at crack	1.0	8.7	8.7	8.7	537
alachlor	at crack	2.0	9.0	9.0	8.0	490
metribuzin	at crack	0.25	9.0	9.0	8.3	487
metribuzin	at crack	0.75	9.0	9.0	8.0	485
alachlor + metribuzin	at crack	1.0+0.25	9.0	9.0	8.0	493
alachlor + metribuzin	at crack	1.0+0.75	9.0	9.0	7.3	481
alachlor + metribuzin	at crack	2.0+0.25	9.0	9.0	7.0	488
alachlor + metribuzin	at crack	2.0+0.75	9.0	9.0	6.7	497
linuron	DP	1.5	9.0	9.0	8.7	463
untreated	-	-	4.0	5.3	8.6	437
						ns
				Coefficient of variation		11%

[1] DPI = delayed pre incorporated; DP = delayed preemergence

[2] 9 = no crop injury or excellent weed control; 7 = commercially acceptable; 1 = complete crop kill or no weed control

[3] Means of three replications; ns = nonsignificant at 5% level

Table 2. Effects of tank and prepackage mixes of alachlor and metribuzin applied delayed preemergence on weeds and potatoes at Freeville, NY.

Chemical[1]	Rate (lb/A ai)	Timing[2]	Visual Rating By Species[3] Pigweed 7/29	Lambs-quarter 7/29	Potato 7/29	Total Potato Yield[4] (cwt/A)
alachlor	2.0	DP	9.0	8.7	8.3	393
metribuzin	0.25	DP	9.0	9.0	8.7	419
metribuzin	0.375	DP	9.0	9.0	8.7	407
metribuzin	1.0	DP	9.0	9.0	9.0	404
alachlor + metribuzin (TM)	2.0+0.25	DP	9.0	9.0	8.3	431
alachlor + metribuzin (TM)	2.0+0.375	DP	9.0	9.0	8.7	428
alachlor + metribuzin (PM)	2.0+0.375	DP	9.0	9.0	9.0	439
untreated			7.0	6.3	8.7	408
						ns
			Coefficient of variation			12%

1 TM = tank mix; PM = prepackage mix
2 DP = delayed preemergence
3 9 = no crop injury or complete weed control; 7 = commercially acceptable; 1 = complete crop kill or no weed control
4 Means of three replications; ns = nonsignificant at 5% level

Table 3. Response of weeds and potatoes to delayed preemergence application of tank and prepackage mixes of alachlor and metribuzin on Long Island, NY.

Chemical[1]	Rate (lb/A ai)	Visual Ratings By Species[2] Ladysthumb	Barnyard-grass	Potato	Total Potato Yield[3] (cwt/A)
alachlor + metribuzin (TM)	1.6+0.3	9.9	9.9	1.7	383
alachlor + metribuzin (TM)	2.0+0.375	-	-	1.0	369
alachlor + metribuzin (TM)	2.4+0.45	9.6	9.9	1.3	350
alachlor + metribuzin (PM)	1.6+0.3	9.9	9.9	2.0	341
alachlor + metribuzin (PM)	2.0+0.375	9.9	9.9	1.3	297
alachlor + metribuzin (PM)	2.4+0.45	-	9.5	1.0	354
untreated		5.0	3.0	1.0	-

1 TM = tank mix; PM = package mix
2 0 = no control or no crop injury; 10 = complete control or crop kill
3 A yield difference of 52 cwt is significant at 5% level, t-test
4 Number of shoots/ft^2
- No assessment made

ACKNOWLEDGMENT

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THE EFFECT OF ALACHLOR AND LINURON ON SIX POTATO VARIETIES[1/]

Joseph B. Sieczka[2/]

ABSTRACT

Five herbicide treatments were applied to six potato (Solanum tuberosum L.) clones to determine their effects on weed control, plant injury, yield and tuber size. Phytotoxic effects were most severe and long lasting when alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] was applied at a rate of 4 lbs/A in combination of 0.75 lbs/A of linuron [3-3,4-dichlorophenyl)-1-methoxy-1-methylurea]. This treatment reduced yields of the clones 'Superior', 'Green Mountain' and 'Hudson' most severely. 'Katahdin' and 'Kennebec' yields did not appear to be affected. Applications of alachlor at 4 lbs/A or linuron at 0.75 lbs/A applied alone or alachlor at 2 lbs/A in combination with 0.75 lbs/A of linuron did not reduce yields.

INTRODUCTION

Herbicides are applied as a standard practice to help control weeds in potato fields. Annual broadleaved weeds have been effectively controlled by the right combination of herbicide and tillage practice. However, good consistant control of annual grasses and nutsedge (Cyperus esculentus L.) is being sought. Selleck and Weber (5) stated that 15,000 acres of potato land on Long Island are infested with nutsedge. About 10-15% of the total agricultural acreage in the Northeast is estimated to be infested (4).

The use of alachlor at 3.0 lb/A provided good control of annual grasses with no adverse effects on yield (3,5). Higher rates can control nutsedge (2,5). Information is needed to determine if these rates will affect potato growth and yield. Data on clonal response to high rates is also needed since potato varieties respond differently to some herbicides (1,6). The purpose of this study is to obtain this information.

MATERIALS AND METHODS

The clones 'Katahdin', 'Superior', 'Kennebec', 'Green Mountain', and 'Hudson' were main plots of a split plot experiment planted on May 24, 1976. The subplots were herbicide treatments which consisted of 1) untreated check, 2) alachlor, 4.0 lbs/A, 3) alachlor, 2 lbs/A, plus linuron, 0.75 lbs/A, 4) alachlor, 4 lbs/A, plus linuron, 0.75 lbs/A, and 5) linuron, 0.75 lbs/A. The main plots were 5 rows wide and subplots arranged in random order within each main plot. The main plots were also randomized within each of the four replications. The herbicide treatments were applied with a hand-held CO_2 pressurized sprayer applying 90 gallons of spray/A at 35 psi. The same herbicide treatments were applied to a guard row planted with 'Norchip' seed; however, only 2 replications were possible. The herbicides were applied on June 10, 1976. On this date approximately 70% of the Superior plants had emerged, 40% of the Green Mountain, 28% of the Kennebec, 10% of the Hudson

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and only a trace of the Katahdin. Plots 34" wide and 20' long. Ratings are based on a scale of 1 to 9, with 1 being equivalent to: no weed control, severe damage, and vigorously growing vines for weed control, phytotoxicity, and maturity, respectively; 9 is equivalent to 90-100% weed control, no damage, and dried up vines.

RESULTS AND DISCUSSION

Table 1 contains data on weed control, phytotoxicity and maturity. All the herbicide treatments resulted in good weed control for the entire growing season. Weeds were present in the no chemical plots throughout the season. However, a combination cultivation-hilling operation on June 25 greatly reduced the weed problem.

'Katahdin' exhibited no crop injury from herbicide treatments. More phytotoxicity was observed with the combinations of alachlor and linuron then with either material used alone. The most severe damage was noted on the 'Superior', 'Green Mountain' and 'Hudson' clones. The degree of injury may be directly related to the characteristically fast rate of growth of these clones during the early part of the growing season. 'Kennebec' and 'Norchip' showed injury on June 15 but only a slight amount of vine damage was seen after that date.

None of the treatments substantially affected vine maturity.

The results in Table 2 indicate that alachlor at 4.0 lb/A in combination with 0.75 lb/A of linuron reduced total yield and mean tuber weight of 'Superior', 'Green Mountain', and 'Hudson'. Statistical analysis of the yield data show that the differences between main effects (varieties and herbicide treatments) and the interaction were significant at the 0.005 level (see Table 3).

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Table 1. The effect of alachlor and linuron alone and in combination, on weed control, phytotoxicity and maturity of 6 potato varieties [1/]

Treatment	Ratings: Weed Control				Phytotoxicity			Maturity
	6/15	6/22	6/28	9/1	6/15	6/22	6/28	9/1
Katahdin								
no chemical	6.8	4.0	7.8	7.5	9.0	9.0	8.8	2.8
alachlor (4 lb/A)	8.5	8.8	9.0	9.0	8.8	8.8	9.0	2.8
alachlor (2 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	3.0
alachlor (4 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	8.8	8.8	8.8	2.5
linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	2.3
Kennebec								
no chemical	6.8	4.8	7.5	8.5	9.0	9.0	9.0	3.5
alachlor (4 lb/A)	9.0	9.0	9.0	9.0	8.3	8.3	8.8	3.3
alachlor (2 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	7.5	8.3	8.8	3.8
alachlor (4 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	7.0	8.8	9.0	4.0
linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	8.3	8.8	9.0	3.3
Green Mountain								
no chemical	5.5	4.5	8.3	9.0	9.0	9.0	9.0	1.0
alachlor (4 lb/A)	9.0	9.0	9.0	9.0	8.0	7.8	8.5	1.0
alachlor (2 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	6.0	7.5	8.8	1.0
alachlor (4 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	6.5	7.3	8.0	1.0
linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	6.8	8.8	8.8	1.5
Superior								
no chemical	4.3	2.0	6.0	7.0	9.0	9.0	9.0	8.3
alachlor (4 lb/A)	9.0	8.8	9.0	8.8	5.5	8.0	8.8	8.8
alachlor (2 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	4.0	8.3	8.8	8.8
alachlor (4 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	4.0	7.8	8.3	8.5
linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	5.5	8.8	9.0	8.8
Hudson								
no chemical	5.0	3.5	6.8	7.8	9.0	9.0	9.0	4.0
alachlor (4 lb/A)	9.0	9.0	9.0	9.0	8.3	7.8	8.5	4.0
alachlor (2 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	7.8	7.8	8.3	3.8
alachlor (4 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	7.5	7.3	8.0	4.0
linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	8.0	9.0	9.0	4.3
Norchip								
no chemical	7.5	1.5	7.0	8.5	9.0	9.0	9.0	6.0
alachlor (4 lb/A)	8.5	9.0	9.0	9.0	8.5	8.0	9.0	4.5
alachlor (2 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	6.0	8.5	9.0	4.0
alachlor (4 lb/A) + linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	5.5	8.0	9.0	4.0
linuron (0.75 lb/A)	9.0	9.0	9.0	9.0	6.0	9.0	9.0	5.0

[1/] Ratings are expressed as means of 4 replications for all varieties except Norchip. Data were collected on 2 replications for this clone. Ratings were based on a scale of 1 to 9, with 9 being equivalent to 90-100% weed control, no damage, or dried up vines for weed control, phytotoxicity, and maturity, respectively.

Table 2. The effect of alachlor and linuron, alone and in combination, on yield and tuber size of 5 potato varieties.

Treatment	Total Yield[1/] (cwt/A)	Mean Tuber Wt. (oz)	% Total Yield 2-3 1/4"	3 1/4-4"	> 4"
Katahdin					
no chemical	322	5.3	68	21	0
alachlor (4 lb/A)	325	4.8	70	17	0
alachlor (2 lb/A) + linuron (0.75 lb/A)	325	4.9	62	22	0
alachlor (4 lb/A) + linuron (0.75 lb/A)	335	6.4	60	31	0
linuron (0.75 lb/A)	346	5.3	69	20	0
Kennebec					
no chemical	332	5.8	70	16	0.8
alachlor (4 lb/A)	368	5.9	64	19	1.7
alachlor (2 lb/A) + linuron (0.75 lb/A)	353	5.9	83	20	1.3
alachlor (4 lb/A) + linuron (0.75 lb/A)	360	5.8	74	13	0
linuron (0.75 lb/A)	358	6.3	69	21	0
Green Mountain					
no chemical	336	5.8	67	20	1.5
alachlor (4 lb/A)	313	5.4	70	16	0
alachlor (2 lb/A) + linuron (0.75 lb/A)	302	5.1	69	16	0.6
alachlor (4 lb/A) + linuron (0.75 lb/A)	277	4.8	69	15	0
linuron (0.75 lb/A)	335	5.6	65	21	1.5
Superior					
no chemical	259	4.7	68	15	1.1
alachlor (4 lb/A)	250	4.4	77	15	0
alachlor (2 lb/A) + linuron 0.75 lb/A)	270	4.4	74	10	1.5
alachlor (4 lb/A) + linuron 0.75 lb/A)	197	3.8	90	7	0
linuron (0.75 lb/A)	304	4.9	73	12	0
Hudson					
no chemical	337	5.6	56	36	0
alachlor (4 lb/A)	349	5.8	61	30	1.6
alachlor (2 lb/A) + linuron 0.75 lb/A)	353	6.5	54	33	2.9
alachlor (4 lb/A) + linuron 0.75 lb/A)	298	5.5	58	31	1.5
linuron (0.75 lb/A)	321	5.7	54	34	2.3

[1/] Differences between the main effects of varieties and herbicide treatments and the interaction were significant at the 0.005 level.

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Table 3. Main effects of 1976 alachlor and linuron x variety study

Treatment	Total Yield[1/] (cwt/A)	Mean Tuber Wt (oz)
Variety		
Katahdin	330	5.3
Kennebec	354	5.9
Green Mountain	313	5.3
Superior	256	4.4
Hudson	332	5.8
Herbicide		
no chemical	317	5.4
alachlor (4 lb/A)	321	5.3
alachlor (2 lb/A) + linuron (0.75 lb/A)	320	5.4
alachlor (4 lb/A) + linuron (0.75 lb/A)	294	5.3
linuron (0.75 lb/A)	333	5.6

[1/] See footnote 1, Table 2

Table 4. The effect of alachlor and linuron, alone and in combination, on yield and tuber size of Norchip

	Total Yield (cwt/A)	Mean Tuber Wt (oz)	% Total Yield		
			2-3 1/4"	3 1/4-4"	> 4"
no chemical	354	4.8	72	13	2.6
alachlor (4 lb/A)	303	4.6	61	19	0
alachlor (2 lb/A) + linuron (0.75 lb/A)	351	5.1	71	12	0
alachlor (4 lb/A) + linuron (0.75 lb/A)	349	4.9	69	17	0
linuron (0.75 lb/A)	339	4.4	68	13	0
$D_{(.05)}$ Tukey	(ns)				

HERBICIDES FOR ANNUAL WEED CONTROL IN POTATOES

G. W. Selleck, L. E. Weber and W. J. Sanok[1/]

ABSTRACT

Several herbicides were applied alone and in combination at preemergence and pre- plus post- at layby, and again at vinefall of Superior and Katahdin varieties of potatoes. Applications were made on quadruplicated plots on Haven loam soil with a tractor-mounted sprayer delivering 43 gpa at 35 psi. Weeds present were barnyardgrass (*Echinochloa crusgalli* (L.) Beauv., ladysthumb (*Polygonum persicaria* L.) and common ragweed (*Ambrosia artemisiifolia* L.).

Results: Outstanding single treatments for control of the weed spectrum were alachlor at 2.5 lb/A or more, cyanazine at 2.0 lb/A, oryzalin or penoxalin at 1.5 lb/A and Vel 5052 at 2.0 lb/A, controlling barnyardgrass and ladysthumb 80% or better for a period of 7 weeks. Methazole at 3.0 lb/A controlled weeds present 70% or better throughout the growing season. MV 687 was excellent for control of barnyardgrass and ladysthumb but was injurious to potatoes. Herbicide combinations, however, were more consistently effective, including alachlor (2) with linuron (.75), dinoseb (3), metribuzin (.5), cyanazine (2) or methazole (1.5); metribuzin (.5) with CGA 24705 (1.5), FMC 25213 (1.5), H 26910 (2), dinitramine (.5) or penoxalin (1); linuron (1) with FMC 30371 (1.5), FMC 25213 (1.5), H 26910 (2) or butralin (1.5); and EPTC (3) with cyanazine. Certain of the treatments, e.g. CGA 24705 + metribuzin and alachlor + cyanazine, metribuzin or linuron, exhibited unacceptable acetanilide phytotoxicity symptoms, particularly on variety Superior. However, yields were not significantly affected.

Preemergence + layby combinations of metribuzin (.5) + metribuzin (.5), or alachlor (2), or methazole (1); alachlor (2) + metribuzin (.5); and linuron (1.1) + trifluralin (.6) provided excellent season-long control of the weeds present. Alachlor + metribuzin (3.0 + 0.5 lb/A) and linuron + trifluralin were the only combinations in which potato injury approached unacceptable levels, but yields were not adversely affected. Under the conditions of this experiment and paucity of late weed growth, applications at vinefall were of little benefit.

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OBSERVATIONS ON QUACKGRASS CONTROL IN POTATOES[1/]

Joseph B. Sieczka and Matthias Reisen[2/]

ABSTRACT

Observations on the control of quackgrass (Agropyron repens) and phytotoxicity to plants of the potato (Solanum tuberosum L.) clone 'Kennebec' from fall and spring applied herbicides were made in 1976. Fall application of metribuzin [4 amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4H) one] at 1.0 lb/A did not substantially affect quackgrass growth. Metribuzin applied in the spring at 1.0 lb/A either alone or in combination with 0.25 lb/A of paraquat [1,1-dimethyl-4,4'-bipyridinium ion] was also ineffective in controlling quackgrass. Slight phytotoxicity was noted from the spring applications of metribuzin to the few potato plants that emerged prior to treatment; however, the symptoms were short lived. Severe injury was observed on emerged potato plants shortly after an application of dinoseb [2-sec-butyl-4,6-dinitrophenol] at 3 lbs/A and dalapon [2,2-dichloropropionic acid] at 8.5 lbs/A. This combination did not control quackgrass. Very good control of the weed with no phytotoxic effects on the crop was obtained with both of the following treatments: pronamide [3,5-dichloro-N-(1,1 dimethyl-2-propynyl) benzamide] applied at 1.5 lbs/A in the fall, and glyphosate [N-(phosphonomethyl) glycine] at 3.0 lb/A applied prior to plowing.

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Table 1. Observations on quackgrass control in potatoes.

Treatment			Weed Control Ratings 1/		
Material	lb/A	Date	6/14	7/15	9/22
1. no chemical			1	1	1
2. pronamide	1.5	10/24/75	6	8	8
3. metribuzin plus metribuzin	1.0 1.0	10/24/75 6/09/76	3	4	4
4. metribuzin plus metribuzin plus paraquat	1.0 1.0 0.25	10/24/75 6/09/76 6/09/76	4	5	5
5. metribuzin	1.0	6/09/76	2	1	1
6. glyphosate	3.0	5/05/76	7	8	9
7. dinoseb plus dalapon	3.0 8.5	6/09/76 6/09/76	3	5	5

1/ Ratings based on scale of 1 to 9, 1 = 90-100% control, 1 = no control,
7 = commercially acceptable weed control

WEED CONTROL IN POTATOES WITH PREPLANT INCORPORATED HERBICIDES APPLIED ALONE, IN COMBINATION, AND WITH FOLLOW-UP PREEMERGENCE HERBICIDES

R. W. Michieka, R. D. Ilnicki, and J. Somody[1/]

ABSTRACT

The objective of this study was to evaluate some new herbicides and herbicide combinations for weed control and crop tolerance by applying them prior to planting with incorporation and by applying some herbicides prior to planting with soil incorporation followed by preemergence applications of others.

Herbicides and application techniques used in this study included the following: 2-chloro-N-(2-ethyl-6-methyl phenyl)-N-(2-methoxy-1-methylethyl) acetamide (metolachlor) and 5-ethyl dipropylthiocarbamate (EPTC) applied prior to planting; EPTC applied prior to planting and followed by preemergence applications of 2- [[4-chloro-6-(ethylamino)-s-triazin-2-yl] amino] -2-methyl-propionitrile (cyanazine), 2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione (methazole) and combinations of methazole plus 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor); 4-(1,1-dimethyl-ethyl)-N-(1-methyl propyl)-2,6-dinitrobenzeneamine (butralin) applied prior to planting and followed by a preemergence application of 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron); and 4-(amino-6-tert-butyl-3-(methylthio)as-triazin-5(4H)-one (metribuzin) and alachlor each applied alone and in combination with soil incorporation prior to planting.

All prior-to-planting herbicide treatments were applied on April 20, 1976, one day before planting. Sequential or followup herbicide treatments were made immediately after planting. In addition to the herbicide treatments, on May 4 half of each plot (2 rows) was dragged off. Weed control ratings were made on July 28.

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Weeds in the experimental area included lambsquarters (Chenopodium album L.), Pennsylvania smartweed (Polygonum pensylvanicum L.), and barnyardgrass (Echinochloa crusgalli (L.) Beauv.).

Metolachlor was particularly effective on barnyardgrass and Pennsylvania smartweed but ineffective on lambsquarters. The drag-off operation improved control of lambsquarters in these plots but did not improve control of the other two species.

EPTC, alone, produced good control of barnyardgrass but not of lambsquarters or Pennsylvania smartweed. The drag-off operation did not improve control of the two broadleaf weeds and only slightly that of barnyardgrass. An overlay of methazole improved control of the broadleaf weeds to a slight degree but not that of barnyardgrass. The drag-off operation improved only the control of barnyardgrass.

Overlays of cyanazine, i.e., the preemergence applications, on EPTC-treated plots improved control of the three weed species over that of EPTC alone and a subsequent drag-off operation improved control even more.

Combinations of methyazole and alachlor, applied as overlays on EPTC plot improved control of all weeds considerably and the followup drag-off did not improve control greatly.

Sequential applications of linuron over butralin were particularly good on lambsquarters, fair on barnyardgrass, and poor in Pennsylvania smartweed. A drag-off operation improved control even more of lambsquarters but only slightly the control of Pennsylvania smartweed and barnyardgrass.

Metribuzin by itself applied prior to planting was very effective on the broadleaf weeds but poor on barnyardgrass. The drag-off procedure improved control of all weeds. Combinations of alachlor and metribuzin improved control of the grassy weed over that of metribuzin alone and the drag-off operation improved greatly control of all weeds.

No herbicide or herbicide combination affected stands or growth of potatoes.

POTATO VINE KILLING IN MAINE - 1975

Hugh J. Murphy and Michael J. Goven[1]

ABSTRACT

Comparisons of differential rates of 7-oxabicyclo[2.2.1] heptane 2,3-dicarboxylic acid (endothall), 2-*sec*-butyl-4,6-dinitrophenol (dinoseb), 6,7-dihydrodipyrido[1,2 α:2′,1′-*c*] pyrazine diium ion (diquat), 1,1′-dimethyl-4, 4′-bipyridium ion (paraquat), and 2-(ethylamino)-4-(isopropylamino)-6-(methyl-thio)-*s*-triazine (ametryne) were studied for white potato vine desiccation. Dinoseb, endothall, diquat, and paraquat gave satisfactory vine kill in most cases, particularly at the higher rates of active material used. Adjuvants other than #2 oil with dinoseb did not appear to increase activity of ametryne, endothall, or diquat. A volume-pressure study with endothall and dinoseb indicated that the higher volumes of water diluent used along with pressures of 80 psi and higher gave the best vine desiccation. Vine regrowth ratings indicated that the more complete the vine desiccation, the less the vine regrowth.

INTRODUCTION

The following paper reports the results of potato vine killing studies conducted in Maine during the 1975 growing season. In addition, evaluation of tubers harvested from treated plots was made during the 1975-76 storage season, and emergence tests were conducted during the 1976 growing season.

MATERIALS AND METHODS

All desiccants and adjuvants were applied in 80 gallons of water per acre at 40 psi except the study reported in Table 4, and to actively growing potato vines on the dates indicated in each table of data presented. A compressed air sprayer equipped with a two nozzle brush type hand boom was used to apply all foliar applications. Nozzle type used was Delavan Raindrop with No. 33974-3 tips. Plots were single rows, 20 feet long with single buffer rows between desiccant treatments. Plots were arranged in randomized block designs and each treatment replicated 6 times.

Using a 5-step rating system as presented in Table 1, vine kill ratings were made at regular intervals following application of chemical desiccants. At the date of last vine kill ratings, the percent of hills showing vine regrowth was recorded.

At harvest time, approximately 15 pounds of tubers were collected at random from each plot and stored at 50F. for examination during the

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winter storage season. Storage studies included examination of tubers for possible storage disorders, vascular discoloration, and skin blemishes which might be caused by chemical desiccants. Tubers were snipped for vascular discoloration in late December and composited by treatments for storage at 38F. In May 1976, these tubers were planted in replicated field plots to obtain emergence and yield data and to observe any possible side effects which might be related to the 1975 desiccant treatments.

Table 1. Potato vine killing code. Maine - 1975.

1 = Poor or no kill of leaves or stems.
2 = 90% of leaves killed but no stem kill.
3 = 100% of leaves and 40% of stems killed.
4 = 100% of leaves and 70% of stems killed.
5 = 100% of leaves and stems killed.

RESULTS AND DISCUSSION

Data presented in Table 2 suggest that all treatments using endothall provided better desiccation of potato vines than either ametryne or dinoseb. Paraquat, endothall, and dinoseb plus #2 oil gave satisfactory (>3.5) vine kill in this study. The larger amounts of vine regrowth were with dinoseb and endothall. No regrowth was apparent with ametryne because it was still active at the last date ratings were made. The inclusion of Monitor insecticide to kill any aphids attracted to the new growth (regrowth) of vines did not improve the efficacy of the desiccants but did reduce late season leafroll disease infection as read from samples sent to Florida for virus testing. High amounts of tuber vascular discoloration were measured where oil was added to the dinoseb treatments. Emergence data indicated that none of the treatments in this study reduced emergence of plants from tubers harvested in 1975 and used for seed in 1976.

Results of a study to determine the effect of rates of endothall applied as single and split applications on vine killing are presented in Table 3. In this same study several different adjuvants were also included to determine if they would improve the efficacy of the desiccants. Single applications of 1.04 pounds of endothall provided satisfactory (>3.5) vine kill but split applications totaling 1.04 pounds and 2.08 pounds did a much better desiccation job. Diquat at a rate of 0.50 pound per acre gave very good vine desiccation. In this study neither ametryne or dinoseb provided satisfactory vine kill. Of the several adjuvants none appeared to improve the efficacy of endothall to any great extent. The activity of ametryne, however, was increased by the addition of X-77 and UBI-1126. In one case, the data in Table 3 indicates that the adjuvant Wex decreased the activity of endothall applied at 0.52 pound per acre.

A third study in Maine was conducted to determine a range of pressure and water dilution that might improve the vine desiccation activity of endothall and dinoseb. Data presented in Table 4 indicate that with both desiccants higher volumes applied at pressures of 80 psi or higher gave complete vine desiccation and without any vine regrowth.

Table 2. Effect of dinoseb, endothall, ametryne, and paraquat in combination with Monitor on desiccation of Katahdin potatoes. Maine - 1975.

Treatments[1] Pounds of A.I. per Acre	Vine Kill ratings 9-4	Vine Kill ratings 9-11	% Re-growth 9-11	% Vascular Discoloration Slight	% Vascular Discoloration Medium	% Vascular Discoloration Severe	% Emer-gence 1976	% Leaf-roll 1976
No treatment	1.0	1.0	--				99	0.4
1.875 lbs. Dinoseb + 5 gals. #2 oil	3.2	3.5	7.8	14.4	4.8	5.6	100	8.3
1.875 lbs. Dinoseb + 5 gals. #2 oil and 1½ pts. Monitor	3.3	3.2	6.5	12.0	1.2		98	0.6
1.875 lbs. Dinoseb + 1½ pts. Monitor	2.0	1.7	14.0	0.8			99	0.6
1.04 lbs. Endothall + 5 gals. #2 oil	3.9	3.8	8.4	0.8			100	5.2
1.04 lbs. Endothall + 5 gals. #2 oil and 1½ pts. Monitor	4.2	4.1	7.0	1.2			100	0.2
1.04 lbs. Endothall + 1½ pts. Monitor	3.6	3.8	8.2	2.0			100	0.6
2.5 lbs. Ametryne + 8 oz. X-77	1.3	2.4	No				98	
2.5 lbs. Ametryne + 8 oz. X-77 and 1½ pts. Monitor	1.3	2.3	No	0.8			100	
1.5 lbs. Ametryne + 1½ pts. Monitor	1.1	1.6	No	0.4			100	0.2
0.5 lb. Paraquat	3.6	3.9	1.8	0.4			100	4.1
0.5 lb. Paraquat + 1½ pts. Monitor	3.5	3.6	1.4	2.0			100	0.2

[1]Treatments applied - August 29. Weather - clear and sunny. Temperature - 70F. Vine growth - very heavy but senescing.

Table 3. Effect of several adjuvants and split applications of Endothall on desiccation of Katahdin potatoes. Maine - 1975.

Treatments[1] Pounds of A.I. per Acre	Vine kill ratings		% Vascular Discoloration			% Emergence	Yield Cwt./A.
	9-4	9-11	Slight	Medium	Severe	1976	1976
No treatment	1.0	1.0	0.4			98	344
0.52 lb. Endothall	2.7	2.8*				100	318
1.04 lbs. Endothall	3.4	3.6				99	318
0.52 lb. Endothall + 8 oz. X-77	2.9	3.1				100	310
1.04 lbs. Endothall + 8 oz. X-77	3.5	3.5	0.8			100	320
1.04 lbs. Endothall + 2 qts. Booster Plus E	3.6	3.5	0.8			100	312
0.52 lb. Endothall + 5 gals. #2 oil	3.1	2.6*				100	328
0.52 lb. Endothall + 0.25 lb. Paraquat	3.1	3.1	3.2			96	314
0.52 lb. Endothall + 2 qts. Oxy-cop	1.8	1.9*	1.2			98	343
0.52 lb. Endothall + 1 qt. Tronic	3.4	3.5				100	314
0.52 lb. Endothall + 2 qts. Booster Plus E (repeated 5 days later)	2.8	3.7				100	312
1.04 lbs. Endothall + 2 qts. Booster Plus E (repeated 5 days later)	3.6	4.5	6.5	0.5	2.0	100	299
0.52 lb. Endothall + 1.0% UBI-1126	3.5	3.5*				100	314
0.50 lb. Diquat	4.5	4.9	13.5	1.4	0.4	98	291
0.50 lb. Diquat + 2 qts. Booster Plus E	4.2	4.4				99	296
1.25 lbs. Dinoseb + 5 gals. #2 oil	3.2	32.*	0.8	1.2	0.4	100	304
1.5 lbs. Ametryne	1.4	1.8	0.4			96	336
1.5 lbs. Ametryne + 1.0% UBI-1126	2.3	3.0*	2.8			94	318
1.5 lbs. Ametryne + 8 oz. X-77	1.6	2.3				96	322
1.87 lbs. Dinoseb + 2 qts. Booster Plus E	2.9	3.0*	20.1	0.4		100	316
0.52 lb. Endothall + 1 qt. Wex	1.2	1.5*	1.0			100	338

[1]Treatments applied - August 28. Weather - clear, sunny. Temperature - 70F.

*Treatments showing 3 to 5% regrowth on September 11, 1976.

Table 4. Effect of differential pressure and water diluent rates on efficacy of endothall and dinoseb for desiccation of Katahdin potatoes. Maine - 1975.

Desiccant treatment[1] Pounds of A.I. per Acre		Pressure psi	Water dilution gals.	Vine kill ratings 9-18	Vine kill ratings 9-28	% Regrowth 10-3
No treatment		--	--	1.0	1.0	--
0.52 lb. Endothall	+ 2 qts. Booster Plus E	40	40	1.0	1.0	--
0.52 lb. Endothall	+ 2 qts. Booster Plus E	80	40	2.8	3.2	12.4
1.04 lbs. Endothall	+ 2 qts. Booster Plus E	40	40	3.0	3.6	12.0
1.04 lbs. Endothall	+ 2 qts. Booster Plus E	80	40	3.8	4.0	10.8
0.52 lb. Endothall	+ 2 qts. Booster Plus E	40	80	3.8	4.0	10.2
0.52 lb. Endothall	+ 2 qts. Booster Plus E	80	80	4.6	4.8	No
1.04 lbs. Endothall	+ 2 qts. Booster Plus E	40	80	4.0	4.2	5.6
1.04 lbs. Endothall	+ 2 qts. Booster Plus E	80	80	4.8	5.0	No
1.04 lbs. Endothall	+ 2 qts. Booster Plus E	80	120	5.0	5.0	No
1.04 lbs. Endothall	+ 2 qts. Booster Plus E	120	120	5.0	5.0	No
1.04 lbs. Endothall	+ 2 qts. Booster Plus E	150	150	5.0	5.0	No
2.50 lbs. Dinoseb	+ 5 gals. #2 oil	40	40	3.6	3.6	14.8
2.50 lbs. Dinoseb	+ 5 gals. #2 oil	40	80	4.2	4.6	14.6
2.50 lbs. Dinoseb	+ 5 gals. #2 oil	80	120	5.0	5.0	No
2.50 lbs. Dinoseb	+ 5 gals. #2 oil	120	120	5.0	5.0	No
2.50 lbs. Dinoseb	+ 5 gals. #2 oil	150	150	5.0	5.0	No

[1]Treatments applied with a commercial F.M.C. sprayer on September 11. Weather - sunny, cool. Temperature - 60F. Some slight frost damage between 9-18 and 9-28. Killing frost the night of October 2, preventing additional readings.

1976 POTATO VINE KILLING RESULTS - UPSTATE NEW YORK[1/]

Joseph B. Sieczka[2/]

ABSTRACT

Sixteen vine killing treatments were applied to Kennebec potato vines in 1976. Rate of vine desiccation was greatest with paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) at 1.0 lb/A. The combination of ametryn [2-(ethylamino)-4-(isopropylamino)-6-(methylthio)-s-triazine] applied at 1.5 lb/A followed in five days by 1.0 lb of dinoseb (2-sec-butyl-4,6-dinitrophenol) at 1.0 lb/A produced more acceptable results than did either material alone at higher rates. UBI-1126 at 0.25% dilution improved the effectiveness of ametryn. However the performance of other labeled vine desiccants was not improved. UBI-N252 (2,3-dihydro-5,6-dimethyl-1,4-dithiin-1,1,4,4,-tetroxide) was effective in a split application when applied at 1.0 lb/A on 8/31/76 followed by 0.5 lb/A on 9/6/76.

INTRODUCTION

This study is part of an on going program to evaluate methods and materials used to aid in the preharvest desiccation of potato vines. Promising desiccants without label clearance are evaluated annually as are techniques to improve the effectiveness of labeled compounds. Data are collected on rate of vine kill, yield, and tuber quality.

MATERIALS AND METHODS

Experimental treatments were applied to 'Kennebec' potato vines on the Thompson Vegetable Research Farm at Freeville, New York. The potatoes were planted on May 25, 1976, in rows 68 inches apart. The wide spacing facilitated spraying and eliminated the need for guard rows. Plot size was one row by 20 feet long. Plots were arranged in a randomized complete block design with four replications. Treatments were applied with a hand-held, CO_2 pressurized sprayer applying 62 gal/A at 35 psi.

Vine desiccation materials, rates, and dates of application are given in Table 1. The potato vines were showing initial signs of senescence when the first vine killing treatments were applied on August 26.

Plots were harvested on October 10 and 11, 1976. Data reported here include rate of vine desiccation, total yield, and specific gravity. Data on the amount of vascular discoloration, degree of skinning and storability will be collected during the storage period.

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Ratings on vine desiccation are based on a scale of 1 to 9, with the numerical figures applying to the following degree of desiccation:

1. = 0-20% kill of leaves, stems green
2. = 21-40% kill of leaves, stems green
3. = 41-60% kill of leaves, stems green
4. = 61-80% kill of leaves, stems green
5. = 81-100% kill of leaves, stems green
6. = 100% kill of leaves, 1-30% kill of stems
7. = 100% kill of leaves, 31-60% kill of stems
8. = 100% kill of leaves, 61-90% kill of stems
9. = 100% kill of leaves, 90-100% kill of stems

In addition to the above described experiment, observations were made on the performance of dinoseb at 2.0 lb/A combined with Amway Spray Adjuvant at a rate of 1 pt/100 gal of spray.

RESULTS AND DISCUSSION

The fastest rate of vine kill was with single applications of paraquat at 1.0 lb/A & diquat at 1.0 lb/A (see Table 1). The slowest rate of kill was with ametryn applied without an adjuvant at 2.4 lb/A, this treatment was commercially unacceptable. The addition of UBI-1126 at 0.25% of final spray greatly improved the effectiveness of ametryn but did not substanially improve the effectiveness of endothall [7-oxabicyclo-(2.2.1) heptane-2,3-dicarboxylic acid]. The performance of dinoseb at 2.0 lbs/A was about the same with either UBI-1126 or Booster plus E. However, dinoseb at 1.0 lb/A with Booster plus E five days after an application of ametryn at 1.5 lbs/A resulted in better vine desiccation than either used separately at higher rates.

Single applications of diquat at 0.25 and 0.5 lbs/A, and UBI-N252 at 1.0 and 2.0 lbs/A, and two applications of 0.5 lbs/A of UBI-N252 five days apart performed about the same or slightly better than single applications of dinoseb. The split application of UBI-N252 at 1.0 lb followed five days later by 0.5 lb/A resulted in slightly better vine desiccation than the other UBI-N252 treatments.

Observations on four replicates of dinoseb at 2.0 lbs/A combined with Amway Spray Adjuvant indicate that the material is comparable to Booster plus E and other adjuvants used with dinoseb.

Table 1. The effect of vine desiccation treatments on yield, specific gravity and rate of vine kill.

	Treatment			Total Yield	Specific	Rating 1/				
	Material	lb/A	Date	(cwt/A)	Gravity	8/26	8/31	9/6	9/12	9/19
1.	Control			334	1.086	2.0	2.0	2.5	2.5	3.5
2.	ametryn dinoseb + Booster plus E	1.5 1.0 (2 qts)	8/26 8/31	270	1.080	1.8	2.5	5.8	7.8	8.8
3.	dinoseb + Booster plus E	2.0 (2 qts)	8/31	253	1.086		1.5	5.0	6.3	8.3
4.	dinoseb*	2.0	8/31	268	1.084		1.5	4.3	6.0	8.0
5.	ametryn	2.4	8/31	286	1.085		2.0	3.0	4.5	7.3
6.	ametryn*	2.4	8/31	246	1.085		2.5	3.0	6.5	8.8
7.	endothall	1.04	8/31	291	1.085		2.0	4.5	6.5	8.3
8.	endothall*	1.04	8/31	262	1.085		1.5	5.0	7.3	8.5
9.	paraquat**	1.0	8/26	277	1.082	2.3	6.8	8.0	9.0	9.0
10.	diquat**	0.25	8/31	268	1.086		1.8	4.3	6.3	8.0
11.	diquat**	0.5	8/31	280	1.086		1.8	4.8	6.8	8.8
12.	diquat**	1.0	8/31	288	1.084		1.8	5.8	8.3	9.0
13.	UBI-N252*	0.5 0.5	8/31 9/6	269	1.085		2.0	3.8	6.5	8.8
14.	UBI-N252*	1.0	8/31	263	1.083		2.3	4.5	6.8	8.8
15.	UBI-N252*	1.0 0.5	8/31 9/6	271	1.084		2.8	4.5	7.3	9.0
16.	UBI-N252*	2.0	8/31	283	1.085		2.0	4.3	6.8	8.8
	$D_{(.05)}$ Tukey			(68)	(0.006)	(ns)	(1.6)	(1.4)	(2.2)	(1.7)

1/ Rating based on a scale of 1-9, 1=green leaves and stems, 5=all leaves desiccated, green stems, 9=complete kill.

* 0.25% UBI-1126

** X-77 added at a rate of 8 oz/100 gal.

NEW COMPOUNDS WITH POTENTIAL FOR WEED CONTROL IN TOMATOES

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ABSTRACT

Experiments were conducted in 1975 and 1976 to determine the potential of several new herbicides for use in tomato (Lypersicon esculentum Mill.) weed control programs. In direct-seeded tomatoes, FMC 25213 (r-2-ethyl-5-methyl-c-5-(2-methylbenzyloxy)-1,3-dioxane), showed promise for providing broad spectrum weed control. CGA 24705 (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide) and Hoe 23408 were found selective for annual grasses. With transplanted tomatoes, oxadiazon (2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one) preplant (pp) and Hercules 26905 (o-ethyl-o-(3-methyl-6-nitrophenyl)-N-sec butyl phosphorothioamidate) preplant incorporated (ppi) provided effective weed control in addition to the compounds mentioned for the seeded crop. Dinitramine (N^4,N^4-diethyl-a,a,a-trifluoro-3,5-dinitrotoluene-2,4-diamine) provided comparable weed control to the standard trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) treatments. Of the compounds studied, the Hoe 23408 material was of particular interest in view of crop tolerance to both pre and postemergence applications which increases the flexibility of use. Crabgrass (Digitaria sp) did show resistance to postemergence treatments but green foxtail (Setaria viridis (L.) Beauv.) and barnyard grass (Echinochloa crus-galli (L.) Beauv.) were susceptible.

INTRODUCTION

Weed control systems in tomato culture are not entirely satisfactory. Many acres of direct-seeded tomatoes in the mid-west and east are disced under in the spring because of failure of present standard treatments and the prohibitive cost of hand weeding. The objective of these studies was to determine the potential of new herbicides which may aid in weed control programs for tomatoes.

MATERIALS AND METHODS

In 1975 and 1976, experiments were located on a sandy loam soil and sandy clay soil respectively. Organic matter levels ranged from 2.2 to 2.7 percent and pH from 5.8 to 6.7. All experiments were randomized complete block designs with four replications utilizing single row plots 1.5 m by 6.1 m in size. Applications were made with a bicycle plot sprayer delivering 308 L/ha at 2.1 kg/cm^2, using compressed air as a propellant. Preplant incorporated treatments were rototilled 6 to 7.5 cm deep within one hour of application. Chemicals used are listed in Table 1. Treatments, planting and harvesting dates are reported in Table 2. Weed control was measured visually using a 1 to 9 rating system in which 9 represented complete control and 1 no control and where 7 was considered the minimum level to be commercially acceptable. Crop phytotoxicity was determined using a 1 to 5 rating system where 5 represented no injury and 1

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crop kill. In both years, the dominant broadleaf weeds were: common lambsquarters (*Chenopodium albium* L.), smartweed (*Polygonum pensylvanicum* L.), black nightshade (*Solanum nigrum* L.), and redroot pigweed (*Amaranthus retroflexus* L.). Annual grasses were represented by crabgrass, green foxtail, and barnyard grass.

RESULTS AND DISCUSSION

Continuous heavy rainfall throughout the 1975 crop season resulted in several flushes of weeds developing throughout the summer. Since no supplimental cultivation or hand weeding was practiced (except the "weeded controls"), severe weed competition resulted, and many treatments which provided fair to good initial control failed to produce a crop, Table 3. The high rate of CGA 24705 incorporated, provided comparable initial weed control to the standard trifluralin but both proved inadequate for season long weed pressure experienced under the test conditions. Hoe 23405 was found to be only selective for annual grass weeds. Transplanted tomatoes tolerated both preplant and postemergence applications. Crabgrass showed resistance to postemergence Hoe 23408 treatments whereas foxtails were controlled. Combinations of Hoe 23408 with metribuzin, either preplanting or postplanting, provided good control and permitted crop development. Dinitramine at 0.56 kg/ha was comparable to trifluralin at 1.12 kg/ha. Oxadiazon controlled both broadleaf weeds and grasses throughout the season and was judged the best treatment in the test. FMC 25213 also was promising considering crop tolerance and overall weed control.

In 1976, tomato trials were carefully hand weeded after initial weed control ratings were made in June and the % reduction in weeding time (from the untreated controls) was used as an additional measurement of herbicide efficacy. There appeared to be good agreement between visual weed control ratings and hand weeding times, Tables 4, 5, and 6. No significant crop phytotoxicity was observed from any treatments applied in 1976 (data not shown).

Results from the transplanted tomato trial are summarized in Table 4. The high rate of CGA 24705 was comparable to trifluralin, both being somewhat weak against smartweed. The level of control provided by trifluralin was considered commercially acceptable. Oxadiazon provided a good balance of broadleaf and grass control at the 2.2 and 3.4 kg/ha rate. Hercules 26905 also was promising when used preplanting but failed to control weeds when applied postplanting. MV 687 was judged unsatisfactory against broadleaf or grass weeds at either rate used in this test. FMC 25213 applied postplanting with metribuzin failed to control grasses when used in this manner. Butralin was very effective when combined with metribuzin as a preplant tank-mix treatment. Dinitramine at 0.56 kg/ha was comparable to trifluralin at 1.12 kg/ha, as in the 1975 trial. The 1.12 kg/ha rate was considered better since it controlled smartweed more effectively.

In the direct seeded tomato trial, the standard diphenamid treatment failed to provide control of smartweed, Table 5. Postemergence applications of Hercules 26905 or cyperquat over previously treated diphenamid plots did not enhance weed control in this trial. However, the prime objective of these treatments was to determine crop tolerance, and the seedling crop (4 to 5 leaf stage) did withstand the rates used without significant injury. The pebulate/napropamide formulated combination provided borderline control of smartweed but was effective on annual grasses. The higher rate resulted in tip burn of tomato seedlings. MV 687 and CGA 24705 were selective primarily for annual grass weeds providing a high level of control. The addition of metribuzin to CGA 24705 resulted in significantly improved weed control and the greatest reduction in hand weeding time of all treatments in this experiment. FMC 25213 alone provided broad spectrum weed control, and while smartweed escapes were observed, they were severely deformed. However, the presence of these smartweed plants required hand weeding time which was not indicative of performance. FMC 25213 plus metribuzin proved very effective in visual ratings and reduced weeding times significantly. Yield data were not obtained from this trial because of variability in stands related to poor crop germination during a dry period in early May.

Two additional experiments involving Hoe 23408 conducted with seeded and transplanted tomatoes in 1976 are summarized in Table 6. This selective grass herbicide provided grass control comparable to the diphenamid standard without signs of phytotoxicity to the seedling crop at the 2.2 kg/ha rate. Metribuzin used in combination with Hoe 23408 to provide control of broadleaf weeds was fairly effective, but smartweed and nightshade escapes were too numerous to be commercially acceptable. In the transplant trial, tomatoes tolerated up to 4.5 kg/ha of Hoe 23408 applied preplanting even though adequate grass control was achieved at 1.12 kg/ha. Combinations of Hoe 23408 with metribuzin provided better control than trifluralin alone. Postplanting applications of Hoe 23408 alone appeared to give satisfactory initial grass control; however, crabgrass recovered. When Hoe 23408 was combined with metribuzin as a postplanting treatment, the level of grass control remained high throughout the season. The only significant yield reductions occurred in the unweeded control plots and where Hoe 23408 was used alone and broadleaf weed competition occurred.

Data from these experiments support that reported by Mohammed and Sweet (1) that FMC 25213 and Hoe 23408 may have a potential role in weed control programs for tomatoes.

LITERATURE CITED

1. Mohammed, E. S. and R. D. Sweet. 1976. Postemergence applications of metribuzin to direct seeded tomatoes. Proc. Northeast. Weed Sci. Soc. 30: 174-179.

Table 1. Chemical names or designations of herbicides studied.

Common name or designation	Chemical Name
butralin	4-(1,1-dimethylethyl)-N-(1-methylpropyl-2,6-dinitro-benzenamine
CGA 24705	2 chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide
cyperquat	1-methyl-4-phenylpyridinium
dinitramine	N^4,N^4-diethyl-a,a,a-trifluoro-3,5-dinitrotoluene-2,4-diamine
diphenamid	N,N-dimethyl-2,2-dipheylacetamide
FMC 25213	r-2-ethyl-5-methyl-c-5-(2-methylbenzyloxy)-1,3-dioxane
Hercules 26905	o-ethyl-o-(3-methyl-6-nitrophenyl)-N-sec-butyl phosphorothioamidate
Hoe 23408	not available
metribuzin	4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one
MV 687	not available
napropamide	2-(a-naphthoxy)-N,N-diethylpropionamide
oxadiazon	2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one
pebulate	S-propyl butylethylthiocarbamate
trifluralin	a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine

Table 2. Pertinent time sequences for experiments conducted.

	Direct seeded trial	Transplanted tomato trials	
Activity	1976	1975	1976
preplant treatments	4/28	5/21	5/12
planting and variety	4/29 - C-28	5/22 - C-28	5/14 - C-37
preemergence treatments	4/30		
postemergence treatments	6/9 crop 2-3 leaf	6/10	6/4
weed control rating	6/14	6/26	6/22, 8/3
harvest	no	8/25	8/27

Table 3. Response of weeds and transplanted tomatoes to several herbicides at Napoleon, Ohio, in 1975.

Treatment			Weed Control Rating			Yield
Herbicide	Rate kg ai/ha	Appl.	B.L.W.	Grass	Crop Phyto.	Metric Ton /ha
Weeded control	--	--	9	9	5	32.7
Unweeded control	--	--	1	1	5	0
Trifluralin	1.12	ppi	7.8	8.2	5	0
CGA 24705	1.4	pp	6.1	8	5	0
CGA 24705	2.8	pp	6.6	9	5	0
CGA 24705	3.4	ppi	7.5	9	4.7	0
Hoe 23408	2.2	pp	1	9	5	0
Hoe 23408	4.5	pp	2	9	5	0
Hoe 23408	1.12	post	1	7	5	0
Hoe 23408	2.2	post	1	9	5	0
Dinitramine	0.56	ppi	7.2	8.8	5	0
Oxadiazon	2.2	pp	8.0	9	5	29.8
FMC 25213	2.2	pp	7.6	9	5	17.7
Hoe 23408 + metribuzin	2.2 + 0.56	pp	7.2	8.5	4.5	19.5
Hoe 23408 + metribuzin	1.12 + 0.56	post	7.6	9	5	27.8
LSD	5%		0.8	0.6	NSD	NSD
	1%		1.1	0.9		

Table 4. Response of weeds and transplanted tomatoes to herbicides at Napoleon, Ohio in 1976.

			Weed control rating 1-9				% Reduction	
			B.L.W.		Grass		in Hand Weeding	Yield
Treatment	Rate kg ai/ha	Appl.	6/22	8/3[a]	6/22	8/3	Time 6/29	metric ton/ha
Weeded control			8.5	8.6	8.5	7.4	92	59.1
Unweeded control			1.5	2.6	1.5	5.2	--	53.3
Trifluralin	1.0	ppi	7.1	7.0	7.8	8.9	73	61.8
CGA 24705	1.5	ppi	4.8	4.7	6.0	6.6	44	56.4
CGA 24705	3.0	ppi	7.1	7.7	7.5	8.9	77	54.9
CGA 24705 + Metribuzin	1.5 + 0.38	ppi post	7.9	8.5	7.8	8.4	78	50.2
Oxadiazon	1	pp	6.9	6.5	5.3	4.6	62	58.2
Oxadiazon	2	pp	7.8	6.9	6.5	6.9	75	60.7
Oxadiazon	3	pp	7.9	7.7	7.3	7.7	72	63.8
Hercules 26905	2	ppi	6.9	6.8	8	8.4	74	62.3
Hercules 26905	4	ppi	7.9	8.4	8.3	8.8	83	57.1
Hercules 26905	4	post	4.3	4.9	3.3	5.4	0	51.7
MV 687	2	ppi	4.3	3.4	4.3	7.8	39	54.4
MV 687	6	ppi	6.0	6.1	7.0	8.6	61	48.2
FMC 25213 + Metribuzin	1.0 + 0.25	post	6.8	6.4	2.5	5.9	58	50.6
FMC 25213 + Metribuzin	1.5 + 0.38	post	7.6	7.4	5.5	7.6	67	63.2
Butralin + Metribuzin	2 + 0.5	ppi	8.1	8.4	8.0	8.2	76	63.4
Dinitramine	0.5	ppi	7.3	7.0	8.0	8.2	85	65.9
Dinitramine	1.0	ppi	8.0	8.6	8.3	9.0	86	56.7
L.S.D.	5%		1.3	1.0	2.4	2.2	22%	NSD

a note all plots were hand weeded once on 6/29, therefore ratings on 8/3 reflects late germination or regrowth of weeds.

Table 5. Evaluation of weed control performance in direct-seeded tomatoes at Napoleon, Ohio, in 1976.

Treatment	Rate kg ai/ha	Appl.	Weed Control Rating B.L.W.	Weed Control Rating Grass	% Reduction in weeding time
Weeded control	--	--	9	9	98
Unweeded control	--	--	1	1	--
Diphenamid	6.7	ppi	5.3	7	15
Diphenamid + Hercules 26905	3.3 + 2.2	ppi + post	4	3.5	20
Diphenamid + Hercules 26905	3.3 + 4.5	ppi + post	4.8	6.0	17
Diphenamid + Cyperquat	3.3 + 3.3	ppi + post	4.0	5.5	11
Pebulate + napropamide	4.5 + 1.7	ppi	5.1	7.3	43
Pebulate + napropamide	6.7 + 1.7	ppi	7.1	8.3	27
MV 687	2.2	ppi	1.3	8.5	8
MV 687	4.5	ppi	1.5	8.0	22
CGA 24705	1.7	ppi	2.8	8.5	10
CGA 24705	1.7	pre	1.3	8.3	15
CGA 24705	3.3	pre	4.5	8.0	21
CGA 24705 + metribuzin	1.7 + 0.28	pre	6.5	8.3	77
FMC 25213	2.2	pre	7.1	8.0	20
FMC 25213 + metribuzin	1.1 + 0.28	pre	7.4	7.8	55
LSD	5%		1.5	1.7	23

Table 6. Effectiveness of Hoe 23408 in direct-seeded and transplanted tomatoes in 1976.

Treatment	Rate kg ai/ha	Appl.	Weed Control Rating B.L.W.		Weed Control Rating Grass		% Reduction in weeding time	Yield metric ton/ha
Seeded tomatoes			6/10		6/10		6/22	
Weeded control	--	--	9		9		--	
Unweeded control	--	--	1		1		--	
Diphenamid	6.7	ppi	5.3		7.8		39	
Hoe 23408	2.2	pre	2.0		8.3		39	
Hoe 23408 + metribuzin	2.2 + 0.28	pre	6.6		8.0		55	
LSD 5%			1.5		2.1			
Transplanted tomatoes			6/10	7/29	6/10	7/29	6/28	
Weeded control	--	--	9	9	9	9	86	79.1
Unweeded control	--	--	1	1	1	1	--	38.7
Trifluralin	1.12	ppi	6.8	6.4	8.0	8.8	74	72.6
Hoe 23408	2.2	post	1	1	7.8	4.8	15	49.7
Hoe 23408 + metribuzin	1.1 + 0.56	pp	8	7.8	4.8	8.2	72	74.1
Hoe 23408 + metribuzin	4.5 + 0.56	pp	7.9	7.3	8.5	9.0	67	80.9
Hoe 23408 + metribuzin	1.1 + 0.56	post	8.1	7.6	8.0	8.0	75	69.7
Hoe 23408 + metribuzin	2.2 + 0.56	post	8.0	7.1	8.0	9.0	70	66.3
LSD 5%			1.3	1.1	1.8	1.9		19.0

POSTEMERGENCE COMBINATIONS OF METRIBUZIN WITH CERTAIN INSECTICIDES AND A FUNGICIDE ON POTATOES AND TOMATOES[1/]

D. T. Warholic, E. S. Mohammed, G. W. Selleck, and R. D. Sweet[2/]

ABSTRACT

Metribuzin [4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)one] at 0.2, 0.25, and 0.5 lb/A was combined with the insecticides carbofuran, azinphosmethyl, parathion, methamidophos, and the fungicide mancozeb and sprayed postemergence on Katahdin potatoes (*S. tuberosum*) at two sites in New York State. Postemergence combinations of 0.125 lb/A of metribuzin with either endosulfan or azinphosmethyl were also sprayed on direct seeded tomatoes (*L. esculentum* cv. New Yorker).

Where postemergence applications were early and where only two types of pesticides were combined in one spray potato yields were not affected. However, in tomatoes, metribuzin in combination with endosulfan or azinphosmethyl reduced early fruit yield. A metribuzin-endosulfan combination also reduced total fruit yield.

INTRODUCTION

It has been shown that multiple low rates of metribuzin applied postemergence are both safe and effective on Katahdin potatoes (1, 2) and direct seeded tomatoes (3). If it were possible to combine other pesticides with these low rates of metribuzin, some advantages could be gained in terms of convenience, number of trips in the field, etc.

To be practical the timing of any herbicide-pesticide combination would have to coincide with the control objectives of each pesticide. In both potatoes and direct seeded tomatoes a fungicide or insecticide spray can be synchronized with postemergence weed control application. In potatoes the timing of the first low rate postemergence application of metribuzin can be integrated into the fungicide program for late blight (*Phytophthora infestans*) or the insecticide program for control of the Colorado potato beetle (*Leptinotarsa decemlineata* Say) (4). In direct seeded tomatoes, the timing of the first herbicide spray coincides with the first insecticide spray for flea beetle (*Epitrix cucumeris* Harris) (5).

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The objectives in these studies, therefore, were to determine whether some selected metribuzin-pesticide combinations used on tomatoes and potatoes were: 1) compatible in the tank, 2) not antagonistic to pesticide activity, and 3) safe on the crops.

MATERIALS AND METHODS

This report is a summary of a single year's work on potatoes at two locations, the Homer C. Thompson Vegetable Research Farm near Ithaca, and the Long Island Vegetable Research Farm near Riverhead, NY. The tomato work is also based on one year's work at the Freeville site only.

Freeville Potato Study

In mid-April 800 lb/A of 13-13-13 was broadcast and plowed down. Katahdin potatoes were planted on 34" centers, 9" between seed pieces on May 17. An additional 1250 lbs of 12-24-12 fertilizer was banded through the planter. The plots were dragged off on June 2 with a finger weeder set to cultivate about 2" in depth. The entire experimental area was then sprayed with 3 lbs/A of dinoseb (2-sec-butyl-4,6-dinitrophenol) to suppress broadleaf weeds.

On June 26 one postemergence application of metribuzin was applied alone or in combination with 0.5 lb/A of carbofuran[3/] or azinphosmethyl or 2 lb/A of mancozeb. At the time of application the crop was 12 to 14" tall and redroot pigweed (Amaranthus retroflexus L.) 2 to 6" in height. Crop and weed ratings were taken on July 1. Weeds were removed in all plots not treated with an herbicide and in the dinoseb check on July 3.

All treatments were applied with a hand held CO_2 pressurized small plot sprayer delivering 45 gal/A at 35 psi through Tee-Jet 8004 flat spray nozzles. All rates are reported in active ingredient. Plot size was 6 x 20', two rows of potatoes per plot, three replications and arranged in a RCB design. Tubers were harvested on October 1.

Long Island Potato Study

Katahdin potatoes were planted on 34" centers 12" between seed pieces on April 23, and at the same time 1875 lbs of 8-16-8 was banded.

A few plots received 0.5 lb/A of metribuzin alone preemergence on May 5 followed (by another 0.5 lb postemergence spray) on June 1 by a postemergence application containing 0.5 lb of metribuzin, 1.5 lb of mancozeb, plus either carbofuran, azinphosmethyl, parathion, or methamidophos.[4/] Most of the plots

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3/ Carbofuran is marketed as Furadan. Azinphosmethyl is marketed as Guthion.

4/ Methamidophos is marketed as Monitor.

were treated with two postemergence sprays of metribuzin at either 0.2 or 0.5 lb/A. All these sprays included in addition to metribuzin, 1.5 lb of mancozeb, and one of the insecticides mentioned above and were applied on June 1 and 19. The whole experimental area was cultivated before the second postemergence spray was applied. Potatoes were 10" high on June 1 and at layby on June 19. Treatments were applied with a tractor-mounted sprayer delivering 100 gal/A at 60 psi with cone nozzles. The weekly routine fungicide-insecticide program was continued until harvest. Potato, ladysthumb (*Polygonum persicaria* L.) and barnyardgrass (*Enchinochloa crusgalli* L.) ratings were taken on June 11 and August 19. Potatoes were harvested on October 7. Plots were 5.6 x 30' and were sprayed in a RCB design with four replication.

Freeville Tomato Study

Plots were seeded on 34" centers on May 24 with two rows of New Yorker tomatoes. One postemergence treatment of metribuzin alone at 0.125 lb/A or the same rate of metribuzin plus either endosulfan or azinphosmethyl at 1 lb/A was applied on June 11. At this time tomatoes were in the 1 to 2 true leaf stage, pigweed at 2 to 4 leaf and lambsquarter (*Chenopodium album* L.) at 4 to 6 leaf stage. All treatments were applied with a hand held CO_2 pressurized small plot sprayer delivering 55 gal/A at 35 psi with Tee-Jet 8004 flat spray nozzles. Visual crop and weed ratings were taken on June 17. Tomato plants were thinned to 12" and all plots hand weeded on June 24. Weed free plots were maintained until the experiment terminated. Flower clusters were counted June 22. Data on plant number, plant fresh and dry weight, red ripe fruit and total fruit yield was taken from 20' of row on September 9. Only the latter two harvest indices will be reported here.

RESULTS AND DISCUSSION

Freeville Potato Study

No tank incompatabilities and no precipitates were apparent during mixing or spraying any of the metribuzin-pesticide combinations. Although 3 lb/A of dinoseb was applied over the entire experimental area the redroot pigweed stand was sufficient for a weed control assessment on the performance of metribuzin. The results of this experiment are summarized in Table 1. Weed activity of metribuzin was not decreased by the addition of carbofuran, azinphosmethyl or mancozeb. No phytotoxicity to the crop was observed with either rate of metribuzin alone or any pesticide combination. Crop safety was also confirmed by yield data which revealed no significant yield differences among treatments. It is believed the slightly lower yields in the non-herbicide and dinoseb plots were due to the slight delay in hand weeding the plots and not from any chemical treatment.

Long Island Potato Study

Methods as well as results differ from the Freeville study. These methods should be kept in mind when considering the results. First of all, combinations in the Freeville study included either an insecticide or a fungicide with metribuzin, not both. In the Long Island study all three were combined for all postemergence applications while none was applied singly. Secondly, at Freeville a single metribuzin pesticide spray was applied whereas at Long Island most plots received two postemergence applications. In addition, a few preemergence treatments were made on Long Island.

It is quite clear in the Long Island test that those plots receiving one postemergence spray yielded substantially higher than plots receiving two sprays (Table 2). With the information at hand we can only speculate about the causes of this yield difference. All treatments have one postemergence treatment in common but not the layby or the preemergence treatments. Both the layby and preemergence treatments, therefore, should be held suspect. It is impossible to say whether a single chemical or some permutation of the three chemicals used at layby was responsible. The results from Freeville suggest that the 2 oz rate of metribuzin should not reduce yields (1, 2). This year's results from this same station agree that rates of metribuzin at 0.25 or 0.5 lb/A alone or in combination with one other pesticide was safe on Katahdin potatoes. This suggests that the combination of the three pesticides at layby may be responsible for the reduced yields.

A yield increase resulted wherever metribuzin was applied preemergence but it would be difficult to attribute the increases to this treatment unless we assumed that early weed competition was a significant factor, however, this was not the case. Other factors, especially soil type and rainfall differences, cannot be ruled out. It is obvious that additional work will have to be done.

Some positive results coming from this test are: 1) no tank incompatibilities were observed with any metribuzin-fungicide-insecticide combination, 2) two applications of metribuzin either one pre and one post or two post applications were necessary for acceptable control of barnyardgrass and ladysthumb, 3) the addition of a fungicide and insecticide did not appear to diminish the efficacy of metribuzin.

Freeville Tomato Test

As in the two potato tests, no antagonsim in the tank and no decrease in weed activity of metribuzin was observed in any of the tank mixes (Table 3). In addition, it was again observed that very low rates of metribuzin if properly timed would provide effective broadleaf control with good crop safety.

Little or no phytotoxicity was observed with most of the treatments. The combination of metribuzin and endosulfan appeared to be slightly injurious. A delay in removing the weeds in the insecticides and weeded plots had an overriding effect on these treatments. Flower cluster number, red fruit and total fruit yields were reduced. There was good agreement between these latter three measurements where fruit cluster number was high, red fruit and total fruit yield were also high. Low flower cluster number correlated well with low red fruit and total fruit yields.

The red fruit yields from those plots treated with 0.125 lb of metribuzin was significantly higher than every other treatment. In total fruit yield this treatment was significantly higher than in all plots where endosulfan was used.

Wherever metribuzin was used in control of redroot pigweed was excellent. These plots, therefore, should have been free from the effect of weed competition which strongly influenced the other plots. Surprisingly though, flower cluster number, red ripe fruit and total yield in those plots where metribuzin was combined are low. Both pesticide combinations are significantly lower in red fruit yield as compared to metribuzin sprayed alone. In total fruit yield only the metribuzin-endosulfan combination was significantly lower than the metribuzin plots. This suggests that there is an interaction between metribuzin and endosulfan.

Follow-up work is needed to determine if yield reduction in spite of minimum visible phytotoxicity is a typical response to be expected with seeded tomatoes.

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Table 1. Metribuzin applied postemergence alone or in combination with either an insecticide or fungicide on Katahdin potatoes (Freeville).[c]

Treatment	lbs/A	Rating[a] Crop	RRPig.	Total Yield cwt/A
1. metribuzin	0.25	9.0	8.3	507
2. metribuzin	0.50	9.0	8.0	515
3. carbofuran	0.50	9.0	3.0	483
4. azinphosmethyl	0.50	9.0	3.3	470
5. mancozeb	2.00	9.0	4.3	464
6. metribuzin	0.25			
carbofuran	0.50	9.0	8.0	542
7. metribuzin	0.50			
carbofuran	0.50	9.0	8.3	496
8. metribuzin	0.25			
azinphosmethyl	0.50	9.0	8.7	512
9. metribuzin	0.50			
azinphosmethyl	0.50	9.0	8.0	507
10. metribuzin	0.25			
mancozeb	2.00	9.0	8.0	518
11. metribuzin	0.50			
mancozeb	2.00	9.0	8.3	513
12. dinoseb[b]	3.00	9.0	4.3	482
				ns
		Coefficient of variation		9.9%

[a] 1=no effect on weeds, complete kill of crop; 7=commercially acceptable weed control and crop; 9=complete weed kill, no effect upon crop

[b] Applied delayed preemergence

[c] Mean of three replications

Table 2. Crop and weed ratings for selected metribuzin-pesticide tank mix combinations (Riverhead).

	Treatment	Rate lb/A	Timing [a]	Ratings Potato [b]	Smartweed [c]	Barnyard-grass [c]	Yield cwt/A
1.	metribuzin metri+carbofuran	0.5 0.5+1.0	Pre Post	0.5	9.9	9.5	408*
2.	metribuzin metri+azinphos.	0.5 0.5+1.0	Pre Post	0.5	9.8	9.5	436*
3.	metribuzin parathion	0.5 2.0	Pre Post	0.5	9.7	9.3	417*
4.	metribuzin	0.5 1.0	Pre Post+Post	0.5	9.8	9.6	429*
5.	metribuzin carbofuran	0.2 1.0	Post+Post	0.5	9.9	9.8	382
6.	metribuzin azinphosmethyl	0.2 1.0	Post+Post	0.5	9.9	9.6	344
7.	metribuzin parathion	0.2 2.0	Post+Post	1.0	9.9	9.7	355
8.	metribuzin	0.2 1.0	Post+Post	0.5	9.9	9.8	364
9.	metribuzin carbofuran	0.5 1.0	Post+Post	1.5	9.9	9.8	342
10.	metribuzin azinphosmethyl	0.5 1.0	Post+Post	1.5	9.9	9.7	352
11.	metribuzin parathion	0.5 2.0	Post+Post	1.0	9.9	9.8	371
12.	metribuzin	0.5 1.0	Post+Post	1.0	9.0	9.8	355
13.	carbofuran	1.0	Post+Post	1.0	8 ft^2	8 ft^2	365
14.	azinphosmethyl	0.5	Post+Post	0.5	6 ft^2	13 ft^2	343
15.	parathion	2.0	Post+Post	0.5	7 ft^2	10 ft^2	310

[a] All postemergence treatments included 1.5 lbs of mancozeb

[b] 0=no injury; 10=complete kill, rated 6/11

[c] 1=no control; 10=complete kill, rated 8/19

* Significant from checks at 1% level

Table 3. Visual ratings, flower number, and tomato yield from postemergence metribuzin-insecticide combinations.[b]

	Treatment	lb/A	Rating[a] Tomato	Rating[a] RRP	Flower Cluster Per Plant	Fruit Ripe	Total lb/plot
1.	metribuzin	0.125	7.7	9.0	2.0	13.5	52.1
2.	endosulfan	1.000	9.0	1.3	0.8	4.0	29.2
3.	azinphosmethyl	1.000	8.7	1.7	1.0	3.8	33.6
4.	metribuzin endosulfan	0.125 1.000	7.3	9.0	1.3	6.3	30.0
5.	metribuzin azinphosmethyl	0.125 1.000	7.7	8.7	1.4	7.8	43.5
6.	hand weeded	--	7.7	1.0	0.9	3.2	31.1
7.	not weeded	--	8.3	1.7	0.1	0.1	0.3
					Bayes LSD 5%	4.4	21.7

[a] 1=no effect on weeds, complete kill of crop; 7=commercially acceptable weed control and crop; 9=complete weed kill, no effect upon crop.

[b] Mean of three replication

THE EFFECT OF STRESSING ON STAND AND YIELD OF METRIBUZIN-TREATED TOMATO TRANSPLANTS

E. H. Nelson and R. A. Ashley[1)]

ABSTRACT

Tomato (Lycopersicon esculentum Mill. 'Heinz 1350') transplants were grown in a greenhouse at 16.5 C with watering as required and weekly supplemental nutrient application. Three weeks before field-setting, half of the transplants were stressed by means of water and nutrient deprivation. A set of transplants, containing both stressed and unstressed plants, was treated with .56kg ai/ha metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)one) 3 days after field-setting; another set of transplants, stressed and unstressed, was treated at the same rate 10 days after field-setting. Stands of unstressed transplants were significantly reduced by the metribuzin either 3 or 10 days after field-setting. The metribuzin applied 3 days after planting reduced the early yield of unstressed plants significantly although application 10 days after planting did not significantly affect early yield. Total yields were improved significantly for stressed treated plants as compared to unstressed treated plants. Yields on a per plant basis were unaffected by stressing and/or metribuzin treatment.

INTRODUCTION

It is generally accepted that plants subjected to a specific stress are often more tolerant of a variety of subsequent physiological stresses (1). In 1976, an experiment was conducted at the University of Connecticut Agronomy Research Farm in Storrs, Ct., to determine the response of stressed and unstressed tomato transplants to metribuzin applied either 3 days or 10 days after field-setting.

MATERIALS AND METHODS

Heinz 1350 tomatoes, recognized as "moderately tolerant" of metribuzin (2), were seeded in the greenhouse April 2, transplanted to a peat-vermiculite mix in 5.5 cm peat pots April 13, and field-set May 21. On May 3, approximately 3 weeks before field-setting, the transplants were separated into two groups. The first group was watered daily and fertilized weekly with 20-20-20 soluble fertilizer. These transplants were considered unstressed. The second group of transplants was watered only at the stage of visible wilting and was not fertilized. These transplants were considered stressed. At the time of setting-out, the unstressed transplants averaged 30 cm and had six true leaves. The stressed counterparts averaged 23 cm and had six true leaves. The stressed plants had noticeably shorter internodes and anthocyanescent veins.

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Two individually randomized experiments, each containing both stressed and unstressed transplants, were planted on May 21. Three m rows containing five plants each were planted 1 m apart. The soil was Woodbridge fine sandy loam with pH 6.2 and 3% organic matter content. Each of the two experiments was arranged in a randomized complete block design with four replicates. Each block contained four plots: 1) unstressed untreated transplants, 2) unstressed treated transplants, 3) stressed untreated transplants, and 4) stressed treated transplants.

The two experiments differed only in the time of herbicide application. On May 24, 3 days after planting, plots in the first experiment were treated preemergent to weeds with metribuzin at .56kg ai/ha. On June 1, 10 days after planting, plots of the second experiment were treated. At the time of the June 1 herbicide application, lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), common ragweed (Ambrosia artemisiifolia L.) and large crabgrass (Digitaria sanguinalis L. Scop.) up to 1.5 cm were evident. Weather data for transplant time, herbicide application time, and 1 week following appear in Table 1.

Crop injury and weed control ratings were taken seven times from May 27 to August 6. Crop injury was measured as stand reduction or degree of tissue damage (0-no damage; 10-complete kill). Yield data, the number and weight of fruit, were taken from July 26 through September 27. Harvests up to and including that of August 16 were reported as early yield since market conditions were such that tomatoes commanded a relatively high price throughout that period. Untreated plots were hand weeded to minimize any effect of weed competition on yield.

RESULTS AND DISCUSSION

Metribuzin at .56kg ai/ha provided excellent control of the dominant broadleaf species (lambsquarters, redroot pigweed, and common ragweed) over a two-month period and good season-long control. Initial control of large crabgrass, the dominant grass species, was excellent. However, this species reappeared after 7 weeks, more quickly than any other species.

Adverse weather conditions, cloudy days and low night temperatures, apparently affected the survival of all transplants. Untreated controls, stressed and unstressed, were reduced 10% and 14% (Table 2), respectively, in the first experiment. Stressed transplants did, however, show significantly less stand reduction with application of metribuzin 3 days after transplant than did unstressed transplants, 30% vs 70%, respectively (Table 2). There were no differences in stand reduction at the .05 level among the untreated plants and the stressed treated plants. Only the unstressed treated plants showed significantly reduced stand.

Table 1. Weather data recorded at University of Connecticut Agronomy Research Farm 5/20/76 to 6/10/76

May	20	1) 21	22	23	2) 24	25	26	3) 27	28	29	30	31
Air temperature-high (C)	8.9	12.2	22.2	16.7	17.2	18.3	12.8	14.4	23.3	26.1	22.2	20.0
Air temperature-low (C)	1.1	3.3	5.6	3.9	6.1	5.6	7.8	6.1	12.8	8.9	12.8	11.1
Light conditions	Cldy	Cldy	Clr	Clr	Clr	Clr	PCldy	PCldy	Clr	Clr	Cldy	PCldy
Rainfall (cm)	1.45											

June	4) 1	2	3	5) 4	5	6	7	8	9	10
Air temperature-high (C)	25.0	21.7	19.4	21.1	21.7	23.3	18.9	24.4	29.4	29.4
Air temperature-low (C)	13.9	7.8	7.2	5.0	6.7	10.6	9.4	13.3	12.2	14.4
Light conditions	PCldy	Cldy	Clr	Clr	Clr	PCldy	PCldy	Clr	Clr	Clr
Rainfall (cm)		3.0					.15			

1) Tomatoes field-set
2) Experiment 1 treated
3) Experiment 1 first observation
4) Experiment 2 treated
5) Experiment 2 first observation

Table 2. Stand reduction in tomato transplants treated with .56kg ai/ha metribuzin 3 days or 10 days after field-setting

Stressing treatment	Time of metribuzin application following field-setting 3-Day		10-Day	
	Stand reduction 1) rating	2) %	Stand reduction 1) rating	2) %
Unstressed untreated	.7	14	.7	15
Unstressed treated	3.5	70	1.2	25
Stressed untreated	.5	10	0	0
Stressed treated	1.5	30	.5	10
LSD	1.7	--	.6	--

1) Stand reduction using treatment means (plants killed per rep) with 5 plants per treatment and 4 replications
2) Stand reduction using percentages

After 10 days of continued cool, partly cloudy weather, the second experiment of unstressed and stressed plants was treated with metribuzin. Unstressed and stressed controls showed 15% and 0% (Table 2) stand reduction, whereas unstressed and stressed treated plants showed 25% and 10% stand reduction. The stand of stressed untreated plants was not reduced, and stand reduction of stressed treated plants was not significantly different compared to that of stressed untreated plants. In terms of stand, the response of stressed plants, treated and untreated, was significantly better than that of unstressed untreated plants which was, in turn, significantly better than that of unstressed treated plants.

The trend among the treatments was similar whether herbicide application occurred 3 or 10 days after transplant. The overall lower stand reduction (Table 2) of plants treated after 10 days may have been due to stressing of all plants in the field brought about by cool weather between the time of transplanting and the time of herbicide application.

Ratings for tissue damage were taken 4 days after herbicide treatment in each of the two experiments. Among those plants in the experiment treated with metribuzin 3 days after field-setting (Table 3), the amount of tissue damage was highly significant for unstressed treated plants as compared to all other plants. Of those plants in the experiment treated 10 days after field-setting, unstressed untreated plants and stressed treated plants responded similarly with moderate (approximately 1.5 rating) tissue damage. Unstressed treated plants exhibited significantly more damage, stressed untreated plants significantly less.

Table 3. Tissue damage to tomato transplants treated with .56kg ai/ha metribuzin 3 days or 10 days after field-setting

Time of treatment	Condition of tomato plants				
Days after planting	Unstressed untreated	Unstressed treated	Stressed untreated	Stressed treated	LSD (.05 level)
3	3.2[1]	5.9	2.8	3.9	1.2
10	1.6	2.3	1.1	1.6	.4

1) Stand reduction (0-none; 10-complete kill)

The amount of tissue damage 4 days after treatment was ultimately reflected in stand reduction (Table 2). Surviving individual plants, stressed and unstressed, treated and untreated, even in plots sustaining significant tissue damage, tended to produce similar yields. Therefore, the critical amount of tissue injury reported on a per plot basis was reflected in stand reduction and eventual total yield reduction. There were no differences in yields on a per plant basis. The amount of tissue damage was critical only as it influenced stand which, in turn, influenced total yield rather than yield on a per plant basis (Table 4).

Using the market price of tomatoes in Connecticut in 1976 as the criterion, the harvests up to and including that of August 16 were considered in calculating early yield. Plants treated 10 days after field-setting exhibited no differences in early yields (Figure 2 and Table 4). When herbicide application took place only 3 days after transplant, the herbicide treatment reduced early yield with a significant difference between untreated and treated plants. Of the treated plants, the stressed plants produced better early yields than did the unstressed.

Total yields reflected highly significant differences among the treatments. Unstressed plants and stressed treated plants produced comparable yields when treated 3 days after field-setting. Only for unstressed treated plants were yield reductions highly significant. Therefore, stressing dramatically decreased stand reduction and increased total yield of metribuzin-treated transplants as compared to unstressed treated transplants. Among the plants treated after 10 days, a similar trend occurred. Stressed treated plants again produced significantly higher yields than unstressed counterparts. In general, stressing proved advantageous as stressed transplants produced comparable yields whether treated or untreated, and these yields were significantly better than those of unstressed transplants, treated and untreated (Figures 1 and 2 and Table 4).

Figure 1. Early and total yields of Heinz 1350 tomato transplants treated with .56kg ai/ha metribuzin 3 days after field-setting

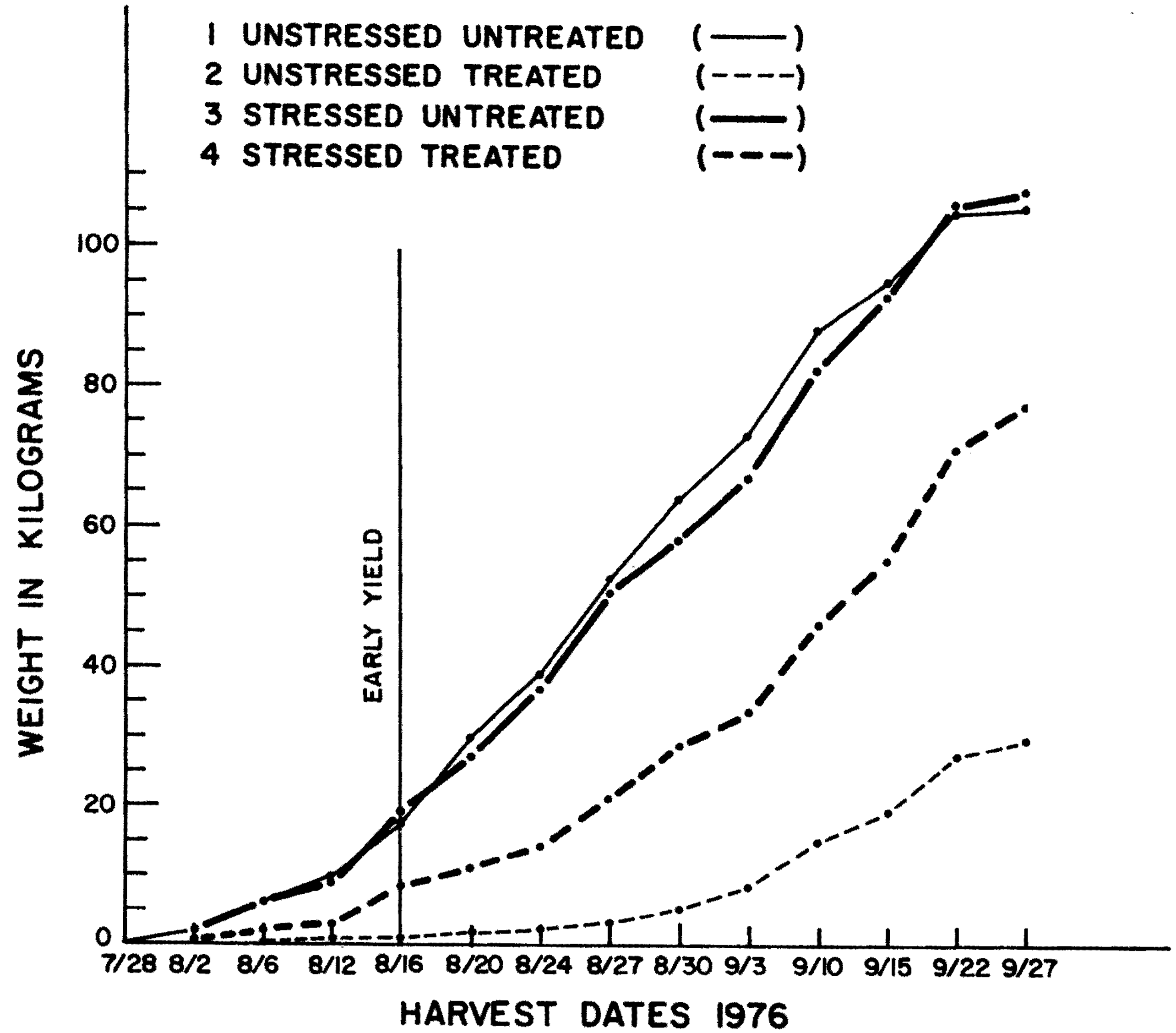

Figure 2. Early and total yields of Heinz 1350 tomato transplants treated with .56kg ai/ha metribuzin 10 days after field-setting

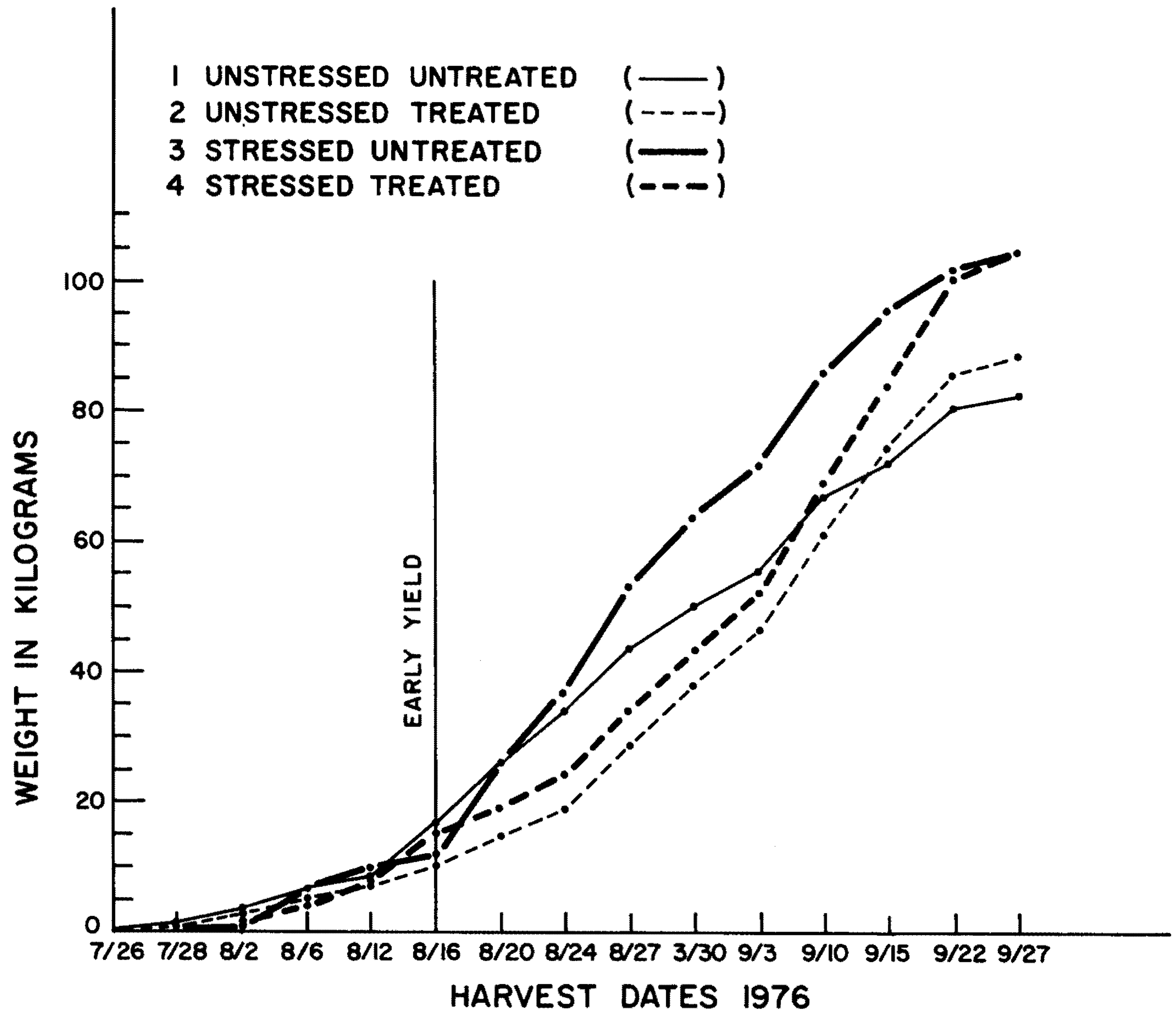

Table 4. Weights in kilograms of tomatoes harvested from transplants treated with .56kg ai/ha metribuzin 3 days or 10 days after field-setting

	Condition of tomato plants				
	Unstressed untreated	Unstressed treated	Stressed untreated	Stressed treated	LSD (.05 level)
Early yield 3-day treatment	4.42	0.36	5.03	2.17	1.38
Early yield 10-day treatment	2.10	1.82	2.48	1.97	NS
Per plant yield 3-day treatment	6.41	3.65	6.03	5.37	NS
Per plant yield 10-day treatment	4.90	5.84	5.35	5.95	NS
Total yield 3-day treatment	26.71	7.37	27.13	18.66	9.65
Total yield 10-day treatment	20.61	21.90	26.78	26.49	4.53

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LOW RATES OF LINURON ON CARROTS AND PARSNIPS[1]

Sudabathula R. Rao and R. D. Sweet[2]

ABSTRACT

Three experiments were conducted to evaluate the response of carrots (Daucus carota L.) and parsnips (Pastinaca sativa L.) to single and multiple applications of linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea] alone or in combination with stoddard solvent and trifluralin (α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine). Linuron, stoddard solvent, or trifluralin alone failed to give acceptable control of grasses and broadleaves. Single and multiple applications of linuron at 2, 4, and 8 oz/A alone failed to control annual grasses and at 1 and 2 lb/A injured both crops. Excellent weed control and crop tolerance was obtained by one or two applications of linuron at 2 or 4 oz/A following trifluralin preplant incorporated or stoddard solvent early postemergence. Linuron at 4 oz/A applied 3 or 7 days after the application of stoddard solvent injured parsnip but not carrots. However, 8 oz/A at this short time interval injured both crops.

INTRODUCTION

Carrots and parsnips are very vulnerable to weed growth because of their slow emergence and long growing season. Linuron has been widely used, but single applications either fail to give season long weed control or injure crops when applied postemergence (1, 6). Stoddard solvent has also been used extensively, however, it often fails to control late emerging grasses (2). Trifluralin gives good control of annual grasses, but is inconsistent in controlling broadleaves, especially redroot pigweed (Amaranthus retroflexus L.) (3). Multiple applications of linuron alone or in combination with trifluralin were reported to give good weed control and carrot yields (4, 5). Ivany, Dickerson, and Sweet (2) demonstrated the differential tolerance of carrot varieties to high rates of linuron following the early postemergence application of stoddard solvent. Growers in New York State have also obtained injury on carrots when linuron was applied soon after the application of stoddard solvent.

The purpose of this research was two-fold: 1) to determine the response of carrots and parsnips to low rates of single and multiple applications of linuron alone or in combination with trifluralin and stoddard solvent, and 2) to determine how soon linuron can be applied without injuring carrots following the early postemergence application of stoddard solvent.

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MATERIALS AND METHODS

A total of three experiments were established on Eel silt loam soil at the Thompson Vegetable Research Farm, Freeville, NY. Prior to plowing 1000 lb/A of a 15-15-15 fertilizer was broadcast in late May and the experimental area was disced twice after plowing. The entire area was fitted with a spring tooth harrow and meeker harrow just prior to the application of preplant incorporated (PPI) treatments. Plots measuring 6 ft. x 15 ft. were laid out and certain treatments applied. Within an hour, a spring tooth harrow set to operate 2 to 3 inches deep and a meeker harrow were pulled over the entire experimental area down and back in the same direction at 5 mph speed. All the plots were then restaked and seeded. All chemical treatments were applied with a hand-held CO_2 powered small plot sprayer equipped with four 8004 nozzles in a boom. Spray volume was 60 gal/A applied at 35 psi.

The first two experiments were seeded on June 16, 1976 and June 18, 1976, respectively. One row each of Gold Pak and Scarlet Nantes carrots and one row of All-America parsnips were planted in Experiment I and two rows of Gold Pak carrots were planted in Experiment II. Experiment III was seeded on June 10, 1976 as in Experiment I, but in addition, one row was seeded to Japanese millet [*Echinochloa frumentacea* (Roxb.) Link.]. The seeding depth was 1/4 inch for all the species and varieties. Preemergence treatments were applied on the same day of planting. Delayed preemergence (DP) treatments, however, were made 3 and 8 days after planting before crops and weeds emerged in Experiment II and III, respectively. All treatments were replicated twice in a randomized block design. Supplemental watering was given by sprinkler under dry weather conditions. Timings of herbicide applications and stages of growth of crops and weeds are presented in Table 1.

Visual ratings of weed control and crop response were made for all three experiments. Carrot yields were taken in the third experiment. Weed species present were redroot pigweed (*Amaranthus retroflexus* L.), chickweed [*Stellaria media* (L.) Cyrillo], hairy galinsoga [*Galinsoga ciliata* (Raf.) Blake], common purslane (*Portulaca oleracea* L.), smooth crabgrass [*Digitaria ischaemum* (Schreb.) Muhl.] and witchgrass (*Panicum capillare* L.).

RESULTS AND DISCUSSION

In general, there was some stand reduction of carrots and parsnips due either to heavy rainfall or to seeding problems.

Experiment I: Application of linuron, trifluralin, or stoddard solvent alone failed to give acceptable weed control (Table 2). Linuron at 1 lb/A applied late postemergence alone or in combination injured both carrots and parsnips. Foliar injury on carrots with linuron at 3/4 to 1 lb/A post has also been reported by other workers (1, 2, 5) and is further substantiated in this test. Three applications of linuron at 2, 4, or 8 oz/A either failed to control annual grasses or injured the crops. However, excellent weed control and crop tolerance was obtained with two applications of linuron at these same rates following the early post application of stoddard solvent.

Table 1. Growth stages of crops and weeds at various timings of herbicide application.

Crop/Weed Species	Experiment I			Experiment II			Experiment III					
	EP[1] 21 DAP[2]	Post 24 DAP	LP 38 DAP	EP 16 DAP	Post 23 DAP	LP 31 DAP	EP 18 DAP	EP+ 3 days 21 DAP	EP+ 7 days 25 DAP	Post 28 DAP	Post 7 days 35 DAP	LP 38 DAP
carrots	1-2 lf	2 lf	6-7"	cotyl	2-3 lf	4-5"	1-2 lf	1-2 lf	2-3 lf	2-3 lf	4-5"	4-6"
parsnips	cotyl	1 lf	3"	--	--	--	1 lf	1 lf	1-2 lf	2 lf	3 lf	3 lf
annual grasses[3]	2-5"	3-5"	2'	1-1.5"	3-4"	1'	3-4 lf	4-5 lf	5-6 lf	1.5'	2'	2-2.5'
chickweed	--	--	--	--	--	--	4 lf	8 lf	8-12 lf	3-6"	3-6"	3-7"
galinsoga	2"	3"	1'	1"	2.5"	10"	4 lf	6 lf	8 lf	3"	5"	8"
pigweed	3"	8"	1.5'	1"	3"	1'	5 lf	8 lf	8-9 lf	6"-1'	6"-1'	1.5-2'
purslane	3-4"	5"	1.5'	1-2"	4-6"	7-8"	--	--	--	--	--	--

[1] EP=early post; LP=late post
[2] DAP=days after planting
[3] Annual grasses include Japanese millet, smooth crabgrass and witchgrass

Table 2. Influence of single and multiple applications of linuron alone or in combination with trifluralin and stoddard solvent on crops and weeds (Experiment I).

Chemical (lb/A) and Timing	Visual Ratings[1]					
	Crop Response[2]		Weed Control[2]			
	Carrots	Parsnips	Annual Grasses[3]	Galinsoga	Pigweed	Purslane
1. stoddard solvent 75 GPA EP	8.0	8.5	9.0	1.0	8.0	8.5
2. trifluralin 3/4 PPI	8.0	5.0	9.0	4.5	6.0	6.5
3. linuron 1 LP	7.0	5.5	3.0	4.0	4.5	3.0
4. stoddard solvent 75 GPA EP +linuron 1/8+1/8 Post+LP	7.0	7.5	8.5	9.0	9.0	9.0
5. stoddard solvent 75 GPA EP +linuron 1/4+1/4 Post+LP	8.0	8.0	9.0	9.0	9.0	9.0
6. stoddard solvent 75 GPA EP +linuron 1/2+1/2 Post+LP	9.0	8.5	9.0	9.0	9.0	9.0
7. linuron 1/8+1/8+1/8 EP, Post+LP	8.0	7.5	5.0	9.0	9.0	9.0
8. linuron 1/4+1/4+1/4 EP, Post+LP	7.0	5.5	6.0	9.0	9.0	9.0
9. linuron 1/2+1/2+1/2 EP, Post+LP	5.5	4.5	8.5	9.0	9.0	9.0
10. trifluralin 3/4 PPI+linuron 1 LP	6.0	6.5	8.5	9.0	9.0	8.0
11. stoddard solvent 75 GPA EP +linuron 1 LP	7.0	6.5	9.0	8.0	8.0	6.5
12. untreated control	6.5	4.0	2.5	5.0	2.0	1.0

[1] 1=no effect on weeds, complete kill of crops; 7=commercially acceptable weed control and crop; 9=complete weed kill, no effect on crop
[2] Rated 45 days after planting
[3] Annual grasses include Japanese millet, smooth crabgrass and witchgrass

Experiment II: Single applications of linuron at 2, 4, or 8 oz/A did not injure carrots but failed to give acceptable weed control (Table 3). However, rates of 1 and 2 lb/A gave excellent weed control but injured carrots. The low ratings recorded in treatments 1, 4, and 5 were because of poor initial stand due to a seeding problem. Noll (4) also reported injury on carrots with two applications of linuron at 12 oz/A applied pre and late post following PPI applications of trifluralin, which supports the above findings of injury on carrots at high rates of linuron. Multiple applications of linuron at 2 oz/A superimposed on pre, DP, or EP treatments of the same chemical failed to control annual grasses. Excellent weed control and crop tolerance was obtained with two applications of linuron at 2 oz/A post and late post following trifluralin. Single application of linuron at 2, 4, or 8 oz/A pre, DP, or EP following trifluralin also provided acceptable weed control and negligible crop damage. The low ratings recorded in treatments 21 and 25-28 were because of a seeding problem. Linuron at 1 lb/A, however, injured carrots.

Experiment III: In general, Scarlet Nantes was a little more susceptible than Gold Pak to high rates of linuron. Also Scarlet Nantes in any particular treatment yielded slightly higher than Gold Pak. However, because of the overall similarity in response of these two varieties to the chemical treatments, the yield data for them was combined (Table 4). Due to considerable variation in yields from plot to plot only a few treatments were significantly different. Linuron at 8 oz/A post, stoddard solvent and trifluralin when applied alone resulted in significantly lower yields of carrots probably because of poor weed control. Single application of linuron at 2 oz/A applied DP, EP, or post following trifluralin as well as linuron at 4 or 8 oz/A EP following trifluralin yielded significantly higher than untreated control.

Linuron at 4 oz/A 3 or 7 days following the application of stoddard solvent neither injured foliage not reduced carrot yields, however, parsnips were slightly injured. When linuron was applied at a rate of 8 oz/A 3 days following the application of stoddard solvent, it injured the foliage and decreased the carrot yield. At 7 days foliage was also slightly injured but there was no reduction in yield. Ivany, Dickerson and Sweet (6), reported no increase in foliar injury on carrots due to linuron at 1 and 2 lb/A following early post application of stoddard solvent. However, in their work linuron was applied 17 days following stoddard solvent.

In summary, single or multiple applications of linuron, stoddard solvent, or trifluralin alone failed to provide acceptable weed control and resulted in lower carrot yields. Linuron at higher rates of 1 and 2 lb/A injured both carrots and parsnips. Excellent weed control and crop tolerance were generally obtained with one or two applications of 2, 4, or 8 oz/A of linuron following either trifluralin or stoddard solvent.

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Table 3. Response of carrots to linuron and trifluralin when applied alone or in combination at various timings (Experiment II).

Chemical (lb/A and Timing	Visual Ratings[1]				
	Carrots		Annual Grasses[2]	Pigweed	Purslane
	a[3]	b[4]	b	b	b
1. linuron 1/8 Pre	6.0	6.0	4.0	4.0	3.0
2. linuron 1/8 DP	7.0	7.0	6.0	4.0	7.0
3. linuron 1/8 EP	7.0	6.0	5.0	4.0	4.0
4. linuron 1/4 Pre	6.0	6.5	5.5	6.0	3.0
5. linuron 1/4 DP	4.5	4.5	6.5	7.0	5.0
6. linuron 1/4 EP	7.5	7.0	6.5	7.5	8.0
7. linuron 1/2 Pre	7.0	7.0	7.0	9.0	5.0
8. linuron 1/2 DP	8.0	8.0	6.5	9.0	8.0
9. linuron 1/2 EP	7.0	6.0	6.5	8.5	9.0
10. linuron 1 Pre	6.5	7.0	8.0	9.0	9.0
11. linuron 1 DP	6.5	6.0	9.0	9.0	9.0
12. linuron 1 EP	5.5	5.5	9.0	9.0	9.0
13. linuron 2 Pre	6.5	7.0	9.0	9.0	9.0
14. linuron 2 DP	5.5	5.5	9.0	9.0	9.0
15. linuron 2 EP	5.5	6.0	9.0	9.0	9.0
16. linuron 1/8+1/8+1/8 Pre+Post+LP	7.0	7.0	1.0	6.0	7.0
17. linuron 1/8+1/8+1/8 DP+Post+LP	7.0	7.0	1.0	8.0	6.0
18. linuron 1/8+1/8+1/8 EP+Post+LP	7.0	7.0	2.0	9.0	9.0
19. trifluralin 3/4 PPI	8.0	8.0	8.0	6.0	9.0
20. trifluralin 3/4 PPI+ linuron 1/8 Pre	7.0	7.0	9.0	5.0	9.0
21. trifluralin 3/4 PPI+ linuron 1/8 DP	6.5	6.0	8.0	7.5	7.0
22. trifluralin 3/4 PPI+ linuron 1/8 EP	7.0	6.5	7.5	8.5	7.5
23. trifluralin 3/4 PPI+ linuron 1/4 Pre	8.5	6.5	8.5	7.5	3.5
24. trifluralin 3/4 PPI+ linuron 1/4 DP	7.0	6.0	6.5	9.0	7.5
25. trifluralin 3/4 PPI+ linuron 1/4 EP	6.5	6.0	9.0	9.0	9.0
26. trifluralin 3/4 PPI+ linuron 1/2 Pre	6.0	6.0	9.0	9.0	8.5
27. trifluralin 3/4 PPI+ linuron 1/2 DP	6.0	6.0	9.0	9.0	9.0
28. trifluralin 3/4 PPI+ linuron 1/2 EP	6.5	6.5	9.0	9.0	9.0
29. trifluralin 3/4 PPI+ linuron 1 Pre	5.0	6.0	9.0	9.0	9.0
30. trifluralin 3/4 PPI+ linuron 1 DP	7.0	7.0	9.0	9.0	9.0
31. trifluralin 3/4 PPI+ linuron 1 EP	6.5	7.0	9.0	9.0	9.0
32. trifluralin 3/4 PPI+ linuron 1/8+1/8 Post+LP	8.0	8.0	9.0	8.0	9.0
33. trifluralin 3/4 PPI+linuron 1/8+1/8+1/8 Pre+Post+LP	6.0	6.0	4.0	8.0	6.0
34. untreated control	7.0	6.5	2.0	2.0	1.0

[1] 1=no effect on weeds, complete kill of crop; 7=commercially acceptable weed control and crop; 9=complete weed kill, no effect on crop
[2] Annual grasses include Japanese millet, smooth crabgrass and witchgrass
[3] Rated 33 days after planting
[4] Rated 47 days after planting

Table 4. Crop and weed response to low rates of linuron applied alone or in combination with trifluralin and stoddard solvent (Experiment III).

Chemical (lb/A) and Timing	Visual Ratings[1]						Carrot Root Yield (lb/2x5' rows) c[5]
	Carrots a[3]	Parsnips a	Annual Grasses[2] b[4]	Chick-weed b	Galin-soga b	Pig-weed b	
1. stoddard solvent 75 GPA EP	7.0	6.5	6.5	3.5	8.0	6.5	6.0
2. trifluralin 3/4 PPI	7.5	6.5	7.5	7.0	5.0	7.0	9.7
3. linuron 1/2 Post	8.0	7.5	1.5	8.5	9.0	4.5	2.9
4. trifluralin 3/4 PPI+linuron 1/8 DP	7.0	7.5	9.0	9.0	9.0	8.0	13.0
5. trifluralin 3/4 PPI+linuron 1/8 EP	7.5	7.5	8.0	9.0	9.0	9.0	15.4
6. trifluralin 3/4 PPI+linuron 1/8 Post	7.5	7.5	8.5	9.0	9.0	9.0	13.9
7. trifluralin 3/4 PPI+linuron 1/4 DP	6.5	7.0	8.5	9.0	9.0	8.5	8.4
8. trifluralin 3/4 PPI+linuron 1/4 EP	7.0	7.5	9.0	9.0	9.0	9.0	12.6
9. trifluralin 3/4 PPI+linuron 1/4 Post	6.5	7.5	8.5	9.0	9.0	7.5	9.9
10. trifluralin 3/4 PPI+linuron 1/2 EP	6.5	7.0	9.0	9.0	9.0	9.0	11.0
11. stoddard solvent 75 GPA EP+ linuron 1/8+1/8 Post+LP	6.5	6.5	7.0	9.0	9.0	8.5	9.7
12. stoddard solvent 75 GPA EP+ linuron 1/4+1/4 Post+LP	6.5	7.0	7.0	9.0	9.0	9.0	9.5
13. stoddard solvent 75 GPA EP+ linuron 1/4 EP+3 days	7.5	7.0	7.5	9.0	9.0	9.0	15.9
14. stoddard solvent 75 GPA EP+ linuron 1/4 EP+7 days	7.0	6.5	9.0	9.0	9.0	9.0	11.3
15. stoddard solvent 75 GPA EP+ linuron 1/4 Post+7 days	7.5	7.5	6.5	8.5	9.0	9.0	12.1
16. stoddard solvent 75 GPA EP+ linuron 1/2 EP+3 days	6.5	6.0	8.5	9.0	9.0	9.0	8.2
17. stoddard solvent 75 GPA EP+ linuron 1/2 EP+7 days	7.0	6.5	8.5	9.0	9.0	9.0	13.5
18. stoddard solvent 75 GPA EP+ linuron 1/2 Post+7 days	6.5	7.5	8.0	9.0	9.0	9.0	9.9
19. untreated control	8.0	7.5	1.0	1.0	6.0	1.0	1.5
LSD .05							9.0

1 1=no effect on weeds, complete kill of crop; 7=commercially acceptable weed control and crop; 9=complete weed kill, no effect on crop

2 Annual grasses include Japanese millet, smooth crabgrass and witchgrass

3 Rated 23 days after planting

4 Rated 54 days after planting

5 Harvested 112 days after planting

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CHEMICAL WEED CONTROL IN CARROTS

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ABSTRACT

Weed control studies with carrots (Daucus carota L.) were carried out in 1975 and 1976 in northwest Ohio. In 1975, under conditions where no cultivation or hand weeding was practiced, a combination treatment consisting of trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) preplant incorporated (ppi) followed by a postemergence application of linuron (3-(3,4-dichlorophenyl-1-methoxy-1-methylurea) provided season long weed control. Carrots tolerated postemergence applications of Hoe 23408 and this material selectively controlled annual grass weeds. In 1976, a combination of Hoe 23408 plus linuron resulted in more rapid weed kill than observed with either material alone. A study of linuron/carbaryl (1 Napthyl N-methylcarbamate) interaction did not reveal any synergistic activity under conditions of this trial. The time required to hand weed plots was found to correlate well (r = 0.89) with visual weed control ratings and provided another measurement of herbicide efficacy.

Observation trials in commercial carrot fields demonstrated that metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one) effectively controlled horseweed (Conzya canadensis (L.) Cronq.), and Hercules 26905 (o-ethyl-o-(3-methyl-6-nitrophenyl)-N-sec butyl phosphorothioamidate) prevented an established dodder (Cuscuta sp) infestation from spreading.

INTRODUCTION

Stoddard solvent, linuron, and trifluralin are some of the main herbicides used for weed control on carrots. The current price of stoddard solvent has made this material extremely expensive compared to the pre 1974 era and relative to other herbicides. There is a need to provide alternative herbicides to avoid resistant weeds becoming the dominant species in carrot fields. Two examples of this occurring are dodder in New Jersey, Delaware, and Maryland carrot growing areas and horseweed in Ohio. One of the most serious weed problems facing carrot growers on muck soils are annual grasses because trifluralin and other preemergence herbicides are inactivated in the high organic matter content of these soils. Therefore, a selective postemergence grass herbicide would be a solution to this problem.

These trials were conducted in an effort to evaluate new compounds for potential use in carrots.

MATERIALS AND METHODS

Studies were conducted at Napoleon, Ohio, on a sandy loam soil in 1975 and a sandy clay soil in 1976 with organic matter levels ranging from 2 to 2.5% Three row plots, with 50 cm row spacing and measuring 1.5 m by 6.1 m in size

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were used in randomized complete block designs with four replications. Chemicals evaluated are listed in Table 1. Dates of treatments and other activities are summarized in Table 2. All treatments were applied with a bicycle plot sprayer delivering 308 L/ha at 2.1 cm^2 using compressed air as a propellant. Preplant treatments were incorporated with a rotary powered tiller to a depth of 7 cm within one hour of application. Dominant broadleaf weeds in both years were lambsquarters (Chenopodium album L.), smartweed (Polygonum pensylvanicum L.), redroot pigweed (Amaranthus retroflexus L.), while annual grasses were represented by barnyard grass (Echinochloa crus-galli (L.) Beauv.), crabgrass (Digitaris sp), and green foxtail (Setaria viridis (L.) Beauv.). Weed control was assessed using a 1 to 9 rating system where 9 represented complete control and 1 no control, with 7 the minimum level for commercial acceptance. Crop phytotoxicity was rated on a 1 to 5 scale where 5 represented no visible injury and 1 crop kill. Yields were obtained by harvesting the center row and grading roots as marketable (crown diameter greater than 3.75 cm) smalls and culls.

In addition to the replicated trials in 1976, two non-replicated trials were located in commercial carrot fields, one with a heavy horseweed population and one with a moderate dodder infestation. The horseweed test was treated on June 18, 1976, with four rates of metribuzin: 0.28, 0.56, 0.84, and 1.12 kg/ha, when carrots were 30 cm tall and the horseweed 30 - 35 cm in height. The dodder infestation was treated on July 20, 1976 with Hercules 26905 when dodder was well established (flowering plus seed pods formed) on carrots 20 - 25 cm tall. Four rates of Hercules 26905 were tried: 2.2, 4.5, 6.7, and 8.9 kg/ha. Visual observations were made following treatment but no yield data were obtained.

RESULTS AND DISCUSSION

In 1975, the carrot experiment was not cultivated or hoed with the exception of the weeded control plots which were hand hoed three times during the season. As a result, weed competition from uncontrolled weeds prevented marketable sized roots from developing in a number of plots, Table 3. Trifluralin provided borderline control of broadleaf weeds permitting black nightshade (Solanum nigrum L.) and smartweed escapes. Of significance was the fact that the 1.65 kg/ha rate of trifluralin did not result in crop injury on this sandy loam soil. This rate was three times the recommended dosage for this soil type. Some commercial carrot growers have expressed concern that trifluralin was causing crop injury but this data does not support this thinking. Linuron, the other standard treatment was not effective on annual grasses. The most effective treatment in the trial was a combination of these two standards. Dinitramine required 4.5 kg/ha when applied as a preemergence treatment to provide comparable weed control to trifluralin at 1.12 kg/ha incorporated. Hoe 23408 selectively controlled annual grasses without significant crop injury when applied postemergence at up to 3.4 kg/ha. Hoe 23408 in combination with linuron provided a wider spectrum of weed control with only some temporary crop phytotoxicity observed. The somewhat lower yield obtained from this combination may reflect early weed competition prior to application plus surviving weed escapes. Metribuzin at the rate used did not provide satisfactory weed control. Some tip burn occurred to carrots receiving the postemergence application but this was considered similar to that often observed with linuron treatments.

In 1976, the experimental area was cultivated and maintained weed-free after weed control ratings were obtained on June 16. The weeding time required for each plot was carefully recorded and the percent reduction in weeding time, from the unweeded control, was used as another measurement of herbicide efficacy. There appeared to be good agreement between weed ratings and reduction in weeding time, Table 4. A significant correlation was measured between the broadleaf weed control ratings and the percent reduction in hand weeding time, r = 0.66, but not with the grass control ratings, r = 0.46. The means of the broadleaf and grass weed ratings indicated a higher level of correlation, r = 0.89, existed between the two methods of evaluating herbicide efficacy.

Trifluralin or dinitramine ppi treatments followed by linuron postemergence provided excellent weed control and good crop yields. Hoe 23408 alone, postemergence, gave fair control of foxtail and barnyard grass, but crabgrass recovered. Combining linuron with Hoe 23408 rssulted in a significantly faster burn-down of weeds than achieved with either material alone. Broadleaf weeds were dead within 48 hrs; whereas, when linuron was applied alone, it took 5 to 6 days before weeds were considered killed. At the same time, crop phytotoxicity in the form of leaf margin burn was more severe with the combination of linuron with Hoe 23408. This injury was temporary as new growth appeared normal and final crop yields were similar to the weeded control. Chloroxuron used as a pre plus post treatment was satisfactory considering weed control and crop yield as was the trifluralin plus chloroxuron combination treatment. DCPA was included in this trial primarily to provide residue data and to determine crop tolerance. DCPA controlled grasses but not broadleaf weeds, and carrots tolerated both preemergence and early postemergence treatments.

A series of plots were treated with linuron and the insecticide carbaryl in combinations; a) as a tank mix, b) linuron applied first and carbaryl applied 48 hrs later, c) carbaryl applied first and linuron applied 48 hrs later, in addition to linuron used alone. No significant differences were measured in crop phytotoxicity; however, weed control rating and weeding time were adversely affected where carbaryl was applied 48 hrs after linuron application. These results are not in agreement with those reported by DelRosaria and Putnam (1) who found a synergistic reaction occurred when these two pesticides were applied together or within 24 to 48 hrs of each other and resulted in increased phytotoxicity to carrots. The fact that the variety Danvers 126 was used in this study and not Chantenay may account for the different results. However, the poorer weed control resulting from the delayed carbaryl application cannot be explained.

In the observation trials in commercial carrot fields, metribuzin at 0.28 kg/ha did not provide satisfactory control of horseweed, but the three higher rates were all effective. Carrots tolerated the high - 1.12 kg/ha rate of metribuzin without signs of phytotoxicity. At the second site, Hercules 26905 treatments applied to a well established dodder infestation stopped all further growth of this plant. All tendrils and runner growth turned a dark orange color and while not dead, new growth was not observed during the remainder of the summer. The fact that no phytotoxicity was observed at the 8.9 kg/ha rate of Hercules 26905 when adequate dodder control was obtained with 2.2 kg/ha indicates a good safety margin in carrot tolerance.

LITERATURE CITED

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Table 1. Chemical names or designations of compounds investigated in 1975 and 1976.

Common name or designation		Chemical Name
Butralin	-	4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6,dinitrobenzenamine
Carbaryl	-	1-Napthyl N-methylcarbamate
Chloroxuron	-	3-(p-(p-chlorophenoxy)phenyl)-1,1-dimethylurea
Dinitramine	-	N^4,N^4-diethyl-a,a,a-trifluoro-3,5-dinitrotoluene-2,4-diamine
DCPA	-	dimethyl tetrachloroterephthalate
Hercules 26905	-	o-ethyl-o-(3-methyl-6-nitrophenyl)-N-sec-butyl phosphorothioamidate
Hoe 23408	-	not available
Linuron	-	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea
Metribuzin	-	4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one
Trifluralin	-	a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine

Table 2. Sequence of dates for various activities associated with replicated carrot trials conducted in 1975 and 1976.

	Date	
Activity	1975	1976
preplant treatments	4/30	4/20
seeding (variety Danvers 126)	4/30	4/20
preemergence treatments	5/7	4/30
postemergence treatments	6/4 crop 5 cm, 2½ leaf stage	6/2 crop 6-7 cm, 3 leaf stage
weed rating	6/19	6/16
hand weeding time study	--	6/22
harvest	9/24	9/29

Table 3. Response of weeds and carrots to several herbicide treatments at Napoleon, Ohio, in 1975.

Treatment	Rate kg/ha	Appl.	Weed control rating B.L.W.	Weed control rating Grass	Crop phyto.	Yield metric T/ha Marketable	Yield metric T/ha Total
Weeded control	--	--	9	9	5	31.8	38.75
Unweeded control	--	--	1	1	5	--	--
Trifluralin	1.12	ppi	7	8	5	37.2	41.7
Trifluralin	1.65	ppi	7	8	5	39.9	47.3
Linuron	1.12	post	7	3	5	28.0	34.7
Trifluralin + Linuron	0.56 + 1.12	ppi	8	8	5	49.9	55.3
Dinitramine	2.24	pre	6	8	5	28.2	38.5
Dinitramine	4.5	pre	7	8	5	34.7	43.5
Hoe 23408	1.12	post	1	8	5	--	--
Hoe 23408	2.24	post	1	9	5	--	--
Hoe 23408	3.36	post	1	9	5	--	--
Hoe 23408 + Linuron	1.12 + 1.12	post	7	9	4.5	24.9	32.9
Metribuzin	0.28	pre	5	2	5	--	--
Metribuzin	0.28	post	6	2	5	21.9	31.6
LSD	5%		1.5	2.3	NSD	12.3	11.9

Table 4. Response of weeds and carrots to 23 treatments at Napoleon, Ohio, in 1976.

Treatment	Rate kg ai/ha	Appl.	Weed control rating B.L.W.	Weed control rating Grass	% Reduction in weeding time	Crop phyto.	Yield Metric T/ha Marketable	Yield Metric T/ha Total
Weeded control	--	--	9	9	--	4.9	54.1	74.6
Unweeded control	--	--	1	1	--	4.4	44.0	59.4
Trifluralin	1.12	ppi	4.7	7.5	49	4.9	54.3	75.9
Linuron	1.12	post	7.1	4.9	63	4.7	53.7	73.9
Trifluralin + Linuron	1.12 + 1.12	ppi post	7.2	8.6	82	4.9	57.4	76.1
Trifluralin + Linuron	0.56 + 1.12	ppi post	7.4	6.6	79	4.9	57.4	77.2
Trifluralin + Linuron	0.56 + 0.56	ppi post	7.0	7.5	70	4.4	64.7	83.2
Dinitramine	2.24	pre	4.4	8.0	60	4.5	45.8	65.8
Dinitramine	4.5	pre	6.8	8.0	81	4.4	51.3	74.4
Dinitramine + Linuron	2.24 + 1.12	pre post	8.3	8.1	94	4.3	57.0	80.3
Linuron + Hoe 23408	1.12 + 1.12	post	7.2	6.4	64	3.7	53.7	77.2
Linuron + Hoe 23408	1.12 + 2.24	post	7.7	7.8	85	3.5	62.1	82.7
Linuron + Hoe 23408	1.12 + 3.36	post	6.8	7.5	73	3.2	55.9	75.9
Hoe 23408 + Hand Hoe	3.36	post	2.9	6.1	--	2.8	44.1	60.1
Chloroxuron	4.5 + 4.5	pre + post	7.4	7.8	80	4.6	62.5	81.2
Trifluralin + Chloroxuron	1.12 + 4.5	ppi post	7.2	6.6	81	4.6	60.1	80.3
Butralin	2.24	ppi	4.3	7.5	58	4.6	57.4	76.1
DCPA	11.5	pre	5.0	7.5	--	4.7	52.4	74.4
DCPA	23.0	pre	4.2	8.5	--	4.4	45.8	67.3
DCPA	11.5	post	--	--	--	4.9	48.8	69.3
Linuron + carbaryl	1.12 + 2.24	post-	7.3	5.0	69	4.7	65.3	83.6
Linuron + carbaryl 48 hr. later	1.12 2.24	post post	6.2	5.5	45	4.4	53.0	76.3
Carbaryl + linuron 48 hr. later	2.24 1.12	post	7.4	5.2	61	4.6	62.7	83.8
LSD 5%			1.8	1.6	18%	.63	11.2	11.0

WEED CONTROL IN BEETS WITH HERBICIDES

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ABSTRACT

An experiment was conducted to evaluate six herbicides for the weeding of beets (Beta vulgaris). All herbicides when used alone were applied at two rates. Cycloate (S-ethyl N-ethylthiocyclohexanecarbamate) was applied as a preplant incorporation treatment, pyrazon (S-amino-4-chloro-2-phenyl-3(2H)-pyredazione), Vel 5052 (S-propyl dipropylthiocarbamate) and R3322 (3-(3,4-dichlorophenyl)-3-(ethoxalyl)-1, 1-dimethylurea) were applied as preemergence treatments and desmedipham (ethyl m-hydroxycarbanilate carbanilate (ester)) and phenmedipham (methyl m-hydroxycarbanilate m-methylcarbanilate) were applied postemergence when beets had two true leaves. Combination treatments preplant incorporation treatments followed by postemergence treatments and preemergence followed by postemergence treatments were included in the trials. Without lambsquarter (Chenopodium album L.) control yields were poor. In this years trial the best herbicides were desmedepham and phenmedipham.

INTRODUCTION

Several herbicides were tested alone and in combination for weed control of weeds in beets. The herbicides included in the trials were the recommended herbicides and others thought to be promising. Dry soil at time of planting and dry weather following seeding delayed emergence of the beets.

MATERIAL AND METHODS

The experiment was conducted at the Rock Springs Farm located 10 miles west of University Park, PA. The soil, a Hagerstown silt loam, was plowed in the fall of 1975 and the seedbed prepared April 13, 1976. The preplant incorporation treatments were applied April 14 and the field seeded that same day. The preemergence treatments were applied April 15 one day after seeding and the postemergence treatments applied 26 days after seeding when the beets had two true leaves.

Although a number of weeds were present only lambsquarter was a serious weed. Where this weed was not controlled it was difficult to see the beets or other weeds.

Single row plots were 26 feet long and 3 feet wide. Treatments covered the row for a width of 18 inches with cultivation controlling the weeds between the rows. Treatments were randomized in each of 8 blocks. Fifteen feet of row from each plot was harvested July 16.

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A rating scale of 0 to 10 was used to evaluate weed control. Zero being least desirable and 10 most desirable.

RESULTS AND DISCUSSION

The results are presented in Table 1. Lambsquarter control with cycloate applied preplant incorporation was good in early June but largely lost by mid July. Pyrazon and Vel 5052 applied preemergence did not control lambsquarter. Desmedipham and phenmedipham applied 26 days after the seeding of the beets controlled the lambsquarter throughout the growing season. R33222 at the 4 pound per acre applied preemergence controlled lambsquarters in early June but by mid July lambsquarter control was poor.

Under the condition of the experiment the best herbicides for weeding of beets was desmedipham at 1 and 2 pounds per acre and phenmedipham at 1½ and 3 pounds per acre applied 26 days after seeding when beets had 2 true leaves.

Table 1. The effect of herbicides alone and in combination on weeds and beets.

	Treatment	lbs ai	Application Days From Plant	Average Per Plot: Weeds 0-10: Grass July 14	Lambsquarter June 7	Lambsquarter July 14	Ragweed July 14	All Weeds July 14	Harvest (15' of row): No. Plants	Wt. Roots lbs.
1	Nothing	-	---	9.5	0.0	1.3	9.0	1.3	43	0.5
2	Cycloate	3	PPI-0	9.9	8.4	5.4	7.6	4.9	65	3.9
3	Cycloate	4½	PPI-0	9.5	8.7	5.9	8.9	5.5	56	4.0
4	Pyrazon	3	PRE+1	9.5	3.8	0.1	9.4	0.4	60	0.6
5	Pyrazon	4½	PRE+1	10.0	2.5	1.1	9.8	1.0	77	2.2
6	VEL 5052	2	PRE+1	10.0	1.1	0.4	8.3	0.4	37	1.3
7	VEL 5052	3	PRE+1	9.8	2.4	0.9	8.5	0.9	52	0.0
8	Pyrazon	5	POST+26	9.8	4.0	1.0	9.8	1.3	80	0.6
9	Desmedipham	1	POST+26	8.8	9.9	8.0	9.1	8.0	88	8.2
10	Desmedipham	2	POST+26	9.3	10.0	9.4	9.6	9.3	95	12.3
11	Phenmedipham	1½	POST+26	9.6	10.0	9.4	9.3	9.4	92	13.3
12	Phenmedipham	3	POST+26	9.4	10.0	8.8	9.5	8.5	110	10.4
13	Cycloate & Desmedipham	3&1	PPI-0 & POST+26	9.8	10.0	9.4	9.0	9.0	60	13.4
14	Cycloate & Phenmedipham	3&1½	PPI-0 & POST+26	9.9	10.0	10.0	9.5	9.6	76	14.9
15	Pyrazon & Desmedipham	3&1	PRE+1 & POST+26	8.9	9.9	8.6	9.9	8.5	65	11.3
16	Pyrazon & Phenmedipham	3&1½	PRE+1 & POST+26	9.4	10.0	9.4	10.0	9.0	102	12.5
17	VEL 5052 & Desmedipham	2&1	PRE+1 & POST+26	9.0	9.8	9.3	9.5	8.9	88	9.6
18	VEL 5052 & Phenmedipham	2&1½	PRE+1 & POST+26	9.3	10.0	9.5	9.3	8.6	110	12.3
19	R33222	2	PRE+1	9.3	6.6	2.5	9.5	2.5	53	4.5
20	R33222	4	PRE+1	9.3	9.6	5.8	10.0	5.8	18	3.0
	Least significant difference 5%			0.3	2.4	1.3	0.9	1.3	28	3.3
	Least significant difference 1%			0.3	2.9	1.6	NSD	1.6	34	4.1

HERBICIDES FOR WATERMELONS

C. E. Beste[1/]

ABSTRACT

Two years of studies have shown that butralin [4-(1,1-dimethyl ethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine] preplant incorporated at 1.0 and 2.0 lb/A was an effective herbicide for seeded watermelons (Citrullus vulgaris Schrader cv. Charleston Gray) in a Norfolk loamy sand. Butralin was also satisfactory for seeded 'Crimson Sweet' watermelons based on one year of studies. Butralin provided better weed control than preplant incorporated bensulide [O,O-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl) benzenesulfonamide], naptalam (N-1-naphthylphthalamic acid) or the combination. The combination of bensulide and naptalam (4.0 + 2.0 lb/A) provided better weed control than either herbicide alone. Butralin controlled goosegrass [Eleusine indica (L.) Gaertn.) and common purslane (Portulaca oleracea L.) better than the bensulide and naptalam combination; however, common lambsquarters (Chenopodium album L.) control was similar. Watermelon plant stands and yields were not effected by these herbicides.

One year's data showed that chloramben methyl ester (3-amino-2,5-dichlorobenzoic acid) at 1.5 and 3.0 lb/A and dinoseb (2-sec-butyl-4,6-dinitrophenol) at 1.5 lb/A were not acceptable preemergence treatments for 'Charleston Gray' watermelons. The combination of butralin (1.0 lb/A) preplant incorporated plus chloramben (1.5 lb/A) preemergence was acceptable. HOE-23408 [[methyl 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoate]] at 0.75 lb/A plus dinoseb at 1.5 lb/A preemergence provided significantly better grass control than dinoseb alone at 1.5 lb/A preemergence and HOE-23408 did not injure watermelons.

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WEED CONTROL IN CUCUMBERS IN A CONVENTIONAL PLANTING AND IN A STALE SEED BED

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ABSTRACT

Two weeding trials were conducted on cucumbers (Cucumis sativus). In the first experiment the preparation of the soil and the seeding of the cucumbers were a day apart. In the second experiment there was a delay of thirteen days from seed bed preparation until the seeding of the cucumbers. Weeds in the untreated plots were a mixture of grasses, redroot pigweed (Amaranthus retroflexus L.), tumbleweed (Amaranthus albus L.) and purslane (portulaca oleracea L.). Herbicides were applied in a band over the row and weeds between the rows were controlled by cultivation. The best treatments in the conventional planting were bensulide (0,0-diisopropyl phosphorodithioate s-ester with N-(2 mercaptoethyl)benzenesulfonamide) incorporated into the soil prior to seeding and naptalam (N-1-naphthylphthalamic acid) applied preemergence or postemergence. In the delayed seeding experiment glyphosate (N-(Phosphonomethyl)glycine) and paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) applied prior to cucumber emergence controlled the weeds throughout the season.

INTRODUCTION

Cucumbers because of their vining growth habit are difficult to weed with a cultivator. They are equally difficult to weed with an herbicide as the herbicides cleared for use do not kill weeds equally well under varied soil and weather conditions. Two approaches were made to solve this weeding problem. In the first, with conventional planting practices, what were considered the best herbicides were used alone and in combination. In the second, where delayed seeding was practiced, the short residual herbicides glyphosate, paraquat were used alone and in combination with other herbicides that had a longer residual effect.

MATERIAL AND METHODS

This study was conducted at the Rock Springs Farm located 10 miles west of University Park, PA. The soil, a Hagerstown silt loam was plowed in the fall of 1975 and the seedbed prepared June 15, 1976. The variety greenpack was used in both experiments.

Weeds were grasses, possible as many as four species, redroot pigweed, tumbleweed and a scattering of other weeds. Single row plots were 36 feet long and 5 feet wide. The treatments covered the row for a width of 18

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inches with cultivation controlling the weeds between the rows. Treatments were randomized in each of six blocks. A rating scale of 0 to 10 was used to evaluate cucumber injury and weed control, overall and by species. 0 being least desirable and 10 most desirable.

In the first experiment cucumbers were seeded one day after seedbed preparation and following the preplant incorporation treatements. All preemergence treatments were applied the day following seeding and the postemergence treatments 9 days after seeding. All plots were harvested Aug. 18 two months after seeding.

In the second experiment the cucumbers were seeded 13 days after seedbed preparation and the herbicides applied the next day. At that time most of the weeds had emerged and the cucumbers had not emerged. All plots were harvested Aug. 31, two and a half months after the cucumbers were seeded.

RESULTS AND DISCUSSION

The results in the conventionally planted cucumbers are presented in Table 1. Plots treated with bensulide at 6 pounds per acre preplant incorporation had a stand of plants equal to the check, no injury and good control of grasses and purslane but with only a fair overall weed control due primarily to poor redroot pigweed control. Naptalam treated plots, at four pounds per acre, applied preemergence had good weed control with all weeds but had a slightly reduced yield. Chloramben at 2 pounds per acre applied preemergence injured the cucumbers and possibly reduced the yield as compared to the best treatments. The numbered compounds applied preemergence or postemergence in plots treated with conventional herbicides did not improve the yield although some of them improved the weed control.

The results in the stale seed bed plots are presented in Table 2. Both glyposate and paraquat controlled the weeds without injuring or reducing the cucumber stand as compared to the untreated plot. The addition of naptalam improved the weed control of purslane with both glyposate and paraquat. Although the seedbed was quite hard at time of seeding the number of cucumbers that emerged was three times that of the number that emerged with the conventional planting.

Table 1. The effect of herbicides alone and in combination in a conventional seeding on weeds and cucumbers.

	Treatment	lbs ai	Application Days From Planting	Average Per Plot: Stand of Plants	Injury *0-10	Weeds *0-10: Grass	R.R. Pigweed	Purslane	All Weeds	Harvest: No. Fruit	Wt. Fruit lb.
1	Nothing	---	---	33	9.2	6.6	2.2	6.3	0.6	44	33
2	Bensulide	6	PPI-0	29	9.0	9.3	5.5	8.3	4.8	56	41
3	Bensulide & Naptalam	6&4	PPI-0 & PRE+1	21	8.3	9.5	9.2	9.3	9.2	44	31
4	Bensulide & VEL5052	6&4	PPI-0 & PRE+1	26	7.7	10.0	8.8	9.2	7.3	47	33
5	Bensulide & Chloramben	6&2	PPI-0 & PRE+1	27	8.7	9.5	5.7	9.0	5.8	55	39
6	EL 161	1	PPI-0	21	7.8	9.0	6.3	8.3	5.8	51	36
7	EL 161	1½	PPI-0	14	4.8	9.5	9.0	8.8	7.5	23	18
8	Naptalam	4	PRE+1	30	8.3	8.7	8.5	8.5	7.7	49	35
9	Naptalam + VEL5052	4+4	PRE+1	24	6.3	9.8	9.0	7.7	7.3	38	25
10	Naptalam + Amiben	4+2	PRE+1	26	7.8	8.2	7.5	9.3	7.0	46	36
11	Naptalam + R37878	4+3	PRE+1	27	7.7	9.3	8.3	6.3	5.3	49	33
12	Naptalam + R33222	4+3	PRE+1	1	0.8	9.3	9.2	8.5	8.5	2	2
13	Naptalam + HOE23408	4+1½	PRE+1	26	7.7	10.0	6.7	7.5	5.6	40	29
14	Chloramben	2	PRE+1	25	9.0	7.8	3.8	8.0	2.7	40	33
15	Chloramben + R37878	2+3	PRE+1	32	8.7	8.8	6.2	7.3	4.7	53	40
16	Chloramben + R33222	2+3	PRE+1	2	1.3	9.2	7.2	9.5	7.2	5	4
17	Chloramben + HOE23409	2+1½	PRE+1	31	9.2	9.8	3.7	7.2	2.8	43	32
18	Chloramben & HOE23409	2&1½	PRE+1 & POST+9	28	8.3	10.0	3.3	8.3	4.2	46	29
19	Chloramben & Naptalam	2&4	PRE+1 & POST+9	26	6.3	8.5	10.0	7.0	6.5	50	34
	Least Significant Difference 5%			7	1.1	0.7	1.6	1.9	1.9	13	8
	Least Significant Difference 1%			8	1.3	0.9	2.0	2.3	2.3	16	10

* Rating 0-10, 0 least desirable
10 most desirable

Table 2. The effect of herbicides alone and in combination in a stale seedbed on weeds and cucumber.

	Treatment	lbs ai	Application Days From Planting	Stand of Plants	Injury *0-10	Average Per Plot: Weeds *0-10: Grass	Purslane	R.R. Pigweed	Tumbleweed	All Weeds	Harvest: No. Fruit	Wt. Fruit lb.
1	Nothing	--	---	87	8.8	3.8	3.2	5.7	2.8	0.0	128	81
2	Glyphosate	2	PRE+1	86	8.0	8.3	6.2	9.5	8.0	8.2	143	91
3	Glyphosate	3	PRE+1	87	9.3	9.5	9.3	9.7	9.3	9.5	160	111
4	Paraquat	2	PRE+1	94	9.0	8.2	8.3	9.2	9.3	9.0	171	102
5	Paraquat	3	PRE+1	91	8.8	8.7	7.8	8.7	8.5	8.5	158	107
6	Glyphosate + Naptalam	2+4	PRE+1	80	8.3	8.5	8.8	9.8	10.0	9.2	150	88
7	Paraquat + Naptalam	2+4	PRE+1	85	8.5	8.7	9.2	9.2	9.7	9.0	142	90
8	Paraquat + Penoxalin	2+1½	PRE+1	80	5.5	9.8	9.0	9.8	10.0	9.8	68	40
9	Paraquat + Glyphosate	1+1	PRE+1	88	9.0	9.0	8.5	9.3	9.3	8.8	153	92
	Least significant difference 5%			NSD	1.2	1.7	1.7	1.2	1.9	1.4	42	24
	Least significant difference 1%			NSD	1.6	2.4	2.3	1.7	2.6	1.9	58	33

* Rating 0-10, 0 least desirable
10 most desirable

EVALUATION OF ACTIVATED CARBON AND LINURON ON SEEDED ASPARAGUS[1/]

C. E. Beste[2/]

ABSTRACT

A field study in 1976 showed that linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea] at 1.0 to 2.0 lb/A did not injure seeded asparagus (Asparagus officinalis L., cv. Mary Washington) on a Norfolk sandy loam; however, 4.0 lb/A was injurious. Activated carbon in a 1 inch band over the row at a 100 lb/A broadcast-rate reduced the injury from 4.0 lb/A preemergence linuron. The weed control with 1.0 lb/A linuron was decreased by activated carbon. Preemergence chloramben (3-amino-2,5-dichlorobenzoic acid) at 3.0 lb/A was more effective for goosegrass [Eleusine indica (L.) Gaertn.] control and less effective for broadleaf weed control than linuron. Postemergence linuron at 0.5 and 1.0 lb/A on 3 to 7 inch tall asparagus ferns had good crop tolerance; however, 2.0 lb/A linuron caused unacceptable injury. Two postemergence applications of 0.5 or 1.0 lb/A linuron were efficacious for asparagus; however, two applications of 2.0 lb/A linuron caused severe injury. Activated carbon bands appeared to reduce the phytotoxicity of postemergence linuron at 2.0 lb/A.

INTRODUCTION

Asparagus can be established by either seeding or by transplanting one to three year old crowns which are grown from seed in nursery fields. The production of crowns from seed in a nursery field utilizes a 20 to 40 fold higher asparagus plant population than a commercial field. Most asparagus fields in Delmarva are established by planting crowns because seeded fields require an additional year of growth before spear production begins. However, the lack of adequate weed control for slow-growing seeded asparagus has also discouraged seeded production fields. More effective weed control is also needed for the nursery fields due to the lack of labor for hand weeding and due to the reduction of crown size caused by weed competition. Larger crowns are sold for a premium price because they will produce spears suitable for commercial harvest sooner than smaller crowns.

Chloramben at 4 to 6 lb/A preemergence provided adequate weed control in seeded asparagus (3); however, 8 lb/A was required for optimum asparagus root-weight yields (2). Linuron showed good tolerance on seeded asparagus at 1.0 to 2.0 lb/A (3). Chloramben was slightly weak on fall panicum (Panicum dichotomiflorum Michx.), common ragweed (Ambrosia artemisiifolia L.), and common lambsquarters (Chenopodium album L.) at 3.0 lb/A (1).

1/ Scientific Article No. A2267 ,Contribution No. 5263 , of the Maryland Agricultural Experiment Station, Department of Horticulture

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The objective of this study was to determine the effect of activated carbon on the selectivity of preemergence linuron for seeded asparagus and to determine the tolerance of asparagus to postemergence linuron.

MATERIALS AND METHODS

'Mary Washington' asparagus was seeded 1.25 to 1.38 inches deep in a Norfolk sandy loam (1.0% organic matter) on June 8, 1976 at the University of Maryland Vegetable Research Farm, Salisbury. The seeding rate was 10 seeds per ft. Prior to planting, 600 lb/A of 10-10-10 fertilizer was applied and disced. The herbicide plots were 6 by 18 ft with two rows per plot and a row spacing of 24 inches. A randomized complete block design with four replications was used for the herbicide treatments. Activated carbon[3/] was applied in a 1 inch band over the row at a broadcast rate of 100 lb/A or 8.6g of activated carbon per 100 linear ft of row for some treatments prior to the preemergence herbicide. The activated carbon was mixed with water and applied with an 8003 Tee Jet nozzle mounted parallel with the row. Preemergence and postemergence herbicide treatments were made in water at 34 gal/A with a bicycle sprayer and CO_2 was used as the propellant. Postemergence treatments were made on July 29 when the fern height was 3 to 7 inches and on September 7 when the fern height was 12 inches. The maximum air temperatures were July 29: 87°F, July 30: 89°F, and Sept. 7: 85°F, Sept. 8: 89°F. The plots were cultivated and handweeded on July 26.

Weed populations were determined on June 25 by counting the weeds in 1 sq. ft. per plot between the rows. The weed population in the asparagus row was determined on July 2 by counting the weeds within 1 inch of the row for 36 inches of row length (0.48 ft^2) in each plot. A weed rating of 0 to 10 (i.e. 0 = no control) was made on July 7 for goosegrass, carpetweed (Mollugo verticillata L.) and common purslane (Portulaca oleracea L.). A rating was also made for weed control in the row on July 7. Cutleaf evening primrose (Oenothera laciniata Hill.) control was rated on September 7 and the population in the control was 3 plants/sq. ft.

The asparagus plant population was determined by counting the plants in 3 ft of row per plot on July 2. A rating of 0 to 10 for asparagus foliar necrosis was made on August 6 and September 13. A plant injury rating from 0 to 10 was made on September 7 where 0 indicates no injury based on plant size and vigor. The asparagus fern height was determined by measuring the height of three plants per plot on October 8.

Rainfall occurred on the following dates: June 17, 1.0 in.; July 1, 0.51 in.; July 4, 0.48 in.; July 12, 2.02 in.; July 17, 0.20 in.; July 28, 0.98 in.; July 31, 0.30 in.; Aug. 1, 0.65 in.; Aug. 9, 2.40 in.; Aug. 15, 1.64 in.; Aug. 28, 2.0 in.; Sept. 10, 0.85 in.; Sept. 16, 0.50 in.

3/ Gro Safe, Atlas Chemical Co., Wilmington, DE

RESULTS AND DISCUSSION

Linuron at 1.0 and 2.0 lb/A preemergence did not injure asparagus and the activated carbon was not beneficial; however, activated carbon appeared to reduce the injury from 4.0 lb/A preemergence linuron (Table 1). The low rainfall in 1976 after seeding may have reduced the potential for injury. Linuron at 1.0, 2.0, and 4.0 lb/A or chloramben, 3.0 lb/A preemergence did not affect asparagus stands (Table 1). Weed control in the row was significantly reduced by activated carbon with linuron rates of 1.0 and 2.0 lb/A preemergence (Table 1). The reduction in weed control was not commercially acceptable. Chloramben at 3.0 lb/A provided better goosegrass control than linuron at 1.0 lb/A preemergence. Preemergence linuron at 1.0 lb/A provided slightly better control of carpetweed, purslane, and cutleaf evening primrose than chloramben.

After the plots were handweeded in late July, only a few weeds regrew for an evaluation of the weed control from postemergence linuron. The postemergence linuron treatments significantly improved the control of cutleaf evening primrose which is a serious winter weed that germinates in late summer. The single application of postemergence linuron was as effective as the double application for weed control.

The asparagus ferns were not injured by one or two postemergence applications of linuron at 0.5 lb/A. However, 1.0 lb/A linuron postemergence caused necrosis of the fern leaves and slight reduction of fern growth although not significant. Linuron at 2.0 lb/A caused unacceptable injury. Activated carbon appeared to reduce the injury from postemergence linuron treatments of 1.0 and 2.0 lb/A when compared to the chloramben preemergence treatments without activated carbon. However, the asparagus response to postemergence linuron might be effected by the preemergence treatment of either chloramben or linuron.

Activated carbon does not appear necessary for the selectivity of linuron on seeded asparagus. Linuron may be applied postemergence on seedling asparagus with either linuron or chloramben as the preemergence herbicide.

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Table 1. An evaluation of preemergence and postemergence linuron with activated carbon for weed control in seeded asparagus on a Norfolk sandy loam soil.

Treatment: Preemergence Herbicide	Lb/A	Postemergence[a/] Linuron (Lb/A): Post I	Post II	Act. Carbon[b/]	Weed Control: 6-25 (Plant/Ft^2): Goose grass	Carpet Weed	Purs lane	7-2 (Plants/Ft^2 Within 1 Inch of the Row): Goose grass	Carpet Weed	Purs lane	Weed Control Rating[c/] 7-7: Goose grass	Carpet Weed	Purs lane	Weeds in Row	9-7 CEP[d/]	Asparagus Growth: Stand[e/] Plants Per Ft.	Fern necrosis[f/] 8-6	Fern necrosis[f/] 9-13	Plant[f/] Injury 9-7	Fern[g/] Height (Inches)
1. Control-weedy		--	--	No	12.0b	30.5b	12.0b	11.6d	57.6g	11.0b	0	0	0	0	0	7.5a	0a	0a	9.0	4.1e
2. Control-handweeded		--	--	No	0a	0a	0a	0a	0a	0a	10	10	10	10	10	5.2ab	0a	0a	0	18.8a
3. linuron	1.0	--	--	Yes	1.5a	0a	0a	7.0a-d	29.6f	5.0ab	6.8	8.6	9.2	2	6.8	6.9ab	0a	0a	0	17.4ab
4. linuron	2.0	--	--	Yes	1.0a	0a	0a	2.6abc	1.0ab	0a	7.9	9.9	10	7.1	7.0	6.7ab	0a	0a	1.2	19.5a
5. linuron	4.0	--	--	Yes	0a	0a	0a	2.0abc	0a	0a	9.4	10	10	9	10	7.3a	0a	0a	1.0	19.3a
6. linuron	1.0	--	--	No	3.3a	0.3a	0a	1.0abc	0a	0a	6.8	9.7	9.5	10	7.3	5.8ab	0a	0a	0.7	19.5a
7. linuron	2.0	--	--	No	0.3a	0a	0a	0a	0a	0a	8.6	10	10	10	7.9	5.8ab	0a	0a	0.4	19.7a
8. linuron	4.0	--	--	No	0a	0a	0a	0.6ab	0a	0a	9.3	10	10	10	10	6.3ab	0a	0a	2.3	16.1ab
9. linuron	1.0	+ 0.5	+ --	Yes	2.3a	0a	0a	9.6bcd	15.6cde	10.0b	6.0	9	9	3.3	10	6.6ab	1.0ab	0a	2.5	17.1ab
10. linuron	1.0	+ 0.5	+ 0.5	Yes	0.5a	0.5a	0a	7.0a-d	17.0c-f	0a	6.6	9.1	9.6	3.5	10	7.1ab	0a	0.9ab	0.7	19.7a
11. linuron	1.0	+ 1.0	--	Yes	2.8a	0a	0.3a	4.6a-d	22.6def	6.6ab	6.9	9.1	9.6	4.0	10	5.4ab	2.0bc	0a	2.9	16.3ab
12. linuron	1.0	+ 1.0	+ 1.0	Yes	3.8a	0.5a	0a	10.0cd	21.0def	4.6ab	6.0	8.5	9.0	2.0	10	7.2ab	2.2bc	4.1d	2.5	15.0abc
13. linuron	1.0	+ 2.0	--	Yes	3.0a	0a	0.8a	9.6bcd	16.0cde	1.6a	6.1	9.3	9.3	1.5	10	6.8ab	4.8d	0a	3.2	16.1ab
14. linuron	1.0	+ 2.0	+ 2.0	Yes	4.3a	0a	0a	10.0cd	23.6def	3.6ab	5.3	8.5	9.5	1.0	10	5.8ab	5.1d	6.8e	4.4	11.5cd
15. chloramben	3.0	--	--	No	1.5a	1.5a	0.5a	1.6abc	9.6a-d	1.0a	7.9	8.5	9.4	10	1.5	5.6ab	0a	0a	0	18.5ab
16. chloramben	3.0	+ 0.5	--	No	0.8a	1.5a	0a	1.0abc	7.0abc	0a	9.0	8.3	9.2	9.6	9.4	4.5b	0a	0a	0.5	19.0a
17. chloramben	3.0	+ 0.5	+ 0.5	No	1.3a	0a	0a	0a	14.0b-e	0a	8.7	7.8	9.3	9.8	9.0	6.8ab	1.0ab	1.1b	2.1	18.3ab
18. chloramben	3.0	+ 1.0	--	No	2.0a	1.3a	0.3a	2.6abc	11.6a-e	0a	8.6	8.4	9.3	9.5	10	5.6ab	2.5c	0.4ab	3.7	16.7ab
19. chloramben	3.0	+ 1.0	+ 1.0	No	0.8a	1.5a	0a	1.0abc	7.6abc	0a	7.9	8.4	8.5	9.8	10	5.4ab	3.3c	2.8c	3.1	15.1abc
20. chloramben	3.0	+ 2.0	--	No	2.0a	2.0a	0a	2.0abc	7.6abc	0a	8.2	8.1	9.3	9.5	10	6.8ab	5.5de	0.4ab	5.7	13.6bcd
21. chloramben	3.0	+ 2.0	+ 2.0	No	4.5a	3.5a	0.3a	6.0a-d	11.0a-e	0.6a	7.5	8.0	7.9	9.8	10	6.5ab	6.5e	4.8d	5.7	9.6d

Means within columns followed by the same letter are not sifnificantly different with the Duncan's Multiple Range Test at 0.05.

a/ Post I applied 7-29, ferns 3 to 7 inches tall; Post II applied 9-7, ferns 12 inches tall.

b/ Applied in a 1 inch band over the row at a broadcast rate of 100 lb/A.

c/ Rating: 0 = no control, 10 = complete control.

d/ Cutleaf evening primrose population = 3 plants/ft^2.

e/ Counted on July 2, 1976.

f/ Rating: 0 = no injury or necrosis, 10 = plants killed or all leaves were necrotic.

g/ Measured on October 8, 1976.

HERBICIDES FOR WEED CONTROL IN SWEET CORN AND CABBAGE

G.W. Selleck and W.J. Sanok [1/]

Abstract

Herbicide trials were conducted at the Long Island Vegetable Research Farm on direct-seeded cabbage (Brassica oleracea) and sweet corn (Zea maydis var rugosa). Outstanding candidates for selectivity in seeded cabbage and control of barnyardgrass (Echinochloa crusgalli L. Beauv.), purslane (Portulaca oleracea L.) and pineappleweed (Matricaria matricarioides L.) were H22234 at 1.5 lb/A and oryzalin at 1.0 lb/A. Alachlor at 1.5 lb/A also gave excellent control to those weeds present but initial stunting of cabbage seedlings was evident. By the end of the season, phytotoxicity was not visible with alachlor or any other treatment.

All combinations of alachlor/cyanazine, alachlor/atrazine, CGA 24705/ atrazine and the heaviest rate of CGA 24705/CGA 18762 were excellent for control of crabgrass (Digitaria sanguinalis L. Scop.), lambsquarters (Chenopodium album L.), purslane and fall panicum (Panicum dichotomiflorum Michx.). The CGA 24705 + CGA 18762 at 2 + 2 lb/A ai. was marginal for purslane control and other broadleaved weeds at eight weeks. None of the herbicides tested appeared phytotoxic to the sweet corn varieties which were Goldie, Style Pak, and Seneca Chief.

Introduction

Sweet corn and cabbage are two vegetables grown in rotation in Long Island agriculture.

The increasing cost of labor, and the development of better field seeding techniques has greatly increased interest in the production of direct-seeded cabbage. However, weed competition during early stages of growth remains a major problem. Presently registered herbicides have been effective in controlling most weed species in cabbage, but the continually changing weed spectrum has necessitated the development of new herbicides. Sensitive crops in the rotation following sweet corn necessitate utilization of non-persistent herbicides, or lower rates of the more persistent ones to avoid phytoxicity or residual problems.

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Materials and Methods

In the cabbage trial, Danish Ballhead Cabbage was direct-seeded with a Stan Hay seeder on Haven loam soil. The plots were 2 rows wide by 20 foot long and replicated four times. Herbicides were applied using a tractor-mounted sprayer delivering 43 gpa at 35 psi. Pre-plant incorporated treatments were applied just prior to planting. Preemergence treatments were applied prior to germination. Irrigation was used to supplement natural rainfall. Phytotoxicity ratings were made on July 20 and weed control ratings on August 4.

Tank mix and package mix herbicides were applied preemergence in varieties Goldie, Style Pak and Seneca Chief sweet corn. The corn was planted on June 21 and treated on June 22. Plots were 6 rows wide by 30 feet long and replicated 4 times. Herbicides were applied using a tractor-mounted sprayer delivering 43 gpa at 35 psi. Ratings were made on July 8 and August 16. All plots were hilled July 26 after the first assessment.

A second experiment was conducted on Sweet Corn variety Sweet Sue, using alachlor at 2 lb/A with atrazine at 1.2 lb/A. These applications were made preemergence, ground crack, one, two, three, four, five, six or seven leaf stages. A single application was made to each plot on July 2 to sweet corn planted periodically between June 4 and June 30.

Results and Discussion

Table 1 indicates the results of weed control and phytotoxicity ratings in direct-seeded cabbage. Alachlor at 1.5 lb/A ai. resulted in some initial stunting but by September 15 this was no longer noticeable. For the three major weed species present (barnyardgrass, purslane and pineappleweed) H22234 at 1.5 lb/A and oryzalin at 1.0 lb/A resulted in excellent control. Alachlor at 1.5 lb/A also gave excellent control of these three species. Butralin at 1.5, dinitramine at 0.3, fluchaluralin at 1.0, penoxylin at 1.0, profluralin at 0.75, CDAA at 6.0 and nitrofen at 4.0 provided good to excellent control of both purslane and barnyardgrass. However, they were not effective in controlling pineappleweed.

In the sweet corn trial, none of the three varieties tested, Goldie, Style Pak and Seneca Chief were injured by the chemicals used. The chemicals and rates for sweet corn herbicides are listed in table 2. All combinations of alachlor/cyanazine, alachlor/atrazine, CGA 24705/atrazine and the higher rate of CGA 24705/CGA 18762 resulted in excellent control of crabgrass, lambsquarter, purslane and fall panicum. Atrazine at 2 lb/A alone did not adequately crabgrass or fall panicum. CGA 24705 at 2 lbs. + CGA 18762 at 2 lb/A resulted in marginal control of purslane. The combination of these two materials at 1.5 lb/A also provided only fair control of lambsquarter at eight weeks after application. The combination of butylate at 4 lbs. pre-plant incorporated, followed by 2-4-D amine at 0.4 lbs. postemergence also resulted in excellent weed control.

This corn herbicide trial indicates that there are a number of chemicals that provide excellent weed control in this crop which will result in little or no residual chemical for other crops to follow. In the last trial, alachlor at 2 lb/A ai. plus atrazine at 1.2 lb/A applied at emergence, ground crack, one, two, three, four, five, six or seven leaf stage provided excellent weed control for both crabgrass and purslane. On July 7 a 20% leaf burn was recorded where the material was applied at the one leaf stage and up to 10% burn or phytotoxicity to corn in later stages of development. One week later, July 14, all corn plants were growing normally and no visible delay in maturity was evident in any of these treatments. Although burning resulted from the alachlor/atrazine application, it was temporary and the corn soon recovered from the treatment.

Table 1 Weed control 1/ and phytotoxicity 2/ ratings in seeded cabbage

				Control ratings		
Treatment	Timing	Rate AIA	Phyto	Purslane	Barnyardgrass	Pineappleweed
Butralin	PPI	1.5	2.5	8.1	9.1	4.5
Dinitramine	PPI	0.3	2.5	8.2	9.5	2.1
Fluchaluralin	PPI	1.0	1.0	7.9	8.5	4.0
Oryzalin	PPI	1.0	1.8	9.4	9.2	7.5
Penoxylin	PPI	1.0	2.0	9.7	8.5	1.6
Profluralin	PPI	0.75	1.0	7.6	8.5	0
Trifluralin	PPI	0.5	0	7.2	6.6	0
Alachlor	pre	1.5	3.2	9.5	9.9	9.2
CDAA	pre	6.0	2.6	7.6	9.6	-
Nitrofen	pre	4.0	1.5	9.8	9.1	0
H 22234	pre	1.5	1.5	9.6	9.9	8.7
H 22234	pre	3.0	2.1	9.4	9.7	-
Untreated check 3/			1.0	6	5	7

1/ 0 = no control, 10 = complete control
2/ 0 = no injury, 10 = complete kill
3/ no shoots per sq ft.

Table 2 Weed control ratings 1/ with herbicides in sweet corn

			Weed Species						
	Rate		Crabgrass		Lambsquarter		Purslane		Fall Pancium
Chemical	AIA	Mix 2/	7/8	8/16	7/8	8/16	7/8	8/16	7/8
alachlor	2.0								
+ atrazine	1.0	TM	9.8	9.6	9.8	9.9	9.8	-	9.8
alachlor	1.7								
+ atrazine	0.8	TM	9.8	9.9	9.8	9.7	9.8	9.9	9.8
alachlor	2.0								
+ atrazine	1.0	PM	9.7	9.9	9.8	9.9	9.8	9.9	7.5
alachlor	1.7								
+ atrazine	0.8	PM	9.8	9.9	9.1	9.9	9.8	-	9.8
alachlor	2.0								
+ cyanazine	1.25	TM	9.8	9.9	9.8	9.7	9.8	9.5	9.8
alachlor	2.0								
+ cyanazine	1.0	TM	9.8	9.9	9.8	9.9	9.8	-	9.8
butylate	4.0								
+ 24-D amine	0.4	3/	9.3	9.7	9.7	9.9	9.5	9.9	9.3
CGA 24705	1.5								
+ atrazine	1.9	PM	9.8	9.9	9.8	9.4	9.6	-	9.8
CGA 24705	2.0								
+ atrazine	2.5	PM	9.7	9.9	9.8	9.9	9.8	-	9.8
CGA 24705	2.5								
+ atrazine	3.1	PM	9.8	9.9	9.8	9.9	9.8	9.9	9.8
Untreated check 4/			7	7	6	5	17	17	6
CGA 24705	1.5								
+ CGA 18762	1.5	PM	8.8	9.6	8.5	6.3	7.0	5.0	8.5
CGA 24705	2.0								
+ CGA 18762	2.0	PM	9.8	9.8	7.7	9.8	7.7	6.1	9.8
CGA 24705	2.5								
+ CGA 18762	2.5	PM	9.7	9.6	9.0	8.6	9.0	8.3	9.8
atrazine	2.0		3.3	5.6	9.8	9.9	9.8	8.0	5.0

1/ 0 = no control, 10 = complete control
2/ TM = Tank mix, PM = Package mix
3/ Butylate applied preplant incorporated
24-D amine applied postemergence
4/ Shoot density/ sq ft.

HERBICIDES FOR WEED CONTROL IN ONIONS AND SHALLOTS

W.J. Sanok, G.W. Selleck and W.L. Kline[1/]

Abstract

Three herbicide experiments were conducted on Long Island in 1976 to evaluate chemical control of weeds in onions (*Allium cepa* L.) and shallots (*Alium ascalonicum* L.). In the first experiment CDAA at 6 lb/A or DCPA at 6 lb/A were applied to seeded Early Yellow Globe onions followed by postemergence application of methazole at 0.5, 0.75, and 1.0 lb/A ai. or nitrofen at 2 and 3 lb/A. A total of five postemergence applications were made. At the last postemergence application RH 2919 at 0.12 and 0.5 lb/A were substituted for the nitrofen treatments. In a second experiment CDAA and DCPA preemergence followed by nitrofen was applied to ten varieties of onions. In a third experiment, CDAA at 4 and 6 lb/A, nitrofen at 2 and 3 lb/A and alachlor 1.5 and 2 lb/A were applied at 50% emergence of shallots. These same applications were repeated two more times postemergence to these shallots. In the three experiments, all chemical herbicides tested resulted in varying degrees of weed control but no unacceptable phytotoxicity to the crop. Alachlor and nitrofen provided good to excellent control of weeds present. Methazole at 0.5 lb/A appeared to be effective on a broader spectrum of weeds than nitrofen at 3 lb/A.

Introduction

Onions and other related crops do not compete well with weeds for space, light, or nutrients. As a result, one of the major problems in onion and shallot production has been adaquate weed control. Presently registered herbicides have been effective in controlling most weeds in onions but have limitations due to timing restrictions and application and short residual of herbicides. In addition, with constant use of the same chemicals resistant weeds continue to be a major problem.

Materials and Methods

Two experiments using herbicides on onion were conducted at the Long Island Vegetable Research Farm on a Haven loam soil. In the first experiment the Early Yellow Globe variety was direct-seeded on April 8. Both CDAA and DCPA at 6 lb/A ai. were applied on April 15 preemergence to the onions. Postemergence application of methazole and nitrofen were applied at the 2- or 3-leaf stage.

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A total of six applications replicated four times were made during the season. The plots were two rows wide by 30 ft. long and application was made with a tractor mounted sprayer delivering 43 gpa at 35 psi. In addition to traditional check plots, untreated checks were located adjacent to each treatment. Irrigation supplemented natural rainfall when needed. On the last application July 27, RH 2919 at 0.12 and 0.5 lb/A was substituted for the nitrofen application. Manual hoeing was necessary three times during the season, on June 6, June 23 and July 26 to maintain satisfactory weed control throughout the season.

In the second experiment ten varieties of onions including Early Yellow Globe, Ruby Red and Harris Hybrids 1926, 195155, 5556, 1955, 5551, 556L, and 1426 and EA2603 were planted on April 8. These onions were treated with preemergence application of CDAA and DCPA followed by nitrofen postemergence.

Six herbicide treatments involving CDAA at 4 and 6 lb/A, alachlor at 1.5 and 2 lb/A and nitrofen at 2 and 3 lb/A were applied on April 28 to shallots. The shallots had been planted three weeks earlier and were 50% emerged at the time of application. The plots were three rows wide by 30 ft. long and replicated three times. Treatments were made with a hand-held sprayer delivering 43 gpa at 35 psi. The location of this experiment was on a Plymouth sandy loam soil. Irrigation was used periodically to supplement rainfall. Treatments were made three times. Two tillage operations were also used between applications to provide season long weed control.

In all experiments ratings were made prior to the follow-up postemergence treatments. Weed species present on experiments one and two were: crabgrass (*Digitaria sanguinalis* (L) Scop.), pineappleweed (*Matricaria matricaroides* (Less.) Porter), barnyardgrass (*Echinochloa crusgalli* (L.) Beauv), purslane (*Portuloca oleracea* L.), fall panicum (*Panicum dichotomiflorum* Mich). In the experiment on shallots the weed species present were: lambsquarter (*Chenopodium album* L.), carpetweed (*Mullogo verticillata* L.), ladysthumb (*Polygonum persicaria* L.), crabgrass (*Digitaria sanquinalis* (L.) Scop.), mouseear chickweed (*Cerasticum vulgatum* L.), and ragweed (*Ambrosia artemisufolia* L.).

Results and Discussion

In all experiments there was no significant phytotoxicity to the crop. In the case of shallots, alachlor at 2.0 lb/A preemergence caused some early stunting but symptoms were not visible at mid-season or later.

In the first experiment on direct-seeded onions, methazole at 0.5 lb/A appeared to be effective on a broader spectrum of weeds then nitrofen at 3 lb/A. The treatment involving DCPA appeared to give better control of crabgrass and barnyardgrass then those involving CDAA (Table 1). This is probably due to the fact that CDAA is more soluble with a shorter residual on mineral soil. Weed emergence was insufficient on the RH 2919 plots to assess weed control. There were no statistically significant yield differences between any of these chemical treatments.

In experiment II involving ten varieties of onions, there were no differences in yield attributed to the chemical treatment.

Table 2 is a summary of the results of weed ratings on the shallot experiment. All products were effective for control of chickweed. Alachlor and nitrofen were fairly consistent for control of the five weed species present. In addition to the three herbicide applications, two tillage operations were necessary to provide adaquate season-long weed control.

Because of the meager vegetative growth of onions and shallots, from these trials it is evident that multiple applications of herbicides plus some cultivation are generally necessary to provide season long weed control.

Table 1 Weed control ratings 1/ in onions

			Weed Species						
	Rate		Crabgrass			Barnyardgrass	Pineappleweed	Purslane	Fall Panicum
Chemical	AIA	Timing	6/4	7/19	8/16	7/19	6/4	7/19	7/19
DCPA	6	pre							
+ methazole	1	2 leaf	-	9.9	9.9	9.9	6.6	9.9	9.9
DCPA	6	pre							
+ methazole	0.5	3 leaf	9.3	9.2	9.3	9.1	8.5	9.9	9.9
DCPA	6	pre							
+ methazole	0.75	3 leaf	-	9.9	9.8	9.8	8.5	9.9	9.0
DCPA	6	pre							
+ methazole	1	3 leaf	9.0	9.9	9.8	9.8	-	9.9	9.9
CDAA	6	pre							
+ methazole	0.75	3 leaf	8.2	5.5	9.3	3.1	-	6.6	4.3
DCPA	6	pre							
+ nitrofen	3	2 leaf	9.0	4.8	8.9	8.3	5.1	9.9	-
CDAA	6	pre							
+ nitrofen	3	2 leaf	6.1	1.2	7.2	3.7	-	9.9	-
CDAA	6	pre							
+ methazole	1	3 leaf	8.7	9.2	9.9	9.7	-	9.9	-
DCPA	6	pre							
+ methazole	0.75	2 leaf	9.8	9.8	9.9	9.9	9.1	9.9	9.9
untreated check 2/			3		4	-	2	1	-

1/ 1 = no control, 10 = complete control
2/ density of shoots per sq. ft.

Table 2 Weed control ratings [1] with herbicides in shallots

Chemical	Rate AIA	Lambsquarter 6/30	Lambsquarter 7/6	Lambsquarter 7/30	Carpetweed 7/30	Ladysthumb 7/6	Ladysthumb 7/30	Crab-grass 7/30	Chick-weed 7/30	Ragweed 6/30	Ragweed 7/6
CDAA	4	-	4.0	1.0	4.5	8.0	9.5	3.0	9.0	2.7	3.8
CDAA	6	1.0	1.0	2.3	7.4	1.0	9.7	9.8	9.7	5.5	1.0
nitrofen	2	3.0	8.8	4.0	9.8	9.4	9.8	4.5	9.8	5.0	5.5
TOK	3	1.0	9.3	8.3	9.8	9.8	9.8	7.9	9.8	2.7	1.0
alachlor	1.5	9.8	8.3	1.5	7.1	9.5	3.0	9.7	9.8	9.3	8.0
alachlor	2	9.0	9.3	1.0	9.5	9.4	8.7	9.8	9.8	8.8	8.8
Untreated check [2]		-	-	5	3.3	-	2	7	29	-	3

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

[2] No. of shoots per sq ft.

THE RESPONSE OF SNAPBEANS AND LIMA BEANS TO SOME DINITROANILINE HERBICIDES

Richard D. Ilnicki and Ratemo W. Michieka[1/]

ABSTRACT

Several dinitroaniline herbicides were evaluated for weed control and crop tolerance in snapbeans and lima beans on a Sassafras loam soil at the Adelphia Research Station, Adelphia, New Jersey. All herbicides were applied prior to planting and soil incorporated.

In a previous study (Proc. NEWSS 29:197-198, 1975) it was established that N-(cyclopropylmethyl)-a,a,a-trifluoro-2,6-dinitro-N-propyl-p-toluidine (profluralin) was the safest on snapbeans followed by 4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine (butralin); N-(2-chloroethyl)-2,6-dinitro-N-propyl-4-(trifluoromethyl) aniline (fluchloralin); a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin); and N^4,N^4-diethyl-a,a,a-trifluoro-3,5-dinitrotoluene-2,4-diamine (dinitramine). For lima beans, the safest herbicide was fluchloralin, followed by trifluralin, profluralin, butralin, and dinitramine.

This was a comparable study; however, fluchloralin was deleted and N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine (penoxalin) and USB 3153 (chemistry not disclosed) were added.

It was observed that all herbicides studied reduced stand and vigor of both snapbeans and lima beans. Considering all rates of all the herbicides the two safest herbicides on snapbeans were penoxalin and trifluralin; the most severe were profluralin and dinitramine. Butralin and USB 3153 were intermediate. This was not completely in agreement with our earlier finds. However, when the mid-rate or the rate most likely to be used for weed control were compared the safest herbicides were profluralin and penoxalin followed by butralin, trifluralin, USB 3153,

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and dinitramine, the latter being the most injurious. This order, from least to most severe, was very similar to findings reported earlier.

For lima beans, the findings were as follows: averaging all the rates for each herbicide studied the safest herbicides were trifluralin and penoxalin; the most severe were profluralin and dinitramine. Butralin and USB 3153 were intermediate. By comparing the rates most likely to be used for optimum tolerance with acceptable weed control the safest herbicides were trifluralin and profluralin; the most injurious were penoxalin and dinitramine; butralin and USB 3153 were intermediate. This order, from least to most severe, was comparable to our earlier findings.

THE EFFECTS OF SOME PREEMERGENCE HERBICIDES AND HERBICIDE COMBINATIONS ON SNAPBEANS AND LIMA BEANS

R. D. Ilnicki, R. W. Michieka, and J. Somody[1/]

ABSTRACT

A number of preemergence herbicides and herbicide combinations were evaluated for weed control and crop tolerance in snapbeans and lima beans at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey, on a Sassafras loam soil.

Included in the study were the following herbicides: 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide (metolachlor) at 1 1/2, 2, and 2 1/2 lb/A; 2-sec-butyl-4,6-dinitrophenol (dinoseb) at 3 and 4 1/2 lb/A; combinations of metolachlor plus dinoseb at 1 1/2 + 3 and 2 + 3 lb/A, respectively; N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine (penoxalin) at 3/4, 1, and 1 1/2 lb/A; 4-amino-6-tert-butyl-3-(methylthio)-_as_-triazine-5 (4H)-one(metribuzin) at 1/4, 3/8, and 1/2 lb/A; combinations of penoxalin plus metribuzin at 3/4 and 1 + 1/4 and 3/8 lb/A, respectively; VEL 5052 at 1, 2, and 4 lb/A; N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine (ethalfluralin) at 1 and 1 3/4 lb/A; 3-amino-2,5-dichlorobenzoic acid (chloramben) at 2 and 3 lb/A; ethalfluralin plus chloramben at 1 and 1 1/4 + 1 3/4 and 2 lb/A, respectively; 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) at 2 and 2 1/2 lb/A; and VEL 5052 plus dinoseb at 1 and 2 + 3 lb/A, respectively.

From this study, it was observed that snapbeans were more senstitive to herbicide treatments than lima beans. Lima beans stand was slightly reduced by the combination of metolachlor plus dinoseb.

Snapbeans (var. Provider) was particularly sensitive to most of the herbicide treatments. This variety was unusually sensitive to the herbicide treatments studied. Herbicide treatments producing the least amount of injury were penoxalin,

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ethalfluralin, VEL 5052, ethalfluralin, chloramben, alachlor, combinations of ethalfluralin and chloramben, and combinations of VEL 5052 and dinoseb. Treatments producing the greatest injury were metolachlor, dinoseb, combinations of metolachlor plus dinoseb, metribuzin, and combinations of metribuzin plus penoxalin.

All herbicides and herbicide combinations produced acceptable control of lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), carpetweed (Mollugo verticillata L.) and fall panicum (Panicum dichotomiflorum Michx.).

LONG-TERM USE OF HERBICIDES IN A HIGHBUSH BLUEBERRY PLANTING

W. V. Welker, Jr.[1/]

ABSTRACT

In 1966 we established a planting of highbush blueberries [*Vaccinium australe* (Small), variety Earliblue] to study the influence of repeated annual applications of selected herbicide treatments upon plant vigor, yield, and weed control. We used a randomized complete block design with four replicates. Each plot consisted of five bushes with a spacing of 4 ft between bushes within the row and 10 ft between rows. Terbacil (3-*tert*-butyl-5-chloro-6-methyluracil) at 2 and 4 lb ai/A and fluometuron [1,1-dimethyl-3-(α,α,α-trifluro-*m*-tolyl) urea] at a rate of 6 lb ai/A were applied each spring from 1969 through 1976. A combination of diuron (3-(3,4 dichlorophenyl)-1,1-dimethylurea) at 2 lb ai/A and terbacil at a rate of 2 lb ai/A was applied each spring from 1973 through 1976. Herbicide rates were selected that were sufficiently high to insure good weed control, the intent being to study the tolerance of blueberries to long-term exposure to these herbicides.

All herbicide treatments provided excellent weed control for the duration of the study. Yields were not significantly reduced by terbacil at either 2 or 4 lb ai/A. The 4 lb rate did, however, cause a reduction in vegetative growth that resulted in the blueberry bushes appearing less vigorous than the untreated control. This effect became evident in 1971 and continued through 1976 with little increase in severity. Fluometuron caused no reduction in yield during the first 3 years; however, yields were seriously reduced from the fourth year on. The bushes treated with fluometuron showed foliar symptoms beginning in 1970. These symptoms increased steadily through 1976. The vigor of the plants was reduced and die-back of the growing tips occurred. The combination of diuron and terbacil caused no reduction in yield or visual injury to the bushes.

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EVALUATION OF GLYPHOSATE AND PARAQUAT ON STRAWBERRIES

J. Ray Frank and J. A. King[1]

ABSTRACT

Weed control in strawberry (*Fragaria* X *ananassa* Duch. cv Midway) was evaluated in large-scale field studies during 1976 following postplant applications of glyphosate (N-(phosphonomethyl)glycine) and paraquat (1,1'-dimethyl-4,4'bipyridinium chloride) with or without the use of black plastic mulch. The responses of 91 weed species were observed during the test period.

One to three postplant applications of each compound were applied. Glyphosate was applied 2, 4, and 5 lb/A ai. Paraquat applications were made at 0.5, 1 and 2 lb/A ai.

Paraquat gave weed control of many species at all three application rates. Applications made during three consecutive weeks at each rate gave temporary weed control. Three applications spaced out during the growing season at 0.5 lb/A gave more than 50% weed control. Three treatments of paraquat at 1 lb/A appeared to be as effective as the same number of treatments at 2 lb/A. These treatments reduced weed cover over 70%.

Glyphosate applications at each rate on three consecutive weeks gave temporary weed control. Three applications spaced out during the growing season controlled many species and reduced weed cover up to 90%.

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CONTROL OF APPLE ROOT SUCKERS

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ABSTRACT

Shoots arising from the root system of apple (Malus domestica Borkh) trees were more abundant where sod and weed growth was eliminated with herbicides than where such growth was controlled by mowing. Herbicide regimes allowing such sucker growth included combinations of amitrole (3-amino-s-triazole) with diuron [3-(3,4-dichlorphenyl)-1,1-dimethylurea] or simazine [2-chloro-4,6-bis(ethylamine)-s-triazine], and dalapon (2,2-dichloropropionic acid) with diuron. AMS (ammonium sulfamate) and 2,4-D [2,4-dichlorphenoxy(acetic acid], afforded measures of controlling suckers. AMS was satisfactory in five years of large scale use. In another year leaf symptoms appeared on occasional trees in the summer after AMS was applied to suckers on the trunk as well as those from the roots of topworked trees. Symptoms were similar to those of apple mosaic.

INTRODUCTION

Suckers growing from the rootstock interfere with culture and harvest, and may aggravate certain disease and insect problems. They are usually pruned back to ground level with dormant season, but their number may increase by growth from lateral buds. Attempts to control sucker growth with paraquat proved unsatisfactory with even three applications during one growing season (1). NAA has controlled sucker growth on apple trunks (3) and, in combination with a growth regulator of long chain fatty alcohols,(Off-Shoot-T) has been effective on root suckers of apple, cherry, and quince (2). Glyphosate [n-(phosphonomethyl)glycine] is highly effective in killing root suckers (4,5), but tree injury that might not be evident until next year is still to be assessed.

MATERIALS AND METHODS

In the fourth year of a commercial planting of McIntosh and Red Delicious growing on M2 rootstocks differential herbicide regimes were begun in comparison with the grower's standard practice. Herbicides were applied in May of each year by knapsack sprayer in 50 or 100 gal/A on 8 by 8 foot plots under the trees. After four years residual herbicides were used alone in certain treatments where perennial grasses had been eliminated. Grower practice consisted of rotary tree tiller driven around the trees 3 to 5 times per year in the early years, periodic mowing between rows in all years. Mowing reached to within two feet of the tree trunks in herbicide plots as well as checks. Suckers were cut by hand each dormant season. Preliminary herbicide trials for sucker control were applied in 50 to 200 gal/A at 20 to 25 psi. The larger scale applications of AMS involved spraying to runoff at pressure of 200 psi or higher, with spray concentration of 57 to 71 lb ai/100 gal and sufficient surfactant to give complete filming of the apple leaves.

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RESULTS AND DISCUSSION

Sucker growth was most abundant where grass and weed growth was almost eliminated by amitrole plus simazine (Table 1). Suckers were rare where early years of tillage were followed by mowing. Nearly complete cover of quackgrass (Agropyron repens (L.) Beauv,), orchardgrass (Dactylis glomerata L.), and other weeds had developed in these plots. Under dalapon plus diuron where a moderate cover of buckhorn plantain (Plantaga lanceolata L.) developed, sucker population was intermediate.

The sucker clumps noted as being more than 6 inches distant from the trunks originated as adventitious buds from roots. Their scarcity in the till-mow regime as compared with herbicides could reflect in part the longer period of surface root destruction by the four additional years of tillage. It could also reflect allelopathy, and the effects of shade and cover over the soil surface. None of the herbicides clearly stimulated or repressed suckers. However, perhaps by coincidence, suckers were significantly more numerous in plots treated with the higher rate of simazine (Trts. 1,2) than in equally weed-free plots treated with the low rate or no simazine, but with diuron (Trts. 3, 4).

In small scale trials, summer applications or AMS or oil soluble amine formulations of 2,4-D showed promise for killing growing suckers (Table 2). Kill by AMS was greater than shown in the final count of live suckers; about half of these had emerged from below ground level since treatment. Nevertheless, the records for AMS, taken in October, show a marked reduction in number and size of suckers to be cut over winter. No injury symptoms were noted on other parts of the trees in the current or following season. However, only six to ten trees were observed in a test and they were ten years old or older.

AMS was used extensively in variety collection orchards at Geneva in five years between 1968 and 1974. Sprays were applied in late June or early July under more than 100 trees with dense growth of M7 suckers and a similar number with seedling suckers in each of four years. Control was commercially satisfactory. After two years, however, sucker numbers in a given block had often multiplied to the level that treatment was repeated. None of the trees, all more than ten years old, showed damage other than to the suckers.

A leaf symptom attributed to AMS appeared in one unique population of trees. Low branches had been cut from the trees a year before treatment and numerous suckers growing on the trunks, as well as root suckers, were sprayed on a hot day in mid July, 1975. In June of the next year chlorotic leaves appeared on scattered spurs and shoots on 12 of 71 trees that had been treated. The varying patterns of bright chlorosis, similar to those of apple mosaic, included nearly complete chlorosis, patches between main veins, mottling of small spots, and chlorosis of portions of the midrib or main veins. Later leaves on affected shoots were usually normal. A similar symptom had been observed in previous minor test after low branches on young trees had been sprayed.

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Table 1. Prevalence of M2 root suckers under McIntosh and Red Delicious as related to weed control regime. Sept. 1967.

Weed control regime[a/] (Herbicide, lb ai/A) 1959-62	1963-67	% Weed Cover	No. trees	% With Suckers	b/	Sucker Clumps Per Tree	b/
1 Amitrole 2 +simazine	same, 1+4	1	16	94	81	4.4 ±0.8	3.7 ±0.8
2 As above	simazine 4	4	16	81	81	3.4 ±0.7	3.1 ±0.7
3 Dalapon 8	amitrole 1 +diuron 3	7	13	69	69	2.2 ±0.3	1.9 ±0.3
4 Atrazine 4	diuron 1.5 +simazine 2	3	15	67	60	2.7 ±0.7	2.1 ±1.6
5 Dalapon 8 + diuron 3	same	55	29	52	34	1.2 ±0.3	0.8 ±0.2
6 Rototill	mow	90	21	24	14	0.4 ±0.2	0.2 ±0.1

a/ Herbicides in May of each year; rototill and mow several times.
b/ Of certain root origin; omit suckers within 6 inches of trunks.

Table 2. Sucker control by AMS and 2,4-D oil soluble amine.

Rootstock	M7	M2	M2	Seedl.
Treatment date:	Jul 8,'67	June 13,'72	Jul 6,'73	Jul 16,'74
Herbicide	AMS	2,4-D	2,4-D	AMS
Lb/gal per acre	110/200	2.0/50	1.5/50	140/200
Sucker no.	267	207	164	444
Maximum height a/	12 inch	10 inch	15 inch	25 inch
Final live suckers				
% of original no.	16%	5%	3%	25%
Maximum height a/	5 inch	-	-	7 inch
Weeks after trt.	12	5	10	12

a/ Mean of tree-plot maximums.

CONTROL OF PROSTRATE SPURGE IN MUCK ONIONS[1]

S. L. Dallyn, K. W. Stone, D. T. Warholic, and A. M. Schippers[2]

ABSTRACT

Seedlings of prostrate spurge (Euphorbia supina Raf.) emerged in muck grown onions (Allium cepa L. Downing Yellow Globe) during the period May 14 to July 15. Good to excellent control of this pest was obtained with 6 to 9 lb/A ai propachlor (2-chloro-N-isoproplacetanilide). The same rates of CDAA (N-N-diallyl-2-chloroacetamide) were effective provided the chemical was incorporated immediately after application. The addition of 1 to 2 lb/A ai CDEC (2-chloroallyl diethyldithiocarbamate) but not chlorpropham (isopropylm-chlorocarbanilate) to both propachlor and CDAA enhanced their activity against prostrate spurge. Late directed sprays of Herbisan [diethyl dithiobis (thionoformate)] at 7.5 lb/A ai gave excellent control of the weed but had relatively short residual activity. RH2915 (chemistry undisclosed), bifenox [methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate] and nitrofen (2,4-dichlorophenyl-p-nitrophenyl ether) were ineffective; methazole [2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,4-dione] showed some promise. Cultivation provided a substantial measure of control and the use of directed sprays permitted higher rates of the effective herbicides without increasing onion damage.

INTRODUCTION

Prostrate spurge, known locally as milk pusley, has been an increasing problem in most of the onion producing areas of New York State. A survey of a number of fields in 1975 suggested the weed has probably become established due to removal of its major weed competitors by herbicides. Also, it was most prevalent where onions were grown in a monoculture and where little if any cultivation was used. In addition to its effects during the growing season the pest is particularly troublesome at harvest. It forms great mats of interwoven plants which plug the harvesters and complicate drying and curing of the crop. A season long control program must be developed which will keep growers' fields clean until harvest time.

Currently labeled herbicides, as used by growers, and a number of experimental materials used in 1975 did not give satisfactory control (2). Observations made last year indicated that cultivation provided a fair measure of control and that tolerance to herbicides increased greatly with size of the plants. Information was also obtained that propachlor was definitely superior to CDAA, at least in the absence of cultivation or incorporation. All these factors were considered in setting up the 1976 program.

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MATERIALS AND METHODS

A commercial field in the Elba muck area of New York known to be heavily infested with prostrate spurge, was selected for the trial. Experience in 1975 indicated it was essential to control this pest in the early seedling stage as once the plants reached a diameter of two inches or more they were very difficult to kill. Thus it was decided that as soon as a treatment began to fail, follow-up applications of selected herbicides would be made in an attempt to maintain acceptable commercial control through harvest.

The plot size was 5 ft. by 18 ft. with four rows of onions per plot. A randomized complete block design with three replications was used. Application was with a hand-held CO_2 pressurized, small plot backpack sprayer. All materials were applied in 100 gal/A water except where otherwise noted as low volume 50 gal/A. All chemical rates given are active ingredient per acre.

Table 1 contains a summary of the 25 treatments in the main experiment. The first five received a preemergence application of propachlor ten days after seeding. The onions were in the "loop" stage on the May 13 treatment date and at the two to three leaf stage on June 9. Treatments 6 through 13 were set up as four paired-plots with one of each cultivated immediately after the sprays were applied. The growers' regular equipment-a basket weeder-was used on May 13, May 21, June 9, June 16, and a small toothed cultivator on June 28. Treatments one to five, 21-24, and one of the two checks were also cultivated as above. The other check was kept clean by shallow hoeing and hard pulling. The primary objective of treatments 21 to 24 was to assess the value of directed spraying with fairly high rates of several materials.

Weed control and crop injury ratings were made at one to two week intervals throughout the growing season; the final one on weeds, August 31, was immediately prior to harvest. Following that final evaluation 10 ft. of the two center rows of each plot were pulled and the number and weight of bulbs determined.

In addition to the main experiment described above, two observational trials were applied to other onions which had been kept reasonably weed free with CDAA plus cultivation. I. One June 17, two replications of the following were applied: 1) propachlor 6 plus CDEC 2, 2) CDAA 6 plus CDEC 2, 3) propachlor 6 plus CDAA 6, 4) same as 3) plus CDEC 2, 5) propachlor 4 plus CDAA 4 plus CDEC 2 at low volume, and 6) propachlor 9 plus CDEC 4. These received no further herbicides but were cultivated June 28. II. On July 14 the following directed sprays were applied to another set of reasonably clean plots: 1) Herbisan 7.5, 2) Herbisan 7.5 plus 1 qt. booster oil, 3) CDAA 9 and 4) nitrofen 4. This was considered the latest possible date directional equipment could get through the rows; these plots received no further attention until harvest.

Information was obtained on the germination pattern of the weed by taking stand counts in the two checks, treatments 25 and 25T, of each of the three replications. An area three feet long between the two center rows, 14 inches apart, was marked out and this same area counted each time. In the cultivated checks counts were made and the seedlings removed just before cultivation; in the hand checks weeds in the count area were pulled so that a very minimum amount of soil disturbance occurred.

RESULTS AND DISCUSSION

The behavior of prostrate spurge in 1976 was somewhat different than in the previous year. This was probably related to a marked contrast in growing conditions--unusually warm and dry in 1975 but just the opposite in 1976. It appeared to the authors that even though germination was high (Figure 1) the developing plants did not display the same vigorous aggressive growth of the previous year. The natural habitat and characteristics of the pest do not rule out this possibility (1).

The main difference affecting early control, at least, may have been that through there were many spurge seedlings present at onion emergence last year there were none this year. On May 13 when the bulk of the plots received their first application at loop stage, there were still none in evidence. Four to five days later many spurge seedling had emerged in the preemergence and check plots (Table 2 and Figure 1) There are two possible explanations for this--the cold, wet spring delayed germination, or the occurrence of several late spring frosts killed off the very young seedlings before they were of sufficient size to be noticeable.

The weed control ratings are summarized in Table 2. In evaluating these data it is important to refer back to Table 1 to determine the preceeding applications involved in each treatment, otherwise the changing ratings from date to date are meaningless. The emergence pattern of the weed should also be considered (Figure 1) since essentially no seedlings emerged after mid July. This explains why Herbisan, a short residual material, applied to the checks on July 7 provided good control; and applied to treatments 17 and 19 on July 14 provided excellent control right through to harvest. Herbisan used earlier, however, as on treatments 21 and 22 on June 28 was satisfactory for only about two weeks; and these plots became heavily infested before the August 31 harvest date.

Little information was obtained on the value of propachlor used preemergence since the spurge did not appear until two weeks later. There was no effect of the herbicide left at this time and the weed count increased rapidly up to the May 21 sprays. Complete weed control was obtained in treatments one to five from then on. The total amount of herbicides used in these treatments was high but part of the objective was to determine onion tolerance and also to determine the effect of CDEC as an additive to CDAA and propachlor. CDEC did appear to increase activity and also caused some crop damage, (Table 3).

The main objective of treatments 6 to 13 was to compare effectiveness of CDAA and propachlor with and without incorporation (tillage). There was a very marked and consistent benefit from incorporating CDAA, but there was no effect on propachlor. From a practical standpoint the most important finding of the trial was that CDAA incorporated immediately was as effective as propachlor in control of prostrate spurge.

RH 2915 at 4 oz/A ai, caused some leaf burning of the onions and did not control the weed. Methazole at 3/4 lb/A ai damaged onions slightly and did not provide sufficient weed control; at 1 lb/A ai, weed control was fairly good and though considerable onion leaf burning occurred, yield was not affected. Bifenox provided moderate control at the 2 lb/A ai rate but appeared to have a short residual effect.

Directed sprays of Herbisan, 7.5 ai/A, applied June 28 killed vigorously growing spurge seedlings within an hour with little or no damage to onions. The addition of booster oil had no apparent effect one way or the other. Residual control lasted slightly over two weeks. CDAA directed towards the base of the onions resulted in good control for four weeks and caused no crop injury--the only safe way to use this rate, 9 lb/A ai, of the material. Nitrofen proved to be very weak against spurge.

As mentioned earlier a number of observational treatments involving various combinations of propachlor, CDAA, and CDEC were put out on June 17. All six of these treatments gave good control for four weeks and the five containing CDEC were still fairly clean at harvest. The addition of CDEC definitely increased effectiveness, as was found to be the case in the main experiment as well. Treatments corresponding to 21 to 24 of the main experiment were also applied to other plots but at the latest date, July 14, it seemed practical to get spray equipment through the field. Herbisan gave excellent control through harvest, nitrofen gave poor control. CDAA resulted in very mediocre control in contrast to that obtained in treatment 23 where the material was applied June 28. The difference is believed due to the lack of incorporation on July 14. A "layby" application of CDAA will have to be made while it is still possible to get through with mechanical tillage equipment.

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Table 1. List of treatments in main experiment giving rates of herbicide, ai/A, and dates of application.

Tr. No.	4/29	5/13	5/21	6/9	6/28	7/7	7/14
1	propachlor 6		CDAA 9 chlor[c] 6	CDAA 6 chlor 6	propachlor 3 CDEC 1	repeat 6/28	repeat 6/28
2	propachlor 6		propachlor 6	CDAA 6 chlor 6	propachlor 6 CDEC 2		repeat 6/28
3	propachlor 9		CDAA 9 chlor 6	CDAA 6 chlor 6	propachlor 3 CDAA 3	repeat 6/28	repeat 6/28
4	propachlor 9		propachlor 6	CDAA 6 chlor 6	CDAA 3 CDEC 1	repeat 6/28	repeat 6/28
5	propachlor 6		CDAA 6 chlor 6	repeat 5/21	CDAA 6 CDEC 2		repeat 6/28
6 & 7[a]		CDAA 6 chlor 6		repeat 5/13	repeat 5/13		b
8 & 9[a]		propachlor 6 chlor 6		repeat 5/13	repeat 5/13		
10 & 11[a]		CDAA 9 chlor 6		repeat 5/13	repeat 5/13		
12 & 13[a]		propachlor 9 chlor 6		repeat 5/13	repeat 5/13		
14		CDAA 9 chlor 6		RH2915 4 oz low vol	repeat 6/9		CDAA 9 directed
15		CDAA 9 chlor 6		methazole 3/4 low vol	repeat 6/9		
16		CDAA 9 chlor 6		methazole 1 low vol	repeat 6/9		
17		CDAA 9 chlor 6		bifenox 1 low vol	repeat 6/9		Herbisan 7.5 + oil 1 qt di-
18		CDAA 9 chlor 6		bifenox 2 low vol	repeat 6/9		rected
19		CDAA 9 chlor 6		CDAA 6	repeat 6/9		Herbisan 7.5 + oil 1 qt di-
20		CDAA 9 chlor 6		CDAA 9	repeat 6/9		rected
21[a]		CDAA 9 chlor 6		repeat 5/13	Herbisan 7.5 directed		
22[a]		CDAA 9 chlor 6		repeat 5/13	Herbisan 7.5 + 1 qt oil directed		
23[a]		CDAA 9 chlor 6		repeat 5/13	CDAA 9 directed		
24[a]		CDAA 9 chlor 6		repeat 5/13	nitrofen 4 directed		
25[a]	check - regular tillage					Herbisan 7.5 directed	
25	check - hand weeded					Herbisan 7.5 directed	

[a]plots 1-5, 7, 9, 11, 13, 21-25 received incorporation-cultivation to maintain control [b]CDAA 9, directed spray, on treatment 6 [c]chlorpropham

Table 2. Control ratings[a] for prostrate spurge throughout the growing season. See Table 1 for details on rates and timing of treatment applications.

	5/18	6/16	6/28	7/7	7/14	7/23	8/3	8/11	8/31
1	2.8	10.0	9.2	10.0	10.0	10.0	10.0	10.0	10.0
2	2.8	7.5	9.2	10.0	10.0	10.0	10.0	10.0	10.0
3	3.8	8.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0
4	3.8	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
5	3.8	10.0	9.2	10.0	10.0	10.0	10.0	10.0	10.0
6	6.8	4.5	3.3	4.2	4.2	8.3	6.8	5.0	7.5
7	8.3	10.0	8.3	10.0	9.2	8.3	10.0	8.3	10.0
8	3.3	7.5	9.2	10.0	10.0	9.2	10.0	10.0	9.2
9	8.3	10.0	9.2	10.0	10.0	10.0	10.0	10.0	9.2
10	6.8	7.5	6.8	10.0	8.3	8.3	8.3	6.8	9.2
11	8.3	10.0	10.0	10.0	10.0	10.0	10.0	10.0	9.2
12	5.0	10.0	10.0	10.0	10.0	9.2	10.0	8.3	10.0
13	10.0	10.0	9.2	10.0	10.0	10.0	10.0	8.3	9.2
14	10.0	5.0	4.2	3.3	3.3	6.8	6.8	5.0	7.5
15	8.3	6.3	4.2	7.5	5.0	5.0	5.0	5.0	5.0
16	10.0	8.5	5.8	9.2	7.5	5.8	8.3	6.8	8.3
17	8.3	5.0	5.0	5.8	4.2	10.0	10.0	10.0	10.0
18	10.0	7.5	6.8	9.0	5.0	4.2	5.0	1.8	5.8
19	10.0	5.0	4.2	3.3	2.5	10.0	10.0	10.0	9.2
20	8.3	7.5	5.0	8.3	9.2	9.2	8.3	6.8	9.2
21	8.3	7.5	7.5	10.0	8.3	5.8	3.3	3.3	4.2
22	10.0	10.0	9.2	10.0	8.3	5.0	1.8	1.8	3.3
23	8.3	10.0	9.2	10.0	10.0	9.2	6.8	6.8	7.5
24	10.0	10.0	9.2	9.2	3.3	4.2	1.8	1.8	3.0
25	0.0	0.0	3.3	4.2	10.0	10.0	8.3	5.0	7.5
25T	6.8	4.5	2.5	4.2	10.0	10.0	10.0	8.3	7.5

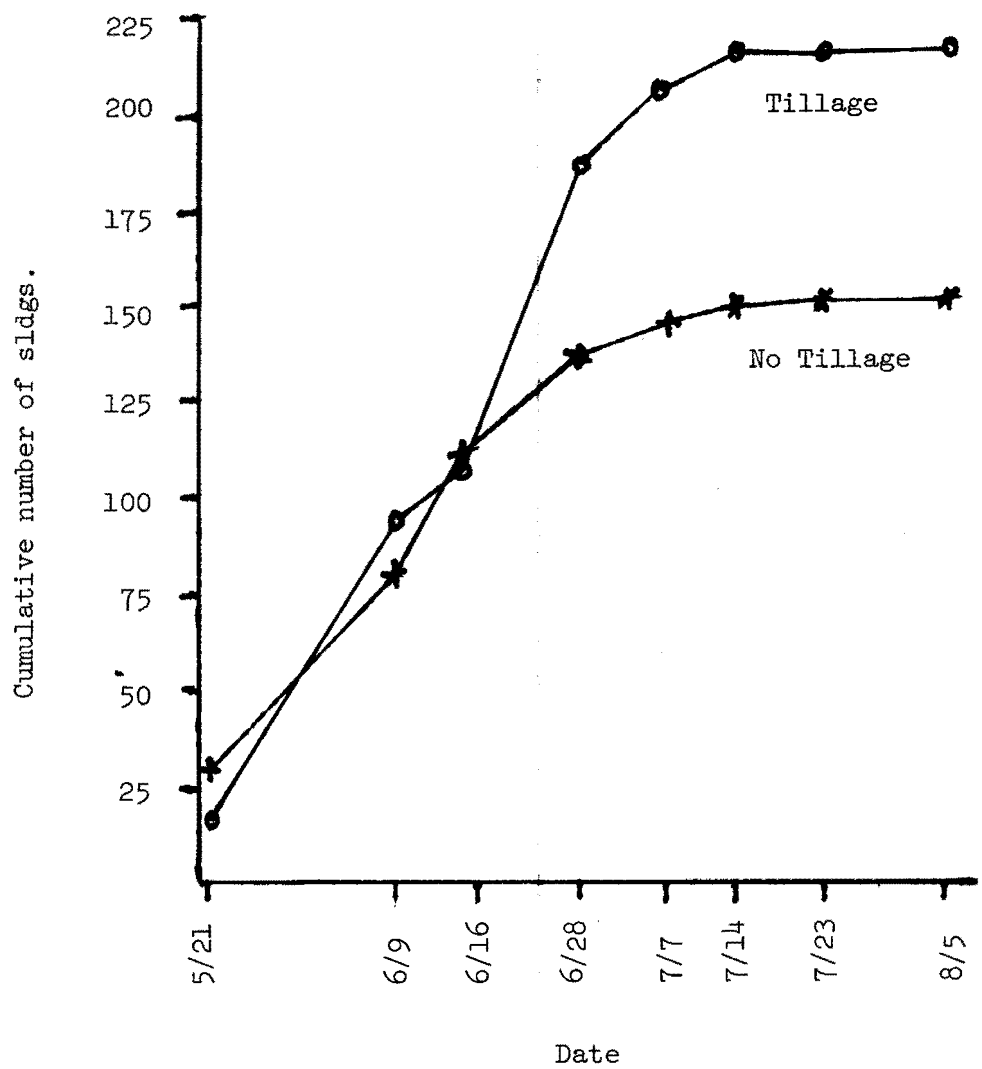
[a]0-no effect on weed; 10-complete kill

Table 3. Effect of treatments on amount of foliar damage to onions during the growing season and on final yield.

Treatment	Yield-lbs/plot 10' by 2 center rows	Onion Foliar Injury Rating[a] 6/16	6/28	7/23
1	25.7	1	0	1
2	21.8	2	4	2
3	23.0	2	3	2
4	25.8	1	2	1
5	24.3	2	2	2
6	26.3	2	2	2
7	29.2	2	2	2
8	25.8	2	4	2
9	26.2	2	3	2
10	23.3	2	3	3
11	26.2	2	3	2
12	26.8	3	3	2
13	26.0	2	2	2
14	26.5	2	3	2
15	27.2	2	2	1
16	30.0	4	3	1
17	26.3	0	0	2
18	26.7	1	1	0
19	25.2	0	1	3
20	28.2	3	3	1
21	29.3	2	2	2
22	26.8	2	2	2
23	29.0	2	2	2
24	29.2	0	1	0
25 cultivated	30.5	0	0	0
25 hand weeded	29.2	0	0	0
LSD 5%	5.1			

[a]0-no injury, 10-complete kill

Figure 1. Seedling emergence of prostrate spurge. The cumulative counts are averages from an area 3 ft by 14 in.



EVALUATION OF GLYPHOSATE FOR MULTIFLORA ROSE CONTROL

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ABSTRACT

Multiflora rose (*Rosa multiflora* L. Thumb), is a very aggressive and competitive perennial shrub whose establishment in pastures or near cornfields can limit production. Glyphosate (N-phosphonomethyl glycine, isopropylamine salt) appears to give control when applied during the blossom and post blossom stages at the rate of 1.00% (v/v), or 0.50% (v/v) with 0.50% (v/v) of MON 0011 (a nonionic surfactant).

INTRODUCTION

Although multiflora rose (*Rosa multiflora*, L.) is a very important shrub in horticultural circles because of its vigorous and aggressive nature, it is an unwelcome competitor in rough pasturage situations for precisely the same reason. In a rough pasture with light grazing pressure, multiflora rose spreads quickly, cutting down the amount of grazable land, and if the rose borders a corn field, according to Labisky and Anderson (3) it can reduce corn yield by as much as 20% in the first row.

Multiflora rose is native to Japan, Korea, and parts of China, and was introduced to this country as root stock for horticultural work. It is a perennial shrub which reproduces by seeds and rooting at the tips of its drooping canes. The stems of a typical plant are about 3 meters long, and grow in clumps with the first 2 meters erect and the tips drooping close to the ground. The stems have many stiff thorns. The fruits (hips) are bright red, and usually last until spring (1).

Today's problems with multiflora rose originated in the late 1930's when the need for low cost livestock barriers and erosion control prompted the U. S. Soil Conservation Service to experiment with and intentionally spread large plantings. The Soil Conservation Service advised farmers to plant massive hedge rows of "natural fencing", further selling the idea by reporting that multiflora rose provided excellent nesting, escape, and cover for wildlife, and that the abundant hips were eaten by songbirds throughout the winter and early spring. Unfortunately, the very fact that birds, primarily Cedar Waxwings (*Bombycilla cedrorum*) and Robins (*Merula migratoria*) eat the seeds has contributed heavily to the uncontrolled spread of multiflora rose (10).

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By 1949, Charles A. Dambach and others (7) realized the nuisance potential of multiflora rose. Complaints in the mid 1950's and early 1960's by farmers and landowners prompted many northeastern states to pass laws forbidding private individuals and government agencies from further large scale hedge plantings (8,2).

Of the various currently practiced cultural methods of multiflora rose control, including excavation, mowing, grazing, and burning, excavation of the entire plant on a plant by plant basis appears to be the only method that has any permanent impact. This is a tedious and time consuming practice.

For this series of experiments, glyphosate (N-phosphonomethyl glycine) was chosen because of its activity on perennial weeds (4,5,7). Glyphosate is non-residual, avoids runoff, avoids killing non-contacted species, and allows reestablishment of desirable species (6,9).

The objective of the test was to find the optimum rate and date of application of glyphosate for the control of multiflora rose. This was accomplished by evaluating three dates of application and four rates of glyphosate.

MATERIALS AND METHODS

These tests were conducted in southeastern Pennsylvania near the village of New London. The test plot was a meadow with fairly steep rolling hills. The multiflora rose population was very heavy with plants ranging from well established bushes to new plants. The plants selected for treatments were of comparable size and age.

The first date of application was 4 June. This date coincided with the blossom stage. The weather remained clear for several days after spraying. The second date of application was 12 July and coincided with a post blossom state. Unfortunately, rain occurred almost immediately after completion of treatment and persisted for about 10 minutes, dropping approximately 0.25 cm of precipitation. The third application was delayed until 5 October to allow the foliage to recover from the activity of a heavy infestation of Japanese beetles (Popillia japonica) that made evaluation difficult. However, this final application coincided with senescence and results will be evaluated in the spring.

The treatments evaluated are listed in Table 1. As noted, four rates of glyphosate were used on each of three dates of application. At Dates 2 and 3, sequential applications were evaluated by retreating bushes treated on Dates 1 and 2 respectively. The effect of additional surfactant on glyphosate activity was investigated by using 0.50% (v/v) MON 0011 (a nonionic surfactant) with each rate of glyphosate at each date of application.

The glyphosate was applied with a CO_2 sprayer using a single cone nozzle (TX-18). Vegetation was sprayed until the leaves were wet but short of runoff. A spray pressure of 30 psi (2.1 Kg/cm^2) was used. A complete random design was used with three replicates of each treatment. The percentage control obtained by use of the various treatments was assessed by rating the plants at four intervals over the season.

RESULTS AND DISCUSSION

Examination of the effect of an early June (blossom stage) application of glyphosate on multiflora rose in terms of rate response (Table 2) appears to suggest that a rate of 1.00% (v/v) of glyphosate is required to give control. Alternately, the use of MON 0011 appears to compress the break point of control to the 0.50% (v/v) level. However, additional time is required to test the validity of either assumption.

The available data concerning effects of glyphosate application in terms of time (Table 3) are limited in utility by rainfall after the second application. The plants not receiving MON 0011 suggest that a post blossom stage application offers no significant improvement in control. However, these treatment data further support 1.00% (v/v) as the necessary concentration strength in terms of rate required for control. The addition of MON 0011 to the 0.50% (v/v) concentration of glyphosate appears to significantly increase its activity on multiflora rose.

Sequential applications (Table 4) at these time intervals do not appear to add to control of multiflora rose. However, as in the above observations, long term data will be needed before complete evaluation can be made.

Table 5 represents long term control data on the June and July applications. These data taken at 120 and 150 days after treatment bear out the need of 1.00% (v/v) of glyphosate for best control. Date 2 application rate data support Date 1 data, but are reduced overall due to rainfall. As seen in the earlier tables, additional surfactant appears to increase glyphosate activity and lower the rate of acceptable control to include 0.50% (v/v). Again, data from sequential applications show that this approach does not result in additional control.

The effects of single autumnal or sequential autumnal applications were investigated but there has been insufficient time for their evaluation.

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Table 1. Treatments used in the evaluation of glyphosate for control of multiflora rose.

Rate of Application of Glyphosate	Date of Application
0.25% (Rate 1)	4 June 1976 (Date 1)
0.50% (Rate 2)	"
1.00% (Rate 3)	"
2.00% (Rate 4)	"
0.25% + 0.50% MON 0011[1/]	4 June 1976
0.50% + 0.50% MON 0011	"
1.00% + 0.50% MON 0011	"
2.00% + 0.50% MON 0011	"
0.25%	4 June & 12 July 1976
0.50%	" "
1.00%	" "
2.00%	" "
0.25%	12 July 1976 (Date 2)
0.50%	"
1.00%	"
2.00%	"
0.25% + 0.50% MON 0011	"
0.50% + 0.50% MON 0011	"
1.00% + 0.50% MON 0011	"
2.00% + 0.50% MON 0011	"
Control	

1/ MON 0011 is a nonionic surfactant.

Table 2. Effect of early June (bloom stage) application of glyphosate on control of multiflora rose.

Treatment (% concentration of glyphosate)	Control Rating[1/] (no surfactant)	Control Rating (0.50% MON 0011)
0	0	0
0.25	4.2	6.3
0.50	9.0	10.0
1.00	10.0	10.0
2.00	10.0	10.0
L.S.D. 5%	3.0	

1/ 54 days after treatment (DAT).

Table 3. Effect of early July (post blossom stage) application of glyphosate on multiflora rose control.

Treatment (% concentration of glyphosate)	Control Rating[1/] (no surfactant)	Control Rating (0.50% MON 0011)
0	0	0
0.25	3.7	2.2
0.50	3.5	8.0
1.00	10.0	7.3
2.00	8.0	8.0
L.S.D. 5%	3.9	

1/ 16 DAT.

Table 4. Effect of sequential applications of glyphosate, applied in early June and July, on control of multiflora rose.

Treatment (% concentration of glyphosate)		Control Rating[1/] (no surfactant)
0		0
0.25		9.0
0.50		9.3
1.00		10.0
2.00		10.0
	L.S.D. 5%	1.8

1/ 16 days after the second treatment.

Table 5. Final evaluation of glyphosate for use in control of multiflora rose.

Treatment (% concentration of glyphosate	Control (no surfactant)	Control (0.50% MON 0011)
	4 June Application 1/	
0	0	0
0.25	5.1	7.9
0.50	7.2	9.5
1.00	10.0	10.0
2.00	10.0	10.0
L.S.D. 5%	0.9	1.7
	12 July Application 2/	
0	0	0
0.25	6.5	5.2
0.50	6.2	7.2
1.00	7.7	8.0
2.00	9.0	8.8
L.S.D. 5%	2.6	2.4
	Sequential Treatment Application 3/ of 4 June and 12 July	
	Control	
0	0	
0.25	8.3	
0.50	9.7	
1.00	10.0	
2.00	9.0	
L.S.D. 5%	1.2	

1/ 150 DAT.

2/ 120 DAT.

3/ 120 days after second treatment.

BASAL APPLICATIONS OF TRICLOPYR IN OIL OR WATER

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ABSTRACT

Basal applications were made with M-4021 which contains four pounds of triclopyr [(3,5,6 trichloro-2-pyridinyl)oxy] acetic acid per gallon as the ethylene glycol butyl ether ester at rates of 1/2, 1, 2, and 4 gallons per hundred gallons of spray mixture. At two locations, basal sprays were made with oil as the carrier. At two other locations, basal sprays were made with either oil or water.

Triclopyr in either oil or water plus surfactant basal sprays controlled most species at all locations. All species were controlled with 2 gallons M-4021 per 100 gallons of spray. With the oil carrier, some species were controlled with 1/2 gallon M-4021 per hundred gallons of spray. Use of oil as a carrier resulted in more rapid control than where water plus surfactant was used as the carrier. Brush treated with water basals showed continued effects into the second growing season. Water basals look very promising at rates of 1 to 2 gallons of M-4021 per hundred gallons of spray.

INTRODUCTION

The use of selective sprays to control unwanted vegetation on utility rights-of-way is ever increasing because of concerns of public opinion, aesthetics, and wildlife. Basal applications are the selective application technique most frequently used. They can be used over a wide period of time, anytime without snow, and if applied during the dormant season, brownout is avoided and less spray volume is required than selective foliage sprays. The chief drawback is the oil required in terms of both availability and cost and in addition, the spray crews do not like to spray with oil.

With this in mind, several trials were established to evaluate the effectiveness of triclopyr applied as a basal spray in oil or another surfactant spray carrier.

MATERIALS AND METHODS

The formulation used was M-4021 which contains four pounds of triclopyr per gallon as the ethylene glycol butyl ether ester.

The formulation was mixed in oil or water plus surfactant and applied with backpack low-pressure wand sprayers. The applications were made using a standard basal technique of wetting the lower 15-18 inches of stem to the point of runoff. The oil used was kerosene in New Hampshire and Maine, No. 2 diesel in Pennsylvania, and Exxon 3414 in Massachusetts. The water treatments included a surfactant (Emulsifier A® in Massachusetts and an agricultural surfactant in Maine) and Nalco-Trol®. The rates of M-4021 used in all experiments were 1/2, 1, 2, and 4 gallons/100 gallons of spray. The temperatures for the winter applications (Tables 1 and 2) were 35-38°F while the temperatures for the summer applications were approximately 80°F. (Tables 3 and 4).

The species involved in the four experiments are as follows:

Common Name	Scientific Name
Ash	Fraxinus sp.
Black Birch	Betula lenta
Black Cherry	Prunus serotina
Sweet Cherry	Prunus avium
Black Gum	Nyssa sylvatica
Hickory	Carya sp.
Black Locust	Robinia pseudo-acacia
Red Maple	Acer rubrum
Red Oak	Quercus rubra
White Oak	Quercus alba
Pine	Pinus strobus
Poplar	Populus sp.
Walnut	Juglans nigra

RESULTS AND DISCUSSION

The results of the basal applications are shown in Tables 1-4. Excellent control of a wide variety of species was achieved at all locations. The results in Pennsylvania (Table 1) show some species variability at low rates (1 gallon M-4021 per hundred gallons), but at rates of 2 gallons M-4021 per 100 gallons of spray, brush control was complete on all species. The more resistant species were red oak, black birch, black gum, and ash. It is interesting to note that the evaluation made the second growing season showed a higher brush control than the evaluation made the first growing season.

The results in New Hampshire (Table 2) indicate that a considerable amount of resprouting was found in the second growing season compared to the first growing season and compared to the results in Pennsylvania. Maple showed poor control at 1/2 and 1 gallon of M-4021 per 100 gallons of spray and fair control at 2 gallons of M-4021 and higher. First year readings on this species appeared excellent. Red oak was another species that showed a great deal of resprouting but was controlled at 2 gallons of M-4021 or higher.

The results in Massachusetts (Table 3) are extremely interesting in that they show excellent control of brush from water basals of triclopyr. The water basals did not react nearly as fast as the oil basals nor were they as effective as oil at rates of 1 gallon of M-4021 or lower but at 2 gallons of M-4021 per 100 gallons of spray virtually complete control of ash (10-12 feet tall) was effected. Even when comparing 1/2 gallon of M-4021 in oil to 2 gallons of M-4021 in water, there is an economic tradeoff because of the cost of oil. With the messiness of oil spray and the uncertainty of oil availability long range, water basals are clearly desirable and advisable. In addition, there was noticeably more herbaceous plants in the water plots than in the oil plots.

The results in Maine (Table 4) are similar to those of Massachusetts. The oil sprays gave excellent control of oak and maple at 1/2 gallon M-4021 or above, but black birch required 2 gallons of M-4021 in either water or oil. In water, 1/2 gallon of M-4021 seemed to worsen with the time but the 1 gallon of M-4021 rate seemed to improve. This would indicate that the effective rate is between 1 and 2 gallons of M-4021 per 100 gallons of spray.

Overall, the results from basal applications of triclopyr look excellent. Although it does not appear clear-cut, there is an apparent trend toward better results from basal applications during the growing season than during the dormant season.

The water basal results are the most exciting. Since the energy crisis of a few years ago, increased emphasis has been put on research into reducing or eliminating oil in basal sprays. Until now, however, no herbicide material has given satisfactory results from water basal sprays.

TABLE I. BRUSH CONTROL 7 AND 19 MONTHS FOLLOWING BASAL APPLICATIONS OF TRICLOPYR IN DIESEL OIL. METRO EDISON, HAMBURG, PENNSYLVANIA.

		Percent Control							
		9-25-75				9-27-76			
Species	Rate-gallon M-4021/hg1/	1/2	1	2	4	1/2	1	2	4
red oak		51	62	100	93	75	70	100	100
black birch		29	85	100	100	100	100	100	100
red maple		100	100	100	100	100	100	100	100
hickory2/		100	100	100	100	100	100	100	100
sweet cherry		100	100	-	100	100	100	-	100
poplar		77	-	100	100	100	-	100	100
black cherry		100	100	100	100	100	100	100	100
black gum		40	23	100		100	100	100	
ash		42	62	100	100	57	60	100	100
walnut		80	100	-	100	100	100	-	100
white oak2/		100	-	-	100	100	-	-	100
black locust			100				100		

1/Applied 2-25-75.
2/Only a few stems represented (1-2/plot).

TABLE II. BRUSH CONTROL 7 AND 21 MONTHS FOLLOWING BASAL APPLICATIONS OF TRICLOPYR IN KEROSENE. NEW HAMPSHIRE PUBLIC SERVICE, BOW, NEW HAMPSHIRE.

		Percent Control							
		7-15-75				9-16-76			
Species	Rate-gallon M-4021/hg1/	1/2	1	2	4	1/2	1	2	4
cherry		55	25	-	-	50	100	-	-
maple		100	90	96	100	5 2/	25 2/	85 2/	75 2/
red oak		83	95	70	67	50 2/	50 2/	90 2/	90 2/
white oak		76	78	80	92	80	90 2/	100	100
white pine		-	42	20	-	-	100	100	-

1/Applied 12-6-74.

2/Low readings because of resprouts but many resprouts have deformed leaves.

TABLE III. ASH CONTROL 11 AND 15 MONTHS FOLLOWING APPLICATION OF TRICLOPYR IN OIL OR WATER PLUS SURFACTANT BASAL SPRAYS. NEW ENGLAND ELECTRIC SYSTEM, SHIRLEY, MASSACHUSETTS.

	Percent Control			
	5-10-76		9-15-76	
Rate-gallons M-4021/hg 1/	Oil 2/	Water 3/	Oil 2/	Water 3/
1/2	95	5	95	5
1	100	25	95	55 4/
2	100	95	100	95
4	100	95	100	100

1/Application 6-25-75.
2/Exxon 3414 Spray Oil.
3/10ml of Emulsifier A® and 1.25ml Nalco-Trol® for each liter of spray.
4/Only partially leafed out.

TABLE IV. BRUSH CONTROL 14 MONTHS FOLLOWING APPLICATION OF TRICLOPYR IN OIL OR WATER PLUS SURFACTANT BASAL SPRAYS. CENTRAL MAINE POWER, CORNISH, MAINE.

	5-18-76							
	Oil				Water			
Rate-gallons M-4021/hg 1/	1/2	1	2	4	1/2	1	2	4
birch	50	85	100	100	50	50	80	100
oak	100	100	100	100	50	50	95	100
maple	50	100	100	100	50	50	100	100
	8-10-76							
	Oil 2/				Water			
	1/2	1	2	4	1/2 3/	1 3/	2 3/	4 4/
birch	50	60	95	100	30	80	99	100
red maple	100	100	100	100	25	75	99	100
white oak	100	100	100	100	35	80	100	100
red oak	100	100	100	100	30	80	95	100

1/Applied 6-23-75.
2/Kerosene.
3/Also 2.25ml/l an agricultural surfactant and .8ml/l Nalco-Trol®.
4/Also 10ml/l an agricultural surfactant and 1.25ml/l Nalco-Trol®.

WOODY PLANT CONTROL FROM LOW VOLUME APPLICATIONS OF TRICHLOPYR

B.C. BYRD, R.D. FEARS, L.L. SMITH, L.E. WARREN, J.C. RYDER. AND C. T. LICHY 1/

ABSTRACT

Woody vegetation control trials were established in 1974 and 1975 using triclopyr-[3,5,6-trichloro-2-pyridinyl (oxy) acetic acid] - alone as amine salt or as ester; or triclopyr in combination with 2,4-D, or with a formulation of picloram plus 2,4-D. Applications were made by ground or air in water in total volumes of from 15 to 50 GPA, at ten locations in nine states. At most locations comparisons were made with standard commercially available products.

In 1975 and 1976, a total of 34 deciduous and nine evergreen species were observed in one or more of the 62 treatment plots established the previous year.

Relative efficacy values are reported as probable rate ranges required for commercially acceptable control on certain species. Further refinement of dosages may be needed on other species.

1/ Herbicide Field Research and Development Specialists, Charlotte, N.C.; Wayside, Miss.(X2), Davis, Cal., Minneapolis, Minn. and Philadelphia, PA., respectively.

FIELD TRIAL COMPARISON OF TECHNIQUES OF ROOT KILL ON PROBLEM SPECIES

Michael C. McNamara[1]

Abstract

Three basic methods of brush control were compared for their control of black locust (Rabinia pseudoacacia L.) root suckers and stump sprouts from the variety of other hardwood species found on the right-of-way. The selective basal method showed the best control of the black locust root suckers. Where the brush was cut, the pre cut basal method showed better control over the black locust root suckers and stump sprouts from the other hardwood species than the stump treatment method.

Introduction

It has been a standard practice for tree trimming and brush cutting crews on Pennsylvania Electric Company property to cut the tall standing brush and then chemically treat the stumps. This method of brush control has worked relatively well for the control of stump sprouts for the majority of tree species treated. The problem with this type of chemical treatment is not so much in the lack of control of the stump sprouts of the treated stumps, but in the total lack of control of the stump sprouts from untreated stumps and the erratic control of the root suckers of the black locust.

The possible reasons for the poor results with the stump treatment method can be listed under two categories:

1. Untreated Stumps
2. Insufficient Amount of Chemical Solution Applied.

1. Untreated Stumps - When a cutter is cutting the brush on the right-of-way, he is cutting trees from 6 inches in diameter to $\frac{1}{2}$ inch in diameter and he is making his cuts as close to the ground as possible. After the brush is cut, it is either dragged to a chipper and chipped, or to the edge of the right-of-way and piled. During this dragging of brush, some of the stumps will be covered over with debris. These covered stumps will not be chemically treated because they cannot be seen. Also, there will be stumps missed because of human error.

2. Insufficient Amount of Chemical Solution Applied - So many times, the man spraying the stumps only puts enough chemical down to just dampen the exposed stump. Without a tall stem present to permit the chemical to run down and puddle at the base, many stumps do not receive enough chemical solution to control the stump sprouts, let alone the root suckers. Also, a common problem with inexperienced men is the application of the chemical solution to only the cut surface of the stump. This puts very little, if any solution, where it is needed.

[1]Forestry Supervisor, Southern Division
Pennsylvania Electric Company

The solution to the problems with stump treatment can be found in the basal spray methods employed during the chemical spray program. With a basal spray, the stem to be removed is treated from 12 inches to 18 inches from the ground and the chemical solution is permitted to run down the stem and puddle at the base. This method of treatment assures a sufficient amount of chemical solution on the plant. Also, because the stems are standing and the oil carrier in the chemical solution leaves a stain on the treated stems; there is little chance, other than human error, of not treating all of the stems.

Methods and Materials

With these possible solutions to the problem in mind, a small test area was chosen to compare the results of the three basic methods of brush control on the control of stump sprouts from all species found on the right-of-way and the root suckers of the black locust.

The location of the test area is on a distribution right-of-way that parallels U. S. Route 36 one mile south of Newburg, in Clearfield County, Pennsylvania.

The right-of-way was initially cut in 1970. At this time, there was no chemical applied. As a result of no chemical being applied, the right-of-way immediately resprouted, and by 1975, the regrowth had reached the conductors at many points. What made this section of right-of-way ideal for the type of test to be conducted, was that about 75% of the regrowth was black locust.

The methods of brush control to be compared were:

1. Chemical Stump Treatment - This method involves the removal of the brush from the right-of-way and then the chemical treatment of the stumps.

2. Selective Basal Treatment - This method involves the spraying of the brush from the ground up to about 18" high, depending on the diameter of the stem to be removed.

3. Pre Cut Basal - This method involves the chemical treatment of the brush using the selective basal method followed by the cutting of the treated stem.

The chemical used was picloram plus 2,4,5-T containing 1 lb. picloram plus 4 lb. 2,4,5-T per gallon as the isooctyl and propylene glycol butyl ether esters respectively.[1] This chemical was mixed at the rate of one gallon of chemical per 100 gallons of fuel oil. This solution was mixed at crew headquarters in 55 gallon drums. The chemical was applied with back pack sprayers.

The test was conducted on October 20, 1975 using a four man brush cutting crew. The result of this test were taken on July 15, 1976.

[1] Tordon 155 Mixture Herbicide was the formulation employed.

RESULTS

Treatment	% Black Locust	No. Locust Sprouts	Untreated Stumps or Stems All Species
Chemical Stump #1	95%	307	39
Chemical Stump #2	50%	536	41
Selective Basal	50%	66	5
Pre Cut Basal	95%	158	24

Upon review of the results, the selective basal method showed the best control of the black locust sprouts, and also showed the lowest number of untreated stems. This method of brush control is best suited for lines that are in areas where the dead stems may be left standing. For the areas that must have the brush removed because of location, i.e., road crossings, lines paralleling the roads and residential areas, the pre cut basal method shows a marked improvement in prolonged brush control over the stump treatment method.

RIGHT-OF-WAY MANAGEMENT WITH AERIALLY APPLIED HERBICIDES

Roy R. Johnson [1/]

ABSTRACT

Control of tall-growing woody plants and development of a stable low-growing herb and shrub community are essential goals of a utility right-of-way vegetation management program.

These goals may be reached by mechanical brush control, ground application of herbicides using broadcast or selective techniques or by aerial application of herbicides. The choice among various alternatives for right-of-way vegetation management is influenced by terrain, present clearance between vegetation and conductors, brush species present and their average growth rate, past management programs, scenic potential of the right-of-way, restrictions on aerial applications of certain herbicides and relative costs of alternative methods. Selection of the proper application equipment and herbicide mixture can make aerial application of herbicides economical, environmentally sound and esthetically pleasing with little or no adverse impact on plants or animals adjacent to the right-of-way.

In 1972, various phenoxy-picloram mixtures were applied to a utility right-of-way in southwestern Virginia using an experiment model of the Microfoil [2/] Boom equipped with .060 nozzles mounted on a helicopter. Additional aerial herbicide applications have been made on adjacent rights-of-way each year since 1972. A mixture of 2,4,5-T [(2,4,5-trichlorophenoxy)acetic acid] + 2,4-D [(2,4-dichlorophenoxy)acetic acid] + picloram (4-amino-3,5,6-trichloropicolinic acid) at 11.2 + 5.6 + 1.6 kg/ha controlled 92% of the problem brush species. A mixture of dichlorprop [2-(2,4-dichlorophenoxy)propionic acid] + 2,4-D + picloram at 6.7 + 11.2 + 1.6 kg/ha also gave 92% brush control.

Trials applied in 1975 and evaluated in 1976 indicated that mixtures of dichlorprop + 2,4-D + picloram at 9.6 + 4.8 + 1.2 kg/ha, dichlorprop + picloram at 9.6 + 1.2 kg/ha and 2,4,5-T + picloram at 9.6 + 1.2 kg/ha gave 84%, 77% and 73% control.

Other mixtures of 2,4-D, dichlorprop, 2,4,5-T and picloram also provided satisfactory control of tall-growing brush. Vegetation adjacent to the rights-of-way was not affected by the herbicide treatment. Observation of plant succession on these rights-of-way indicated that after the first growing season, perennial grasses and biennial and perennial forbs increased in density, while tall woody plants were nearly eliminated.

1/ Assoc. Nat'l Program Director, Field Dev. Dept., Amchem Products, Inc., Ambler, Pennsylvania 19002.

2/ Registered trademark of Amchem Products, Inc.

LOW COST OF POWER LINE RIGHT OF WAY MAINTENANCE FOR BEAUTY AND USE

John B. Middleton[1]

The Pennsylvania Electric Company (Penelec) with its headquarters in Johnstown, Pennsylvania has been using herbicides for power line right of way maintenance since prior to 1955. The author joined Penelec in that year. Trials and limited use of herbicides were being undertaken by Penelec at that time.

Pennsylvania Electric Company serves 39% of the land area of Pennsylvania. This company serves all or part of 33 of Pennsylvania's 67 counties. On its distribution lines, Penelec has 487,600 customers. With this large land area, Penelec serves more of Pennsylvania than any other power company. The Penelec system is unique in being the location of three mammoth mine-mouth coal generating stations located in the heart of the bituminous fields. These three generating stations are shared in ownership by other privately owned power utilities from Pennsylvania and neighboring states. All of this generation means extra high voltage transmission lines by the hundreds of miles. The main voltage from these mammoth generating stations is 500 KV. The minimum width of a right of way for 500 KV is 200 feet.

Appearance has always been a main consideration for the application of herbicides in Penelec. Back in the 50's a larger portion of waterborne material was being used. It is currently being used at a more modest pace. At that time selective basal and helicopter applications were also used to advantage. The trend has been away from the waterborne and helicopter applications because of their disturbance to the environment and their undesirable appearance. Our main method of treatment has been selective basal. Selective basal is used around the year, but strict limitations are endured due to the weather in December, January, February, and March. The parts of Pennsylvania that Penelec occupies is subjected to some tough weather in the winter. If it were possible, most of Penelec's work would be done during the dormant season since success is as available then as at other times when the proper herbicides are applied.

With the use of waterborne herbicides, Penelec requires that they be applied as selectively as possible. Although it is impossible to do stem by stem selectivity when using the waterborne material, it is possible to get exceedingly good results by selectively treating areas or patches of undesirable brush while preserving the material which would be helpful to retain.

Helicopter application is used on a limited basis on areas that are not open to scrutiny of the public. We have many isolated stretches of rights of way in Penelec. Some of these are used for helicopter application. Although helicopter is recognized as a tool it does not have the effectiveness of kill of a good waterborne application and entirely lacks selectivity on areas that

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need to be treated. Side trimming has never been a part of the Penelec program. It is our feeling that herbicides are to kill entire plants that are undesirable, not to discolor or injure plants for the hopeful gain of line clearance. We believe it is an intrusion on the rights of the property owner to side trim with herbicides. That is really ugly. Chemical companies sometimes try to sell it but we do not buy it.

Penelec is pained by the poor treatment that is applied by other users of herbicides. Penelec, being a very large user of herbicides, either suffers immediately or later for objectional treatment applied by other companies. Many times Penelec encounters a problem in obtaining consent to apply chemicals because of an experience a property owner has had with a different organization who applied herbicides without consideration for that property owner or in poor judgment.

In Penelec we have attained beauty on our rights of way through selectivity. Our selectivity goes back to the initial clearing of the right of way. In more recent transmission clearing operations in Penelec, selective right of way clearing was started in 1963. On our initial clearing, selectivity in clearing extends for the total length of the right of way for certain species with emphasis of effort on areas that are most observed by greater number of the population. Initial clearing is always accompanied by either basal herbicide treatment preceeding the clearing operation or stump treatment. In the last six years all of our clearing has had herbicide treatment basally applied prior to felling of trees for transmission clearing. Pre-cutting basal is more difficult than stump treatment but gives outstandingly better results. The main reason for the better results is obvious. Trees are easier to find than stumps that are covered with dirt or are too small to be found.

In our selective basal treatment, Penelec uses the following materials in diesel oil or #2 fuel oil:

1. D and T Ester (Dichlorophenoxyacetic Acid and Trichlorophenoxyacetic Acid)

2. 2,4,5-T Ester (Trichlorophenoxyacetic Acid)

3. Pilloram (4-Amino-3,5,6-Trichloropicolinic Acid and 2,4,5-Trichlorophenoxyacetic Acid)

4. Dicamba (3,6-Dichloro-o-anisic Acid and 2,4,5-Trichlotlophenoxyacetic Acid)

Selectivity has been accomplished through use of the list of <u>plants not to be treated on the right of way that follows</u>:

All grasses, ferns, and herbaceous plants.

All annual weeds and annual plants.

All forbes.

Low-growing shrubs including:

1. Mountain laurel (Kalmia latifolia)
2. Sweetfern (Comptonia Peregrina)
3. Bush honeysuckle Pinxterbloom Azalea (Azalea nudiflorum)
4. Low blueberries (Vaccinium spp.)
5. Huckleberries (Gaylussacia spp.)
6. Viburnums (Viburnum spp.)
7. Trailing arbutus (Epigaea repens)
8. Checkerberry Wintergreen (Gaultheria procumbens)
9. Partridge berry (Mitchella repens)
10. Meadow sweet (Spiraea spp.)
11. American yew (Taxus canadensis)
12. Alder (Alnus spp.)
13. Hazelnut (Corylus spp.)
14. Witch hazel (Hamamelis virginiana)
15. Dwarf willow (Salix humilis)
16. Holly (Ilex spp.)
17. Choke berry (Pyrus melanocarpa)
18. Choke cherry (Prunus virginiana)
19. Elderberry (Sambucus spp.)
20. Rhododendron (Rhododendron)
21. Scrub oak (Quercus spp.)
22. Spice Bush (Lonicera benzoin)
23. Blackberry (Rubus allegheniensis)
24. Raspberry (Rubus occidentalis)

Small trees to be preserved on the right of way where conductor height will permit:

1. White flowering dogwood (Cornus florida)
2. Redbud (Cercis canadensis)
3. Hawthorn (Crataegus spp.)
4. Blue Beech - American Hornbeam (Carpinus caroliniana)
5. Shadbush (Amerlanchier canadensis)
6. Iron wood - Hophornbeam (Ostrya virginiana)
7. Red Cedar - Juniper (Juniperus virginiana)
8. Sumac - Staghorn, Smooth, Dwarf (Rhus spp.)
9. Striped Maple (Acer pennsylvanicum)
10. Mountain Maple (Acer spicatum)
11. White Cedar (Thuja occidentalis)
12. Wild Apple (Malus Pumila)
13. American Crabapple (Malus coronaria)

It has been apparent throughout the program of selective treating that plants which have been preserved on the right of way minimize the invasion of new plants to threaten conductors. Competition from this plant material certainly reduces the amount of invasion that is going to occur. Recently a study has been conducted by the Northeastern Forest Experiment Station at their Kane Experimental Forest to determine the inhibitory qualities of certain plants on tree species. The Allegheny National Forest is primarily interested in raising quality trees as a crop. The species which they are primarily interested in for economical and silvicultural reasons are Wild

Black Cherry (Prunus serotina), Sugar Maple (Acer saccharum), Red Maple (Acer rubrum), and White Ash (Fraxinus americana). These species are among those that bug us in the right of way management program. The Kane Experimental Forest have conducted experiments using grass (gramineae), ferns (filicaleae), asters (compositae), and goldenrod (solidago) to determine if they had any effect on the germination and invasion of the aforementioned timber type trees. In their testing they use the above ground parts and the root systems separately to determine any inhibitory effect. In performing this experiment they prepared a leachate from both the tops and the roots and applied this as a watering process. Distilled water was used as their control. In all cases there was a very definite inhibitory effect. This may sound sickening to the chemical companies but it is a big help to the managers of vegetation that has to be manipulated. This is a natural phenomena that has been working to our advantage that up until now we don't know what to think about it. Just imagine all of the experiments that are in the future to determine the inhibitory or benefactive possibilities by each and every member of our plant kingdom.

Managers of vegetation have many excellent tools in the kit of herbicides that are currently available. We try to utilize the best for a particular job in Penelec. All of our rights of way are treated on a prescription basis. The timing for treatment is always determined by field inspection. I don't think I can over-emphasize the importance of visualy observing on the ground. I know there are many ways of programming. When getting into computer garbage you can waste money and we can't afford to do that in our company.

THE WONDERFUL POWER OF SELECTIVITY TO POWER LINE RIGHTS OF WAY

Charles J. Olenik[1]

In recent years there has been an ever increasing demand by homeowners, business and industry for more and more reliable electric service. To accomodate this increased use, companies such as Penelec have constructed new power plants, stepped up voltages on existing power lines, and constructed new and higher voltage transmission and distribution lines to handle the increasing load. However, having the facilities to generate and carry the energy produced is only part of the aspect of providing reliable service to the customer. New and existing rights of way that are the "highways" of electrical energy must be maintained to prevent any interruption in the flow of energy. Specifically, interruptions caused by trees or brush reaching conductors thereby causing outages and other major and very costly problems.

At the present time, we as right of way managers have numerous synthetic growth hormones that do a reliable job in fighting the encroachment of undesirable tree species on our rights of way. However, we are also facing a fact of increasing public awareness in the areas of environmental quality, ecology, land use and the value of an undisturbed natural landscape. This fact adds another dimension to the problem of right of way management. That is, we must maintain our rights of way to provide reliable service and at the same time manage these same areas so as to provide an aesthetically pleasing appearance and a land area useful for wildlife and recreation. The answer to this problem therefore cannot be just any chemical brush control program. There must be some thought and planning to choose a chemical technique that will provide adequate vegetation control and in addition be economical, safe and aesthetically pleasing. To accomplish this goal we should consider some basic factors that are present on all rights of way:

Conditions Existing on the Right Of Way

This information must be gathered by a field survey of the right of way, which means we have to get out and walk and make some observations to determine:

1. Density of undesirable tree species.
2. Density of desirable vegetation.
3. Height of brush to be treated.
4. Terrain.
5. Access.
6. Agricultural activities in and near the right of way as well as State and Federal lands that cross the area to be treated.
7. Population.
8. Main Road and highway crossing.
9. Stream and river crossings.

[1]Supervisor of Forestry, Eastern Division, Pennsylvania Electric Company, Altoona, Pa..

Gathering this information is a major part in making a final decision as to the type of chemical technique deemed necessary.

Consideration should be given to the techniques available and the advantages and disadvantages of each as they relate to the field survey. Some of the methods of application used on Pennsylvania Electric Company property over the years that have been proven effective are:

SELECTIVE BASAL APPLICATION - Summer and Dormant Application

I. All woody plant species in the right of way, except species designated to be left for future ground cover, shall be treated with chemical in oil so as to saturate each stem completely at the ground line and to a height of I2 to I8 inches on the stem and completely encircling each stem. Where sprout growth originates from a stump, the treatment shall also be applied completely around the stump and any exposed roots.

2. Extreme care must be taken to treat only the tall growing tree species.

3. All chemical solution shall be applied by nozzleman walking the right of way. The applicating equipment may be either power driven equipment or knapsack spray tanks. Spray nozzles shall be adjusted to produce a coarse spray of large droplets at 30 pounds or less pressure.

4. Treatment season shall be year around.

5. All evergreen plants, except those listed, shall be treated over their complete height, including all leaves, twigs, and stems, in addition to the basal treatment.

6. All stems of ash species over 5 feet in height shall be removed by completely cutting at the 3 inch height. The brush from this mechanical cutting shall be disposed of in a manner acceptable to the property owner. No burning of this brush will be permitted without the approval of the company. Stumps of this brush to be treated in accordance with specifications for selective basal treatment except for height of treatment.

7. The following plants are not to be treated on the right of way:

   A. All grasses, ferns, and herbaceous plants

   B. All annual weeds and annual plants

   C. Low-growing shrubs including:

I. Mountain laurel	Kalmia latifolia
2. Sweetfern	Comptonia peregrina
3. Azalea	Azalea nudiflorum
4. Huckleberries	Gaylussacia spp.
5. Blackberry	Rubus allegheniensis

6. Raspberry — Rubus occidentalis
7. Spice bush — Lonicera benzoin
8. Choke cherry — Prunus virginiana
9. Choke berry — Pyrus melanocarpa
10. Dwarf willow — Salix humilis
11. Witch hazel — Hamamelis virginiana
12. American yew — Taxus canadensis
13. Partridge berry — Mitchella repens
14. Wintergreen — Gaultheria procumbens

D. Small trees to be preserved on the right of way where conductor height will permit:

1. White flowering dogwood — Cornus florida
2. Redbud — Cercis canadensis
3. American hornbeam — Carpinus caroliniana
4. Shadbush — Amelanchier canadensis
5. Iron wood — Ostrya virginiana
6. Red cedar — Juniperus virginiana
7. Striped maple — Acer pennsylvanicum
8. American crabapple — Malus coronaria

8. All brush over 5 feet in height, except the above, located within 100 feet of all improved roads and highways shall be cut and stump treated. The cut brush shall be disposed of in a manner acceptable to the property owner and so as not to be visible from the road or highway.

9.

Advantages

1. Selectivity in choosing stems to be treated.
2. Foliage "Brown Out" can be eliminated with dormant application.
3. Control over application of the chemical solution.
4. Can be applied year around.
5. Most acceptable to the public.

Disadvantages

1. Excessive cost when applied on dense brush.
2. Limitations by terrain and access.
3. May be a problem in obtaining oil.

WATER BORNE, STEM-FOLIAGE APPLICATION

1. All undesirable vegetative growth shall be sprayed with a solution of chemical and water so as to completely wet the entire leaf andstem surface until there is run-off; except that evergreen tree species over 5 feet in height shall be removed by cutting at the 3 inch height.

2. Extreme care must be exercised to insure that each plant is entirely

covered with chemical solution, both in leaf and stem surface. To accomplish this complete coverage, it is necessary that the nozzleman treat each plant individually from a position close to the plant. Each plant must be treated from more than one direction.

3. All chemical material shall be applied by nozzlemen walking the right of way. The nozzle opening size shall be #9 or larger. The nozzle pressure shall not exceed I50 pounds pressure. To assure complete coverage of plants on the outer edges of the right of way, it is necessary that they be sprayed by men walking to the edge of the right of way and directing their spray to the center of the right of way. Off right of way damage is not permitted.

4. Pump equipment used to pump or mix spray materials shall not be used to pump water from streams or ponds into spray tanks.

5. Chemical treatment is applied between June I and August I5.

6. Chemical treatment shall not be made when there is a danger of wind drift of spray materials causing off right of way damage.

7. Water borne, stem-foliage treatment shall stop at least I00 feet from all road crossings, stream crossings, residences, and agricultural areas and the selective basal application substituted.

8. All brush over 5 feet in height, except small trees and shrubs, located within I00 feet of all roads shall be cut and stump treated.

Advantages

I. Economical in dense brush.
2. Moderate to good control in dense stands of brush.

Disadvantages

I. Foliage "Brown Out".
2. Limitations by terrain and access.
3. Less selectivity in choosing stems to be treated.
4. Less control over application of chemical solution.
5. Limitations by weather conditions.
6. Limited time period of application.
7. Water supply may be a problem in some areas.

APPLICATION BY HELICOPTER

I. Because of the complex nature of this job and the high degree of skill required in this operation, only qualified helicopter pilots with adequate experience in aerial right of way spraying shall be used.

2. It is necessary that all brush on the right of way be treated from two directions parallel with the line in order to overcome the shielding effect of the brush foliage on the forward motion of the spray droplets thus causing lack of treatment on the back side of the brush clumps. To accomplish treatment from two directions, one-half the prescribed volume of solution will be applied to the right of way by the helicopter flying in one direction; and one-half the volume will be applied by the helicopter flying the same swath in the reverse direction. The pilot shall exercise good judgment in applying the spray material to the brush. Where the density of brush varies on the rights of way, an effort shall be made to vary the application with the brush density. Side dressing of the trees along the edge of the right of way is not permitted. Damage to trees and other plants off the right of way will not be tolerated.

3. Each property owner on the right of way shall be contacted by the contractor's personnel to obtain consent for helicopter application.

4. Treatment shall be from June 1 and shall be completed before August 15. Application shall not be made when winds exceed 5 miles per hour.

5. Helicopter application shall stop at least 100 feet from all road crossings, stream crossings, residences, and agricultural areas and the selective basal application substituted.

6. All brush over 5 feet in height, except small trees and shrubs, located within 100 feet of all roads shall be cut and stump treated.

7. Selective cut areas shall be marked by the contractor so that they can be identified from the air and not treated.

Advantages

1. Economical
2. Effective kill on dense stands of tall brush.
3. Access and terrain aren't a problem.

Disadvantages

1. Foliage "Brown Out".
2. Less controll application of chemical solution.
3. No selectivity of application.
4. Limitations by weather conditions.
5. Limited time period for application.
6. Disapproval by a larger portion of landowners than with other types of application.

With all the information on hand, a decision can be made so as to complement the conditions existing on the right of way with the proper chemical technique.

In some cases, several chemical techniques may be employed along a single right of way. This is especially true in Penelec's service area where power lines traverse diverse types of topography and land use areas.

As an example, during the 1975 spray year, one 500 KV right of way was treated using different chemical techniques. A right of way survey was completed the previous year and presented a situation where a selective basal application and helicopter application could be properly used along different sections of the right of way.

Approximately 270 acres were set up for the selective basal application because of the light to moderate density of brush intermixed with a variety of desirable vegetation. Access to and along the right of way was adequate for men and power driven equipment to accomplish their job with little difficulty. Finally, the areas surrounding the right of way were mainly crop lands and pasture areas. These existing conditions on the right of way dictated the selective basal approach.

Approximately 100 acres of the same right of way traversed remote, steep, mountain ridges and slopes supporting dominant, tall, stands of Black Birch (Betula lenta) and Black Locust (Robina pseudoacacia). Access was limited with the population of the surrounding area being sparse. In this situation the helicopter application was a very useful and economical tool to be used without the public disapproval that may have occured in a more populated or agricultural area.

By using this approach to vegetation management on this particular right of way, as well as others, Penelec has achieved an effective control of tree species without the public disapproval that may result when we disregard all other factors and base an entire spray program on the economic aspect alone. Although economics enters the picture, other factors must be considered so that in years to come chemical brush control will not be government regulated or prevented altogether.

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HERBICIDE IMPROVES TREE GROWTH AND NUTRIENT UPTAKE

Robert D. Shipman[1/]

ABSTRACT

Survival and height growth of underplanted yellow-poplar (Liriodendron tulipifera L.) seedlings were used to determine the effects of controlling a low-quality oak-hickory stand with fenuron. Dry, pelleted fenuron (25% a.i.) was applied circumbasally to individual unwanted oak-hickory trees at the rate of 1 tsp. per 2 in. of tree diameter. On an upland hardwood site of predominantly clay loam soils located in central Pennsylvania, 24 one-tenth acre plots were established in a complete factorial experiment and treated as described above in June 1965. Two years after the herbicide application, one-year-old yellow-poplar seedlings were hand-planted on all 24 plots at a 6 by 6 ft. spacing. Throughout a 5-year period (1967-72) data were obtained on rainfall amount, maximum-minimum air temperature and percent available soil moisture for each treatment at 4 and 12 in. soil depths. Soils under each treatment were sampled for acidity, organic matter content, textural characteristics and for nutrient content. Similarly, yellow-poplar leaf samples were obtained annually throughout the 5-year period and analyzed for their nutrient level content.

Height growth and survival of the planted yellow-poplar was significantly better on fenuron treated plots than on the untreated controls after five growing seasons. On herbicide treated plots, nitrogen, phosphorus and potassium nutrient uptake by yellow-poplar was higher than on non-herbicide treated plots. For calcium and magnesium, however, the greatest uptake occurred on untreated plots.

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FOUR YEARS OF ALACHLOR ON ORNAMENTALS

Francis R. Gouin and Conrad B. Link[1/]

ABSTRACT

Alachlor (2-chloro-2',6'diethyl-N-(methoxymethyl) acetanilide) granules have been applied yearly at 2 concentrations alone and in combination with granular simazine (2-chloro-4,6bis(ethylamino)-s-triazine), triflurlain(a,a,a,-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), and linuron (3-(e,4-dichlorophenyl)-1-methoxy-1-methylurea) once each spring from 1972 to 1976 on 5 species of broadleaf evergreens, 2 species of narrowleaf evergreens, 2 species of deciduous shrubs and 2 species of deciduous trees. The initial applications were made in the spring of 1972, 4 weeks after lining-out and all subsequent yearly applications were made in late April or early May.

Weed control was highly satisfactory during the first 2 years in plots receiving alachlor at 7.2 kg ai/ha combined with simazine at 1.8 kg ai/ha and trifluralin at 4.8 kg ai/ha. Plots with only alachlor at 9.6 kg ai/ha were clean of grasses, but contained several species of broadleaf weeds. Yellow nutsedge (Cyperus esculentus L.) which was present in the field prior to planting and evident in the control plot, was almost completely eradicated in plots receiving 9.6 kg ai/ha of alachlor within the first years and controlled after two years in all plots receiving 7.2 kg ai/ha of alachlor. However, during the 3rd and 4th years of trials, resistant weeds such as ivyleaf morningglory (Ipomoe hederacea (L.) Jacq.), common morningglory (I. purpurea (L.) Roth.) and field bindweed (Convolvulus arevensis (L.)) invaded all plots heavily except plots receiving alachlor-simazine, and alachlor-linuron.

Phytotoxic symptoms were present only on the deciduous shrubs receiving alachlor-linuron and only during the first growing season. A slight reduction on total growth with alachlor at 9.6 kg ai/ha was evident on Strawberry bush (Calicanthus floridus L.) and forsythia (Forsythia intermedia Zabel.) Also alachlor at 7.2 and 9.6 kg ai/ha appears to inhibit suckering of Sawtooth oak (Quercus acutissima Maxim.). Sawtooth oaks treated with alachlor alone or in combination with other herbicides were either slow developing sprouts or failed to develop sprouts after the original trunks were pruned to the ground 1 year after lining-out for trunk renewal purposes.

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HERBICIDES FOR HEMLOCK SEEDBEDS

J. F. Ahrens and M. Cubanski[1/]

ABSTRACT

Herbicides were evaluated during 1976 in seedbeds of eastern hemlock (*Tsuga canadensis* (L.)Carr.) at the Connecticut State Forest Nursery in Voluntown. Alachlor [2-chloro-2'-6'-diethyl-*N*-(methoxymethyl)acetanilide], CGA-24705 [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide], oxadiazon [2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4-oxadiazolin-5-one], and oryzalin (3,5-dinitro-N^4,N^4-dipropylsulfanilamide), severely injured the hemlocks when applied in May on newly emerged seedlings. Napropamide [2-(α-naphthoxy)-N,N-diethylpropionamide] at 2 or 3 lb/A in May and June caused excessive injury, but one application at 3 lb/A in May did not. Two applications of bifenox [methyl-5-(2,4-dichlorophenoxy)-2-nitrobenzoate] at 3 lb/A also caused excessive injury, whereas one May application at 3 to 6 lb/A did not.

The least injurious treatments for hemlock seedlings were DCPA (dimethyl tetrachloroterephthalate) and diphenamid (N,N-dimethyl-2,2-diphenylacetamide). Diphenamid at 3 to 4 lb/A in May gave excellent control of crabgrass (*Digitaria* sp.), oldfield toadflax (*Linaria canadensis* (L.)Dumont), and carpetweed (*Mollugo verticillata* L.). DCPA at 6 or 9 lb/A in May and June gave acceptable control of oldfield toadflax and excellent control of carpetweed and crabgrasses. Neither herbicide significantly affected weights of hemlock seedlings in the beds, or the growth of Japanese millet (*Echinochloa frumentacea*) in treated soil assayed at the end of the growing season.

INTRODUCTION

Hemlock seedlings are sensitive to preemergence herbicides. In experiments conducted at the Connecticut State Forest Nursery (1) prometryn [2,4-bis(isopropylamino)-6-(methylthio)-s-triazine] proved safe and effective for controlling weeds on newly emerged seedlings of several conifers, but not seedling hemlocks. DCPA was found to be safe on hemlock seedlings as well as other conifers. Diphenamid and napropamide also were safe on several conifers, but were not tested in hemlocks. The purpose of this study was to evaluate these and other preemergence herbicides for use in hemlock seedbeds.

MATERIALS AND METHODS

A trial was conducted at the Connecticut State Forest Nursery in Voluntown on a sandy loam soil amended through the years with wood chips and containing 5 percent organic matter. Hemlock seeds were broadcast on prepared beds in late November and were covered with a mulch of pine needles. After the seeds

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germinated in late April, most of the mulch was removed and the seedbeds were covered with a shade of plastic mesh. The plastic was removed to apply the herbicides.

Two seedbeds 4 by 300 ft were used for the experiment. Herbicides were applied with a hand-held sprayer with two nozzles spraying 3 ft swaths across the beds. The sprayer was calibrated to deliver 50 gal/A. The herbicide plots were spaced 5 ft apart, leaving 2 ft untreated between each. One plot in ten also was left untreated. The herbicide treatments were replicated three times in randomized complete blocks. All plots were irrigated within 1 hr of application and daily in the absence of rainfall thereafter.

The herbicides were first applied on May 20, 1976 when the hemlock seedlings were 1/2 to 3/4 in tall in the cotyledon stage. Some seedlings of oldfield toadflax were present at treatment. Weed control was evaluated visually by two persons on June 23 and July 23 on a scale of 0 to 10, with 0 as no control and 10 as 100 percent control. The plots were handweeded after evaluating weed control and on June 23 the herbicides were reapplied. Treatments that caused excessive injury in May were not reapplied in June.

Injury to the hemlocks was evaluated by two persons on a scale of 0 to 10, with 0 indicating no injury and 10 indicating dead seedlings. Average injury greater than 2.0 at the end of the season was considered excessive.

On September 29, samples of hemlock seedlings and soil were taken from untreated and certain treated plots. Approximately 50 seedlings from each plot were lifted with their roots and about 3 inches of attached soil. The seedlings were carefully separated from the soil, washed, blotted, and weighed. The soil was mixed, placed in pots, seeded to Japanese millet, watered, and placed in the greenhouse for assay of herbicide residues. Top growth of the millet was weighed after 3 weeks.

In June the primary weeds in the plot area were oldfield toadflax and carpetweed, but crabgrass plants were present in small numbers. In July all three weeds were abundant in untreated plots.

RESULTS AND DISCUSSION

Growth of the hemlocks was poorer and more variable than normal in this test and plant injury sometimes was detected only by careful comparisons with adjacent controls. The weed control and injury evaluations following herbicide applications in May, or May and June, are given in Table 1.

<u>Oxadiazon</u>, <u>alachlor</u>, <u>CGA-24705</u>, and <u>oryzalin</u> severely injured the hemlock seedlings at all rates applied in May. Injury from oryzalin developed slowly (2-3 months) whereas injury from the others occurred within 1 month of application. In results not shown, oxadiazon was also applied at .75 lb/A in combination with DCPA at 6 lb/A or diphenamid at 2 lb/A. These treatments were more effective than the individual herbicides but they also caused severe injury to the hemlocks. In earlier work at this nursery (1), oxadiazon and oryzalin had shown promise for use in pine and spruce at 1 lb/A.

Table 1. Weed control in June and July, and injury in July or September following herbicide applications on May 20 or May 20 plus June 23, 1976.

Herbicide and formulation	Rate, lb/A ai	Dates applied	Weed Control 1/ June 23 1 month All weeds	July 23-2 months All weeds	Crab-grass	Toadflax+ carpetweed	Injury 2/
untreated	-	-	0	0	0	0	0.3
DCPA 75W	6	May+June	8.2	8.9	10.0	8.2	1.3
	9	May	8.7	8.8	9.3	8.7	1.0
	9	May+June	8.0	9.2	9.9	9.0	0.3
	18	May	8.3	9.0	10.0	8.2	1.3
diphenamid-50W	3	May+June	9.3	9.6	9.9	9.8	1.0
	4	May	9.3	9.8	10.0	10.0	0.3
	4	May+June	9.5	9.9	10.0	9.9	1.7
	8	May	9.6	9.5	10.0	9.8	1.7
oryzalin 75W	.5	May+June	8.7	9.5	10.0	9.7	7.3
	.75	May	8.7	9.2	9.8	8.3	5.7
	.75	May+June	8.0	9.7	10.0	9.7	7.7
	1.5	May	9.2	9.7	9.8	9.5	6.3
oxadiazon-75W	1	May	9.3	9.7	9.7	9.8	7.3
	1.5	May	9.5	9.8	9.9	9.9	4.8
	3	May	9.8	9.8	9.0	9.8	7.7
napropamide-50W	2	May+June	9.2	9.3	10.0	8.7	2.7
	3	May	9.2	9.0	9.7	8.3	0.7
	3	May+June	9.6	9.7	10.0	9.8	2.3
	6	May	9.6	9.5	9.7	9.3	2.0
alachlor-ec	3	May	9.9	8.8	9.5	8.5	8.3
	4	May	9.5	9.0	9.5	8.8	9.3
	8	May	9.8	9.8	10.0	9.8	9.5
CGA-24705-ec	3	May	9.2	8.0	10.0	7.2	8.3
	4	May	9.1	9.0	9.9	9.3	8.2
	8	May	9.8	9.8	10.0	9.8	9.0
bifenox 80W	2	May+June	8.0	9.3	9.0	9.8	0
	3	May	8.3	8.2	7.2	9.7	1.3
	3	May+June	7.0	9.0	8.5	10.0	2.0
	6	May	8.0	8.8	7.7	9.8	0.3

1/ 0 = no control, 10 = 100% control.
2/ 0 = no injury, 10 = dead plants; the highest values for the July or September evaluations are shown, averaged for three replicates.

Napropamide at 3 lb/A in May controlled most weeds for the season without significant injury to hemlocks, but at 2 lb/A in May and June or 6 lb/A in May, injury in July appeared excessive. However, by September hemlock seedlings in napropamide-treated plots showed mild injury and were as large or larger than seedlings in many of the control plots (Table 2). Soil residues of napropamide in September following two applications at 3 lb/A or one at 6 lb/A markedly reduced growth of Japanese millet in a greenhouse assay. This is in agreement with an earlier study in which we found napropamide residues that were toxic to seeds of oats, but not Norway spruce (Picea abies (L.) Karst.).

Table 2. Seedling weights of hemlocks in September and weights of Japanese millet in soil samples from selected treatments.

Herbicide	Rate	Dates applied	Fresh weights of 50 seedlings of hemlock-grams 1/	Fresh weights of Japanese millet-grams 2/
untreated		-	12.3	1.33
		-	7.1	1.64
DCPA	9	May+June	11.3	2.15
	18	May	13.6	2.07
diphenamid	4	May+June	9.6	2.34
	8	May	8.7	1.98
napropamide	3	May+June	10.4	.09
	6	May	13.7	.16
LSD - P = .05			N.S.	.67

1/ Weights of tops plus roots averaged for 3 replicates. Comparisons between plants from treated and untreated plots showed no effects of the herbicides on root size.

2/ Fresh weights of tops, averaged for 3 replicates.

Bifenox controlled carpetweed and oldfield toadflax more effectively than crabgrasses, with minor injury to hemlocks at 3 or 6 lb/A in May or 2 lb/A in May and June. At 3 lb/A in May and June, however, bifenox reduced hemlock vigor in September.

DCPA and diphenamid gave good to excellent control of weeds with little injury to the hemlocks. Diphenamid at 3 lb/A was more effective than DCPA at 6 to 18 lb/A, especially in controlling oldfield toadflax. However, DCPA at 9 lb/A in May and June gave acceptable control of all weeds for the season with minimal injury to hemlock seedlings. Neither herbicide reduced growth of Japanese millet in soil taken in September from the upper 3 inches of treated plots. Better growth of millet in soil from DCPA or diphenamid plants than soil from untreated plots is attributed to lower nutrient levels in control plots due to weed competition. These results with DCPA and diphenamid in hemlock seedbeds compare favorably with past results on other conifer species at this nursery (1). DCPA also was found to be the least injurious of several herbicides tested in seedling deciduous plants (2).

ACKNOWLEDGEMENT

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1976 PREEMERGENCE WEED CONTROL IN NURSERY LINERS

Arthur Bing[1]

ABSTRACT

Preemergence herbicides were applied to newly planted nursery liners at two locations. Alachlor (2-chloro-2',6'diethyl N (methoxymethyl) acetanilide) and alachlor plus simazine (2-chloro 4,6-bis (ethylamino)-s-triazine) combinations gave nearly complete weed control without injury to the test plants. Combinations of other herbicides with simazine were also effective. Velsicol 5052 was very effective against all plants.

INTRODUCTION

Ornamental plants must not only have a good appearance to command a premium price but also grow fast enough to be profitable. Effective weed control is essential for attaining this objective. The Cornell Ornamentals Research Laboratory has a continuing program of evaluating pre- and postemergence herbicide treatments on ornamental plants (1)(2)(3). This report deals with post-plant preemergence treatments on newly planted nursery liners at Farmingdale and Riverhead, N. Y. during the 1976 growing season. Combinations of herbicides show the most promise for safe, broadspectrum weed control.

MATERIALS AND METHODS

The nursery liners listed in Table 1 were planted at Farmingdale (F) on April 28-29 and at Riverhead (R) on May 2-3, one variety per row with 2 ft between plants in 15 rows 400 ft long and 3 ft apart.

All plants were cultivated once, and emerged weeds were scuffled out or hand pulled before preemergence treatments. During the growing season overhead irrigation was applied as needed but adequate rain occurred during the treatment period. Spray applications were made with a handpumped sprayer using a Tee Jet 8003 nozzle. Granulars were weighed and applied to the plots with a simple hand shaker that is a cylinder with holes in the cover. Each plot was a band 8 ft wide across the 15 rows and included 4 plants in each row and covered an area of 360 sq ft. Each treatment was replicated twice, location determined by chance. Sprays were semidirectional with no effort to avoid foliage. At Farmingdale preemergence treatments were applied on May 17 on a cloudy day with a temperature of 65-70°F. Rain occurred the night before treatment and again soon after treatments were finished. Herbicides were applied at Riverhead on May 21. The temperature was about 70°F, soil was moist but rough from the cultivation. A heavy wind and a shower interrupted application about half way through the field in the morning but applications were completed later in the afternoon. Plant stand was good at both Farmingdale and Riverhead at the time of treatments. Herbicides used in this experiment are listed in Table 2. Dinitramine was applied unevenly at Riverhead because of the wind.

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After weed control was evaluated in early July all weeds were removed by hand. Weed regrowth was evaluated in late August. Weed control was rated on a scale of 1 to 10 with 10 for no weed growth, 9 just a trace of weeds, 8 only a few weeds, to 1 full of weeds. Table 3 shows the general weed control and grass and non grass control at both Farmingdale and Riverhead. Table 4 and 5 show control of specific weeds at Riverhead and Farmingdale.

Crop tolerance was evaluated on Oct. 6 at Farmingdale and Oct. 7 at Riverhead. A rating of 1 is for a dead or missing plant to 10 for excellent growth and appearance. A rating of 8 or higher would show no injury and acceptable growth. Results are in Table 7 and 8.

RESULTS AND DISCUSSION

Alachlor applied alone or in combination with simazine was very effective at both locations. Alachlor 15G plus simazine 4G were applied separately in the 4+1 lb treatment. In the other alachlor plus simazine treatments an experimental combined granule containing 8 1/3% alachlor and 1 2/3% simazine was just as effective against weeds and safe on the crop at rates up to 8 + 1.6 lb. Velsicol 5052 was non-selective killing both crops and weeds. It may be a good soil sterilant. Dinitramine performed better at Farmingdale probably because of the wind problem at Riverhead. Hercules 26910 was more effective at 4 lb than 2 lb. Pronamide was used to study crop tolerance. It is not effective against weeds under the conditions of the experiment but is useful for late fall weed control. The simazine napropamide combination granule was not as effective as in previous seasons giving only fair control at Riverhead of grasses and non-grasses. Barnyard grass (Echinochloa crusgalli L. Beauv.) was a problem at Riverhead but not at Farmingdale. Groundsel (Senecio vulgaris L.) and redroot pigweed (Amaranthus retroflexus L.) were more plentiful at Farmingdale. Purslane (Portulaca oleracea L.) and crabgrass (Digitaria sp.) were common in both places. Also at Farmingdale there was some common lambsquarter (Chenopodium album L.) and common ragweed (Ambrosia artemisiifolia L.) . Some rows of nursery plants did poorly and were left out of final consideration. Only Vel 5052 consistently injured all kinds of plants. Consistently high ratings show good tolerance. Occasional poor plants could be due to other causes. Consistently low ratings indicate injury. Except for Vel 5052 the treatments did not cause definite injury. Although most treatments gave good to excellent weed control, Hercules 26910 was weaker on redroot pigweed, groundsel and barnyard grass; CGA 24705 was weak on Pennsylvania smartweed and red root pigweed.

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Table 1 Liners planted at Farmingdale (F) and Riverhead (R)

Location	Common Name	Scientific Name
FR	Andromeda	*Pieris japonica* D. Don.
F	Azalea, Hinodigeri	*Rhododendron obtussum hinodegiri* Planch.
F	Azalea	*Rhododendron obtussum* Planch.
F	Azalea	*Rhododendron obtussum* Planch.
R	Dogwood, flowering	*Cornus florida* L.
FR	Firethorn	*Pyracantha coccinea Lelandi* Roem. Dipp.
FR	Goldenbells	*Forsythia intermedia* Zabel
F	Hemlock, Canadian	*Tsuga, canadensis* Carr.
F	Holly, Green Island	*Ilex crenata, Green Island* Thunb.
FR	Holly, Heller's	*Ilex crenata Helleri* Thunb.,Bailey
R	Honeysuckle, Gold Flame	*Lonicera Heckrotti* Rehd.
R	Hydrangea, Peegee	*Hydrangea paniculata grandiflora* Sieb.
FR	Juniper, Hetz	*Juniperus chinensis hetzii glauca* L.
FR	Maple Amur	*Acer Ginnala* Maxim.
FR	Maple, Japanese	*Acer Palmatum* Thunb.
FR	Pine, Japanese black	*Pinus thunbergii* Parl.
FR	Privet, California	*Ligustrum ovalifolium* Hassk.
FR	Yew, Hicks	*Taxus intermedia Hicksii* Rehd.

Table 2 Preemergence herbicides used on nursery liners

Common Name	Chemical Name	Formulation
Alachlor	2,chloro-2',6'-diethyl-N-(methocymethyl)acetanilde	15G
Alachlor		4G
Alachlor+		8 1/3G
simazine	2-chloro-4,6-bis(ethylamino)-s-triazine	1 2/3G
CGA 24705	(2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1 methylethyl(acetamide)	6EC
Dinitramine	N^4,N^4-diethyl-a,a,a-trifluoro-3,5-dinitrotoluene-2,4-diamine	2G
Hercules 26905		4EC
Hercules 26910		4EC
Napropamide+	2-(a-naphthoxy)-N-N-diethylpropionamide	10G
simazine		2.5G
Oryzalin	3,5-dinitro-N^4,N^4-dipropylsulfanilamide	75WP
Oxadiazon		4G
Promamide	3,5-dichloro(N-1,1-dimethyl-2-propynyl)brnzamide	50WP
Simazine		4G
Vel 5052	(2-Chloro-N-(2,6 dimethyl phenyl)-N(1,3-dioxylan-2-yl) methyl acetamide)	5G

Table 3 Weed control in nursery liners at Riverhead and Farmingdale, New York treated postplant preemergence

Treatment		Riverhead			Farmingdale		
Common Name	Rate	General	Grass	Non-Grass	General	Grass	Non-Grass
Alachlor	5	6[a]	9	7	9	10	9
	6	9	9	10	9	10	9
	8	9	9	9	10	10	10
Alachlor simazine	4+1	8	8	9	9	9	9
	5+1	9	9	10	10	10	10
	6+1.2	9	9	10	10	10	10
	7+1.4	10	10	10	10	10	10
	8+1.6	9	9	9	10	10	10
Vel 5052	2	9	9	10	10	10	10
	4	10	10	10	10	10	10
Hercules 26910	2	7	8	8	5	7	6
	4	8	9	8	8	9	8
Hercules 26905	4	8	8	9	7	8	8
	8	9	10	9	8	9	8
CGA 24705	2	7	9	7	7	9	7
	4	9	9	10	8	10	8
Simazine oryzalin	1+2	7	7	10	9	9	9
Simazine oxadiazon	1+2	7	7	10	8	9	10
Simazine napropamide	1+4	7	7	8	8	10	8
Simazine dinitramine	1+½	5	6	9	9	9	9
Pronamide	4	4	5	9	4	6	5
Simazine napropamide	1.5+5	5	7	6	9	9	9
Untreated		3	5	6	2	4	3
Handweeded		5	6	7	10	10	10

[a]Rating 1 = full of weeds to 10 = no weeds

Table 4 Weed control in nursery liners at Riverhead, N. Y. treated postplant preemergence. Treated May 21 Observed July 8, 1976

Treatment		Weed Control			
Common Name	Rate	Purslane	Crabgrass	Barnyard grass	Penn Smartweed
Alachlor	5	[a]	9	9	7
	6			9	
	7			9	9
	8			9	9
Alachlor simazine	4+1	9	10	8	9
	5+1	10	10	9	10
	6+1.2	10	9	9	10
	7+1.4	10	10	10	10
	8+1.6	10	10	9	10
Vel 5052	2	10	10	9	10
	4	10	10	10	10
Hercules 26910	2	9	9	8	9
	4	10	9	9	9
Hercules 26905	4	9	9	8	10
	8	9	10	10	10
CGA 24705	2	9	10	9	7
	4	9	10	10	9
Simazine oryzalin	1+2	10	9	7	10
Simazine oxadiazon	1+2		9	9	
Simazine napropamide	1+4			8	9
Simazine dinitramine	1+½	9	7	7	9
Kerb	4		7	7	
Simazine napropamide	1.5+6	10	9	8	6
Untreated		8	7	6	6
Handweeded		9	8	7	10

[a] Rating 1 = Full or weeds to 10 = no weeds

Table 5 Weed control in nursery liners at Farmingdale, N. Y. treated postplant Preemergence. Treated May 17 Observed July 6, 1976

Treatment		Weed Control					
Common Name	Rate	Purslane	Groundsel	Red Root	Crabgrass	Ragweed	Lambs Quarter
Alachlor	5	10[a]	10	10	10	9	10
	6	10	10	10	10	9	9
	7	10	10	10	10	10	10
	8	10	10	10	10	10	10
Alachlor simazine	4+1	9	10	10	9	9	10
	5+1	10	10	10	10	10	10
	6+1.2	10	10	10	10	10	10
	7+1.4	10	10	10	10	10	10
	8+1.6	10	10	10	10	10	10
Vel 5052	2	10	10	10	10	10	10
	4	10	10	10	10	10	10
Hercules 26910	2	9	8	8	9	9	9
	4	10	9	8	10	9	10
Hercules 26905	4	9	9	8	10	9	10
	8	9	9	9	10	10	10
CGA 24705	2	10	10	8	10	8	8
	4	9	9	9	9	10	9
Simazine oryzalin	1+2	10	10	9	10	10	10
Simazine oxadiazon	1+2	10	10	10	9	10	10
Simazine napropamide	1+4	10	10	8	10	9	10
Simazine dinitramine	1+½	9	10	9	10	10	10
Pronamide	4	9	6	6	9	8	9
Simazine napropamide	1.5+6	10	10	9	10	9	9
Untreated		7	6	6	8	7	9
Handweeded		10	10	10	10	10	10

[a] Rating 1 = full of weeds to 10 = no weeds

Table 6 Tolerance of nursery liners to postplant preemergence herbicides applied at Farmingdale, N. Y. May 17 and rated on October 6, 1976

Treatment		Tolerance Rating													
Common Name	Rate	Jap. black pine	Hemlock	Heller's holly	Azalea Hinodigeri	Firethorn	Hicks yew	Forsythia	Privet	Green Is. Holly	Hetz Juniper	Jap. Maple	Amur Maple	Andromeda	Azalea
Alachlor	5	6[a]	9	9	8	10	9	10	10	8	8	7	7	6	9
	6	6	9	9	5	10	10	10	10	8	9	7	8	3	9
	7	5	8	9	9	10	10	10	9	8	7	9	9	5	9
	8	8	9	10	10	10	10	10	10	9	8	6	9	6	8
Alachlor simazine	4+1	8	10	10	6	10	10	10	10	9	9	5	6	4	9
	5+1	8	9	8	9	9	9	10	9	8	8	6	7	4	9
	6+1.2	6	9	8	7	10	10	10	10	8	9	5	5	5	8
	7+1.4	4	10	10	9	10	10	10	10	9	8	4	8	4	8
	8+1.6	4	9	9	5	10	9	10	10	8	9	5	6	6	6
Vel 5052	2	2	2	1	1	2	7	2	8	9	3	2	1	1	1
	4	1	1	1	1	1	1	1	1	1	1	2	1	1	1
Oryzalin simazine	2+1	7	7	8	8	9	10	10	10	8	7	4	8	4	9
Napropamide simazine	4+1	7	9	10	7	9	9	10	5	8	9	8	9	5	8
	6+1.5	5	8	8	9	10	9	10	10	8	9	6	8	4	9
Hercules 26910	2	9	9	9	9	10	6	9	10	8	6	6	7	5	9
	4	5	9	9	7	9	9	10	10	8	8	8	8	6	10
Hercules 26905	4	9	9	9	9	9	8	10	9	4	8	4	5	3	9
	8	9	9	7	9	9	8	10	5	8	8	5	5	5	9
Untreated		4	8	8	5	9	9	8	9	6	7	6	6	2	6
Oxadiazon simazine	2+1	9	7	9	8	9	9	10	10	8	8	3	8	5	9
CGA 24705	2	6	8	8	7	10	9	10	9	7	6	5	9	3	7
	4	7	9	9	6	9	10	10	10	8	8	7	9	4	8
Handweeded		6	10	9	8	10	10	10	10	8	8	4	8	6	6
Dinitramine simazine	½+1	7	9	9	7	10	9	10	10	9	6	8	9	5	8
Pronamide	4	3	8	6	6	10	7	9	10	7	8	4	4	2	5

[a]1 = plants dead or missing to 10 = excellent growth

Table 7 Tolerance of nursery liners to postplant preemergence herbicides applied at Riverhead, N. Y. May 21, ratings made Oct. 7, 1976

Treatment		Tolerance Rating												
Common Name	Rate	Privet	Firethorn	Hydrangea	Forsythia	Jap. Black Pine	Hetz Juniper	Heller's Holly	Hicks yew	Andromeda	Jap. Maple	Flowering Dogwood	Honeysuckle	Amur Maple
Alachlor	5	9[a]	9	5	10	5	5	7	9	7	5	6	8	8
	6	9	9	5	10	6	7	9	8	5	6	8	10	9
	7	9	9	8	10	4	3	8	9	7	4	6	10	8
	8	7	9	9	9	5	3	8	9	7	6	7	10	9
Alachlor simazine	4+1	8	9	2	10	5	3	8	9	5	7	8	10	8
	5+1	10	10	1	9	1	6	9	9	7	7	6	10	8
	6+1.2	8	10	2	10	6	5	8	9	8	5	6	10	9
	7+1.4	8	9	2	9	1	5	9	9	4	5	5	10	9
	8+1.6	8	10	1	10	3	8	8	9	4	5	4	10	10
Vel 5052	2	1	2	1	3	2	3	2	2	3	2	1	2	1
	4	1	1	1	1	1	1	1	1	1	1	1	1	1
Oryzalin simazine	2+1	8	9	0	10	4	4	8	8	8	6	6	10	9
Napropamide simazine	4+1	6	9	5	10	7	7	8	8	7	8	7	10	9
	6+1.5	10	10	5	10	6	8	8	9	6	8	3	7	8
Hercules 26910	2	9	10	5	10	5	5	8	9	8	9	7	10	9
	4	8	10	4	10	4	5	8	8	7	6	7	10	9
Hercules 26905	4	9	8	6	9	3	3	7	8	5	6	7	10	9
	8	8	9	5	10	3	6	7	9	5	5	4	10	8
Untreated		9	10	7	10	4	5	6	9	7	7	6	10	8
Oxadiazon simazine	2+1	9	9	2	9	9	8	8	9	7	6	7	10	7
CGA 24705	2	10	10	6	10	4	7	8	9	5	7	7	10	9
	4	8	10	4	10	2	7	7	9	6	6	8	10	9
Handweeded		10	9	10	10	3	7	9	9	6	9	6	10	9
Dinitramine simazine	½+1	9	10	1	10	3	4	8	9	6	5	5	10	6
Pronamide	4	9	10	3	10	4	8	8	8	8	6	4	10	9

[a] 1 = plants dead or missing to 10 = excellent growth

CONTROLLING PERENNIAL WEEDS IN ESTABLISHED LANDSCAPE PLANTINGS

Francis R. Gouin[1/]

ABSTRACT

Ornamental plantings on institutional grounds frequently become infested with perennial weeds. Few post-emergent herbicides are labeled to control weeds under such circumstances. Glyphosate (N-Phosphonomethyl Glycine) at 1.2 (high) and 2.4 (low) kg ai in 557 L of water/ha. was broadcast sprayed over established plantings of Waukegan juniper (Juniperus horizontalis 'Douglasii' Hort.) and Rock cotoneaster (Cotoneaster horizontalis Decne.) infested with Bermudagrass (Cynadon dactylon (L.) Pers.), Canada thistle (Cirsium arvense (L.) Scop.) and yellow nutsedge (Cyperus esculentus L.) in July and in September.

The high July application controlled Canada thistle without causing any visible phytotoxic symptoms on the foliage of both species of ornamentals. The low application rate appeared to have retarded the growth of Canada thistle and caused marginal chlorosis on Rock cotoneaster. Neither July applications controlled or influenced the growth of yellow nutsedge or Bermudagrass.

September applications at both concentrations resulted in total weed control. However, the foliage of Rock cotoneaster exhibited moderate to severe symptoms of marginal chlorosis. Waukegan juniper did not appear to have been affected by either rates of applications. Test applications of glyphosate at 2.4 kg ai/ha in July, August and September 1974-1975 over Andora juniper (J. horizontalis 'Plumosa' Hort.) resulted in good control of Bermudagrass with no visible phytotoxic symptoms to the foliage or on the subsequent growth of the plants.

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GLYPHOSATE TO CONTROL PERENNIAL WEEDS IN LANDSCAPE PLANTINGS

Arthur Bing[1/]

ABSTRACT

Perennial weeds are very difficult to eradicate from a landscape planting of perennial plants. Glyphosate [N-(phosphonomethyl)glycine] is a systemic effective against many perennial weeds and leaves no residue on the soil that can leach down to the roots. Directed sprays of glyphosate at 1-2 lb in 40 gal water per acre were applied to control mugwort (*Artemesia vulgaris* L.), field bindweed (*Convolvulus arvensis* L.), poison ivy (*Rhus radians* L.), yellow nutsedge (*Cyperus esculentus* L.), quackgrass (*Agropyron repens* L. Beauv.), Japanese knotweed (*Polygonum cuspidatum* Sieb. & Zucc.) and other weeds in plantings of trees, shrubs and ground covers.

Mugwort, poison ivy, and quackgrass were easily controlled by spraying with 1-1.5 lb of glyphosate. The larger growing Japanese knotweed is controlled with 2-3 lb of glyphosate but it is difficult to spray without also spraying desirable plants. Field bindweed required repeated applications at 2-3 lb for control. Hedge bindweed (*Convolvulus sepium* L.) appears to be more difficult to control. As new tubers of yellow nutsedge start growing, repeat applications are necessary.

Conifers such as Juniper (*Juniperus*) and yew (*Taxus*) are fairly tolerant to glyphosate. A rate of 2-3 lb will kill tips of branches but the plants soon put on new growth that covers the damage. Canadian hemlock (*Tsuga canadensis*) burns easily but also grows new foliage and branches.

The ground covers English ivy (*Hedera helix* L.) and Japanese spurge (*Pachysandra terminalis* Sieb. & Zucc.) tolerate 0.5-1.5 lb glyphosate and this may be a new approach to weed control in ground cover plantings.

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CONTROLLING RIP-SHINS (BRAMB_ES) AND MUGWORT WITH GLYPHOSATE

Francis R. Gouin[1/]

ABSTRACT

Brambles (Rubus spp.) are frequently troublesome weeds on Christmas tree farms and mugwort (*Artemesia vulgaris* L.) is often a nuisance in new and in established nurseries. Because they spread by rhizomes, mass propagation of these weeds occured during normal field preparation practices. To effectively control these weeds, complete eradication is essential prior to preparing the soil for planting.

Several phenoxy herbicides and 2-amino-1,2,4-triazole are effective at high concentrations in controlling these weeds. However, these herbicides leave a soil residue that is harmful to ornamental plants and in addition they must be used with extreme caution to avoid injury to nearby ornamentals from drift.

Glyphosate (N-Phosphonomethyl Glycine) was applied on brambles growing in full sun and under partial shade at 1.2, 2.4, and 4.8 kg ai in 557 L of water per ha at 20 to 30 day intervals starting in mid June, July, August, September, and October 1976. In October a 0.6 kg ai/ha concentration was added to the list of treatments. Only brambles sprayed in June with 4.8 kg concentration appeared to have been injured. Brambles sprayed with the lower concentrations were only retarded and did not appear to have been controlled because normal growth resumed in August. July applications at 2.4 and 4.8 kg concentrations resulted in visible permanent injury to all brambles sprayed. There appeared to have been some retardation in the growth of brambles sprayed with 1.2 kg concentration. Visible permanent damage was observed on brambles treated in August and September at all concentrations. The October treatments were not evaluated. Brambles growing in the partial shade appear to be equally sensitive to glyphosate as those growing in the full sun. However, plant symptoms responce appears to be delayed.

June applications of glyphosate at 2.4 and 4.8 kg concentrations on mugwort resulted in visible injury within 3 to 4 weeds, but regrowth in both treatments was observed in August. The 1.2 kg concentration gave no visible sign of injury. However, July, August, and September treatments at all levels of treatments resulted in complete control. The October treatments were not evaluated.

Final observation on these plots will not be made until June 1977.

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CONTROL OF PERENNIAL AND ANNUAL WEEDS IN ESTABLISHED PLANTINGS OF NARROWLEAF EVERGREENS

Chiko Haramaki [1/]

ABSTRACT

Nursery plantings of mature established Ware's arborvitae (Thuja occidentalis 'Ware'), Goldplume falsecypress (Chamaecyparis pisifera 'Goldplume') and Savin juniper (Juniperous sabina) were treated with directed sprays of glyphosate (N-(phosphonomethyl)glycine) in combinations with diuron (3-3,4-dichlorophenyl)-1,1-dimethylurea), simazine (2-chloro-4,5-bis(ethylamino) -S-triazine) and DPX-3674 (Velpar) - (3-cyclohexyl-6-(dimethylamino)-1-methyl-2,3,5-triazine-2,4(1H,3H)-dione) to the existing annual and perennial weeds. Long term effective weed control was obtained with little or no damage to mature narrowleaf evergreen plants, when glyphosate was applied at at 2 pounds of active ingredients per acre in combination with one of the pre-emergent herbicides at 2 pounds of active ingredient per acre.

INTRODUCTION

The control of annual and perennial weeds in established plantings of ornamental trees and shrubs in nurseries and landscaped areas have been dealt with in the past by mulching, hand weeding and mechanical means. More recently herbicides have been used to control weeds during the dormant period. The control of weeds during the growing season in heavily infested areas of established plantings still remains a problem.

Several researchers have indicated that effective control of existing annual and perennial weeds could be obtained by the use of glyphosate (1,2, 3,4,5,6,7). Good control of Canada thistle (Cirsium arvense Scop.) (5,6) common dandelion (Taraxacum officinale Weber) (1), field bindweed (Convolvulus arvensis L.) (6,7), mugwort (Artemisia vulgaris L.) (4,5) and quackgrass (Agropyron repens Beauv.) (1,2,3,5) was obtained by the use of glyphosate. The use of glyphosate plus a preemergent herbicide gave effective control of existing weeds and subsequent germinating weeds. Preemergent herbicides such as asulam (methyl sulfanilylcarbonate) and simazine (1,3) have been used with glyphosate. Plants which have showed to be tolerant to directed sprays of glyphosate include Hetz juniper (Juniperus chinensis 'Hetz'), Hicks yew (Taxus media 'Hicks'), Japanese garden juniper (Juniperus procumbens), Japanese holly (Ilex crenata), Norway spruce (Picea abies), rhododendron (Rhododendron), weigela (Weigela sp.) and white pine (Pinus strobus) (4,5,6). Susceptible plants have included California privet (Ligustrum ovalifolium), forsythia (Forsythia sp.), Japanese maple (Acer palmatum), multiflora rosa (Rosa multiflora), sweetgum (Liquidambar styraciflua), and Toringo crabapple (Malus sieboldi).

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Table 1. Effect of Postemergent Applications of Glyphosate on Weed Growth, 1976.

	Quackgrass*		Grasses		Broadleaves		All Weeds	
	7-16	10-23	7-16	10-23	7-16	10-23	7-16	10-23
0	3.4	6.3	4.7	6.8	4.2	3.2	8.8	10.0
½#/A	2.7	4.4	4.0	5.2	5.2	4.0	9.2	9.2
1#/A	2.1	3.3	3.1	3.8	5.4	4.2	8.6	8.0
2#/A	1.4	1.0	2.4	1.3	6.9	4.3	9.3	5.6

* 0 - No weeds, 10 - 100% weed coverage

Table 2. Effect of Postemergent Applications of Glyphosate and Diuron on Weed Growth, 1976.

	Quackgrass*		Grasses		Broadleaves		All Weeds	
	7-16	10-23	7-16	10-23	7-16	10-23	7-16	10-23
0+2#/A	3.2	4.8	4.3	5.9	4.5	3.1	8.9	9.0
½+2#/A	3.1	2.6	3.8	3.6	4.6	3.3	8.4	6.9
1+2#/A	3.6	1.9	4.6	2.8	4.3	3.7	9.0	6.4
2+2#/A	3.2	1.2	4.2	1.7	4.8	2.6	9.0	4.2

* 0 - No weeds, 10 - 100% weed coverage.

The objective was to find a herbicide or a combination of herbicides which would decrease or eliminate the existing annual and perennial weeds and retard or prevent the growth of new weeds in an established planting of mature narrowleaf evergreens with minimum damage to the nursery plants.

METHODS AND MATERIALS

The experiment was conducted at the student nursery at University Park, Pennsylvania in an established planting of narrowleaf evergreens which were growing in a Hagerstown silt loam. The crop plants were Ware's arborvitae which were approximately two feet wide and four feet tall, goldplume false-cypress which were one foot wide and one and a half feet high, and savin juniper which were approximately three and a half feet wide and one and a quarter feet high.

The weeds were periodically mowed but not treated with herbicide prior to the experiment. Three weeks after the last mowing, the herbicides were applied on July 17, 1976. The temperatures were: air - 64°F, soil surface - 64°F, 2" below soil surface - 64°F when the applications were started and air - 74°F, soil surface - 74°F, and 2" below soil surface - 72°F when completed. The soil moisture was at field capacity and the wind varied from 0 to 5 miles

Table 3. Effect of Postemergent Applications of Glyphosate and Simazine on Weed Growth, 1976.

	Quackgrass*		Grasses		Broadleaves		All Weeds	
	7-16	10-23	7-16	10-23	7-16	10-23	7-16	10-23
0+2#/A	4.2	4.7	5.0	5.2	4.1	3.8	8.0	9.0
½+2#/A	2.9	2.4	3.8	3.0	5.0	2.9	8.8	5.9
1+2#/A	3.2	2.1	4.2	2.7	4.4	1.6	8.7	4.2
2+2#/A	3.0	0.4	3.7	1.3	5.1	0.9	8.8	2.6

* 0 - No weeds, 10 - 100% weed coverage.

Table 4. Effect of Postemergent Applications of Glyphosate and DPX-3674 (Velpar) on Weed Growth, 1976.

	Quackgrass*		Grasses		Broadleaves		All Weeds	
	7-16	10-23	7-16	10-23	7-16	10-23	7-16	10-23
0+2#/A	3.6	1.8	5.4	2.4	3.4	2.1	8.9	4.6
½+2#/A	3.4	2.9	5.2	1.8	3.3	1.9	8.6	3.7
1+2#/A	2.4	1.2	4.1	1.3	4.6	2.3	8.7	3.7
2+2#/A	1.6	0.6	3.0	0.8	5.2	2.0	8.2	2.8

* 0 - No weeds, 10 - 100% weed coverage.

per hour. The sky was clear and sunny at the beginning and partly cloudy at the end. Most of the weeds were approximately 6 inches tall with a few up to 18 inches in height. The herbicides were applied as a spray directed to the weeds and the base of the nursery plants.

Glyphosate was applied at the rate of 1/2, 1 and 2 pounds of active ingredients per acre. An untreated control was included in the trial. Glyphosate at the same rates of application was also applied with diuron at 2 pounds of active ingredient peracre. This was repeated with simazine at 2 pounds of active ingredient per acre, and again with DPX-3674 (Velpar) at 2 pounds of active ingredient per acre. Each treatment or combination of treatments was replicated nine times. There were twelve untreated plots. All plots were 50 square feet.

RESULTS AND DISCUSSION

The predominant weeds in the plots prior to herbicide application in decreasing order of frequency were creeping buttercup, *Ranunculus repens* L.; quackgrass, *Agropyron repens* Beauv.; orchardgrass, *Dactylis glomerata* L.;

Table 5. Effect of Postemergent Applications of Glyphosate and Other Herbicide Combinations on Nursery Plant Growth, 1976.

	Ware's Arborvitae*		Gold Plume False Cypress		Savin Juniper	
	7-16	10-23	7-16	10-23	7-16	10-23
Glyphosate						
0	1.0	0.3	1.0	0.7	0	0
½#/A	0.7	1.0	1.3	1.0	0	0
1#/A	0.3	0.3	0.7	0.3	0	0
2#/A	0.3	0.3	1.0	0.3	0	0
Glyphosate and Diuron						
0+2#/A	0.3	0.3	2.0	2.7	0	0.7
½+2#/A	0.3	1.3	1.3	2.0	0.7	0
1+2#/A	0.7	1.0	1.7	1.7	0	0
2+2#/A	0.3	1.0	1.0	2.0	0	0.3
Glyphosate and Simazine						
0+2#/A	1.0	1.3	0.7	0	0	0
½+2#/A	0.3	0.7	1.3	1.0	0	0
1+2#/A	0.7	0.3	1.3	0.7	0	0
2+2#/A	0.3	0.7	1.0	1.3	0.3	0
Glyphosate and DPX-3674 (Velpar)						
0+2#/A	0.3	0.7	1.3	2.0	0	0
½+2#/A	0.7	1.3	1.0	2.0	0	0.3
1+2#/A	0.3	1.0	1.0	2.0	0.3	0
2+2#/A	0	1.0	1.3	1.7	0	0.3

* 0 - No Injury, 5 - Dead.

crownvetch, Coronilla varia and common blue violet, Viola papilionacea.

Four weeks after application the weeds in all plots treated with glyphosate at 2 pounds of active ingredient per acre were all effectively controlled, and there was a definite reduction in weed growth at 1 pound of active ingredient per acre. The weeds in all plots treated with 2 pounds of active ingredient of DPX-3674 had extensive necrosis.

On October 23, 1976, fourteen weeks after application, the plots were examined in detail. In the glyphosate treated plots at 2 pounds of active ingredient per acre the creeping buttercup, crownvetch, orchardgrass and buckhorn plantain, (Plantago lanceolata L.) were almost eliminated, and the populations of quackgrass and Canada thistle (Cirsium arvense Scop.) were greatly reduced (Table 1). These weeds were replaced by yellow rocket (Barbarea vulgaris R. Br.), curly dock (Rumex crispus L.), shepherdspurse (Capella bursa-pastoris Medic.) common yarrow (Achillea millefolium L.) and white cockle (Lychnis alba Mill.).

In the plots treated with glyphosate at 2 pounds and duiron at 2 pounds of active ingredient per acre, orchardgrass, common blue violets, buckhorn plantain and yellow woodsorrel, (Oxalis stricta L.) were eliminated (Table 2). The number of quackgrass and red raspberry (Rubus idaeus L.) plants were greatly reduced. Creeping buttercup and crownvetch populations were also reduced. There were a few wild garlic (Allium vineale L.), shepardspurse, yellow rocket and curly dock plants which were not originally present.

The plots treated with glyphosate at 2 pounds and simazine at 2 pounds of active ingredient per acre had the crownvetch, common blue violets, yellow woodsorrel, dandelion (Taraxacum officinale Weber) and Virginia creeper (Parthenocissus quinquefolia Planch) plants eliminated (Table 3). The populations of orchardgrass, quackgrass, and creeping buttercup were greatly reduced. There were some white cockle, shepardspurse and yellow rocket plants present.

Orchardgrass, common blue violets, yellow woodsorrel, dandelion, Virginia creeper and wild carrot (Daucus carota L.) plants were eliminated by the sprays of glyphosate at 2 pounds and DPX-3674 at 2 pounds of active ingredient per acre (Table 4). The number of creeping buttercup and quackgrass plants were greatly reduced. There were a number of wild garlic and some curly dock plants in these plots.

Tolerance of the mature narrowleaf evergreen plants to directed sprays of glyphosate and selected preemergent herbicides was good. Very little injury differences was noted in the Ware's arborvitae and Savin juniper plants before and after treatment. There was a slight increase in the amount of injury on the goldplume falsecypress plants when treated with DPX-3674 at 2 pounds of active ingredient per acre.

Elimination of existing growing weeds can be obtained by postemergent applications of glyphosate at 2 pounds per acre but the treated areas are soon filed with weeds from germinating seeds. The use of preemergent herbicides such as diuron, simazine and DPX-3674 in combination with glyphosate can result in quick elimination of existing annual and perennial weeds and retard the growth of germinating weed seeds for long term effective weed control with minimal injury to some mature narrowleaf evergreen varieties.

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POSTEMERGENCE HERBICIDES ON THE BARK AND BASAL SPROUTS OF SHADE TREES

J. F. Ahrens[1]

ABSTRACT

Paraquat (1,1'-dimethyl-4,4'-bipyridinium ion), dinoseb (2-sec-butyl-4,6-dinitrophenol), cacodylic acid (hydroxydimethylarsine oxide) and glyphosate /N-(phosphonomethyl)glycine/ were applied in water on the lower trunk and basal sprouts of eight newly planted deciduous trees as one-year whips. The trees included Acer platanoides 'Superform' and 'Crimson King', Gleditsia triacanthos inermis 'Sunburst' and 'Imperial', Platanus orientalis, Sorbus aucuparia, Quercus palustris and Tilia cordata 'Greenspire'.

Paraquat at 2 or 4 lb/100 gal and dinoseb at 12 or 24 lb/100 gal killed the basal sprouts of Acer and Gleditsia without direct injury to crowns. However, both concentrations of paraquat severely injured the bark of Gleditsia 'Sunburst' and the higher concentration injured the bark of G. 'Imperial'. Both concentrations of dinoseb injured the bark of Tilia.

Glyphosate at 3 and 6 lb/100 gal and cacodylic acid at 9.9 and 19.8 lb/100 gal killed most basal sprouts on which they were applied without injury to the bark of any cultivar. Glyphosate at 6 lb/100 gal caused slight injury to the crown of Acer 'Superform', and severe injury to one Platanus that had many basal sprouts and a small crown. Cacodylic acid injured the crowns of all trees (Acer and Gleditsia) that had basal sprouts at treatment, but did not injure those without basal sprouts.

INTRODUCTION

Herbicides that are used to control established weeds in woody plants frequently contact the trunk and basal sprouts. Therefore, it is important to know the tolerance of various tree species to applications on the bark and basal foliage. Paraquat, a standard postemergence herbicide for woody plants, often injures immature or "green" bark, resulting in partial or complete girdling of the plant. Dinoseb, however, is presumed safe on the bark of most woody plants. Less is known about the effects of cacodylic acid on the bark and basal sprouts of young shade trees. Earlier we observed injury to the crown of established dogwood (Cornus florida) from sprays of cacodylic acid on basal sprouts (3).

Putnam (6) reported that applications of glyphosate on the lower trunk and suckers of apple, pear, and sour cherry did not injure the bark or the crown, but similar applications on newly planted peach trees severely injured the crown and split the bark. During a 4-year period, we observed no crown injury from glyphosate on the lower bark and suckers of established apple trees. Lord (5) reported injury from glyphosate on the current season's growth of apple trees and on one-year-old wood of dormant clonal rootstocks. Curtis (4)

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reported that glyphosate injured apple trees when applied to fresh pruning wounds, but not when applied to pruning wounds that were two weeks old. Ahrens (1) also reported localized injury to junipers, yews, and pine from applications of glyphosate on pruning wounds.

The purpose of this work was to determine the tolerance of several newly planted deciduous shade trees to high dosages of paraquat, dinoseb, cacodylic acid and glyphosate applied on the lower trunk and on any basal sprouts that were present.

MATERIALS AND METHODS

Trees growing in a commercial nursery in Bloomfield, Connecticut, were used for these tests (Table 1). The one-year-old whips were transplanted into the sandy loam soil during the week of April 12, 1976. A broadcast application of simazine /2-chloro-4,6-bis(ethylamino)-s-triazine/ at 1 lb/A plus DCPA (dimethyl tetrachloroterephthalate) at 10 lb/A was made in late April as in standard nursery practice.

On June 16, 1976, four herbicides were sprayed to runoff on the lower 18 inches of bark and basal sprouts of the eight cultivars described in Table 1. The treatments were applied with a knapsack sprayer on three trees of each cultivar. The air temperature was 92°F at application and rain fell 12 hours later. Injury to the bark, sucker sprouts, and to the crown (upper leaves) was evaluated at 1, 3, 7 and 14 weeks after spraying.

The herbicides and their dosages in lb/100 gal or g/L included: cacodylic acid (PHYTAR 560) at 9.9 lb/100 gal (11.9 g/L) and 19.8 lb/100 gal (23.8 g/L), dinoseb (PREMERGE) at 12 lb/100 gal (14.4 g/L) and 24 lb/100 gal (28.8 g/L), glyphosate (ROUNDUP) at 3 lb/100 gal (3.6 g/L) and 6 lb/100 gal (7.2 g/L), and paraquat (PARAQUAT CL) at 2 lb/100 gal (2.4 g/L) and 4 lb/100 gal (4.8 g/L). Dosages of glyphosate are given in terms of acid equivalent. Dosages of the others are given in terms of active ingredient.

RESULTS AND DISCUSSION

Paraquat at 2 or 4 lb/100 gal killed the leaves of all basal sprouts within 3 weeks, but did not affect the upper leaves until late in the season and then only in those honeylocusts (*Gleditsia* sp.) that showed bark injury. Bark injury was caused by paraquat only on the honeylocusts and was most severe on 'Sunburst', which were almost completely girdled. Within 14 weeks these trees showed reduced top growth and had resprouted vigorously at the soil line. In the 'Imperial' honeylocusts, localized necrosis of bark occurred at the base of the treated sprouts and one of the three trees sprayed with 4 lb/100 gal developed patches of necrotic bark after 7 weeks. Although the pin oaks (*Quercus palustris*), London planetrees (*Platanus orientalis*), and 'Greenspire' lindens (*Tilia cordata*) also had green bark or green tinged bark, they were not affected by paraquat.

Dinoseb killed the basal sprouts of the maples (*Acer* sp.) and the honeylocusts within 1 week, but caused no crown or bark injury except to 'Greenspire' linden. At 7 weeks after treatment the bark of the lindens was rust colored and corky in the areas sprayed with dinoseb. The external corky bark rubbed off when touched. At 14 weeks the injury was severe at both dosages. Scraping the bark revealed green tissues beneath, and the crowns appeared healthy. Although this bark injury on the lindens appeared to be superficial, these trees will be observed during 1977 to determine the full extent of the damage.

Within a week after application, cacodylic acid at 9.9 or 19.8 lb/100 gal on the basal sprouts of the honeylocusts and maples caused leaf necrosis on branch tips 2 to 4 ft above sprayed areas. After 7 weeks, the injured leaves in the crowns of honeylocusts and maples had fallen off and dead shoot tips were evident at the higher dosage. About 10 percent of the foliage in the crowns was affected. Trees without basal foliage at the time of treatment with cacodylic acid were not injured.

Glyphosate at 3 or 6 lb/100 gal killed the basal sprouts of the honeylocusts and 'Crimson King' maples within 3 weeks, but at 3 lb/100 gal caused only 30 to 50 percent necrosis on basal sprouts of 'Superform' maples and London planetrees. Injury to the crowns from sprays on basal foliage developed only at the higher dosage on 'Superform' maples and on one of three planes. Crown injury on the 'Superform' maples appeared as necrosis of leaf tips on isolated branches. After 7 weeks, this injury was no longer evident and the trees appeared to be healthy.

The planetree that was injured by glyphosate had a small crown and basal sprouts that constituted about 40 percent of the foliage of the tree. Injury to the crown was severe with necrosis on most leaves within 3 weeks, and dwarfing of leaves and crown at 7 and 14 weeks. No evidence of crown injury from glyphosate occurred on any of the other trees, including the honeylocusts and 'Crimson King' maples, which also had basal sprouts at the time of treatment. No injury to the bark or effects on plant vigor were observed on these trees.

Paraquat and dinoseb are contact herbicides not easily translocated in plant tissues. Both killed basal sprouts of trees but did not appear to move to crowns. The sensitivity to paraquat of certain green-barked trees such as the honeylocusts was confirmed in this test. Dinoseb also appears to be potentially injurious to the bark of linden.

Cacodylic acid apparently moves readily from basal sprouts to crowns, with potentially severe effects. Root or bark uptake of cacodylic acid might be involved, except that only trees with basal sprouts showed injury to crowns. Clearly, basal sprouts should be removed from trees before sprays of cacodylic acid are applied at high dosages.

Glyphosate is known to be translocated. Based on our observations in this and other studies in woody plants, injury to crowns from basal applications occurs, a) when the treated basal foliage constitutes a large portion of the foliage of the tree, or b) at high rates of application. No apparent movement from basal sprouts to crowns occurred at 3 lb/100 gal, a rate higher than is required for control of perennial weeds. We did not observe on these ornamental species the bark injury reported with glyphosate in peaches (6).

Observations during a second season will be needed to evaluate long term effects of these herbicides on the trees.

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Table 1. Species, sizes, bark color, and the presence of basal sprouts on one-year-old whips of deciduous trees receiving herbicide applications on the lower bark on June 16, 1976.

Species name	Stem diameter at 1 ft, inches	Height, feet	Color of bark	Presence of sprouts on lower 18 inches
Acer platanoides 'Superform' 1/	3/8-½	6-8	brown	several
Acer platanoides 'Crimson King' 1/	3/8-½	8-9	brown	several
Gleditsia triacanthos inermis 'Imperial' 1/	3/8-3/4	6-8	green	several
Gleditsia triacanthos-inermis 'Sunburst' 1/	3/8-3/4	6-8	green	several
Platanus orientalis 2/	½-3/4	6-9	green tinge	few, variable
Sorbus aucuparia 3/	3/4-1	8-9	brown	none
Quercus palustris 3/	½-3/4	9-10	green	none
Tilia cordata 'Greenspire' 1/	½-3/4	5-6	green tinge	none

1/ Grafted in 1974, grown in 1975, and dug in the fall.

2/ Cuttings cut back in 1974, grown in 1975, and dug in the fall.

3/ Seedlings cut back in 1974, grown in 1975, and dug in the fall.

CONTROL OF SMOOTH CRABGRASS IN KENTUCKY BLUEGRASS AND RED FESCUE USING PRE- AND POSTEMERGENCE HERBICIDES

T. L. Watschke, D. J. Wehner, and J. M. Duich[1/]

ABSTRACT. Nine herbicides were evaluated for pre- and postemergence control of crabgrass, *Digitaria ischaemum* (Schreb.) Schreb. ex Muhl. in Kentucky bluegrass (*Poa pratensis* L.) and creeping red fescue (*Festuca rubra* L.). Preemergence materials used were DCPA (dimethyl tetrachloroterephthalate) 5G (16/30 and 24/48 mesh), 75W, and 6F; butralin [4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2, 6-dinitrobenzenamine] 2.3G and 2.0G; prosulfalin (N-[[4-(dipropylamino)-3,5-dinitrophenyl]sulfonyl]-S,S-dimethylsulfilimine) 50W; HOE-22870 (undisclosed) 2.5G; bensulide (O,O-diisopropylphosphorodithioate S-ester with N-(2-mercaptoethyl)benzenesulfonamide) 3.6G; benefin (N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine) 2.5G; and AC-92390 (N-Sec-Butyl-2,6-dinitro-3,4-xylidine) 2.5G. Chemicals which gave acceptable control (above 85%) of crabgrass in both turf species were DCPA (all formulations), prosulfalin, butralin (both formulations), bensulide, and siduron. The high rates of HOE-22870, benefin, and AC-92390 gave acceptable control in red fescue. Moderate injury was found on red fescue treated with DCPA (all formulations) and the high rates of butralin (2.3G) and benefin. Postemergence materials used were DSMA (disodium methanearsonate) 2.9G and HOE-22870 2.5G. The best postemergence control resulted from applications of DSMA, however, control from either material was not comparable to that obtained with preemergence materials. The high rate of HOE-22870 injured bluegrass severely.

INTRODUCTION

Experimental herbicides undergo extensive testing to determine their efficacy in a given crop-weed situation. Crabgrass is a problem in home lawns and other intensively managed turf areas. The professional turf manager is interested in new preemergence herbicides which are safer, have more flexability, and are economically comparable to available materials. The nonprofessional often requires an herbicide which would provide good postemergence crabgrass control.

The purpose of this study was to compare the pre- and postemergence crabgrass control and turf phytotoxicity of four experimental herbicides with five commercially available materials. Several of these herbicides have been evaluated previously (2, 3) and in other locations (1).

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MATERIALS AND METHODS

This research was conducted at the Joseph Valentine Turfgrass Research Center, the Pennsylvania State University. Ten-year-old stands of Kentucky bluegrass and creeping red fescue were treated with nine herbicides for crabgrass control. Turf was maintained at a 3.2 cm height of cut and received 760 kg/ha of a 16-8-8 on June 29. Supplemental irrigation was applied at time of fertilization. Small crabgrass, Digitaria ischaemum (Schreb.) Schreb. ex Muhl. was plentiful from natural reseeding and provided 95 percent cover in untreated plots.

Preemergence materials were applied to two replications of each turf species on April 20 except for DCPA 5G (16/30 mesh) which was applied on May 11. Postemergence materials were applied on July 7 with reapplication on July 26. Spray materials were applied to 0.9 x 7.3 m plots with a hand held boom calibrated to deliver 76 L/ha. Granular formulations were applied to 1.2 x 1.8 m plots with a shaker bottle. All plots were bordered on two sides by an untreated check strip.

Commercial materials used were DCPA 5G (16/30 and 24/48 mesh), 75W, and 6F; siduron 50W; DSMA 2.9G; bensulide 3.6G; and benefin 2.5G. The experimental materials used were prosulfalin 50W; HOE-22870 2.5G; butralin 2.0G and 2.3G; and AC-92390 2.5G. Application rates appear in Table 1. Crabgrass control and injury were rated on August 23.

RESULTS AND DISCUSSION

Using 85% control as a standard, all commercially available materials except benefin gave acceptable crabgrass control in both turf species. Benefin at the high rate controlled crabgrass in red fescue but caused unacceptable injury. Thinning of fescue also occurred from applications of DCPA. Similar results have been previously reported for these materials (1, 2, 3).

Two of the four experimental materials, prosulfalin and butralin, gave crabgrass control comparable to DCPA in both turf species. There was slightly more injury to red fescue with butralin compared to previous years (2, 3). There was little difference in control between the two formulations used. HOE-22870 and AC-92390 at the high rates provided acceptable control of crabgrass in red fescue.

DSMA gave better postemergence control of crabgrass than HOE-22870. However, control from both material was inferior to that obtained from preemergence materials. The high rate (4.48 + 4.48 kg/ha) of HOE-22870 caused severe discoloration of Kentucky bluegrass.

Table 1. Evaluation of pre- and postemergence herbicides for crabgrass control and injury to Kentucky bluegrass and creeping red fescue. Preemergence herbicides applied April 20, 1976. Postemergence herbicides applied July 7 and July 26, 1976.

Treatment	Formulation	kg a.i./ha	% Crabgrass Control KBG	% Crabgrass Control CRF	% Injury* KBG	% Injury* CRF
Preemergence						
DCPA	75W	11.2	97	98	3	13
DCPA	6F	11.2	99	99	0	10
DCPA	5G(24/48)	11.2	93	89	0	11
DCPA	5G(16/30)	11.2	87	90	3	6
Prosulfalin	50W	2.8	93	94	3	0
Siduron	50W	13.44	90	87	0	0
Butralin	2.3G	4.48	87	89	0	9
Butralin	2.3G	6.72	98	98	0	12
Butralin	2.0G	4.48	86	91	3	0
Butralin	2.0G	6.72	95	94	7	7
Bensulide	3.6G	11.2	90	90	0	0
Bensulide	3.6G	13.44	94	97	3	0
Bensulide	3.6G	16.8	98	98	0	0
Benefin	2.5G	2.24	67	77	5	5
Benefin	2.5G	3.36	77	90	3	12
AC 92390	2.5G	3.92	82	85	3	5
AC 92390	2.5G	4.48	83	95	5	0
HOE-22870	2.5G	4.48	77	77	0	0
HOE-22870	2.5G	6.72	82	90	3	0
Postemergence						
HOE-22870	2.5G	(4.48 + 2.24)	10	45	0	5
HOE-22870	2.5G	(4.48 + 4.48)	23	55	30	0
DSMA	2.9G	(4.48 + 4.48)	65	67	0	0

*Injury refers to discoloration and/or thinning.

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CRABGRASS CONTROL AND CHANGES IN STAND OF THE TURF SPECIES

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ABSTRACT

Plots established in a 10-year-old turf in 1974 were preemergently treated for three successive years for control of crabgrass (Digitaria spp.). Turf was predominantly red fescue (Festuca rubra L.) with a little Kentucky bluegrass (Poa pratensis L.). Seven herbicidal treatments controlled crabgrass adequately over the 3-year period. Average stands of crabgrass were 6% or less in late summer. These included benefin (N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine), bensulide [O,O-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl)benzenesulfonamide], butralin (4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine), DCPA (dimethyl tetrachloroterephthalate), profluralin [N-cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine], and prosulfalin [N-[[4-(dipropylamino)-3,5-dinitrophenyl]sulfonyl]-S,S-dimethylsulfilimine] at one or more rates of treatment. Siduron [1-2-methylcyclohexyl)-3-phenylurea] treatments performed less satisfactorily. They averaged about 20% stand of crabgrass. Stands of turfgrasses appeared to be somewhat thinner and/or slight discoloration was noted in some years within a month after treatment with bensulide, butralin, and profluralin. The proportionate stands of the turfgrass species was greatly changed by treatments. By September of the third year, Kentucky bluegrass had increased from 3% in the check plots to 30 to 45% in plots treated with benefin, butralin, DCPA and profluralin. A trend toward increases in Kentucky bluegrass in other treatments was observed, but it was not statistically significant.

INTRODUCTION

Herbicides that adequately controlled crabgrass in turf were introduced in the early 1960's (4,5) and many additional herbicides for use in turf have been introduced since. This experiment began in 1974 on an old established turf, predominately red fescue with some Kentucky bluegrass was treated with herbicides for 3 years. The treatments were repeated in the same plots each year. Detailed notes were not taken on turf vegetative composition in the first and second years but were taken at the end of the third season. This paper provides data on the relative performance of old and new herbicides used for crabgrass control for 3 years of the experiment and on the effects of these herbicides on the vegetative composition of turf composed of two important turf species growing in an association.

MATERIALS and METHODS

Plots, 2 by 5 m in three randomized blocks, were established in a 10-year-old turf that was mostly red fescue with a small amount of bluegrass. The turf

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had been maintained at a low level of fertility for the previous 8 years. The soil was Codorus silt loam with 4.8% organic matter and a pH of 6.1. Before treatment each year, plots were vertically mowed and excess grass residues removed. Seed of large crabgrass (Digitaria sanguinalis L.) was uniformly broadcast on April 29, 1974 (62 kg/ha), April 9, 1975 (40 kg/ha), and April 8, 1976 (20 kg/ha). In 1974, plots were mowed at 5 cm height, thereafter mowing was at 2.5 cm height. Plots were supplementally irrigated when no rain fell within one week of herbicide treatment and thereafter when no rain fell for long periods. Medium fertility was maintained by application of 0.5 kg/are of N as needed (2 to 2.5 kg/are annually). Phosphorus and potassium were added on the basis of soil test results. Granular herbicides were applied by mechanical spreader. Wettable powder and emulsifiable concentrate herbicide formulations were applied in aqueous carrier at 346 l/ha in 1974 and at 252 l/ha in 1975 and 1976. Most herbicide treatments (Table 1) were repeated annually in the same plots for 3 successive years. Periodically, the relative stands of crabgrass were estimated visually and thinning or discoloration of turf species were noted. We estimated relative percentage of Kentucky bluegrass and red fescue in the turf on September 13, 1976.

RESULTS and DISCUSSION

Crabgrass control was acceptable with all herbicides applied for 3 years, with the exception of siduron (Table 1). Percentage stands of crabgrass in plots treated with these herbicides other than siduron did not differ significantly and averaged 6% or less. Siduron plots averaged about 20% crabgrass, which was significantly higher than plots treated with other herbicides but significantly lower than in the check plots. Siduron is the only herbicide that can be safely used for selective crabgrass control on new seedings of many turf species.

Within a month or two after treatment, three of the herbicides visibly injured the turf (Tables 2, 3). Turf in profluralin- and butralin-treated plots was slightly discolored and stands appeared less dense. Bensulide did not cause discoloration but caused thinner stand appearance. Effects of other herbicides on appearance of turf were not evident.

Because red fescue and Kentucky bluegrass responded differently to some herbicides, an estimate of the relative stand composition of these turf species in the plots was made September 13, 1976. Relative stand compositions were significantly different from the check in plots treated with profluralin, DCPA, butralin, and benefin (Table 3). Profluralin and butralin treatments significantly increased the percentage of Kentucky bluegrass and decreased the percentage of red fescue. These shifts were not always related to visible injury soon after treatments were applied. DCPA and benefin caused similar shifts in stand composition but did not cause significant visible injury symptoms following treatment (Table 2). Bensulide caused significant injury symptoms following treatment (Table 2) but the shift toward Kentucky bluegrass was moderate and significantly lower than that of DCPA (Table 3). This may indicate that DCPA had less suppressive effect on Kentucky bluegrass than bensulide. In plots on which the other herbicides were used, Kentucky bluegrass tended to increase even though the changes in stand composition were insignificant.

Our results agree with those of Jagschitz (2) who found a reduction in red fescue and an increase in Kentucky bluegrass on plots treated with DCPA. Gaskings (1) found that treatment with DCPA reduced tiller and rhizome production of Kentucky bluegrass, and Juska and Hovin (3) found that treatment of soil with benefin, bensulide, and DCPA reduced rhizome yields of 'Newport' Kentucky bluegrass seedlings. Gaskings (1) observed that such injury explained the thinning of turf observed by other workers.

Significant differences in vegetative composition were more readily observed in this experiment than in the usual lawn situation because of the initial predominance of red fescue with only a little Kentucky bluegrass. Since red fescue was more susceptible to injury by some herbicides, the significant effects from treatment were easily assessed. In this case, repeated treatments for 3 years resulted in partial replacement of red fescue with Kentucky bluegrass; an increase of Kentucky bluegrass from 3% in the check to 45% in the profluralin plots. Small bare areas in the plots were caused by treatment injury to the red fescue. If there had been no Kentucky bluegrass component originally, the red fescue would probably have spread back into these areas and a full stand of red fescue would have been maintained throughout the experiment. This did not happen because Kentucky bluegrass tended to fill in the bare spaces resulting from injury faster than the red fescue and was able to maintain stands in space so occupied. The small gains made each year by Kentucky bluegrass tended to be additive.

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Table 1. Percentage stand of crabgrass in a red fescue and Kentucky blue-grass turf treated with preemergence herbicides, 1974-76[1/].

Herbicide	Rate (kg/ha)	Crabgrass, % Stand 8/12/74	9/9/75	8/10/76	3-Year Ave.[2/]
profluralin, 2% gran.	2.2	1	1	2	1 a
DCPA, 75% W.P.	11.2	<1	6	1	3 ab
butralin, 2.5% gran.	4.5	0	9	4	4 ab
benefin, 2.5% gran.	2.2	5	11	3	6 ab
prosulfalin, 50% W.P.	2.2	6	9	4	6 b
prosulfalin, 50% W.P.	3.4	0	6	1	2 ab
prosulfain, 50% W.P.	2.2 + 2.2			<1	
bensulide, 6.2% gran.	11.4	0	1	1	2 ab
NTN 6867, EC (2.5 lb/gal)[3/]	4.5		28	18	
siduron, 50% W.P.	11.2		17	11	
siduron, 4.7% gran.	11.2	11	30	22	21 e
siduron, 4.7% gran.	11.2 + 11.2	11	27	18	18 e
AC 92390, gran.[3/]	2.2	6	11		
check		97	88	85	90 f
SE of mean		1.9	4.0	2.6	1.7

1/ Treatments were applied April 26, 1974, April 17, 1975, April 8, 1976 (the second treatment of repeated treatments - 2.2 + 2.2 and 11.2 + 11.2 - were made on June 4, 1974, May 24, 1975, and June 4, 1976). Treatments for 2 or more years were made in the same plots each year. Herbicide formulations used were wettable powders (W.P.), granular (gran.) and emulsifiable concentrates (EC). Where data are not shown, no treatment was made in that year.

2/ Data followed by the same letter are not significantly different at 5% level by Duncan's multiple range test.

3/ NTN 6867 [*O*-methyl *O*-(4-methyl-2-nitrophenyl)(1-methylethyl)phosphor=amidothioate]; AC 92390 (*N*-*sec*-butyl-2,6-dinitro-3,4-xylidine).

Table 2. Visual appearance ratings of a red fescue and Kentucky bluegrass turf in early summer after preemergence treatments with herbicides in 1974 and 1975[1/].

Herbicide	Rate (kg/ha)	Turf Appearance Rating[2/] 6/10/74	6/30/75	Average
profluralin, 2% gran.	2.2	90 b	77 c	83 c
DCPA, 75% W.P.	11.2	98 a	99 a	98 a
butralin, 2.5% gran.	4.5	78 c	95 ab	86 c
benefin, 2.5% gran.	2.2	98 a	99 a	98 a
prosulfalin, 50% W.P.	2.2	98 a	100 a	99 a
prosulfalin, 50% W.P.	3.4	100 a	99 a	99 a
bensulide, 6.2% gran.	11.2	95 a	94 b	94 b
NTN 6867, EC (2.5 lb/gal)	4		100 a	
siduron, 50% W.P.	11.2		99 a	
siduron, 4.7% gran.	11.2	98 a	100 a	99 a
siduron, 4.7% gran.	11.2 + 11.2	100 a	100 a	100 a
check			99 a	99 a

1/ Treatments were applied April 26, 1974 and April 17, 1975 (the second treatment of repeated treatments -11.2 + 11.2 - were made on June 4, 1974 and May 24, 1975. Herbicidal formulations used were wettable powders (W.P.), granulars (gran.), and emulsifiable concentrates (EC). Where data are not shown, treatments were not made in that year.

2/ Scale 0-100; 100 = no visible effect. Scores were based on visual estimates of discoloration of turf and thinness of the stand. Red fescue was injured more than Kentucky bluegrass by most treatments. Data followed by the same letter are not significantly different at 5% level by Duncan's multiple range test.

Table 3. Percent Kentucky bluegrass in a red fescue-Kentucky bluegrass turf as affected by herbicidal treatments for crabgrass control for 3 years[1/].

Herbicide	Rate (kg/ha)	Percent Kentucky bluegrass in mixed turf[2/]
profluralin, 2% gran.	2.2	45 d
DCPA, 75% W.P.	11.2	38 cd
butralin, 2% gran.	4.5	37 cd
benefin, 2.5% gran.	2.2	30 bcd
prosulfalin, 50% W.P.	2.2	18 abc
prosulfalin, 50% W.P.	3.4	17 abc
prosulfalin, 50% W.P.	2.2 + 2.2[3/]	18 abc
bensulide, 6.2% gran.	11.4	13 ab
NTN 6867 EC, 2.5 lb/gal.	4.5[3/]	13 ab
siduron, 50% W.P.	11.2[3/]	12 ab
siduron, 4.7% gran.	11.2	7 ab
siduron, 4.7% gran.	11.2 + 11.2	7 ab
Check		3 a

1/ Treatments were applied April 26, 1974, April 17, 1975, and April 8, 1976. Herbicidal formulations were wettable powders (W.P.), granulars (gran.), and emulsifiable concentrates (EC). The second treatments of repeated treatments - 2.2 + 2.2 and 11.2 + 11.2 - were applied June 4, 1974 and May 24, 1975. Species composition notes were taken September 3, 1976.

2/ The proportion of Kentucky bluegrass and red fescue turf species in the turf of the check was 3 and 97% respectively. Numerical values shown are those for Kentucky bluegrass. To obtain corresponding values for red fescue subtract the numbers in this column from 100%. Data followed by the same letter are not significantly different at 5% level by Duncan's multiple range test.

3/ Siduron treatment was applied in 1975 and 1976, in 1974 no treatment was applied to these plots; NTN 6867 was applied in 1975 and 1976 and in 1974 profluralin (GA-2-638 gran.) was applied at 2.2 kg/ha; and the prosulfalin treatment was applied in 1976, and in 1974 and 1975 AC 92390 was applied at 2.2 kg/ha.

TOLERANCE OF NUTSEDGE, CRABGRASS AND TURFGRASSES TO POSTEMERGENCE HERBICIDES[1]

John A. Jagschitz[2]

ABSTRACT

Postemergence herbicides and application methods were evaluated on several turfgrass species and two weeds in 1976. Selective control of smooth crabgrass {Digitaria ischaemum (Schreb.) Muhl.} was obtained with DSMA (disodium methanearsonate), MSMA (monoammonium methanearsonate), and HOE-22870 (unknown) while results with M-4212 (unknown, DOWCO 356) appear limited because of grass injury. Promising results for nutsedge (Cyperus esculentus L.) control were provided by certain treatments of bentazon {3-isopropyl-1H-2,1,3-benzothiadiazin-(4) 3H-one 2,2-dioxide}, cyperquat (1-methyl-4-phenylpyridinium), DSMA, and perfluidone {1,1,1-trifluoro-N-{2-methyl-4-(phenylsulfonyl)phenyl} methanesulfonamide}. Nutsedge control was easier to achieve with midsummer rather than late spring treatment. Comparable nutsedge control and Kentucky bluegrass (Poa pratensis L.) tolerance was obtained with sprayer and hose proportioner. Mowing had little effect on nutsedge control. Mowing one hour before spraying resulted in greater injury to Kentucky bluegrass compared to mowing one hour after treatment. Increasing the spray volume of DSMA reduced bluegrass injury. 'Merion' Kentucky bluegrass, 'Jamestown' red fescue (Festuca rubra L.), 'Exeter' colonial bentgrass (Agrostis tenuis Sibth.), and 'Penncross' creeping bentgrass (Agrostis palustris Huds.) were all tolerant to bentazon. Bluegrass and fescue were more tolerant than other grasses to cyperquat and HOE-22870 while with DSMA, Kentucky bluegrass was the most tolerant. 'Manhattan' perennial ryegrass (Lolium perenne L.) showed little tolerance to HOE-22870.

INTRODUCTION

Crabgrass and nutsedge are two troublesome weeds in turfgrass areas. Recent research has shown that there are promising herbicides for selective postemergence control of crabgrass and nutsedge (1,2,3,4,5). To further evaluate these chemicals and several newer herbicides, three crabgrass tests, three nutsedge tests, and four grass tolerance tests were conducted during 1976. Also in some of these tests the following factors were studied: (1) dates and number of treatments, (2) spray gallonage, (3) formulations, (4) mowing before and after treatment, and (5) sprayer versus hose-proportioner.

MATERIALS AND METHODS

Three crabgrass studies were conducted at the Rhode Island Agricultural Experiment Station. They were on established lawn areas at least two years old and maintained at a cutting height of 1.5 inches. One area contained

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Kentucky bluegrass, another red fescue and the third perennial ryegrass. Treatments were started in the bluegrass and fescue areas on July 19, and crabgrass was readily visible with some plants starting to tiller. Treatments were started in the ryegrass area on August 2, and the crabgrass plants were larger and had several tillers. The herbicides, rates, dates of application, spray gallonage, and other details are shown in Tables 1 and 2. Plot size was 4 by 4 feet with three replications. Visual estimates of grass injury were made following treatment on a scale of 0 to 10, with 0 no injury and 10 as brown or dead turf. A reading of 2.0 could be considered objectionable. Percent crabgrass control was determined by comparing initial and final estimates of crabgrass cover.

The three nutsedge studies were conducted at a local sod farm (Tuckahoe Turf Farms, Slocum, R.I.). Two were on Kentucky bluegrass (1.5 inch height), and the third on 'Penncross' creeping bentgrass (.375 inch height). Both grasses were in their second season of growth. The herbicides, rates, dates of application, gallonage and other details are shown in Tables 3, 4 and 5. Plot size for treatments in Table 3, Table 4 and the sprayer test portion of Table 5 was at least 4 by 4 feet and replicated three times. Plot size for treatments in the hose-proportioner test portion of Table 5 was 3 by 10 feet and replicated two times. Visual estimates of grass injury were made through September using the scale of 0 to 10 as described above. Nutsedge plant counts were made in August in a minimum area of 13 square feet for each plot. Percent control was determined by comparing treated to untreated plots. The turfgrass tolerance test was initiated on four grasses at the Experiment Station in August. The grass areas were several years old and were maintained at various mowing heights. The grasses and heights were: 'Merion' Kentucky bluegrass (1.5 inches), 'Jamestown' red fescue (1.5 inches), 'Exeter' colonial bentgrass (.75 inches) and 'Penncross' creeping bentgrass (.25 inches). Herbicides were applied to plots measuring 4 by 4 feet with three replications. Visual estimates of grass injury were made periodically on a scale of 0 to 10 as described previously.

RESULTS AND DISCUSSION

Crabgrass Control

The results with herbicides applied in July on young crabgrass in Kentucky bluegrass and red fescue areas are presented in Table 1. Excellent control (90-100%) with slight grass injury (less than 2.0) was obtained with two applications of MSMA at the 1.5 lb rate at a seven-day interval. Two applications of DSMA at the 3 lb rate gave effective results in bluegrass while in fescue it caused temporary objectionable injury (2.0 or greater). Both MSMA and DSMA usually caused more injury at higher rates, more injury from three applications compared to two, and more injury to fescue than bluegrass. Excellent control of young crabgrass without objectionable injury to bluegrass or fescue was provided by a single application of HOE-22870 at 8 lb or by two applications (7-day interval) at 4 lb. Results were similar with or without the use of a wetting agent or when sprayed at 50 or 174 gpa. M-4212 provided effective crabgrass control, but caused objectionable grass injury. Kentucky bluegrass was more tolerant of M-4212 than red fescue.

Table 1. Turfgrass Injury and Crabgrass Control from Herbicides Applied in 1976 to Kentucky Bluegrass and Red Fescue.

Herbicide	Rate lb ai/A 7/19	7/26	8/2	Turfgrass Injury[a] Kentucky bluegrass 7/19 to 8/12	8/26	Red fescue 7/19 to 8/12	8/26	% Crabgrass Control[b] Kentucky bluegrass	red fescue
DSMA	3	3	0	1.9	1.0	2.3	1.1	99	99
" "	3	3	3	1.8	1.1	2.5	2.0	100	100
" "	4	4	0	2.5	1.6	3.2	1.8	99	99
" "	4	4	4	2.9	1.6	3.3	3.0	99	100
MSMA	1.5	1.5	0	1.6	.6	1.4	.8	99	99
" "	2	2	0	2.1	.9	3.0	1.6	100	100
M-4212[c]	.5	.5	0	1.1	.1	1.6	1.2	45	41
" "[c]	1	1	0	1.1	1.2	3.4	3.5	71	71
" "[c]	2	2	0	2.6	3.0	3.3	3.5	92	90
HOE-22870[c]	2	0	0	.0	.0	.3	.0	26	18
" " " "[c]	4	0	0	.6	.7	.3	.3	63	71
" " " "[c]	8	0	0	1.3	1.1	1.6	.6	96	92
HOE-22870	2	0	0	.0	.0	.2	.1	14	24
" " " "	4	0	0	.8	.2	.3	.3	70	55
" " " "	6	0	0	.3	.1	.7	.4	79	83
" " " "	8	0	0	.9	.8	.7	.2	93	93
" " " "	4	4	0	1.2	1.2	.9	.6	95	96
HOE-22870[d]	4	0	0	.2	.2	.9	.7	62	61
" " " "[d]	6	0	0	.8	.5	1.2	.8	78	77
" " " "[d]	8	0	0	.6	.6	.9	.4	89	84
" " " "[d]	4	4	0	.1	.8	1.2	1.0	92	89

[a]scale 0-10 (10=brown)

[b]control August 26, crabgrass cover in bluegrass 82%, fescue 61%

[c].1% wetting agent (X-77)

[d]50 gpa, other sprays at 174 gpa

Table 2. Crabgrass Control and Turfgrass Injury from Herbicides Applied in 1976 to a Lawn-Area Containing Predominately Perennial Ryegrass.

Herbicide[a]	lb ai/A 8/3	8/11	Turfgrass injury[b] 8/12	8/20	8/26	Percent crabgrass control[c]
DSMA	3	3	.5	1.0	1.5	99
DSMA	4	4	.9	.8	1.2	99
HOE-22870	6	0	1.4	2.9	3.9	54
HOE-22870	8	0	2.7	2.7	3.1	58
HOE-22870	16	0	4.0	4.3	4.5	91
HOE-22870	4	4	1.8	2.2	2.2	38
HOE-22870	6	6	2.3	5.7	6.0	86
HOE-22870	8	8	2.2	7.0	7.5	96

[a]50 gpa sprays

[b]scale 0-10 (10=brown)

[c]control August 26, crabgrass cover 76%

Results from treatments to older crabgrass in the 'Manhattan' perennial ryegrass area are presented in Table 2. The DSMA treatments were as effective as those on younger crabgrass in the earlier test. Injury to the ryegrass was not objectionable. Twice the amount of HOE-22870 was required to obtain comparable control as in the earlier test. Young crabgrass may be more susceptible to HOE-22870. Perennial ryegrass appears to have little tolerance to HOE-22870.

Nutsedge Control

The data from the three postemergence nutsedge tests are presented in Tables 3, 4, and 5. Nutsedge emergence began in early May, with maximum emergence by late May. Excellent nutsedge control with only slight injury to Kentucky bluegrass or 'Penncross' creeping bentgrass was provided by bentazon. Two spray applications in July at rates ranging from .5 to 1 lb were effective while treatments started in June required three applications at 1 lb for comparable control. Treatments started in late May were the least effective. This supports earlier research (4) which showed less herbicide and/or fewer applications were required for control as the season progressed from late spring to midsummer. The same trend was evident with cyperquat and DSMA. Results with the granular formulation (5% ai) of bentazon suggest it may be as effective as spray treatments.

Excellent results were obtained in Kentucky bluegrass with one or two applications of cyperquat in July at the 2 lb rate. Two applications starting in June provided effective control, but there was temporary objectionable injury. Excellent control, from June or July cyperquat treatments, was obtained in the 'Penncross' creeping bentgrass area, but injury was objectionable with the July treatment. Possibly one application in July would provide control without objectionable injury.

With DSMA in bluegrass, one application in July at the 4 lb rate provided effective results. Two applications applied in June or July gave excellent control, but bluegrass injury was objectionable in most cases. Effective control in the bentgrass area was coupled with objectionable injury.

Perfluidone applied at 4 lb in June or July or with two applications at 2 lb in June provided excellent control in the Kentucky bluegrass area with only slight injury. May treatments also provided excellent control, but injury was objectionable. A single 2 lb rate applied in July in the 'Penncross' creeping bentgrass area provided effective results.

The effect of mowing, spray volumes and sprayer versus hose proportioner on the effectiveness of bentazon, cyperquat and DSMA is presented in Table 5. Nutsedge control and Kentucky bluegrass injury was similar when using a sprayer or hose proportioner. Mowing one hour before herbicide treatment generally resulted in greater bluegrass injury while mowing one hour after treatment resulted in less injury. Mowing had little effect on nutsedge control. Increasing the spray volume from 2.5 to 5 and to 10 gallons per 1000 square feet decreased the degree of injury from DSMA without altering control. Nutsedge control from bentazon was slightly better at the two higher spray volumes.

Turfgrass Tolerance

Injury ratings with DSMA, HOE-22870, bentazon and cyperquat applied in August to 'Jamestown' red fescue, 'Exeter' colonial bentgrass, 'Penncross creep-

Table 3. Effect of Herbicides, Number of Treatments, and Treatment Dates on Nutsedge Control and Turfgrass Injury when Applied in 1976 to Kentucky Bluegrass.

Herbicide	lb ai/A	Number treat- ments[a]	Percent Nutsedge Control[b] (treatments started)			Maximum Turfgrass Injury[c] (treatments started)		
			May 24	June 22	July 16	May 24	June 22	July 16
Bentazon	.5	2	30	82	90	.6	.4	.1
"	.75	2	42	82	95	.3	.2	.1
"	1	1	--	--	62	--	--	.3
"	1	2	70	88	94	.1	.8	.8
"	1	3	71	96	98	.1	1.0	.6
Bentazon (gran)	2	3	--	96	95	--	.5	.0
Cyperquat	2	1	33	66	94	.3	.5	.9
"	2	2	63	90	99	.4	2.1	1.4
"	4	1	38	88	96	1.8	.8	1.4
DSMA	4	1	--	--	91	--	--	1.3
"	4	2	41	95	93	1.4	3.1	2.7
"	4	3	87	88	99	2.3	3.4	2.2
Perfluidone (wp)	2	2	100	99	--	2.9	.2	--
" "	4	1	99	98	100	3.2	.3	.1

[a]7 to 10 day interval between treatments, sprays at 50 gpa, granular applied by hand

[b]based on 7 to 8 nutsedge plants per sq. ft. in untreated plots (August 2 to 16)

[c]scale 0 to 10 (10=brown), maximum through September

Table 4. Nutsedge Control and Turfgrass Injury from Herbicide Treatments Starting on Two Dates in 1976 to Penncross Creeping Bentgrass.

Herbicide	Rate lb ai/A	Number[a] treat- ments	Percent nutsedge control[b] (treatments started)		Maximum turfgrass Injury[c] (treatments started)	
			June 3	July 9	June 3	July 9
Bentazon	1	2	69	96	.8	.8
Cyperquat	2	2	98	99	1.2	2.7
DSMA	4	2	70	95	1.5	3.5
Perfluidone (wp)	2	1	68	98	1.2	1.4

[a]7 to 8 day interval between treatments, sprays at 50 gpa

[b]based on 21 nutsedge plants per sq. ft. in untreated plots on August 4 for June treatments and on 4 plants per sq. ft. on August 23 for July treatments

[c]scale 0 to 10 (10=brown), maximum through September

Table 5. Effect of Mowing, Gallonage and Sprayer-type on Nutsedge Control and Turfgrass Injury from Herbicides Applied in 1976 to Kentucky Bluegrass.

Mowing at 1.5 inches relative to herbicide		Cyperquat 2 lb/A[a] water gal./1000 sq. ft.			Bentazon 1 lb/A[a] water gal./1000 sq. ft.			DSMA 4 lb/A[a] water gal./1000 sq. ft.		
before	after	2.5	5	10	2.5	5	10	2.5	5	10
		Percent nutsedge control[b]								
1 hour		97	98	97	87	94	95	97	95	99
	1 hour	96	99	99	87	94	92	98	95	95
	24 hours	98	100	98	85	96	88	96	95	94
	96 hours	99	99	97	88	91	95	98	94	97
	96 hours[c]	97	98	98	85	93	93	97	96	98
		Turfgrass injury[d]								
1 hour		1.0	2.3	1.6	.7	.8	.5	2.7	2.3	1.8
	1 hour	.2	.2	.9	.2	1.1	.2	1.3	1.2	.8
	24 hours	.4	1.2	1.2	.3	.5	.0	2.5	2.1	1.2
	96 hours	.5	1.1	.4	.1	.6	.2	2.1	1.2	1.4
	96 hours[c]	.7	1.0	.5	.1	.0	.0	2.1	1.9	1.1

[a]two applications - July 15 and 22

[b]based on 6.5 nutsedge plants per sq. ft. in untreated plots of hose proportioner test area and on 5.3 plants in sprayer test area on August 19

[c]CO_2 sprayer with single TeeTet nozzle, others using Ortho hose-proportioner

[d]scale 0 to 10 (10=brown), maximum through September

Table 6. Tolerance of Turfgrasses to Various Herbicides Applied as Sprays at 50 gpa in 1976.

Herbicide	lb ai/A		Turfgrass Injury[a]: Jamestown red fescue			Exeter colonial bentgrass			Penncross creeping bentgrass			Kentucky bluegrass		
	8/3	8/11	8/12	8/20	8/26	8/12	8/20	8/26	8/12	8/20	8/26	8/12	8/20	8/26
DSMA	3	3	1.2	3.3	3.7	-	-	-	-	-	-	.2	1.6	.5
" "	4	0	1.0	1.3	1.4	-	-	-	-	-	-	.5	.0	.5
" "	8	0	3.3	2.9	2.5	-	-	-	-	-	-	1.0	.2	.0
" "	4	4	1.3	3.8	3.7	.5	2.2	.8	2.1	2.5	1.3	1.2	2.3	1.8
" "	8	8	3.2	7.3	6.3	2.3	5.6	3.9	4.6	6.7	5.7	1.4	3.1	3.3
HOE-22870	4	4	1.2	1.1	.8	1.3	2.7	1.6	1.7	2.4	.6	.0	.0	.6
" " " "	6	6	1.3	.9	.4	-	-	-	-	-	-	.8	.1	.0
" " " "	8	0	.7	.8	.8	1.7	1.4	.0	1.5	1.8	1.6	.3	.0	.3
" " " "	8	8	.9	.9	1.2	2.5	4.4	3.5	3.3	4.8	3.3	1.0	1.4	1.4
" " " "	16	0	2.8	1.7	.8	3.1	3.3	1.5	3.7	3.6	3.0	1.2	.1	.0
Bentazon	1	1	.0	.3	.0	.0	.3	.0	.3	.1	.0	.3	.0	.3
" "	2	2	.2	.5	.3	1.4	.9	.1	1.4	.8	.3	.1	.0	.0
" "	4	4	1.0	1.8	1.0	2.6	1.4	.0	4.1	2.2	.3	.6	.5	1.4
Cyperquat	2	0	.5	.3	.0	.3	.0	.0	.4	.1	.0	.0	.0	.1
" "	2	2	.4	1.4	1.6	1.3	2.2	2.0	-	-	-	.2	.1	1.6
" "	4		.7	.8	.8	1.6	2.2	1.7	.9	.9	.6	.5	.0	.4
" "	4	4	.5	1.1	2.8	-	-	-	-	-	-	.8	1.9	3.3
" "	8	0	1.9	2.1	1.9	3.7	4.6	3.3	1.9	2.7	1.5	1.8	1.4	1.7

[a]scale 0-10 (10=brown)

ing bentgrass and 'Merion' Kentucky bluegrass are presented in Table 6. As observed in the earlier tests, Kentucky bluegrass was more tolerant to DSMA than fescue or the bentgrasses. The standard DSMA treatment of two applications at 4 lb caused temporary objectionable injury to the two bentgrass and Kentucky bluegrass while injury to fescue was more lasting. None of the four grasses could tolerate double the standard DSMA rate without showing considerable injury.

Results with the crabgrass test showed that bluegrass and fescue had good tolerance to HOE-22870 while 'Manhattan' perennial ryegrass had little tolerance. In this test at the standard rate of 8 lb or two applications at 4 lb both bluegrass and fescue again showed good tolerance. At double these rates bluegrass was still tolerant while fescue showed some temporary objectionable injury. Both bentgrasses showed some tolerance to HOE-22870 at the standard rates, but there was considerable injury at the double rates.

In the nutsedge tests Kentucky bluegrass and 'Penncross' creeping bentgrass showed good tolerance to bentazon. Results in this tolerance test show that the four grass species were tolerant of bentazon at the standard rate (two applications at 1 lb) and double that rate. Kentucky bluegrass and red fescue still had good tolerance to a 4X rate while both bentgrasses showed only temporary objectionable injury.

Kentucky bluegrass had good tolerance to cyperquat in the nutsedge tests while tolerance of 'Penncross' creeping bentgrass was variable. The four grass species in the tolerance test had good tolerance to one application of cyperquat at the 2 lb rate. At double the rate only colonial bentgrass had temporary objectionable injury. At the 4X rate Kentucky bluegrass tolerance was good while fescue and creeping bentgrass had temporary objectionable injury and colonial bentgrass had severe injury. Both bluegrass and fescue were tolerant of two applications at the 2 lb rate while colonial bentgrass had objectionable injury.

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CONTROL OF *POA ANNUA* WITH ENDOTHAL

T. L. Watschke and J. M. Duich[1/]

ABSTRACT. Endothal (7-oxabicyclo (2.2.1) heptane-2,3-dicarboxylic acid) was applied in different granular formulations to a mixed annual bluegrass (*Poa annua* L.) - Kentucky bluegrass (*Poa pratensis* L.) turf over a three year period (1974-1976). Selective control of *Poa annua* was found at all rates used, but best control occurred early in 1975 on plots that had received 9.0 and 6.7 kg/ha on the first two treatment dates of 1974. Following these first two dates, all plots received 4.5 kg/ha on two other occasions during 1974. Control on turf receiving initial high rates indicates that the granular formulation of endothal may accumulate in the soil. This effect from the initial high rates was apparent through the last observation date in 1976, although the *Poa annua* population was observed to be increasing. Multiple applications of endothal appear necessary to lower populations to the point where the use of preemergence control materials would be feasible. The addition of wetting agent to endothal had no affect on control.

INTRODUCTION

Although not seeded for turfgrass use, annual bluegrass invades close cut irrigated, intensively managed turfs, and within a three to five year period is capable of becoming the dominant component of the stand.

It is considered to be a weed because of prolific seedhead production (even at putting green height), is inherently shallow rooted, is susceptible to most turf diseases, and is physiologically weakened by high temperatures. Consequently, many control measures have been researched. Success has varied (1, 2, 4, 5, 11) with application of calcium arsenate, lead arsenate, and sodium arsenite resulting in better control than most other materials. However, recent cessation of tricalcium production has necessitated the development of alternative control measures. Preemerge controls have been effective, however they are expensive and do not allow for overseeding of desired species.

Research on the control of *Poa annua* with growth regulators has been conducted for over twenty years (3, 6, 7, 8, 9, 10, 12, 13). Selective

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growth regulation, seedhead inhibition, and seedling eradication have been the goals of this approach to control, and as with arsenicals, success has varied.

One of the growth regulators, endothal, was found to be effective in seedhead suppression, but was erratic, depending on soil moisture and temperature, and season of the year (12). Recently, work with root applied endothal has shown that root absorption of this compound is greater for *Poa annua* than either *Poa pratensis* L. or *Agrostis palustris*, Huds. (12).

The objective of this research was to ascertain the efficacy of granular endothal formulations applied to a mixed *Poa annua*-*Poa pratensis* turf.

MATERIALS AND METHODS

This work was conducted at the Valentine Turfgrass Research Center, University Park, Pennsylvania. Application rates and dates are shown in Table 1. All formulations were applied to 0.9 x 4.2 M plots with a drop-type spreader and treatments were replicated three times. At the time of the initial application, *Poa annua* comprised approximately 85 percent of the stand, the remainder was Kentucky bluegrass. The experimental area was located between two bentgrass research plots and was utilized as a grassed alley for equipment movement at the research center. Aside from compaction associated with equipment movement on the site, the area was usually wet as it also served as a grassed area for movement of water from surface drainage. Mowing height was 1.3 cm because the area was maintained identical to that bordering the bentgrass plots. Consequently, management favored the perpetuation of *Poa annua* rather than Kentucky bluegrass. *Poa annua* control was rated four times in 1974, three times in 1975, and once in 1976. Injury was rated four times in 1974 and twice in 1975.

RESULTS AND DISCUSSION

The formulation of granular endothal used did not appreciably affect *Poa annua* control (Table 2). Incorporation of a wetting agent did not significantly affect control. For all formulations and rates, control of *Poa annua* was greater after the second application (approximately 50%). However, control following the third and fourth applications in 1974 did not substantially increase the control found after the second application.

Best control (approximately 70%) was found after the first application in 1975 on plots that had received high rates on the first two application dates in 1974 (9.0 and 6.7 kg/ha). Endothal is not known to have long soil residual when applied as a liquid, but in this test, repeated applications of granular formulations resulted in apparent soil accumulation. This trend continued for the duration of the test.

Formulation and rate had little affect on the discoloration of the turf (Table 3). The most severe discoloration was recorded on October 22, 1974. Severe discoloration of turf from fall applications of the liquid formulation has previously been reported (13). Discoloration occurred on both bluegrass and Poa annua, but the bluegrass recovered approximately three weeks after application.

Although these results are encouraging, evaluations for control in September, 1975, revealed that Poa annua had increased in plots where control was better than 70 percent the previous spring. It appears that multiple applications at rates higher than those used here are necessary for complete control. However, changes in management and experimentation with overseeding are necessary to fully assess the potential of granular endothal as a Poa annua control material.

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Table 1. Formulations, dates of application, and application rates of granular endothal applied to a mixed *Poa annua*-*Poa pratensis* turf.

Formulations			Rates (kg/ha) and Dates of Application					
1974	1975		1974				1975	
All Dates	May	Sept.	5/16	7/11	8/13	10/3	5/19	9/11
2G	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5
2G[a]	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5
7.2G	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5
2G	2G	2G	9.0	6.7	4.5	4.5	4.5	6.7
2G	2G[a]	2G	9.0	6.7	4.5	4.5	4.5	6.7
7.2G	7.2G	2G	9.0	6.7	4.5	4.5	4.5	6.7

[a]Indicates formulation contained wetting agent.

Table 2. The effect of different granular endothall formulations on the control of *Poa annua* in a turf with a base population of *Poa pratensis*.

Formulations			Rates (kg/ha) and Dates of Application						Dates of Observation						
1974	1975		1974				1975								
All Dates	May	Sept.	5/16	7/11	8/13	10/3	5/19	9/11	6/17/74	8/13/74	10/3/74	5/19/75	6/10/75	9/11/75	6/23/76
									% Control						
2G	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5	25	42	45	48	55	48	52
2G[a]	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5	30	48	50	48	58	42	42
7.2G	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5	40	50	43	48	52	40	45
2G	2G	2G	9.0	6.7	4.5	4.5	4.5	6.7	22	60	52	58	77	58	57
2G[a]	2G[a]	2G	9.0	6.7	4.5	4.5	4.5	6.7	33	53	63	53	72	62	60
7.2G	7.2G	2G	9.0	6.7	4.5	4.5	4.5	6.7	37	42	37	50	72	53	60

[a]Indicates formulation contained wetting agent.

Table 3. The effect of different granular endothal formulations on the discoloration of a mixed *Poa annua*-*Poa pratensis* turf.

Formulations			Rates (kg/ha) and Dates of Application						Dates of Observation					
1974	1975		1974				1975							
All Dates	May	Sept.	5/16	7/11	8/13	10/3	5/19	9/11	7/18/74	8/19/74	10/10/74	10/22/74	6/2/75	10/2/75
									Discoloration[b]					
2G	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5	2.7	2.7	2.3	5.3	2.7	2.3
2G[a]	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5	3.0	2.7	3.7	7.7	2.0	2.3
7.2G	2G	2G	6.7	4.5	4.5	4.5	4.5	4.5	2.7	2.7	2.3	6.3	1.2	2.0
2G	2G	2G	9.0	6.7	6.7	4.5	4.5	6.7	3.0	2.0	3.0	5.3	3.3	2.3
2G[a]	2G[a]	2G	9.0	6.7	6.7	4.5	4.5	6.7	3.3	2.3	3.3	7.3	2.7	2.0
7.2G	7.2G	2G	9.0	6.7	6.7	4.5	4.5	6.7	3.0	2.7	2.0	5.7	3.7	2.3

[a] Indicates formulation contained wetting agent.

[b] Discoloration rated on a scale of 0-10, with 0 = no discoloration, 10 = brown.

LEACHING OF DICAMBA AND VEL-4207 IN MODIFIED SOIL

F. W. Hotzman and W. H. Mitchell [1]

ABSTRACT

Experimental golf greens consisting of eight modified soils were used to study the relative leaching of dicamba (3, 6-dichloro-*O*-anisic acid) and dicamba derived from Vel-4207 ([phenylimino]di-2, 1-ethanediyl bis [3, 6-dichloro-2-methoxybenzoate]). The modified soils contained from 60 to 80% sand and variable amounts of silt loam topsoil, calcined clay and humus. Infiltration rates of soil mixtures ranged from 5 to over 30 cm of water per hour. A soybean hypocotyl-root elongation bioassay was used to measure the relative amounts of herbicide in leachate samples. Leachate samples were collected after approximately 2.5 cm of irrigation water had been applied. A percent growth inhibition was calculated for each leachate sample. The total average percent inhibition for leachate samples from dicamba and Vel-4207 plots was 20.4 and 11.9%, respectively. The amount of growth inhibition from dicamba was related to infiltration rates, while that from Vel-4207 plots was related to the percent soil organic matter.

INTRODUCTION

Dicamba readily moves in most soils. When used for broadleaf weed control in lawns it can move into the root zone of ornamental trees and shrubs causing damage. It has been found to move readily in both a loam soil and a sandy loam soil with the greatest concentration slightly behind the wetting front (3). Differences in movement of dicamba in muck, clay, and sandy loam soils were related to the rate of water movement (2). Dicamba movement was greater when water was applied in 0.25 than in 1-inch increments (6). Dicamba showed upward movement in soil columns which were subirrigated (6). Some adsorption has been observed on kaolinite clay, but not on other soils and clays (1,2,3). This was attributed to the high anion adsorption capacity of kaolinite clay which in turn may explain some of the reduction in dicamba mobility.

Vel-4207 is resistant to leaching. Harger and Rieck (4) conducted short term leaching studies using labeled dicamba and Vel-4207. When the compounds were placed on soil columns and three inches of water applied, leachate samples exhibited 55 and 2.5% activity for dicamba and Vel-4207, respectively. Activity was evenly distributed throughout the profile for dicamba, while 90% of the activity for Vel-4207 remained in the top half inch of soil. The major metabolite of Vel-4207 was found to be dicamba (4.5).

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The objective of the research reported herein was to study the relative leaching of dicamba and dicamba derived from Vel-4207 under field conditions. Vel-4207 itself is resistant to leaching. However, dicamba derived from Vel-4207 is readily capable of leaching. The nature of the leaching pattern of these materials would provide insight to the practical use of Vel-4207 adjacent to dicamba sensitive species.

MATERIALS AND METHODS

Three 0.046 ha experimental golf greens were constructed in 1972. Each green consisted of eight soil mixtures, prepared off-site and placed in 1.8m by 6.1m plots. The drainage line for each 1.8 m by 6.1 m plot, consisted of 3.18 cm polyethylene tubing with a double row of 0.4 cm by 10.2 cm slits placed on 30.5 cm centers. Drainage lines were covered with 10.2 cm of 0.6 to 1.2 cm pea stone. Washed sand was layered over the pea stone to a depth of 2.5 cm. The appropriate soil mixture was layered over the sand to a depth of 0.36 m. Each 1.8 by 12.2 by 0.36 m plot was separated by four mil polyethylene film.

Dicamba and Vel-4207 were applied at rates of 0.6 and 1.1 kg ai/ ha, respectively, in 280.5 l/ha of water and at a pressure of 2.1 kg/cm^2 December 11, 1975. Herbicides were applied with a hand CO_2 sprayer. Canvas strips were placed around each treatment area during application of materials to prevent spray drifting onto adjacent areas.

Leachate samples were collected in 1.0 l jars after approximately 2.5 cm of irrigation water had been applied. In addition, samples were collected during periods of rain for the first month. Water samples were taken before treatment, and 1, 5, 15, 20 and 148 days after treatment. After samples were collected, subsamples were taken and placed under refrigeration until bioassayed.

A bioassay was established using soybean (Glycine max (L.) Merr., 'James'). Ten seeds were placed in paper toweling which had been folded to secure the seeds and facilitate later observations. The seeds and toweling were placed in 500 ml glass jars. A 15 ml leachate sample was added to each jar. The jars were covered with parafilm, and placed in a dark incubator for four days at 28^o C. After four days, the length of the root-hypocotyl for each seedling was measured. The average root-hypocotyl length was calculated for each, and converted to a percent growth inhibition of the respective pretreatment leachate sample. A standard curve was established using dicamba in concentrations ranging from 0.0 to 1.0 ppmw. The percent growth inhibition was plotted against the $\log_{10}$ of the concentration.

A split plot design with three replications was used. The main effect was time and the sub- and sub-sub effects were soils and herbicides, respectively.

RESULTS AND DISCUSSION

Differences in inhibition values associated with time and soils were not significant. However, herbicide, herbicide X time, and herbicide X soil interactions were all highly significant.

The results of the standard curve are given in Table 2. The regression coefficient for percent growth inhibition vs. $\log_{10}$ dicamba concentration was 0.98.

Figure 1 shows the amount of growth inhibition in leachate samples over the five collection periods. Each value is an average for the three replications and seven soils. For the first three collection periods, significantly more growth inhibition occurred with leachate samples from dicamba than from Vel-4207 sprayed plots. This difference did not exist at 20 days, while at 148 days more inhibition occurred with Vel-4207 samples than with dicamba. The amount of dicamba leached generally increased for the first three collection periods. At 20 days, there was a significant drop in phytotoxicity and further drop at 148 days. These results indicate that most of the dicamba had been leached during the 15-day period following treatment.

Vel-4207 leachate samples increased in phytotoxicity from the first to the second collection period. From five to 148 days after treatment a relatively constant amount of phytotoxicity was observed from leachate samples, indicating a relatively constant breakdown of Vel-4207.

Table 3 shows the percent growth inhibition associated with the seven modified soils. Each value is an average for the three replications and five collection periods. In all the modified soils, except soil 8, there was substantially more growth inhibition from leachate samples from dicamba than from Vel-4207 sprayed plots. In soil 8, substantially more inhibition occurred from leachate samples from the Vel-4207 plots. This significant interaction between soils and herbicide has not been adequately explained by any of the parameters measured. Since calcined clay was used only in soil 8, its presence could explain this difference in response to herbicide treatment.

Generally, dicamba movement was related to the rate of water movement in soils. Leachate samples from soil 6 had the greatest percent inhibition, and this soil also had the highest infiltration rate. In addition, soils 1 and 4 had high infiltration rates and high levels of inhibition. Leachate from soil 8 had one of the lowest infiltration rates and the lowest percent inhibition. Leachate from soil 5, had one of the lowest levels of inhibition; however, it had one of the higher infiltration rates. This may be attributed to the relatively high organic matter and clay content of this soil.

The amount of inhibition in leachate samples from Vel-4207 plots varied from a high of 19.5% in soil 8 to a low of 6.1% in soil 3. Generally, leachate from soils which were high in organic matter was more inhibitory than that from lower organic matter. Soils 8 and 6 had 8.6 and 6.1% organic matter, respectively. Leachate samples from these soils produced the highest percent inhibition. Soils 3 and 4 had 4.9 and 4.4% organic matter, respectively and leachate samples from these soils had low levels of inhibition. A possible explanation for these differences involves the rate of breakdown of Vel-4207 to dicamba. In soils with high organic matter, the rate of breakdown could be assumed to be higher due to ability of these soils to support a higher microbial population. Using this reasoning, in soils with lower organic matter, the rate of breakdown would be reduced. Two exceptions to this generalization were found in soils 1 and 5. Soil 5 had a relatively high content of organic matter (7.6%) and clay (11.3%). The percent inhibition was low (7.0%). Under these conditions, one might expect a higher percent inhibition due to a fast rate of breakdown of Vel-4207. Perhaps in soil 5, even though the breakdown was rapid, the free dicamba was adsorbed to the organic matter and clay to such an extent that it was not readily leached. Soil 1 had a low organic matter content, although it had a high percent inhibition. Assuming a low rate of breakdown, most of the free dicamba was leached due to the low clay (4.2%) and organic matter (4.7%) and the relatively high infiltration rate of this soil.

The level of phytotoxicity in leachate samples from Vel-4207 plots was significantly less than from dicamba plots during a 15-day period following treatment. Soon thereafter there was a sharp drop in the level of dicamba to a concentration below that sustained by the breakdown of Vel-4207. These data confirm the high mobility of dicamba as well as the slow release nature of Vel-4207. The effect of a sustained low concentration of dicamba in the rhizosphere of ornamentals has not been studied.

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Table 1. Chemical and physical measurements of soil mixtures

Soil Mixtures			% O.M.		Mech. Anal.			Moisture Retention		Infiltration
No.	Description v/v	pH	Loss on Ignition	Vol. Wt. g/ml	Sand %	Silt %	Clay %	1.01 kg/cm^2	15.29 kg/cm^2	rate cm/hr
1	80% Washed Sand 20% Peat	6.6	4.7	1.54	87.3	8.5	4.2	28.0	6.9	11.8
2	80% Unwashed Sand 20% Peat	6.4	6.3	1.47	79.2	14.3	6.5	30.8	8.1	8.9
3	80% Evesboro Loamy Sand 20% Peat	6.2	4.9	1.54	81.8	12.0	6.2	38.7	7.7	4.1
4	Rutledge Loamy Sand	6.6	4.4	1.63	80.5	12.2	7.3	24.1	6.3	10.7
5	60% Unwashed Sand 20% Matapeake Silt Loam 20% Peat	6.2	7.6	1.44	65.0	23.7	11.3	33.8	11.7	17.3
6	60% Unwashed Sand 20% Matapeake Silt Loam 20% Mushroom Soil	7.0	6.1	1.49	58.8	27.0	14.2	31.3	12.1	24.3
8	60% Unwashed Sand 10% Calcined Clay 10% Matapeake Silt Loam 20% Peat	6.4	8.6	1.34	71.5	19.0	9.5	38.8	12.9	8.4

[a]Hydrometer Method

Table 2. Effect of dicamba on root-hypocotyl length.

Dicamba concentration (ppmw)	percent growth inhibition of pretreatment [a].	log 10(10 x+ 1)[b]
0	0	0
0.05	3	.176
0.07	22	.230
0.1	36	.30
0.3	61	.602
0.5	73	.778
0.7	84	.903
0.9	87	1.00
1.0	88	1.04

a. Each value is an average for three replications.

b. Dicamba concentrations coded to facilitate calculations.

Table 3. Average Percent Growth Inhibition from Leachate Samples Collected over a 148 day Period from 7 Modified Soils.

Herbicide	Soils							
	1	2	3	4	5	6	8	$\bar{X}$
Dicamba	22.6	22.8	17.3	26.5	17.2	28.5	7.5	20.4
Vel-4207	14.8	10.9	6.1	7.6	7.0	17.3	19.5	11.9
$\bar{X}$	18.7	16.8	11.7	17.0	12.1	22.9	13.5	

$L.S.D._{.05}$: Soils N.S.

$L.S.D._{.05}$: Herbicides 3.5

$L.S.D._{.05}$: Soils x Herbicides 11.3

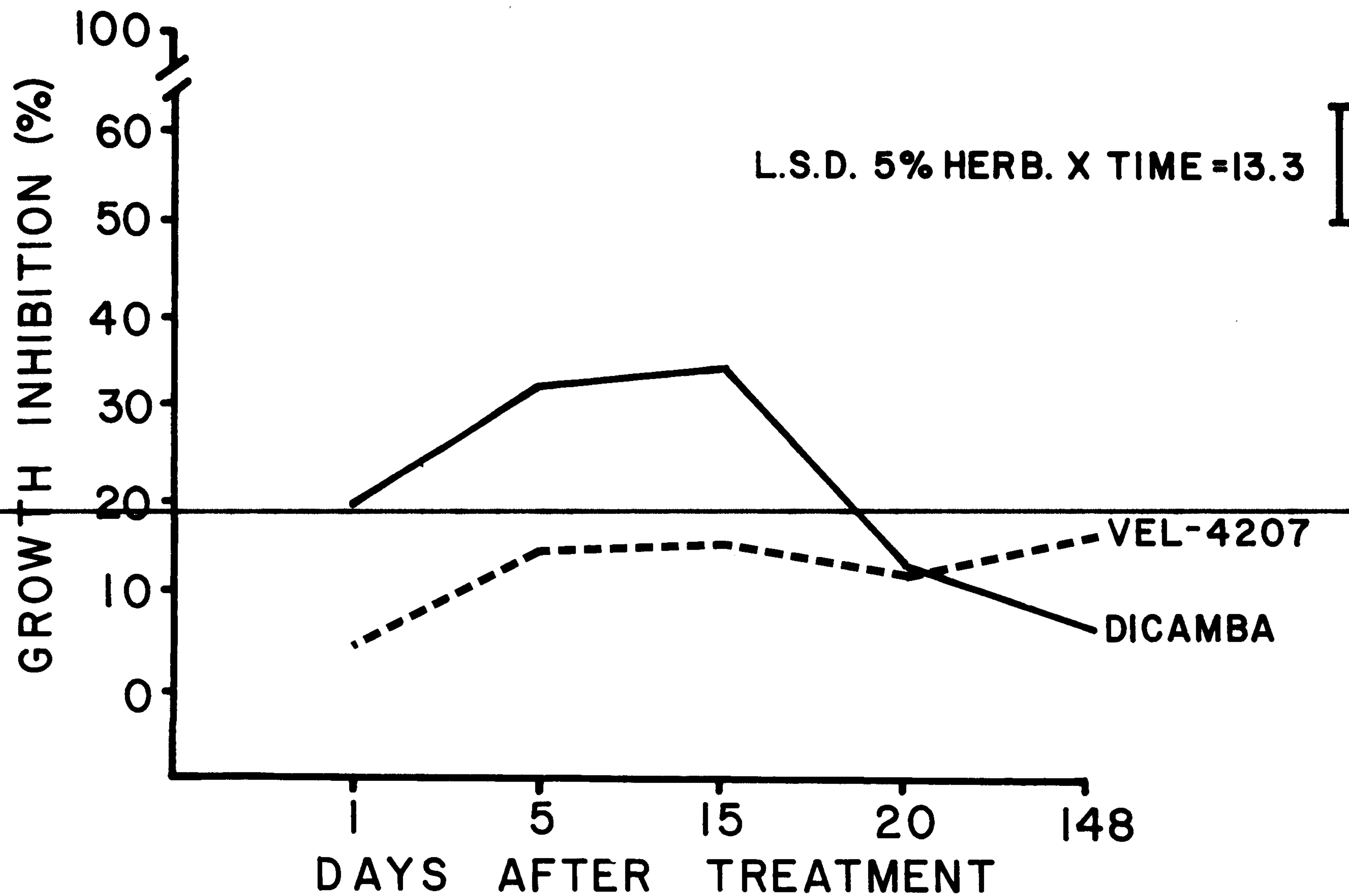

FIGURE 1. PERCENT SOYBEAN ROOT-HYPOCOTYL GROWTH INHIBITION FOR LEACHATE SAMPLES FROM DICAMBA AND VEL-4207.

PROTECTING TURFGRASS SEEDINGS FROM CHEMICAL RESIDUES WITH ACTIVATED CHARCOAL[1]

John A. Jagschitz[2]

ABSTRACT

Field experiments were conducted to determine if activated charcoal (GRO-SAFE)[3] would adsorb and nullify the harmful effects of herbicide residues in soil when establishing turfgrass. Improved Kentucky bluegrass (*Poa pratensis* L.) stands were obtained with the use of activated charcoal in seedbeds containing residues of amitrole(3-amino-*S*-triazole) plus simazine[2-chloro-4,6-bis (ethylamino)-*S*-triazine], benefin(*N*-butyl-*N*-ethyl-*a*,*a*,*a*-trifluoro-2,6-dinitro *p*-toluidine), bensulide[*O*,*O*-diisopropyl phosphorodithioate *S*-ester with *N*-(2-mercaptoethyl)benzenesulfonamide], butralin[4-(1,1-dimethylethyl)-*N*-(1-methylpropyl)-2,6-dinitrobenzenamine], a broadleaf mixture of 2,4-D[(2,4-dichlorophenoxy)acetic acid] plus dicamba(3,6-dichloro-*o*-anisic acid) plus mecoprop[2-[(4-chloro-*o*-tolyl)oxy] propionic acid] plus silvex[2-(2,4,5-trichlorophenoxy)propionic acid], endothall(7-oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid), H-25893(unknown), HOE-22870(unknown), MBR-6033[*N*-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide], MH(1,2-dihydro-3,6-pyridazinedione) plus CF(methyl 2-chloro-9-hydroxyfluorene-9-carboxylate and methyl-9-hydroxyfluorene-9-carboxylate and methyl 2.7-dichloro-9-hydroxyfluorene-9-carboxylate), PPG-139(unknown), profluralin[*N*-(cyclopropylmethyl)-*a*-*a*-*a*-trifluoro-2,6-dinitro-*N*-propyl-*p*-toluidine], and prosulfalin[*N*-[[4-(dipropylamino)-3,5-dinitrophenyl]sulfonyl]-*S*,*S*-dimethylsulfilimine]. Inhibition caused by tricalcium arsenate was not deactivated by charcoal. Improved Italian ryegrass (*Lolium multiflorum* Lam.) stands were obtained from the use of charcoal in seedbeds containing pronamide[3,5-dichloro(N-1-1-dimethyl-2-propynyl)benzamide]. Charcoal coated seed nullified some of the harmful effects of bensulide and the broadleaf mixtures; however, the soil treatment was much more effective. Herbicides which did not inhibit Kentucky bluegrass establishment from seed were cyperquat(1-methyl-4-phenylpyridinium), DSMA(disodium methanearsonate), glyphosate [*N*-phosphonomethyl)glycine], melfluidide[*N*-[2,4-dimethyl-5-[[(trifluoromethyl) sulfonyl]amino]phenyl]acetamide], and metham (sodium methyldithiocarbamate). In some tests soils that received no herbicides had improved grass stands when charcoal was used. The use of charcoal in chemically treated soil where Kentucky bluegrass - red fescue (*Festuca rubra* L.) sod was transplanted resulted in less grass injury and greater rooting strength.

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INTRODUCTION

While attempts to establish turfgrass from seed in soil containing residues of chemicals or herbicides often leads to failure, activated charcoal has been used to adsorb these residues and reduce their harmful effects (1,3,4,6). Activated charcoal has also been used to nullify harmful effects of chemicals in soils where sod was transplanted (2) and on established grass where chemicals were misused or spilled (5). A series of field tests conducted from 1973 through 1976 investigated the effects of activated charcoal on additional herbicides, especially some of the newer ones. The herbicides were added to soil where turfgrass seedings were grown or where sod was transplanted. In addition the value of coating the seed with charcoal instead of adding charcoal to the soil before seeding was also investigated.

MATERIALS AND METHODS

Eight tests on the effect of activated charcoal were performed on Bridgehampton silt loam soil at the Rhode Island Agricultural Experiment Station. Each test area was prepared as a seedbed, and herbicide treatments were applied to plots measuring at least 3 by 3 feet in seeding tests and 1.5 by 4 feet in the sod test. Treatments were replicated three times in randomized complete block or split block designs. The herbicides, rates (ai) and dates of applications are presented in the tables. Benefin, butralin, oxadiazon, profluralin and tricalcium arsenate were applied by hand as granular formulations. The other herbicides were applied as sprays using 86 to 272 gpa with the exception of metham at 2420 gpa. The plots were watered after treatment and as needed to maintain moist soil. Sod was laid five weeks after treatment, and the seedings were made at various time intervals (see tables). The grasses in the various tests were Kentucky bluegrass, red fescue, colonial bentgrass (*Agrostis tenius* Sibth.) and Italian ryegrass. The seeding rate per 1000 sq ft for ryegrass was 9.5 lb and for the other grasses ranged from 1.3 to 3.6 lb. Prior to seeding or sod laying the top inch of soil was loosened and activated charcoal was applied at the rates specified in the tables. After the charcoal had dried, it was mixed with the loose soil by raking two to four times. The area was then seeded and raked twice. Seed coated with charcoal was supplied by ICI United States Inc. Visual estimates of percent grass stand were made at various times after seeding and served to indicate herbicide residue toxicity. Visual estimates of grass injury were made in the sod transplanting test on a scale of 0 to 10 with 10 as brown or dead grass. Sod root strength was measured by recording the force necessary to lift four, 4-inch plugs from each plot. At the time of transplanting a metal ring with a cross-bar was placed under each plug. By attaching a hook to the cross-bar and lifting with a hand-held scale fitted with a maximum indicator, the weight pull measurements were recorded. The data from all tests were analyzed at the 5% level, and means were separated using Duncan's multiple range test.

RESULTS AND DISCUSSION

Results with turfgrass seedings made with and without activated charcoal in soil containing herbicide residues are presented in Tables 1 through 5. The results could have been influenced by frequency and amount of irrigation

Table 1. Turfgrass Stand as Affected by Charcoal Use After Seeding Kentucky Bluegrass 'Merion" in Soil Treated One Week Earlier (July 17, 1973) with Herbicides.

Herbicide Treatment	Activated charcoal[a]	Percent Turfgrass Stand[b] Time after seeding 4 weeks	7 weeks
Bensulide 10 lb/A	None	1 e	2 e
	Seed coat	13 d	20 d
	Spray	45 b	73 ab
2,4-D + dicamba + mecoprop + silvex 1 + .25 + 1 + .5 lb/A	None	20 d	40 c
	Seed coat	47 b	68 b
	Spray	63 a	87 a
None	None	33 c	63 b
	Seed Coat	67 a	80 ab
	Spray	65 a	88 a

[a]Charcoal spray 300 lb/A in 500 gpa, seed coating 350 lb/A #251 Filcoat.

[b]Means within a column followed by a similar letter are not significantly different at the 5% level.

Table 2. Effect of Charcoal on Turfgrass Stand Seven Weeks After Seeding Red Fescue, Kentucky Bluegrass and Colonial Bentgrass in Soil Treated Earlier (June 10, 1974) with Bensulide.

Herbicide treatment	Activated charcoal[a]	Percent Turfgrass Stand[b] Seeding time after herbicide 5 weeks	10 weeks	15 weeks
Bensulide 10 lb/A	None	19 b	35 d	9 c
	Seed coat	30 b	50 c	13 b
	Spray	56 a	72 b	34 a
None	None	65 a	80 ab	--
	Seed coat	62 a	83 a	26 ab
	Spray	68 a	82 a	--

[a]Charcoal spray--300 lb/A in 500 gpa, seed coating--157 lb/A T.C. 2486

[b]Means within a column followed by a similar letter are not significantly different at the 5% level.

Table 3. The Influence of Charcoal on Turfgrass Stand Five and Ten Weeks After Seeding Kentucky Bluegrass 'Parade' in Soil Treated Ten Days Earlier (July 13, 1976) with Herbicides.

Herbicide Treatment	Activated charcoal[a]	Percent Turfgrass Stand[b] Time after seeding 5 weeks	10 weeks
Benefin 2 lb/A	None	11 cd	43 d
	Seed coat	21 bc	58 cd
	Spray	63 a	82 ab
DSMA 5 lb/A	None	68 a	90 ab
	Spray	58 a	77 ab
DSMA 5 lb/A (after seed)	None	74 a	94 a
Prosulfalin 2 lb/A	None	1 d	2 e
	Spray	35 b	72 bc
None	None	64 a	85 ab
	Seed coat	62 a	75 abc
	Spray	70 a	85 ab

[a]Charcoal spray--300 lb/A 500 gpa, seed coat T.C. 7969 48 lb/A

[b]Means within columns with a similar letter are not significantly different at the 5% level.

Table 4. Italian Ryegrass Stand Five and Nine Weeks After Seeding with and without Activated Charcoal in Soil Treated 15 Days Earlier (July 31, 1975) with Pronamide.

Herbicide treatment	Charcoal spray lb/A	Percent turfgrass stand[a] Time after seeding 5 weeks	9 weeks
Pronamide 1 lb/A	0	1 d	1 d
	109	63 ab	67 ab
	218	70 a	72 a
Pronamide 2 lb/A	0	0 d	0 d
	109	53 bc	52 c
	218	53 bc	58 bc
None	0	52 c	50 c
	109	72 a	73 a
	218	72 a	77 a

[a]Means within columns with a similar letter are not significantly different at the 5% level.

or rainfall, time interval between use of chemicals and seeding, depth of mixing with soil, and the rates of herbicides and charcoal. Herbicides which did not inhibit Kentucky bluegrass seedings, even if charcoal was not used, were cyperquat, DSMA, glyphosate, melfluidide and metham. DSMA was safe to use even at time of seeding. Although tricalcium arsenate showed no effect on the stand of bluegrass seven weeks after seeding, there was an initial reduction (unpublished four-week data). Charcoal did not improve the stand, which supports an earlier suggestion (5) that charcoal may not adsorb arsenate. With endothall, however, bluegrass stands were reduced initially; but both four and seven week data showed improvement when charcoal was used. Experience has shown that with time, most grass stands will become equal and complete.

Herbicides which inhibited bluegrass seedings and were deactivated by charcoal resulting in improved bluegrass stands were amitrole + simazine, benefin, bensulide, a mixture of 2,4-D + dicamba + mecoprop + silvex, H-25893, HOE-22870, PPG-139, and profluralin (initial inhibition). In earlier work (5), amitrole + simazine used at double the present rate was not deactivated by a similar charcoal rate which suggests that deactivation could be accomplished by a higher charcoal rate. Kentucky bluegrass establishment was also inhibited in soils containing residues of butralin, MBR-6033, and prosulfalin; and although charcoal improved the stands, they were thinner than those in untreated soils. With these three materials higher rates of charcoal appear necessary especially when the time interval between chemical use and seeding is short. Earlier data (5) showed that butralin did not inhibit seedings after a four-week interval; however, the present test intervals were one week or less. Similar results occurred with MH + CF as shown in Table 5. There was no bluegrass stand reduction when seedings were made five weeks after chemical use while there was a reduction with seedings made within three days. Activated charcoal was capable of deactivating MH + CF. Improved Italian ryegrass stands were obtained from the use of charcoal in seedbeds containing pronamide.

The results from three tests where seeds were coated with charcoal are presented in Tables 1, 2 and 3. The specific coatings as used in these tests did nullify some of the harmful effects of bensulide and the broadleaf mixture. However, the coating was not as effective as treating the soil with charcoal at the time of seeding. Charcoal coatings may be of value for low concentrations of residues. As shown in Table 2, the coating was more effective for bensulide when the time interval between application and seeding was 10 or 15 weeks rather than five.

Data on turf injury and root strength for bluegrass-fescue sod that was transplanted on soil treated five weeks earlier with herbicides are presented in Table 6. With both sets of data the F value in the analysis of variance was significant for the overall effect of charcoal. There was less turfgrass injury and greater root strength where activated charcoal was used in the soil at sod transplanting time. Had the time interval between chemical treatment and sod transplanting been shorter and rooting been quicker, greater differences might have been anticipated, especially between the chemical treatments. Results by other researchers (2) have shown such differences in shorter periods of time.

An interesting observation that was observed in earlier tests (3), especially on the initial grass stands, can also be noted in Tables 1, 4 and 5. Soils that received no herbicide had improved grass stands when activated

Table 5. Kentucky Bluegrass Stand Seven to Nine Weeks after Seeding and Using Activated Charcoal in Soil Treated Earlier (1973, 1974 and 1975 Tests) with Herbicides.

Time soil treated before seeding / Herbicide treatment	lb/A	Percent turfgrass stand[a] Charcoal spray None	300 lb/A
One week (July 17, 1973)			
Amitrole + simazine	1.5 + 4.5	6 e	70 abc
Butralin	4	0 e	22 d
Endothall	2	58 c	78 ab
Metham (32.7%)	(109 gal/A)	75 ab	82 a
Tricalcium arsenate	209	65 bc	67 abc
None	--	68 abc	78 ab
Five weeks (June 10, 1974)			
CF + MH	1 + 3	80 a	78 a
H-25893	4	41 d	64 abc
HOE-22870	2	55 cd	80 a
PPG-139	15	47 d	78 a
Profluralin	2	57 bcd	73 a
None	--	71 ab	78 a
Three days (August 12, 1975)			
Butralin	5	13 f	61 d
CF + MH	1 + 3	40 e	78 abc
Cyperquat	4	69 bcd	82 a
DSMA	5	75 abc	81 ab
Glyphosate	3	67 cd	78 abc
MBR-6033	4	14 f	33 e
Mefluidide	.375	71 abcd	75 abc
Prosulfalin	2.5	0 g	31 e
None	--	60 d	81 ab

[a]Means within each soil treatment date with a similar letter are not significantly different at the 5% level.

Table 6. Grass Injury and Rooting Strength of Kentucky Bluegrass - Fescue Sod Layed with and without Activated Charcoal on Soil Treated Five Weeks Earlier (June 3, 1975) with Herbicides.

Herbicide	Formulation	lb ai/A	Grass Injury (0-10)[a] 10 wk after sod lay None	Charcoal[b]	Root Strength lb/sq ft 12 wk after sod lay None	Charcoal[b]
Alachlor	4 lb/gal	2	2.0	1.0	229	275
Amitrole + simazine	15 + 45% WP	1.5 + 4.5	1.2	1.0	264	275
Atrazine	80% WP	2	1.8	1.3	183	206
Benefin	2.5 granular	2.5	2.0	1.5	218	241
Bensulide	4 lb/gal	12.5	2.5	2.0	218	275
Butralin	2.3% granular	5	2.5	2.3	206	264
DCPA	75% WP	12	1.7	1.2	264	286
Linuron	50% WP	1	1.3	1.3	264	252
Oxadiazon	2% granular	4	1.7	1.7	252	229
Siduron	50% WP	12	2.3	1.5	218	241
None	-	-	1.5	1.0	286	286
None	-	-	1.0	0.8	286	252
Average effect of charcoal[c]			1.8	1.3	247	263

[a]Scale 0-10, 0 = none, 10 = brown or dead.

[b]Charcoal spray--300 lb/A in 500 gpa of water.

[c]LSD at 5% level between charcoal means for grass injury = 0.4 and for root strength = 15.0. Other F values were not significant.

charcoal was used in the seedbed. This may be due to soil warming from heat absorbed by the black charcoal or to the adsorbtion of substances harmful to seedling growth that could have come from any one of several sources.

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CHEMICAL RENOVATION OF COOL-SEASON TURFGRASS SPECIES WITH GLYPHOSATE

W. M. Riden and J. M. Duich[1/]

ABSTRACT

Mature stands of colonial bentgrass (Agrostis tenuis Sibth.) - creeping bentgrass (A. palustris Huds.), tall fescue (Festuca arundinacea Schreb.), and creeping bent infested Kentucky bluegrass (Poa pratensis L.) were chemically renovated with glyphosate at 4 rates on 5 dates of treatment application. Fall 1975 treatments were followed by groove seeding of Pennfine perennial ryegrass (Lolium perenne L.). No significant difference on ryegrass seedling stand among treatments was found. Survivors of creeping bentgrass and Kentucky bluegrass were found in the bluegrass plot, but the low numbers were non-significant among treatments. No survival was found in the bentgrass plot. Tall fescue survival was significantly greater on treatments applied just before an .076 cm rain. The other dates and rates were not significantly different. In other experiments, the effect of glyphosate rate and surfacant were evaluated on tall fescue (Festuca arundiacea Schreb.) and red fescue (Festuca rubra L.). Significant differences were found between rates but not surfactant levels.

Time of grooving was also evaluated for effect on glyphosate activity using groove treatments before and after chemical application at several intervals. Significantly greater survival of creeping bentgrass (Agrostis palustris Huds.) occurred when the area was grooved within 4 hours after application. Treatments grooved more than 4 hours after application were not significantly different.

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INITIAL AND RESIDUAL EFFECTS OF GROWTH REGULATORS ON A PENNSTAR-FLYKING KENTUCKY BLUEGRASS BLEND

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ABSTRACT. Sustar (3-trifluoromethyl-sulfonamido-p-acetotoluidide), MH (1,2-dihydro-3,6-pyridazinedione), and mefluidide N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]phenyl]amino]phenyl] acetamide were applied in three separate experiments, to a 'Pennstar'-'Fylking' Kentucky bluegrass blend to evaluate growth retardation, injury, and residual effects. The first experiment was not mowed, and three weeks after application, turf treated with growth regulators was shorter than untreated. Two weeks after application, granular formulations of mefluidide were rated to have caused more discoloration than either the liquid formulation or Sustar. The second experiment was mowed on a weekly basis after clipping weights were taken. All mefluidide treatments retarded growth more than MH while discoloration was similar. Growth retardation lasted for approximately five weeks. The third experiment was similar to the second, except that nitrogen fertilizer (urea) was applied. The results of this test were similar to experiment two except that retardation lasted only four weeks and was followed by a growth stimulation. Reapplication at reduced rates suppressed this growth stimulation, but treated and untreated turf grew at approximately the same rate. One year following treatment, experiments two and three were rated for density. The high rates of mefluidide and Sustar caused reductions in turf density. This lack of density was partially the result of increased disease activity (both leaf spot, *Helminthosporium* spp. and stripe smut, *Ustilago striiformis*). The 0.25G formulation of mefluidide caused less injury than liquid and should be tested further.

INTRODUCTION

Chemical inhibition of turfgrass growth has long been a frustrating research problem for turfgrass scientists. Many chemicals have been shown to retard growth, but negative side effects have, for the most part, limited them to non-use areas (1,2,3,4,5,6,7). In spite of the drawbacks, new chemicals are continually being developed and the formulations of older ones are being changed. Consequently, field evaluation of these materials is needed.

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Information is also needed concerning the residual effects of these materials.

The objective of this research was to determine the effects of three growth regulators on growth and color of a Fylking-Pennstar Kentucky bluegrass (Poa pratensis L.) blend. Density ratings were taken one year following treatment to assess residual effects.

MATERIALS AND METHODS

Experiment 1

In 1975, two growth regulators were applied to a ten-year old mixed stand of Pennstar and Fylking Kentucky bluegrasses. The two materials used were mefluidide N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide and Sustar (3-trifluoromethyl-sulfonamido-p-acetoluidide). Application rates appear in Table 1. Application was made June 5; sprays were applied with a boom-type plot sprayer and granulars with a drop-type spreader to 0.9 x 1.8 m plots. Irrigation was applied when needed and no fungicides were applied. On June 17 color ratings were taken, turf height was measured on July 30, and on July 1 all leaves above 7.5 cm were harvested from each plot and weighed.

Experiment II

This test utilized another part of the turf stand used in experiment I. MH (1,2-dihydro-3,6-pyridazinedione) was used in addition to mefluidide and Sustar. Application rates are shown in Table 2. Materials were applied by the same means described for experiment I, the only difference was that the plots were 0.9 x 2.7 m. In this test, reapplication of each treatment was made at lower, equal, or higher rates. Reapplication rates were determined by the results obtained for the initial treatment. Color ratings were taken nine times following the initial treatment. This test was mowed weekly following sampling for growth. Growth was assessed by collecting and weighing (fresh weight) the clippings from one pass of a reel-type mower (representing 2.2 m^2). Irrigation was applied when needed and no fungicides were applied.

Experiment III

This test utilized another section of the turf stand used in the other two experiments. Mefluidide and MH were the chemical treatments used and their rates appear in Table 4. Application technique and plot size were identical to experiment II. This test site was fertilized on May 29 with urea at the rate of 0.44 kg N/100 m^2. Color was rated nine times following the initial treatment and the growth response was measured as described for experiment II.

Density ratings were taken on experiments II and III on June 16, 1976.

RESULTS AND DISCUSSION

Experiment I

Three weeks after treatment, all treated turf was shorter than the check (Table 1). Mefluidide granular formulations (vermiculite and kobrite; designated as v and k in tables) kept the turf shorter than the liquid formulation and Sustar. The same trend was also true for the clipping weights, but the differences were greater. Both granular formulations caused more discoloration than liquid mefluidide or Sustar. Part of the discoloration was due to (Sclerotinia homeocarpa) which was present on all turf in the experiment. However, since treated turf remained short and new growth was suppressed, the disease appeared worse in these plots. The lower color ratings for treated turf, however, were primarily the result of growth regulator injury rather than disease.

At the conclusion of the test, the height of the turf was gradually lowered to the original mowing height (2.5 cm), however, some scalping still occurred. Trim mowing may be necessary to reduce scalping of turf that is to be maintained at a lower height after the growth suppression from chemical treatment subsides. Jagschitz (5) has reported that trim mowing appeared to reduce the injury that occurred on treated turf when mowing on a regular basis was resumed. The post inhibition stimulation of growth that has been reported for turf treated with growth regulators (7) may cause an elevation of the bud line which would make it more susceptible to scalping.

Experiment II

All formulations and rates of mefluidide retarded growth of the turf more than Sustar or MH (Table 2). The two highest rates of the vermiculite granular and the kobrite formulation retarded growth the most, but also caused the most discoloration (Table 3). The initial high rate of the liquid mefluidide caused more growth suppression than the lower rate and the retardation lasted approximately a week longer. The higher liquid rate however, caused more discoloration than the high rates of the granular formulations.

Reapplication of all materials in July did not retard growth as much as the June application. At best, the post inhibition stimulation was reversed on turf treated with the two high rates of granular mefluidide. Since the data in Table 2 reflect the difference between treated and untreated turf, it should be expected that as growth slowed in mid-summer, these differences became smaller.

For all materials, the retarding effect on the turf lasted approximately four weeks. This response has been previously reported (4,5,7). Apparently, this phenomenon is a complex interaction of these chemicals with the seasonal metabolic changes of cool season turfgrasses.

By August 25, all treated turf, except that treated with mefluidide granular (k), was rated to have color similar to the check. Also, by this time, all treated turf was growing faster than untreated.

Experiment III

This experiment was similar to experiment II except that 0.44 kg N/100 m^2 from urea was applied approximately one week prior to treatment with the growth regulators. The most striking difference in the results between experiment two and three was the amount of growth stimulation that occurred after the chemical inhibition subsided in experiment three (Tables 2 and 4). Since the turf was chemically inhibited from growing, it probably did not utilize the available nitrogen until growth resumed. Also, while it was not growing, photosynthesis continued, and carbohydrate may have accumulated which would provide the materials for a flush of growth. Growth was not inhibited as long in this test as in experiment two, but color ratings were higher (Tables 4 and 5). Apparently, nitrogen fertilization can over-ride some of the growth retarding capabilities of these materials.

To assess residual effects, density ratings were taken approximately one year after treatment for the turf in experiments two and three. Sustar and the high rates of mefluidide caused turf thinning (Tables 6 and 7). However, some of the thinning can be attributed to disease. In late April and early May, stripe smut (*Ustilago striiformis*) and leaf spot (*Helminthosporium* spp.) were active on the turf that had been treated with these materials.

In the results reported here, the new 0.25G formulation of mefluidide caused less injury than the liquid and should be tested further, but residual injury, particularly from Sustar, appeared to be severe enough to limit the usefulness of this material for fine turf.

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Table 1. The effect of growth regulators applied June 5, 1975, on the weight, height and color of a Pennstar-Fylking Kentucky bluegrass. Color was rated on June 17, height was measured on June 30, and weights were taken July 1.

Material	Formulation	Rate kg/ha	Weight(g)	Height (cm)[a]	Color[b]
Mefluidide	0.25 G (v)	1.12	85	9.9	5.3[c]
Mefluidide	0.25 G (k)	1.12	77	8.9	6.0[c]
Mefluidide	4 EC	0.07	93	10.2	8.0
Sustar	2 S	1.68	167	11.2	7.7
Check		0.00	363	16.5	8.7

[a]Height of turf at application was approximately 7.5 cm.

[b]Color rating; 0=10, 0 = yellow, 10 = dark green.

[c]Treatment color partially due to dollar spot (_Sclerotinia homeocarpa_).

Table 2. Growth retardation of Pennstar-Fylking Kentucky bluegrass treated with five growth regulators on June 5, and July 2 or July 17, 1975.

Material		Application Dates and Rated (kg/ha)			Difference between treated and adjacent untreated turf												
					Date												
		(6/5)	(7/2)	(7/17)	6/10	6/17	6/24	7/1	7/8	7/15	7/22	7/29	8/25	9/2	9/9		
					g												
Mefluidide	0.25 G (v)	0.37	0.56	--	68	80	55	40	3	37	32	7	-38	-11	- 1		
Mefluidide	0.25 G (v)	0.75	0.56	--	87	115	83	57	5	31	27	3	-13	-10	- 1		
Mefluidide	0.25 G (v)	1.12	--	0.56	93	121	74	31	-21[a]	- 3	25	15	-25	-36	-18		
Mefluidide	0.25 G (k)	1.12	--	0.56	116	120	76	72	-22	-19	11	24	-18	-14	- 7		
Mefluidide	4 EC	0.04	0.06	--	78	99	89	76	21	34	28	-6	-28	-15	- 2		
Mefluidide	4 EC	0.07	0.06	--	93	110	96	132	27	48	32	-4	-19	-18	- 7		
Sustar	2 S	1.68	1.68	--	67	93	57	28	22	30	2	1	-25	-15	- 4		
MH	3 EC	1.68	1.68	--	41	68	52	56	11	17	2	-4	-20	- 4	- 3		

[a]Negative numbers indicate that treated turf outyielded check.

Table 3. Color ratings of Pennstar-Fylking Kentucky bluegrass treated with five growth regulators on June 5, and July 2 or July 17, 1975

Material	Application Dates and Rated (kg/ha)			Observation Dates								
	(6/5)	(7/2)	(7/17)	6/10	6/17	6/24	7/2	7/8	7/15	7/22	7/29	8/25
Mefluidide 0.25 G (v)	0.37	0.56	--	7.7[a]	8.0	7.7	8.7	8.7	7.3	7.7	7.0	7.7
Mefluidide 0.25 G (v)	0.75	0.56	--	8.0	6.7[b]	6.7	8.3	8.0	6.7	7.7	5.7	8.0
Mefluidide 0.25 G (v)	1.12	--	0.56	8.0	6.7[b]	6.3	7.7	8.7	7.7	7.7	5.0	7.7
Mefluidide 0.25 G (k)	1.12	--	0.56	8.0	6.3[b]	5.7	7.7	8.7	7.7	7.7	5.3	6.7
Mefluidide 4 EC	0.04	0.06	--	7.7	7.3	6.7	8.3	8.0	6.0	6.7	6.3	8.0
Mefluidide 4 EC	0.07	0.06	--	7.3	7.0	5.0	6.0	6.3	5.3	6.0	6.0	8.0
Sustar 2 S	1.68	1.68	--	7.0	8.0	8.3	8.3	7.7	7.0	8.7	6.7	7.7
MH 3 EC	1.68	1.68	--	7.0	8.0	8.0	8.3	7.7	7.0	7.3	6.3	7.7
Check	--	--	--	7.0	9.0	9.0	8.7	8.0	7.3	7.3	7.3	7.3

[a]Color rating; 0-10, 0= yellow, 10 = dark green.

[b]Color rating partially effected by dollar spot (Sclerotinia homeocarpa).

Table 4. Growth retardation of Pennstar-Fylking Kentucky bluegrass treated with four growth regulators on June 5 and July 2, 1975. Test area received 0.44 kg N/100 m^2 from urea on May 29.

Material	Application Dates and Rates (kg/ha)		Difference between treated and adjacent untreated turf										
			Date										
	(6/5)	(7/2)	6/10	6/17	6/24	7/1	7/8	7/15	7/22	7/29	8/25	9/2	9/9
			g										
Mefluidide 0.25 G (v)	0.75	0.56	97	109	73	- 93[a]	-42	1	-13	- 6	-38	-25	- 5
Mefluidide 0.25 G (v)	1.12	0.56	105	125	71	-277	-41	5	-15	-22	-29	-23	- 3
Mefluidide 0.25 G (k)	0.75	0.56	109	124	76	-140	- 6	35	19	16	-23	-10	- 1
Mefluidide 0.25 G (k)	1.12	0.56	106	125	67	-223	-20	12	9	9	- 6	- 3	- 3
Mefluidide 4 EC	0.07	0.06	103	106	106	- 47	6	36	9	-27	-33	-33	-13
MH 3 EC	1.68	1.68	19	59	52	28	-21	- 7	- 6	-22	-17	-17	-15

[a]Negative numbers indicate that treated turf outyielded check.

Table 5. Color ratings of Pennstar-Fylking Kentucky bluegrass treated with four growth regulators on June 5 and July 2, 1975. Test area received 0.44 kg N/100 m^2 from urea on May 29.

Material	Application Dates and Rates (kg/ha)		Observation Dates								
	(6/5)	(7/2)	6/10	6/17	6/24	7/2	7/8	7/15	7/22	7/29	8/25
Mefluidide 0.25 G (v)	0.75	0.56	9.0[a]	7.3[b]	8.3	9.3	8.7	8.0	9.0	6.7	8.7
Mefluidide 0.25 G (v)	1.12	0.56	9.0	7.0	7.7	8.7	8.7	7.7	9.0	7.3	9.0
Mefluidide 0.25 G (k)	0.75	0.56	9.0	7.0[b]	7.3	9.0	9.0	6.7	8.7	5.7	8.3
Mefluidide 0.25 G (k)	1.12	0.56	9.0	7.0[b]	7.3	9.0	9.0	7.0	7.7	6.0	8.7
Mefluidide 4 EC	0.07	0.06	8.3	7.3	7.0	9.0	9.0	6.7	7.7	7.3	9.0
MH 3 EC	1.68	1.68	8.0	7.7	7.3	7.7	9.0	8.0	9.0	6.0	8.3
Check	--	--	8.0	9.3	9.0	9.0	7.7	7.7	7.7	7.0	7.7

[a]Color rating; 0-10, 0 = yellow, 10 = dark green.

[b]Color rating partially effected by dollar spot (Sclerotinia homeocarpa).

Table 6. Density ratings taken June 16, 1976 on Pennstar-Fylking Kentucky bluegrass treated with four growth regulators on June 5 and July 2, 1975. Test area received 0.44 kg N/100 m^2 from urea on May 29, 1975.

	Application Dates and Rates (kg/ha)		Density[a]
	(6/5)	(7/2)	
Mefluidide 0.25 G (v)	0.75	0.56	7.7
Mefluidide 0.25 G (v)	1.12	0.56	6.7
Mefluidide 0.25 G (k)	0.75	0.56	7.0
Mefluidide 0.25 G (k)	1.12	0.56	6.0
Mefluidide 4 EC	1.68	1.68	7.0
Check	--	--	7.7

[a]Density rated on a scale of 0-9 with 0 = bare soil, and 9 = 100% turf cover.

Table 7. Density ratings taken June 16, 1976, on Pennstar-Fylking Kentucky bluegrass treated with four growth regulators on June 5 and July 2, 1975.

Material	Application Dates and Rates (kg/ha) (6/5)	(7/2)	(7/17)	Density[a]
Mefluidide 0.25 G (v)	0.37	0.56	----	7.7
Mefluidide 0.25 G (v)	0.75	0.56	----	7.0
Mefluidide 1.12 G (v)	1.12	----	0.56	8.0
Mefluidide 0.25 G (k)	1.12	----	0.56	8.0
Mefluidide 4 EC	0.04	0.06	----	8.3
Mefluidide 4 EC	0.07	0.06	----	7.7
Sustar 2 S	1.68	1.68	----	6.7
MH 3 EC	1.68	1.68	----	7.3
Check	----	----	----	8.0

[a]Density rated on a scale of 0-9 with 0 = bare soil, and 9 = 100% turf cover.