PREEMERGENCE ACTIVITY OF SC-0774 IN CONTROLLING ANNUAL WEEDS IN CORN

P. C. Bhowmik and U.B. Nandihalli[1]

ABSTRACT

Field experiments were conducted to examine the preemergence activity of SC-0774 (ICI, chemistry not released) in controlling annual weeds in minimum-till (one discing) corn in 1986 and in conventional-till (moldboard plow followed by discing) corn in 1987. All treatments were applied preemergence on May 8, 1986 and 1987 with a standard flat-fan, three nozzle backpack sprayer, using compressed CO2 at 150 kPa to deliver 187 L/ha. The experimental design was a randomized complete block with three replications. Plot size was 1 by 3 m. Major weed species were large crabgrass [Digitaria sanguinalis (L.) Scop.], yellow foxtail (Setaria lutescens (Weigel) F.T. Hubb.), fall panicum (Panicum dichotomiflorum Michx.), common lambsquarters (Chenopodium album L.), and redroot pigweed (Amaranthus retroflexus L.) in both years. Corn injury (June 16, 1986 and June 17, 1987), weed control ratings (June 17 and August 19, 1986; June 16 and August 5, 1987), and corn yields were used for the evaluation.

The combination of SC-0774 and cyanazine at 0.84 + 2.2 and 1.1 + 2.2 kg ai/ha applied preemergence provided excellent (95% or better) control of all weed species in 1986 under minimum-tillage system. Corn 'Agway 584S' injury increased as the rate of SC-0774 increased from 0.56 to 1.12 kg/ha in combination with cyanazine at 2.2 kg/ha, with up to 42% injury observed with the highest rate (1.12 kg/ha) of SC-0774. Both silage and grain yields were slightly reduced by these treatments. Also, the combination of SC-0774 and SC-0051 at 0.56 + 1.12 and 0.84 + 1.12 kg/ha applied preemergence gave excellent control of large crabgrass, fall panicum, common lambsquarters, and redroot pigweed under reduced-tillage system.

SC-0774 at 0.84 kg/ha gave excellent (95% or better) control of all annual grass and broadleaf weed species in 1987 under conventional-tillage system. Shallow incorporation of SC-0774 was not as effective in controlling annual weeds as the preemergence treatments. A preemergence application of SC-0774 at 0.84 or 1.12 kg/ha with R-29148 gave better control of large crabgrass, yellow foxtail, fall panicum, common lambsquarters, and redroot pigweed than the control obtained with the shallow incorporation of the same treatment. The addition of R-29148 to SC-0774 treatments did not alter herbicidal activity of SC-0774 and minimized potential corn injury. Corn silage and grain yields were significantly greater than the untreated plots.

In summary, SC-0774 at 0.84 kg/ha effectively controlled large crabgrass, yellow foxtail, fall panicum, common lambsquarters, and redroot pigweed in both years under both conventional- and minimum-tillage systems. SC-0774 demonstrated potential for use as a preemergence herbicide for selective weed control in corn.

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EFFECTS OF QUACKGRASS CONTROL WITH GRAMINICIDES ON YIELD AND QUALITY OF SEEDLING ALFALFA

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ABSTRACT

Quackgrass [Agropyron repens (L.) Beauv.] is an aggressive perennial weed that infests new and established stands of alfalfa resulting in both reduced alfalfa yields and decreased forage quality. A field experiment was conducted in 1986 to evaluate five postemergence graminicides for quackgrass control in seedling alfalfa and determine the effects of quackgrass control on alfalfa yield and forage quality.

Sethoxydim, fluazifop-P, haloxyfop, BAS 517 02H and quizalofop were evaluated for quackgrass control at 0.14 and 0.28 kg/ha and split applications of 0.14 kg/ha applied five days apart. Additional herbicide treatments included sethoxydim at 0.56 kg/ha, fluazifop-P at 0.21 kg/ha and quizalofop at 0.07 kg/ha. Alfalfa 'Saranac AR' was conventionally seeded on April 29, 1986. Blanket applications of fenoxaprop at 0.14 kg/ha and 2,4-DB at 1.12 kg/ha were applied on May 28 and May 29, respectively, for the control of annual grass and broadleaf weeds. Herbicide treatments for quackgrass control were applied on June 9 when alfalfa was at the 6-to 8-trifoliate leaf stage and quackgrass was at the 4-to 6-leaf stage. Plot size was 1.5 by 6 m. All herbicide treatments were applied with a backpack CO_2 sprayer at 152 kPa in 450 L/ha. Treatments were arranged in a randomized complete block design with four replications.

First harvest dry matter yields of quackgrass were reduced greater than 80% as compared to the quackgrass yield of the control (2840 kg/ha) with all rates of fluazifop-P, haloxyfop and quizalofop, the 0.56 kg/ha rate of sethoxydim and the 0.28 kg/ha rates of BAS 517 02H. These treatments increased average first cut alfalfa yields (2330 kg/ha) 162% over the alfalfa yield of the control (890 kg/ha). All rates of haloxyfop and quizalofop and the 0.21 and 0.28 kg/ha rates of fluazifop-P resulted in a greater than 80% dry matter yield reduction of quackgrass at the second cut as compared to the quackgrass yield of the control (1850 kg/ha). These treatments increased average second cut alfalfa yields (2300 kg/ha) 100% over the alfalfa yield of the control (1150 kg/ha).

All herbicide treatments improved forage quality at the first harvest. The crude protein content of the untreated quackgrass (13.6%) was significantly lower than the crude protein content of the first harvest alfalfa in the control (21.5%). Increased crude protein content in treated forage plots resulted from both the greater percentage of alfalfa as well as the increased crude protein content of the treated quackgrass. Herbicides treatments also increased digestibility and feed intake of the forage.

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WEED CONTROL IN CORN WITH NEW EXPERIMENTAL HERBICIDES[1]

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ABSTRACT

Several experimental herbicides were evaluated for preemergence weed control in corn. These included SC 0774, SC 0735, SC 0051, AND PPG 4000. Weeds in the experimental area included lambsquarters, velvetleaf, jimsonweed, giant foxtail, and redroot pigweed. PPG 4000 was effective on all weeds except velvetleaf. SC 0774 was ineffective on pigweed; SC 0051 controlled most weeds except giant foxtail. SC 0735 was effective on all weeds, except at low rates when applied alone. Additions of cyanazine, atrazine or metolachlor to these herbicides improved weed control.

INTRODUCTION

Since corn is a very important in New Jersey and the USA, there is still interest in developing effective and safe herbicides for this crop. It was the objective of the study to evaluate several new experimental herbicides and to determine whether they would be effective on most of the weeds associated with this crop. At present chemical identities of these herbicides have not been made available to research workers.

MATERIALS AND METHODS

A field test was conducted in 1987 at the Adelphia Research Station. The variety Midstates 747 was planted on May 22 in Freehold sandy loam soil with 1.5% organic matter. Plots 4 rows wide by 19 feet were established after planting to receive herbicide treatments. The experimental design was a complete randomized block with three replications.

Herbicides were applied in a water carrier utilizing a CO_2-propelled backpack sprayer at a delivery volume of 40 gpa. All treatments were applied immediately after planting. Soil conditions at application were as follows: dry above with some moisture below the surface, temperature 84 F.

Weed species, in the experimental area, were as follows: velvetleaf (Abutilon theophrasti L.), redroot pigweed (Amaranthus retroflexus L.) lambsquaters (Chenopodium album L.), jimsonweed (Datura stramonium L.), and giant foxtail (Setaria feberi Herrm.). Weed

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control ratings were made on July 15 using a scale of 0 to 10, where 0 = no control and 10 = complete reduction in stand.

The center rows of each plot were mechanically harvested on October 17, 1987. Field weights were adjusted to 15.5% moisture and were converted to bushels per acre. Analysis of variance with a LSD multiple comparisons test was performed on yield data.

RESULTS AND DISCUSSION

Herbicides, rates, ratings and yield data are listed in Table 1. Control plots included nontreated plots and plots that received an application of 1.25 lb/acre metolachlor + 1.0 lb/acre atrazine in a tank mix.

PPG 4000 at 1.2 lb/acre produced excellent control of giant foxtail and pigweed but only fair control of lambsquarters. With the addition of metolachlor, PPG 4000 gave control of jimsonweed. Control of velvetleaf was poor for all PG 4000 treatments at all rates.

SC 0051 alone at the two rates, provided excellent control of lambsquarters, velvetleaf, and jimsonweed, however, control of giant foxtail was poor at the low rate. SC 0551 at the low rate produced poor control of pigweed while at the higher rate control of pigweed was excellent. This compound at 0.25 lb/A in combination with atrazine at 1.0 lb/A provided poor control of velvetleaf, and was less effective on lambsquarters and jimsonweed. Control of giant foxtail was poor at each rate, except at 0.25 lb/A in combination with atrazine.

SC 0735 in all combinations and rates gave excellent control of lambsquarters, velvetleaf, and jimsonweed. At the low rate, without atrazine, this product provided adequate control of giant foxtail but was ineffective on pigweed. Alone at the higher rate, excellent control was achieved for giant foxtail and pigweed. Combinations with atrazine did not increase control of weed species for this compound.

SC 0774 alone provided excellent control of jimsonweed and adequate control of lambsquarters, velvetleaf, and giant foxtail. This compound provided poor control of pigweed except in combination with atrazine. The combination of SC 0774 with atrazine, did not improve control of velvetleaf or giant foxtail. SC 0774 at rates of 0.38 and 0.50 lb/A, in combination with cyanazine provided less control of velvetleaf. Control of pigweed without atrazine was poor.

Among these new compounds SC 0735 stands out for weed control. SC 0774 was effective in combination with atrazine which provided control of pigweed. SC 0051 performed similarly at medium to high rates when alone or in combination with atrazine. PPG 4000 provided good control when combined with metolachlor. Untreated plot yields were significantly lower than the lowest yielding treatment, by approximately 53%.

Yields were significantly different from the check at the 0.05 level. These data indicate that all experimental compounds have potential as preemergence corn herbicides and that control may be improved when combined with some standard corn herbicides.

Table 1. Effects of SC 0051, SC 0735, SC 0774, and PPG 4000 on weed control and corn yield.

HERBICIDE	RATE lb/A	WEED CONTROL[1] CHEAL	ABUTH	DATST	SETFA	AMARE	YIELD Bu/A
Metolachlor	1.2	7.7	2.0	6.7	9.0	10.0	122.8
PPG 4000 + Metolachlor	0.6 + 2.0	10.0	0.0	10.0	9.9	10.0	122.0
PPG 4000 + Met[2]	1.2 + 2.0	9.9	4.9	10.0	9.9	10.0	151.8
SC 0051	0.5	9.6	9.1	10.0	5.3	5.8	126.4
SC 0051	1.0	10.0	10.0	10.0	4.7	10.0	107.2
SC 0051 + Atrazine	0.25 + 1.0	8.3	4.3	8.3	9.7	8.3	136.6
SC 0051 + Atrz	0.50 + 1.0	10.0	10.0	10.0	6.3	10.0	117.1
SC 0051 + Atrz	0.75 + 1.0	9.9	9.8	10.0	6.3	10.0	114.4
SC 0735	0.50	10.0	10.0	10.0	7.5	6.0	154.1
SC 0735	0.75	10.0	10.0	10.0	9.0	10.0	153.5
SC 0735 + Atrz	0.50 + 1.0	9.7	9.7	10.0	8.3	9.3	167.4
SC 0735 + Atrz	0.75 + 1.0	10.0	10.0	10.0	8.3	9.7	159.5
SC 0774	0.50	7.0	7.0	9.7	8.0	5.3	105.6
SC 0774	1.00	8.7	8.2	9.7	8.7	5.5	112.0
SC 0774 + Atrz	0.50 + 1.0	10.0	7.0	8.3	6.7	10.0	143.7
SC 0774 + Atrz	1.00 + 1.0	10.0	7.5	10.0	7.7	10.0	147.4
SC 0774 + Cynz	0.38 + 1.0	9.3	6.7	10.0	6.7	5.7	101.9
SC 0774 + Cynz	0.50 + 1.0	9.3	6.7	10.0	8.7	5.7	93.3
Met + Atrz	1.25 + 1.0	4.7	10.0	8.7	10.0	8.0	129.9
Untreated	--	5.0	6.7	3.7	5.0	2.3	44.0
Cyanazine	1.50	4.0	10.0	8.3	4.3	10.0	105.6
Metolachlor	1.50	4.3	3.0	7.5	10.0	5.0	99.4
Metolachlor	3.00	0.0	9.0	10.0	9.7	10.0	112.9
Atrazine	1.50	9.0	4.0		3.3	10.0	131.7
LSD (.05)	-	-	-	-	-	-	42.6

[1]Based on scale 0 to 10, where 0 = no control and 10 = complete control

[2]Abbreviations: Atrz = Atrazine; Cynz = Cyanazine; Met = Metolachlor ABUTH = Velvetleaf; AMARE = Pigweed; CHEAL = Lambsquarters; DATST = Jimsonweed; SETFA = Giant Foxtail

CONTROL OF WARM SEASON GRASSY WEEDS IN ALFALFA AND COOL SEASON FORAGE GRASS SEEDINGS

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INTRODUCTION

Forage specialists have long recommended the seeding of forage grasses with alfalfa (Medicago sativa L.) to reduce the potential for frost heaving of the alfalfa in the spring and to reduce the encroachment of weeds as the alfalfa thins out. Since there has never been a herbicide that is safe on both alfalfa and forage grass seedings, this practice has slowly been discontinued where herbicides that are safe on legume seedings but not grasses are used. The most commonly used herbicides for grassy weed control in new legume seedings have been EPTC (S-ethyl dipropylcarbamothioate) and benefin [N-butyl-N-ethyl-2,6-dinitro-4-(trifluoromethyl) benzenamine] which both needed to be incorporated and as a result could not be used in no-till seedings. Weed control in no-till seedings was limited to paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) or glyphosate [N-(phosphonomethyl) glycine] for burndown or weed control before seeding. The control of broadleaved weed seedlings in a legume or legume/grass mixture has been reasonably well met with 2,4-DB [4-(2,4-dichlorophenoxy) butanoic acid]. There has been and continues to be a dire need for a herbicide that will control grassy weeds in a legume/forage grass mixture. The objective of this research was to determine how well fenoxaprop [(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy] phenoxy] propanoic acid] would satisfy this need. Other research has indicated some tolerance by C3 cool season grasses to fenoxaprop and most forage grasses in temperate regions of the world are cool season grasses (1,2,3,4,5,6,7,8). In order to get a better test of how safe fenoxaprop was to alfalfa and several cool season forage grasses, they were planted separately in this trial.

MATERIALS AND METHODS

This trial was a split-split-split plot design with four replications. The main plots were comprised of an untreated check, three rates of fenoxaprop at 0.08, 0.12, and 0.16 lb ai/A with 1% v/v emulsifiable crop oil applied at the 2-4 leaf stage and 0.12, 0.16, and 0.20 lb ai/A with crop oil at the 2-4 tiller stage of forage grass growth. The sub-plots were conventional and no-till seedings. Conventional tillage included spring plowing and disking with a final fitting from a roterra. The 2.1 by 9.84 m sub-sub-plots were four forage species; perennial ryegrass (Lolium perenne L. 'Reveille'), timothy (Phleum pratense L. 'Climax'), orchardgrass (Dactylis glomerata L. 'Pennlate') and alfalfa. All seedings were made with a no-till Tye[2] drill in 25 cm rows on April 3, 1986. The trial area had been in corn (Zea mays L.) for two years prior to 1986 and had been treated with low residue herbicides. The primary weed problem was giant (Setaria faberi Herrm.) and yellow (Setaria glauca (L.) Beauv.) foxtail with a significant presence from yellow nutsedge (Cyperus esculentus L.), common lambsquarters (Chenopodium album L.) and redroot pigweed (Amaranthus retroflexus L.). There were also a few patches of Canada thistle (Cirsium arvense (L.) Scop.) and quackgrass (Agropyron repens (L.) Beauv.).

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[2] No-Till Drill from Tye Co., Lockney, TX

The soil was a Murrill silt loam (Typic Hapludult) with approximately 16% sand, 67% silt, 14% clay, 2.5% organic matter and a pH of 6.5. Soil test results indicated all nutrients were adequate and no fertilizer was applied.

A blanket treatment of 2,4-DB amine @ 0.75 lb ai/A was applied on May 27 for control of common lambsquarters and redroot pigweed seedlings. About a month later on June 26 a blanket treatment of bentazon [3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide] + 2,4-D amine [(2,4-dichlorophenoxy) acetic acid] @ 0.75 + 0.75 lb ai/A was applied to all the forage grass plots for control of yellow nutsedge and Canada thistle. Neither treatment appeared to have any detrimental effect on the forage grasses.

Even after these blanket treatments, Canada thistle was still a problem and the growth of the forage species was poor due primarily to weed competition. Instead of making a first harvest in early July as would normally be possible, everything was mowed off and all results were based on a second cutting made on Sept. 10 and 11, 1986. Percent composition of seeded forage, giant and yellow foxtail, and broadleaved weeds were estimated just before harvest. A 1 by 8.66 m swath was harvested out of the center of each plot with a small plot harvester. Total fresh weight was recorded and a sub-sample was saved for dry wt. determination. Yields were calculated from dry wt. and percent composition data and ANOV's run using the SAS statistical package.

RESULTS AND DISCUSSION

The forage crop species had a greater effect on weed growth than did tillage or fenoxaprop treatments (Tables 1 and 2). When averaged over tillage and fenoxaprop treatments, alfalfa was the most competitive against foxtails but not significantly better than 'Pennlate' orchardgrass or 'Reveille' perennial ryegrass. Total forage yields for 'Climax' timothy were the highest because of reduced timothy growth and competition which allowed significantly greater foxtail and broadleaved weed growth than for the other forage species (Table 1). In general, total forage yields were higher for the no-till seedings in spite of a significant reduction in alfalfa and forage grass yields. This reduction was more than made up for by increased foxtail and broadleaved weed growth (Table 1).

All rates and dates of fenoxaprop application significantly reduced foxtail yields in the forage grass seedings but not in alfalfa (Table 2). Alfalfa was the most competitive to start with and there wasn't as much foxtail to control as in the forage grasses. There was no significant difference in foxtail yields as a result of rate or date of fenoxaprop application except for the relatively non-competitive timothy. When averaged over forage species, there was a trend toward decreasing foxtial yields with increasing rates of fenoxaprop applied on June 4 and a further reduction in foxtail yields from increasing rates of fenoxaprop applied on June 20 (Table 3). It would apear however, that the forage species benefited as much from the early release from foxtail competition by fenoxaprop treatments on June 4 as from the slightly greater release by treatments applied on June 20 (Table 4). Yields of desirable forage species was as good for the low rate of fenoxaprop (0.08 lb ai/A) applied on June 4 as for any of the other treatments. Yields of broadleaved weeds were significantly greater for all fenoxaprop treatments relative to the untreated check due to reduced competition from the foxtails. If broadleaved weeds are present, a separate treatment will definitely be needed to keep them under control.

Table 1. Components of forage yield from four forage crops when averaged over seven fenoxaprop treatments and four replications.

Forage Crop & Tillage	Second Cutting Component of Forage Yield			
	Total	Forage	Foxtails	BLW's[1]
	(----------lb/A @ 12% moisture----------)			
Forage Crop Yields When Averaged over Tillage				
Alfalfa	3450 b[2]	2511 a	627 b	310 b
'Pennlate' Orchardgrass	3447 b	2427 a	765 b	256 b
'Reveille' Per. Ryegrass	3189 c	2334 a	684 b	172 b
'Climax' Timothy	3915 a	1067 b	2123 a	724 a
LSD for Forage Effects	233	255	296	148
No-Tillage				
Alfalfa	3699 b	2448 b	912 c	339 cd
'Pennlate' Orchardgrass	3679 b	2044 c	1313 b	321 cd
'Reveille' Per. Ryegrass	3456 bc	1942 c	1235 bc	278 d
'Climax' Timothy	4265 a	681 f	2982 a	601 b
No-Till Forage Crop Ave.	3775 a	1779 b	1610 a	385 ns
Conv. Tillage				
Alfalfa	3202 cd	2574 a	341 b	281 b
'Pennlate' Orchardgrass	3216 c	2809 a	216 b	190 bc
'Reveille' Per. Ryegrass	2923 d	2725 a	133 b	65 c
'Climax' Timothy	3565 b	1454 b	1264 a	848 a
Conv. Till Forage Crop Ave.	3226 b	2391 a	489 b	346 ns
LSD for Tillage by Forage Eff.	244	337	375	155
LSD for Tillage Effects	334	393	552	151

[1] Broadleaved weeds consisted of C. lambsquarters, redroot pigweed and Canada thistle.

[2] Column means followed by the same letter are not significantly different at the 5% level according to Fisher's Protected LSD.

Table 2. Foxtail yields for seven fenoxaprop treatments on four forage crops when averaged over tillage, and four replications.

Fenoxaprop Treatment	Second Cutting Foxtail Yields in			
	Alfalfa	Orchgrass	Ryegrass	Timothy
(lb ai/A and Date)	(----------lb/A @ 12% moisture----------)			
Untreated Check	1207 a[1]	1871 a	1863 a	3613 a
0.08, June 4	713 a	560 b	790 b	2657 b
0.12, June 4	346 a	566 b	218 b	2306 b
0.16, June 4	552 a	872 b	453 b	2148 bc
0.12, June 20	663 a	731 b	744 b	1447 cd
0.16, June 20	480 a	353 b	567 b	1307 d
0.20, June 20	425 a	401 b	150 b	1383 cd
LSD for Fenoxaprop Effects	783	783	783	783

[1] Column means followed by the same letter are not significantly different at the 5% level according to Fisher's Protected LSD.

Table 3. Component of forage yield for seven fenoxaprop treatments when averaged over tillage, four forage crops and four replications.

Fenoxaprop Treatment	Second Cutting Component of Forage Yield			
	Total	Forage	Foxtails	BLW's[1]
(lb ai/A and Date)	(----------lb/A @ 12% moisture----------			)
Untreated Check	3877 a[2]	1434 a	2328 a	115 b
0.08, June 4	3755 a	2103 a	1266 b	385 a
0.12, June 4	3640 a	2064 a	1158 bc	414 a
0.16, June 4	3553 a	1833 a	1142 bc	570 a
0.12, June 20	3359 a	1880 a	931 bc	548 a
0.16, June 20	3507 a	2012 a	886 bc	608 a
0.20, June 20	3057 a	1836 a	725 c	496 a
LSD for Fenoxaprop Effects	844	527	482	255

[1] Broadleaved weeds consisted of C. lambsquarters, redroot pigweed and Canada thistle.

[2] Column means followed by the same letter are not significantly different at the 5% level according to Fisher's Protected LSD.

Table 4. Forage crop yields for seven fenoxaprop treatments when averaged over tillage, and four replications.

Fenoxaprop Treatment	Second Cutting Forage Yields			
	Alfalfa	Orchgrass	Ryegrass	Timothy
(lb ai/A and Date)	(----------lb/A @ 12% moisture----------			)
Untreated Check	2649 a[1]	1693 b	1729 b	474 c
0.08, June 4	2537 a	2850 a	2346 b	1316 ab
0.12, June 4	2734 a	2489 a	3164 a	964 abc
0.16, June 4	2521 a	2508 a	2282 b	729 bc
0.12, June 20	2454 a	2283 ab	2248 b	1309 ab
0.16, June 20	2559 a	2873 a	2167 b	1454 a
0.20, June 20	2120 a	2290 ab	2400 b	1226 ab
LSD for Fenoxaprop Effects	675	675	675	675

[1] Column means followed by the same letter are not significantly different at the 5% level according to Fisher's Protected LSD.

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FIELD EFFICACY STUDIES WITH SC-0051, SC-0774, AND SC-0735 IN CORN

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ABSTRACT

Field studies were conducted with SC-0051 and SC-0774 in corn (Zea mays L.) during 1985, 1986, and 1987 growing seasons at the Eastern Shore Agricultural Experiment Station, Painter, Virginia. In 1987, the chemical analogue SC-0735 was also tested. Results from these studies showed SC-0051 applied postemergence at 0.14 kg ai/ha or preemergence at 0.56 kg/ha provided excellent control of horseweed (Conyza canadensis L.), common lambsquarters (Chenopodium album L.), and common ragweed (Ambrosia artemisiifolia L.). These use rates caused no injury to corn. A preemergence rate of 0.84 kg ai/ha of SC-0774 provided good control of giant foxtail (Setaria faberi Herrm.) and large crabgrass [Digitaria sanguinalis (L.) Scop.]. A 1.1 kg/ha rate of SC-0774 caused significant bleaching to corn in some tests. Early bleaching did not result in yield reductions and was significantly reduced by the safener R-29148. A preemergence rate of 0.56 kg ai/ha or a postemergence rate of 0.42 kg/ha of SC-0735 provided good control of giant foxtail, common ragweed, horseweed, and common lambsquarters. No injury was observed from applications of SC-0735 at rates up to 0.84 kg/ha preemergence or 0.56 kg/ha postemergence.

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THE EFFECTS OF SOIL TEMPERATURE, ALACHLOR, AND METOLACHLOR ON INJURY OF FIELD CORN (ZEA MAYS)

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Alachlor and metolachlor were applied preemergence at 2.2 and 4.4 kg ha^{-1} to two varieties of field corn (*Zea mays* L. 'Pioneer 3906' and 'Pioneer 3925'). The plants were grown at five constant soil temperatures (12, 17, 22, 27 and 32°C) under ambient greenhouse conditions. At five weeks the plants were harvested and fresh and dry weights of roots and shoots and heights of the plants and apices were recorded. There were no significant differences in plant weight or height between controls or treated plants when grown at soil temperatures of 12 and 17°C. At these lower temperatures growth responses to alachlor and metolachlor did not differ with either variety or rate of applied herbicide. As soil temperatures increased, crop sensitivity also increased. 'Pioneer 3925' was more sensitive than 'Pioneer 3906' to both rates of both herbicides at 22, 27 and 32°C and was more sensitive to alachlor than to metolachlor at 27 and 32°C. 'Pioneer 3906' responded similarly to both herbicides.

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EFFECTS OF ETHEPHON ON CORN AT DIFFERENT N LEVELS[1]

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ABSTRACT

Experiments were conducted in New Jersey in 1986 and 1987 to evaluate the performance of ethephon as an anti-lodging agent in corn. Ethephon was applied at two rates (0.125 and 0.250 lb ai/A) and two application dates. The first application date in both years was when corn was in the 8- to 10-leaf stage. The second application date was at the 10- to 12-leaf stage in 1986 and the 12- to 14-leaf stage in 1987. Nitrogen was applied at rates of 100, 150, and 200 lb/A. Ethephon application at both rates and stages resulted in lower plant and ear heights. Significant differences in yield were not seen in 1986 but yields were significantly lower with ethephon at both rates for the second application date and at the 0.250 rate for the first application date. Yield reductions appeared to be related to reduced weight per ear. Reductions in yield were offset by increased fertility to some degree.

INTRODUCTION

Ethephon [(2-chloroethyl)-phosphonic acid] is an ethylene-releasing compound which may have a number of agricultural applications (2). In high-management small grains, it may shorten and thicken straw, preventing the lodging which can occur at high populations and high nitrogen levels (1). Some research (3,4) has shown that ethephon may also help to prevent lodging in corn, particularly under narrow-row conditions. An experiment was conducted in 1986 and 1987 to evaluate the effect of ethephon on corn grown at high populations at three different nitrogen fertility levels. The objective of this study was to increase nitrogen levels for maximum yields and to determine if ethephon could be used to check vegetative growth and reduce lodging.

MATERIALS AND METHODS

Experiments were conducted at Adelphia, New Jersey on a Freehold sandy loam (Typic Hapludult). In both 1986 and 1987 the cultivar planted was Midstates 747. Planting date was May 30 in 1986 and May 29 in 1987. Plots were 8 rows wide, with a row spacing of 13 inches and a plot length of 19 feet. Plant population was 36,000 plants per acre. The previous crop was turf

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in 1986, and soybeans in 1987. Weed control was obtained with preemergence metolachlor and atrazine at 1.5 and 1.0 lb ai/A, respectively. Plants were irrigated as needed in 1986. In 1987 rainfall was abundant and well-distributed throughout the season, and irrigation was not necessary.

The treatments used in both years were three levels of nitrogen, two rates of ethephon, and two ethephon application dates. Treatments were arranged factorially. Field design was a randomized complete block, and included additional control (no ethephon) treatments at all three fertility levels. N levels were 100, 150, and 200 lb/A, with 100 lb applied as part of a 10-10-10 fertilizer and the remainder applied in the form of ammonium nitrate. Ethephon rates were 0.125 and 0.250 lb/A. Ethephon was applied in a CO2-propelled backpack sprayer in 40 gallons of water per acre using flat-fan nozzle tips at 30 psi. In 1986 ethephon was applied on July 3, when the unemerged tassel was 0.5 inches long and corn plants had 8 to 10 leaves, and on July 15, when tassels were 1.5 inches long and plants were at the 10- to 12-leaf stage. In 1987 the first application date was July 6, when unemerged tassels were 0.75 inches long and corn plants had 8-10 leaves. Bad weather delayed the second application date in 1987 until July 15, when developing tassels were approximately 6 inches long and plants had 12 to 14 leaves.

Two rows from each plot were hand-harvested in October for yield, and a ten-ear subsample was collected to obtain moisture and shelling percentages. Data taken, in addition to yields, included plant height (from ground to tip of tassel), ear height (ground to base of ear), ear number, and weight per ear.

RESULTS AND DISCUSSION

Sinificant sources of variation according to an analysis of variance are presented in Table 1. The most consistent result across the years was a reduction in height. Plant and ear heights were significantly lower with ethephon application in both years (Table 2). In 1986, plant height mean was 116.8 inches with no ethephon and 97.2 inches with ethephon averaged across rates and treatment dates. In 1987, the height decrease was from 117.5 to 97.5 inches. Plant height differences were greater at the higher rates and at the second application date in both years. Height decreases of approximately 22 and 28% were seen in 1986 and 1987, respectively, at the 0.25 rate of ethephon and the second application date. Ear heights were also lower with ethephon application in both years. In 1986, only ethephon rate was a significant source of variation in ear height (Table 1). In 1987, however, height reductions were significantly greater at the higher rates and at the second application date (Table 2).

Table 1. Significant sources of variation in plant and ear heights, ear weight, and yield, 1986 and 1987.

1986

Plant height	Ear height	Yield	Ear weight
ethephon rate stage at application rate*stage	ethephon rate	n.s.	ethephon rate

1987

Plant height	Ear height	Yield	Ear weight
ethephon rate stage at application	ethephon rate N level*rate stage*rate	n.s. N level N*rate N*stage rate* stage	ethephon rate N level*stage N level*rate N level*stage

Table 2. The effect of ethephon on corn plant and ear height, 1986 and 1987.

Year	Ethephon rate (lb ai/A)	Growth stage (leaf #)	Plant height (inches)	Ear height (inches)
1986	0		116.8	51.3
	0.125	8-10	109.5	45.0
	0.125	10-12	102.2	40.9
	0.250	8-10	103.3	35.6
	0.250	10-12	91.0	36.4
		lsd(.05)	3.76	3.53
1987	0		117.5	54.9
	0.125	8-10	109.9	48.0
	0.125	12-14	91.7	47.0
	0.250	8-10	103.7	43.4
	0.250	12-14	85.9	46.8
		lsd(.05)	4.91	2.56

In 1986 ethephon had no significant effect on corn yield. Weight per ear, however, was decreased slightly but significantly by ethephon at both rates (Table 3). This decrease may have been too small to result in a significant yield difference, or it may have ben offset by an increases in some other yield component. In 1987, ethephon reduced yield significantly at both application stages at the 0.25 lb/A rate, but caused significant yield reductions at the 0.125 lb/A rate only at the second application date (Table 3). Weight per ear was reduced significantly in 1987, with the greatest reductions at the higher rate

and at the second application date at the lower rate. It seems likely that reduced ear weight is responsible for the reduction in yield seen in 1987. Differences in ear number were significant but so small as to have had little conceivable effect on yield. Other workers have found similar reductions in ear weight, and have attributed them to reductions in kernel number rather than kernel weight (3).

Table 3. Effects of ethephon on corn yield, 1986 and 1987.

Rate	Stage	Yield (bu/A)	Ear weight (lb)
		1986	
0		216.2	0.499
0.125	8-10	214.6	0.423
0.125	10-12	227.6	0.476
0.250	8-10	222.0	0.470
0.250	10-12	228.2	0.469
	lsd(.05)	n.s.	n.s.
		1987	
0		210.1	0.438
0.125	8-10	206.7	0.415
0.125	12-14	185.9	0.375
0.250	8-10	177.3	0.366
0.250	12-14	180.4	0.361
	lsd(.05)	8.89	.006

Fertility had little effect on any of the parameters measured in 1986. In 1987, however, the low N level produced significantly lower yields and ear weights than the two higher levels. Significant interactions occurred between N level and both rate and stage of ethephon application for both yield and ear weight in 1987 (Table 1). Yields and ear weights can be seen in Table 4. Yield reductions due to ethephon application appear to be greater at the low and intermediate fertility levels than at the higher N level.

The results of this study are in agreement with those of other researchers, who have found that ethephon application results in decreases in both plant and ear height. Because of the absence of lodging conditions in both years, we could not evaluate the effect of this shortened stature on lodging and resulting yield losses. The effects of ethephon on yield are likely to vary greatly with experimental conditions, and this makes determination of proper timing and rates difficult. Ethylene has a multitude of physiological effects upon plants, and more research needs to be done on its effects on corn. It seems clear, however, that because of possible yield reductions resulting from ethephon use, great care must be taken in ethephon applications to corn in the absence of conditions which have a high likelihood of producing lodging.

Table 4. The effect of N fertility level on yield and ear weight of corn at different ethephon rates and stages of application, 1987.

N level (lb/A)	Ethephon rate (lb/A)	Application stage (leaf no)	Yield (bu/A)	Weight per ear (lb)
100	0.125	8-10	195.7	0.359
100	0.125	12-14	183.6	0.349
100	0.250	8-10	166.0	0.343
100	0.250	12-14	165.6	0.339
100	no ethephon		198.3	0.413
150	0.125	8-10	207.5	0.441
150	0.125	12-14	181.9	0.379
150	0.250	8-10	185.0	0.373
150	0.250	12-14	186.5	0.363
150	no ethephon		231.7	0.474
200	0.125	8-10	222.1	0.462
200	0.125	12-14	192.1	0.397
200	0.250	8-10	181.0	0.380
200	0.250	12-14	188.9	0.382
200	no ethephon		211.9	0.450
		lsd(.05)	8.89	0.006

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DPX-V9360: A NEW CORN HERBICIDE FOR POSTEMERGENCE CONTROL OF ANNUAL AND PERENNIAL GRASSES

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DPX-V9360 is a new experimental corn herbicide from Du Pont. Postemergence applications at 16-70 g ai/ha provide control of several annual and perennial grasses, with suppression of certain broadleaf weeds. Field studies conducted in the Northeast region during 1985-1986 showed that excellent control of many troublesome grasses was obtained, including; foxtails (Setaria spp.), fall panicum (Panicum dichotomiflorum), barnyardgrass (Echinochloa crusgalli (L.) Beauv.), shattercane (Sorghum bicolor (L.) Moench), and both seedling and perennial johnsongrass (Sorghum halepense (L.) Pers.) and quackgrass (Agropyron repens (L.) Beauv.). Tolerance of corn to DPX-V9360 is excellent for a number of varieties. DPX-V9360 is most effective when applied with a non-ionic surfactant to small actively growing weeds. Soybeans are sufficiently tolerant to DPX-V9360 so that no rotational crop restrictions are expected with this crop. However, additional work is needed to establish the rotational crop flexibility with other crops.

DPX-M6316, A NEW HERBICIDE FOR POSTEMERGENCE BROADLEAF WEED CONTROL IN SOYBEANS

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ABSTRACT

DPX-M6316 is being developed by the Du Pont Company for postemergence control of broadleaf weeds in soybeans [Glycine max (L.) Merr.]. DPX-M6316 has excellent activity against several major soybean weeds, including velvetleaf (Abutilon theophrasti Medik.), pigweed species (Amaranthus spp.), common lambsquarters (Chenopodium album L.), and smartweed species (Polygonum spp.), at rates in the range of 2 to 9 g/ha. Inhibition of acetolactate synthase has been identified as the primary mode of action of DPX-M6316 and differential metabolism of DPX-M6316 is the basis for selectivity between soybeans and susceptible weeds. Soybean varieties differ in tolerance to DPX-M6316. Further work is required to determine which, if any, lack sufficient tolerance to allow the use of the compound. The use of a surfactant enhances performance and including fertilizer in the spray mixture improves control of velvetleaf. DPX-M6316 rapidly degrades in soil; no recropping restrictions are expected. DPX-M6316 will be evaluated under an Experimental Use Permit in 1988 with commercial sales anticipated in 1989.

1/ E. I Du Pont de Nemours and Company, Inc., Wilmington, DE 19898

THIAMETURON POSTEMERGENCE IN SOYBEANS

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ABSTRACT

Field studies were conducted in soybeans [Glycine max (L.) Merr. 'Asgrow 5149'] in 1987 to evaluate weed control and crop response by postemergence applications of thiameturon, thiameturon + chlorimuron, and combinations with adjuvants including surfactant, crop oil concentrate (COC) and 30% nitrogen (N). Thiameturon provided good season-long smooth pigweed (Amaranthus hybridus L.) control at rates of 1.1 to 8.9 g/ha. Adequate control of common lambsquarters (Chenopodium album L.) was not obtained with thiameturon at 2.4 to 8.9 g/ha without an adjuvant. The addition of surfactant at 0.06, 0.125, and 0.25% v/v, COC at 2.4 L/ha, and 30% N at 9.4 L/ha influenced control and crop injury. The addition of COC and surfactant increased common lambsquarters control, while 30% N reduced control. All adjuvants increased crop injury. Additional studies with combinations of thiameturon and chlorimuron indicated that weed control was broadened by the addition of surfactant and COC.

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RESPONSE OF WHEAT, BARLEY, AND NO-TILL DOUBLE CROP SOYBEANS TO SOME SULFONYLUREAS[1]

R.D. Ilnicki, A. Enache, and F. Katz[2]

ABSTRACT

Several sulfonylurea herbicides were evaluated for weed control in wheat (Triticum aestivium L.) and barley (Hordeum vulgare L.) and for their residual effects on no-till double crop soybeans (Glycine max (L.) Merr. that followed the small grain harvests. Included in the study were spring applications of DPX M6313 at 0.02 to 0.07 kg/ha, DPX E8698 at 0.03 to 0.07 kg/ha, and CGA 131036 at 0.03 to 0.05 kg/ha in 1986; DPX E8698 at 0.02 to 0.03 kg/ha, DPX R9674 at 0.02 to 0.03 kg/ha, and CGA 131036 at 0.03 to 0.05 kg/ha all applied in the fall and spring of the 1986-1987 season and DPX M6316 at 0.03 to 0.06 kg/ha applied only in the spring of 1987. After small grain harvest the plot areas were planted to no-till soybeans. All herbicides were effective for the winter annual weeds found in the small grains and no injury to wheat or barley resulted from any of the herbicides treatments.

Injury to soybeans, expressed as stunted growth and reduced yield, resulted from CGA 131036 at 0.05 kg/ha grain regardless when applied to the small grains.

[1]New Jersey Agricultural Experiment Station Publication No. J-15472-1-87.

[2]Res. Prof. and Grad. Students, respectively, Dept. of Soils and Crops, Cook College-Rutgers Univ., New Brunswick, N.J. 08903

RESIDUAL WEED CONTROL IN INTERCROPPED SOYBEANS[1]

E. Prostko and R.D. Ilnicki[2]

ABSTRACT

A field study was conducted in 1986-87 to evaluate the effect of several fall-applied small grain herbicides on weed control in soybeans (Glycine max L.) that were interplanted into standing barley (Hordeum vulgare L.) the following spring. Fall herbicide treatments consisted of DPX M6316, CGA-131036, and metribuzin applied at various rates. In untreated plots, the effect of the intercropping itself seemed to provide acceptable weed suppression of fall panicum (Panicum dichotomiflorum Michx), redroot pigweed (Amaranthus retroflexus L.) and giant ragweed (Ambrosia artemisiifolia L.). The addition of DPX-M6316 and metribuzin alone did not consistently increase the amount of weed control obtained in the intercropping system. CGA-131036, at rates of 0.037 and 0.049 kg/ha, caused significant soybean injury and failed to provide control of fall panicum. There were no significant differences in soybean yields between treated and untreated intercropped plots except for those plots that were treated with CGA-131036, where the reductions in yield were attributed to the crop injury and lack of fall panicum control. All intercropped soybean yields were significantly lower than monoculture soybean yields.

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[1]New Jersey Agricultural Experiment Station Publication No. J-15173-1-87

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Table 1. The effect of fall-applied herbicides on weed control in a barley-soybean intercropping system, Adelphia, N.J., 1987.

Herbicide	Rate (kg/ha)	Soybean[1] Injury	Weed Control Ratings[2] PANDI	AMARE	AMBEL	Soybean Yield (kg/ha)
DPX-M6316	0.04	0.0	6.3	9.3	8.8	4039
DPX-M6316	0.07	0.0	9.0	9.8	9.0	4391
CGA-131036	0.04	0.5	1.3	9.8	9.3	3257
CGA-131036	0.05	1.8	1.3	10.0	10.0	2640
Metribuzin	0.28	0.0	6.8	9.0	8.8	3947
Metribuzin	0.43	0.0	6.3	8.8	8.8	4143
No herbicides	-	0.0	7.0	9.3	7.3	4075
Metolachlor + linuron[3]	1.68 + 0.56	0.0	9.0	10.0	10.0	4953
LSD (.05)		0.3	1.5	0.6	1.4	501

[1]Ratings taken 7/21/87. Scale 0-10; 0 = no injury, 10 = complete kill.
[2]Ratings taken 9/24/87. Scale 0-10; 0 = no control, 10 = complete control .
PANDI = *Panicum dichotomiflorum* Michx.
AMARE = *Amaranthus retroflexus* L.
AMBEL = *Ambrosia artemisiifolia* L.
[3]Monoculture soybeans

EVALUATION OF PREPLANT INCORPORATED APPLICATIONS OF CLOMAZONE

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ABSTRACT

Field studies were conducted in soybeans [Glycine max (L.) Merr. 'Essex'] in 1987 to evaluate weed control by clomazone alone at two depths of incorporation and in combinations with other herbicides in soybeans. Clomazone alone provided good early-season jimsonweed (Datura stramonium L.) control at 0.6 to 1.1 kg/ha, but control diminished with time as the season progressed. Smooth pigweed (Amaranthus hybridus L.) control by clomazone was inadequate all season long. Preplant incorporated combinations of clomazone at 0.8 kg/ha with metribuzin at 0.2 kg/ha, chlorimuron (0.03 kg/ha) plus linuron (0.35 kg/ha), and imazaquin at 0.1 kg/ha provided the best smooth pigweed control. The addition of linuron at 0.4 kg/ha alone to clomazone did not improve smooth pigweed control. The 0.8 and 1.1 kg/ha rates of clomazone provided fair to good season-long large crabgrass [Digitaria sanguinalis (L.) Scop.] control although the 0.6 kg/ha rate of clomazone provided inadequate large crabgrass control. In contrast, yellow foxtail [Setaria glauca (L.) Beauv.] control was good late in the season at all rates of clomazone. In general, weed control was reduced by deep incorporation of clomazone. Clomazone treatments incorporated 3 to 5 cm provided significantly better jimsonweed, large crabgrass, and yellow foxtail control than clomazone incorporated 8 to 10 cm deep.

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PREPLANT INCORPORATED FMC 57020 FOLLOWED BY PREEMERGENCE HERBICIDES IN SOYBEANS[1]

R.D. Ilnicki, A. Enache, and E. Prostko[2]

ABSTRACT

Some new commercially prepared combinations of single herbicides were applied preemergence in soybeans (Glycine max (L.) Merr.) following preplant incorporated clomazine (FMC 57020) to determine their effects on weed control and soybean tolerance. Included in the experiment were commercially prepared combinations of linuron and chlorimuron, metolachlor and metribuzin, and metribuzin and chlorimuron. Rates of the combinations included those of the individual herbicides normally used alone as well as other rates. Herbicides found in the combinations were also applied alone. AC 263222, a new experimental herbicide, was also included in the experiment.

All treatments of single and combination herbicides were applied immediately after planting following preplant incorporated clomazine at 0.84 kg/ha. Weeds in the experimental area included redroot pigweed (Amaranthus retroflexus (L.), ivyleaf morningglory [Ipomea hederacea (L.) Jacq.] and yellow nutsedge (Cyperus esculantus L.)

Clomazine alone produced very good control of redroot pigweed and yellow nutsedge. Ivyleaf morningglory was more difficult to control. Sequential applications of single and combination herbicides improved control of all weeds; however, control of ivyleaf morningglory was only improved a little. There was no significant advantage with the combinations over the herbicides used alone. AC 263222 appears to be a promising herbicide for soybeans.

There were no injury and yield reductions in soybeans from any of the treatments.

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[1]New Jersey Agricultural Experiment Station Publication No. J-15472-3-87.

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LABEL REVISION UPDATE FOR FMC-57020 4EC HERBICIDE

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ABSTRACT

The revised label for FMC-57020 4EC herbicide on soybeans is presented. Significant changes include the addition of several species to the list of weeds controlled. These include Spurred anoda (Anoda cristata), Florida pusley (Richardia scabra), Tropic croton (Croton grandulosus), Kochia (Kochia scoparis), Field sandbur (Cenchrus pauciflorus), and Texas panicum (Panicum texanum). Weeds partially controlled are woolly cupgrass (Eriachloa villosa), yellow foxtail (Setaria lutescens), and wild proso millet (Panicum milliaceum). Recommended tank-mixes to broaden the weed control spectrum has been expanded to include FMC-57020 plus pendimenthalin; metolachlor; alachlor; trifluralin; ethalfluralin and chlorimuron ethyl plus metribuzin.

Rotational guidelines have also been revised. Pumpkins (Cucurbita pepo), peppers (Capsicum sp.), potatoes (Solanum tuberosum), and tomatoes (Lypersicon esculentum) have been added to the list of rotational crops.

Instructions for sprayer cleanup have been clarified, recommending that a small volume of crop oil or liquid fertilizer be flushed through systems when switching from water dilutions to applications utilizing crop oil or liquid fertilizer as a carrier.

Soil incorporated banded applications have been added to the General Application Instructions. Rates vary with band and row width.

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ACTIVITY OF IMAZETHAPYR IN SOYBEANS

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ABSTRACT

Field studies were conducted in 1986 and 1987 to evaluate imazethapyr as a preplant incorporated, preemergence, and postemergence herbicide for soybeans [Glycine max (L.) Merr.]. In full-season no-till soybeans, imazethapyr rates of 0.094 to 0.125 lb ai/A did not provide acceptable control of established horseweed (Conyza canadensis L.) or prickly lettuce (Lactuca serriola L.) when tank mixed with paraquat in 1986 nor prickly lettuce in 1987 when mixed with HOE-39866 or 2,4-D. Control of common lambsquarters (Chenopodium album L.) generally averaged between 60 and 80% although in one study, control was nearly 100%. Alone and with metolachlor or alachlor, imazethapyr controlled large crabgrass (Digitaria sanguinalis L.), fall panicum (Panicum dichotomiflorum Michx.) giant foxtail (Setaria faberi Herrm.), and barnyardgrass [Echinocloa crusgalli (L.) Beauv.].

In conventional soybeans, preplant incorporated imazethapyr controlled smooth pigweed (Amaranthus hybridus L.), common lambsquarters, and several annual grasses, although grass control diminished with time. A minimum rate of 0.078 lb/A was required for 80% early-season control of jimsonweed (Datura stramonium L.) and morningglory species (Ipomoea spp.). Smooth pigweed and common lambsquarters were consideraby more susceptible to imazethapyr preemergence than were morningglory species, jimsonweed, and common ragweed (Ambrosia artemisiifolia L.). Postemergence applications were active against jimsonweed, smooth pigweed, common ragweed, and morningglory species but were not adequate against common lambsquarters. Control of annual grasses was approximately 10% higher postemergence than preemergence.

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RATE AND APPLICATION STUDIES WITH IMAZETHAPYR IN SOYBEANS

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ABSTRACT

Field evaluations were conducted in 1987 with imazethapyr in the Atlantic coast states. These studies were implemented to further define the use rate and the weeds controlled from preplant, preemergence, and early post emergence applications. Both soil and early post emergence applications with imazethapyr were evaluated when applied at rates ranging from 0.05 - 0.10 kg/ha. The soil applied studies were with imazethapyr alone, or in combination with the standard rate and/or reduced rates of grass herbicides which included pendimethalin, alachlor, and metolachlor. Early post emergence applications were made alone.

The data suggests that commercial control can be obtained with the various methods of application on a wide selection of both grassy and broadleaf weed species.

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CONTROL OF LARGE SEEDED BROADLEAF WEEDS IN SOYBEANS

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ABSTRACT

Field studies were conducted in 1987 examining herbicide programs for the control of burcucumber (Sicyos angulatus L.), giant ragweed (Ambrosia trifada L.), and spurred anoda [Anoda cristata (L.) Schlecht] in soybeans [Glycine max (L.) Merr.]. Studies were planted in late May or early June and arranged as randomized complete block designs with three replications. Individual plots were 3 m wide by 8 m long. Herbicides were applied in water utilizing a CO_2 pressurized backpack sprayer. Preemergence and preplant incorporated applications were applied in 168 L/ha of water carrier at 137 kPa pressure while postemergence applications were applied in 243 L/ha of water carrier at 261 kPa pressure. Walking speed was 4.8 km/ha. All preplant incorporated applications were disced in two times in the same direction to a depth of 10 to 15 cm. Visual weed control ratings were made on a scale of 0 to 100, with 0 indicating no weed control and 100 corresponding to complete control. Yields were not obtained.

Due to continued germination of seed throughout the season, burcucumber was the hardest weed to control. Even with adequate rainfall, preemergence applications of chlorimuron plus linuron, imazaquin, or imazethapyr, as well as preplant incorporated applications of clomazone or imazethapyr, were ineffective (control <60%) in controlling burcucumber. Preplant incorporated applications of either imazaquin, or chlorimuron plus linuron, provided fair (60 to 70%) control. Best burcucumber control (70 to 90%) was obtained with preemergence applications of chlorimuron plus linuron followed by a postemergence application of chlorimuron, and with preplant incorporated applications of imazaquin followed by a postemergence application of imazaquin.

For giant ragweed, split (preplant incorporated followed by postemergence) applications of imazaquin or imazethapyr provided good (>70%) control, as did preplant incorporated applications of chlorimuron plus linuron. Clomazone provided poor (< 60%) giant ragweed control. Among the postemergence herbicides evaluated, chlorimuron, acifluorfen, or fomesafen provided best control.

Preplant incorporated applications of clomazone were very effective in providing season-long control (>80%) of spurred anoda, with a rate of 1.12 kg/ha. Weed escapes were observed with lower rates of clomazone. Split (preplant incorporated follows by postemergence) applications of imazaquin or imazethapyr also provided good (>70%) spurred anoda control. Bentazon was the only herbicide providing good (>70%) postemergence activity.

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POSTEMERGENCE CONTROL OF JOHNSONGRASS IN SOYBEANS

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ABSTRACT

Lack of acceptable season-long control of johnsongrass [Sorghum halepense (L.) Pers.], a noxious weed in Maryland, prompted investigations examining herbicide programs for the control of this perennial grass in soybeans [Glycine max (L.) Merr.]. Field trials were conducted from 1985 to 1987 in Queenstown, MD, on a Matapeake silt loam soil with a pH averaging 6.2 and an organic matter content of 1.5% (w/w). The soybean variety 'Williams' was planted in mid-June of 1985, and 'Essex' variety in late May of 1986 and 1987. Herbicides utilizing water as the carrier were applied through a CO_2 pressurized backpack sprayer. Preplant incorporated and preemergence treatments were applied in 168 L/ha of water at 137 kPa pressure while postemergence treatments were applied in 243 L/ha of water at 261 kPa pressure. Preplant applications were incorporated one time to a depth of 7-15 cm. The experiments were arranged as a randomized complete block design with three replications and individual plots were 3 m wide (4 rows) by 8 m long. Visual weed control ratings on a scale of 0 to 100 were made throughout the season, with 0 equalling no control and 100 indicating complete control.

Preplant incorporated (PPI) and preemergence (PRE) experiments were examined in 1985 and 1987. A standard PPI tank-mix of trifluralin plus vernolate provided poor (<55%) control of johnsongrass both years when evaluated early-season. In plots where clomazone was applied by itself, poor johnsongrass control was also obtained. Depending upon the study, applications of pendimethalin plus imazaquin, PRE, PPI or split (PRE or PPI followed by postemergence), resulted in fair to good (65-80%) control up to 5 weeks after application. Treatments of pendimethalin plus imazethapyr applied in the same fashion provided similar control.

Utilizing fluazifop-P as a standard postemergence treatment, rates of 0.21 kg/ha resulted in fair to good (>60%) season-long control. Similar control of johnsongrass was obtained with sethoxydim at 0.34 kg/ha or BAS 517 02 H at rates of 0.17 kg/ha or greater. Quizalofop as well as clethodim showed promise in controlling johnsongrass postemergence in soybeans. While early-season control of johnsongrass was observed with fenoxaprop, severe regrowth was observed late-season in 1986 and 1987, with or without the addition of an adjuvant.

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RE-40885: A NEW BLEACHING HERBICIDE FOR USE IN COTTON, PEANUTS, SORGHUM AND SUNFLOWERS

D. D. ROGERS, J. C. HULBERT AND R. L. BROOKS [1/]

ABSTRACT

RE-40885 [2/] is a new furanone herbicide discovered by Chevron Chemical Company, Agricultural Chemicals Division, USA. The compound was selected from a novel series of 5-amino-4 phenylfuran-3(2H)-ones and has demonstrated selectivity in peanuts, cotton, sorghum and sunflower following preplant incorporated (ppi) and preemergence (pre-em) applications. Peanuts and sorghum are tolerant to postemergence (post-em) applications. Other crops which have exhibited tolerance to RE-40885 include potatoes, barley, peas, safflower and cucumbers. Certain crops including sorghum and potatoes have demonstrated varietal differences in tolerance to RE-40885.

RE-40885 possesses strong bleaching activity and incorporates a vinylogous amide substructure common to a number of other bleaching herbicides. Susceptible species germinate and exhibit immediate and extensive chlorosis. Herbicidal symptoms and molecular structure strongly suggest activity is primarily due to inhibition of carotenoid biosythesis.

An extensive range of economically important weeds have demonstrated susceptibility to RE-40885 (Table 1). Proposed use rates will vary depending on soil texture and organic matter content. RE-40885 is recommended for evaluation as a ppi or pre-em treatment at 0.56 to 0.84 kg a.i./ha on coarser textured, lower organic matter soils and at rates ranging from .84 to 1.12 or greater kg a.i./ha on finer textured, higher organic matter soils.

Post-emergence activity on weeds is markedly enhanced with addition of nonionic surfactant to the spray mix. Proposed use rates for post-em applications range from .28 to .84 kg a.i./ha with 0.5 to 1.0 % V/V of nonionic surfactant. Cotton is not tolerant to over the crop post-em sprays, but may be treated with sprays directed at stems below leaves after reaching a height of at least 20 cm.

[1/] Chevron Chemical Company, Tucker, GA 30084

[2/] Trade name BENCHMARK™

TABLE I

Relative activity of RE-40885 on several weed species.

Susceptible weeds	
Abutilon theophrasti	Ipomoea spp. (annual)
Amaranthus spp.	Jacquemontia tamnifolia
Ambrosia artemisiifolia	Melochia corchorifolia
Brassica spp.	Mullugo verticillata
Cassia obtusifolia	Polygonum spp.
Cassia occidentalis	Portulaca oleracea
Chenopodium album	Sesbania exaltata
Datura stramonium	Richardia scabra
Desmodium tortuosum	Sida spinosa
Echinochloa crus-galli	Solanum nigrum
Suppressed weeds	
Avena fatua	Digitaria sanguinalis
Bromus secalinus	Lolium multiflorum
Cyperus esculentus	Panicum texanum
Cypetus rotundus	Setaria spp.
Dactyloctenium aegyptum	Sorghum halepense
	Xanthium pensylvanicum

CHLORIMURON SOURCES

L. M. Walker, H. P. Wilson, E. S. Hagood, and T. E. Hines[1/]

ABSTRACT

Field studies were conducted in soybeans [Glycine max (L.) Merr. 'Asgrow 5149'] in 1987 to determine the efficacy and crop response to postemergence applications of chlorimuron (C) + linuron (L) at 9 and 108 g/ha, respectively and chlorimuron (C) + metribuzin (M) at 9 and 54 g/ha, respectively. CL and CM are prepackaged mixes currently labeled for preemergence broadleaf weed control in soybeans. The rate of chlorimuron in the prepackaged mixes for preemergence application is five times the amount used alone postemergence. Application of CL and CM in postemergence at 20% the preemergence rate provided good control of jimsonweed (Datura stramonium L.), smooth pigweed (Amaranthus hybridus L.), and common lambsquarters (Chenopodium album L.). Significant crop injury occurred after application, but crops recovered nearly completely within 2 weeks. The importance of this study is based on the economic advantage of using CL or CM over chlorimuron alone.

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SUBTERRANEAN CLOVER: A NEW APPROACH TO WEED CONTROL[1]

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ABSTRACT

Alternative weed control measures are important when thinking about decreasing the amount of pesticides applied and costs/acre. Such a possible alternative is the use of subterranean clover (Trifolium subterraneum L.) as living mulch to control weeds. Field experiments were conducted in 1986 and 1987 to evaluate the effects of subterranean clover living mulch on weed populations in field corn (Zea mays L.). In 1986, a 3 x 3 factorial design experiment was used and treatments included combinations of three mulching systems (living mulch = subterranean clover, dead mulch = annual winter rye (Secale cereale L.) and no mulch) with three tillage practices (conventional, minimum tillage, and no-tillage). In 1987, for technical purposes, the design employed was completely randomized block with 4 replications. Subterranean clover var. Nangeela was used in both years. Conventional tillage + no mulch (corn alone) plots sprayed over the whole area with metolachlor + atrazine (1.68 + 1.34 kg/ha) were considered as standard checks. The results indicated that subterranean clover living mulch provided good to excellent control on ivyleaf morningglory [(Ipomea hederacea (L.) Jacq.], common lambsquarters (Chenopodium album L.), redwood pigweed (Amaranthus retroflexus L.) and common ragweed (Ambrosia artemisiifolia L.) in 1987 and ivyleaf morningglory, velvetleaf (Abutilon theophrasti L.), horseweed (Conyza canadensis L.) and jimsonweed (Datura stramonium L.) in 1986.

Little control of fall panicum (Panicum dichotomiflorum Michx) was obtained in 1986, while in 1987 control was acceptable. Total weed biomass was greatly reduced in all living mulch combinations and kept at low levels during the corn growing season. Total weed biomass of all the other combinations increased dramatically toward the end of the growing season. Conventional tillage + no mulch (corn alone) treatments performed the best in terms of both silage and corn grain yield. However, living mulch + no tillage combination resulted in relatively high yields, and for economic reasons, these overcame the yield of the standard check.

In summary, results from this two-year study indicated that subterranean clover has a definite potential for controlling weeds without decreasing the corn yields.

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[1]New Jersey Agricultural Experiment Station Publication No. J-15274-1-87.

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SMOOTH BEDSTRAW CONTROL IN PASTURES AND HAYFIELDS

Russell R. Hahn[1/]

ABSTRACT

Since pasture uses of silvex were canceled, there have been no practical chemical control options for smooth bedstraw (Galium mollugo L.) in pastures and grass hayfields. Rapid spread of this perennial weed and increased interest in no-tillage renovation of pastures and hayfields prompted these investigations. Experiments were conducted in extensively managed grass hayfields with severe bedstraw infestations to determine what herbicide(s) might replace silvex and the feasibility of making a no-tillage alfalfa seeding following chemical control of bedstraw. Herbicide treatments were applied in water to 10 by 25 ft plots using 8003 flat spray tips mounted on a compressed air plot sprayer calibrated to deliver 30 gpa. Randomized complete-block designs with four replications were used.

The preliminary experiment was initiated on July 26, 1982 in Oneida County, NY where herbicides were applied to bedstraw with 3 to 4 inches of regrowth. Control ratings indicated that glyphosate had limited activity against this weed at rates up to 4 lb ai/A. Applications of 4 lb ai/A of dicamba, 0.125 or 0.25 lb ai/A of picloram, or 0.5 or 1 lb ai/A of triclopyr provided control that was equal to, or better than that obtained with the previously recommended rate of 2 lb ai/A of silvex. A second experiment was initiated in Columbia County, NY to compare fall and spring herbicide applications and to determine their residual effect on a subsequent no-tillage alfalfa seeding. Applications were made on October 12, 1984 to bedstraw with 3 to 4 inches of regrowth and on May 11, 1985 to bedstraw with 8 to 12 inches of growth. Hay was harvested in late June and the site then prepared for a no-tillage alfalfa seeding by spraying the regrowth with 0.5 lb ai/A of paraquat in early August. A second application of 0.25 lb/A of paraquat was made just prior to no-tillage seeding of alfalfa on August 29, 1985. Hay yields were determined by harvesting a 3 by 33 ft area in the center of each plot on July 2, 1986.

Bedstraw control ratings (Table 1) made on July 23, 1985 showed that efficacy was affected by the time and rate of herbicide application. Fall herbicide applications were more effective than spring applications. Although the 1 lb/A rate of dicamba did not result in acceptable bedstraw control, the 2 lb/A rate applied in October did provide acceptable control. The fall application of 0.063 lb/A of picloram or 0.125 lb/A of picloram applied in the fall or spring provided excellent bedstraw control. Bedstraw responded similarly to the 2,4-D plus triclopyr mixture with the 1.125 lb/A rate providing good control in the fall and the 1.5 lb/A rate providing good control when applied in fall or spring. There were no significant differences in hay yield among the treatments, however there were differences in composition. All herbicide treatments except those with 1 lb/A dicamba had significantly less bedstraw than the untreated check. In addition, hay from many of these treatments had a higher proportion of alfalfa than hay from the check.

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Table 1. Smooth bedstraw control ratings following fall or spring herbicide applications, and hay yields and composition following no-tillage alfalfa seeding in a grass hayfield.

Herbicide	Rate	When App.	Bedstraw control[a/]	Hay yield	Hay composition			
					Bedstraw	Alfalfa	Forbs[b/]	Grass
	(lb/A)			(T/A)	(%)			
Dicamba	1.000	Fall	3.3	3.0	34	27	3	36
Dicamba	1.000	Spring	1.5	2.9	28	19	3	50
Dicamba	2.000	Fall	6.8	2.8	2	43	9	46
Dicamba	2.000	Spring	3.8	3.1	18	53	6	23
Picloram	0.063	Fall	9.3	2.8	1	46	4	49
Picloram	0.063	Spring	7.0	3.0	4	59	8	29
Picloram	0.125	Fall	9.8	2.9	0	36	4	60
Picloram	0.125	Spring	9.0	2.9	2	46	13	39
Silvex	2.000	Fall	7.0	3.2	4	52	3	41
Silvex	2.000	Spring	7.3	3.1	4	58	10	28
Triclopyr + 2,4-D	0.375 0.750	Fall	8.5	3.1	3	41	4	52
Triclopyr + 2,4-D	0.375 0.750	Spring	6.8	2.8	7	43	14	36
Triclopyr + 2,4-D	0.500 1.000	Fall	8.8	3.0	1	40	5	54
Triclopyr + 2,4-D	0.500 1.000	Spring	7.8	2.8	3	58	11	28
Untreated	---	---	0.0	3.0	31	21	1	47
LSD (0.05)			(0.9)	(0.4)	(12)	(25)	(9)	(25)

a/ Bedstraw control ratings: 0 = no effect; 10 = complete kill.
b/ Broadleaf weeds other than smooth bedstraw.

POTENTIAL HERBICIDES FOR USE IN SWEET WHITE LUPIN

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ABSTRACT

Sweet white lupin (Lupinus albus L.) is an annual grain legume which could prove useful in cooler regions of the United States. As is typical for developing crops no labeled herbicides exist for use on lupins and the safety of available herbicides on this crop is not well established. This series of studies was conducted to evaluate pre- and postemergence herbicides for efficacy and crop safety on lupins.

Field experiments evaluating preemergence herbicides were conducted at Presque Isle, Maine during 1986 and 1987. Treatments consisted of dinoseb (5.04 kg ai/ha), linuron (1.12 or 2.24 kg ai/ha), metolachlor (2.24 or 4.48 kg ai/ha), chloramben (2.24 kg ai/ha), pendimethalin (1.12 or 2.24 kg ai/ha), and paraquat (1.12 kg ai/ha) applied alone and in various combinations. Experimental design was a RCB with four replications. Competition, primarily from common lambsquarters (Chenopodium album L.), hempnettle (Galeopsis tetrahit L.), and mustard spp. (Brassica kaber, Raphanus raphanistrum, and Brassica campestris) increased crop height and reduced yields by 25% during 1986 and more than 50% during 1987. Minor marginal leaf necrosis was induced by treatments containing dinoseb, pendimethalin, metolachlor and the high linuron rate. Crop injury was minor and did not adversely affect subsequent growth and yield. Treatments containing linuron and dinoseb provided commercially acceptable weed control during 1986. Only linuron provided acceptable mustard control during 1987. Linuron, pendimethalin, and paraquat alone and in various combinations provided effective control of common lambsquarters and mixed broadleaf weeds during both seasons. Data from a postemergence screening trial conducted during 1986 indicated that single applications of 0.84 kg ai/ha MCPA, 0.84 kg ai/ha dinoseb, 1.12 kg ai/ha bentazon, and 0.56 kg ai/ha acifluorfen unnacceptably injured lupins when applied at the five-leaf stage.

A postemergence herbicide trial was conducted at Newport, Maine during 1987. Lupins were drilled on May 21 and 0.6 kg ai/ha trifluralin was applied immediately after planting. Treatments were applied on June 25 at the eight-leaf stage of lupin. Experimental design was a RCB with five replications. Treatments consisted of bentazon (0.28 and 0.56 kg ai/ha), 2,4-DB (0.56 kg ai/ha), bentazon and 2,4-DB tank mixes, and tank mixes containing equal concentrations of linuron and alachlor (0.56, 0.84, 1.12, and 2.25 kg ai/ha). All treatments caused substantial crop injury. Bentazon and 2,4-DB did not acceptably control mustards and also delayed lupin maturation. The crop recovered from foliar injury induced by linuron and alachlor combinations. These treatments gave acceptable control of mustards, but did not significantly improve yields when compared to weedy checks.

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RESIDUAL CONTROL OF BURCUCUMBER WITH POSTEMERGENCE RATES OF CHLORIMURON

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ABSTRACT

Postemergence applications of chlorimuron have been reported to provide season-long control of burcucumber (Sicyos angulatus L.) in soybeans[Glycine max (L.) Merr.]. Greenhouse studies were conducted to evaluate the residual activity of postemergence rates (9, 18, and 27 g ai/ha) of chlorimuron on burcucumber. Burcucumber seeds were scarified and stored in damp sand at 4C. Chlorimuron was applied to pots containing a Matapeake silt loam soil (1.5% OM, pH of 6.3). Four burcucumber seeds were planted in each pot either immediately prior to herbicide application (0-day), 14, or 28 days after treatment. Visual injury ratings were obtained 3 and 6 weeks after planting. The experiment was arranged as a completely randomized design with 3 replications per treatment. The 0-day treatment of 9, 18, and 27 g/ha chlorimuron produced 82, 97, and 92% injury to burcucumber, respectively, 6 weeks after treatment. Chlorimuron continued to injure burcucumber when seeds were planted 2 and 4 weeks after treatment. The 4-week treatment of 9, 18, and 27 g/ha chlorimuron produced 68, 88, and 93% injury to burcucumber, respectively, 6 weeks after planting. Residual activity of postemergence applications of chlorimuron will provide control of late-season flushes of burcucumber.

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ECONOMIC IMPACT OF PIGWEED AND MORNINGGLORY INTERFERENCE ON NARROW ROW SOYBEANS

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ABSTRACT

Despite a wide array of preemergence and preplant incorporated herbicides for soybeans, broadleaf weeds continue to pose problems for many growers. Deciding how to solve these postemergence broadleaf weed problems is complex. Environmental conditions, herbicide costs and efficacy, weed species, number, and size must all be considered. Efforts are under way to develop computer models and other types of guidelines which would take these factors into consideration and help growers make individualized, economical decisions.

The purpose of this study was to determine the effects of smooth pigweed (Amaranthus hybridus) and ivyleaf morningglory (Ipomoea hederacea) on yield of narrow row soybeans. In addition yield loss predictions and chemical recommendations made by the computer model being developed by Coble et.al. of North Carolina State University were compared to actual data obtained under mid-Atlantic growing conditions.

The study was conducted in 1987 on the Kipplinger farm in Montgomery County, Maryland. The soil was a clay loam with high fertility and a pH of 6.7. 'Asgrow 3127' soybeans were planted in 15" rows on June 20 with a no-till planter. Very heavy populatons of pigweed and morningglory emerged along with the soybeans.

Randomized complete block experiments with three replications of each weed density and chemical were conducted. Additional replications of weedy check and weedfree plots were included. Each plot was 37.2 m^2.

Weed density plots were established July 15 and weeded throughout the season as needed. Pigweed densities were 0, 5, 10, 20 and the natural density of 120 per 25 sq. ft. Morningglory densities were 0, 3, 6, 9 and the natural density of 20 per 25 sq. ft.

The four highest rated chemicals as indicated by the computer model were applied July 17 when soybeans were in the second trifoliate and pigweed and morningglory were in the five to six leaf stage. Weather conditions the week prior to application were cool and soil moisture was good. Treatments were acifluorfen (.56 kg/ha), the package mix of acifluorfen plus bentazon (.33 + .84 kg/ha), chlorimuron (13 g/ha) and imazaquin (.14 kg/ha).

All plots were machine harvested and adjusted for foreign matter and moisture. Weed free plots yielded 53 bu/A. Yield in weedy checks containing both pigweed and morningglory was reduced approx 32%. Pigweed was more competitive than morningglory. All four herbicides gave excellent results with yields comparable to hand weeded plots. The computer model has potential for local use, however, it requires modification to acurately predict yield loss and chemical control results.

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Regrowth of Sethoxydim-Treated Johnsongrass

S. Glenn[1/]

ABSTRACT

Field and greenhouse studies were initiated to evaluate the effects of sethoxydim and several additives on johnsongrass [Sorghum halepense (L.) Pers.] control and regrowth. Field studies evaluated 0.2 kg ai/ha sethoxydim in combination with 1% (V/V) soybean oil (SO), 1% (V/V) DAX, 2.8 kg/ha $(NH_4)_2SO_4$, or 1.4 l/ha liquid N (28%). Applications were made to 38- to 45-cm high johnsongrass over top of soybeans [Glycine max (L.) Merr.]. The study was arranged as a randomized complete block design with three replications. Johnsongrass control was most likely affected by droughty conditions. Sethoxydim + SO provided 65% control 4 weeks after treatment and 43% control 6 weeks after treatment. The main culm of many plants treated with sethoxydim + SO was destroyed but regrowth often occurred. This regrowth appeared to originate exclusively from the crown and first stem node. Combining sethoxydim with $(NH_4)_2SO_4$ or N significantly reduced johnsongrass control 6 weeks after treatment compared to that obtained with sethoxydim + SO. Reduced johnsongrass control occurred because of greater regrowth from the crown and first stem node of treated plants. Greatest johnsongrass control (70% 6 weeks after treatment) was found with the sethoxydim + DAX treatment. In greenhouse studies, 0, 0.05, 0.1, and 0.2 kg ai/ha sethoxydim in combination with 1% SO, 1% DAX, or 2.8 kg/ha $(NH_4)_2SO_4$ was applied to 45- cm high johnsongrass (originated from 4- node segments). Plants were either left unclipped or clipped 1, 3, 7, or 14 days after treatment just above the first stem node. Injury to the main culm of unclipped johnsongrass was evaluated 14 days after treatment. Regrowth of all plants was examined 14 days after clipping. The study was arranged as a completely random design with three replications. Sethoxydim + DAX provided the greatest johnsongrass injury. Combinations with $(NH_4)_2SO_4$ significantly reduced johnsongrass injury compared to that obtained with DAX or SO as an additive. All regrowth of johnsongrass occurred from the crown and/or stem node. No new shoots developed from the rhizome nodes. In general regrowth increased as the time between treatment and clipping increased. Regrowth was reduced by all sethoxydim treatments. Regrowth of sethoxydim-treated johnsongrass was lowest with DAX and greatest with $(NH_4)_2SO_4$ as the additive.

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REGROWTH CHARACTERISTICS OF JOHNSONGRASS FOLLOWING FLUAZIFOP-BUTYL APPLICATIONS

M. A. Cairoli and S. Glenn[1/]

ABSTRACT

Greenhouse studies were conducted to determine fluazifop-butyl-2,4-D interactions in johnsongrass [Sorghum halepense (L.) Pers.]. Applications of 0, 0.07, 0.13 and 0.25 kg ai/ha fluazifop-butyl alone or in combination with 0.56 kg ai/ha 2,4-D were made to 50-55 cm high johnsongrass (originated from 4-node segments) by a belt-driven sprayer. The study was arranged as a completely randomized design with 4 replications. Injury symptoms were evaluated 4 weeks after treatment. Johnsongrass injury from applications of fluazifop-butyl alone ranged from 95% (0.07 kg/ha) to 100% (0.25 kg/ha). Combining 2,4-D with fluazifop-butyl decreased johnsongrass injury to 68% with 0.07 kg/ha and 85% with 0.25 kg/ha fluazifop-butyl. In greenhouse studies, regrowth of johnsongrass plants following applications of 0, 0.13 or 0.25 kg/ha fluazifop-butyl alone or in combination with 0.56 kg/ha 2,4-D was evaluated. Plants (50 cm high) that originated from 4-node segments were clipped 1, 7 or 14 days after treatment just above the first node. New shoots were harvested 28 days after clipping and dry weights were obtained. The study was arranged as a completely randomized design with 3 replications. All fluazifop-butyl treatments reduced regrowth compared to the controls. Regrowth occurred from the first node and crown. Regrowth increased with increasing time between treatments and clipping. Regrowth of johnsongrass was greater when 2,4-D was combined with fluazifop-butyl compared to fluazifop-butyl applied alone. When averaged across clipping intervals, 2,4-D increased johnsongrass regrowth 179% and 305% when combined with 0.07 and 0.25 kg/ha fluazifop-butyl, respectively. Studies were conducted to evaluate the effects of fluazifop-butyl alone and in combination with 2,4-D on johnsongrass rhizome regrowth. Two-node segments of rhizomes were treated with 10^{-8}, 10^{-7}, 10^{-6} and 10^{-5} M fluazifop-butyl alone or in combination with 10^{-4} M 2,4-D in petri dishes. An additional study using similar procedures with ^{14}C-fluazifop-butyl was conducted to determine the absorption of fluazifop-butyl. Absorption of ^{14}C-fluazifop-butyl by rhizomes was 0.49%. 2,4-D was not found to have an effect on fluazifop-butyl absorption. Rhizomes treated with fluazifop-butyl at 10^{-8} and 10^{-7} M regrew. Fluazifop-butyl at 10^{-6} and 10^{-5} M inhibited regrowth from rhizomes. Fluazifop-butyl at 10^{-6} M inhibited rhizome regrowth 100% compared to the control. Since 0.49% fluazifop-butyl was absorbed from the media the critical endogenous concentration of fluazifop-butyl required to inhibited rhizome regrowth was 4.9×10^{-9} M. Higher concentrations of fluazifop-butyl (10^{-5} M) was required to inhibit rhizome regrowth when combined with 2,4-D. These results suggest that 2,4-D is not antagonizing the translocation of fluazifop-butyl since the antagonism occurred in localized tissue.

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EFFECTS OF TRIFLURALIN ON CORN GROWTH AND NUTRIENT CONTENT

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ABSTRACT

A series of glasshouse experiments was conducted to determine the effects of trifluralin on root growth and mineral relations of corn (Zea mays L.) seedlings. Root weight to shoot weight ratios of corn seedlings were directly related to soil concentrations of trifluralin. Root length to shoot weight ratios, however, were inversely related to trifluralin rates. A lag period between the development of root and foliar injury symptoms was observed. Trifluralin disrupted both mineral and water relations of exposed plants. Phosphorus and potassium concentrations of shoot tissue were reduced up to 60 and 35%, respectively, by 0.25 ppm trifluralin. Growth inhibition due to trifluralin was partially overcome by supplementing soil with nutrients. Phosphorus absorption was more sensitive to trifluralin than that of potassium. Transpiration rates of corn leaves were reduced up to 27 and 56% by 0.25 and 0.50 ppm, respectively. Reduced corn growth rates due to trifluralin injury apparently are due to the combined effects of root inhibition on mineral and water relations.

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PHOTOSYNTHETIC RESPONSE OF TWO MILKWEEDS, ASCLEPIAS TUBEROSA AND A. SYRIACA, HEMPSTEAD PLAINS, NEW YORK

Dwight T. Kincaid[1], Amrita G. de Soyza[1], and Richard Stalter[2]

ABSTRACT

The photosynthetic responses of two milkweeds, Asclepias tuberosa and A. syriaca were measured at midday on August 4, September 3, and October 8, 1987 at Mitchell Field, New York with a LI-COR model 6200 Portable Photosynthesis System. A total of 285 gas exchange readings was taken; 151 on A. syriaca; 76 on A. tuberosa; 16 on Solidago canadensis; and 42 on Prunus serotina. Net photosynthesis for both milkweeds was lowest on October 8 and was correlated with leaf senescence and colder air temperature. Both milkweeds had nodal trends in photosynthetic rates and transpiration rates with rates peaking at intermediate nodes.

Compared to A. syriaca, A. tuberosa has higher water use efficiency (mol fixed per mol water lost); maintains lower transpiration rates with higher stomatal diffusion resistances; and maintains much higher xylem water potentials (-1.2 versus -8 bars).

INTRODUCTION

Hempstead Plains, Long Island, New York, was once a vast treeless plain encompassing 24,291 ha (7). Today the plains have been reduced to small parcels of land, the largest of which is situated on an abandoned portion of Mitchell Field. The climate, geology, soils and ecology of the plains have been described in detail by Stalter (7). The flora of the 8 ha remnant of the Plains has been most recently described by Stalter and Lamont (8), who identified 171 taxa within the 8 ha remnant at Mitchell Field during the 1986 growing season.

Asclepias tuberosa L. and A. syriaca L. are members of the Asclepiadaceae family. Asclepias tuberosa, a native of the United States and southern Ontario, is the most variable of the northeastern milkweeds (3). Its leaves are irregularly alternate, rarely opposite, linear-lanceolate to occasionally oblong. The juice of the stem and leaves of this species is not milky. Flowers consist of a deeply 5-parted corolla with orange to yellow hoods.

Asclepias syriaca is an alien species that arrived in eastern North America shortly after the country was settled by Europeans. Its leaves are opposite and are much larger than those of A. tuberosa. The plant has a milky latex, and the green to white - purplish flowers are 12 - 25 mm long (3). Both milkweeds are common at Hempstead Plains with the alien, A. syriaca, favoring disturbed sites and the native A. tuberosa favoring undisturbed sites. However, they often grow within 10m of each other at Hempstead Plains; and this attracted our interest in their comparative water relations and gas exchange behavior.

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On 12 middays from May 1986 through May 1987, we measured the xylem water potentials for plants of A. tuberosa and A. syriaca. The mean for A. tuberosa was -1.2 bars (± 0.52 SD, n=19); and it was very significantly different (F = 9, P < .01 in ANOVA) than the mean of -8.0 bars for A. syriaca (± 8.91 SD, n=22). Since over the course of a year, the smaller leaves of A. tuberosa experienced less water stress, and were less variable in their water potentials than the nearby, and larger leaves of A. syriaca, we hypothesized that there would be differences in gas exchange rates. Also, since Solidago canadensis L. (goldenrod) is a dominant forb and Prunus serotina Ehrh. (black cherry) is the most successfully invading woody taxon at the site, we decided to include plants of these species in the gas exchange study.

METHODS

The LI-6200 Portable Photosynthesis System (LI-COR Inc., Lincoln, Nebraska), an integrated, solid state infrared gas analyzer, porometer and data logger, was used with a one liter leaf chamber for simultaneous determination of net photosynthetic rates, photosynthetically active radiation (PAR), leaf stomatal diffusion resistance, transpiration rate, vapor pressure deficit and leaf and air temperatures. Xylem water potential was measured with a Scholander-type pressure chamber (Soilmoisture Corp., Santa Barbara, CA).

The gas exchange rates of the leaves were measured at solar noon ± 1 hour at PAR values which were very stable and uniform (1749 ± 180 umol/sq.m/sec, n = 227) on August 4, September 3, and October 8, 1987. During these measurements, the difference in temperature between the air in the chamber and the leaf temperature was only 1.2 ± .88 degrees.

RESULTS AND DISCUSSION

Net photosynthesis was highest in A. tuberosa in August (21.1 umol/sq.m/sec) (Table 1) and declined over the study period. As expected, on October 8, several leaves of both milkweeds were in negative carbon balance (Figure 1). Net photosynthesis for A. syriaca was lower on August 4 but higher on September 3 than A. tuberosa. The photosynthetic rates were identical in October, a time of senescence. Stomatal diffusion resistance was consistently and significantly higher in A. tuberosa than in A. syriaca (Table 1), correlating nicely with it's higher xylem water potentials at the time of gas exchange measurement and over the preceeding year. The lower graph of Figure 1 shows that while the response curves for transpiration versus air dryness are identical in slope between the two milkweeds, A. tuberosa loses less water at any given atmospheric vapor pressure deficit.

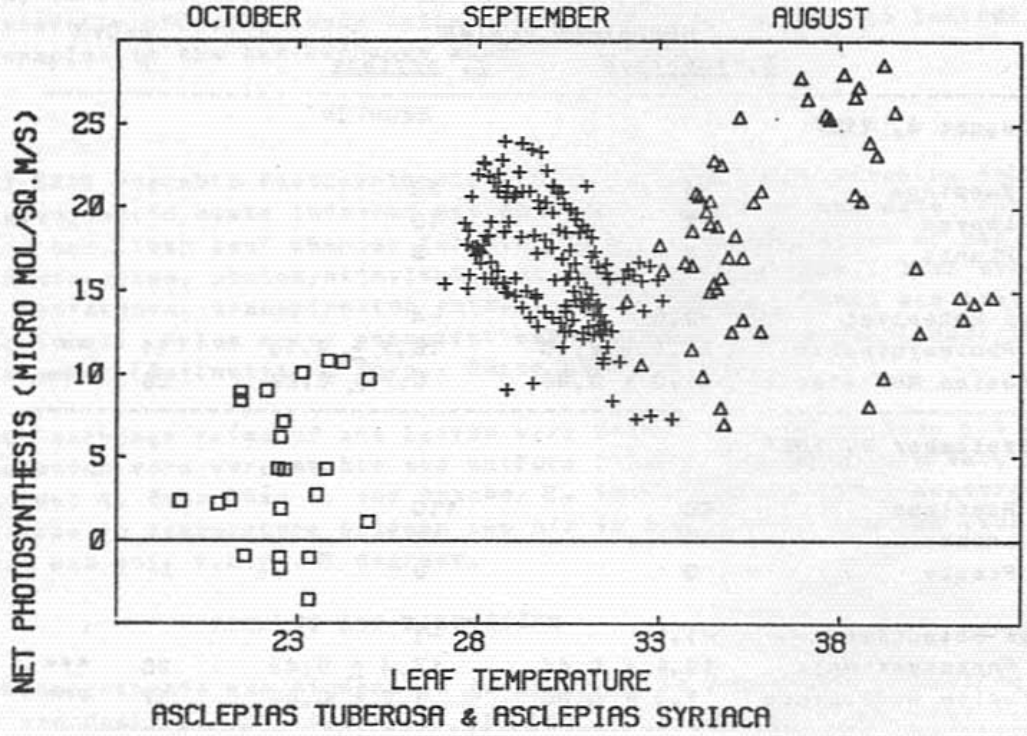
Compared to A. syriaca, A. tuberosa has higher water use efficiency (mol fixed per mol water lost); maintains lower transpiration rates with higher stomatal diffusion resistances; and maintains much higher xylem water potentials (-1.2 versus -8 bars). Our measurements indicate that both milkweeds have nodal trends in photosynthesis and transpiration with the rates for both, peaking at intermediate nodes (Figure 2).

Cain et al. (1) studied the vegetation of Hempstead Plains and observed that "trees when present, are stunted and short-lived." He further reported that individual trees of Prunus serotina, the most common invading tree, fared poorly. Our observations of Prunus serotina in 1987 revealed healthy trees producing 0.2 m or more of twig growth. On August 4 and September 3 we recorded 42 leaf gas exchange measurements for this species. On August 4, despite a very low water potential of -23 bars in the unwilted leaves of black cherry, net

Table 1. Means and standard deviations for net photosynthesis [umol/sq.m/sec] and stomatal diffusion resistance [sec/cm] using the LI-6200 Portable Photosynthesis System [LI-COR, Inc.]. Xylem water potential was measured [-bars; 2 replications] after the gas exchange measurements were finished for a particular plant. For the gas exchange variables, single classification ANOVA was used to test means for homogeneity.

	HEMPSTEAD PLAINS		ANOVA	
	A. tuberosa	*A. syriaca*	F	P
Date: August 4, 1987				
No. Readings	24	30		
No. Leaves	12	15		
No. Plants	3	3		
Water Potential	-2.5	-4		
Net Photosynthesis	21.1 ± 6.40	16.2 ± 4.16	11	**
Diffusion Resistance	1.0 ± 0.03	0.7 ± 0.22	26	***
Date: September 3, 1987				
No. Readings	40	110		
No. Leaves	16	15		
No. Plants	3	3		
Water Potential	-1.3	-1		
Net Photosynthesis	13.8 ± 2.44	17.4 ± 3.43	38	***
Diffusion Resistance	1.5 ± 0.50	1.2 ± 0.40	17	***
Date: October 8, 1987				
No. Readings	12	11		
No. Leaves	11	11		
No. Plants	4	4		
Water Potential	-1.8	-1.5		
Net Photosynthesis	4.4 ± 4.53	4.1 ± 4.08	0	ns
Diffusion Resistance	2.5 ± 0.80	1.8 ± 0.56	6	*

Figure 1. Upper Graph: Scatterplot of net photosynthesis versus leaf temperature, merged for the two species of milkweeds, for 3 middays in 1987 at Hempstead Plains. Lower Graph: Linear, least-squares regression analysis calculated for each species and drawn within the range (in X) of the data. The two slopes are homogeneous ($F = 0.57$ for 1,223 df). *Asclepias syriaca*: N = 151 points, coefficient of determination = 0.45, t-statistic = 11.0 for regression, $P < .001$. *Asclepias tuberosa*: N = 76 points, coefficient of determination = 0.59, t-statistic = 10.3, $P < .001$.



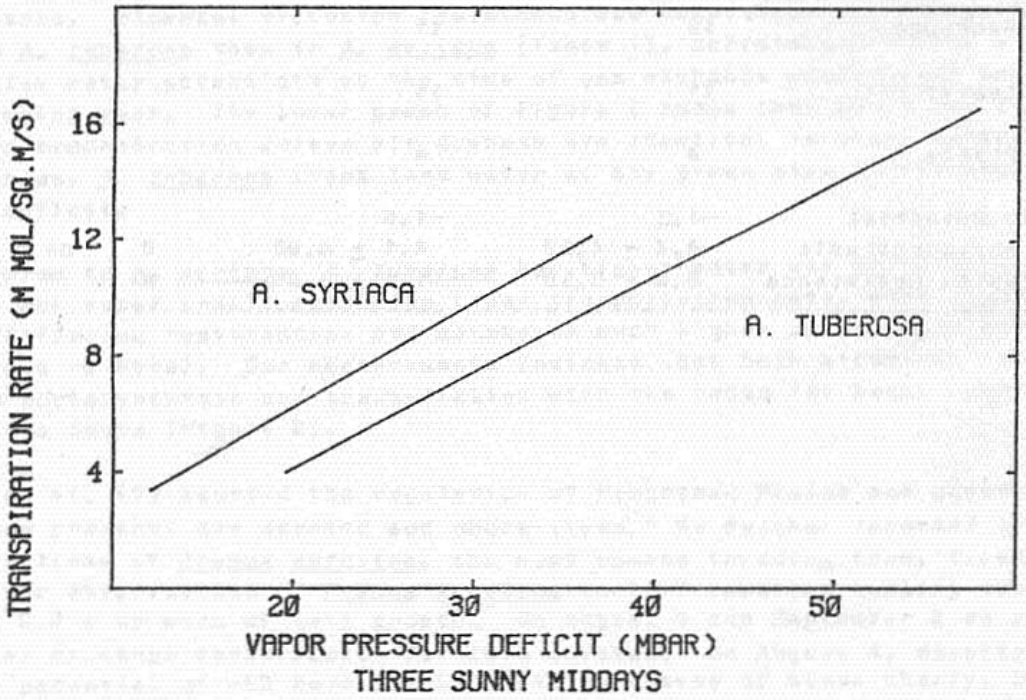
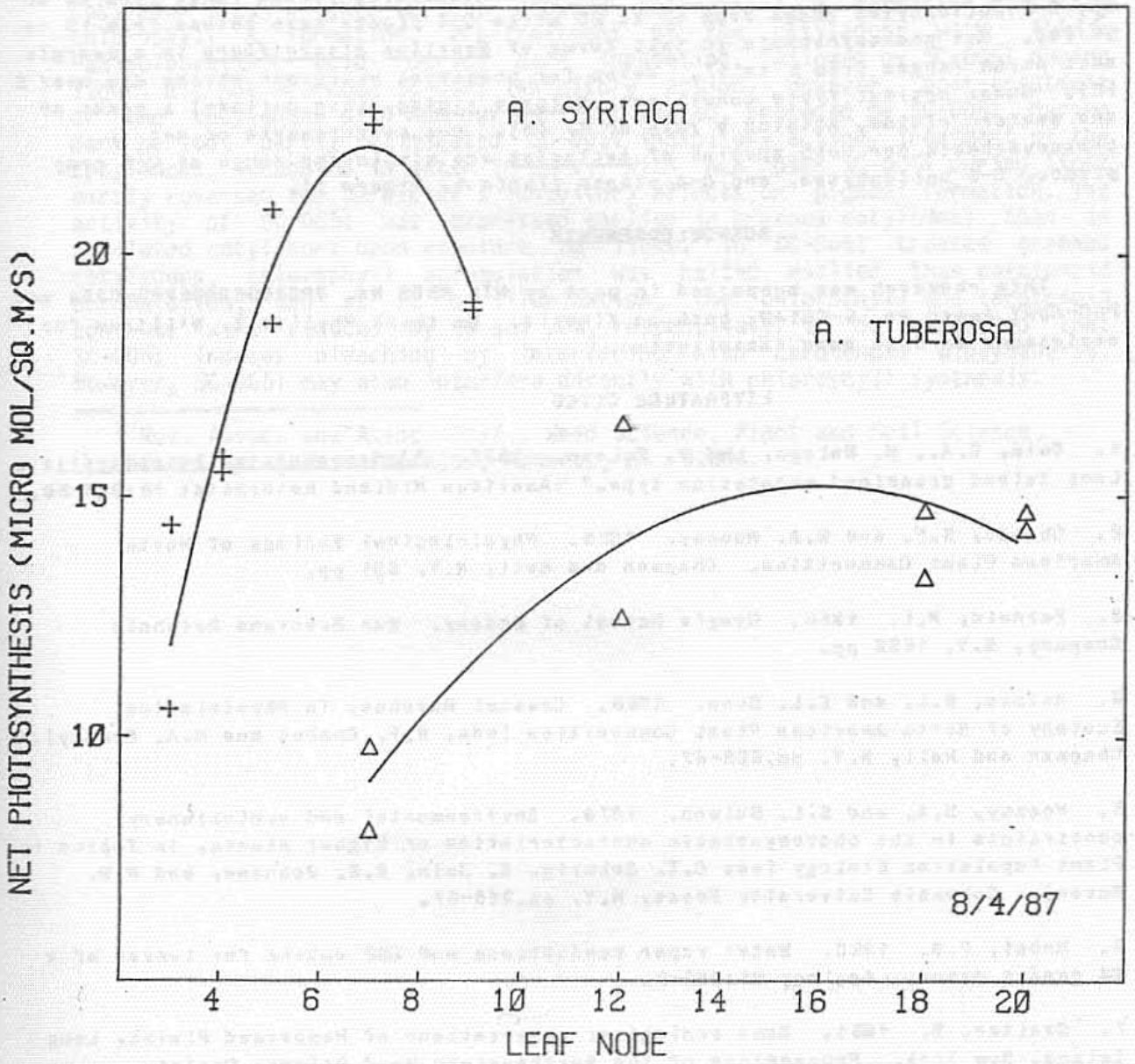


Figure 2. Leaf nodal trends in net photosynthetic rate measured for a single plant of A. syriaca and a single plant of A. tuberosa on August 4, 1987 at Hempstead Plains.



photosynthesis averaged 22.6 [umol/sq.m/sec.; n = 24 readings], the highest value of our study for any taxon [Table 1].

On August 4 and September 3 we recorded 16 leaf gas exchange measurements for Solidago canadensis, a dominant forb at Hempstead Plains [8]. On both dates, net photosynthesis was lower for Solidago than for the milkweeds [15 and 12 umol/sq.m/sec.; compare to Table 1]. Solidago was in flower at the time of measurement; and xylem water potentials were moderate [-3 to -17 bars].

There are copius references on the leaf gas exchange responses of species in a variety of habitats in North America [2]. Maximum rates per leaf area expressed in umol per sq. meter per second for C-3 crop plants range from 13 to 50; C-3 heliophytes range from 13 to 25 while C-4 plants have values from 19 to 50 [4]. Net photosynthesis in tall forms of Spartina alterniflora in a Georgia salt marsh ranges from 8 to 17. Means for chaparral evergreen shrubs are near 8 [5]. Under optimal field conditions, Hilaria rigida, [big galleta] a grass of the western plains, attains a rate of 67 [6]. Our measurements of net photosynthesis for both species of Asclepias are within the range of C-3 crop plants, C-3 heliophytes, and C-4 plants [Table 1, Figure 1].

ACKNOWLEDGEMENTS

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EFFECT OF SC-0051 ON PHOTOSYNTHETIC PIGMENT SYNTHESIS IN CUCUMBER COTYLEDONS

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ABSTRACT

The effect of SC-0051 (ICI, chemistry not released) on chlorophyll and carotenoid formation was investigated by using cucumber (*Cucumis sativus* L.) cotyledon greening system. The herbicidal activity of SC-0051 on pigment synthesis was dependent upon concentration and light intensity. Time-course of chlorophyll and carotenoid accumulation during 24 h illumination showed a concurrent decrease in both pigment levels with no apparent reduction in cotyledon fresh weight. SC-0051 reduced chlorophyll *b* formation more than chlorophyll *a* formation. Pre-treatment of the cotyledons with ALA (δ-aminoleuvulinic acid) during dark incubation, followed by SC-0051 during light, did not overcome SC-0051 inhibitory action. However, post-treatment of the cotyledons with ALA during light period, preceded by SC-0051 during dark period, partly eliminated SC-0051 inhibitory action. Treatment of the cotyledons, incubated in water in dark, with ALA plus SC-0051 during light partly reversed the herbicide's inhibitory effects on pigment formation. The activity of SC-0051 was expressed earlier in greened cotyledons than in etiolated cotyledons upon exposure to light. In SC-0051 treated greened cotyledons, chlorophyll accumulation was halted earlier than carotenoid accumulation, and at 72 h illumination, the chlorophyll and carotenoid contents were reduced by 66 and 38%, respectively. It is suggested that SC-0051 induces bleaching by interfering with carotenoid biosynthesis. However, SC-0051 may also interfere directly with chlorophyll synthesis.

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THE EFFECTS OF BAS 517 OH ON GLUCOSE-UL-^{14}C METABOLISM IN CORN ROOT TIPS

Hwei-Yiing Li and Chester L. Foy[1/]

ABSTRACT

The ^{14}C-metabolite distribution pattern following glucose-UL-^{14}C metabolism in corn (Zea mays L. 'Pioneer 3320') root tips was determined.

After a 6-hour incubation with an LC^{50} value of approximately 0.1 μM BAS 517 OH, tissue lipids were extracted and the tissue extracts were further separated into positively charged, negatively charged and neutral fractions by column chromatography.

Compared to controls, BAS 517 OH-treated tissues contained less ^{14}C-lipid and relatively more ^{14}C-labeled amino acids and carboxylic acids. The results indicate that glycolysis and the TCA cycle involved in glucose metabolism are not affected by BAS 517 OH; whereas, similar to sethoxydim, BAS 517 OH causes inhibition of lipid synthesis.

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Table 1. Percentage distribution of ^{14}C in CO_2 and lipid- and water-soluble compounds following a 6-hour incubation of corn root tips in glucose-UL-^{14}C medium with or without 0.1 μM BAS 517 OH[a].

	Control	BAS 517 OH treated
CO_2	40.3	38.2
Amino acids	21.3	28.3
Carboxylic acids	9.1	11.2
Lipids	2.2	1.4
Sugar	27.1	20.9

[a]Data represented are percentages of total radioactivity recovered from various fractions extracted from 0.5 g corn root tips, and are averages of two replications each for the control and the herbicide treatment.

HERBICIDE-INDUCED POLYAMINE ACCUMULATION

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ABSTRACT

Polyamines have been linked to cell division, growth and stress-induced responses in plants and other organisms. A number of plant species exposed to drought, mineral deficiency, acid conditions, high temperatures or high salinity have responded by accumulating endogenous putrescine. The herbicide napropamide has also produced dramatic increases in putrescine and cadaverine in pea roots meristems. An increase in these diamines occurred after cell division and DNA synthesis were reduced by 80%. This was the first report of a stress-induced polyamine accumulation resulting from herbicide exposure. Subsequent experiments reported here indicate that other herbicides with distinctly different mechanisms of action also increase the endogenous concentration of putrescine and cadaverine. Root growth, mitotic entry and polyamine levels were determined in 5 mm sections of pea root tips exposed to 10 μM glyphosate, trifluralin, chlorsulfuron, and 2,4-D. The inhibitory effect on root growth closely correlated with a reduction in the number of cells undergoing mitosis. A reduction in growth and cell division was also directly proportional to increases in putrescine and cadaverine (Table 1). After 72 h of treatment, putrescine levels were 236, 653, 793 and 1003% and cadaverine levels were 209, 417, 185 and 299% that of control in pea roots treated with glyphosate, trifluralin, chlorsulfuron and 2,4-D, respectively. The levels of spermidine and spermine, however, did not significantly different from those of control 96 h after treatment. These results suggest that an accumulation of putrescine and cadaverine may be a common response to herbicide-induced stress, similar to the response observed under of number of other stress conditions. It is possible that putrescine and cadaverine may accumulate to phytotoxic levels and consequently play an important role in the mode of action of a number of herbicides.

Table 1. Pea root growth, mitotic index, putrescine and cadaverine accumulation 72 h after treatment with 10 μM glyphosate, trifluralin, chlorsulfuron, and 2,4-D.

Herbicide	Root growth inhibition (%)	Normal mitotic figures (% total cells)	Putrescine	Cadaverine
			nmoles/g fresh wt (nmoles/root)	
control	0	5.0	318 (0.85)	216 (0.58)
glyphosate	17	2.0	749 (1.81)	451 (1.09)
trifluralin	91	0	640 (5.55)	279 (2.42)
chlorsulfuron	95	0	2523 (9.88)	400 (1.57)
2,4-D	100	0.3	3191 (14.10)	645 (2.85)

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HERBICIDE TOLERANCE OF WILD GLYCINE SPECIES

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ABSTRACT

Perennial Glycine species, which are wild relatives of the cultivated soybean (G. max), represent a widely diverse genetic pool in the soybean germplasm collection. Studies were initiated to evaluate the response of perennial Glycine species to non-selective soybean herbicides. Seeds from 20 plant accessions from G. arenaria, G. argyrea, G. canescens, G. clandestina, G. curvata, G. cyrtoloba, G. latifolia, G. latrobeana, G. microphylla, G. tabacina, and G. tomentella were germinated for 7 days and transplanted to the greenhouse. Use rates of 1.1 kg ai/ha of glyphosate, 0.01 kg ai/ha of chlorsulfuron, and 0.3 kg ai/ha of 2,4-D and atrazine were sprayed directly over top of the plants 4 weeks after transplanting, using a single plant belt-driven sprayer. Experimental design was a RCB with 3 replications. Plant heights were taken before herbicide application and at 4 weeks after application. Visual injury sysmptoms were rated on a scale from 0 (no injury) to 100 (death) at 1, 2, and 4 weeks after application. Controls were added to each accession in each replication. Glycine accessions which showed the highest tolerance to 2,4-D and atrazine were evaluated further. Atrazine and 2,4-D were applied at 0.6 kg ai/ha, 1.1 kg ai/ha, and 2.2 kg ai/ha. The same procedures as described above were used with the addition of dry weights obtained 4 weeks after application. All Glycine accessions were severely injured and stunted by the glyphosate and the chlorsulfuron treatments. Many accessions showed a high degree of tolerance to low rates of atrazine and 2,4-D (0.3 and 0.6 kg ai/ha), however, all plant accessions were severely injured at higher rates of atrazine (1.1 and 2.2 kg ai/ha). A majority of the accessions from several different species showed a high tolerance to higher rates of 2,4-D (0.6 and 1.1 kg ai/ha) However, only the G. latifolia and G. microphylla still showed a high tolerance at 2.2 kg ai/ha of 2,4-D. Injury to the G. latifolia accession 1466 and G. microphylla accession 1479 from 2.2 kg ai/ha 2,4-D was 3.3% for both accessions 4 weeks after application. The height and biomass of accession 1479 when treated with 2.2 kg ai/ha 2,4-D was 97.0 and 69.4%, respectively, of the untreated controls.

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WATER RELATIONS OF 94 TAXA, HEMPSTEAD PLAINS, NEW YORK

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ABSTRACT

Xylem water potentials for 94 taxa from Hempstead Plains, Mitchell Field, Long Island, New York were measured using a Scholander-type pressure chamber on 12 middays from May 1986 through May 1987. A total of 1195 measurements was taken. The grand mean was -11.2 bars ± 6.66 SD with a range from 0 bars down to a low of -59 bars. The frequency distribution was highly statistically significant for skewness (g1 = -1.87) and for leptokurtosis (g2 = 7.55) for the entire data set, as well as on each of the sample days. Tree saplings such as Quercus coccinea and shrubs, e.g. Rubus spp., developed low water potentials in the late fall and winter, although this pattern was not universal for all the woody species. Herbaceous taxa had an extremely wide range of water potentials during times of spring drought. Strategies such as underground protection of meristematic tissue linked to variations in the seasonality of growth, and combined with differential water relations and divergent gas exchange responses, may assist in the extraction of soil water and in the maintenance of positive carbon balance, and allow survival and growth during drought induced water stress. Our results on the highly variable nature of water status, suggest a partitioning of the habitat, perhaps assisting in the packing of 171 species within the 8 ha remnant of prairie at Hempstead Plains.

INTRODUCTION

The water status of a plant, particularly of the photosynthetic organs, influences photosynthetic rate, plant growth rate, reproduction, survival, and by inference, plant distribution. Water potential is the best measure of water status in plants because the very movement of water through the soil-plant atmosphere continuum is controlled by the decrease in water potential which exists along this continuum [3]. Xylem water potential is easily measured using a Scholander-type pressure chamber, although the method is destructive. There have been many studies of water relations in a variety of plant communities [1] but we know little about the variability that might exist, say at midday, among a large number of species in any clearly defined type of plant community. This is because it is logistically difficult to sample large numbers of leaves in a short time using the pressure chamber method.

Hempstead Plains, Long Island, New York, was once a vast treeless plain encompassing 24,291 ha (Stalter and Lamont 1987). Today the plains have been reduced to small parcels of land, the largest of which is situated on an abandoned portion of Mitchell Field. The climate, geology, soils and ecology of the plains have been described in detail by Stalter [7,9]. The flora of the 8 ha remnant of the Plains at Mitchell Field has been most recently described by Stalter and Lamont (1987), who identified 171 taxa within this site during the 1986 growing season. Because there is little vertical stratification of the vegetation in a prairie, we wished to determine if homogeneity existed in xylem water potential among a large number of the dominant taxa.

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METHODS

At solar noon [± 1 hour], we harvested the leaves and twigs of 94 species [55 % of the 171 taxa present] across the eight ha site at Mitchell Field and immediately placed them into a Scholander-type pressure chamber [Model 3000, Soilmoisture Corp., Santa Barbara, CA]. This was done on 12 dates beginning May 30, 1986 through May 1, 1987 for a total of 1195 samples. Table 1 lists these dates, with the number of taxa and the number of twigs [or leaves] measured. We were able to make large numbers of measurements within several hours by using two pressure chambers and three investigators.

Table 1. Dates, sample sizes, and means for xylem water potential measured at Hempstead Plains.

DATE	NO. SPECIES	NO. SPECIMENS	MEAN [-bars]
May 30, 1986	25	92	-15.2
June 9, 1986	40	179	-10.4
June 27, 1986	37	89	-17.0
July 22, 1986	45	131	-12.5
July 29, 1986	54	148	- 9.3
September 2, 1986	53	137	- 7.9
October 3, 1986	46	119	- 7.9
November 14, 1986	20	56	-13.6
December 11, 1986	19	54	- 8.3
January 22, 1987	10	28	-24.3
March 6, 1987	13	38	-15.1
May 1, 1987	40	124	-15.5
TOTALS	94	1195	-11.23

Table 2. Xylem water potential measurements grouped by season. Means are heterogeneous [ANOVA, F = 39 ***]. All frequency distributions are strongly skewed and leptokurtic.

SEASON	N	MEAN [bars]	SD	g 1	g 2
Spring	395	-11.2	5.34	-1.3	5.1
Summer	505	-11.1	6.22	-1.3	4.6
Fall	229	- 9.4	6.17	-1.9	5.9
Winter	66	-19.0	11.64	-1.5	2.2

Table 3. Xylem water potentials for trees, shrubs, liana, grasses, and forbs from May 1986 to May 1987. Means are heterogeneous [ANOVA, F = 7.94 ***]. All frequency distributions are strongly skewed and leptokurtic.

PLANT FORM	N	MEAN [bars]	SD	g 1	g 2
Trees	142	-13.8	6.79	-1.4	3.5
Shrubs	137	-12.3	9.17	-2.6	9.3
Liana	24	-16.7	7.56	-	-
Grasses	61	-13.0	6.30	-1.2	2.7
Forbs	260	-10.5	6.53	-1.1	2.4

Table 4. Xylem water potentials for five goldenrods, Hempstead Plains, New York. Means are heterogeneous [ANOVA, F = 6.0 ***]

SPECIES	N	MEAN [bars]	SD
Solidago canadensis	24	-8.9	5.43
Solidago nemoralis	17	-11.7	3.71
Solidago rugosa	13	-12.6	3.17
Solidago graminifolia	20	-15.0	4.59
Solidago tenuifolia	3	-16.3	1.53

The plant material was sealed in the pressure chamber with the cut surface of the stem or leaf petiole protruding. We observed the cut surface with a hand lens while air pressure in the chamber was gradually increased. As chamber pressure increases, chamber pressure energeticaly matches the xylem tension, and the water column in the xylem is forced back up to the cut surface. When bubbles first appear on the cut surface of the twig or petiole, the pressure within the chamber equals the water potential [in negative bars] of the xylem of the plant material at excision. When the bubbles appear, the investigator immediately turns off the air supply valve and records the pressure reading. A fully hydrated leaf under no water stress may approach 0 bars water potential - the state of free water. The drier [lower water potential] the tissue, the greater the balance pressure.

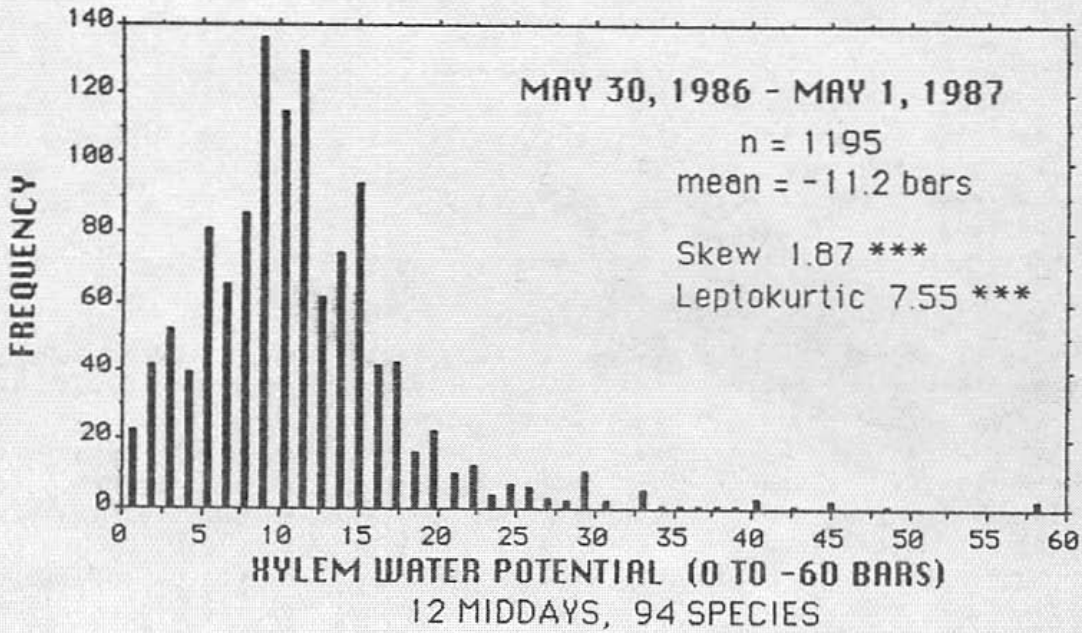
RESULTS AND DISCUSSION

A total of 1195 measurements was taken. The grand mean was -11.2 bars ± 6.66 SD with a range from 0 bars down to a low of -59 bars. The frequency distribution was highly statistically significant for skewness and for leptokurtosis for the entire data set [g1 = -1.87; g2 = 7.55; Figure 1], as well as on each of the sample days and for the different life forms. Relative to a normal probability distribution, our data had more extremely low water potential values, and had more values clumped around the mean. Water potentials were highest [i.e. under the least amount of water stress] in the fall and were lowest in the winter [Table 2]. The means for the seasons were heterogeneous [ANOVA, F = 39 ***].

During the growing season, mean water potentials for all species varied from -17 to -9.3 bars (Table 2). Plains species develop significantly different water potentials during any test period (e.g. Table 4). Solidago canadensis is least water stressed of the goldenrods (mean = -8.9 bars, N = 24) while the most common goldenrod, Solidago graminifolia develops a significantly lower water potential (mean = -15, N = 20) during the growing season.

A comparison of mean water potential for trees, shrubs, a single liana, grasses and forbs indicates that the liana, Celastrus orbiculatus experienced the greatest water stress. Individual twigs of Quercus coccinea developed water potentials as low as -45 bars during the winter of 1987 while Rubus flagellaris went down to -58 bars. Forbs generally were the least water stressed (Table 3).

Figure 1. The frequency distribution of the xylem water potential for 94 species, Hempstead Plains, New York.



Water potential measurements under normal conditions in the growing season have yielded results ranging from -1 bars in aquatic plants (5), -4 to -10 bars in several species of Viola in New England (2), to - 24 bars in Ilex opaca (8), to - 52 bars in Picea pungens (5). For the latest summary information on water potentials in the field for North American species see Chabot and Mooney (1).

In general, deciduous leaves of mesic species wilt when water deficits decline to around -15 bars water potential. Both deciduous and evergreen trees show diurnal trends in water potential corresponding to the cycles of opening and closing of the stomata. The pre-dawn water potential of a leaf is in equilibrium with the soil around the roots. As the sun rises, gas exchange begins, leaf water potential declines to a low at midday and early afternoon. For evergreen leaves in winter, the stomata are closed, water loss rates are reduced 10 to 100 fold and almost no diurnal cycles in water potential develop (6).

The plants at Hempstead Plains exist in an environment subject to burning, grazing, and drought [7]. An excellent account of the adaptations of grassland plants to water stress is found in Risser [4]. Some of the physiological and morphological adaptations to drought include pubescence, sunken stomates, motor cells that aid in leaf curling; earlier seasonal growth e.g. members of the Brassicaceae and Caryophylaceae, and greater water use efficiency with a C-4 pathway [1,2,4,8]. Moreover, the meristematic tissue of perennial Plains grasses and Carex pensylvanica is underground and therefore protected during burning.

There are few trees and shrubs at Hempstead Plains [9]. Most Plains species have their perennating tissue protected during the unfavorable part of the growing season. In our study, some woody vegetation is subjected to extreme water stress in winter [Table 1]. While some twigs subjected to low water potentials in winter undoubtedly die, the twigs we tested and examined with a hand lens had a moist cross section. Moreover, the death of twigs may not lead to the death of plants. Thus the presence of the predominantly herbaceous vegetation at Hempstead Plains may involve water relations as well as life history strategy, yearly carbon balance, herbivory, and role in succession.

ACKNOWLEDGEMENTS

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THE EFFECTS OF THREE PHENOLIC ACIDS ON CORN SEED GERMINATION AND RADICLE AND SHOOT GROWTH

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ABSTRACT

In this preliminary study, the allelopathic effects of ferulic acid, gallic acid, and vanillic acid were examined on corn (Zea mays L.) seed germination and root and shoot elongation. The concentrations used were 0, 5×10^{-5}, 1×10^{-4}, 5×10^{-4}, 1×10^{-3}, 5×10^{-3}, 1×10^{-2} M. Germination experiments were conducted in the dark at 25° C. Shoot and root lengths of germinated seeds were measured after 7 days. Statistical analysis of the data using the least square estimate method indicated that the three allelochemicals inhibited seed germination as well as root and shoot elongation. Ferulic acid was most effective in inhibiting root and shoot growth, while gallic acid was most effective in inhibiting seed germination. Moreover, the 1×10^{-3}, 5×10^{-3}, and 1×10^{-2} M concentrations were more inhibitory than the other concentrations used in these experiments.

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ALTERATION OF MEMBRANE PERMEABILITY BY ALLELOCHEMICALS IN SUSPENDED CELL CULTURES

M. E. Radecke and S. Glenn[1/]

ABSTRACT

Studies were conducted to assess the mode of action of two common phenolic acids on cell growth. Caffeic acid and t-cinnamic acid at 10^{-3} M were added at the time of subculturing (0-day) to mixaploid rice cell suspension cultures grown on modified MS media amended with 146 mg/L glutamine, 0.1 mg/L 6-Benzyladenine and 2 x 10^{-6} M 2,4-D. The cell suspensions were subcultured every 7 days to ensure continuous cell division. Growth of the treated cell suspension cultures was measured by the settled cell volume technique after 7 days. Addition of caffeic acid and t-cinnamic acid resulted in a 70% reduction in cell volume as compared to the controls (0.1 ml MeOH). Cells treated with caffeic acid became black after 24h. This was believed to be due to the formation of an orthoquinone complex between caffeic acid and hydroxide ions released from the cells. A similar phenomenon was noted when caffeic acid + 0.1 N KOH were added. The blackening of the cells, however, was instantaneous. Caffeic acid + KOH caused only slight growth inhibition of the cells. The adverse effect of t-cinnamic acid, however, was not reversed by the addition of 0.1 N KOH. Electrical conductivity measurements were obtained 0, 1, 3, 5, 24, and 168h after treatment to monitor ion flux. Initially (24h) no differences among the treatments were recorded. Higher conductivity values, however, were measured after 168h in cell cultures treated with caffeic acid and t-cinnamic acid ± KOH compared to the controls and caffeic + KOH. These high readings are indicative of cell growth inhibition. To determine the time of cell death a viability test was conducted using fluorescein diacetate. Untreated and treated rice cells were examined after 0, 5, 24, 48, and 168h. A reduction in cell viability was observed in cultures treated with t-cinnamic acid ± KOH and caffeic acid after 5h. Reduced viability was more evident with time. Cells treated with caffeic acid + KOH remained viable after 168h. To determine whether caffeic acid is interferring with permeability of the plasmalemma, 0.1 ml of ^{14}C-urea (200,000 DPM) were added to the suspension cultures at 0-day. Absorption of ^{14}C-urea into cells treated with 0 or 10^{-3} M caffeic acid ± 0.1 N KOH was measured 1, 3, 5, 24, 48, 72, and 168h after treatment. Caffeic acid increased ^{14}C-urea absorption 22% and 26% compared to the controls and caffeic acid + KOH, respectively, after 3h. At 24h, caffeic acid significantly reduced ^{14}C-urea accumulation compared to the controls. This trend continued with later samplings and was also evident when KOH was added. Since caffeic acid reduced the accumulation of ^{14}C-urea in cells in the presence or absence of KOH it does not appear that this effect is responsible for cell growth inhibition. The initial increase in ^{14}C-urea absorption due to caffeic acid treatment was not evident in the presence of KOH. This suggests that factors responsible for this accummulation of urea may cause the eventual death of cells.

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WEED-CROP RESPONSES TO HERBICIDES ON FIVE YEAR NO-TILL CORN

C. B. Coffman and J. R. Frank [1]

ABSTRACT

Long term effects of continous corn (Zea mays L.) plus annual herbicide applications on weed flora have been investigated in a conservation tillage study composed of strict no-till and minimum till systems. Measurements taken included crop and weed growth, crop yields, weed cover, and dominant weed species frequency and distribution. Comparisons were made among herbicide treatments as well as handweeded and unweeded controls. The study was conducted in the Piedmont physiographic provence of Maryland on a Duffield silt loam. The site had a well established weed population consisting largely of annual grasses and perennial broadleaved species, maintained by infrequent mowing and having no cropping history for at least a decade prior to esablishment of this research project. Strict no-till studies utilized tank mixtures of preemergence corn herbicides whereas minimum tillage studies utilized tank mixtures of EPTC+ or butylate+ with atrazine. Table 1 shows the annual percent weed cover per treatment plus the five year treatment means. Thiocarbamate plus atrazine mixtures, minimally incorporated, and no-till preemergence treatments containing alachlor and atrazine generally resulted in the best weed control. The most ubiquitous weed over time and across treatments was smooth pigweed (Amaranthus hybridus L.). Perennial species including poison ivy (Rhus radicans L.), Canada thistle (Cirsium arvense (L.) Scop.), and hemp dogbane (Apocynum cannabinum L.) tended to remain associated with field locations where they were first observed at the beginning of the investigation. However, horsenettle (Solanum carolinense L.) was distributed throughout treatment replications and across treatments by the end of the five-year investigation.

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Table 1. Annual percent weed cover responses to herbicide treatments in a conservation tillage system[a].

Treatments	1981	1982	1983	1984	1985	mean
Unweeded control	98a	99a	100a	98a	100a	99a
Strict no-tillage						
Atrazine[b], simazine, paraquat	50c	80ab	65abc	75ab	60bcd	66b
Atrazine, alachlor, paraquat	61bc	70ab	40bcd	18ef	22e	42cd
Atrazine, simazine, glyphosate	49c	56b	75ab	43cde	33de	51c
Atrazine, alachlor, glyphosate	62bc	61b	35cde	15f	12e	37d
Atrazine, cyanazine, paraquat	63bc	72ab	93a	82ab	58bcd	74b
Atrazine, cyanazine, glyphosate	61bc	62b	93a	70bc	60bcd	69b
Cyanazine, alachlor, paraquat	88ab	67b	47bcd	67bc	73ab	68b
Cyanazine, alachlor, glyphosate	91ab	74ab	37cde	55bcd	67bc	64b
Minimum tillage						
Atrazine[c], EPTC+	39c	85ab	28cde	17ef	40cde	42cd
Atrazine[c], butylate+	39c	78ab	22de	32def	53bcd	45cd

[a] Values within columns followed by the same letter are not statistically different at the 5% level according to the LSD test.

[b] Rates of herbicides: atrazine 2.8 kg/ha; simazine 2.2 kg/ha; paraquat 0.56 kg/ha; alachlor 2.8 kg/ha; glyphosate 2.2 kg/ha; cyanazine 2.2 kg/ha; EPTC+ 4.5 kg/ha; butylate+ 4.5 kg/ha.

[c] Atrazine rate with EPTC+ and butylate+ 2.2 kg/ha.

BIOLOGY AND ECOLOGY OF *Bidens cernua* L. AND *B. vulgata* GREENE

D.L. Benoit

Both nodding beggarticks (*Bidens cernua* L.) and tall beggarticks (*B. vulgata* Greene) are found in ditches and marshes of southwestern Quebec, Canada. *B. cernua* has recently become a serious weed in carrots grown in much soil while *B. vulgata* has remained a weed found mostly in ditches. A common garden experiment was set up in 1985 and in 1987 to describe and compare the growth characteristics of these two species in a non-competitive situation. Hardened seedlings of uniform age and size were randomly transplanted at equidistance (1m x 2m apart) in late spring (May 24, 1985 and May 29, 1987). No fertilizers or pesticides were used and weed control was maintained by frequent hoeing. Four randomly chosen plants of each species were harvested at two weeks interval and biomass production was determined. *B. vulgata* had a smaller leaf area index and initiated flowering four weeks earlier than *B. cernua*. Tall beggarticks produced less total biomass, fewer flowers and fewer seeds per flower than nodding beggarticks. The latter also produced adventicious roots at the internodes of its lower branches, providing better anchorage to the plant. The stem of *B. vulgata* was easily damaged by wind. The flowers of *B. cernua* produced a sweet smelling nectar which was highly attractive to bees, bumblebees (Apidae) and waps (Vespidae). Excellent herbicide tolerance was observed for *B. cernua* regardless of the herbicide used and the timing of application. A high seed output coupled with the reduced tillage practiced in carrot production in muck soil, ensured that this weed maintained its population size eventhough its seed bank was short-lived. Both the growth characteristics and herbicide tolerance can provide an explanation for the recent high frequency (70%) of *B. cernua* in carrot fields in Quebec.

ALLELOPATHIC PROPERTIES OF SUBTERRANEAN CLOVER

M.J. Else and R.D. Ilnicki

ABSTRACT

Recent research has shown that living mulches can provide both erosion and weed control in row crop systems. In New Jersey, the winter annual pasture legume subterranean clover (Trifolium subterraneum L.) has been used as a living mulch in no-till corn. Excellent weed control was provided both in the cool months of the year and in the summer when only dead subclover residue was present. Allelopathic properties have been found in a large number of plants, including some Trifolium species, and thus the possibility of allelopathy in subclover was investigated. Seed germination bioassays showed allelopathic activity of water extracts of subclover plants collected both when actively growing and as dead residue. Reductions and/or delays in germination and reduced root and shoot growth were found in a wide range of species, including radish (Raphanus sativus L.), lettuce (Lactuca sativa L.), garden cress (Lepidium sativum L.), barnyardgrass (Echinochloa crus-galli), and johnsongrass (Sorghum halepense L.). Some autotoxicity was evident as well. Sub clover seedlings also exhibited some allelopathic properties, and the activity appeared to be both in the seed coat and in seedling tissue. It is concluded that the investigation of possible allelopathic effects in living mulches is important, both from a weed control standpoint and because a highly allelopathic mulch could negatively affect the crop planted into it.

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[1]New Jersey Agricultural Experiment Station Publication No. J-15173-3-87

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SOIL MOISTURE RELATIONSHIPS OF CLOMAZONE

William K. Vencill, Henry P. Wilson, Thomas E. Hines, and Kriton K. Hatzios [1/]

ABSTRACT

Greenhouse studies were initiated to determine the effect of soil moisture on clomazone efficacy in sterilized and unsterilized soil. Treatments of clomazone at 0.6, 0.8, and 1.1 kg/ha were made to sterilized and unsterilized soil. One set of treatments was saturated for one week after application while the other set was left dry. Flats were seeded with large crabgrass [*Digitaria sanguinalis* (L.) Scop.]. Clomazone efficacy was determined by visual injury (bleaching) and fresh weight. Clomazone treatments made to sterilized soil had significantly higher visual injury and lower fresh weight than treatments to unsterilized soil. Visual injury was significantly greater in clomazone-treated dry soil than saturated soil, while significant differences in fresh weight were not found. These studies indicate that soil moisture may affect clomazone efficacy in the soil via microbial degradation.

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HERBICIDAL EFFECTS OF FOMESAFEN[1]

Robert M. Devlin[2] and Zdzislaw K. Koszanski[3]

ABSTRACT

The effect of fomesafen on the germination and growth of wheat and radish, pigment synthesis in etiolated corn leaves, and biomass synthesis in bean was studied. Fomesafen had little effect on the germination of wheat and radish. At 100 ppm, fomesafen inhibited wheat shoot and root growth. Radish was more sensitive to fomesafen than wheat, 1 ppm of the herbicicde causing shoot fresh and dry weight inhibition. Fomesafen inhibited the synthesis of chlorophyll and carotenoid pigments in etiolated corn leaf sections exposed to light. Biomass synthesis in bean leaves was also inhibited by fomesafen.

INTRODUCTION

Fomesafen{5-[2-chloro-4-(trifluromethyl)phenoxy]-N-(methylsulfonyl)-2-nitrobenzamide} is a relatively new herbicide that has shown strong postemergence activity on a wide spectrum of broadleaf weeds when applied over the top on soybeans (1,2,7,). At higher rates than needed for postemergence, broad spectrum preplant or preemergence activity can also be obtained for soybeans (2).

Fomesafen belongs to a class of herbicides called diphenylethers that are activated in light by carotenoids before initiating radical chain reactions with membrane fatty acids (4,8,). Disruption of cellular membranes follows, causing loss of selective permeability finally leading to cellular death.

In the present study the influence of fomesafen on the germination and growth of wheat (*Triticum aestivum* L.) and radish (*Raphanus sativus* L.), pigment synthesis in etiolated corn (*Zea mays* L.) leaf sections, and biomass synthesis in bean (*Phaseolus vulgaris* L.) leaves was studied.

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MATERIALS AND METHODS

Seeds of wheat and rasish were imbibed for 6 h in solutions of fomesafen. For germination tests some of the imbibed seeds were transferred to 9-cm petri dishes containing three pads of filter paper. Each dish contained 50 seeds and 7 ml (5 ml for radish) of distilled water. Constant conditions were maintained by allowing the seeds to germinate in the dark at 25±1°C in an incubator. Germination was recorded one, two, and three days (radish) or two, three, and four days (wheat) after planting.

The remaining imbibed seeds were sown in 8-cm styrofoam pots (15 seeds per pot) containing moist vermiculite and grown in a growth chamber under constant conditions of light (152 $\mu E\ m^{-2}s^{-1}$, 16 h light and 8 h dark) and temperature (22±1°C). After shoot emergence 40 ml of 1/2 strength Hoagland solution were applied daily to each pot. After 10 days (wheat) and 14 days (radish) the seedlings were removed from the pots and the roots thoroughly washed. The ten largest seedlings (determined by shoot length) from each pot were selected and their shoot length, root length, fresh weight, and dry weight determined.

For pigment synthesis experiments corn seeds were soaked for 6 h in distilled water. The imbibed seeds were sown in styrofoam pots containing moist vermiculite and grown in complete darkness in a growth chamber for eight days at 25±1°C. Under safelight the coleoptiles were removed and the primary leaf cut into one cm sections. The etiolated leaf sections were floated on different solutions of fomesafen in petri dishes. The pH of all solutions was adjusted to 6.8±0.2. The petri dishes were then placed in the growth chamber in complete darkness at 25°C. After 8 h in the dark the leaf sections were exposed to light (152 $\mu E\ m^{-2}s^{-1}$) for 8, 14, and 32 h in the growth chamber. After each time period leaf sections were analyzed for chlorophyll and carotenoid content according to the methods of Devlin et al. (3).

The effect of fomesafen on biomass synthesis in bean leaves was determined according to the methods of Devlin et al. (5). Bean seeds were soaked for 6 h in distilled water. The imbibed seeds were sown in styrofoam pots containing moist vermiculite and grown in a growth chamber under constant conditions of light (167 $\mu E\ m^{-2}s^{-1}$, 16 h light, 8 h dark) and temperature (21±1°C). After shoot emergence 50 ml of Hoagland solution was applied daily to each pot. After 18 days of growth fomesafen was applied as a mist spray (10 ml per pot). The plants were returned to the growth chamber and grown under the same previously described conditions. Three days after treatment disks, 1.5 cm in diameter, were punched out of the bean leaves with a cork borer and their fresh and dry weight determined. Following removal of the disks, the plants were returned to the growth chamber for 24 h under continuous light (167 $\mu E\ m^{-2}s^{-1}$) and temperature (25°C). Leaf disks were again taken and their fresh and dry weight determined. All experiments were replicated four times.

RESULTS AND DISCUSSION

Fomesafen had very little effect on the germination of radish. Slight inhibition (14%) occurred at 1,000 ppm (Table 1). Germination of wheat treated with fomesafen was both delayed and inhibited. Four days after planting, germination of wheat treated with 10 ppm fomesafen was inhibited 7% (Table 1). Increasing the concentration of fomesafen to 100 and 1,000 ppm had little additional effect on wheat germination (Table 1).

Table 1. Effect of fomesafen on the percent germination of wheat and radish.

Fomesafen (ppm)		Days after planting-Radish 1	2	3	Days after planting-Wheat 2	3	4
0		71	98	98	90	94	96
10^{-2}		69	96	97	87	89	91
10^{-1}		70	98	99	88	90	90
10^{0}		67	95	97	86	87	88
10^{1}		73	96	97	84	88	89
10^{2}		67	93	95	84	87	88
10^{3}		55	82	84	81	87	88
LSD	5%	11	4	3	4	5	4
	1%	15	5	4	5	7	6

At 100 ppm fomesafen caused a 27% inhibition of wheat shoot growth in length and at 1,000 ppm a 64% inhibition (Table 2). Wheat shoot fresh weight and dry weight were similarly affected. For example, at 100 ppm fresh weight was down 26% and dry weight down 11%. At 1,000 ppm fomesafen, shoot fresh weight was down 66% and dry weight down 62% (Table 2). Growth in length of wheat roots was only slightly inhibited (9%) by 1,000 ppm fomesafen. At that concentration root fresh weight and dry weight were down 28 and 30%, respectively (Table 2).

Radish growth was more sensitive to fomesafen than wheat. For example, at 10 ppm fomesafen radish shoot growth in length, fresh weight, and dry weight were inhibited 87, 97, and 88%, respectively (Table 3). Even at 1 ppm the herbicide significantly reduced radish shoot fresh weight and dry weight (Table 3). At 1 ppm fomesafen the length of radish roots was reduced 21% and root fresh weight and dry weight reduced 30 and 29%, respectively (Table 3).

The synthesis of chlorophyll and carotenoid pigments in etiolated corn leaf sections exposed to light was inhibited by fomesafen. The chlorohyll content of sections treated with 0.1, 1, and 10 ppm fomesafen and exposed to 8 h light was reduced 25, 32, and 52%, respectively (Table 4). In addition, there was an inverse relation-

ship between the chlorophyll a:b ratio and the concentration of fomesafen used. For example, etiolated corn leaf sections exposed to 8 h light had a chlorophyll a;b ratio of 2.06. When treated with 0.1, 1, and 10 ppm fomesafen the a:b ratio dropped to 1.79, 1.63, 1.00, respectively (Table 4).

Table 2. Effect of fomesafen on the growth of wheat.

		Shoots			Roots	
Fomesafen (ppm)	Length (mm)	Fresh Wgt (mg/10pl)	Dry Wgt (mg/10pl)	Length (mm)	Fresh Wgt (mg/10pl)	Dry Wgt (mg/10pl)
0	183	1695	185	142	1411	128
10^{-2}	193	1740	190	149	1376	124
10^{-1}	186	1693	184	146	1426	121
10^{0}	189	1711	187	142	1317	117
10^{1}	187	1746	196	142	1474	132
10^{2}	134	1256	165	138	1084	101
10^{3}	66	575	71	129	1022	90
LSD 5%	9	123	11	8	145	12
1%	12	167	14	11	198	16

Table 3. Effect of fomesafen on the growth of radish.

		Shoots			Roots	
Fomesafen (ppm)	Length (mm)	Fresh Wgt (mg/10pl)	Dry Wgt (mg/10pl)	Length (mm)	Fresh Wgt (mg/10pl)	Dry Wgt (mg/10pl)
0	48	4763	333	140	1145	70
10^{-2}	48	4759	313	141	1289	72
10^{-1}	50	4777	337	129	1205	71
10^{0}	46	3972	278	110	798	50
10^{1}	6	164	39	44	219	13
10^{2}	5	156	34	32	169	9
10^{3}	6	155	42	29	127	8
LSD 5%	3	475	29	18	135	7
1%	4	646	40	24	184	9

Exposing etiolated leaf sections to longer periods of light (14 and 32 h) affected chlorophyll production and the chlorophyll a:b ratio in a manner similar to the 8 h light exposure (Table 4)

Etiolated leaf sections treated with fomesafen and then exposed to 8 h light showed a reduction in carotenoid pigment content. Leaf sections treated with 0.1, 1, and 10 ppm fomesafen showed reductions in carotenoid content of 8, 13, and 30%, respectively (Table 5). Under more prolonged periods of light this negative effect on carotenoid production was increased. For example, etiolated leaf sec-

tions treated with 0.1, 1, and 10 ppm fomesafen and then exposed to 32 h light showed reductions of 29, 49, and 80% respectively (Table 5).

Table 4. Effect of fomesafen on chlorophyll synthesis in etiolated corn leaf sections exposed to different periods of light. Total chlorophyll (TCHl) is recorded in ug/g fresh tissue.

Fomesafen (ppm)	8 h Light Chl a:b	8 h Light TChl	14 h Light Chl a:b	14 h Light TChl	32 h Light Chl a:b	32 h Light TChl
0	2.06	104	2.50	133	3.08	268
10^{-1}	1.79	78	2.15	103	2.80	166
10^{0}	1.63	71	1.59	88	2.08	117
10^{1}	1.00	50	0.87	58	0.79	77
10^{2}	0.69	54	0.63	52	0.59	59
10^{3}	0.62	41	0.60	47	0.56	53
LSD 5%	—	18	—	19	—	26
1%	—	25	—	26	—	36

Table 5. Effect of fomesafen on carotenoid synthesis in etiolated cornleaf sections exposed to different periods of light.

Fomesafen (ppm)	8 h Light (ug/g)	8 h Light (%)	14 h Light (ug/g)	14 h Light (%)	32 h Light (ug/g)	32 h Light (%)
0	76	100	84	100	136	100
10^{-1}	70	92	75	89	96	71
10^{0}	66	87	60	71	69	51
10^{1}	53	70	41	49	27	20
10^{2}	45	59	30	36	19	14
10^{3}	51	67	33	39	19	14
LSD 5%	12	—	11	—	13	—
1%	16	—	14	—	18	—

The adverse effect of fomesafen on chlorophyll and carotenoid production is most likely due to a loss of cell membrane selective permeability. Diphenylether herbicides are activated by light absorbed by carotenoid pigments (4,8,), the carotenoids apparently being destroyed in the process (6). The activated herbicide then causes the initiation of a free radical chain reaction with polyunsaturated fatty acid moieties of phospholipid molecules found in cellular membranes. This results in a loss of membrane selective permeability eventually leading to cellular death (8).

Biomass synthesis was inhibited by fomesafen. Over a 24 h period a 13% drop in dry weight was recorded in bean leaves previously treated with 10 ppm fomesafen. At 100 ppm the herbicide reduced fresh weight by 20% and dry weight by 27% (Table 6). The

reduction of biomass synthesis is most likely due to the inhibitory influence of fomesafen on chlorophyll and carotenoid production.

Table 6. Effect of fomesafen on biomass synthesis in bean leaves.

Fomesafen (ppm)		Fresh Weight ($mg/m^2/h$)	Fresh Weight (%)	Dry Weight ($mg/m^2/h$)	Dry Weight (%)
0		423	100	78	100
10^{-1}		422	100	79	101
10^{0}		439	104	83	106
10^{1}		417	99	68	87
10^{2}		337	80	57	73
10^{3}		221	52	52	66
LSD	5%	15	—	7	—
	1%	21	—	9	—

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WEED SUPPRESSION BY HAIRY VETCH RESIDUE

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ABSTRACT

Hairy vetch (Vicia villosa L. Roth) residue was removed from the field during the spring of 1987 and assayed for weed suppression in the greenhouse. Weed seeds were planted in a sandy loam soil in metal flats prior to adding various rates of hairy vetch residue to the soil surface. Emerged weeds were counted and weighed at three weeks after planting. A cubic regression model with hairy vetch residue dry weight as the independent variable gave a reasonable fit to all data.

There was 3870 kg/ha of dry matter of hairy vetch in the field when residue was collected on May 13, 1987. This is typical of hairy vetch rates reported by other researchers. In the greenhouse assay, this rate of hairy vetch residue on the soil surface did not provide much weed suppression. Averaged over all weed species tested, weed numbers were reduced by only 37% and weed fresh weight was reduced by only 23% compared to control values.

Weed species differed in response to hairy vetch residue. Velvetleaf (Abutilon theophrasti Medik.) growth was stimulated by field rates of hairy vetch while a rate of approximately 8000 kg/ha was required to reduce velvetleaf growth by 90%. Green foxtail (Setaria viridis (L.) Beauv.) was more sensitive than velvetleaf to hairy vetch residue and required approximately 7000 kg/ha for a 90% growth reduction. Redroot pigweed (Amaranthus retroflexus L.) was the most sensitive species tested. Pigweed growth was reduced by 50% by field rates of residue and required approximately 6000 kg/ha for a 90% growth reduction.

Hairy vetch residue was collected at three times: May 7, 1987, the day before paraquat application; May 13, 1987, five days after paraquat application; and June 9, 1987, one month after paraquat application. Residue collected either just before or just after paraquat application did not differ in suppression of the three weeds described above. However, residue collected one month after paraquat application was less suppressive than residue collected earlier when comparisons were made at equivalent residue rates. The rate of one-month-old residue required to give 90% reduction in growth of pigweed, foxtail, and velvetleaf was approximately 9000 kg/ha, 13000 kg/ha, and >17000 kg/ha, respectively. These data suggest that maximum weed suppression by hairy vetch residue occurs shortly after hairy vetch death. However, even at this time, normal field rates of dead hairy vetch residue will not provide much weed suppression and other methods of weed control will be needed.

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OBSERVATIONS ON HYPERA RUMICIS (L.), A WEEVIL FEEDING ON CURLY DOCK

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ABSTRACT

Observations and experiments at Mansfield, Connecticut suggest that *Hypera rumicis* (L.) (Coleoptera: curculionidae) is affecting the perennial weed, curly dock (*Rumex crispus* L.). A computer and manual literature search and personal communication with biocontrol workers revealed no references or unpublished work on using *H. rumicis* to aid control of this weed.

When ten larvae or two adults were added to each caged plant in 1986 and 1987, respectively, plants became devoid of green tissue and in the longer experiment (1986) produced no seed. Regrowth after weevils and fertilizer were removed (1987) was shorter in height and evapotranspiration greater where plants were previously defoliated by this weevil. Combined aerial biomass (regrowth plus initial growth harvested) was reduced by weevil feeding. There was a trend toward reduced root and total plant biomass as a result of weevil feeding, but this was not significant, perhaps due to root reserves built up during the months prior to exposure to weevils, as well as residual fertilizer available during regrowth.

In natural infestations in the field, one plant was completely defoliated in 1986 at one site and a total of 32 stems found devoid of green laminae in 1987 at three sites. Defoliated plants were harvested at one site in 1987 and were lower in height and aerial biomass than plants least damaged at the same site (7 by 10 m). No seed was produced on 24 stems by defoliated plants at this site. By 16 Sept. 1987 only 10 percent of a sample of these 24 stems exhibited foliage. However, the unharvested hay crop may have been critical in 90 percent of the sample not regrowing, though a nearby plant which was not completely defoliated by weevils and which was harvested exhibited considerable regrowth. Many other plants, although not devoid of green laminae, were severely defoliated. A pasture also contained curly dock plants devoid of green tissue. Observations suggest defoliation at all of the above sites was due primarily to *H. rumicis*.

No-choice larvae feeding tests on rhubarb (*Rheum rhaponticus* L.) and buckwheat (*Fagopyrum esculentum* Moench.) leaf disks resulted in $\leqslant$ 1.3 percent destruction of leaf area. Examination of two old stands of rhubarb in close proximity to curly dock infested with this weevil indicated no economic damage to rhubarb first growth. Mounted adults and egg masses were observed on rhubarb in the field and a caged pot experiment. Larvae, pupae, or puparia of *H. rumicis*, however, were not found in the three rhubarb stands examined. No larvae emerged from egg masses on caged rhubarb. Most (92.5 percent) larvae failed to develop into adults when fed rhubarb petiole. Adults can fly to rhubarb, mate, and lay eggs, but not complete their life cycle on this closely related crop. It is hypothesized that rhubarb contains a substance, perhaps oxalate, which inhibits egg hatch/larval development of *H. rumicis*.

Research which includes curly dock, especially in pastures and hayfields, may be affected by this weevil reducing the competitiveness of curly dock. Monitoring and insecticide application may be necessary to truly quantify the effect of weed controls, such as herbicides or mowing, on this weed.

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PROBLEMS OF CANADA THISTLE CONTROL IN A CROWNVETCH GROUNDCOVER

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ABSTRACT

Canada thistle [Cirsium arvense (L.) Scop.] is a noxious weed for many states. Not only is it a problem for farmers, but also for roadside vegetation management specialists. In Pennsylvania, where crownvetch (Coronilla varia L.) has been used extensively as a groundcover, Canada thistle control with herbicides has been particularly difficult.

Several field experiments were conducted in 1986-87 to screen potential herbicide treatments for control of Canada thistle without injuring the crownvetch. Due to Canada thistle's perennial, creeping root system, which can store a large amount of total nonstructural carbohydrates (TNC), one application per season of herbicides tested on Canada thistle has not given complete control. Regrowth is common and researchers believe this regrowth is from rootstocks of treated plants.

Using the results of the above screening trials, the three best treatments were found to be atrazine at 4.0 lbs ai/A, clopryalid at 1.0 lbs ai/A, and hexazinone at 2.0 lbs ai/A. These herbicides were applied to a healthy, undisturbed thistle stand and the TNC of the lateral Canada thistle roots were measured at two week intervals over a complete growing season. The objective was to determine the best time for treatment of the regrowth. After treatment application on June 12, regrowth was first noted on July 22. This included growth from the basal stem area of exsisting shoots in the hexazinone treatment and new aboveground growth from all three treatments. On August 6, it was observed that many roots in the atrazine and hexazinone treatments were decaying to a degree not expected. It was also noted that there were new roots developing from what were thought to be treated plants at the time. Samples therefore included an inappropriate amount of root tissue from younger, developing roots from what are now thought to be untreated roots. By Septmber 2, no live lateral roots of the treated plants could be found. Only newer roots from apparently untreated plants were present.

Since all treatments apparently resulted in total root kill, it is concluded that the measurement of TNC as an indicator of treatment efficacy to assess plant vigor is invalid when one unknowingly samples roots from both untreated and foliar treated plants.

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USING DORMANT STEM TREATMENTS TO CONTROL ROADSIDE VEGETATION

Gregory T. Lyman and Larry J. Kuhns[1/]

ABSTRACT

Two experiments were conducted to test the efficacy of herbicides broadcast applied in the dormant season on roadside brush. The first experiment was conducted in March 1986 in Perry Co. Pa. The second was conducted December, 1986 and March, 1987 in Chester Co. PA. The treatments applied are presented in Tables 1 and 2, respectively. All treatments were applied with a Radiarc[2/] spraying system in the equivalent of 80 gallons of water per acre. The first experiment was applied using two rates of triclopyr(1% and 5% v.v.) in three different emulsifiable crop oils; Booster Plus E[3/], Cidekick[4/], and Clean Cut + Pine[5/] each at 2% v/v. Two additional treatments were triclopyr (1%) + metsulfuron methyl (1oz./100 gal.), and triclopyr(1%) + glyphosate(1%). Both included Booster Plus E(2%). Boxelder maple (Acer negundo L.), red maple (Acer rubrum L.), ash spp. (Fraxinus L.), hickory spp. (Carya Nutt.), oak spp. (Quercus L.), privet spp.(Ligustrum L.) redbud (Cercis canadensis L.), hackberry (Celtis occidentalis L.), cherry spp.(Prunus L.), elm spp.(Ulmus L.), mulberry (Morus alba L.), and sumac spp.(Rhus L.), viburnum (viburnum spp. L.), ostyra spp. (Ostrya (Mill.) K. Koch), grew within the plot areas. The understory consisted of perennial grasses and herbaceous weeds.

Triclopyr at 5% provided excellent results regardless of crop oil treatment. All treatments of triclopyr at 1% produced less control. When applied at 1% triclopyr, Cidekick + tryclopyr provided less control than the other crop oil treatments. Brush treated with triclopyr at 1% resprouted and the long term control was unacceptable. Resprouting was noted on stems greater than 1" in diameter of cherry, maple, ash, ostrya, and redbud. The addition of metsulfuron methyl or glyphosate to tryclopyr at 1% did not increase the level of control over triclopyr(1%) alone. Triclopyr at 5% controlled almost all brush contacted with the exception of some minor resprouting of maple and marginal control of cherry. Some treatments of triclopyr at 5% were effective in controlling stems well beyond the treated area. All treatments controlled the understory plants with control increasing as the rate of triclopyr increased.

In the second experiment, roadside brush was treated with triclopyr at two rates, dicamba + 2,4-D[6/], or a combination of triclopyr and dicamba + 2,4-D[6/], at two separate timings during the dormant season (Table 2). The treatments were applied on December 16, 1986 and March 12, 1987 to examine herbicide efficacy and the effect of timing of application on control of roadside brush. Plots were established along a roadside in Chester County PA. Boxelder maple (Acer negundo L.), ash spp. (Fraxinus L.), butternut (Juglans cinerea L.), hickory spp. (Carya Nutt.), oak spp. (Quercus L.), hackberry (Celtis occidentalis L.), cherry spp.(Prunus L.), elm spp.(Ulmus L.), mulberry (Morus alba L.), grew within the plot areas. The understory consisted of perennial grasses, herbaceous weeds, poison ivy (Toxicodendron radicans L.), and periwinkle (Vinca minor L.).

None of the treatments applied in December provided adequate brush control for roadsides. Triclopyr at 1% applied in March provided good control of boxelder, butternut, and hickory. All contacted stem tips were killed, but some resprouting occured on the stem below the branch tip. Triclopyr at 1.5% + dicamba(.09%) + 2,4-D(.26%) provided adequate control of hackberry and poison ivy and marginal control of oak, but was not effective on elm or hickory. Triclopyr at 3% provided excellent control of ash, boxelder, hackberry, mulberry, cherry, and elm, with some minor resprouting noted on ash. Treatments including triclopyr killed the broadleaf understory vegetation. The amount of understory vegetation controlled increased as the rate of triclopyr increased. Dicamba(.18%) + 2,4-D(.51%) provided little or no control of roadside brush when applied to dormant stems in this manner.

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2/ - Radiarc, a registered trademark of Waldrum Specialties, Inc., Ambler, PA

3/ - Booster E a product of Agway Inc., Syracuse, NY

4/ - Cidekick a product of JLB International Chemical Inc., Vero Beach, FL

5/ - Clean Cut + Pine a product of Arborchem Products, Fort Washington, PA

6/ - The Dicamba + 2,4-D used was formulated as Banvel 520, a product of Sandoz Crop Protection Co., Chicago Ill

Table 1. Control ratings of roadside brush treated in March 1986. All treatments were applied in the equivalent of 80 gallons of water per acre with the emulsifiable crop oils applied at 2% by volume.

CHEMICAL	RATE	EMULSIFIABLE CROP OIL	PERCENT CONTROL
Triclopyr	1%	Cidekick	50
Triclopyr	5 %	Cidekick	95
Triclopyr	1 %	Clean Cut + Pine	90
Triclopyr	5 %	Clean Cut + Pine	99
Triclopyr	1 %	Booster Plus E	80
Triclopyr	5 %	Booster Plus E	99
Triclopyr + Metsulfuron methyl	1 % 1oz./100 gal. water[1/]	Booster Plus E	50
Triclopyr + Glyphosate	1 % 1 %	Booster Plus E	75

1/- 1oz./100 gallons water = 28.3 grams/378.5 liters water

Table 2. Control ratings of roadside brush treated with triclopyr, dicamba + 2,4 D and a emulsifiable crop oil applied in December 1986 and March 1987. All treatments were applied in the equivalent of 75 gallons of water per acre and contained 2% by volume of the emulsifiable crop oil Clean Cut + Pine. Treatments were rated on September 27, 1987.

CHEMICAL	RATE	APPLICATON TIME & CONTROL RATING[3/]	
		DECEMBER'86	MARCH'87
Triclopyr	1%	1	4
Triclopyr	3%	2	4.75
Triclopyr + Dicamba[2/] + 2,4-D	1.5% .09% .25%	2	3.5
Dicamba[2/]+ 2,4-D	.18% .51%	1	1.5

1/ - Control Rating - 0 = No effects, 5 = Dead

2/ - The dicamba + 2,4-D used was formulated as Banvel 520 and was used as .75% and 1.5% v.v. respectively is a product of Sandoz Crop Protection Co., Chicago, Ill

EFFECT OF THREE SPRAY VOLUMES ON ROADSIDE BRUSH CONTROL RESULTS WITH FOSAMINE HERBICIDE

R. R. Johnson 1/

ABSTRACT

Brush control directions for fosamine herbicide recommend the application of suggested rates of the herbicide in a spray volume of at least 100 gal/A. Application of fosamine in reduced spray volumes would result in a cost savings if efficacy were not reduced.

In September 1986, a volume study using fosamine herbicide was applied to roadside and fencerow brush near Ackermanville, PA. Volumes of 25, 50 and 100 gallons per acre were applied using a Radiarc 2/ sprayer mounted in the vertical position. Fosamine rate was keep at 8 lb/A. Spray volume was varied by vehicle speed. A variable nozzle arrangement was used to obtain uniform foliage coverage.

An evaluation of stem kill was made on November 3, 1987. Control of oaks (*Quercus* spp. L.), shagbark hickory (*Carya ovata* Mill.), blackberry (*Rubus* spp. L.), multiflora rose (*Rosa multiflora* Thunb.) and white ash (*Fraxinus americana* L.) was similar at all three spray volumes. Control of boxelder (*Acer negundo* L.) and black cherry (*Prunus serotina* Ehrh.), two species which are difficult to control with fosamine, was more complete at the 25 gal/A spray volume than at 100 gal/A. Control of boxelder at 50 gal/A was intermediate between 25 and 100 gal/A.

Table 1. Percent stem kill of woody plants on Nov 3, 1987, after application of fosamine at 8 lb/A on Sep 26, 1986.

Species	Spray volume gal/A		
	100	50	25
white ash	90	90	100
black cherry	70	--	100
n. red oak (*Quercus borealis* Mich.)	100	90	100
boxelder	40	60	100
hickory	30	40	40
plum (*Prunus americana* Marsh.)	--	--	100
multiflora rose	90	90	90
Sassafras (*Sassafras albidum* Nutt.)	0	80	70
walnut (*Juglans nigra* L.)	--	20	100
blackberry	100	100	100
sumac (*Rhus glabra* L.)	100	100	100

1/ Consultant, RJ Services, 1727 Butler Pike, Ambler, PA 19002
2/ Radiarc Sprayer is a trademark of Waldrum Specialties, Inc.

CONTROL OF ROADSIDE VEGETATION WITH FOLIAR APPLIED HERBICIDES

Gregory T. Lyman and Larry J. Kuhns 1/

ABSTRACT

An experiment was conducted to examine the efficacy of fosamine ammonium applied at differing rates and in combination with other herbicides on September 10, 1986 along a roadside in Delaware County, Pa. The treatments were applied with a Radiarc2/ spray system in the equivalent of 75 gallons of water per acre. Fosamine ammonium was applied alone at 1.5% and in combination with metsulfuron methyl (1 oz./100 gal. water), and was applied at 1% or 1.5% in combination with triclopyr (.5%), glyphosate (1%), or dicamba + 2,4-D3/. Boxelder maple (Acer negundo L.), silver maple (Acer saccharinum L.), black locust (Robinia pseudoacacia L.), ash spp. (Fraxinus spp. L.), crabapple spp. (Malus spp. L.), multiflora rose (Rosa multiflora Thunb.), butternut (Juglans cinerea L.), and sumac spp. (Rhus spp. L.) were growing within the plot areas.

Fosamine ammonium at 1.5% in combination with metsulfuron methyl (1oz/100 gal. water), or glyphosate 1%, or tyiclopyr .5%, provided better control of apple, boxelder, butternut, and black locust, than fosamine ammonim 1.5% applied alone. Fosamine ammonium at 1.5% and metsulfuron methyl 1 oz./100 gal. water offered good control of all contacted portions of apple, ash, and black locust, while contacted foliage of boxelder was chlorotic and stunted but is expected to recover and contine to grow. Fosamine ammonium at 1.5% and triclopyr 1% showed good control of ash, buckeye, and maple with some resprouting on apple and multiflora rose. Fosamine ammonium 1.5% and glyphosate 1% demonstrated good control on contacted foliage of apple, butternut, black locust, and multiflora rose, with some minor resprouting of butternut. Fosamine ammonium 1.5 and dicamba + 2,4-D3/ provided control on contacted foliage of locust, butternut, and multiflora rose, with limited regrowth of multiflora rose and locust while vigorous regrowth occured from the trunk of butternut. Fosamine ammonium at 1% with triclopyr .5%, or glyphosate 1%, or dicamba + 2,4-D3/, provided better contol than when fosamine ammonium at 1.5% was applied alone. Fosamine ammonium 1% and tryclopyr .5% controlled contacted parts of apple, boxelder, black locust, and multiflora rose, with resprouting occuring from major branches of boxelder and multiflora rose. Fosamine ammonium at 1% and glyphosate at 1% showed excellent control of apple, ash, boxelder, black locust, silver maple, and multiflora rose with regrowth occuring from major branches on boxelder while ash foliage was displaying severe distortions 5 feet from the treated area. Fosamine ammonium at 1% and dicamba + 2,4-D3/ controlled butternut, while resprouting was present on apple and maple.

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2/ - Radiarc is a registered trademark of Waldrum Specialties, Ambler PA

3/ - The dicamba + 2,4-D used was formulated as Banvel 720, a product of Sandoz Crop Protection Co., Chicago, Ill

Table 1. Treatment list and control comments of roadside brush treated September 1,1986 with two rates of fosamine ammonium (1% and 1.5%), alone (1.5%) and in combination with metsulfuron methyl, triclopyr, glyphosate, and dicamba + 2,4-D[1/].

CHEMICAL	RATE	CONTROL [1/]							
		Apple	Ash	Buck-eye	Box-elder	Butter-nut	Black Locust	Silver Maple	Mult. Rose
Fosamine ammonium	1.5%	3			3	4	5		3
Fosamine ammonium + Metsulfuron methyl	1.5% 1oz./100gal. water	5	5		3		5		
Fosamine ammonium + Tryclopyr	1.5% 0.5%	4	5	5				5	4
Fosamine ammonium + Glyphosate	1.5% 1.0%	5				6	5		5
Fosamine ammonium + Dicamba [2/] + 2,4-D	1.5% .064% .12%					5	5		5
Fosamine ammonium + Tryclopyr	1.0% 0.5%	5			4		5		4
Fosamine ammonium + Glyphosate	1.0% 1.0%	5	6		4		5	5	5
Fosamine ammonium + Dicamba [2/] + 2,4-D	1.0% .064% .12%	4				5		4	

1/ - Rating Scale:

1 - No injury
2 - Slight injury to contacted branches
3 - Contacted branches are severely stunted and chlorotic, recovery expected
4 - Some dead tips on contacted branches with some resprouting
5 - All or most of contacted branches are dead
6 - Some branches not contacted by the herbicide are severely injured or dead
7 - Entire plant is dead

2/ - The dicamba + 2,4-D used was formulated as Banvel 720 and used at .5% v.v., a product of Sandoz Crop Protection Co., Chicago, Ill

HERBACEOUS COMPETITION: A MAJOR LIMITING FACTOR IN THE REGENERATION OF HARVESTED OAK STANDS

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Todd W. Bowersox

ABSTRACT

Sustained yield forest management is dependent on the successful regeneration of harvested forest stands with desired tree species. Obtaining this desired regeneration is often easier said than done. Maturing oak stands are currently being harvested in Pennsylvania and many of these stands are failing to develop an adequate density of desired species through natural forms of regeneration. Many biotic and abiotic factors have been blamed for the lack of stems from both sprout and seed origins. Competition from herbaceous vegetation which invades harvested sites is often cited as a limiting factor.

To quantify the effects of herbaceous vegetation on the growth of tree seedlings, two studies were initiated-one in 1984 and the other in 1985. Four tree species, red oak (Quercus rubra L.), white ash (Fraxinus americana L.), yellow-poplar (Liriodendron tulipifera L.) and white pine (Pinus strobus L.), were planted and grown in the presence and absence of two herbaceous communities. One community was dominated by hay-scented fern (Dennstaedtia punctilobula Michx.) and the other was dominated by poverty oats grass (Danthonia spicata L.). Weed free areas were established and maintained by annual applications of glyphosate. Deer browsing was minimized by a five wire electric fence. Third and fourth year results clearly demonstrated that both fern and grass competition severely limited seedling height growth. White ash and yellow-poplar were most sensitive to competition. In the presence of competition, white ash and yellow poplar averaged about 1.5 m in height after four growing seasons compared to 3.0 m in the absence of competition. Height growth of red oak and white pine was less sensitive to competition.

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GLYPHOSATE, TRICLOPYR-PICLORAM EFFECTS ON SURVIVAL OF DIRECT-SEEDED RED OAK FOLLOWING GYPSY MOTH DEFOLIATION

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ABSTRACT

A study was initiated in Fall, 1985 to evaluate the effects of understory vegetation control and residual overstory density on survival of direct-seeded red oak (Quercus rubra L.) seedlings following salvage cutting of a gypsy moth defoliated mixed oak stand in Huntingdon County, Pennsylvania. The experiment was arranged as a randomized complete block design with six replications of three understory herbicide treatments. Each replication consisted of an untreated control, glyphosate 1 gal (4 lb a.i.)/130 gal water, and a mixture of 3 pts triclopyr (4 lb a.i.) + 4 pts picloram (.5 lb a.i.)/130 gal water. One-half of the treatments were applied on a Buchanan soil (lower slope) and the remaining half on a Laidig soil (upper slope). Both soil types occupied a southwesterly aspect.

The herbicide treatments were applied commercially using a truck-mounted sprayer on September 13-19, 1985. Eight months after herbicide application (April, 1986), 25 previously stratified red oak acorns obtained from a single seed source were sown in each of 10 randomly located milacre subplots within each of the 18 blocks. No seed protection devices or fencing to exclude white-tailed deer or other seed predators were constructed. Observations on the frequency of surviving red oak seedlings were recorded in the Fall of 1986 and 1987 respectively.

The triclopyr-picloram treatment exhibited excellent control of the competing understory vegetation, particularly the woody tree and shrub species, whereas the glyphosate treatment provided satisfactory control of grasses, broadleaf weeds and nearly complete control of fern competition. Tests for significant mean differences in red oak seedling survival were made employing the GLM, Regression, and ANOVA procedures in the SAS statistical package.

The results indicated no significant differences in frequency of surviving red oak seedlings among the understory herbicide treatments applied for either year (Table 1). However, a significant difference in seedling survival occurred between the two soil types, the highest rate occurring on the Buchanan soil, presumably due to the more optimum soil moisture and drainage conditions for oak development (Table 2).

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Table 1. Percent survival of red oak acorns by herbicide treatment and year.

Treatment	1986	1987
glyphosate	8.00 a[1]	7.07 a
triclopyr-picloram	5.93 a	4.87 a
control	7.73 a	4.93 a

Table 2. Percent survival of red oak acorns by soil type and year.

Soil Series	1986	1987
Buchanan (lower slope)	11.42 a[2]	8.84 a
Laidig (upper slope)	3.02 b	2.40 b

1 Mean values followed by the same letter are not significant at 5% level.
2 Mean values not followed by the same letter are significantly different at 5% level.

TANK MIXING GLYPHOSATE WITH ADJUVANTS AND OTHER HERBICIDES FOR STRIPED MAPLE CONTROL

Stephen B. Horsley[1]

ABSTRACT

Striped maple (Acer pensylvanicum) is a noncommercial understory tree that interferes with the development of advance regeneration of Allegheny hardwoods. In small plot studies, 1.12 kg ai/ha of glyphosate applied in early August or early September resulted in 84% or better control of striped maple 3 m tall. Under commercial conditions where understory trees range from less than 0.3 m to greater than 6 m in height, striped maple kill is often less than predicted from small plot trials. Chelation of the glyphosate molecule by divalent cations found in hard water, restricted foliar penetration, and inadequate coverage of target trees with herbicide are possible sources of the problem. In 1985, a field experiment was initiated to determine whether increased control of striped maple could be obtained under commercial conditions by tank mixing glyphosate with adjuvants or other herbicides. Eight adjuvants or herbicides were evaluated in tank mix with 1.12 kg ai/ha of glyphosate. Two adjuvants, diammonium ethylene diamine tetra acetic acid (EDTA) (0.25% w/v) and ammonium sulfate (2% w/w), addressed the possibility that hard water reduced glyphosate activity. Possible herbicide penetration problems were evaluated with three surfactant treatments: Sorbicide Herbicide Adjuvant (1% v/v), X-77 (0.5% v/v), and Frigate Agricultural Adjuvant (0.5 v/v). Glyphosate was also tank mixed with 2,4-D (0.53 kg ai/ha) and with metsulfuron methyl (0.007 kg ai/ha and 0.014 kg ai/ha). Control plots were treated with glyphosate alone. The experiment was conducted in an Allegheny hardwood stand having a dense understory of striped maple, located near Oswayo, PA. Field layout used the completely randomized block design. Tank mixes were applied in 113 L/ha of spray mix to 1.01 ha (metsulfuron methyl, 0.61 ha) plots in late August or early September using a mechanized commercial air-blast sprayer with the valute tilted 15° above the horizontal. Striped maple control was evaluated one and two years after treatment on 15 systematically located 1.83 m radius sample plots. Kill or degree of damage was recorded by height class: less than 1.5 m, 1.5 to 3 m, 3 to 4.5 m, and 4.5 to 6 m. Two general responses were noted in all treatments. First, striped maple kill one year after treatment was less than that obtained after two years. Many damaged stems died between the first and second year after treatment. Second, kill differed by stem height class. Kill of stems less than 1.5 m tall was substantially less than that of taller stems. Thus, aiming the sprayer valute upward to obtain better coverage of taller stems resulted in less kill of the shorter stems. Comparison of tank mixes with glyphosate alone was based on kill of 1.5 to 6 m stems where spray coverage was adequate. Glyphosate alone resulted in 80% kill of these stems. Both glyphosate plus EDTA and glyphosate plus ammonium sulfate gave similar results. Since these treatments did not enhance glyphosate activity, hard water probably is not an important contributor to reduced striped maple kill. The three surfactants tank mixed with glyphosate gave differing results. Striped maple kill was 25 to 30% less with Sorbicide, the same with X-77, and 10 to 15% greater with Frigate than with glyphosate alone. Tank mixing 2,4-D with glyphosate reduced kill of striped maple. Both rates of metsulfuron methyl gave results similar to glyphosate alone.

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IMMUNOASSAYS: THEIR APPLICATION TO RAPID RESIDUE DETECTION AT PART PER BILLION CONCENTRATIONS

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ABSTRACT

Immunoassays are test procedures that utilize antibodies as the basis for detecting various substances. Traditionally, immunoassays have found application in the detection and quantitation of proteins, viruses, bacteria, toxins, drugs, and hormones in clinical and veterinary specimens. Now, immunoassays are being found to be highly suited for the detection/quantitation of environmental compounds, especially pesticide residues. Historically the domain of the analytical chemist and GC-MS, HPLC, etc., antibody-based formats are finding increased favor. Immunoassays are especially useful for screening large numbers of samples quickly and at great cost savings; conventional analytical techniques can then be used for confirmation and specific compound identification. While numerous formats exist for the detection of compounds by immunochemical procedures, the Company has developed an approach known generically as a Competitive Inhibition Enzyme ImmunoAssay (CIEIA). In this procedure, an antibody is made to a pesticide, e.g. the herbicide Atrazine, and is coated to a polystyrene test tube. Sample atrazine and an enzyme "tagged" atrazine are added to the tube and simultaneously "compete" for the antibody. Results of the test are disclosed by the addition of a substrate which becomes distinctly colored in the presence of the enzyme. In essence, the greater the concentration of atrazine in the sample, the less the enzyme and hence the lower the color. Immunoassays are extremely flexible, and can be used to detect residues in soil, water, and food with little or no sample clean-up.

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EFFECTS OF HERBICIDE RESIDUES ON GERMINATION AND EARLY SURVIVAL OF RED OAK ACORNS

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ABSTRACT

A greenhouse experiment was conducted to determine the effects of parent herbicide residues on red oak (Quercus rubra L.) acorns, as indicated by differences in percentage germination and juvenile height growth. One, two and four times the manufacturer's recommended rates of dicamba, 2, 4-D, glyphosate, glyphosate plus nonionic surfactant, hexazinone, picloram, simazine, sulfometuron methyl, triclopyr, and tricolpyr plus picloram were applied to acorns sown in pots containing two different forest soil types (Table 1). Changes in germination percentage, hypocotyl and radicle development throughout a 50-day growth period were used to categorize the variation in acorn response to herbicide application.

Herbicide residues of dicamba, 2, 4-D, picloram, sulfometuron methyl, triclopyr, and triclopyr plus picloram significantly ($p \leq 0.05$) reduced the percent of germinating acorns.

Although there were trends of decreasing mean seedling height with increasing rate of application of several herbicides, only picloram, sulfometuron methyl, and triclopyr significantly reduced post-germination seedling height growth. Treatments with glyphosate, glyphosate plus nonionic surfactant, hexazinone, and simazine had little or no effect on percentage germination or seedling height growth. However, hexazinone inhibited photosynthesis and resulted in eventual death of all seedlings. Soil type had a significant ($p \leq 0.05$) effect on herbicide availability and subsequent phytotoxicity.

INTRODUCTION

Since 1965, when the Bureau of Forestry, Department of Environmental Resources and various wood-using industries adopted the even-aged management system (clearcutting) many northern hardwood and mixed oak stands have failed to regenerate naturally with commercially important tree species. The white-tailed deer (Odocoileus virginianus), fire suppression, insects, weevils, rodents, invasion by herbaceous vegetation, ferns, sedges and grasses have been cited as possible causes (7). In the past, the ability of foresters to successfully regenerate oak/hickory stands has been met with mixed results. On average to poor oak sites foresters have been moderately successful (1), but they have had little success at reproducing this type on better sites (12). Once a mature oak/hickory stand on a high quality site has been harvested (by clearcutting), red maple (Acer rubrum L.), yellow poplar (Liriodendron tulipifera L.), and sweet birch (Betula lenta L.) often become the dominant component in the succeeding stand (9). A number of researchers have proposed the shelterwood method of regenerating oak stands (10,13). Others recommend the use of herbicides to control subcanopy vegetation (5). Several researchers (2,4) have suggested that regeneration cuts should be timed with good seed crops. In addition, it has been suggested that nonselective broadcast treatments of herbicides should be coordinated with peak acorn crops (3). However, we do not understand the flowering and fruiting requirements well enough to predict when these treatments should be implemented. It is the lack of information on the effects of specific herbicides on the germination and subsequent development of oak seedlings originating from acorns stratified in the soil following understory treatment with herbicides which stimulated the initiation of the present exploratory study. A voluminous amount of documented information is available on the effects of herbicides on established hardwood vegetation, but an extensive literature review revealed little information on the effect of herbicide

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residues on the germination of hardwood seed, specifically oak acorns. The primary objectives of this study were to evaluate the effects of 11 post and preemergent herbicides, applied singly or in combination at recommended and excessively high rates on the percent germination, juvenile seedling height growth, and inhibition of red oak acorns under greenhouse conditions.

MATERIALS AND METHODS

Red oak (Quercus rubra L.) acorns were collected during the period September 24 to October 14, 1984. To reduce the amount of variation associated with each treatment, all seeds were extracted from a single, open grown 16-inch diameter red oak tree located on the University Park campus. Acorns were selected for uniform cup scar color and degree of pericarp damage (6). Water flotation was then used to discard weevil infested acorns (8). This procedure was followed to decrease the proportion of unsound acorns placed in stratification.

Since red oak acorns exhibit embryo dormancy, lots of approximately 10 kg of sound acorns were stored in 4 ml plastic bags and placed in cold storage. Moist paper towelling was placed inside the bags to reduce the risk of desiccation. Temperature was maintained between -1.0 C and 3 C. Acorns were checked periodically for mold and the towelling was remoistened as needed. The acorns were stratified from October 1, 1984, until planting and herbicides were applied on March 29, 1985.

Preliminary germination trials began February 26, 1985 to determine if embryo dormancy had been broken. Three replicates of 10 acorns each were placed within pads of moist paper towelling in covered containers. The towelling was kept moist throughout the germination trials and the acorns were kept at room temperature (approx. 21 C) The average germination from Trial 1 was 89%; repeat trials on March 11, 1985 resulted in a 94% germination. From these preliminary trials, it was concluded that embryo-dormancy had been broken and greenhouse planting could begin.

Soil of two types, a Buchanan (Aquic Fragiudults) and a Laidig soil series (Typic Fragiudults) was obtained on February 26 and 27, 1985, located in Huntingdon County, Pennsylvania. For each soil type a sample was taken from three representative locations within a 80-90 year-old oak hickory stand. Samples from the Buchanan series were taken on a midslope position; the Laidig soils were extracted at a lower slope position. At each slope position, the 01 and upper portion of the 02 horizons were removed and a bulk sample of 230 kg soil was extracted to a depth of 25 cm.

For each soil series, the bulk samples were combined and air-dried. Samples were tamped, sieved through a 1.25 cm mesh screen, run through a roller mill to break up large clods, and then sieved through a 0.64 mm mesh screen. After screening, 10 random samples of 2.2 kg each were taken from each composite and analyzed for pH, cation exchange capacity (CEC), and percent sand silt and clay. Eight, 1 kg samples were taken from each soil composite and placed in 12 cm cheese cloth-lined pots, placed on ceramic tension plates and adjusted to field capacity. Five acorns were planted in each pot to a depth of 2.5 cm (11). Herbicide applications were made using a single even flow fan nozzle to deliver 160 ml (278 l/ha)of spray solution over a 1.2 m by 4.8 m plot. Sterile, quartz sand was applied to each pot to prevent evaporation, maintained at 75 to 100 percent pot capacity and randomly rotated on the greenhouse benches throughout the experiment. The number of seedlings emerging from each pot was recorded every day for a period of 50 days (April 1-May 20, 1985). Germination is defined in this experiment as the first observed emergence of the hypocotyl from the soil surface.

All data were analyzed using Statistical Analysis Systems (SAS) general linear models. An arcsine transformation was used on percent germination data to stabilize the variance before entering the ANOVA model. Pairwise comparisons were made using the Bonferonni or Tukey procedure with alpha = 0.05.

RESULTS AND RECOMMENDATIONS

Analysis of variance for percentage germination and seedling height growth revealed that the herbicide-rate-soil interaction to be highly significant. These results indicated that residues affecting the germination and subsequent radicle and hypocotyl development of red oak acorns will vary according to type of herbicide, rate of application and soil type. In this study there appeared to be three types of response of red oak germination to the specific herbicide-rate-soil combinations (Table 2):

1. Glyphosate, glyphosate plus nonionic surfactant, hexazinone, and simazine had little or no significant effect on germination at any rate of application or soil type.
2. Increasing rates for sulfometuron methyl, 2, 4-D, and triclopyr plus picloram significantly decreased the percentage germination and the amount of decrease was dependent upon soil type. In all cases, treatments applied to the Buchanan soils were more injurious than those applied to the Laidig soils.
3. Picloram, triclopyr, and dicamba significantly inhibited germination on both soil types at all rates applied except the 1X rate (Figure 1).

It is difficult to extrapolate information from controlled conditions of the greenhouse to the field environment. Although two forest soils were used in this study, the actual concentration of herbicide residues remaining in the soil after commercial applicaton in an oak/hickory stand is likely to be quite different due to microorganism activity, physical and chemical soil characteristics. Since many of the herbicides tested in this study were foliar applied, the sprays would be directed at the foliage, not the forest floor. Leaf litter and humus layers would also intercept some of the herbicide and, depending upon time of application, the amount of litter found on the forest floor could be extremely variable.

With these limitations in mind, results from this study suggested that glyphosate, glyphosate plus nonionic surfactant, and simazine can be used to control undesirable vegetation with no residual effects on germination of red oak acorns at all rates tested.

Triclopyr and picloram are also foliar applied, so it is likely that the concentration of herbicide found in the soil after such treatment will be lower than that applied in this study. Since these two herbicides have been used to control some of the more difficult to kill species which glyphosate treatments may miss, further research needs to be conducted in the field to determine whether residual activity is an actual limitation to acorn germination as indicated in this study.

Sulfometuron methyl has been suggested for use as a preemergence treatment to control unwanted woody species. Our results suggest that caution should be applied before broadcast treatments of sulfometuron methyl are made. Because of the extreme differences in the response to treatments on red oak acorns by soil type, studies need to be conducted on a wide range of forest soils before general recommendations can be made.

Dicamba and 2, 4-D are also foliar applied and the actual residue concentration in forest soils may differ than the amounts found in this study. Treatments of 2, 4-D are not likely to cause a problem unless applied at excessively high rates. However, results from this greenhouse study with dicamba, even at recommended rates applied to non-cropland areas, may cause some inhibitory effects on germinating acorns.

Finally, hexazinone has been used as a broadcast treatment in southern pines. Currently, it is labelled for use as a spot treatment in hardwood stands. From the results of this study, it is difficult to determine what effects basal bark treatments might have on acorns stored in the soil. In all probability, spot treatments will have a small impact on acorn germination and establishment on a stand-wise basis. Again, further research needs to be conducted to answer this question.

Table 1. Recommended 1X rate of herbicide applications.

Herbicide (Common Name)	1X Rate [1] (kg ai/ha)
dicamba	2.24 kg ai/ha
2, 4-D	2.24 kg ai/ha
glyphosate	2.24 kg ai/ha
glyphosate + nonionic surfactant	2.24 kg ai/ha
hexazinone	2.24 kg ai/ha
picloram	2.24 kg ai/ha
simazine	2.24 kg ai/ha
sulfometuron methyl	0.14 kg ai/ha
triclopyr	2.24 kg ai/ha
triclopyr + picloram	1.12 + 1.12 kg ai/ha

[1] The amount of herbicide recommended for application to non-cropland vegetation.

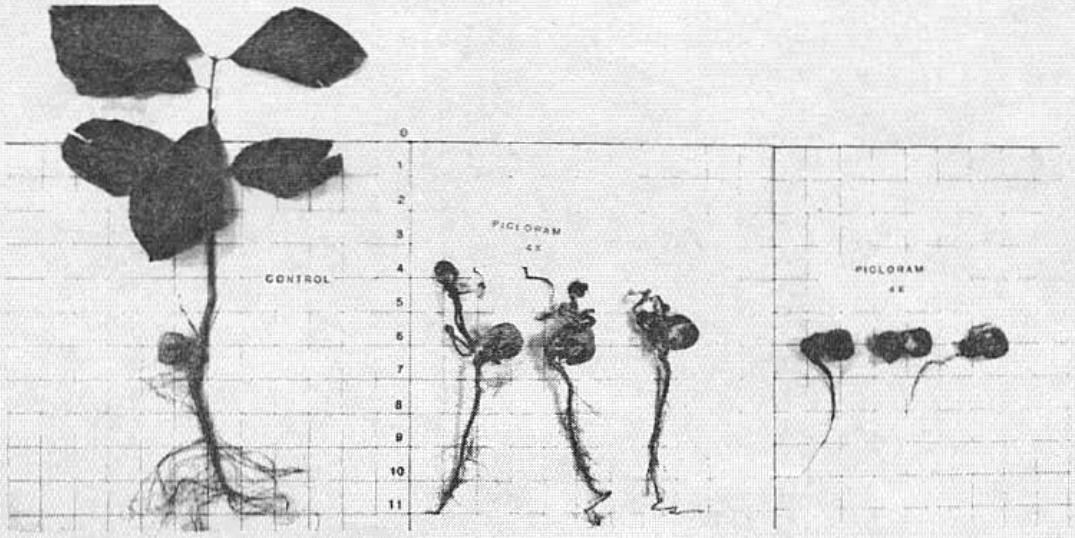

Figure 1. Inhibition of hypocotyl development of red oak acorns germinating in soil treated with picloram at 4X rate. Acorns on the left taken from the Laidig; acorns on right from the Buchanan soil.

Table 2. Percentage germination means for herbicide-rate-soil treatment conditions.[1]

Herbicide	Rate	Percentage Germination[2] Buchanan Soil	Laidig Soil
glyphosate	0X	93.3 a	86.7 a
	1X	93.3 a	93.3 a
	2X	93.3 a	100.0 a
	4X	93.3 a	100.0 a
glyphosate nonionic surf.	0X	93.3 a	100.0 a
	1X	100.0 a	100.0 a
	2X	93.3 a	100.0 a
	4X	100.0 a	100.0 a
hexazinone	0X	100.0 a	93.3 a
	1X	100.0 a	93.3 a
	2X	100.0 a	93.3 a
	4X	93.3 a	93.3 a
simazine	0X	93.3 a	100.0 a
	1X	86.7 a	93.3 a
	2X	100.0 a	86.7 a
	4X	100.0 a	100.0 a
2, 4-D	0X	100.0 a	93.3 ab
	1X	93.3 a	100.0 a
	2X	80.0 ab	93.3 a
	4X	53.3 b	93.3 a
sulfometuron methyl	0X	100.0 a	100.0 a
	1X	53.3 b	100.0 a
	2X	13.3 c	93.3 a
	4X	0.0 c	80.0 ab
picloram + triclopyr	0X	86.7 a	93.3 a
	1X	66.7 a	93.3 a
	2X	0.0 b	93.3 a
	4X	0.0 b	86.7 ab
triclopyr	0X	100.0 a	100.0 a
	1X	0.0 b	100.0 a
	2X	0.0 b	73.3 a
	4X	0.0 b	26.7 b
picloram	0X	80.0 a	100.0 a
	1X	6.7 c	100.0 a
	2X	0.0 c	60.0 b
	4X	0.0 c	0.0 c
dicamba	0X	100.0 a	100.0 a
	1X	0.0 a	80.0 a
	2X	0.0 a	0.0 b
	4X	0.0 a	0.0 b

[1] All comparison means were analyzed on arcsine transformed data.

[2] Within a herbicide treatment, numbers followed by the same letter are not significantly different at the $p \leq 0.05$ based on the Tukey method of multiple comparisons.

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A RAPID TEST FOR ATRAZINE RESIDUES IN WATER AND SOIL BY ENZYME IMMUNOASSAYS

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ABSTRACT

A rapid and inexpensive method has been developed to determine atrazine residues in soil and water. The test is based on immunochemistry and is complete within 5 to 20 min including the extraction step. Samples are quantified using a hand held battery powered photometer which makes possible analysis in the field. The test is linear from 0.5 to 10 ppb. For samples greater than these values, dilutions can be made. The lower limit of detection for water is 0.5 ppb and 2 ppb for soil. Percent coefficient of variation for 14 water samples spiked at 1 ppb was 23.8% and at 4 ppb 10%. Eleven soil samples spiked at 2 ppb gave a coefficient of variation of 20.4%. Agreement between this method and high-performance liquid chromatography was good. Other triazines cross-react making this a broad spectrum test.

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Table 1. Comparison of the immunoassay and HPLC methods for determination of atrazine residues in soil.

Sample	---ppb Atrazine Found--- Immunoassay	HPLC
Soil-1	1900	1370
Soil-2	1700	1630
Soil-3	1100	810
Soil-4	880	660
Soil-5	86	95
Soil-6	4	6
Soil-7	42	10
Soil-8	37	42
Soil-9	ND	ND
Soil-10	2	ND
Soil-11	12	7
Soil-12	20	21
Soil-13	52	83
Soil-14	42	20
Soil-15	26	13
Soil-16	7	5
Soil-17	5	15
Soil-18	22	11

ND = None Detected

CHANGES IN NUTRIENT CYCLING FOLLOWING AERIAL APPLICATION OF TRICLOPYR TO RELEASE SPRUCE-FIR

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ABSTRACT

Herbicide applications may result in increased concentrations of dissolved nutrients in water draining treated areas. Triclopyr was aerially applied to release conifers on a whole-tree clearcut at an average rate of 1.9 kg ae/ha. Nitrate and calcium concentrations increased in soil solution of moderately well drained soils and in stream water draining the clearcut in the first two growing seasons after treatment. Vegetative occupancy of treated sites was important in reducing changes in nitrate concentrations in soil solution on the moderately well drained sites, and in maintaining nitrate levels in the treatment stream below unsafe levels for drinking water.

INTRODUCTION

Forest management activities may have an adverse impact on water quality of streams draining managed watersheds. Stream turbidity, temperature, biology, and chemistry may change as a result of right-of-way construction, forwarding merchantable timber, site preparation activities, and the use of pesticides.

Studies have been conducted in New England to determine the impacts of whole-tree clearcutting on long-term site productivity and nutrient cycling (3, 10, 11) and on stream chemistry and biology (6, 7). These studies have monitored stream chemistry in order to quantify the changes in water quality after harvesting, and the amount of plant-essential nutrients that are lost from these forests via leaching to streams draining clearcuts. These studies and others (5, 12) have indicated that harvesting may result in increased levels of nitrate (NO_3^-) in streamwater for several years due to reductions in plant uptake of nitrogen and increases in nitrogen mineralization and nitrification rates. Increased concentrations of nitrate in stream water result in increased levels of calcium and other cations. The development of vegetation on clearcuts is generally accompanied by reductions in nitrate and associated cations in stream water as plant uptake begins to reduce the amounts of exchangeable nutrients that may leach from the soil. These results indicate that nutrient losses from clearcut watersheds, the potential for future reductions in site productivity resulting from these losses, and adverse impacts of these nutrients on streamwater quality might be minimized by encouraging rapid development of vegetation on harvested land.

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The use of herbicides for brush control and conifer release operations may result in increased levels of nitrate and associated cations in streams draining treated areas if the released crop trees have only established partial site occupancy before release from weed competition. Studies conducted by Likens et al. (5) at Hubbard Brook, NH, which included herbicide application immediately after clearcutting to eliminate all vegetation from the clearfelled watershed, indicated the importance of revegetation for nutrient conservation; but were not designed to evaluate the effect of the herbicide application separately from the clearfelling. In a study of the water quality of ephemeral forest streams in Georgia after site preparation with hexazinone [3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione], Neary et al. (8) observed large increases in stream nitrate concentrations; however, they did not observe any nitrate levels that exceeded health standards, and increases only persisted for two years. The observed increase in nitrate can be viewed as an objective of the herbicide application to the degree that it results in increased availability of nitrogen to crop trees, and that they are stimulated by this "fertilizer effect" of the herbicide treatment; however, if nitrate availability far exceeds the capacity for tree uptake, then adverse impacts on stream quality will result from the operation.

In the red spruce (Picea rubens Sarg.) - balsam fir [Abies balsamea (L.) Mill.] type of New England and eastern Canada, extensive areas that have been managed using even-aged techniques currently require brush control for release of conifer crop trees. To date, there is limited information on the effect of herbicide applications in this region on water quality. The objective of this paper is to summarize the effects of an aerial application of triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid) to a regenerating, whole-tree clearcut spruce-fir watershed in northern Maine on soil solution and stream chemistry and watershed losses of nitrate-nitrogen.

MATERIALS AND METHODS

The study has been conducted on a pair of adjacent watersheds located on Weymouth Point, in Piscataquis County, Maine. The soils are poorly to moderately-well drained, coarse-loamy, mixed, frigid glacial tills of the Chesuncook catena that were derived from slate and phyllite bedrock (11). The 49 ha treatment watershed was whole-tree harvested from June to July 1981 (12). Because of equipment limitations, a buffer strip of trees was maintained along the lower 450 m of the stream draining the clearcut area. The width of the buffer varied from 25 to 50 m along either side of the stream. The adjacent, 73 ha watershed has been used as an uncut control area. Following a regeneration survey of the clearcut by Great Northern Paper Company, an aerial application of triclopyr (2 kg ae/ha) was prescribed for August 1985 as a conifer release operation. The herbaceous cover in the fifth growing season after clearcutting was predominantly red raspberry (Rubus idaeus var. strigosus Maxim.) and fireweed (Epilobium angustifolium L.), with varying amounts of other species depending on the soil drainage class.

The site was treated between 0900 and 1030 hrs on 10 August 1985. A total of 4500 L of mix (225 L of triclopyr as the butoxyethyl ester plus 4275 L water) was applied with a Hiller 12E helicopter equipped with a 10.7 m boom and D8 nozzles with #46 spinners at an average rate of 1.9 kg ae/ha. Color-coded flight line markers were established along four transect lines prior to the operation, to improve the application uniformity. All portions of the clearcut were sprayed, with the exception of a 4.6 ha control block, which was reserved as a control for soil

and soil solution sampling, and the 6.4 ha buffer strip along the lower portion of the treatment stream.

The soil solution has been sampled monthly during the growing season (June through November) since 1980. The soil solution is extracted with porous ceramic cup tension (0.07 MPa) lysimeters at depths of 25 cm and 50 cm below the forest floor. A pair of lysimeters was installed in November 1979 at each depth on each of 12 plots (20 by 20 m) on the treatment watershed, and on four plots on the control watershed. Soil solution samples have been frozen and transported to the USDA Forest Service, Durham, NH for analysis of Ca^{2+}, K^+, Na^+, Mg^{2+}, NH_3, Cl^-, NO_3^-, SO_4^{2-}, pH, and specific conductance.

Changes in vegetation due to the triclopyr were quanitified in a 4 m-radius circular plot around each lysimeter in August 1986. At each tube, an estimate of percent cover by height class was made for each of the major species groups found on the plot. Live-plant volume was estimated from the product of percent cover and height for each species group. Species were grouped by conifer, hardwood, raspberry, fireweed, grass and sedges, forb, and moss categories. Changes in plant cover and height from August 1985 to August 1986 due to the triclopyr were quantified using estimates from dead plant architecture.

Stream water samples were collected biweekly from May through November, and monthly from December through April. Streamwater analyses were the same as those for soil solution. Streamflow volume has been estimated with the BROOK hydrologic simulation model (1), which was calibrated for these watersheds using data collected at the Nashwaak Experimental Watersheds in New Brunswick, Canada. The BROOK model is considered adequate for estimating the effects of whole-tree clearcutting on streamflow (2), and has been used to estimate flow after the triclopyr application. Nutrient outputs were estimated from the product of simulated stream water volume and nutrient concentration for each watershed. Procedures for estimating changes in nutrient losses from the watersheds due to the harvest were discussed in detail by Hornbeck et al. (4). These procedures were used to evaluate the changes following herbicide application as well.

RESULTS AND DISCUSSION

Nitrate concentrations in the mineral soil increased in the first month after triclopyr application (Figure 1), and continued to increase during the next growing season. The patterns in the increased nitrate concentrations were similar to those observed after clearcutting, in that the largest response was in the moderately-well drained soils, while the somewhat poorly and poorly drained soils had much weaker increases in nitrate concentratons following the herbicide application. The changes in nitrate levels continued to follow a strong annual trend reflecting increased microbial activity during the warmer summer months followed by reduced activity in the fall.

The magnitude of the nitrification response is primarily determined by two factors -- the soil nitrification potential, and the amount of reduction in vegetative cover due to the spray. The moderatey-well drained soils have the highest nitrification potential, followed by the somewhat poorly and poorly drained soils. One would expect that if the area around a lysimeter tube were fully occupied by conifers or grass and sedge species, which were not affected by the triclopyr, there would not be an increase in nitrate concentrations in soil solution after spraying, even on well drained soils with high nitrification potential. The average monthly nitrate concentrations plotted in Figure 1 reflect both the soil drainage class and vegetation-reduction effects, and do not allow separate consideration of these variables; however, the correlation between average

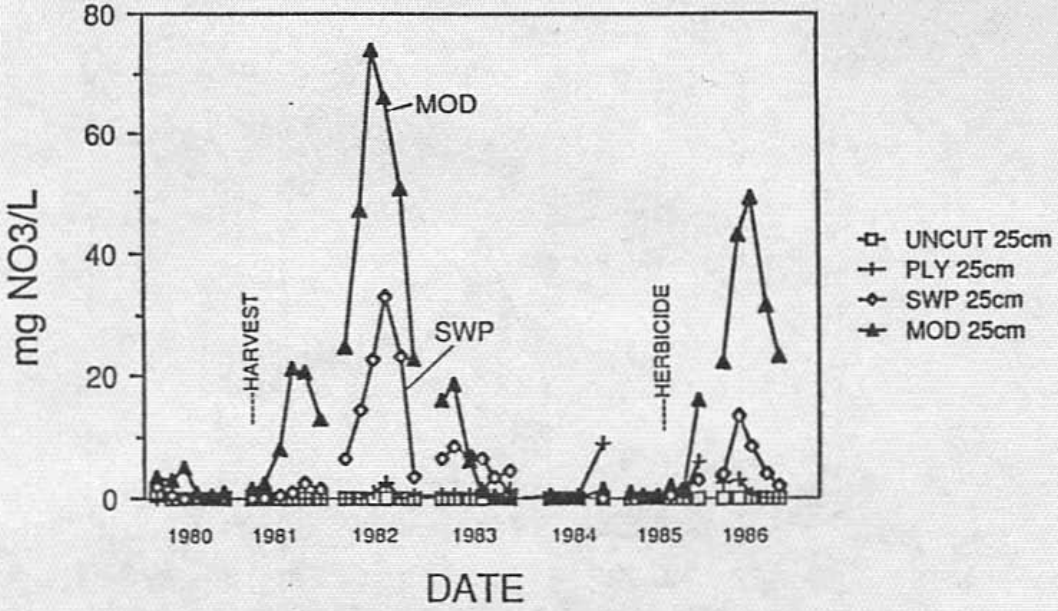

Figure 1. Average monthly nitrate concentrations at the 25 cm depth at Weymouth Point for 1980 through 1986 growing seasons. Sepatate trends are shown for the uncut control (UNCUT) watershed, and for moderately well (MOD), somewhat poorly (SWP), and poorly (PLY) drained soils on the treatment watershed.

annual nitrate concentration in 1986 and reductions in plant volume after herbicide was quite high (r = 0.87) on the moderately well drained soils. The correlation between average annual calcium concentrations for 1986 on moderately well drained soils and reductions in plant volume was also quite high (r = 0.78). There was no relationship between nitrate or calcium concentrations and reductions in plant volume on the poorly and somewhat poorly drained soils. The lack of relationship between nitrate concentrations and reductions in plant volume on the wetter soils is probably due to lack of nitrification potential on these soils.

Stream water concentrations of nitrate increased after the herbicide application with a maximum in November 1985 of 7.17 mg NO_3/L. The nitrate concentrations did not exceed health standards for drinking water in the first two years after treatment. Stream water losses of nitrate-nitrogen after treatment with triclopyr were about 1.5 kg NO_3-N/ha for the 1985 water year and 1.2 kg NO_3-N/ha in 1986 (Figure 2). These losses were somewhat smaller than the annual losses following clearcutting, but of a similar order of magnitude. These losses are considered a minor reduction in soil nitrogen when compared with the magnitude of the whole-tree harvesting removals (10).

The triclopyr application resulted in increased concentrations of nitrate and cations in soil solution and stream water. The increased concentrations were primarily affected by the interaction of soil drainage class and reductions in plant biomass. Nitrate increases after the conifer release operation are an indication of the magnitude of the "fertilizer effect" of the herbicide application. Vegetative uptake after the herbicide application prevented nitrate concentrations in stream water from exceeding health standards. Crop tree occupancy of treated areas must be adequate to reduce nitrate leaching losses to acceptable levels. Herbicide

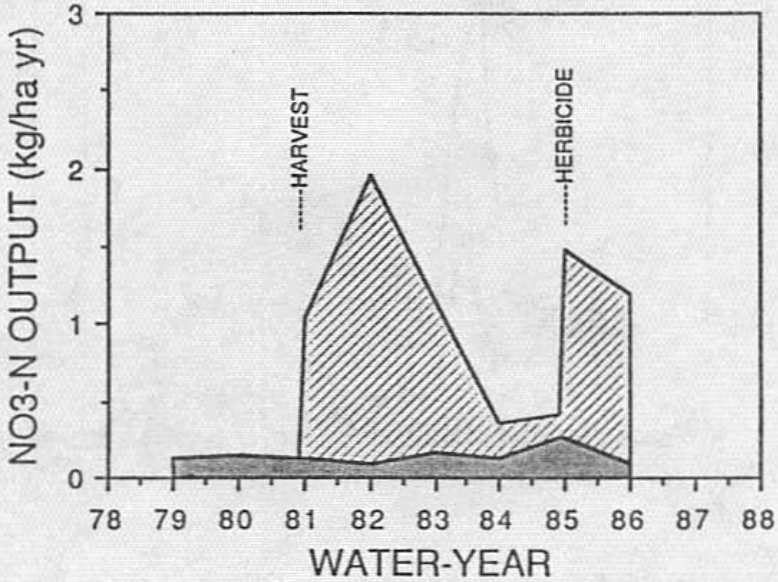

Figure 2. Predicted annual watershed losses of nitrate-nitrogen for the control (shaded area) and treatment (cross-hatched area) watersheds after whole-tree clearcutting and application of triclopyr.

selectivity can be an important way to maintain adequate amounts of vegetation on treated sites.

ACKNOWLEDGEMENTS

This study was supported by the New Hampshire Water Resources Research Center, McIntire-Stennis Project 17, the Cooperative Forestry Research Unit at the University of Maine, Great Northern Paper Company, and Dow Chemical Company. Robert Smith of the USDA Forest Service, Durham, NH assisted with the BROOK simulations.

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MONITORING HERBICIDE CONCENTRATION IN LARGE SCALE APPLICATIONS

Anthony Filauro[1/] and Richard D. Kroeger[2/]

ABSTRACT

The concentration of herbicide mixtures prepared by commercial applicators is difficult to monitor due to the large volumes prepared and the elaborate mixing equipment used. A conductivity meter can be used to determine whether a herbicide mixture is prepared to proper concentration.

INTRODUCTION

Large scale herbicide programs require the use of large mixing equipment. Equipment used by commercial applicators is usually a tank truck that has capacity to hold several thousand gallons. These trucks typically have a large and somewhat elaborate plumbing system. The plumbing system can hold between 25 and 30+ gallons within the meter and the piping that comprises the intake and exhaust manifolds. Herbicide trapped in the plumbing system, will not mix with the proper amount of carrier. This problem of incomplete mixing of herbicide and carrier usually goes undetected since the meter on the tank truck indicates that the proper amount of herbicide has been taken onboard. However, the incomplete mixing of herbicide and carrier introduces an error into the batch mixing process.

The need to monitor herbicide mixtures prepared in large tank trucks required Great Northern Paper to develop a method to check the concentration of herbicide mixtures. The method developed requires the use of a conductivity meter. This has been the method used by Great Northern Paper for the past four years and has proved to be satisfactory.

MATERIALS AND METHODS

The device used by Great Northern Paper is manufactured by the Yellow Springs Instrument Company (Model 33) of Yellow Springs, Ohio. The instrument is relatively compact, is battery powered, and has the electrical probe attached to a 10 to 12 foot cord. The cord must be of ample length to allow for the testing of batch mixtures through the entry port at the top of each compartment in the tank truck. The cord has a weight attached to assure that the probe will sink into the herbicide mixture as it is being agitated.

The method of using a conductivity meter to check the concentration of herbicide mixtures is relatively simple but requires some preparation prior to being used in the field. A small amount of the herbicide mixture to be applied in the field, must be prepared. The mixture should be prepared preferably with distilled water. After preparation, the mixture is tested with a conductivity meter to determine the electrical conductance of the mixture. Since electrical

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conductance is influenced by temperature, the herbicide mixture needs to be tested over a range of temperatures. Great Northern Paper has used a range of temperatures between 10°C (50°F) to 25°C (77°F). This temperature range is adequate for lakes and streams in the area, which are the water sources used to prepare herbicide mixtures.

RESULTS AND DISCUSSION

Conductivity readings of herbicide mixture(s) tested over a range of temperatures, are summarized in Table 1. This table contains all the information that would be needed in the field, when applying the treatments described on a large scale basis.

TABLE 1: Conductivity Readings of Herbicide Mixtures Used in the Field[a]

Temp.	Glyphosate[b]			Triclopyr[c]
C°	0.5/5gpa[d]	0.625/5	0.625/10	0.75/10
10	6,550	7,500	4,550	5,400
11	6,850	7,700	4,700	5,550
12	7,100	8,050	4,800	5,700
13	7,350	8,300	4,950	5,800
14	7,600	8,550	5,100	5,950
15	7,850	8,800	5,250	6,100
16	8,000	9,050	5,400	6,250
17	8,200	9,300	5,550	6,350
18	8,400	9,550	5,700	6,450
19	8,600	9,800	5,850	6,650
20	8,800	10,050	5,950	6,800
21	9,050	10,300	6,150	7,000
22	9,300	10,550	6,300	7,150
23	9,500	10,800	6,400	7,300
24	9,750	11,050	6,550	7,450
25	10,000	11,300	6,700	7,700

[a] Use of this information to test herbicide mixtures in the field is not recommended prior to these readings being verified using a herbicide mixture that has been prepared under controlled conditions.

[b] N - (phosphonomethyl) glycine; Roundup

[c] [(3,5,6-trichloro -2- phridinyl)oxy] acidic acid; Garlon 3A

[d] Gallons of herbicide/gpa.

Implementing the procedure in the field is a simple matter. By immersing the probe of the meter into the tank of the mix truck, the temperature and electrical conductivity of a herbicide mixture can be determined and compared to the expected value found in the prepared table. It is important that the conductance of the water be subtracted from the reading of the mixture, so the influence of the water is removed.

The temperature and conductivity reading should be taken while the mixture is being agitated to assure uniformity of the mixture. The conductivity value indicated by the meter should check within ±2% of the value indicated in the table. If the conductivity reading on the meter does not agree with the value in the table, the herbicide mixture is not mixed properly. Mixing errors are usually caused by insufficient mixing of herbicide and carrier or may be due to herbicide material being trapped in the plumbing system.

The problem of incomplete mixing or having material trapped in the plumbing system is especially important with large tank trucks that are divided into several independent compartments. Improperly prepared herbicide mixtures usually result from an incorrect amount of herbicide being placed in one or more of the compartments. Testing the herbicide mixture in each of the compartments will indicate compartments that register low or high conductivity readings. Mixing herbicide and carrier between compartments which tested high and compartments which tested low is usually sufficient to bring the total mixture to the desired concentration. The end point of mixing is determined when the conductivity reading in the compartments in question, is acceptable.

This method of checking the concentration of herbicide mixtures prepared in large tank trucks operated by commercial applicators is relatively inexpensive. A suitable meter will cost approximately $400. The cost of the meter is justified when compared to the amount of the herbicide product being used and the cost of mistreating an area with an improperly prepared herbicide mixture.

DESIGN OF A STUDY TO MONITOR THE DISPERSAL AND DEGRADATION OF TRICLOPYR IN A FOREST ECOSYSTEM

T.S. MacKay and D.D. Fontaine [1/]

ABSTRACT

In August 1987, Dow Chemical Canada Inc. established a study within a forested area approximately 50 km southwest of Hearst, Ontario. The objective was to monitor the dissipation of triclopyr ester, acid and the major metabolite following aerial application of the herbicide to a stream and adjacent conifer plantation. Ecosystem components studied included stream and pond water, sediment, deciduous foliage, litter, soil under litter and organic matter, exposed mineral soil, aquatic plants, fish and invertebrates. Samples will be collected through a 52 week period or until residues are below the level of detection for two consecutive sampling dates.

Triclopyr ester was applied, over a two day period, to 90 hectares of a black spruce |Picea mariana (Mill.) B.S.P.| and jack pine (Pinus banksiana Lamb.) plantation. There was no attempt to avoid overspraying the stream flowing through the centre of the plantation. This simulated an extreme "worst-case" occurrence in operational aerial application of the herbicide. The application was made under operational spraying conditions with a helicopter. The rate of application was 8 L product/ha (3.84 kg a.e./ha) diluted to 34 L/ha with water.

Two soil sampling sites were located within the treated area on both coarse and fine textured soils. Litter and organic layers were removed from half of each soil sampling plot to expose the mineral soil surface. A third site, outside the treated area, was prepared in the same manner to serve as a control. Prior to and following application, six random cores were taken from each plot, at each site, in 15 cm increments to a maximum depth of 90 cm. These were composited to yield two samples of three cores each for every 15 cm depth. Litter samples were collected from the soil core position of the unexposed soil plots. Foliage samples were taken from randomly selected trees adjacent to each soil sampling site.

Stream water was intensively sampled in the 24 hours which followed herbicide application and again following each of three subsequent significant rainfall events. Significance was determined by an increase in stream level. Sediment and aquatic plant samples were collected prior to and after application. Adult fathead minnows, juvenile yellow perch, crayfish and larval caddis flies were collected and placed in cages within the treated portion of the stream. They were also placed at the control site upstream from the treated area. The mortality of the fish and the invertebrates was observed daily for three days following the herbicide application and the fish were observed again 6, 15 and 30 days after treatment.

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WATERSHED LOSSES OF TRICLOPYR AFTER AERIAL APPLICATION TO RELEASE SPRUCE-FIR

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M.L. McCormack, Jr. [2/]

ABSTRACT

Triclopyr was aerially applied to release conifers on a regenerating, whole-tree clearcut red spruce - balsam fir watershed in northern Maine at an average rate of 1.9 kg ae/ha. Stream water draining the 49 ha of the treated area and an adjacent 73 ha control watershed were sampled periodically for 298 days after the spray operation to monitor triclopyr concentrations. Peak concentrations of 56 ppb triclopyr were observed immediately after the operation due to direct application to the stream channel. Another pulse of 48 ppb triclopyr occurred after an 11mm rain event six days after the operation. The highest concentration observed below a 450 m buffer strip along the treatment stream was 11 ppb. Total losses of triclopyr from the watershed for a 113-day period after the operation were estimated from triclopyr concentrations and stream volumes predicted by the hydrologic simulation model BROOK. The watershed losses were estimated to be 0.02% of the 90.9 kg triclopyr applied. The buffer strip was effective at reducing the losses of triclopyr from the watershed.

INTRODUCTION

The use of herbicides in forestry and right-of-way maintenance operations has the potential to affect the volume of streamflow and streamwater quality. Water volume can change as a result of reductions in evapotranspiration when weed biomass is reduced; while water quality can change as a result of alterations in ecosystem nutrient cycling and through herbicides entering surface and ground waters on sprayed watersheds. In his review of herbicide behavior in the forest environment, Norris (9) summarized that herbicides may enter water draining forested areas by several pathways, including direct application and drift to surface water, mobilization in ephemeral streams, overland flow to surface water, and leaching. Studies conducted in the Pacific Northwest have generally indicated that direct application and drift to surface water, and mobilization in ephemeral streams are the major sources of herbicides to water in forested areas (8,9). The degree to which herbicides may move to ground or surface water via leaching after deposition on the forest floor is a function of climate, site hydrology, the soil characteristics of the treated site, and the properties of the herbicide.

The red spruce (Picea rubens Sarg.) - balsam fir [Abies balsamea (L.) Mill.] type of the northeastern United States and Canada has extensive areas that require brush control to maintain adequate growth rates and stocking of conifer species.The effectiveness of aerially applied triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid) for general brush control and for broadcast applications in conifer release operations in the Northeast has been described by McCormack and Newton (5), and McCormack et al. (4,6). As a result triclopyr has been used extensively in New Hampshire and Maine for both right-of-way maintenance and conifer release operations. From 1981 to 1984, an estimated 8950 kg of triclopyr was used in New Hampshire [3/]; while in Maine, 40% of the estimated 11300 hectares treated with herbicide in 1984 was treated with triclopyr.

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The behavior of triclopyr in the forest environment was reviewed thoroughly by Ghassemi et al. (2) and the USDA (14). Forest studies have been conducted in Sweden (13) and in West Virginia (7). Triclopyr is considered to be a mobile herbicide in the soil; however, its mobility in soil may vary due to the adsorption capacity of the soil, the hydrologic characteristics of the site, and the rate of microbial degradation. Triclopyr movement in soil is generally restricted by organic matter in the forest floor and mineral horizons containing high amounts of organic matter. Triclopyr is weakly acidic, so soil adsorption should be improved in acidic soils. Microbial degradation rates generally increase with temperature, but are reduced by anaerobic conditions. Triclopyr is not considered to be bound by mineral soil particles, so may have the potential to leach to ground and surface waters on cool sites with soils that are low in organic matter, that have high pH, or that have seasonally high water tables. Computer simulation studies with CREAMS(Chemicals, Runoff, and Erosion from Agricultural Management Systems) by Nutter et al. (10) have predicted that triclopyr has relatively high potential for appearance in stormflow from forested sites.

The triclopyr studies summarized by the USDA (14) did not provide adequate information about the fate and movement of triclopyr in conditions similar to those found in the Northeast. This lack of information indicated the need to study the movement of triclopyr in the Northeastern red spruce - balsam fir ecosystem. The objective of this paper is to summarize the watershed losses of triclopyr following an operational-scale, aerial application of triclopyr to a regenerating, whole-tree clearcut spruce-fir watershed in northern Maine.

MATERIALS AND METHODS

The study has been conducted on a pair of adjacent watersheds located on Weymouth Point, in Piscataquis County, Maine. The soils are poorly to moderately-well drained, coarse-loamy, mixed, frigid glacial tills of the Chesuncook catena that were derived from slate and phyllite bedrock (11). The 49 ha treatment watershed was whole-tree harvested from June to July 1981 (12). Because of equipment limitations, a buffer strip of trees was maintained along the lower 450 m of the stream draining the clearcut area. The width of the buffer varied from 25 to 50 m along either side of the stream. The adjacent, 73 ha watershed has been used as an uncut control area. Following a regeneration survey of the clearcut by Great Northern Paper Company, an aerial application of triclopyr (2 kg ae/ha) was prescribed for August 1985 as a conifer release operation. The herbaceous cover of the clearcut was predominantly red raspberry (Rubus idaeus var. strigosus Maxim.) and fireweed (Epilobium angustifolium L.), with varying amounts of other species depending on the soil drainage class.

The site was treated between 0900 and 1030 hrs on 10 August 1985. A total of 4500 L of mix (225 L of triclopyr as the butoxyethyl ester plus 4275 L water) was applied with a Hiller 12E helicopter equipped with a 10.7 m boom and D8 nozzles with #46 spinners at an average rate of 1.9 kg ae/ha. The total amount of triclopyr applied to the watershed was 90.9 kg. Color-coded flight line markers were established along four transect lines prior to the operation, to improve the application uniformity. All portions of the clearcut were sprayed, with the exception of a 4.6 ha control block, which was reserved as a control for soil and soil solution sampling, and the 6.4 ha buffer strip along the lower portion of the treatment stream.

Stream water was sampled at two locations on the treatment stream (above and below the 450 m buffer strip) and at one location on the control stream. Samples were collected at six protocol dates (pretreatment, spray day, and 3, 14, 31, and 60 days after the triclopyr application), and after rain events exceeding 13 mm. These samples were collected in 500 ml polyethylene bottles, protected from light, frozen, and submitted to an independent laboratory for gas chromatography analysis for triclopyr residues.

Streamflow volume for the Weymouth Point watersheds was predicted with the BROOK hydrologic simulation model (1). This model has been calibrated for these watersheds with hydrologic data from the Nashwaak Experimental Watersheds in New Brunswick, Canada, and are considered adequate for predicting streamflow (3). Losses of triclopyr from the clearcut via streamflow (g triclopyr/ha and g triclopyr/watershed) were estimated from the product of triclopyr concentration and simulated stream volume on a daily basis. Daily totals were summed over the period 10 August to 30 November 1985 to estimate the total amount of triclopyr which was lost from the clearcut via stream flow.

RESULTS AND DISCUSSION

Triclopyr was detected above the buffer on the treatment stream for a period of 31 days after treatment (Table 1). The peak triclopyr concentrations above the buffer strip from Day-0 to Day-3 can be attributed to the direct application of the herbicide to the stream channel above that point. A second pulse of triclopyr occurred above the buffer in conjunction with an 11 mm rain event on Day-6. This may be attributed to mobilization of triclopyr in the stream channel during the rain storm. Mobilization could occur as a result of rain washing triclopyr residues into the water column from stream-side slash, and from increases in the width of the surface water as rain swelled the stream. The only time that triclopyr concentrations below the 450 m buffer were above 5 ppb was associated with this storm. Triclopyr concentrations were below detection limits of 5 ppb at both locations on the clearcut after Day-46.

Table 1. Triclopyr concentrations (ppb) in stream water of the control and treated watersheds at Weymouth Point, Maine up to 298 days after application of triclopyr at 1.9 kg ae/ha.

DAYS AFTER APPLICATION	CONTROL STREAM	TREATMENT STREAM: ABOVE BUFFER	TREATMENT STREAM: BELOW 450m BUFFER
	ppb	triclopyr	
PRETREATMENT	<5	>5	<5
0	<5	56	<5
1	<5	16	<5
3	<5	9	<5
6	<5	48	11
8	<5	28	<5
14	-	5	<5
31	<5	6	<5
46	<5	<5	<5
60	<5	<5	<5
69	<5	<5	<5
89	<5	<5	<5
95	<5	<5	<5
116	<5	<5	<5
256	<5	<5	<5
272	<5	<5	<5
298	<5	<5	<5

These results indicate that triclopyr was found in the stream as a result of direct deposition to the surface water and the area around the stream channel, which is the source area for storm flow. Movement to the stream by leaching and subsoil flow was probably negligible. The buffer

strip was very efficient in adsorbing triclopyr from the water column, probably as a result of triclopyr being adsorbed by organic sediments as the water moved through the detritus that fills the streambed.

The butoxyethyl ester of triclopyr is considered highly toxic to rainbow trout and bluegill, with 96-hr LC_{50}'s of 740 and 870 ppb, respectively (14); however, it is unclear how hydrolysis and neutralization processes in aquatic environments affects these toxicity ratings. The highest triclopyr concentrations measured in the study (56 ppb) were far below the levels that are considered for these species of fish, and were of relatively short duration.

For the period 10 August to 30 November 1987, the total loss of triclopyr from the clearcut above the buffer strip was estimated to be 46.50 grams (1.33 g/ha); while the loss from the total watershed (below the 450 m buffer) was estimated to be 14.96 grams (0.32 g/ha). Based on these estimates, the apparent adsorption by the streambed in the buffer strip was 31.5 grams of triclopyr. Losses of triclopyr from the watershed above the buffer strip were an estimated 0.07% of the amount sprayed on that portion of the watershed. Total losses of triclopyr from the entire clearcut were only 0.02% of the 90.9 kg applied.

These results indicate that aerial applications of triclopyr at 2 kg ae/ha to regenerating clearcuts that contain streams in the spruce-fir type may result in small amounts of triclopyr in stream water. Subsurface leaching appeared to be negligible in this study. The pulses of triclopyr resulting from direct application to the stream channel and from mobilization of the herbicide in the stream channel during a rain storm reinforce the importance of maintaining a buffer strip along stream channels to reduce the amount of herbicide in watershed drainage water. Buffer strips of uncut trees along streams in clearcuts would be effective for minimizing changes in stream quality after both harvesting and herbicide treatments.

ACKNOWLEDGEMENTS

This study was supported by the New Hampshire Water Resources Research Center, McIntire-Stennis Project 17, the Cooperative Forestry Research Unit at the University of Maine, Great Northern Paper Company, and Dow Chemical Company. The BROOK simulation model was run by Robert Smith, USDA Forest Service, Durham, NH.

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EARLY DORMANT THIN-LINE AND LOW-VOLUME BASAL APPLICATION OF TRICLOPYR AND FLUROXYPYR TO CONTROL SUGAR MAPLE AND WHITE ASH

Timothy S. MacKay [1/]

ABSTRACT

Industrial and forest vegetation managers require an effective herbicide and a simple application technique which, when combined, will allow them to control undesirable woody brush during all seasons.

An early dormant season trial was established in November, 1986 on a utility right-of-way near Toronto, Ontario to determine the effectiveness of various concentrations of a triclopyr ester herbicide (480 gm a.e./L) and fluroxypyr herbicide (200 gm a.e./L) for the control of sugar maple (*Acer saccharum* Marsh.) and white ash (*Fraxinus americana* L.) using the thin-line or low-volume basal application techniques. Thin-line treatments utilized solutions of 75 and 50 percent triclopyr diluted in diesel fuel applied in a thin stream to the entire circumference of the individual stems about 15 cm above the root collar. Equipment for thin-line treatments consisted of a backpack sprayer equipped with a low volume gun and wand assembly and a straight stream nozzle. The low volume basal treatments were 15 and 25 percent triclopyr and one percent fluroxypyr herbicide in diesel fuel applied to the entire circumference of the lower 30 to 38 cm of each stem including the root collar. The herbicide solution was sprayed to thoroughly wet the surface of the stem but not to the point of runoff. A backpack sprayer with a low volume wand and an adjustable solid cone nozzle was used to apply the low-volume treatments. The air temperature range during the application was -3° to - 5° C. All individual stems within plots measuring 5 m by 25 m were treated.

A randomized sample of ten of each of the sugar maple and white ash trees within each plot was evaluated for percent stem dieback approximately ten months after application. All of the treatments provided 100 percent control of sugar maple. The 75 and 50 percent solutions of triclopyr herbicide, applied as thin-line treatments, resulted in 92 and 90 percent control of white ash respectively. The low volume basal applications of 25 and 15 percent triclopyr herbicide resulted in 100 percent control of white ash. The one percent solution of fluroxypyr provided 65 percent control of white ash. The performance of fluroxypyr warrants more intensive investigation in future trials. There was no evidence of resprouting by either species, following any of the herbicide treatments, after ten months.

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Acknowledgement: William E. Welch of Ontario Hydro is gratefully acknowledged for providing the trial site and assisting with the application and the establishment of plots.

CONTROLLING ASH, BIRCH, AND MAPLE WITH BASAL BARK APPLIED HERBICIDES

Larry J. Kuhns and Gregory T. Lyman [1/]

ABSTRACT

An experiment was conducted to examine the efficacy of imazapyr (6.25% v/v) in basal oil[2/] or triclopyr at two rates (5% & 20% v/v), using diesel fuel and basal oil as diluent and on green ash (Fraxinus pensylvanica Marsh.), black birch (Betula lenta L.) and red maple (Acer rubrum L.). Application was made in March 1987 to dormant trees using a commercial wand consisting of a B&G Extenda-Ban Valve[3/] with an 18" extension, and a Spraying Systems #5500 Cone Jet Nozzle[4/] with a Y-2 tip adjusted to produce a fine mist. Treatments were applied to the bottom 6" to 12" of the stems which ranged from .5" to 6" in caliper for each species. An average of 40 stems per treatment were utilized for ash, 30 stems for maple, and 20 stems for birch. During application to the ash and birch, air and soil (6") temperatures were 13º C and -1º C while -10º C and 2º C respectively were the temperatures during application to maple. Trees were rated for injury approximately 13 weeks after application on 6/9/87 and again approximately 22 weeks after application on 8/19/87.

Herbicide efficacy ratings increased for all treatments on 8/19/87 compared to 6/9/87. There was little difference between using diesel fuel or basal oil as diluent in the treatments containing triclopyr with the exception of black birch, in which triclopyr at 5% and basal oil killed 28% of treated stems while triclopyr at 5% and diesel killed 58% of treated stems by 8/19/87.

On 6/9/87, imazapyr provided the best control of ash when compared to the other treatments, and by 8/19/87 had killed 94% of the treated stems. Triclopyr at 20% killed over 90% of treated stems by 8/19/87 while triclopyr at 5% killed approximately 65% by the same date.

All herbicide treatments were less effective on black birch compared to ash and maple. Injury symptoms were noted on 6/9/87, but no trees were killed by any treatment. By 8/19/87, imazapyr showed only marginal activity. No trees were killed or displayed serious injury systems. Triclopyr at 20% provided the most control of birch, killing 69% (basal oil) and 78% (diesel) of the stems treated.

Red maple was more sensitive to all the herbicide treatments than ash or birch; triclopyr at 20% in basal oil, and triclopyr (5% & 20%) in diesel killed all stems by 6/9/87. At the same date triclopyr at 5% in basal oil killed 81% while imazapyr only killed 17%. By 8/19/87, imazapyr had killed 92% of treated stems and imazapyr had killed 88%.

1/ - Assistant Professor and Project Assistant respectively, Department of Horticulture, The Pennsylvania State University, University Park, PA

2/ - Basal Oil, a product of Arborchem Products Co., Fort Washington

3/ - Trademark of B&G Equipment Co., Plumsteadville, PA 18949

4/ - Trademark of Spraying Systems Inc., Weaton, IL

Table 1. Injury ratings of trees treated with basal bark applications of triclopyr (5% & 20% v/v) in Basal oil or diesel fuel, or imazapyr (6.25% v/v) in Basal Oil. All treatments were applied March, 1987. Basal oil is a highly refined petroleum product produced by Arborchem Products Co, designed to improve herbicide penetration into woody plants.

	Rated 6/9/87 Percentage of Stems in Each Rating Group					Rated 8/19/87 Percentage of Stems in Each Rating Group				
CONTROL RATING[1]	Triclo 5% Basal Oil	Triclo 20% Basal Oil	Triclo 5% Diesel	Triclo 20% Diesel	Imazapyr 6.25% Basal Oil	Triclo 5% Basal Oil	Triclo 20% Basal Oil	Triclo 5% Diesel	Triclo 20% Diesel	Imazapyr 6.25% Basal Oil
White Ash - Average 40 stems per treatment										
0	0	0	0	0	0	0	0	0	0	0
1	0	0	5	0	0	0	0	0	0	0
2	16	2	8	0	3	0	0	2	0	0
3	49	49	60	35	0	5	0	5	0	0
4	30	38	27	65	56	28	7	30	2	6
5	5	11	0	0	41	67	93	63	98	94
Black Birch - Average 20 stems per treatment										
0	0	0	0	0	0	0	0	0	0	0
1	12	0	9	0	65	0	0	0	0	10
2	24	13	5	6	29	6	0	0	0	55
3	64	81	77	75	1	28	5	9	0	35
4	0	6	9	19	0	38	26	36	22	0
5	0	0	0	0	0	28	69	55	78	0
Red Maple - Average 30 stems per treatment										
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	8	0	0	0	0	6	0	0	0	0
4	11	0	0	0	83	6	0	0	0	8
5	81	100	100	100	17	88	100	100	100	92

1) Control Ratings 0 = No Effects, 5 = Dead

CONTROL OF SASSAFRAS ALBIDUM ROOTSUCKERING USING SUMMER AND WINTER APPLICATIONS OF TRICLOPYR ALONE AND IN COMBINATION WITH PICLORAM

Glenn D. Dreyer[1] and William A. Niering[2]

ABSTRACT

Rootsuckering tree species have long been considered a control problem in utility right-of-way vegetation management due to their ability to produce numerous stems from roots when aerial portions of the plant are damaged. The purpose of this research was to monitor the response of a Sassafras (Sassafras albidum (Nutt.) Nees) clone to the following three commercially applied, stem-basal herbicide treatments: 1) triclopyr ester (4 lb ae/gallon), 2% in oil; 2) a combination of triclopyr ester (2 lb ae/gallon) and picloram ester (1 lb ae/gallon), 1.5% in oil; 3) the preceding mixture at 1% in oil, all applied both in July and December 1985. All six plots were located on a transmission r-o-w in Norwich, Connecticut within a continuous 30 by 10 m Sassafras patch believed to be a single clone. Treated plots were 24 m^2; two untreated control plots were 20 m^2. Stems were counted and assigned to height classes before treatment and during each of the following two growing seasons.

To effectively control such rootsuckering species, an herbicide must not only kill the treated stem and the root immediately below, it must also travel laterally through the connecting root system to 1) kill small, untreated stems and 2) prevent sprouting from the root system. Any surviving portions of the clone can regenerate a new colony. All treated Sassafras stems were top-killed (Figs. 1 to 6); however many stems < 1 m were not sprayed. The triclopyr treatments (Figs. 1 & 2) and the triclopyr and picloram combination at 1.5% concentration (Figs. 3 & 4) all stimulated vigorous resprouting in the first year as shown by the increase in stems less than 1 m tall. Many of the new rootsuckers were within 50 cm of treated stems. Only the summer triclopyr treatment showed significant reductions in Sassafras stems by year 2 (Fig. 1). The most effective treatments were the 1% triclopyr and picloram mixtures which did not stimulate excessive suckering for the entire two-year period (Figs. 5 & 6).

In the untreated control plots a natural decrease in stem number was due almost entirely to losses in the smallest size class (Fig. 7). This may be the result of "self-thinning" from competition for light, but browsing by rodents also appeared to be an important factor in control and treated plots. Prior to treatments cover of herbaceous species was continuous below the 3 to 5 m Sassafras canopy. Spraying reduced herb cover 10 to 30 % in the first year and all treatments except the 1% triclopyr & picloram mix reached at least 90% herb cover by the second growing season. Damage to non-target species, especially the shrubs Smooth Sumac (Rhus glabra L.) and Hazlenut Corylus americana Walt.), were most pronounced with winter applications containing picloram.

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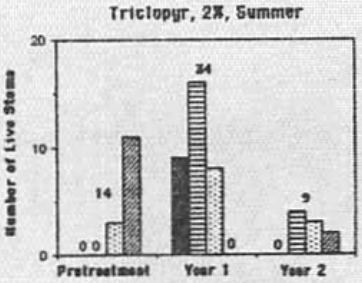
Fig. 1



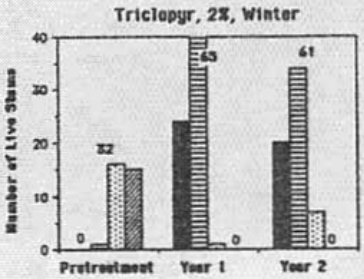
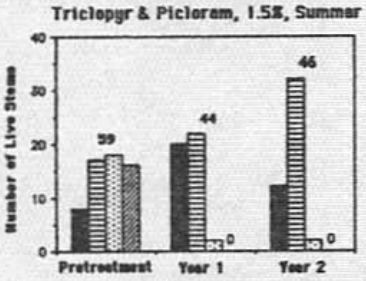


Fig. 2

Fig. 3



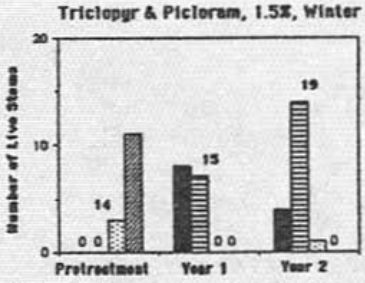
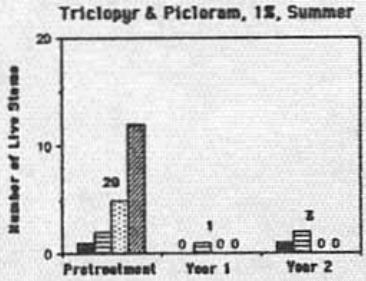


Fig. 4

Fig. 5



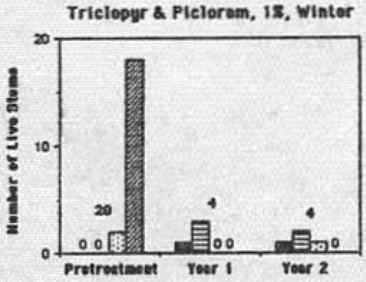


Fig. 6

Height, m
< 0.25
0.25-1.0
1.1-2.0
> 2.0

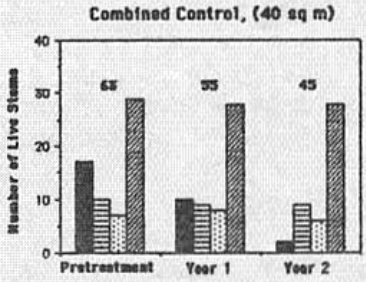


Fig. 7

Figures 1 - 6. Abundance of living *Sassafras albidum* stems in four height classes before herbicide treatment (Pretreatment), during first growing season after treatment (Year 1) and during the second growing season after treatment (Year 2). Each of three treatments was applied in summer and in winter. Zeros indicate the absence of stems in a particular size class. Other numbers are total stem density counts.
Figure 7. Combined Sassafras stem density of two 20 m^2 untreated control plots over two year period.

USING TREE GROWTH REGULATORS TO MAINTAIN TRIMMED TREES ON ELECTRIC UTILITY RIGHTS-OF-WAY

Micheal R. Watson and Graham B. Brown, Jr.[1]

ABSTRACT

Research with growth regulators on trimmed trees under electric utility lines has been ongoing since 1985 at The Potomac Edison Company of Hagerstown, Maryland. Two-year growth results indicate that paclobutrazol is more effective at reducing sprout growth than either XE1019 or flurprimidol. Degree of control varied widely by species injected and month of injection. Greatest cost savings will be realized on two-year trim cycles, though substantial savings can be realized for longer cycles also.

INTRODUCTION

Potomac Edison is an investor-owned electric utility based in Hagerstown, Maryland, with operations covering 7,200 square miles in parts of Maryland, West Virginia and Virginia. Potomac Edison, Monongahela Power and West Penn Power Companies are companies of the Allegheny Power System. Potomac Edison maintains 15,937 miles of line, spends approximately three million dollars annually on tree trimming, and has an estimated tree population of 2.3 million to maintain. It is estimated that 15% of this total population are candidates for injection. Potomac Edison first became interested in tree growth regulators through the Electric Power Research Institute's Delaware, Ohio, project in the late 1970's.

MATERIALS AND METHODS

During this early period, various growth regulators were tried and in the early 1980's a gibberellin inhibitor, paclobutrazol, was developed in a stem injectable formulation. Growth is suppressed by reduced cell elongation at the growing tips while the number of cells remain the same.

A battery-powered drill is used to bore holes 3/16" in diameter on a 30-45° angle to the tree surface and 2-1/2" deep just above the root flare. Injection holes are placed as close to the ground line as possible to minimize any visual impacts. An injection probe is inserted in each hole and the material is delivered at 70 psi. This is a closed system - the material passes directly from the injector into the tree with no environmental exposure.

Spacing of injection holes and the volume delivered per hole is dependent upon tree species. Table 1 shows hole spacing and volume delivered per hole. Upon completion of the injection process, each hole is sealed with a vinyl plug. This is done to prevent any material from back-flushing out of the hole and causing bark stain. It is also felt that plugging the hole provides a public relations benefit as homeowners perceive plugging as necessary to maintaining tree health. The most important consideration of the injection process is drilling the hole. If the hole is not drilled true round, material can leak around the interface of the hole and the probe. If the hole is drilled at a angle greater than recommended, the material will miss active

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xylem tissue and uptake will be slow or not take place. If the hole is too shallow, there is a tendency to force the material between the bark and the xylem which results in bulging of the bark and causes tissue damage in the immediate area of the hole. The person drilling the hole must also gauge bark thickness and make adjustments to the angle of entry. On thick-bark trees, the hole must be drilled in a fissure to intercept the conducting xylem. Also, stem defects and other obvious injury must be avoided near or above an injection site as injection time will be increased or the material will follow the defect (example: frost cracks) and not reach conductive tissue.

RESULTS

Beginning in 1985, we commenced on a formal study of TGR's on our system. Over the next year, over 2,000 trees were measured and injected using three different TGR's, and a data base was established which is currently maintained by Environmental Consultants, Inc. The tree regulators used were paclobutrazol (manufactured by ICI), XE1019 (Chevron), and flurprimidol (Elanco). Paclobutrazol was used on approximately 85% of these trees. Over the next two years, growth on these study trees was measured by ECI personnel. The results are presented here.

A very important aspect of field injection of TGR's is the time required to place the material into the tree. The study provided some interesting information. Injection times are slowest during the cold winter months when trees are frozen, and fastest during mid-summer. Table 2 shows the average monthly injection times. Uptake time also varied with tree species. Generally, ring porous species are the slowest and diffuse porous, the fastest to inject. Table 3 shows a representative sample of tree species and average injection times.

Although we did not collect data on wind velocity, relative humidity, or sunlight intensity, causual observation suggests that these factors also affect injection time. Generally, as wind velocity, relative humidity, and sunlight intensity increased, injection time decreased.

The amount of time required to inject a tree versus the amount of time to trim a tree was also of concern. It was hoped the injection process could take place at the time of trimming. However, it is undesirable to have the tree trimming operation slowed by the injection procedure. To evaluate the relationship of injection time to trim time, arbitrary time classes were established for injection. This classification was: 10 minutes or less - fast injection, 11 to 20 minutes - medium injection, and 21 and over - slow injection. As Table 4 indicates, 83% of the trees injected took less than 20 minutes. Based on this information, the injection time for the majority of trees is well within the time interval required to trim.

Table 5 shows the degree of control obtained over two years with the three TGR's used. Control in the first year with paclobutrazol was far better than the other two formulas. This is the most important year for controlled growth as most sprout growth occurs in this time period. Additionally, XE1019 control improved the second year in relation to growth in unregulated trees, whereas it decreased with the other two regulators.

Table 6 shows the amount of growth reduction by month for all species studied. There is some variance due to month of injection. Trees injected in January had an accelerated growth rate for which we have no explanation. The number of trees injected is small, however, due to the cold weather not allowing material uptake. The figures for April and August are reduced

Table 1. Hole spacing & volumes.

	HOLE SPACING (INCH)	AMOUNT PER HOLE (ML)
ALL SPECIES, EXCEPT:	8	75
MAPLES:	6	30
ASH, OAKS:	6	40
SYCAMORE:	6	150
TULIP POPLAR, WHITE BIRCH, PINE, SPRUCE, CEDAR:	DO NOT INJECT	
BLACK CHERRY:	6	50
BLACK LOCUST:	6	50
WILLOW:	6	150
COTTONWOOD:	6	75
CHINESE ELM:	6	75

NOTE: If the tree has a small crown for the size of the trunk or is smaller than 10 inches in diameter, reduce the injection amount per hole by 1/2.

Table 2. Average monthly injection time (all TGR and species).

Month	Time (Min.)
January	30
February	45
March	10
April	12
May	15
June	22
July	7
August	4
September	4
October	9
November	9
December	10

Table 3. Average injection time by species.

Species	Time (Min.)
Catalpa	18.16
Black Walnut	9.54
Hackberry	4.91
Mulberry	17.17
Black Locust	27.43
Sugar Maple	4.47
American Elm	9.92
Red Maple	12.02
Silver Maple	4.47
White Ash	28.23
Box Elder	5.75
Sycamore	4.49
Kentucky Coffee Tree	20.56
Black Cherry	4.21
Norway Maple	7.32

possibly due to a high percentage of trees injected in these months which were Norway maple, ash and hackberry - species which characteristically show little response due to limited sprout growth on control trees.

The amount of growth reduction also varied by species as shown in Table 7. In comparing these figures with those in Table 3, there does not appear to be a correlation between the degree of control and the rate of the regulator uptake.

DISCUSSION

Cost considerations

Preliminary work at Potomac Edison suggests that we will get a minimum of three year's control from growth regulators with a possibility of four years control in some species. Using three and four year's control, 12% guiding rate of interest, and a 20-year period, various possibilities of trimming and regulation were discounted to present value on an average annual cost per tree basis. Table 8 shows the present worth values for two through four year trimming cycles under various conditions. Where an (R) is shown in the chart, it was assumed that the tree would be re-regulated prior to the effects of the growth regulator ending. An (X) means a tree was trimmed and regulated. As Table 8 indicates, the greatest savings under any conditions are on the two-year trim cycle. The minimum savings is $3.68 per tree and the maximum savings is $6.00 per tree, depending on the assumption. The minimum savings is on a four-year trim cycle ($1.09 to $2.44 per tree). The average annual cost savings per tree is significant if one considers that Potomac Edison trims about 100,000 trees per year which could be regulated.

Future research

Annual growth measurements will continue to be taken through the third and fourth growing seasons, after which time most of these trees will be due for maintenance. At this time, we will examine the trees to assign individual prescriptions based on the present tree condition - either to trim and re-regulate or re-regulate with no trimming. Since the beginning of the study period, we have refined the spacing and amount of material injected per hole which should give us more consistent control on each tree. Additionally, we are continuing work with XE1019 and flurprimidol to expand our knowledge of these compounds.

Another focus of our current research will be to monitor the condition of the injection site in the years following injection. There currently is concern over some trees weeping from the holes, thus creating an area conducive for fungal and bacterial growth. We feel this problem is minimal, but it does occasionally exist and we will be attempting to identify variables which may contribute to this. Also, we have obtained discs from removed trees which were previously injected to view the interior portion of the tree for internal reactions. Preliminary examination indicates that the tree generally compartmentalize the injection site. Contact with other areas of internal decay should be avoided if possible.

Table 4. Percent of all trees by time class.

Time Class	% of Trees
Fast (0-10 min.)	69
Medium (11-20 min.)	14
Slow (21 min.+)	17
	100%

Table 5. Growth reduction percentages by tree growth regulators.

	First Year	Second Year	Combined
Paclobutrazol	49	32	42
XE1019	28	40	32
Flurprimidol	34	29	32

Table 6. Percent growth reduction by injection month for all species.

MONTH	% CHANGE
January	+5
February	-70
March	-52
April	-23
May	-64
June	-60
July	-38
August	-14
September*	-40
October*	-58
November*	-36
December*	-49

*Results are for one year's growth, all other months are two year results.

Table 7. Growth reduction by species after two growing seasons.

Species	Control Growth (Inches)	Treated Growth (Inches)	% Change
Black Locust	87	45	-49
Elm	80	43	-47
Black Willow	50	28	-45
Red Maple	40	23	-41
Silver Maple	66	40	-40
Black Cherry	55	35	-40
Sycamore	80	52	-34
Hackberry	46	33	-27
Norway Maple	39	32	-17
Ash	43	36	-17

Table 8. Trim cycle savings using tree growth regulators.

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	AVERAGE ANNUAL COST PER TREE
Trim 2 Yr. Cycle	X			X			X			X			X			X			X			14.11
Trim 2 Yr. Cycle +3 Yr. Regulate	X						X						X						X			10.43
Trim 2 Yr. Cycle + 4 Yr. Regulate	X							X							X							9.13
Trim 2 Yr. Cycle + 1-3 Yr. Regulate	X				R						X				R						X	9.17
Trim 3 Yr. Cycle	X				X				X				X				X				X	11.48
Trim 3 Yrs. Growth + 3 Yrs. Regulation	X							X							X							9.13
Trim 3 Yrs. Growth + 4 Yrs. Regulation	X								X								X					8.63
Trim 3 Yrs. Growth + 1-3 Yrs. Regulation	X				R							X				R						8.38
4 Yr. Trim Cycle	X					X					X					X					X	9.73
4 Yr. Trim Cycle + 3 Yrs. Regulation	X								X								X					8.64
4 Yr. Trim Cycle + 4 Yrs. Regulation	X									X									X			8.22
4 Yr. Trim Cycle + 1-3 Yrs. Regulation	X				R								X				R					7.69

EFFICACY OF TRICLOPYR IN ROOTKILLING ORIENTAL BITTERSWEET (*Celastrus orbiculatus* Thunb.) AND CERTAIN OTHER WOODY WEEDS

Glenn D. Dreyer[1]

ABSTRACT

Oriental Bittersweet (*Celastrus orbiculatus* Thunb.) is a woody, deciduous, twining vine with attractive yellow and orange colored fruit which closely resembles the native American Bittersweet (*Celastrus scandens* L.). It was introduced to North America in the mid-nineteenth century, was naturalized by the early 1900s and is now recognized as an aggressive weed from northern Georgia to southern Maine. It may be the most significant weed species in coastal Connecticut, where it inhibits forest regeneration and aggressively spreads through a variety of habitats both by twining up and strangling host plants and by overtopping and blanketing existing vegetation. It has a high seed germination rate, tolerates a variety of irradiance levels, spreads by rootsuckering and maintains a very rapid growth rate.

Preliminary attempts during 1983 to kill this vine in the Connecticut Arboretum, New London, Ct. with stem-foliar 2% (vol/vol water) Glyphosate (3 lbs ae/gallon) and 5% amitrole (2 lbs ae/gallon) resulted in 70% stem-kill with glyphosate, no effect with amitrole and no root-kill with either treatment.

In 1984 25 m^2 plots were established in an area traditionally maintained by annual mowing. Vegetation in two sets of three plots, dominated by Oriental Bittersweet, Japanese Honeysuckle (*Lonicera japonica* Thunb.) and various other woody species, was mowed in early June and treated one month later with one of the following herbicides: triclopyr salt (3 lbs ae/gallon); triclopyr ester (4 lb ae/gallon); and a formulation of triclopyr ester (1 lb ae/gallon) and 2,4-D (2 lbs ae/gallon). One percent aqueous solutions of each herbicide were mixed in water and applied to stems and foliage to the point of runoff.

Vegetation sampling one year later (1985, Table 1) indicated that triclopyr controlled Oriental Bittersweet, but not Japanese Honeysuckle or Winged Euonymus (*Euonymus alatus* Thunb.). After analysis, a second treatment of the 1% triclopyr ester was applied to all plots and assessed the following summer (1986, Table 1). These tests and subsequent use of triclopyr ester and salt in Arboretum landscape renovations confirm its effectiveness in rootkilling Oriental Bittersweet. When used in conjunction with mowing, a single, thorough triclopyr treatment can eliminate Oriental Bittersweet infestations and favor grasses, sedges, etc. which are unharmed. Triclopyr also rootkilled Dewberry (*Rubus hispidus* Michx.), and Virginia Creeper (*Parthenocissus quinquefolia* (L.) Planch), but not Japanese Honeysuckle, Winged Euonymus or Poison Ivy (*Rhus radicans* L.).

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SPECIES	TRICLOPYR SALT (PLOTS 1 & 1A)			TRICLOPYR ESTER (PLOTS 2 & 2A)			TRICLOPYR & 2,4-D (PLOTS 3 & 3A)		
	PRE	1985	1986	PRE	1985	1986	PRE	1985	1986
ORIENTAL	5	0	<1[a]	-	-	-	-	-	-
BITTERSWEET	55	<1	<1	30	0	0	30	2	0
VIRGINIA	20	1[a]	0	-	<1	0	30	0	0
CREEPER	8	0	0	<1	0	0	1	1	0
DEWBERRY	85	<1[a]	1	55	<1	<1	60	<1	1
	-	-	-	70	<1	0	30	0	0
POISON IVY	-	-	-	10	1	3	-	-	-
	1	0	0	10	15	8	<1	5	5
JAPANESE	5	15	15	-	-	-	-	5	5
HONEYSUCKLE	30	30	40	-	-	-	65	10	35
WINGED	5	25	10	5	10	1	3	20	5
EUONYMUS	<1	5	5	1	0	0	5	10	2
BLACK CHERRY[b]	2	5	5	<1	3	1	8	8	8
	-	<1	0	1	1	1	<1	<1	5
"GRASSES &	3	5	22	5	25	70	3	20	25
SEDGES"	5	75	95	10	50	95	1	20	75
TOTAL	100	65	92	95	55	100	98	90	90
COVER	92	99	100	92	70	97	98	80	92

Table 1. Percent cover of dominant plants in 25 m^2 plots before treatment (PRE), one year (1985) and two years (1986) later. Each pair of plots was subjected to 1% stem-foliar treatments of one of the three formulations listed across the top in summer, 1984. All six plots recieved a second stem-foliar triclopyr ester treatment in summer, 1985. A dash (-) indicates plant was not present in plot. A Zero indicates rootkill of plants initially present.

[a]Very low percent cover values for these three vines in all plots after treatment are due to encroachment from outside the plot.
[b]*Prunus serotina* Ehrh.

LOW-VOLUME BASAL APPLICATION OF PICLORAM AND TRICLOPYR ON UTILITY RIGHTS-OF-WAY

M. W. MELICHAR AND B. K. WAGGONER[1]

ABSTRACT

Basal herbicide applications provide the most directed, selective means for removing undesirable woody vegetation without affecting desirable woody and herbaceous species. Low-volume basal is becoming the preferred and most widely used basal application technique. This application method involves application of 20 to 30 percent herbicide in an oil diluent to the entire circumference of the lower 12 to 15 inches of stems, including the root collar. Application should adequately wet the stem, but no runoff should occur. Low-volume basal application offers numerous advantages compared to other basal techniques which require larger quantities of oil-based diluents. These include: (1) potential savings in diluent costs, (2) increased labor efficiency because the applicator makes fewer return trips to the mixing truck to refill the backpack tank, (3) low-profile application with minimum odor because much less oil diluent is applied per acre, (4) minimized site compaction and erosion potential because large mixing trucks are not required on the rights-of-way, and (5) less oil-based carrier introduced into the environment. Low-volume basal application of triclopyr (4 lb ae/gallon) and a product combining picloram ester (1 lb ae/gallon) and triclopyr ester (2 lb ae/gallon) has been demonstrated to be a viable, efficacious tool for controlling undesirable woody plants (1).

This paper presents results from low-volume basal trials testing various ratios of picloram and triclopyr in herbicide mixtures. Dormant and growing season trials were established in 1985 and 1986 in Pennsylvania, West Virginia, Connecticut, and Maine. All treatments were applied with a backpack sprayer equipped with a low-volume wand and adjustable solid cone nozzle. Major species treated included black cherry (*Prunus serotina* Ehrh.), maple (*Acer* sp. L.), oak (*Quercus* sp. L.), sassafras (*Sassafras albidum* Trew.), birch (*Betula* sp. Marsh.), white ash (*Fraxinus americana* L.), and aspen (*Populus tremuloides* Michx.).

Second year results combining dormant and growing season tests are presented in Table 1. Each treatment provided at least 83 percent control of all tree species. A very small number of black cherry, oak, and sassafras resprouted after some treatments. Generally, sprouting increased as the relative amount of picloram decreased. No resprouting occurred after application of triclopyr alone. However, this data is based only upon growing season applications. Field observations suggest that control of root-suckering species during early dormant season (November through February) applications is improved by the addition of picloram.

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Table 1. Control of various tree species following dormant and growing season low-volume basal herbicide applications. Results are combined dormant and growing season applications from trials in PA, WV, CT, ME.

Herbicide Treatment 1/	lb a.e./gal Herbicide Mix		Tree Species						
	picloram	triclopyr	Black Cherry	Maple	Oak	Sassafras	Birch	White Ash	Aspen
			% Defoliation						
25% picloram/triclopyr	0.25	0.50	100 (15) 2/	100 (21)	98 (109)	98/2 3/ (42)	99 (67)	84 (10)	100 (15)
18.75% picloram/triclopyr + 6.25% triclopyr	0.188	0.625	100 (9)	100 (28)	83 (28)	99/1 (24)	99 (21)	100 (2)	-- 4/
12.5% picloram/triclopyr + 12.5% triclopyr	0.125	0.75	98/2 (44)	100 (51)	98/1 (58)	100 (22)	96 (49)	85 (50)	100 (16)
7.5% picloram/triclopyr + 7.5% triclopyr	0.075	0.45	100 (10)	100 (23)	100/3 (21)	100 (20)	--	100 (2)	100 (4)
6.25% picloram/triclopyr + 18.75% triclopyr	0.063	0.875	97/4 (252)	100 (191)	96/7 (255)	100/6 (69)	99 (71)	100 (10)	100 (6)
25.0% triclopyr	0	1.0	100 (2)	100 (8)	100 (27)	--	100 (24)	--	100 (11)

1/ Data in table represents a combination of separate tests using kerosene and Arborchem* Basal Oil as carriers.

2/ Numbers in parentheses represent number of treated stems.

3/ Numerator = percent defoliation/denominator = number of treated stems which sprouted.

4/ -- = not tested

* Manufacturered by Arborchem Products Company

BROADLEAFED WEED CONTROL IN WOODY ORNAMENTALS WITH ISOXABEN

Joseph C. Neal[1] and Andrew F. Senesac[2]

Several experiments were conducted in 1986 and 1987 to evaluate the control of broadleafed weeds in field and container grown woody ornamentals with isoxaben. Experiments were conducted on Long Island (Riverhead sandy loam soil) and in Ithaca (heavy clay loam) to evaluate weed control and crop safety. Container experiments were also conducted with two media types; a bark : leaf mold : peat : sand mix and a pine bark : sand mix. Isoxaben was applied at 0.56 kg ai/ha or 1.12 kg ai/ha (0.5 or 1.0 lb ai/A), alone or incombination with oryzalin. These treatments were compared to simazine and other standard products. All herbicide applications were over-the-top with a CO_2 pressurized backpack sprayer calibrated to deliver 30 gpa at 40 psi with flat fan nozzles.

In general, isoxaben provided excellent broadleafed weed control at the rates tested, except for velvetleaf (Abutilon theophrasti Medik.), common mallow (Malva neglecta Wallr.), and pigweed (Amaranthus sp.) (in one experiment). See Table 1. Grassey weeds were suppressed by isoxaben at 1.12 kg ai/ha. Tank mixes with oryzalin provided excellent grass and broadleafed weed control with good crop safety. Isoxaben followed by postemergence graminicides also provided excellent broadleaf and grass control.

With one season's data available on each species, isoxaben was found to be safe on the following woody ornamentals: Douglas fir (Psudotsuga menziesii (Mirb.) Franco), concolor fir (Abies concolor (Gord.) Lindl. ex Hildebr.), False cypress (Chamaecyparis obtusa plumosa-aurea (Siebold & Zucc.) Endl.), forsythia (Forsythia Xintermedia Zab.), rockspray cotoneaster (Cotoneaster horizontalis Decne.), potentilla (Potentilla fructicosa L.), Japanese garden juniper (Juniperus chinensis Var. procumbens (Endl.) Miq.), Japanese rose (Rosa rugosa Thunb.), Japanese barberry (Berberis Thunbergii DC. `Autopurpurea'), green ash (Fraxinus pennsylvanica Marsh.), Yew (Taxus Xmedia Rehd.), California privet (Ligustrum ovalifolium Hassk.), Blue Boy / Blue Girl holly (Ilex Xmeserveae S. Y. Hu.), White pine (Pinus strobus L.), Honey locust (Gleditsia triacanthos L.), rhododendron (Rhododendron roseum elegans), and Coral Bell azalea (Rhododendron obtusum (Lindl.) Planch. `Coral Bell'). Lilac (Syringa vulgaris L.) was injured by isoxaben. Isoxaben was not safe on Douglas fir, Dogwood (Cornus spp.) or honey locust seedbeds.

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Table 1. Assesment of weed control with isoxaben.

Weed species	Weed control, by rate (kg ai/ha) 0.56	1.12
Broadleafed weeds		
ABUTH[a]	N1	N1
AMAxx	N1-E2	P1-E2
AMBEL	E1	E1
CAPBP	--	E1
CHEAL	E1	E1
LAMAM	--	E1
LEPVI	E1	E1
MALNE	N1	N1
OXACO	F1	E1
OXAST	E1	E2
POLPY	G1	E1
POROL	G1	G1-E1
SENVU	G2-E3	E6
STEME	E1	E2
TAROF	G1-E2	E2
VERPE	--	E1
Grassey weeds		
DIGxx	P1-F2	P1-F3
ECHCG	P1	F1
PANCA	E1	E1

N, P, F, G, E No, poor, fair, good, or excellent weed control as determined by visual evaluations of efficacy. Numerals beside each letter indicate the number of experiments in which that weed control observation occured.

[a] Five letter codes for weeds as specified in the WSSA Composite List of Weeds, Weed Sci. 32, supplement 2; with the following exceptions: AMAxx refers to a mixture of redroot and Powell pigweed (AMARE and AMAPO, respectively), and DIGxx refers to a mixture of smooth and large crabgrass (DIGIS and DIGSA, respectively).

MANAGING WEEDS DURING COVER CROP ESTABLISHMENT

Scott D. Guiser and Larry J. Kuhns[1/]

Abstract

Waldina hard fescue (Festuca ovina var. duriuscula L. Koch "Waldina") and Rebel tall fescue (Festuca arundinacea Schreb. "Rebel") were seeded on May 9, 1986 at a rate equivalent to 44 kg/ha in a randomized complete block design replicated three times. Five weed management methods were applied to both species in 1986. One method involved mowing once during the growing season (June). A second method involved mowing three times during the growing season (June, July, and August). The remaining three methods consisted of the three mowings combined with one of three herbicide treatments; 2,4-D, sethoxydim; or fenoxaprop. In 1987 all plots were mowed three times and recieved 83 kg/ha nitrogen. The predominant weed species were giant foxtail (Setaria faberii Herrm.), yellow foxtail [Setaria lutescens (Weigel) Hubb.], barnyardgrass [Echinochloa crus-galli (L.) Beauv.], common ragweed (Ambrosia artemisiifolia L.), and redroot pigweed (Amaranthus retroflexus L.). Annual grasses were flowering at the time of herbicide treatment and ranged in height from 30 to 90 cm.

Six months after seeding, hard fescue had produced greater than 70 percent ground cover under all treatments (Table 1). Tall fescue appeared less tolerant of sethoxydim and competition from infrequently mowed annual weeds than hard fescue. Hard fescue and tall fescue produced similar ground cover percentages under frequent mowing (three times); 2,4-D; or fenoxaprop treatments. Frequent mowing was as effective as herbicide treatments in establishment of both species. Seventeen months after seeding, plots receiving 2,4-D; sethoxydim; fenoxaprop; or frequent mowing had less than10 percent weed cover and greater than 90 percent ground cover (Table 2). Hard fescue and tall fescue that had been mowed only once during the first growing season had greater weed cover than all other treatments. Tall fescue recovered from the sethoxydim treatment applied in the establishment year and produced almost complete ground cover 17 months after seeding. In a related study, established tall fescue was killed by sethoxydim. It is likely that the weed canopy at the time of treatment intercepted the sethoxydim and reduced the effect on tall fescue. Interception of all herbicides applied was likely and their effects on cover crop grasses cannot be concluded from this study.

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Table 1. Effect of five weed management methods on establishment of hard fescue and tall fescue cover crops seeded on May 9, 1986. The percent ground cover of species seeded represents the means of three replications.

	Tall Fescue		Hard Fescue	
Method	11/86	9/87	11/86	9/87
3 mowings	85	97	83	92
2,4-D	90	97	85	94
fenoxaprop	88	98	85	95
sethoxydim	63	99	88	95
one mowing	30	60	73	78

Table 2. Percent weed cover in cover crop plots 17 months after seeding. Percentages presented are the means of three replications.

Method	Tall Fescue	Hard Fescue
3 mowings	3	8
2,4-D	3	6
fenoxaprop	2	5
sethoxydim	1	5
1 mowing	47	33

HERBICIDES FOR FIELD-GROWN WOODY ORNAMENTALS

J.F. Ahrens [1/]

ABSTRACT

Evaluation of herbicides and combinations for field-grown woody ornamentals has been an ongoing part of our research effort. Alternative herbicides are needed if registrations of existing products are cancelled and where current controls are non-existent or inadequate. The following summarizes recent results with new herbicides or uses in woody ornamentals. All were sprayed in 30 gal/A over ornamentals in replicated experiments.

Pendimethalin 4EC did not injure dormant yew (Taxus sp.) or actively growing arborvitae (Thuja occidentalis), forsythia (Forsythia intermedia) or Fraser fir (Abies fraseri) but at 2 or 4 lb/A injured actively growing hemlock (Tsuga canadensis), juniper (Juniperus horizontalis plumosa) and yew. Pendimethalin 60DG at 4 lb/A caused no injury and would be a preferred formulation during active growth.

Cinmethylin EC at 1.5 or 3.0 lb/A or cinmethylin + simazine at 1.5 + 1.5 lb/A gave excellent control of annual weeds and no injury to the above ornamentals.

Combinations that gave excellent preemergence control and no injury to these ornamentals included metolachlor + oryzalin at 5 + 2 lb/A, metolachlor + napropamide at 5 + 4 lb/A and oryzalin + napropamide at 2 + 4 lb/A. Isoxaben + oryzalin at 0.5 + 1.5 lb/A gave excellent preemergence control and no injury to Cotoneaster, Rhododendron, hemlock, Euonymus alatus, arborvitae, forsythia or yew. Double dosages injured Cotoneaster. Further work with these combinations is warranted in ornamentals not tolerant of simazine.

Asulam, acifluorfen, bromoxynil and lactofen were applied for postemergence control of annual weeds. Stages of growth and ornamental species differences greatly affected results. Asulam at 3.34 lb/A injured actively growing hemlock and Fraser fir in June but not in October. Acifluorfen at 0.5 or 1.0 lb/A combined with simazine + oryzalin controlled horseweed (Conyza canadensis L. Cronq.) without injury to dormant yew. Applied alone in June and again in August, however, acifluorfen injured hemlock, arborvitae and forsythia but not yew, juniper or Fraser fir. Bromoxynil at 0.5 or 1.0 lb/A + simazine at 1.6 lb/A in April also controlled winter annual weeds with no injury to dormant yew. However, June + August applications of bromoxynil alone at 0.5 lb/A injured Fraser fir, hemlock, yew and forsythia but not arborvitae or juniper. Lactofen at 0.3 or 0.6 lb/A applied in May and again in August injured actively growing hemlock, arborvitae, forsythia and Fraser fir but not yew or juniper.

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CONTROLLING GRASS COVER CROPS WITH HERBICIDES

Scott D. Guiser and Larry J. Kuhns[1/]

Abstract

Seven herbicides commonly used in the production of nursery stock and Christmas trees were applied alone and in combination to six cover crop grasses. Thirteen herbicide treatments were applied to hard fescue, sheep fescue, chewings fescue, red fescue, tall fescue, and perennial ryegrass in the fall of 1986. Six herbicide combinations were applied to separate plots of hard fescue in the spring of 1987. Plots were rated for control of cover crop grasses. Fall applications of pronamide, pronamide plus simazine, and glyphosate provided excellent control of all grasses. Atrazine, simazine, and oryzalin provided partial control of all grasses when fall applied. Atrazine and simazine applied alone and in combination with oryzalin provided complete control of hard fescue when spring applied. Sethoxydim and fluazifop-P failed to control fine fescue species but did control tall fescue and perennial ryegrass.

Introduction

Permanent grass cover crops are a desirable part of many horticultural cropping systems. Sod strips between rows of nursery stock, Christmas trees, and fruit trees reduce erosion, increase water infiltration, limit weed invasion, and improve working conditions for laborers and equipment (1,4). Cool season turf and forage grass species are used as cover crops by many growers in northeastern United States (4). If allowed to invade the crop row these species limit crop growth (2,3). They may invade the crop row as seedlings when the cover crop is planted or later by vegetative means. Control of cover crop grasses that invade the crop row is necessary if growers are to maximize crop yield and quality. (2)

The purpose of this study was to evaluate the effect of spring and fall applied herbicide treatments on cool season cover crop grasses. The herbicides evaluated are commonly used in the production of nursery stock and Christmas trees.

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Materials and Methods

Three foot wide strips of hard fescue (Festuca ovina var. duriuscula L. Koch), sheep fescue (Festuca ovina L.), chewings fescue (Festuca rubra var. commutata Gaud.), red fescue (Festuca rubra L.), tall fescue (Festuca arundinacea Schreb.), and perennial ryegrass (Lolium perenne L.) were established in the fall of 1984. They were mowed twice per year and received 44 kg/ha nitrogen twice.

Thirteen herbicide treatments were replicated three times in a split block design with herbicides randomized within the blocks. Atrazine [6-chloro-N ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine], simazine [6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine], oryzalin [4-(dipropylamino)-3,5 dinitrobenzene-sulfonamide], sethoxydim [2-[1-(ethoxyimino) butyl]-5-[2-(ethylthio) propyl] - 3 - hydroxy-2-cyclohexen-1-one], glyphosate [N-(phosphonomethyl) glycine], pronamide [3,5-dichloro (N-1,1-dimethyl-2-propynyl) benzamide], and fluazifop-P [(R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl] oxy] phenoxy] propanoic acid] were applied alone and in combination at the rates listed in Table 1. Herbicides were applied via CO_2 pressurized sprayer at 30 psi through an 8004E flat fan nozzle at a rate equivalent to 168 liters per hectare (18 gpa) of water. Crop oil concentrate at one percent volume to volume (1% v/v) was included with sethoxydim and fluazifop-P treatments. All herbicide formulations were liquid except pronamide which was 50 percent wettable powder. Treatments were rated May 4 and September 21, 1987. Plots were rated on a scale of one to ten. One indicates no injury and ten indicates that the plot was totally brown when rated. Roots were not examined to determine their condition.

In a separate study, three year old stands of hard fescue were treated with atrazine, simazine, oryzalin, sethoxydim, and fluazifop-P alone or in combination on April 22, 1987. Treatments were applied via CO_2 pressurized sprayer at 30 psi through an 8004E flat fan nozzle at a rate equivalent to 421 liters per hectare (45 gpa). Non-ionic surfactant was included with sethoxydim and fluazifop-P treatments at one percent volume to volume (1% v/v). Treatments were rated May 28, June 23, and September 21, 1987 as before.

Results and Discussion

Results of fall applied herbicide treatments varied both within and between cover crop species (Table 1).

Table 1. Control of cover crop grasses provided by herbicides applied October, 1986. Control rated May 4 and September 21, 1987. 1 = no injury; 10 = brown.

Herbicide	kg a.i./ha.	Hard Fescue[a] May	Hard Fescue[a] Sept	Sheep Fescue[b] May	Sheep Fescue[b] Sept	Red Fescue[a] May	Red Fescue[a] Sept	Chew. Fescue[a] May	Chew. Fescue[a] Sept	Tall Fescue[a] May	Tall Fescue[a] Sept	Per. Rye[b] May	Per. Rye[b] Sept
Atrazine	3.3	7.7	9.0	8.0	7.0	5.3	4.7	4.7	4.0	6.3	6.0	8.7	10.0
Simazine	3.3	6.7	7.7	5.5	5.5	4.3	5.7	3.7	4.3	5.0	4.0	7.0	7.5
Oryzalin	3.3	4.7	7.0	5.0	6.5	6.4	3.3	5.7	2.7	4.5	2.5	6.5	5.5
Sethoxydim	0.5	1.7	2.0	1.0	1.0	1.7	1.7	1.0	1.0	10.0	10.0	10.0	10.0
Fluazifop-P	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	8.7	6.7	10.0	9.3
Glyphosate	2.2	8.3	7.7	8.5	8.0	9.3	8.3	8.7	5.3	10.0	10.0	10.0	10.0
Pronamide	2.2	8.0	10.0	8.5	10.0	10.0	9.3	10.0	8.7	10.0	10.0	10.0	10.0
Atrazine + Oryzalin	2.2 2.2	7.7	6.7	8.0	8.5	7.7	6.3	6.7	5.0	6.3	5.0	9.5	10.0
Simazine + Oryzalin	2.2 2.2	6.0	5.3	5.5	5.5	6.0	5.3	6.0	4.7	4.7	4.7	4.0	7.0
Simazine + Sethoxydim	2.2 0.5	1.7	3.0	1.0	2.0	3.3	2.7	2.7	1.6	10.0	8.5	10.0	9.7
Simazine + Fluazifop-P	2.2 0.5	4.7	6.0	5.5	4.5	4.3	3.7	4.0	1.3	9.3	8.0	10.0	10.0
Simazine Glyphosate	2.2 1.1	7.3	5.3	8.5	6.0	8.0	6.3	8.0	3.3	9.7	9.3	10.0	10.0
Simazine Pronamide	2.2 2.2	8.7	10.0	9.0	10.0	10.0	8.3	10.0	9.7	10.0	10.0	10.0	10.0

[a] Means of 3 observations
[b] Means of 2 observations

Pronamide either alone or in combination with simazine provided almost complete control of all grass species by May. Glyphosate at 2.2 kg/ha provided similar results. Only limited recovery of the grass had occured by September. Glyphosate at 1.1 kg/ha plus simazine provided good control initially, but the fine fescue species recovered somewhat by September. Atrazine, simazine, oryzalin and their combinations reduced the density and growth of all species. Though the grasses were not totally eliminated, their competitive effects would be reduced. Atrazine treatments were generally rated higher than simazine treatments when applied alone or in combination with oryzalin. The combination of oryzalin plus atrazine or simazine provided similar control to atrazine or simazine at the higher rates alone.

Fall applications of sethoxydim at 0.5 kg/ha and fluazifop-P at 0.5 kg/ha provided almost complete control of tall fescue and perennial ryegrass but caused little or no damage to the fine fescue species (hard, sheep, red, and chewings). The addition of 2.2 kg/ha simazine to sethoxydim or fluazifop-P resulted in improved but still poor control of fine fescue species.

Spring applied treatments of atrazine or simazine alone or in combinaton with oryzalin caused severe injury to hard fescue within one month of application (Table 2). These treatments provided almost complete control within two months. Simazine plus oryzalin was slightly less effective than atrazine plus oryzalin in controlling hard fescue. Spring applications of sethoxydim at and fluazifop-P did not cause any detectable injury to hard fescue.

Table 2. Control of hard fescue provided by herbicides applied April 22, 1986. Rated May 28, June 23, and September 21, 1987. 1 = no injury; 10 = brown.

Herbicide	kg/ha	Rating Date		
		May	June	September
atrazine	8.3	10.0[a]	10.0	10.0
simazine	3.3	7.7	9.7	10.0
sethoxydim	0.5	1.0	1.0	1.0
fluazifop-P	0.5	1.0	1.0	1.0
simazine + oryzalin	2.2+2.2	7.0	8.7	8.6
atrazine + oryzalin	2.2+2.2	8.7	10.0	10.0

[a] All values are means of three observations

These results indicate that herbicides commonly used in nursery stock and Christmas tree production can control cover crop grasses that encroach into crop rows. A single fall application of pronamide provided complete control of cover crop grasses. Glyphosate at 2.2 kg/ha was also an effective fall treatment. A single fall application of atrazine, oryzalin, or simazine either alone or in combination provided partial grass control. A single spring application of atrazine or simazine alone or in combination with oryzalin provided excellent control of hard fescue.

Fine fescue grasses have demonstrated tolerance to sethoxydim and fluazifop while other cool season grass species have been controlled (5). This study confirms that sethoxydim and fluazifop-P are ineffective in providing control of fine fescues but are effective herbicides for control of tall fescue and perennial ryegrass.

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COMPARING OXYFLUORFEN AND LACTOFEN FOR PREEMERGENCE WEED CONTROL IN CONIFER SEEDBEDS

Larry J. Kuhns[1/]

ABSTRACT

Oxyfluorfen is the standard herbicide used for preemergence and limited postemergence control of weeds in conifer seedbeds. This study was designed to compare the efficacy and crop tolerance of lactofen to that provided by oxyfluorfen. Seeds of Austrian pine (Pinus nigra Arnold.), mugo pine (Pinus mugo Turra.), and eastern white pine (Pinus strobus L.) were planted on May 12, 1987. Seeds of Japanese larch [Larix leptolepis (Sieb and Zucc)Gord.] were planted on June 4, 1987. Within one week of planting, oxyfluorfen at 0.55 and 1.1 kg ai/ha and lactofen at 0.28, 0.55, and 1.1 Kg ai/ha were applied over the top of the seedbeds. A CO_2 pressurized sprayer set at 30 psi was used to apply the herbicides through two 8004E nozzles in the equivalent of 252 l/ha of water. At the time of application, air, soil surface, and soil (20 cm) temperatures were 29°, 38°, and 22°C, respectively. Rain began to fall as the spraying was completed. Four cm of rain fell in the next two days. Plots were 2.4 m by 1.5 m and each treatment was replicated three times on each tree species. A randomized complete block design was used in each species. Weed control and crop injury were rated seven weeks after application (5 to 6 weeks after emergence). Weed density and size was so high in many plots that planned postemergence applications of these herbicides were eliminated for the study. Sethoxydim at 0.28 kg/ha was broadcast applied to kill grasses and broadleaved weeds were hand pulled. Fourteen weeks after application the percent stand reduction was estimated.

None of the herbicide treatments directly injured any of the seedlings. The predominant weeds in the control plots were common purslane (Portulaca oleracea L.), yellow foxtail [Setaria lutescens (Weigel) Hubb.] smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.], Pennsylvania smartweed (Polygonum pensylvanicum L.), witchgrass (Panicum capillare L.), common chickweed [Stellaria media (L.) Cyrillo], barnyardgrass [Echinochloa crus-galli L. Beauv.], and woodsorrel (Oxalis stricta L.). The weed control provided by oxyfluorfen at 1.1 kg ai/ha was excellent, while at 0.55 kg ai/ha it was marginally acceptable. Lactofen did not provide acceptable overall weed control at any level. However, its control of broadleaved weeds was excellent; almost all weeds in the lactofen treated plots were annual grasses.

The percent stand reduction was inversely related to weed control; the better the weed control, the fewer the seedlings lost. Seedlings were lost primarily to competition for light, but many were also inadvertently pulled out with weeds.

Oxyfluorfen alone at 1.1 kg ai/ha provides safe and effective preemergence weed control in conifer seedbeds. Lactofen at 1.1 kg ai/ha provides safe and effective preemergence control of broadleaved weeds, but it allows annual grasses to develop.

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Table 1. Weed control provided by five herbicide treatments and percent stand reduction observed with each treatment.

	Rate	Weed Control		Estimated % Stand Reduction[1]			
Chemical	(kg a.i./ha)	Overall[2]	% Grass[3]	Aust. Pine	Mugo Pine	White Pine	Jap. Larch
Control		1.0	60	82	93	92	100
Oxyfluorfen	0.55	7.3	83	7	12	12	60
Oxyfluorfen	1.1	9.5	74	0	5	5	30
Lactofen	0.28	4.1	94	33	88	88	87
Lactofen	0.55	4.7	96	2	85	85	62
Lactofen	1.1	6.0	94	5	25	25	32

1/ Stand reduction was caused by weed competition, not herbicide phytotoxicity

2/ Rated on a scale of 1-10; 1 = no control, 10 = total control

3/ Percent of the weeds present that were grasses

TOLERANCE OF CONTAINER AND FIELD GROWN HERBACEOUS ORNAMENTALS TO ISOXABEN

A.F.Senesac[1/] and J.C.Neal[2/]

ABSTRACT

Isoxaben, a new herbicide currently registered in Europe on cereal crops, is now being evaluated in North America for broadleaf weed control in turf and some woody ornamental species. The purpose of these studies was to evaluate the tolerance of several herbaceous ornamental species to isoxaben.

Three studies were conducted in 1987 at the Long Island Horticultural Research Laboratory, Riverhead. In one study, seedling plugs of six perennial species were transplanted into quart containers containing Cornell soilless mix. The plants were treated immediately after planting on May 18 and aboveground plant fresh weights were recorded ten weeks later. In another study, fifteen ornamental perennials species/cultivars were transplanted into Riverhead sandy loam on May 12 and treated the following day. Of those species producing commercial cutflowers, number and flower fresh weights were recorded throughout the season. Plant vigor was rated on all species periodically throughout the season. The third study examined the response of five annual cut flower species that were transplanted into Riverhead sandy loam and treated immediately on June 3. Marketable flower numbers were recorded weekly throughout the season. In each study, three plants of each species were planted in every plot and all treatments were replicated four times and arranged in a Randomized Complete Block design.

The following species were significantly reduced in fresh weight or vigor by either rate(0.6 and 1.12 kg/ha) of isoxaben: container-grown: Gaillardia (G. aristata,'Goblin), Pasqueflower (Anemone pulsitila 'Red Pasque'), Foxglove (Digitalis purpurea 'Excelsior hybrids') ,field grown: Zinnia (Zinnia elegans), Snapdragon (Antirrhinum majus), Veronica (V. spicata) and Shasta Daisy (Chrysanthemum x superbum 'Alaska')

These species were injured only by the high rate of isoxaben: container-grown: Baby'sbreath (Gypsophyla paniculata 'Perfecta'), Leopard's-Bane (Doronicum caudatum L),: Field-grown: Alyssum.(Aurinia saxitilis L.)

These species were not reduced in vigor or fresh weight by either rate of isoxaben: container-grown: Columbine (Aquilegia hybrida 'McKana Giant'):field-grown: Marigold(Tagetes erecta 'Crackerjack'), Statice (Limonium sinuata), Gazania (G. rigens L.), Yarrow (Achillea millefolium 'Cerise Queen'), Dusty Miller (Senecio cineraria 'Silver Dust') Geum (G. quellyon 'Lady Strathedon' and 'Mrs Bradshaw'), Lamb's ear (Stachys lanata), Bellflower (Campanula carpatica), Stoke's Aster (Stokesia cyanea 'Silver Moon' and 'Blue Danube'), Coreopsis (Coreopsis grandiflora 'Sunray'), Baby's breath (Gypsophila paniculata 'Bristol Fairy') and Purple Coneflower (Echinacea purpurea).

Isoxaben appears to have potential a for providing safe broad spectrum weed control in several herbaceous crops. It is apparent from these studies that differential tolerance to isoxaben occurs among these commonly grown ornamental species.

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PREEMERGENCE WEED CONTROL IN GLADIOLUS CORMEL PRODUCTION

A. Bing[1], A. F. Senesac[2] and M. Macksel[3]

ABSTRACT

A field study of the effect of several preemergence herbicides on the growth of gladiolus cormels was conducted at the Long Island Horticultural Research Laboratory in 1987. Preemergence applications of oryzalin, prodiamine or pendimethalin at 2.2 + 4.5 kg/ha did not adversely affect vigor or corm yield on cultivars Promenade, April, Ajax or Priscilla. A preemergence application of metolachlor at 4.5 kg/ha one day after planting seriously reduced germination, vigor and corm yield. A delay of 2 weeks in the application of metolachlor alleviated injury considerably.

INTRODUCTION

Gladiolus (*Gladiolus hortulenus*) are grown for cut flowers. They are commercially propagated by growing the cormels (bulblets) that were formed at the underside of the new corm the previous season. There is a large demand for new, large corms as they are frequently only grown one year for flowering and then discarded.

Effective safe weed control is necessary to minimize the effects of disease and insects that come from the weeds and to maximize corm yield by reducing weed competition. Cormel germination and growth is slow, so early weed competition can seriously reduce yields. Later weeds can interfere with harvest.

This is the continuation of a long term search for safe effective herbicides on gladiolus (1,2,3,4,5). Cormels are planted more shallow and are more sensitive than corms so herbicides found safe on cormels is considered safe on the larger corms. Comparisons were made of prodiamine [2,4-dinitro-$\underline{N}^3$-$\underline{N}^3$-dipropyl-6-(trifluoro-methyl- 1,3-benzenediamine], pendimethalin [$\underline{N}$-(1-ethylpropyl)-3.4-dimethyl- 2,6-dinitrobezenamine] and oryzalin [3,5-dinitro-$\underline{N}^4$, $\underline{N}^4$- dipropylsulfanilamide]. A new study is on the use of metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide] for yellow nutsedge (*Cyperus esculentus*) control and diquat [6,7-dihydrodipyrido 1,2-$\underline{a}$:2', 1'-c]pyrazinediium ion] to replace dinoseb for cleaning up weeds that may emerge before the gladiolus.

MATERIALS AND METHODS

Gladiolus cormels of the cultivars Promenade, April, Ajax and Priscilla were donated by Alex Summerville. Before planting the cormels were floated in water to separate them from small stones and then dried. Some sprouted before they dried sufficiently which resulted in reduced vigor. The cormels were graded into several sizes by passing them through screens. Lots of 500 were made by including the same weight of each size in a lot so in all plots of a variety there would be the same sizes of cormels.

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Furrows 85 cm between centers were made by a tractor with a potato planter attached. The furrows were leveled on the bottom with a hand hoe resulting in a trench 5 cm deep x 20 cm wide. Each treatment plot contained 4 cultivars. The plots were replicated 4 times and arranged in a randomized complete block design. The cormels were planted May 20, 1987 and covered with a slight hill and then raked nearly level.

Early preemergence applications were made on May 21 using a CO_2 sprayer at 40 psi at 3 mph. The hand held boom had 3 3003 nozzles and applied at 30 gpa. The air temperature was 60° F with a 10-12 mph wind and cloudy. The soil was moist and 60° F at the surface, 56° at 2 in. and 54° F at 6 in. The herbicide formulations and rates used are shown in the tables of results.

On June 4 a delayed pre spray was applied before the gladiolus had emerged, but smartweed (*Polygonum pennsylvanicum*) and common purslane (*Portulaca oleracea*) were already in the cotyledon to 2-leaf stage. The weather was cloudy at 70° F with a 6 mph wind from the southeast. The soil was very moist 70° F at the surface, 70° F at 2 in. ands 67° F at 6 in.

On April 20, 2 tons of wet limestone and 100 lb/A of 10-10-10 was applied per acre when preparing the soil and there was one sidedressing with urea at 1 lb N/1000 ft on June 29. Periodic applications of acephate were made to control insects especially gladiolus thrips.

Shoot emergence counts were made on June 23. Crop vigor ratings were made on each variety in each plot on July12 using a scale of 0 -10, with 10 being the best growth. The corms with attached cormels were hand dug on September 29. Each variety in each plot was put in a labelled screen bottomed tray. The tops were removed by hand and discarded. Some excess soil was sifted out and the rest washed out with a stream of water form a hose. The trays were stacked criss-cross in an empty greenhouse. On October 14 visible stones and debris were removed at the contents of each tray, including corms with attached roots and attached and loose cormels were weighed. The cultivar Priscilla was harvested and weighed 10 days later then the others. Data was evaluated by Duncan's Multiple Range Test at 5%.

RESULTS AND DISCUSSION

There appeared to be differences in the germination from the plots treated with metolachlor so shoot counts were made on May 23 and averages of 4 replicates are shown in Table 1. Metolachlor at 4.45 kg/ha applied the day after planting significantly reduced emergence of all 4 cultivars. Delaying the treatment 2 weeks allowed greater emergence.

The vigor ratings made in July 27 (Table 2) show a significant reduction in vigor from the early application of metolachlor at 4 lb aia with a rating of 6.5 on promenade, and 7.25 on April compared to 8.5 and 9.5 for the handweeded . There were reductions with Ajax and Priscilla, but they were not significant. Oryzalin at 2.2 and 4.5 kg/ha gave high yields comparable to the handweeded plots. Prodiamine and pendimethalin did not significantly reduce vigor.

Cormel yields are shown in Table 3. Although cormel yields show a definite trend toward lower yields from the metolachlor early preemergence, the only significant differences are between handweeded and early preemergence with metolachlor at 4.5 kg/ha with cultivar April and Priscilla and delayed preemergence with metolachlor, plus diquat on Ajax and Priscilla.

There was no significant reduction in yield from 2.2 or 4.5 kg/ha of oryzalin, prodiamine or pendimethalin.

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Table 1. The Effect of Early and Delayed Preemergence Application of Metolachlor on the Emergence of Four Cultivars of Gladiolus.

Treatment	kg/ha	Form.	Timing	SHOOT NUMBER* Promenade	April	Ajax	Priscilla
handweeded	-----	---	---	155.0 a**	202.0 a	89.5 a	28.8 a
metolachlor	2.2	8EC	pre	124.8 ab	171.8 ab	55.0 b	20.3 ab
metolachlor	4.5	8EC	pre	90.0 b	130.0 b	45.5 b	17.0 b
diquat (X 77.25%) +metolachlor	2.2/2.2	2WS/8E	delayed pre	110.3 ab	145.8 ab	54.3 b	28.5 a
diquat(X 77 .25%) +metolachlor	2.2/4.5	2WS/8E	delayed pre	123.5 ab	163.5 ab	49.0 b	18.3 ab

*Shoot emergence counts were recorded 6/23/87
500 cormels (per plot per cultivar)were planted 5/28/87
** Average of 4 reps, means separation at 5% level DMR.

Table2. The Effect of Preemergence Herbicides on the Vigor of Four Gladiolus Cultivars.

Treatment	kg/ha	Form.	Timing	VIGOR RATING* Promenade	April	Ajax	Priscilla
handweeded	-----	---	---	8.5 ab**	9.5 a	9.3 ab	8.3 ab
oryzalin	2.2	85WDG	pre	8.0 bc	9.3 abc	8.5 ab	9.3 a
oryzalin	4.5	85WDG	pre	9.8 a	10.0 a	9.8 a	9.3 a
prodiamine	2.2	65WDG	pre	7.5 bc	8.8 abc	8.5 ab	8.3 ab
prodiamine	4.5	65WDG	pre	8.5 ab	8.8 abc	7.8 ab	7.5 ab
pendimethalin	2.2	60WDG	pre	8.5 ab	8.0 cd	7.3 b	7.3 ab
pendimethalin	4.5	60WDG	pre	9.0 ab	9.5 ab	8.3 ab	8.0 ab
metolachlor	2.2	8EC	pre	8.0 bc	9.0 abc	8.3 ab	7.8 ab
metolachlor	4.5	8EC	pre	6.5 c	7.3 d	7.5 b	6.3 b
diquat (X77.25%) + metolachlor	2.2/2.2	2WS/8E	delayed pre	8.5 ab	9.3 abc	8.8 ab	9.3 a
diquat (X77.25%) + matolachlor	2.2/4.5	2WS/8E	delayed pre	8.8 ab	9.8 ab	7.8 ab	7.3 ab
diquat (X77.25%)	2.2	2WS	delayed pre	8.0 bc	8.5 bcd	8.8 ab	8.0 ab

*Vigor ratings 0-10,10=best plants in test area
** Average of four reps,means separation at 5% level DMR
Rated 7/12/87

Table 3. The Effect of Preemergence Herbicides on the Yield of Cormels of Four Gladiolus Cultivars.

Treatment	kg/ha	Form.	Timing	CORMEL WEIGHT (gm)* Promenade	April	Ajax	Priscilla
handweeded	-----	---	---	481.8 ab**	541.0 a	412.0 a	269.3 ab
oryzalin	2.2	85WDG	pre	415.0 ab	533.5 a	307.8 ab	394.0 a
oryzalin	4.5	85WDG	pre	499.8 ab	421.3 ab	332.8 ab	274.8 ab
prodiamine	2.2	65WDG	pre	303.0 ab	301.8 ab	195.8 ab	186.8 bc
prodiamine	4.5	65WDG	pre	435.0 ab	310.0 ab	193.5 ab	183.3 bc
pendimethalin	2.2	60WDG	pre	362.8 ab	367.3 ab	194.0 ab	174.3 bc
pendimethalin	4.5	60WDG	pre	548.5 a	417.5 ab	348.3 ab	252.3 abc
metolachlor	2.2	8EC	pre	386.8 ab	341.0 ab	210.8 ab	154.5 bc
metolachlor	4.5	8EC	pre	230.0 b	192.0 b	179.8 ab	91.0 c
diquat (X77.25%) + metolachlor	2.2/2.2	2WS/8E	delayed pre	295.8 ab	391.5 ab	211.8 ab	229.5 bc
diquat (X77.25%) + metolachlor	2.2/4.5	2WS/8E	delayed pre	399.0 ab	439.3 ab	106.3 b	94.0 c
diquat (X77.25%)	2.2	2WS	delayed pre	299.0 ab	341.5 ab	229.3 ab	253.5 abc

*Average of 4 replicates
** Cormels harvested 9/29/87

RESPONSE OF TULIP CULTIVARS TO POSTEMERGENT GRAMINICIDES

A. F. Senesac[1], M. Macksel[2] and J. C. Neal[3]

ABSTRACT

A study was conducted to examine the effect that three postemergence graminicides have on the petal quality and flower number of red tulip cultivars (*Tulipa sp.*).

Two cultivars of red tulips, 'Apledoorn' and 'Triumph' were planted in Riverhead sandy loam soil in fall of 1985 at the Long Island Horticultural Research Laboratory. Five bulbs of each cultivar were planted on October 20, 1985 in 3 feet long plots. Overall maintenance preemergence treatments of napropamide (4.5 kg/ha) and oryzalin (2.2 kg/ha) were applied immediately after planting. Treatments consisted of three rates (0.28, 0.56 and 2.2 kg/ha) of fluazifop-P-butyl, sethoxydim or fenoxaprop applied postemergence on April 8, 1986, a few days prior to tulip bud opening. Flower buds at treatment time had emerged 1" above the soil line.

Visual ratings were conducted soon after full flower opening - six days after treatment. Flower quality was severely affected by the two higher rates of fluazifop-P-butyl only. Petal color loss was severe, resulting in a yellow flower. Pigment loss was greatest at the margin of the petals.

The bulbs were left in the soil undisturbed through the spring of 1987. Visual ratings of second year's flowers indicate no discoloration by any of the treatments.

The results suggest that postemergence applications of fluazifop-P-butyl in spring flowering red tulip cultivars can cause severe injury. Furthermore, these red flowered cultivars may provide useful information in further studies of the mode of action of this herbicide.

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APPLICATION TIMING OF IMAZETHAPYR AND IMAZAPYR ON TALL FESCUE TURF

M. S. Welterlen[1/]

ABSTRACT

Timing of spring application of plant growth regulators (PGRs) is important not only in terms of efficacy of growth suppression but also in terms of logistics of application by turf managers. Those treating large turf acreages in various locations are faced with logistical problems in scheduling PGR applications if the critical period of treatment is short. Consequently, new PGRs must be evaluated for the duration of the critical period of application which illicits efficacious suppression of turf height and turfgrass seedheads. The objective of this study was to evaluate effects of spring application timing (50, 75 and 100% turf greenup) and respective rates (74 + 2.7, 99 + 3.7 and 123 + 4.4 g ai ha^{-1}) of imazathapyr plus imazapyr combinations (ACP 1911) and mefluidide (426 g ai ha^{-1}) on a mature 'Kentucky 31' tall fescue (Festuca arundinacea Schreb.) turf.

This study was conducted at Beltsville, Maryland in a Mattapex silt-loam soil (fine silty, mixed mesic Aqualfic Normudults) with a pH of 6.2 and 2.1% organic matter. Prior to PGR application, turf was maintained at 5.7 cm with a rotary mower. PGRs were applied with a CO_2 pressurized sprayer at a dilution rate of 467.5 l ha^{-1} with surfactant (X-77, 0.25% v/v) added to all PGR treatments. Plots were arranged in a randomized complete block design with three replicates. Data was analyzed by analysis of variance.

Early application of the high rate of ACP 1911 at 50% turf greenup resulted in unacceptable visual turf quality and color, which lasted for at least 5 weeks. Quality and color of turf treated with the two lower rates was similar to turf response from mefluidide treatment. Turf height suppression was evident in all treated turf and termination of suppression occurred between 4 and 6 weeks after application. Duration of suppression from ACP 1911 treatment was similar to that of mefluidide. Acceptable seedhead suppression was evident in turf treated with the two higher rates of ACP 1911 and mefluidide; however, the lower rate of ACP 1911 did not provide acceptable seedhead suppression.

Application of ACP 1911 at 75% greenup resulted in a reduction of turf quality for at least 5 weeks. Quality improved with the lower rate of ACP 1911; however, turf treated with the high rate of ACP 1911 did not exhibit quality improvement. Turf discoloration was evident for at least 4 weeks and recovery occurred by 6 weeks after application, even with the high rate of ACP 1911. Height suppression lasted at least 5 weeks and seedhead suppression was evident in all PGR treated turf.

Turf treated with ACP 1911 and mefluidide at 100% greenup remained at acceptable levels throughout the growth suppression period which lasted approximately 6 weeks for all treatments. More discoloration was observed in turf treated with the two higher rates of ACP 1911. Turf treated with the medium rate of ACP 1911 recovered from discoloration; however, turf treated with the high rate of ACP 1911 had not recovered by 6 weeks after treatment. Seedhead suppression was acceptable for all treatments.

In conclusion the optimum rate and timing of ACP 1911 application was the medium rate at 100% greenup. This rate also provided adequate growth suppression and seedhead control if applied earlier than 100% greenup. In addition, turf treated with the medium rate of ACP 1911 recovered from discoloration and quality reductions which were evident with earlier applications.

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Imazethapyr and Imazapyr Combination on Control and Rebound o f Tall Fescue[1]

R. W. Duell, S. D. Sherman and K. M, Makatura[2]

Abstract

Second-year applications of rates of Imazethapyr, alone and in combinations with rates of Imazapyr, were compared with first-year results on the same 'Rebel' tall fescue (Festuca arundinacea) plots.

Seedhead suppression by these rates and materials was generally superior to that from the recommended rate (3/8 lb/acre) of mefluidide. Foliar discoloration (phytotoxicity) and suppression was generally greater than from mefluidide, but considered quite acceptable for roadside turf.

This second season was characterized by better moisture distribution than the first, but suppression, as measured by seedhead counts and harvests 55 and 54 days after treatment, was greater and of longer duration than in the previous relatively dry year. It is speculative whether or not this represents a cumulative (residual) effect, and if turf persistence might have been jeopardized if the site were less productive as many roadsides would be.

In this second season "rebound" was more in the nature of improved color than in greater growth. Protein analyses of two consecutive harvests are planned.

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[1] N. J. Ag. Expt. Sta. Publication No. K 15257-1-87

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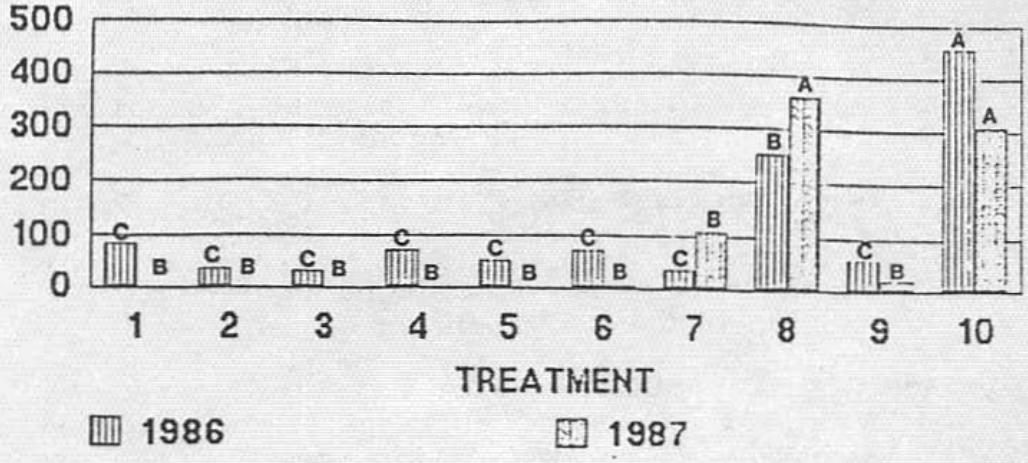
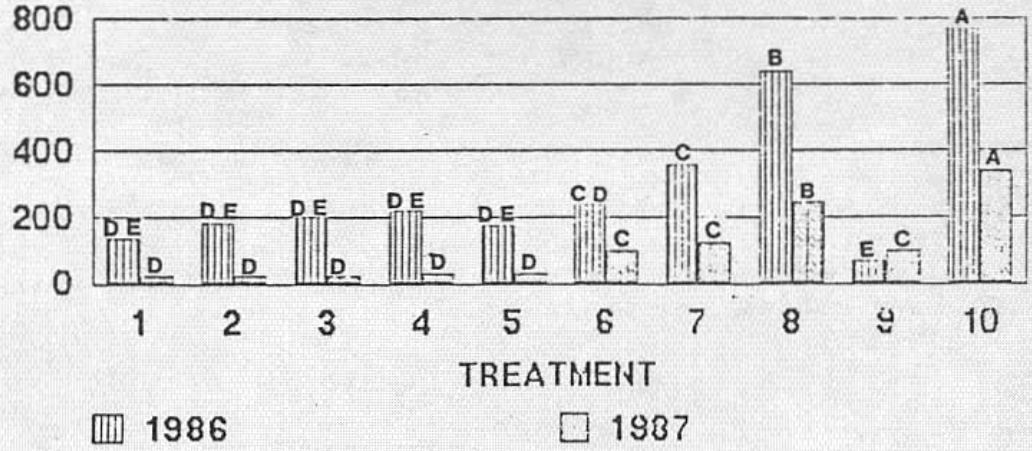
SEED HEAD COUNT

35 DAT IN 1986 44 DAT IN 1987



HARVEST (D.W g/PLOT)

55 DAT IN 1986 54 DAT IN 1987



TREATMENT AC263-499 @

1) 247.1g/ha + Arsenal @ 3.71g/ha
2) 185.2g/ha + Arsenal @ 3.71g/ha
3) 123.5g/ha + Arsenal @ 3.71g/ha
4) 93.8g/ha + Arsenal @ 4.94g/ha
5) 247.1g/ha

TREATMENT

6) AC263-499 @ 185.2g/ha
7) Embark @ 429g/ha
8) Limit @ 2800g/ha
9) Mowed
10) Unmowed

TALL FESCUE GROWTH REGULATION WITH MULTIPLE APPLICATIONS OF ACP 1911X, AC 247,466, AND DPX L5300

J. G. Vollmer and S. W. Bingham[1]

ABSTRACT

Plant growth regulation is becoming a common practice along Virginia highway rights-of-way. The most common turfgrass planted in this situation is "KY 31" tall fescue (Festuca arundinacea Schreb). Field studies on "KY 31" tall fescue were conducted in 1987 at three locations along Virginia highway rights-of-way. The efficacy of experimental plant growth regulators imazapyr plus imazethapyr (ACP 1911X), AC 247,466, and DPX L5300 plus mefluidide were compared against metsulfuron-methyl plus mefluidide and chlorsulfuron plus mefluidide as well as mowed and nonmowed controls. Multiple applications consisted of 1 application per year, 2 applications per year at 14 week intervals, 3 applications per year at 10 week intervals, and 4 appli-cations per year at 6 week intervals when tall fescue was in mid to late boot stage.

One application of AC 247,466 did not result in any phytotoxicity to the turf and resulted in a higher quality turf than standard plant growth regulators. ACP 1911X caused minimal phytotoxicity and also resulted in higher quality turf than standard plant growth regulators. DPX L5300 plus mefluidide varied in seedhead suppression between sights causing a lower quality turf. Two applications per year increased phytotoxicity for all treatments with metsulfuron-methyl plus mefluidide causing necrosis of the tall fescue. Four weeks later, the quality of ACP 1911X, AC 247,466, and DPX L5300 plus mefluidide increased as phytotoxicity decreased. Three applications per year resulted in even greater phytotoxicity. Tall fescue did not fully recover from this interval of treatments prior to first frost. Four applications per year resulted in variable results between sites.

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EVALUATIONS OF PLANT GROWTH REGULATORS FOR ROADSIDE USE

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ABSTRACT

The reduction of mowings through the use of chemical growth regulators offers a management alternative in the culture of low maintenance utility grasses. Chemically suppressing the growth which ultimately influences interspecies competition leading to changes in the botanical composition of treated swards. Undesirable broadleaf weeds and annual grasses tend to invade these areas, resulting in unsightly roadside rights-of-way. In order to document botanical populations shifts, growth regulators must be evaluated throughout the season.

Several growth regulating and herbicidal compounds were applied April 21, 1987 to an unmowed stand of tall fescue (Festuca arundinacea Schreb.) in order to assess their efficacy for foliar suppression, phytotoxicity, seedhead inhibition as well as to evaluate changes in stand composition. Plots were 3 by 9.1m and were replicated three times in a randomized complete block design. All treatments were applied in the equivalent of 374.7 L/ha of water with .25% v/v non-ionic surfactant.

At four weeks after application, all treatments significantly suppressed the canopy height of tall fescue from 53 to 67% when compared to the untreated grass. Phytotoxicity ratings at this time revealed that Mon-8000 alone and in combination with metsulfuron, sulfometuron and chlorsulfuron caused an unacceptable degree of phytotoxicity. Mefluidide + metsulfuron was also rated as causing undesirable injury. Foliar injury caused by the remaining treatments was considered to be tolerable.

Ten weeks after application, plot areas were rated for overall appearance. Factors which influenced this evaluation were stand density, seedhead inhibition, broadleaf weed and annual grass invasion, and the consistency of sward suppression. Plots treated with mefluidide alone and in combination with ferromec, uniconazole, and flurprimidol had some degree of broadleaf weed encroachment but overall appearances were considered acceptable. Swards treated with Mon-8000 alone were rated unacceptable due to the presence of broadleaf weeds and a significant amount of seedheads. All other treatments provided adequate seedhead inhibition with the exception of mefluidide + uniconazole which only shortened seedhead height. Mon-8000 applied in combination with metsulfuron, sulfometuron and chlorsulfuron, and metsulfuron alone and in combination with mefluidide provided adequate broadleaf weed control but caused a substantial reduction of tall fescue. These areas were subsequently invaded by yellow foxtail [Setaria lutescens (Weigel.) Hubb.] which masked the injured tall fescue and resulted in a more desirable appearance. Mon-8000 + chlorsulfuron + dicamba provided desirable control of broadleaf weeds but failed to consistently suppress the foliar and reproductive growth of tall fescue. All rates of ACP-1911x allowed a significant invasion of broadleaf species, particularly crownvetch (Coronilla varia L.).

Twenty five weeks after application, treatments were rated for percent yellow foxtail invasion. At this time, foxtail had been killed by frost and was easily distinguished from tall fescue. All treatments that included sulfonyl urea compounds had the greatest (>85%) encroachment by foxtail. Percent foxtail in plots treated with mefluidide + uniconazole was also significantly greater than the check. All other treatments were not significantly different than the check. Appropriate herbicides must be included in growth regulation programs in order to prevent undesirable species shifts.

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Table 1. Effect of growth regulators on several sward quality parameters at various weeks after treatment (WAT).a/

Treatment	Rate	Phytotoxicity b/ 4 WAT	Sward Appearance b/ 10 WAT	Non-grass species 10 WAT	Annual grasses 25 WAT
	(kg ai/ha)			%	
mefluidide	0.42	6.3b	6.2 bcd	45.0 bcd	36.7 de
mefluidide + ferromec	0.42 + 2.8 L	6.0 bc	5.5 cdef	60.0 abc	33.3 de
mefluidide + uniconazole	0.17 + 0.17	6.0 bc	7.2 a	70.0abc	75.0 abc
mefluidide + flurprimidol	0.14 + 0.84	6.7 b	6.5 ab	65.0 abc	26.7 de
Mon-8000	0.21	4.7 d	4.7 f	61.7 abc	58.3 abcd
Mon-8000 + sulfometuron	0.21 + 0.006	2.3 e	5.0 ef	40.0 cde	86.7 ab
Mon-8000 + chlorsulfuron	0.21 + 0.013	3.0 e	5.3 def	11.7 e	96.7 a
Mon-8000 + metsulfuron	0.21 + 0.014	2.3 e	5.2 ef	6.0 e	96.3 a
Mon-8000 + chlorsulfuron+ dicamba	0.21+0.013+0.056	6.0 bc	5.5 cdef	6.0 e	91.7 a
metsulfuron	0.014	4.7 d	5.5 cdef	16.0 de	83.3 ab
metsulfuron + mefluidide	0.005 + 0.17	3.3 e	5.8 bcde	8.3 e	97.0 a
metsulfuron + chlorsulfuron	0.005 + 0.013	5.7 bcd	5.3 def	8.3 e	96.0 a
ACP-1911X	0.05	5.7 bcd	6.3 abc	81.7 a	11.7 e
ACP-1911X	0.07	5.7 bcd	6.3 abc	78.3ab	43.3 cde
ACP-1911X	0.1	5.0 cd	6.2 bcd	75.0 ab	50.0 bcde
check	0.00	8.0 a	2.7 g	93.3 a	32.0 de

a/ Means separation at the 5% level using Duncan's New Multiple Range Test.

b/ Ratings based on a scale of 0 to 9 : 0 = dead grass or undesirable vegetative cover, 9 = excellent sward quality, <6 = unacceptable for roadsides.

EFFECTS OF TIMING OF GROWTH RETARDANT APPLICATION ON ROADSIDE TURF

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ABSTRACT

An experiment was conducted on a roadside turf in 1987. The objectives of the experiment were to: 1) compare the effects of four timings of growth retardant application on recovery of the treated turf, and 2) evaluate the effectiveness of growth retardants in overall growth reduction of roadside turf. The roadside turf consisted primarily of `Kentucky 31' tall fescue (Festuca aurandinacea Schreb.). Applications were made at dormant stage, 10, 75, and 100% green-up stages on March 20, March 27, April 10, and April 21, 1987, respectively. Treatments were applied with a CO2 backpack sprayer in 567 L/ha at 152 kPa. Observations on turf injury, plant height, seedhead reduction, overall growth reduction, and recovery of the treated turf were made on May 12 and 26, June 15, and July 24, 1987.

ACP-1911 at 420, 560, and 700 g ai/ha reduced (90% or more) growth of tall fescue when applied either at the 75% or 100% green-up stages. On the otherhand, the same treatments were ineffective in reducing overall growth of tall fescue when applied at the dormant or 10% green-up stage. Turf injury ranged from 18 to 25% from the 100% green-up application, 37 to 58% from the 75% green-up, 20 to 23% from the dormant application, and 15 to 18% from the 10% green-up application. In general, ACP-1911 treatments resulted in less injury to tall fescue as compared to amidochlor at 2.8 kg/ha or the combination of metsulfuron and mefluidide at 15 and 70 g/ha when applied at all stages of green-up except the 100% green-up.

ACP-1911 treatments reduced vertical height of tall fescue up to 50% when applied at the 100% green-up and the treatments were less effective when applied at the 75% green-up. Irrespective of the time of application (100 and 75% green-up stages), ACP-1911 at 420 to 700 g/ha reduced seedheads of tall fescue by 77 to 93%. However, ACP-1911 inhibited seedheads of tall fescue more when applied at the 100% green-up than when applied at the 75% green-up stage.

Maximum injury was noted with the combination of metsulfuron and mefluidide at 15 + 70 g/ha with 50% from 100% green-up application and 78% injury from 75% green-up application. Treated tall fescue recovered only by 58 and 18% when applied at the 100 and 75% green-up stages, respectively.

In summary, dormant application and 10% green-up application of ACP-1911 were ineffective in reducing overall growth and seedheads of tall fescue. Treatments of ACP-1911 when applied at the 100% green-up stage significantly reduced overall growth and seedheads of tall fescue with little or no injury to the roadside turf. ACP-1911 demonstrated potential for use as a growth retardant for roadside turf.

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DANDELION CONTROL AND BLUEGRASS GROWTH REGULATION WITH TRICLOPYR, AC 247,466 AND IMAZAQUIN

J. Landwehr Vollmer and S. W. Bingham[1/]

ABSTRACT

Two important maintenance practices of fine turf are mowing and weed control. AC 247,466 has been shown to reduce mowing, however, gives little to no control of broadleaf weeds, such as common dandelion (Taraxacum officinale Weber). Addition of triclopyr to AC 247,466 resulted in improved dandelion control and had no effect on growth regulation. Addition of imazaquin did not improve dandelion control, but did influence growth regulation.

Field studies were conducted in 1987 at Blacksburg, VA to evaluate all combinations of AC 247,466, triclopyr and imazaquin on Kentucky bluegrass (Poa pratensis L.) growth regulation and common dandelion control. AC 246,466, imazaquin and triclopyr 3A were applied at .044, .088, .132 and .125, .25 and .125, .25 lbs ai/A, respectively, to three Kentucky bluegrass varieties, 'Plush', 'Glade-Plush-Ram' and '190'. Both AC 247,466 and imazaquin resulted in adequate growth regulation, with a significant interaction between combinations, on all three Kentucky bluegrass varieties. The combination of AC 247,466 plus imazaquin at .044 and .125 or .25 lbs/A, respectively, resulted in growth regulation equal to AC 247,466 alone at .088 lbs/A.

Neither AC 247,466 or imazaquin alone or in combination afforded any control of common dandelion. Triclopyr at .25 lbs/A alone achieved 50 to 70% control of common dandelion. Combinations of AC 247,466 and/or imazaquin with triclopyr resulted in no significant increase in common dandelion control. Treatments which resulted in both growth regulation and common dandelion control achieved the highest quality ratings.

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TANK MIXING WITH PREEMERGENT MATERIALS TO ENHANCE FENOXAPROP EFFICACY

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Abstract

Field experiments were conducted to evaluate the effect of tank mixing preemergent crabgrass materials with fenoxaprop to enhance control of crabgrass (*Digitaria* spp.) in turf at two locations. Results indicate performance of fenoxaprop alone is variable depending on severity of drought stress at time of application. On Long Island, excellent control was achieved with rates of 0.08 and 0.12 lb ai/A, therefore no enhancement was evident from tank mixing. In White Plains, poor control was attained with 0.08 and 0.12 lb ai/A fenoxaprop. Tank mixing with prodiamine (0.75 lb ai/A) and DCPA (10.5 lb ai/A) did enhance control, while mixing with bensulide (7.5 lb ai/A) was not effective and pendimethalin (1.5 lb ai/A) results were variable.

A separate study was conducted to compare fenoxaprop and pendimethalin alone and in factorial combinations. Results indicate synergistic interactions when fenoxaprop rates were 0.06 or 0.12 lb ai/A at all rates of pendimethalin. Excellent season-long control was afforded at the high rates of both materials in combination (0.24 and 1.5 lb ai/A). However, fenoxaprop at 0.12 lb ai/A combined with 1.5 lb ai/A pendimethalin was not significantly different from the high rate combination which suggests a lower use rate of Fenoxaprop may be employed by adding pendimethalin.

Introduction

The recent registration of fenoxaprop ((±) 2-[4-[(6-chloro-2-bezoxazolyl) oxy] phenoxy]propanoic acid) has enabled turfgrass managers to effectively control crabgrass (*Digitaria* spp.) at low rates with reduced phytotoxicity in certain turfgrass species. However, a few factors have been identified as having an influence on fenoxaprop efficacy such as, crabgrass growth stage, tank mixing with auxin-like broadleaf herbicides, and drought stress (3,4). Neal and Senesac (4) reported alleviation of the reduced efficacy associated with drought stress by tank mixing with specific preemergent materials. The results suggest tank mixing with pendimethalin [n-(1-ethylpropyl)-3,4 dimethyl-2,6 dinitrobenzen-amide] or prodiamine [N^3,N^3-Di-n-propyl-2,4-dinitro-6-(trifluoro-methyl)-m-phenylene diamine] produces a synergistic effect based on performance of the materials applied alone and in combination.

Environmental conditions vary from year to year and with the potential restrictions on municipal water use for turf, an effective means of crabgrass control when moisture is limiting is necessary. Therefore, the objectives of this research are to 1) evaluate enhancement of fenoxaprop efficacy under moderate and severe drought stress by tank mixing with preemergent materials, and 2) to determine the interactive response between fenoxaprop and pendimethalin alone and in a factorial combination.

Materials and Methods

The investigation involved two separate studies. In study I, fenoxaprop was applied alone at two rates (0.08 and 0.12 lb ai/A) and tank mixed with pendimethalin (1.5 lb ai/A), prodiamine (0.75 lb ai/A), DCPA (diethyl tetra- chloroterephthalate)(10.5 lb ai/A) or bensulide (0,0-diisopropyl phoshodithioate S-ester with N-(2-mercaptoethyl) benzenesulfonamide)(7.5 lb ai/A) at two locations. The Long Island site was on a well drained sandy soil and was under severe drought stress throughout most of the study. Approximately 5h prior to application, 1.75cm of rainfall was received by the area and then remained dry for the remainder of the experimental period. The White Plains site was under moderate stress throughout the study and received approximately 2.0cm of rainfall 72h after application. Both sites consisted of a thin stand of turf with a mixture of smooth crabgrass (*Digitaria ischaemum* (Schreb.) Muhl.) and hairy crabgrass (*Digitari sanguinalis* (L.) Scop.). At the time of application crabgrass on Long Island was in the 2 to 3 leaf stage and in the 1 to 3

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tiller stage at White Plains. All materials were applied with a CO_2 backpack sprayer calibrated to deliver 60 gpa at 40 psi using flat fan nozzles. Dates and rates of application appear in tables.

Study II was conducted in White Plains under identical conditions as in study I. Fenoxaprop at 0.06, 0.12, and 0.24 lb ai/A and pendimethalin at 0.5, 1.0, and 1.5 lb ai/A were applied alone and in a full factorial experiment.

Plot size in each study was 6.0 by 10.0 ft and treatments were arranged in a randomized complete block design with either three(study II) or four (study I) replications. Percent crabgrass control was based on comparisons between crabgrass cover in treated plots to that of untreated areas in the study.

Results and Discussion

Study I

On Long Island, under severe drought stress, fenoxaprop at 0.08 or 0.12 lb ai/A provided excellent season - long control (>90%) (data not shown). This response indicates no apparent enhancement from the tank mixing is evident. Applications were made on July 8, 1987 to 2 to 3 leaf crabgrass that had just received rain after 29 days of drought and did not receive moisture for another 20 days after treatments. The success with low rates of fenoxaprop might be partially explained by application to young crabgrass when fenoxaprop is known to be effective (4). However, it can also be hypothesized that drought stressed crabgrass produces a surge of active growth in response to available moisture, thereby increasing effective absorption and translocation of the material before moisture, again, becomes limiting.

In White Plains, under moderate drought stress at time of application and throughout the study, fenoxaprop at 0.08 or 0.12 lb ai/A was ineffective (Table 1). Tank mixing with prodiamine enhanced efficacy and provided excellent season - long control (>90%). Slight enhancement was evident from tank mixes with DCPA, however control was not exceptional and bensulide tank mixes were ineffective. Tank mixes with pendimethalin performed excellent in 1986 field experiments (4), but produced variable results in this study.

Table 1. Efficacy of fenoxaprop in combination with several preemergent materials for the control of crabgrass.

Treatment[a]	lb ai/A	Formulation	Percent control of DIGXX[b] 8wks after trt	12wks after trt
1.Pendimethalin	1.5	60DG	22	20
2.Fenoxaprop	0.08	1E	70	67
& Pendimethalin	1.5	60DG		
3.Fenoxaprop	0.12	1E	57	47
& Pendimethalin	1.5	60DG		
4.Fenoxaprop	0.16	1E	100	98
& Prodiamine	1.5	65DG		
5.Fenoxaprop	0.12	1E	97	100
& Prodiamine	0.75	65DG		
6.Fenoxaprop	0.08	1E	37	23
7.Fenoxaprop	0.12	1E	3	7
8.Pendimethalin	1.5	60DG	3	7
& X77(0.25%v/v)				
9.Fenoxaprop	0.08	1E	63	73
& DCPA	10.5	75WP		
10.Fenoxaprop	0.12	1E	80	77
& DCPA	10.5	75WP		
11.Fenoxaprop	0.08	1E	10	13
& Bensulide	7.5	4E		
12.Fenoxaprop	0.12	1E	47	37
& Bensulide	7.5	4E		
13.Control	.	.	0	0
LSD (0.05)			29	18

a.Application Date: June 18,1987. b.Percent control based on visual rating, where 0=no control and 100=full control.

Study II

Results expressed in percent control of crabgrass are presented in Table 2. The combination of 0.24 lb ai/A fenoxaprop and 1.5 lb ai/A pendimethalin provided excellent season - long control. Ratings assigned at three weeks and twelve weeks after treatment show no significant differences between tank mixes with either 0.06 or 0.12 lb ai/A fenoxaprop. Percent control was not different between 0.12 lb ai/A fenoxaprop mixed with 1.5 lb ai/A and the 0.24 lb rate of fenoxaprop at all rates of pendimethalin. This suggests a reduced dosage requirement of fenoxaprop by adding pendimethalin.

Data presented in Table 3 have been converted into "percent of control" values. To interpret the interactive response of fenoxaprop when tank mixed with pendimethalin a method described by Colby (2) was employed. This method utilizes an "expected response" of the herbicide combination based on performance of the materials alone to determine synergism, antagonism, or additive effects. This method has its limitations (1), but is satisfactory for the purpose of interpreting preliminary responses.

The type of response elicited by a herbicide alone or in combination with another herbicide depends on many factors. A few of which are; individual modes of action and how they might interact on the same or closely related plant processes, ability to be foliarly absorbed, timing of application, rate combinations, and environmental conditions.

The data in Table 3 suggest a synergistic interaction between the materials when fenoxaprop is at 0.06 and 0.24 lb ai/A. This response is reasonable as evidenced by performance of fenoxaprop applied alone. Tank mixing 0.12 lb ai/A fenoxaprop with pendimethalin produced variable results and may reflect limitations in the Colby procedure. Although, study I results for mixes with pendimethalin were variable at approximately the same rates.

This preliminary work indicates many of the combinations resulted in greatly enhanced efficacy under a moderate stress that rendered fenoxaprop alone ineffective. Extensive research will be required to determine the specific nature of the dosage response and the apparent synergism between the materials.

In conclusion, the actual benefit of tank mixing fenoxaprop with pendimethalin might be the ability to enhance efficacy under drought stress and provide consistent control under variable environmental conditions.

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Table 2. Efficacy of fenoxaprop and pendimethalin applied alone and in combination for the control of crabgrass.

Treatment [a]	lb ai/A	Percent control of DIGXX[bc]	
		3wks after trt	12wks after trt
1.Control	.	0	0
2.Fenoxaprop	0.06	5	3
3.Fenoxaprop	0.12	67	53
4.Fenoxaprop	0.24	77	50
5.Pendimethalin	0.50	37	10
6.Pendimethalin	1.00	35	17
7.Pendimethalin	1.50	52	33
8.Fenoxaprop	0.06	62	33
&Pendimethalin	0.50		
9.Fenoxaprop	0.06	62	33
&Pendimethalin	1.00		
10.Fenoxaprop	0.06	73	60
&Pendimethalin	1.50		
11.Fenoxaprop	0.12	68	50
&Pendimethalin	0.50		
12.Fenoxaprop	0.12	80	50
&Pendimethalin	1.00		
13.Fenoxaprop	0.12	80	73
&Pendimethalin	1.50		
14.Fenoxaprop	0.24	90	77
&Pendimethalin	0.50		
15.Fenoxaprop	0.24	90	80
&Pendimethalin	1.00		
16.Fenoxaprop	0.24	97	93
&Pendimethalin	1.50		
LSD (0.05)		21	24

a.Application Date: June 18,1987.
b.Percent control based on visual rating, where 0=no control and 100=full control.
c.DIGXX indicates Bayer code for a mixed stand of smooth crabgrass (*Digitaria ischaemum* (Schreb.)Muhl.) and hairy crabgrass (*Digitaria sanguinalis* (L.) Scop.).

Table 3. Crabgrass control in cool season turf with fenoxaprop and pendimethalin combinations.

Treatment[a]	lb ai/A	Percent of Control[b] 3wks after trt	12wks after trt
1.Control	.	100	100
2.Fenoxaprop	0.06	95	97
3.Fenoxaprop	0.12	33	47
4.Fenoxaprop	0.24	23	50
5.Pendimethalin	0.50	63	90
6.Pendimethalin	1.00	65	83
7.Pendimethalin	1.50	48	67
8.Fenoxaprop	0.06	38 (60)+[cd]	67 (87)+
&Pendimethalin	0.50		
9.Fenoxaprop	0.06	38 (62)+	67 (81)+
&Pendimethalin	1.00		
10.Fenoxaprop	0.06	27 (46)+	40 (65)+
&Pendimethalin	1.50		
11.Fenoxaprop	0.12	32 (21)-	50 (42)-
&Pendimethalin	0.50		
12.Fenoxaprop	0.12	20 (22)+	50 (39)-
&Pendimethalin	1.00		
13.Fenoxaprop	0.12	20 (16)-	27 (31)-
&Pendimethalin	1.50		
14.Fenoxaprop	0.24	10 (15)+	23 (45)+
&Pendimethalin	0.50		
15.Fenoxaprop	0.24	10 (15)+	20 (27)+
&Pendimethalin	1.00		
16.Fenoxaprop	0.24	3 (11)+	7 (34)+
&Pendimethalin	1.50		

a.Application Date: June 18,1987.
b.Means of three replications.
c.Values in parenthesis are calculated expected responses, according to the "expected response" method of Colby (2).
d. Synergism=+; Antagonism=-.

CRABGRASS CONTROL WITH FENOXAPROP IN VARIOUS TANK MIXTURES

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ABSTRACT

Postemergent control of smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.] with fenoxaprop alone and when tank-mixed with selected herbicides, insecticides and fungicides was evaluated in four field trials at The University of Rhode Island Turf Research Farm, Kingston, R.I. Treatments were applied to lawn areas of red fescue (Festuca rubra L.), a mixture of perennial ryegrass (Lolium perenne L.) and Kentucky bluegrass (Poa pratensis L.), and a mixture of perennial ryegrass, Kentucky bluegrass and red fescue. A fourth area was fallow. The red fescue lawn and the fallow area contained large crabgrass [Digitaria sanguinalis (L.) Scop.] in addition to the smooth crabgrass. The ryegrass-bluegrass-fescue area was treated in early June when crabgrass was in the 1-4 leaf stage and germination was still occurring. The ryegrass-bluegrass area was treated in late June when most crabgrass had germinated and was in the 1-5 leaf stage. The fallow and red fescue areas and several treatments in the ryegrass-bluegrass lawn were treated after crabgrass had tillered. Herbicides, rates and dates of treatment are shown in Table 1. Plot size was 4 by 4 feet with three replications. Herbicides were applied as sprays at 60 gpa in the ryegrass-bluegrass-fescue lawn, and 50 gpa in other tests. Lawn areas were irrigated as needed to prevent drought stress. Crabgrass control was evaluated between August 18 and August 24, 1987.

Fenoxaprop alone provided excellent (90-100%) crabgrass control at the .12 lb and .18 lb rates in all but the early postemergent (June 3) trial where germination continued following treatment. Combinations of DCPA, pendimethalin or prodiamine with fenoxaprop at the .12 lb rate resulted in nearly complete control in the early post treatments, as did the MSMA plus DSMA combination.

Combinations of fenoxaprop at .18 lb with broadleaf herbicides provided excellent crabgrass control when applied to crabgrass in the 1-5 leaf stage. When applied to tillered crabgrass in the fallow area on the same date however, mixtures of fenoxaprop with 2,4-D + mecoprop + dicamba, 2,4-D + triclopyr, 2,4-D + dichlorprop, and bromoxynil resulted in poor control. Efficacy of fenoxaprop was not diminished when combined with triclopyr alone or with chlorflurenol. Fenoxaprop at .12 lb combined with dicamba at .12 provided good control (82%) of tillered crabgrass in the red fescue lawn where the same rate of fenoxaprop combined with 2,4-D + mecoprop + dicamba resulted in only 17% control.

Combinations of fenoxaprop at .12 and .18 lb with fluroxypyr resulted in excellent crabgrass control in the 1-5 leaf and tiller stages. Control with fenoxaprop alone at .08 lb was increased from 66% to 81% by the addition of fluroxypyr at .5 lb in the red fescue lawn.

Efficacy of fenoxyprop was not affected by combination of fenoxyprop at .18 lb with chlorpyrifos, iprodione or chlorthalonil. No objectionable turf injury was observed.

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Table 1. Postemergence control of crabgrass in three lawn areas and one fallow area treated in 1987. Crabgrass control was evaluated between August 18 and August 24, 1987.

			Percent Crabgrass Control				
			Crabgrass Growth Stage				
			1-5 Leaf		Tiller		
			Lawn			Lawn	
Herbicide	Formulation	Rate lb ai/A	PR+KB+RF[a] Jun 3	PR+KB Jun 25	Fallow Jun 25	PR+KB Jul 28	RF Jul 28
fenoxaprop	1 EC	.08	-	-	-	-	66
fenoxaprop	1 EC	.12	47	96	-	97	91
fenoxaprop	1 EC	.18	-	98	97	91	93
fluroxypyr	1.7 EC	.5	-	-	-	-	37
pendimethalin	60 DG	1.5	60	-	-	-	-
prodiamine	65 WDG	.5	68	-	-	-	-
fenoxaprop + DCPA	1 EC + 6 F	.12+7.5	96	-	-	-	-
fenoxaprop + pendimethalin	1 EC + 60 DG	.12+1.5	98	-	-	-	-
fenoxaprop + prodiamine	1 EC + 65 WDG	.12+.5	97	-	-	-	-
fenoxaprop + dicamba	1 EC + amine	.12+.12	-	-	-	-	82
fenox. + 2,4-D + MCPP + dicamba	1 EC + amine	.12+1.0+.5+.11	-	89	-	23	17
fenox. + 2,4-D + MCPP + dicamba	1 EC + amine	.18+1.0+.5+.11	-	94	33	68	16
fenoxaprop + triclopyr	1 EC + ester	.18+.5	-	99	93	-	-
fenox. + 2,4-D + triclopyr	1 EC + ester	.18+.75+.375	-	94	41	-	-
fenox. + 2,4-D + dichlorprop	1 EC + ester	.18+.93+.93	-	92	15	-	-
fenoxaprop + bromoxynil	1 EC + ester	.18+1.0	-	95	20	-	-
fenoxaprop + chlorflurenol	1 EC + 1.5 EC	.18+.25	-	98	97	-	-
fenoxaprop + fluroxypyr	1 EC + 1.7 EC	.08+.5	-	-	-	-	81
fenoxaprop + fluroxypyr	1 EC + 1.7 EC	.12+.25	-	-	-	-	93
fenoxaprop + fluroxypyr	1 EC + 1.7 EC	.12+.5	-	-	-	-	94
fenoxaprop + fluroxypyr	1 EC + 1.7 EC	.18+.5	-	99	99	-	-
fenoxaprop + chlorpyrifos	1 EC + 4 E	.18+2	-	98	88	-	-
fenoxaprop + iprodione	1 EC + 50 WP	.18+10.9	-	99	97	-	-
fenoxaprop + chlorothalonil	1 EC + 4.17 F	.18+12.8	-	98	86	-	-
MSMA	6 S	2.0	29	-	-	-	-
MSMA + DCPA	6 S + 6 F	2.0+7.5	96	-	-	-	-
Crabgrass cover in check plots (%)			58%	41%	75%	41%	43%

[a]PR = perennial ryegrass, KB = Kentucky bluegrass, RF = red fescue.

ENVIRONMENTAL AFFECTS ON POSTEMERGENCE CRABGRASS CONTROL IN TURF

William J. Chism and S. W. Bingham [1/]

Two test sites were selected in Virginia to determine the efficacy of controlling a mixed population of smooth crabgrass [Digitaria ischaemum (Screb. ex. Schweig.) Schreb. ex. Muhl.] and large crabgrass [Digitaria sanguinalis (L.) Scop.] with postemergence herbicides in established turf. Five herbicides were tested BAS 514 at 0.56 and 1.12 kg/ha, fenoxaprop-ethyl at 0.14 and 0.28 kg/ha, imazequin at 0.28 and 0.56 kg/ha, quizalofop-ethyl at 0.21 and 0.42 kg/ha and tridiphane at 1.12 and 2.24 kg/ha. The two herbicides that provided adequate control of crabgrass and acceptible turf phytotoxicity at both sites were the two rates of BAS 514 and the two rates of fenoxaprop-ethyl. The other herbicides were unable to adequately control crabgrass under the conditions of the experiment.

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WEED CONTROL IN TURF - 1986 AND 1987[1]

A. Enache, R. D. Ilnicki and E. Prostko[2]

ABSTRACT

Efficacy of experimental and commercially available herbicides when applied to cool-season turfgrasses for pre and postemergence control were evaluated in field trials conducted at the Adelphia Research Center in 1986 and 1987. The herbicides were evaluated for large crabgrass [Digitaria sanguinalis (L.) Scop.] control and for general weed control as well.

This study was conducted as a randomized block design with three replications. Three perennial grasses, ryegrass (Lolium perenne L.), tall fescue (Festuca arundinacea Schreb.) and Kentucky bluegrass (Poa pratensis L.) were the species used. Treatments were applied using a CO_2-propelled backpack sprayer, water as carrier, at 375 l/ha and 221 kPa. The soil was sandy loam with pH 6.1 and OM 1.8%. The preemergence treatments were applied on April 14, 1986 and April 10, 1987. The postemergence treatments were applied on June 16, 1986 and June 24, 1987. Herbicides evaluated in this two-year study were: pendimethalin, prodiamine, oxadiazon, BAS 514-H alone and in combination with 2,4-D, dicamba, and bentazon, CGA 131036, bentazon, and fenoxaprop. In 1987, CGA 41065, AC 263222 and EL 107 were evaluated also. No injury to the grasses was observed with any treatment of the herbicides evaluated. Turfgrasses were rated every month until October.

In both years, BAS 514-H provided the best crabgrass control when applied either pre or postemergence in all turf species (>93%) except in tall fescue where CGA 131036 applied preemergence performed the best in 1986. BAS 514-H also provided good crabgrass and broadleaf control when combined with dicamba, 2,4-D and bentazon in 1987. CGA 131036 gave best control at the low rate in all turf fields. Oxadiazon and fenoxaprop provided >85% crabgrass control in ryegrass and tall fescue, less in Kentucky bluegrass. With respect to the control of other weeds present, pendimethalin, BAS 514-H, oxadiazon, CGA 131036 and prodiamine gave >70% control at all rates.

Looking at the control evolution over the whole summer, BAS 514-H alone or in combination with bentazon provided better and longer control than bentazon or fenoxaprop alone.

In 1987, CGA 41065 treatments resulted in consistent good control (>93%) at all rates or all turf species. EL 107 followed the same pattern. AC 263222 showed less activity in ryegrass than in tall fescue and bluegrass.

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[1]New Jersey Agricultural Experiment Station Publication No. J-15472-5-87.

[2]Graduate Student, Res. Prof. of Weed Sci., and Graduate Student, respectively, Dept. of Soils and Crops, N. J. Agr. Exp. Stn., Cook College-Rutgers Univ., New Brunswick, N.J. 08903

PRE-POST HERBICIDE COMBINATIONS FOR CRABGRASS CONTROL

Scott A. Harrison and Thomas L. Watschke[1]

ABSTRACT

The selective control of annual grassy weeds is a difficult problem facing most turf managers. A number of efficacious preemergence and postemergence herbicides are currently available for the selective treatment of annual grasses in perennial turfgrass stands. Full season control of weedy grasses generally requires multiple applications of these products.

Several studies were conducted at the Pennsylvania State University Golf Course to evaluate various rates, tank mixes, and timings of pendimethalin, DCPA, fenoxaprop, and MSMA as single application, full season treatments for smooth crabgrass [*Digitaria ischaemum* (Schreb.) Muhl.] in a red fescue (*Festuca rubra* L.) and perennial ryegrass (*Lolium perenne* L.) turfgrass stand. Treatments were applied on 5/18/87, 6/2/87, 6/18/87, and 7/21/87 to crabgrass in the spike, 1 to 3 leaf, 2 to 5 leaf, and 3 tiller stages of growth, respectively. Applications were made using a CO_2 pressurized handboom equipped with 6520FF nozzles delivering 175 GPA at 15 PSI. Results are presented in Table 1.

Pendimethalin (1.68 kg/ha) applied on 5/18/87 provided excellent full season control of spike crabgrass, but was not acceptable at the 1 to 3 leaf timing. Fenoxaprop (0.09 kg/ha) alone did not provide adequate control of crabgrass at any timing, however, the addition of nonionic surfactant (0.25 %) resulted in a significant increase in activity at the 1 to 3 and 2 to 5 leaf stages of growth. Examination of the target grasses at the time of application indicated that coverage was less than optimum without additional surfactant and noticeably improved when surfactant was included. Higher application rates of fenoxaprop exhibited superior control for a short term but were reinfested with crabgrass.

Combinations of fenoxaprop and pendimethalin in all cases provided superior crabgrass control than either compound alone, with the exception of the earliest timing. None of these tank mixes, however, were considered acceptable due to poor control of emerged crabgrass.

Fenoxaprop (0.20 kg/ha) and MSMA (2.24 kg/ha, 2 week sequential) both exhibited poor control of crabgrass when applied alone, and good full season control in combination with DCPA (8.4 kg/ha). DCPA in combination with a single application of MSMA did not reduce emerged crabgrass to a tolerable level.

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Table 1. Effect of pre- and postemergence herbicide combinations and timings on control of smooth crabgrass.

TREATMENT (application rate)	6/30/87 % crabgrass control	7/14/87 % crabgrass control	7/14/87 turf injury (0 - 100)	8/13/87 % crabgrass control
Applied 5/18/87 to spike crabgrass				
Pendimethalin (1.68 kg/ha)	100.0	93.1	---	95.6
Fenoxaprop (0.09 kg/ha)	50.0	50.6	---	9.8
Fenoxaprop (0.09 kg/ha) + pendimethalin (1.68 kg/ha)	100.0	98.3	---	93.1
Control	0.0	0.0	---	0.0
Applied 6/2/87, crabgrass 1-3 leaf				
Pendimethalin (1.12 kg/ha)	74.4	51.9	---	42.2
Pendimethalin (1.68 kg/ha)	91.2	84.4	---	55.6
Fenoxaprop (0.09 kg/ha)	37.6	42.2	---	7.2
Fenoxaprop (0.09 kg/ha) + X-77 surfactant (0.25%)	82.4	80.0	---	51.3
Fenoxaprop (0.09 kg/ha) + pendimethalin (1.12 kg/ha)	88.8	83.7	---	71.1
Fenoxaprop (0.09 kg/ha) + pendimethalin (1.68 kg/ha)	89.6	89.6	---	74.0
Control	0.0	0.0	---	0.0
Applied 6/18/87, crabgrass 2-5 leaf				
Fenoxaprop (0.09 kg/ha)	59.1	72.2	---	18.2
Fenoxaprop (0.09 kg/ha) + X-77 surfactant (0.25%)	81.7	89.4	---	42.1
Fenoxaprop (0.13 kg/ha)	85.2	90.0	---	42.8
Fenoxaprop (0.09 kg/ha) + pendimethalin (1.12 kg/ha)	83.5	90.0	---	54.4
Fenoxaprop (0.13 kg/ha) + pendimethalin (1.12 kg/ha)	90.4	88.3	---	63.9
Control	0.0	0.0	---	0.0
Fenoxaprop (0.20 kg/ha)	---	95.8	6.7	66.7
MSMA 6L (2.24 kg/ha x 2 week sequential)	---	77.0	20.0	71.7
Fenoxaprop (0.20 kg/ha) + DCPA 6F (8.41 kg/ha)	---	98.2	3.3	86.7
MSMA 6L (2.24 kg/ha) + DCPA 6F (8.41 kg/ha)	---	89.7	3.3	61.7
MSMA 6L (2.24 kg/ha x 2 week seq) + DCPA 6F (8.41 kg/ha)	---	95.2	26.7	81.7
Applied 7/21/87, crabgrass to 3 tillers				
Fenoxaprop (0.13 kg/ha)	---	---	---	0.4
Fenoxaprop (0.20 kg/ha)	---	---	---	6.0
Fenoxaprop (0.13 kg/ha) + prodiamine (0.28 kg/ha)	---	---	---	20.0
Fenoxaprop (0.20 kg/ha) + prodiamine (0.28 kg/ha)	---	---	---	18.8
Control	---	---	---	0.0

SMOOTH CRABGRASS CONTROL WITH PRE- AND POSTEMERGENCE HERBICIDES, 1987

P.H. Dernoeden and D.B. Davis[1/]

ABSTRACT

The herbicides evaluated were applied to perennial ryegrass (Lolium perenne L.) stands in 50 gpa, and test areas were irrigated within 24 hours of application. All studies were arranged in a randomized complete block with four replications. Percent of plot area covered by smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.] was determined visually in September. Unless otherwise specified, dates and rates of application are noted in Tables 1 and 2.

The herbicides listed in Table 1 were applied to a dense stand of perennial ryegrass and only prodiamine 65WDG (0.75 lb/A) provided excellent (>90%) control of smooth crabgrass. Other prodiamine rates and formulations as well as pendimethalin, DCPA, EL 107 plus either benefin or benefin/trifluralin, and benefin/trifluralin provided fair (67 to 78%) to good (80 to 89%) smooth crabgrass control. Poor control (9 to 31%) was provided by quinclorac and EL 107.

Unlike the aforementioned study, herbicides listed in Table 2 were applied to an open ryegrass stand. Acceptable control in this situation was only provided by sequential applications (1.5 + 1.5 lb/A) of flumetralin 1.2E and pendimethalin 60DG. A single application of pendimethalin 60DG (1.5 lb/A) provided fair (78%) control; however, all other herbicide treatments were ineffective. Diphenamid, and especially AC 222, were extremely phytotoxic (Table 2). All turf in AC 222 treated plots eventually died.

A third, preemergence herbicide evaluation was conducted on an open stand of perennial ryegrass in 1987 for which no data are shown. In that study, excellent smooth crabgrass control was provided by pendimethalin 60DG at 1.5 or 3.0 lb/A. Two formulations of prodiamine (65DG and 46G + fertilizer) provided good control (84 to 89%) whereas, prodiamine 29G + fertilizer provided poor control (33 to 43%).

In a fourth study (data not shown) fenoxaprop (0.18 lb/A) mixed with DCPA (7.5 or 10.5 lb/A), and applied 24 May 1987 to smooth crabgrass seedlings in the 2 to 3 leaf stage, provided 86 to 90% control. Fenoxaprop (0.12 lb/A) tank mixed with either pendimethalin (1.5 lb/A) or prodiamine (0.5 lb/A) provided 92 and 89% control, respectively. MSMA (2.0 lb/A) tank mixed with DCPA (7.5 or 10.5 lb/A) gave 53 and 76% control, respectively. MSMA (1.5 lb/A) applied as a mix with DCPA (7.5 lb/A), and followed by another MSMA (1.5 lb/A) application in 12 days provided 82% control. MSMA treatments yellowed the perennial ryegrass but caused no significant injury to the turf.

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Table 1. Preemergence application of herbicides for smooth crabgrass control in a dense stand of 'Palmer' perennial ryegrass, 1987.

Treatment[x]	Rate	Smooth crabgrass[y] Cover 13 July	Cover 4 Sept	Control 4 Sept
	(lb ai/A)	(%)		
Prodiamine 65WDG	0.50	1c[z]	18def	80
Prodiamine 65WDG	0.75	0c	5f	94
Prodiamine 0.5G	0.50	2c	18def	80
Prodiamine 0.5G	0.75	1c	10ef	89
Prodiamine 1.0G	0.50	4c	22def	75
Prodiamine 1.0G	0.75	1c	13def	85
Pendimethalin 60DG	1.5	4c	22def	75
Pendimethalin 1.7G	1.5	0c	10ef	89
Quinclorac 50W	0.5	33a	80ab	9
Quinclorac 50W	1.0	17b	70bc	20
DCPA 4F	10.5	2c	24de	73
DCPA 4F	10.5 + 5.2	0c	10ef	89
EL 107 + benefin 60DF	0.6 + 2.4	2c	24de	73
EL 107 + benefin 60DF	0.72 + 2.88	0c	19def	78
EL 107 75DF + Benefin/trifluralin 2G	0.5 + 2.0	2c	29d	67
EL 107 75DF + Benefin/trifluralin 2G	0.5 + 3.0	1c	22def	75
EL 107 75DF	0.5	19b	61c	31
Benefin/trifluralin 2G	2.0	1c	19def	78
Untreated	---	31a	88a	—

[x]Herbicides were applied 3 April and the sequential DCPA (5.2 lb/A) treatment was applied 23 May 1987. The test area was subjected to rain (1.2 inches) within 6 hrs of application on 3 April.
[y]Cover was determined visually on a 0 to 100% scale.
[z]Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

Table 2. Preemergence application of herbicides for smooth crabgrass control in an open stand of perennial ryegrass, 1987.

Herbicide[x]	Rate	Area injured 19 Apr	Smooth crabgrass[y] Cover 7 July	Cover 4 Sept	Control 4 Sept
	(lb ai/A)	(%)	(%)		
Flumetralin 2G	0.75	0d[z]	60b	89ab	0
Flumetralin 2G	1.2	0d	38de	88ab	0
Flumetralin 2G	1.5 + 1.5	0d	39de	68cd	20
Flumetralin 1.2E	0.75	2d	37de	71bcd	16
Flumetralin 1.2E	1.2	19c	25ef	64de	25
Flumetralin 1.2E	1.5 + 1.5	2d	2h	7f	92
Diphenamid 90W	2.0	28bc	81a	91a	0
Diphenamid 90W	4.0	35b	87a	88ab	0
AC 222 2ASU	0.125	49a	82a	89ab	0
AC 222 2ASU	0.188	46a	84a	92ab	0
AC 222 2ASU	0.250	48a	80a	75a-d	12
AC 222 2ASU	0.375	52a	52a	74a-d	12
Pendimethalin 60DG	1.5	0d	6gh	19f	78
Pendimethalin 60DG	1.5 + 1.5	0d	0h	5f	94
Tricalcium arsenate 2.8F	30.5	0d	54bc	75a-d	12
Tricalcium arsenate 2.8F	61.0	0d	40cde	84abc	0
Cinmethylin (MF 744) 0.5G	6.9	6d	20ef	76a-d	12
Bensulide 4 EC	10.0	1d	20fg	47e	45
Untreated	---	0d	65ab	85abc	—

[x]Initial treatments were applied 8 April and sequential treatments were applied 25 May 1987. The test area was irrigated within 24 hrs with 1.0 inch of water.
[y]Crabgrass seedlings were first observed 20 April and cover was rated visually on a 0 - 100% scale.
[z]Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

MON-15100 EFFICACY TRIALS FOR ANNUAL GRASS CONTROL IN TURFGRASS

D.C. RIEGO

ABSTRACT

MON-15100 is a new experimental compound being tested for control of annual grasses in turfgrass. This paper is a summary of field development trials undertaken across the Midwest and Northeastern United States in 1987.

Major areas tested were postemergent and preemergent control of crabgrass preemergent control of certain broadleaf weeds, and safety to a variety of cool-season turf species. Results indicate that MON-15100 will provide excellent control of annual grasses and broadleaf weeds in turfgrass with good safety to cool-season turf species.

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SPECTRAL ANALYSIS OF SPRAY DROPLETS GENERATED BY THE CHEMLAWN SPRAY GUN USED TO APPLY PESTICIDES TO LAWNS

K. A. Hurto[1/]

ABSTRACT

The ChemLawn Spray Gun equipped with the 4 GPM nozzle is designed to apply dilute mixtures of fertilizers and pesticides to lawns at a spray volume of 1627 L ha^{-1} (174 gpa). The recommended nozzle flow rate for this application is 15.1 L min^{-1} (4 gpm) at 17 kPa (2.5 psi) nozzle pressure. The 4 GPM nozzle is an injection molded, nylon nozzle containing 48 straight spray jets measuring 1.27 mm in diameter that are arranged on a convex, spherical spray plate. It generates a solid cone spray pattern.

The objective of this study was to measure the droplet spectra of the 4 GPM nozzle operating at flow rates between 14.8 and 18.9 L min^{-1} to study the effect of changes in flow rate on droplet size distribution and to compare the nozzle to a low pressure flat fan nozzle (BJ 0480) operating at 1.3 L min^{-1} (0.35 gpm) flow rate. Spectral analysis was performed with a Bete Droplet Analyzer. This analyzer uses a spatial, direct measurement of droplets via a high speed, video imaging system that is capable of measuring droplets between 2 and 10 000 μM in diameter. Nozzles were positioned 46 cm above the sampling port of the analyzer and droplet spectra was determined at four separate sampling areas in the spray stream.

The 4 GPM nozzle has a VMD of 2128 μM with less than 0.5% of the spray volume composed of spray droplets less than 250 μM in diameter. Droplets as small as 22 and as large as 3559 μM were measured in these studies. Increasing the flow rate from 15.1 to 18.9 L min^{-1} did not significantly increase the percent of total spray volume generated as fine droplets nor reduce the VMD and relative span characteristics of the droplet spectra (Table 1). Droplets formed at the perimeter of the spray stream are larger than those formed in the center of the stream. All droplets emitted from the BJ0480 nozzle were smaller than 250 μM. Droplets as small as 5 and as large as 243 μM were detected for the BJ0480 nozzle (Table 2).

Review of published studies on droplet spectra and spray drift suggest drift problems are associated with droplets smaller than 200 μM. The droplet spectra of the 4 GPM nozzle operating at recommended flow rates generates a very low percentage of its total spray volume as droplets in this size class. Because of this, the larger droplets produced by the 4 GPM nozzle are less likely to drift then the smaller droplets generated by low pressure flat fan nozzles. Consequently, the ChemLawn Spray Gun and 4 GPM nozzle can be used on days when wind speeds would otherwise prevent the use of conventional, low volume spray equipment to apply herbicides. Field drift measurement studies are required, however, to substantiate this assumption.

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Table 1. Particle size characteristics of spray droplets emitted from the ChemLawn Gun equipped with a 4 GPM nozzle operating at different spray pressures and flow rates.

Nozzle Pressure (kPa)	17	21	27
Flow Rate (L min^{-1})	15.1	16.7	18.9
	(droplet diameter in μM)		
Median Volume			
$D_V0.1$	1 528	1 354	1 163
$D_V0.5$	2 128	2 003	2 056
$D_V0.9$	2 798	2 764	2 768
Maximum Droplet	3 559	3 490	3 508
Minimum Droplet*	76	76	76
Arithmetic Mean	389	404	309
Surface Mean	675	662	526
Volume Mean	944	908	767
Sauter Mean	1 842	1 704	1 628
Weight Mean	2 107	2 000	2 001
Volume less than 250 μM	0.26%	0.28%	0.40%
Relative Span	0.60	0.70	0.78

*Smallest droplet diameter detected with this test procedure. Smaller droplets are emitted under the above operating conditions.

Table 2. Comparison of particle size characteristics of spray droplets emitted from a ChemLawn 4 GPM nozzle used by commercial lawn care operators to a BJ0480 flat fan nozzle used in agricultural applications.

	ChemLawn 4 GPM	BJ0480
Nozzle Pressure	28 kPa	207 kPa
Flow Rate	19.8 L min^{-1}	1.3 L min^{-1}
	(droplet diameter in μM)	
Median Volume		
$D_V0.1$	801	75
$D_V0.5$	1 993	129
$D_V0.9$	2 299	207
Maximum Diameter Droplet	2 359	243
Minimum Diameter Droplet*	24	5
Arithmetic Mean	238	69
Surface Mean	422	81
Volume Mean	638	91
Sauter Mean	1 460	115
Weight Mean	1 838	135
Volume less than 250 μM	0.60%	100%
Relative Span	0.75	1.02

*Smallest droplet diameter detected under the conditions of the test procedure.

PREEMERGENCE CONTROL OF CRABGRASS IN A MIXED STAND OF COOL SEASON TURFGRASSES

T. L. Watschke, G. Hamilton, and S. Harrison[1]

ABSTRACT

An experiment was conducted during 1987 to evaluate several herbicides for preemergence crabgrass (Digitaria ischaemum) (Schreb.) Michx. control in a mixed sward of cool season turfgrasses. Injury to desired species was also evaluated. DCPA 75W, prodiamine 65W at both rates, oxadiazon, the benefin-trifluralin combination on fertilizer, pendimethalin 60DG, and CGA-41065 1.2 EC at all rates provided better than 80% control. All rates of cinmethylin, AC 263,222 and imazaquin provided less than 30% control and AC 263,222 caused considerable injury.

The granular formulations of prodiamine (0.5 and 1.0 G) nearly provided acceptable control. However, it appeared that the 0.5 G formulation had more potential than the 1.0 G because there was a rate effect. The 0.5 G provided better particle coverage which increased control, particularly when the rate was increased. The experimental CGA-41065 1.2 EC had very good efficacy particularly at the higher two rates (1.68 and 3.36 kg ai/ha) without causing injury to desired species.

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Table 1. Preemergence control of smooth crabgrass and injury to a mixed cool season turfgrass stand from application of several herbicides and herbicide combinations on April 22, 1987. The study was not irrigated and ratings for injury were made on May 15 and control on August 12, 1987.

Treatment	Rate (kg ai/ha)	Crabgrass (Control %)	Injury (% Thinning)
Cinmethylin 7EC	0.56	6.7	0
Cinmethylin 7EC	1.12	23.3	0
Cinmethylin 7EC	2.24	30.0	0
AC 263,222	0.15	6.7	43
AC 263,222	0.20	0.0	57
AC 263,222	0.28	3.3	60
Imazaquin	0.28	5.0	0
DCPA 75W	11.76	92.7	0
DCPA 6F	11.76	75.0	0
DCPA 56	10.75	70.0	0
Prodiamine 65W	0.56	92.7	0
Prodiamine 65W	0.84	91.0	0
Prodiamine 0.5 G	0.56	71.7	0
Prodiamine 0.5 G	0.84	80.0	0
Prodiamine 1.0 G	0.56	70.0	0
Prodiamine 1.0 G	0.84	70.0	20
Oxadiazon 2G	2.24	92.7	0
Benefin + Trifluralin	1.49 + 0.75	81.7	0
Benefin + Trifluralin	1.49 + 0.75	96.0	0
Benefin 2.5 G	2.24	70.0	0
Pendimethalin 60 DG	1.68	83.3	0
Pendimethalin + F	1.68	71.7	0
CGA-41065 1.2 EC	1.12	81.7	0
CGA-41065 1.2 EC	1.68	91.0	0
CGA-41065 1.2 EC	3.36	98.0	0
EL-107 + Benefin 60 DF	0.8 + 3.1	16.7	0
EL-107 + Benefin + Trifluralin	0.56 + 1.5 + 0.75	92.7	13

RESPONSE OF FIVE KENTUCKY BLUEGRASS CLUTIVARS TO PENDIMETHALIN APPLICATION

R.J.Cooper and L.A. Spokas[1]

ABSTRACT

The purpose of this study was to determine the effects of pendimethalin application on the growth and quality of five commonly used Kentucky bluegrass (Poa pratensis L.) cultivars. Pendimethalin (60% WDG) was applied to 0.91 x 1.82 m plots of 'A-34, Adelphi, Baron, Merion, and Touchdown' Kentucky bluegrass on May 3, 1986. Rates of 1.7 or 3.4 kg ai/ha were applied using a CO_2 powered sprayer at 207 kPa pressure delivering 1390 L/ha. On May 6 1986, 5 cm diameter x 2.5 cm deep plugs were removed from all cultivar/rate combinations and were transplanted into a sandy rooting media in the field to observe root and rhizome develoment (evaluated on 6/2, 7/3, 9/11, and 11/28, 1986). On April 16 1987, pendimethalin was reapplied to a remaining set of Kentucky bluegrass plugs to determine the effect of successive annual application on root and rhizome development (evaluated on 4/15, 5/26, and 8/4, 1987). Turfgrass quality and crabgrass [Digitaria sanguinalis (L.) Scop.] control were evaluated when appropriate during both 1986 and 1987.

Pendimethalin applied at either 1.7 or 3.4 kg ai/ha provided excellent season long crabgrass control during both years. Turfgrass quality (1=brown, low quality; 9=dark green, high quality) was not affected by pendimethalin applied at either rate. No discoloration was noted following application in either year. Quality (mean of all cultivars) for plots treated at 0, 1.7, and 3.4 kg ai/ha averaged 7.5, 7.3, and 7.6, respectively, during the four weeks following application.

Following 1986 application, the 3.4 kg ai/ha rate of pendimethalin significantly reduced root regrowth (P=.01) when determined 30 days after transplanting (6/2). Root mass (mean of all cultivars) averaged 0.43, 0.34, and 0.26 g/plug in response to the 0, 1.7, and 3.4 rates of pendimethalin. Root length (mean of all cultivars) averaged 4.4, 3.6, and 3.0 cm/plug in response to the 0, 1.7, and 3.4 kg application rates, respectively. These reduction were short lived, however, with no further differences in root mass or root length observed during 1986 or 1987.

Total rhizome mass and number of rhizomes produced did not vary in response to pendimethalin application at any time during the study. This is encouraging since preemergent materials are often applied to low quality turf areas exhibiting poor density where it is desirable for the existing turfgrass to spread and colonize bare areas.

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ROOTING AND COVER OF THREE TURF SPECIES AS INFLUENCED BY PREEMERGENCE HERBICIDES

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ABSTRACT

The effect of preemergence herbicides on rooting and cover of bermudagrass (Cynodon dactylon L. 'Midiron'), creeping bentgrass (Agrostis palustris Huds. 'Penncross'), and perennial ryegrass (Lolium perenne L.) were assessed. Rooting from nodes of Midiron bermudagrass stolons established from plugs was not reduced by bensulide, benefin, DCPA, oxadiazon or siduron. Effective preemergence control of stinkgrass [Eragrostis cilianensis (All.) Mosher] by bensulide 4EC, (8.5 kg ha^{-1}) and oxadiazon (4.5 kg ha^{-1}) resulted in improved Midiron cover. Napropamide, but not benefin, DCPA or oxadiazon, reduced root production of Penncross creeping bentgrass. Prodiamine (1.12 and 2.24 kg ha^{-1}) applied twice in 1986 had reduced perennial ryegrass cover when data were collected in spring 1987. Prodiamine (0.56, 1.12 and 2.24 kg ha^{-1}) and pendimethalin (3.4 kg ha^{-1}) reduced root production of perennial ryegrass. Pendimethalin (3.7 kg ha^{-1}) reduced the cover of 'Regal', but not 'Vintage' or 'Pennfine' perennial ryegrass when overseeded into plots 40 days after treatment. Pendimethalin (3.0, 3.4 and 3.7 kg ha^{-1}) and bensulide (11.2 kg ha^{-1}) did not reduce Regal, Vintage or Pennfine cover when overseeded 80 or 120 days after treatment.

INTRODUCTION

There always has been concern among turfgrass managers that preemergence herbicides applied in the spring to control annual grass weeds may adversely affect root growth or fall overseeding of turfgrasses. Several investigations have been conducted to study these possible, deleterious rooting effects. Of all turfgrass species, only Kentucky bluegrass (Poa pratensis L.) rooting responses from the use of preemergence herbicides have been evaluated extensively in the northern U.S. Nearly all commercial preemergence herbicides have been shown to reduce rooting in Kentucky bluegrass (3). In the studies reported herein, however, rooting and cover of creeping bentgrass, bermudagrass, and perennial ryegrass as influenced by preemergence herbicides were assessed.

METHODS AND MATERIALS

Bermudagrass. Three vegetative 'Midiron' bermudagrass plugs (10 cm diam by 6 cm deep) were planted in each plot (1.5 x 1.5 m) on 26 May 1982 in Silver Spring, Md. Soil was a Chillum silt loam with a pH of 6.8 and 2.3% organic matter. Sprayable herbicides were applied in 463 L ha^{-1}, while granules were applied with a shaker bottle on 2 June 1982 and the test area was irrigated within 24 hr of application. The herbicides applied

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were as follows: bensulide [0,0-bis(1-methylethyl)-S-[2-[(phenylsulfonyl) amino]ethyl]phosphorodithioate]; benefin [N-butyl-N-ethyl-2,6-dinitro -4-trifluoromethyl) benzenamine]; DCPA (dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate; oxadiazon (3-[2,4-dichloro-5-(1-methylethoxy) phenyl]-S-(1,1-dimethylethyl)-1,3,4 oxadiazol-2-(3H)-one); and siduron [1-(2-methylcyclohexyl)-3-phenylurea]. Plots were arranged in a randomized complete block with three replications per treatment. Percent stinkgrass and bermudagrass cover and percent plot area green were determined visually on a 0 to 100% scale where 0 = no stinkgrass or bermudagrass and 100 = entire plot area covered. Rooting was estimated visually on a 0 to 5 scale where 0 = no observed rooting into soil from nodes and 5 = rooting into soil from all nodes. Data were analyzed using the analysis of variance and significantly different means were separated using Bayes least significant difference multiple comparison test (Bayes LSD).

Creeping bentgrass. Herbicides were applied as previously described to a mature 'Penncross' creeping bentgrass nursery maintained under putting green conditions in Bethesda, Md. Soil was a sandy loam with a pH of 7.3 and 4.2% organic matter. The herbicides, benefin, DCPA, oxadiazon and napropamide [2-(a-naphthoxy)- N,N-diethylpropionamide] were initially applied 15 ± 5 days April 1982, 1983 and 1984; and sequential treatments were applied 15 ± 1 day June 1982 and 1983. No sequential application was made in 1984. On 21 May 1984, three plugs (6 x 8 cm) were taken per replicate and soil was washed from roots. Roots were severed from plugs and oven dried for 7 days at 60C before being weighed. Plots were 1.5 x 1.5 m and arranged in a randomized complete block with 3 replications. Data were analyzed as previously described.

Perennial ryegrass at Severna Park. Herbicides were applied as previously described to a mature stand of unknown perennial ryegrass cultivars grown on a golf course fairway in Severna Park, Md. Soil was an Evesboro loamy sand with a pH of 6.4 and 4.7% organic matter. The herbicides evaluated were pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2, 6-dinitro benzenamine] and prodiamine [2,6-dinitro- N^1,N^1-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine]. Herbicides were applied to 1.5 by 3.0 m plots arranged in a randomized completed block with four replications on 26 March and 4 September 1986 and 22 April 1987. Three plugs (6 by 8 cm) were taken from each plot on 20 May and 5 August 1987 and washed to remove soil. Roots were dried and weighed, and perennial ryegrass cover data were obtained visually as previously noted. Overall quality was determined visually on a 0 to 10 scale where 0 = plot area dead or brown and 10 = optimum color, density and uniformity. Leaf spot (*Drechslera dictyoides* f. sp. *perenne*) injury was assessed visually a 0 to 5 scale where 0 = no injury, 3 = unacceptable browning or thinning of turf and 5 = severe injury.

Perennial ryegrass overseeding. A two year old stand of perennial ryegrass was treated (as previously described) with pendimethalin 60DG (3.0, 3.4 and 3.7 kg ha^{-1}) and bensulide 4EC (11.2 kg ha^{-1}). Soil was a Sassafrass sandy loam with a pH of 6.9 and 1.0% organic matter. Separate areas were treated with glyphosate [N-(phosphonomethyl) glycine] 10 days prior to overseeding with Regal, Vintage or Pennfine perennial ryegrass on

11 June, 18 July and 29 August 1986. Plots were mechanically overseeded with a grove seeder, which placed seed 0.25 to 0.50 cm below the soil surface. Seed was applied at 275 to 300 kg ha^{-1} and the test area was frequently irrigated to ensure good germination conditions. Plots (1.5 by 1.5 m) were arranged in a randomized complete block with four replications per treatment. Cover data were collected and analyzed as previously described.

RESULTS

Bermudagrass. Data collected 23 July and 17 Sept showed that none of the herbicides evaluated reduced rooting from nodes (Table 1). Untreated Tufcote stolons, however, exhibited superior rooting when compared to untreated Midiron. Bensulide 4EC and oxadiazon (4.4 kg ha^{-1}) significantly reduced stinkgrass when compared to untreated Midiron plots. The reduction of stinkgrass in plots treated with the aforementioned herbicides resulted in improved bermudagrass coverage when data were recorded 28 July. If herbicides had limited rooting, which may not have manifested itself visually, it could result in enhanced winter kill or delayed spring green-up. Plots rated the following spring (6 May), however, showed that none of the herbicides delayed spring green-up or was associated with reduced Midiron cover. By 30 May, cover ratings were increased significantly in several herbicide treated plots, but the enhancement was agronomically insignificant. Bingham and Hall (1), previously reported that oxadiazon applied to Midiron sprigs reduced sod strength but stated that rooting remained adequate. It is, however, interesting to note that while siduron discolored plugs shortly following treatment (18 June 1982), the herbicide had no long-term, deleterious effects on stolon production and rooting from the vegetative plugs.

Table 1. Effects of preemergence herbicides on rooting of stolons from Midiron bermudagrass plugs.

		Rooting, 1982[x]		Cover, 1982[y] 1 July	28 July	Plot area green, 1983	
Herbicide[w]	Rate	23 July	17 Sept	Stinkgrass	Bermudagrass	6 May	30 May
	(kg ai ha^{-1})	--- (0-5 scale) ---		-------- (%) --------		----- (%) ----	
Bensulide 4EC	8.5	2.0bcd[z]	2.2d	2a	47a	64abc	82ab
Bensulide 7G	8.5	1.3d	2.8bcd	37abc	23a-d	64abc	73c
Benefin 2.5G	2.2	1.7cd	3.3bcd	80c	13d	68ab	79abc
Benefin 2.5G	3.4	1.8bcd	2.3cd	53bc	22cd	72ab	83a
DCPA 75W	11.8	1.5cd	2.5bcd	32ab	30a-d	63abc	76b
DCPA 5G	11.8	1.8bcd	2.7bcd	80c	21cd	62bc	79abc
Oxadiazon 2G	2.2	2.5bc	3.0bcd	23ab	35abc	67ab	83a
Oxadiazon 2G	4.5	2.8ab	3.5bc	7a	43ab	73a	83a
Siduron 50W[y]	6.7	2.0bcd	3.0bcd	34ab	27bcd	71ab	84a
Siduron 50W[y]	13.4	2.3bcd	3.7b	25ab	20cd	73a	85a
Untreated Midiron	--	1.8bcd	2.5bcd	68bc	17cd	67ab	76bc
Untreated Tufcote	--	3.8a	5.0a	42abc	11d	55c	82a

[w]Three Midiron plugs (10cm dia x 4 cm deep) were planted in each 1.5 x 1.5m plot on 26 May 1982 and herbicides were applied 2 June 1982.
[x]Rooting was estimated visually on a 0 to 5 scale where 0 = no observed rooting into soil from nodes and 5 = rooting into soil at all nodes.
[y]On 18 June 1982, siduron treated plugs were purple in color and foliar growth was stunted, but stolons were being produced by all plugs.
[z]Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

Creeping bentgrass. Except for napropamide, herbicides applied once or twice annually over the 3 year period did not reduce rooting when data were obtained 40 days (21 May) after the final herbicide application (Table 2). Low rates of oxadiazon (1.1 and 1.7 kg ha^{-1}) applied once annually were associated with enhanced root production. It is important to note that the root system of the bentgrass appeared healthy prior to herbicide application and the turf was not subjected to wear or environmental stress during the test. Hence, the same results may not be achieved in situations where roots are stressed or diminutive. According to the greenskeeper, only napropamide had caused an unacceptable level of discoloration during the test period. Bingham and Schmidt (2) also observed that recommended use rates of bensulide, DCPA and siduron did not inhibit rooting or discolor Penncross or Cohansey creeping bentgrass.

Table 2. Effects of herbicides on rooting of a Penncross creeping bentgrass nursery maintained under putting green conditions in Bethesda, MD.

Herbicide[w]	Rate	Root weight[x]
	(kg ai ha^{-1})	--- (mg)---
Oxadiazon 2G	1.1	1758a[z]
Oxadiazon 2G	1.7	1772a
Oxadiazon 2G	2.2	749b
Oxadiazon 2G	1.1 + 1.1	663bc
Oxadiazon 2G	1.7 + 1.7	839b
DCPA 5G	11.8	887b
DCPA 5G	8.4 + 8.4	826b
Benefin 2.5G	2.2	864b
Benefin 2.5G	2.2 + 2.2	771b
Napropamide 5G/W[y]	2.2	474c
Untreated Control	---	743b

[w]Herbicides were applied 15 ± 5 days April 1982, 1983, and 1984; sequential treatments were applied on 14 or 15 June 1982 and 1983, respectively. No sequential applications were made in 1984.
[x]Root production was assessed by taking three plugs per replicate and washing soil from roots on 21 May 1984.
[y]The WP formation was only applied in 1984.
[z]Means in a column followed by the same letter are not significantly different at the 1% level according to the Bayes LSD.

Perennial ryegrass at Severna Park. The various rates of prodiamine and pendimethalin applied to perennial ryegrass caused no visual problems at Severna Park in 1986. The following spring, prior to reapplication, plots treated with the high rates of prodiamine (1.12 and 2.24 kg ha^{-1}) had reduced cover (Table 3). A nonsignificant trend of reduced cover in plots treated with the aforementioned prodiamine treatments remained apparent when data were collected 20 May and 5 Aug 1987. On 5 Aug, plots treated with the highest rate of prodiamine (2.24 kg ha^{-1}) exhibited inferior quality when compared to nearly all other treatments. Data collected 20 May showed that prodiamine (0.56, 0.84, 1.12, or 2.24 kg ha^{-1}) and pendimethalin had enhanced leaf spot. Pendimethalin treated turf, however, exhibited an unacceptable level of leaf spot injury. Root weight data collected on both dates in 1987 showed that prodiamine and pendimethalin had significantly reduced perennial ryegrass root production.

Table 3. Effects of prodiamine and pendimethalin on cover and rooting of a mature stand of perennial ryegrass grown on a golf course fairway in Severna Park, MD.

Treatment[u]	Rate	Cover[v] 1987			Overall quality[w]	Leaf spot[x]	Root weight[y]	
		22 Apr	20 May	5 Aug	5 Aug	20 May	20 May	5 Aug
	(kg ai ha^{-1})	---------- (%) ----------			(0-10)	(0-5)	-------(mg)-----	
Prodiamine 65WDG	0.28	98.8ab[z]	97.8ab	97.8ab	7.8ab	1.6cd	*	*
Prodiamine 65WDG	0.42	99.0a	98.0ab	98.0ab	8.1a	1.6cd	*	*
Prodiamine 65WDG	0.56	99.0a	98.2ab	98.2ab	7.9ab	2.0bc	448b	200c
Prodiamine 65WDG	0.84	98.0abc	97.0ab	97.0ab	7.9ab	2.4b	*	*
Prodiamine 65WDG	1.12	97.5bc	95.5b	95.5b	7.3bc	2.4b	254cd	358b
Prodiamine 65WDG	2.24	97.0c	96.5ab	96.5ab	7.1c	2.4b	158d	340b
Pendimethalin 1.7G	3.36	99.0a	97.8ab	97.8ab	8.0a	3.8a	330bc	159c
Untreated	---	99.0a	98.5a	98.5a	7.8ab	1.1d	616a	722a

[u]Herbicides were applied 26 March and 4 September 1986, and 22 April 1987. The test area was irrigated or was subjected to rain within 48 hrs of each herbicide application.
[v]Percent of plot area green cover was determined visually using a 0 to 100% value.
[w]Overall quality was determined visually a 0 to 10 scale where 0 = entire plot area brown or dead and 10 = optimum color, density and uniformity.
[x]Leaf spot (D. dictyoides) was assessed visually on a 0 to 5 scale where 0 = healthy turf, 3 = unacceptable browning and/or thinning and 5 = severe injury.
[y]Three (6 by 8 cm) plugs were taken from each of four replicated plots. Soil was washed from roots, roots were severed from plugs, and than oven dried 7 days and 60C before being weighed.
[z]Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.
*Treatment not evaluated.

Perennial ryegrass overseeding. None of the pendimethalin or bensulide treatments had reduced cover of Vintage or Pennfine on any of the three overseeding dates (data not shown). Regal seed germination, and subsequent cover, was reduced by pendimethalin (3.0 and 3.2 kg ha^{-1}) following the 11 June (40 DAT) overseeding, but not the later overseeding dates. The reduction in Regal cover at the high pendimethalin rate (3.7 kg ha^{-1}) from the 11 June overseeding remained apparent when data were recorded 22 Aug and 15 Oct 1986.

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PREEMERGENCE ACTIVITY OF DINITROANILINE HERBICIDES IN COOL SEASON TURF

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ABSTRACT

Studies were conducted between 1982 and 1987 to compare activity of pendimethalin, prodiamine and benefin, to bensulide and DCPA for control of smooth crabgrass (DIGIS) and yellow foxtail (SETLU) in an irrigated thatch-free 'Kenblue' Kentucky bluegrass (POAPR) lawn turf maintained at 4.8 cm. Soil texture is clay loam. DIGIS emerges about April 30 ± 10 days in central Ohio. Treatments were applied between March 15 and May 15 to 2.9 m^2 plots replicated three times in a RCB design. Spray formulations were tank mixed with 2.3% N from a 16-2-5 $N-P_2O_5-K_2O$ fertilizer solution and applied at 1627 L ha^{-1} with a CO^2-propelled sprayer. Granular formulations were applied with a shaker jar. Separate studies were repeated over two or three years. Percent weed control at 19 ± 1 WAT is presented as the mean of all studies ± standard deviation with sample size indicated as [n = x].

DIGIS control in studies conducted between 1982-1987 with 8.4 kg ha^{-1} bensulide was 55.4 ± 33.4% [n = 31], and with 11.2 kg ha^{-1} DCPA, control was 63.1 ± 28% [n = 31]. Benefin averaged across formulations controlled 50.9 ± 23.2% [n = 16] at 2.2 kg ha^{-1}. Granular formulations outperformed spray formulations. Substituting trifluralin for 33% of benefin in prepack formulations increased control to 66.5 ± 29% [n = 11] at 2.2 kg ha^{-1} in studies conducted between 1984-1987. Prodiamine at 0.6 kg ha^{-1} controlled 88.9 ± 15% [n = 24] of DIGIS in trials between 1985-1987. Increasing application rate did not significantly improve control. Pendimethalin at 1.7 kg ha^{-1} controlled 77.3 ± 26.2% [n = 50] of DIGIS in studies conducted between 1983-1987. Increasing rates improved mean control slightly, and reduced the standard error by 7.5%. No differences in control among pendimethalin formulations were noted.

Timing of preemergence applications suggest bensulide was influenced more by date than was pendimethalin, prodiamine, or DCPA. Early postemergence activity was observed for pendimethalin and prodiamine on DIGIS at 2 to 4-leaf stage; but not to more mature stages. Postemergence activity was not observed with bensulide or DCPA.

SETLU control was acceptable with pendimethalin, DCPA, prodiamine, and granular formulations of benefin; while bensulide and spray formulations of benefin provided unacceptable weed control at rates evaluated.

Variations in weed control across years was observed. Chemical control was lower in 1983 and 1987 for all treatments compared to treatments applied in 1982 and 1984-1986.

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PREEMERGENCE BROADLEAF WEED CONTROL WITH HERBICIDES IN TURF

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ABSTRACT

Two studies were initiated, one, in a fallow soil area and the other in a Kentucky bluegrass (Poa pratensis L.) lawn. Granular materials were applied by hand and others as sprays (75 to 150 GPA) to four replicated plots in each study. The herbicides and rates are shown in Table 1. Sixteen treatments were applied Aug 29, 1986 to soil seeded with dandelion (Taraxacum vulgare L.). Henbit (Lamium amplexicaule L.) and common chickweed [Stellaria media (L.) Vill.] from seed in the soil started to emerge in two days while dandelion started several days later. Control estimates were made Sept 24 to Oct 2, 1986. Herbicides were reapplied (Apr 10-16, 1987) to two weed-free replications (glyphosate used Oct 86). A few 3-day-old seedlings were present but most germination of henbit, common chickweed, purslane speedwell (Veronica peregrina L.) and Oxalis spp. occurred later. Control estimates were made Jun 9-22. The weeds were killed with glyphosate and control of Veronica, which germinated Aug-Sept, was made Oct 14. In the lawn study five treatments were applied on Sept 16, 1986. Dandelion seed was broadcast over the area in Dec. Five repeat and 12 new treatments were made Apr 10-16, 1987 and repeated again on Aug 4. Dandelion counts were made on Aug 18, 1986, Aug 3 and Oct 14, 1987.

The results in Table 1 show that some herbicides provided excellent weed control (85-100%). None of the treatments caused objectionable turf injury. Henbit control in soil (Sept-Oct) from August treatment was excellent with benefin+trifluralin, DCPA, oxadiazon, pendimethalin and prodiamine. August residues of isoxaben and oxadiazon provided control of Apr-Jun henbit. With retreatment in April all but four herbicides provided excellent results. Chickweed control in soil (Sept-Oct) from August treatment was excellent with DCPA and pendimethalin. August residues of isoxaben and prodiamine provided Apr-Jun chickweed control. With retreatment in April excellent control was provided by bensulide, isoxaben, pendimethalin and prodiamine. Dandelion control in soil (Sept-Oct) from August treatment was excellent with 2,4-D, 2,4-D plus dichlorprop or triclopyr or mecoprop+dicamba, 2,4-D/MCI 60 (melamine fertilizer) at rates of 1.8 or 2.7 lbs, DCPA, oxadiazon and pendimethalin. Veronica which germinated Apr-Jun in soil was controlled by August residues of isoxaben. April retreatment of 2,4-D/MCI 60 at 2.7 lb rate, 2,4-D+triclopyr, bensulide, prodiamine, isoxaben, oxadiazon and pendimethalin provided excellent results. Control in October was provided by the latter three residues. Oxalis emerging in soil during Apr-Jun was controlled by August residues of oxadiazon. April retreatment of 2,4-D/MCI 60 at 2.7 lb rate, isoxaben, oxadiazon, pendimethalin and prodiamine were effective.

In the lawn study most dandelion germination occurred from mid-July to mid-Sept 1987. Repeat treatments (Sept 86+Apr 87+Aug 87) of 2,4-D, 2,4-D/MCI 60 and granular 2,4-D+mecoprop+dicamba provided excellent dandelion reduction. Of the preemergent herbicides, applied Apr + Aug 1987, the most effective were pendimethalin, isoxaben+benefin+trifluralin, oxadiazon, isoxaben+benefin and DCPA. The least effective herbicides were benefin, siduron, prodiamine, bensulide, benefin+trifluralin and isoxaben.

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TABLE 1. PREEMERGENCE BROADLEAF WEED CONTROL FROM HERBICIDES APPLIED TO SOIL AND LAWN TURF 1986-87.

TREATMENT			PREEMERGENCE SOIL TREATMENT												PREEMERGENCE LAWN TREATMENT						
			AUGUST 1986							AUG 86 + APR 87					SEPT 86 + APR & AUG 87				APR & AUG 87		
			SEPT-OCT 86			JUN 87 (SPR GERM)				JUN 87 (SPR GERM)				OCT 87	AUG	NOV	AUG	OCT	AUG	AUG	OCT
HERBICIDE	FORM-ULATION	LB ai/ACRE	HBT	CHK	DAN*	HBT	CHK	VER	OX	HBT	CHK	VER	OX	VER	86	86	87	87	86	87	87
			% CONTROL												NO. DANDELIONS/16 SQ FT						
2,4-D/MCI 60	1 G fert	.9	42	24	60	28	3	11	57	67	43	79	75	45	0	1	2	5	-	-	-
2,4-D/MCI 60	1 G fert	1.8	63	42	93	28	30	0	41	92	3	75	70	0	0	0	1	1	-	-	-
2,4-D/MCI 60	1 G fert	2.7	59	45	96	56	3	0	58	99	55	98	95	32	0	0	1	1	-	-	-
2,4-D	LIQ amine	.9	55	31	90	31	3	7	57	92	40	79	71	0	0	1	4	0	-	-	-
2,4-D+triclopyr	LIQ ester	.9+.45	81	62	99	47	15	0	60	96	57	88	63	4	-	-	-	-	-	-	-
2,4-D+dichlorprop	LIQ ester	.9+.9	84	72	99	9	27	0	63	66	60	81	67	27	-	-	-	-	-	-	-
2,4-D+mecoprop + dicamba	LIQ amine	.9+.48+.1	74	66	96	28	15	9	58	85	5	83	59	0	-	-	-	-	-	-	-
2,4-D+mecoprop + dicamba	G fert	.9+.45+.03	64	68	98	22	30	9	61	71	14	68	70	4	0	1	5	4	-	-	-
benefin	2.5 G	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	34	49
benefin+trifluralin	2 G	1.33+.67	99	75	21	39	58	77	36	88	59	61	67	0	-	-	-	-	1	7	15
bensulide	4 E	10.0	32	36	58	53	31	0	18	94	85	95	13	27	-	-	-	-	0	16	20
DCPA	75 WP	10.5	100	96	96	14	24	13	12	90	78	50	17	0	-	-	-	-	1	7	9
oxadiazon	2 G	2.5	99	25	100	91	10	78	96	100	34	100	100	86	-	-	-	-	1	6	7
pendimethalin	60 WDG	1.5	100	99	99	61	51	52	48	99	85	100	88	86	-	-	-	-	0	4	6
pendimethalin	60 WDG	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	2
prodiamine	65 WDG	.5	97	59	42	67	87	42	53	99	96	90	85	73	-	-	-	-	1	22	29
siduron	50 WP	10.0	13	42	39	11	55	7	6	53	69	25	32	0	-	-	-	-	0	20	31
isoxaben	75 DF	.125	73	78	51	99	100	97	71	100	100	100	99	99	-	-	-	-	-	-	-
isoxaben	75 DF	.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	10	12
isoxaben+benefin	60 DF	.6+2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7	7
isoxaben+benefin + trifluralin	75 DF,2 G	.5+1.33+.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	6	6
CHECKS, % WEED COVER OR			25%	33%	-	18%	6%	23%	-	19%	9%	14%	-	22%	-	-	-	-	-	-	
NUMBER PER 16 SQ FT			-	-	48	-	-	-	66	-	-	-	38	-	1	1	20	36	1	20	36

*HBT = HENBIT, CHK = COMMON CHICKWEED, DAN = DANDELION, VER = PURSLANE VERONICA, OX = OXALIS SPP.

POSTEMERGENCE BROADLEAF WEED CONTROL IN TURF WITH TRICLOPYR AND PHENOXY HERBICIDES

Brian D. Olson and Wayne G. Wright[1]

ABSTRACT

Two field studies were conducted in 1987 to determine the efficacy of postemergence applications of triclopyr, 2,4-D and mecoprop combinations on broadleaf weeds in turf. Both studies were conducted in Geneva, New York. Site A was located at Seneca Lake Country Club and site B at Glenwood Cemetery. The predominant weed species at site A were white clover (Trifolium repens L.), narrow leaf plantain (Plantago lanceolata L.), dandelion (Taraxacum officinale Weber in Wiggers) and healall (Prunella vulgaris L.). At site B the predominant weed species were white clover, healall and ground-ivy (Glechoma hederacea L.). The weed pressure at sites A and B was extremely heavy and moderate, respectively.

Each study was set up in a randomized complete block design with four replications of each treatment. Plots were 3 x 15 ft with one foot check (untreated) strips separating every other plot. Treatments were applied with a CO_2 backpack sprayer. The spray boom was held 9 inches above the ground and had three 8004 LP TeeJet (Spray Systems Company, Chicago, IL) nozzles spaced 12 inches apart and operated at 15 p.s.i. Wearing protective clothing, the researcher traveled with the sprayer at 2.5 mph to deliver 79.2 gal/A. At sites A and B the treatments were applied on 11 and 17 June, respectively, and the plots rated on 23 and 29 July, respectively. Percent control of each weed species was determined by comparing the plot area to the two nearest check (untreated) strips.

Triclopyr at 0.125, 0.250, and 0.375 lb/A was applied in combination with either 0.50 lb/A 2,4-D plus 1.00 lb/A mecoprop or 1.00 lb/A 2,4-D plus 0.50 lb/A mecoprop. These treatments were compared with 0.125, 0.250, and 0.375 lb/A triclopyr, 0.5 and 1.0 lb/A 2,4-D or mecoprop, 0.5 lb/A 2,4-D plus 1.0 lb/A mecoprop and 1.0 lb 2,4-D plus 0.5 lb/A mecoprop. Commercially available mixtures of triclopyr plus 2,4-D (amine and ester), 2,4-D plus mecoprop plus dicamba, and 2,4-D plus dichlorprop plus dicamba (ester) were applied at different rates (Table 1). All above formulations were amines unless noted.

The combination of triclopyr (all rates), 0.5 lb/A 2,4-D, and 1.0 lb/A mecoprop provided greater weed control except dandelion than triclopyr (all rates) plus 1.0 lb/A 2,4-D plus 0.5 lb/A mecoprop (Table 1). The addition of triclopyr (all rates) to the mixture of 0.5 lb/A 2,4-D and 1.0 lb/A mecoprop significantly increased the efficacy on clover, ground-ivy and healall. For the mixture of 1.0 lb/A 2,4-D and 0.5 lb/A mecoprop the addition of triclopyr (all rates) significantly increased the efficacy on white clover, narrow leaf plantain, dandelion, and healall. When applied alone all rates of triclopyr provided no control of the above mentioned weeds except some control of white clover. These results suggest that the addition of triclopyr to mixtures of 2,4-D and mecoprop maybe synergistic.

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Table 1. Postemergence broadleaf weed control in turf with triclopyr and phenoxy herbicides.

		Percent Control[b]						
		Site A				Site B		
Treatment[a]	lb/A	TRFRE[c]	PLALA	TAROF	PRUVU	TRFRE	GLEHE	PRUVU
Triclopyr	0.125	5hi [d]	3g	0g	0g	13gh	13de	3gh
Triclopyr	0.250	0i	3g	0g	0g	10gh	5e	5fgh
Triclopyr	0.375	13ghi	3g	0g	0g	38ef	15de	8fgh
2,4-D	0.500	18ghi	28efg	15efg	10fg	8gh	50c	15e-h
2,4-D	1.000	0i	55b-e	40b-e	40cde	13gh	78ab	10fgh
Mecoprop	0.500	0i	0g	0g	0g	13gh	5e	0h
Mecoprop	1.000	25fgh	20fg	3fg	30def	25fg	13de	5fgh
2,4-D + mecoprop	0.50/1.00	50cde	70abc	40b-e	68ab	63bcd	53c	23d-h
2,4-D + mecoprop	1.00/0.50	35efg	45b-f	18efg	48b-e	58de	83ab	35b-f
Triclopyr + 2,4-D + mecoprop . . .	0.125/0.50/1.00	70bcd	68abc	43b-e	75a	93a	80ab	65a
Triclopyr + 2,4-D + mecoprop . . .	0.250/0.50/1.00	65bcd	63a-d	43b-e	75a	90a	78ab	63ab
Triclopyr + 2,4-D + mecoprop . . .	0.375/0.50/1.00	73bc	73ab	43b-e	78a	95a	85a	68a
Triclopyr + 2,4-D + mecoprop . . .	0.125/1.00/0.50	53cde	65a-d	53bcd	75a	60cd	68abc	33c-g
Triclopyr + 2,4-D + mecoprop . . .	0.250/1.00/0.50	48def	38def	30c-f	55a-d	83ab	85a	63ab
Triclopyr + 2,4-D + mecoprop . . .	0.375/1.00/0.50	73bc	70abc	58abc	75a	88a	85a	53a-d
Triclopyr + 2,4-D	0.268/0.695	10ghi	43c-f	38b-e	45b-e	45def	65abc	10fgh
Triclopyr + 2,4-D	0.401/1.043	33efg	48b-f	33cde	28ef	80abc	85a	40a-e
2,4-D + mecoprop + dicamba	0.507/0.27/0.053	23ghi	30ef	18efg	38cde	48de	28d	28d-h
2,4-D + mecoprop + dicamba	0.761/0.41/0.079	70bcd	50b-e	43b-e	58abc	88a	75ab	50a-d
Triclopyr + 2,4-D (ester)	0.25/0.50	18ghi	30ef	28d-g	8fg	65bcd	60bc	33c-g
Triclopyr + 2,4-D (ester)	0.375/0.75	33efg	65a-d	58abc	45b-e	80abc	78ab	45a-d
2,4-D + dichlorprop + dicamba (ester)	0.50/0.50/0.125	85ab	73ab	63ab	60abc	98a	60bc	28d-h
2,4-D + dichlorprop + dicamba (ester)	0.75/0.75/0.188	100a	88a	83a	80a	100a	80ab	58abc
Check (untreated)		0i	0g	0g	0g	0h	0e	0h
Least significant difference (0.05) = ...		21	25	25	22	20	19	26
Standard deviation = ...		15.196	17.41	17.56	15.76	13.89	13.61	18.10
Coefficient of variability = ...		40.72	40.77	56.75	38.29	24.74	24.69	59.11

[a] All treatment formulations are amines unless noted. Treatments were applied on 11 and 17 June 1987 to sites A and B, respectively. Each treatment was replicated four times.

[b] Sites A and B were rated for percent control of plants listed on 23 and 29 July 1987, respectively.

[c] TRFRE = white clover, PLALA = narrow leaf plantain, TAROF = dandelion, PRUVU = heallall, and GLEHE = ground-ivy.

[d] Means in a column followed by the same letter are not significantly different at the five percent level as calculated by Duncan's Multiple Range test.

BROADLEAF WEED CONTROL IN TURF WITH POSTEMERGENT HERBICIDES

C.D. Sawyer and J.A. Jagschitz[1]

ABSTRACT

Postemergent control of dandelion (Taraxacum officanale Weber), cinquefoil (Potentilla simplex Michx.), buckhorn plantain (Plantago lanceolata L.) and broadleaf plantain (Plantago major L.) was evaluated in field trials conducted in September, 1982; June 1983; and May and June, 1987. Trials were established in lawn areas at The University of Rhode Island, Turf Research Farm and several other locations on the Kingston, RI campus.

Treatments were replicated 3 or 4 times, and plot size was 16, 18 or 25 sq ft. Herbicides were applied as sprays at 50 gpa. Herbicides, rates and time of application are shown in Table 1. Broadleaf weed control was evaluated 8 or 9 weeks after spraying in May and June trials. September, 1982 treatments were evaluated in May, 1983. None of the treatments caused objectionable turf injury.

All treatments containing 2,4-D provided excellent (>85%) control of dandelion, cinquefoil and both plantain species. MCPA and MCPA+mecoprop+dicamba were somewhat variable in dandelion control, however cinquefoil and plantain control was excellent.

XRM-3972 (clopyralid) and combinations of XRM-3972 with XRM-3724 (triclopyr) gave excellent dandelion and plantain control. Cinquefoil control was poor with these materials.

Chlorflurenol alone or combined with dicamba was inconsistent in control of any of the broadleaf weeds noted. Combinations of chlorflurenol and XRM-3972 provided excellent dandelion and plantain control however cinquefoil was largely unaffected. Chlorflurenol+EF-689 (fluroxypyr) gave excellent cinquefoil control.

F-6025 (chlorimuron) was effective (84% control) only on broadleaf plantain at the highest rate tested. Weed control was unsatisfactory with M-6316 (thiameturon) and CGA-131036 at the rates tested.

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Table 1. Control of dandelion, cinquefoil, buckhorn plantain and broadleaf plantain. Control was evaluated 8-9 weeks after spraying in May and June trials. September, 1982 treatments were evaluated in May, 1983.

		PERCENT CONTROL (weed and treatment date)											
		Dandelion						Cinquefoil		Buckhorn Plantain			Broadleaf Plantain
Herbicide	Rate lb ai/A	Sep 82	Jun 83	May 87	Jun 87	Jun 87	Jun 87	Jun 83	May 87	Sep 82	Jun 83	Jun 87	May 87
dichlorprop	2.0	-	-	-	20	-	-	-	-	-	-	-	-
mecoprop	2.0	-	-	-	53	-	-	-	-	-	-	-	-
triclopyr ester	1.0	99	85	-	93	-	-	-	-	-	-	-	-
dicamba	.5	-	-	-	66	-	-	-	-	-	-	-	-
MCPA	1.5	-	89	-	67	67	-	94	-	-	85	99	-
MCPA + mecoprop + dicamba	.9+.41+.09	-	-	100	77	88	-	-	98	-	-	100	100
2,4-D amine	1.5	-	-	100	87	90	-	-	99	-	-	100	100
2,4-D + triclopyr amine	1.04+.4	-	-	100	-	-	-	-	99	-	-	-	100
2,4-D + triclopyr ester	.75+.375	-	-	100	98	99	-	-	99	-	-	100	100
2,4-D + dichlorprop amine	.69+.69	-	-	100	-	-	-	-	98	-	-	-	-
2,4-D + dichlorprop amine	.93+.93	-	-	100	-	-	-	-	99	-	-	-	100
2,4-D + dichlorprop ester	.93+.93	-	-	100	99	-	-	-	99	-	-	-	100
2,4-D + dichlorprop amine	1.4+1.4	-	-	100	-	-	-	-	99	-	-	-	-
2,4-D + mecoprop + dicamba	1.0+.54+.11	92	92	100	97	99	97	99	99	100	94	100	100
XRM-3972 (clopyralid)	.125	-	-	94	-	-	-	-	9	-	-	-	74
XRM-3972	1.0	-	-	-	100	-	-	-	-	-	-	-	-
XRM-3972 + XRM-3724 (triclopyr)	.125+.375	-	-	-	-	-	100	-	-	-	-	-	-
XRM-3972 + XRM 3724	.375+.062	-	-	100	-	-	-	-	34	-	-	-	100
XRM-3972 + XRM 3724	.375+.125	-	-	100	98	99	-	-	44	-	-	100	100
XRM-3972 + XRM-3724 + dicamba	.125+.125+.125	-	-	100	90	94	-	-	53	-	-	99	-
chlorflurenol	.25	-	-	49	-	-	-	-	9	-	-	-	-
chlorflurenol	.5	-	-	94	-	-	-	-	17	-	-	-	-
chlorflurenol + dicamba	.125+.125	-	-	94	62	72	85	-	62	-	-	42	78
chlorflurenol + dicamba[a]	.125+.125	-	-	91	-	-	-	-	38	-	-	-	-
chlorflurenol + dicamba[a]	.25+.125	27	29	-	-	-	-	30	-	62	65	-	-
chlorflurenol + XRM-3972	.125+.1	-	-	100	-	-	-	-	18	-	-	-	-
chlorflurenol + XRM-3972	.125+.125	-	-	97	94	98	95	-	14	-	-	99	-
chlorflurenol + XRM-3972 + XRM-3724	.125+.1+.1	-	-	100	-	-	-	-	68	-	-	-	99
chlorflurenol + XRM-3972 + XRM-3724	.125+.125+.125	-	-	97	-	-	-	-	73	-	-	-	100
chlorflurenol + XRM-3724	.125+.125	-	-	55	58	60	65	-	76	-	-	73	100
chlorflurenol + XRM-3724 + dicamba	.125+.125+.125	-	-	100	90	94	-	-	74	-	-	99	99
chlorflurenol + EF-689 (fluroxypyr)	.125+.25	-	-	65	-	-	-	-	99	-	-	-	-
F-6025 (chlorimuron)	.0078	-	-	27	-	-	-	-	1	-	-	-	-
F-6025	.0156	-	-	71	-	-	-	-	20	-	-	-	69
F-6025	.0313	-	-	68	50	53	-	-	34	-	-	36	84
M-6316 (thiameturon)	.0078	-	-	23	-	-	-	-	50	-	-	-	-
M-6316	.0156	-	-	13	5	25	-	-	22	-	-	30	9
CGA-131036	.013	-	-	51	-	-	-	-	-	-	-	-	-
CGA-131036	.027	-	-	50	-	-	-	-	-	-	-	-	-
Percent Weed Cover		-	-	-	22%	-	9%	18%	79%	22%	34%	-	9%
Number Weeds/check plot		24	47	11	216	45	-	-	-	-	-	28	-

[a]PO-SAN formulation of chlorflurenol, other treatments contained BREAKTHRU formulation of chlorflurenol.

CONTROL OF COMMON BLUE VIOLET, BUCKHORN PLANTAIN AND OTHER WEEDS IN TURF

P.H. Dernoeden and D.B. Davis[1/]

ABSTRACT

All studies were conducted on low maintenance turfgrass areas and herbicides were applied to replicated plots in 467 L ha^{-1} of water. Common blue violet (Viola papilionacea Pursh) control studies were performed over a three year period, but only 1987 data are shown (Table 1). In 1985, herbicides were applied sequentially (29 May and 19 June), with the second application made at a higher rate. Violet cover data recorded the following spring (29 April 1986), showed that a package mix of 2,4-D + triclopyr (1.2 + 1.9 or 1.7 + 2.6 kg ha^{-1}) had effectively reduced violet cover (3 to 5%) when compared to untreated plots (39% cover). Ester forms of 2,4-D + 2,4-DP; 2,4-D + MCPP + dicamba; and 2,4-D + 2,4-DP + dicamba were ineffective. In 1986, a single application of 2,4-D + triclopyr (1.8 kg ha^{-1}) and two rates of quinclorac (1.1 and 2.2 kg ha^{-1}) applied 25 April had reduced violet cover >90% when plots were evaluated 3 July 1986. Similar results were achieved in 1987 when 2,4-D + triclopyr and quinclorac applied alone or tank mixed with triclopyr or 2,4-D (see Table 1 for date and rates of application). The aforementioned treatments had significantly reduced violet cover; whereas, 2,4-D + MCPP + dicamba and 2,4-D + 2,4-DP were shown again to be ineffective. All herbicide treatments effectively controlled dandelion (Taraxacum officinale Weber) and wild lettuce (Lactuca serriola L.) (Table 1).

Chlorflurenol, clopyralid, dicamba, quinclorac and triclopyr were evaluated in numerous combinations and compared to packaged, phenoxy herbicide mixes for control of buckhorn plantain (Plantago lanceolata L.), white clover (Trifolium repens L.) and dandelion in three studies. In one study, all treatments, except 2,4-D alone, had effectively controlled white clover (Table 2). Triclopyr + chlorflurenol (0.14 + 0.14 kg ha^{-1}) had provided poor buckhorn plantain control at two locations (data from one location shown in Table 2). Triclopyr + dicamba + chlorflurenol, quinclorac + bentazon, and 2,4-D alone provided fair buckhorn plantain control; whereas, all other treatments shown in Table 2 provided good to excellent control. Hairy crabgrass [Digitaria sanguinalis (L.) Scop.] had begun to germinate in the test area at the time of herbicide application (27 April). All treatments with quinclorac had controlled hairy crabgrass (Table 2). Low hairy crabgrass ratings in untreated plots were attributed to a dense broadleaf weed canopy, which probably reduced crabgrass germination and reduced our ability to obtain accurate ratings. In another study, the triclopyr combinations (as shown in Table 2), except triclopyr + chlorflurenol, had effectively controlled dandelion (data not presented).

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Table 1. Evaluation of four herbicides for control of common blue violet (Viola papilionacea Pursh), dandelion (Taraxacum officinale Weber) and wild lettuce (Lactuca serriola L.), 1987

Herbicide[x]	Rate	Cover, 1987		
		Violet		Dandelion + wild lettuce
		6 June	7 Oct	6 June
	(kg ai ha^{-1})	(%)		
2,4-D + MCPP + dicamba (salt, 3.3L)	1.6	14a[z]	17a	0b
2,4-D + triclopyr (amine, 3.3 EC)	1.6	<1b	5c	0b
2,4-D + 2,4-DP (amine, 3.7 EC)	1.6	14a	12b	0b
Quinclorac 50W[y]	1.1	<1b	<1c	2b
Quinclorac 50W[y] + 2,4-D 3L	1.1 + 1.1	1b	<1c	0b
Quinclorac 50W[y] + triclopyr (amine, 3 EC)	1.1 + 0.6	0b	0c	0b
Untreated	—	12a	14b	30a

[x]Herbicides were applied 1 May 1987
[y]Applied with 2.5 L ha^{-1} of surfactant (BAS 090)
[z]Means in column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD

Table 2. Evaluation of herbicides for control of white clover (Trifolium repens L.), buckhorn plantain (Plantago lanceolata L.) and hairy crabgrass [Digitaria sanguinalis (L.) Scop.], 1987.

Herbicide treatment[x]	Rate	Cover		
		White clover	Buckhorn plantain	Hairy crabgrass
	(kg ai ha^{-1})	(%)		
Triclopyr 3EC + clopyralid 3EC	0.42 + 0.14	0b[z]	5de	15abc
Triclopyr 3EC + clopyralid 3EC	0.56 + 0.14	0b	1ef	14bc
Triclopyr 3EC + chlorflurenol 1.5L	0.14 + 0.14	3b	18b	6d
Triclopyr 3EC + dicamba 4L + chlorflurenol 1.5L	0.14 + 0.14 + 0.14	0b	8cd	14bc
Triclopyr 3EC + clopyralid 3EC + chlorflurenol 1.5L	0.14 + 0.14 + 0.14	0b	1ef	19ab
Triclopyr + 2,4-D amine 3.8EC	1.6	0b	<1f	12c
2,4-DP + 2,4-D amine 3.7EC	1.6	<1b	1f	12c
2,4-D + MCPP + dicamba salt 3.3L	1.6	0b	1f	18abc
MCPA + MCPP + dicamba 3.6L (EH 870)	1.1	0b	2ef	20a
2,4-D 3.6L	1.1	15a	1f	12c
[y]Quinclorac 50W	1.1	1b	8cd	<1de
[y]Quinclorac 50W + 2,4-D 3.6L	1.1 + 1.1	0b	1f	<1de
[y]Quinclorac 50W + triclopyr 3EC	1.1 + 0.6	0b	2ef	<1de
[y]Quinclorac 50W + bentazon 4L	1.1 + 1.1	0b	9c	0e
Untreated	---	21a	26a	<1de

[x]Herbicides were applied 27 April and data were collected 16 July 1987.
[y]Treatment was applied with 2.5 L ha^{-1} of surfactant (BAS 090).
[z]Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

PHENOXY AND NON-PHENOXY HERBICIDES FOR CONTROLLING DANDELION, PLANTAIN, CLOVER, AND VERONICA

J.C. Neal[1] and M.R. Mascianica[2]

Abstract

Recent controversy surrounding the future availability of phenoxy herbicides has led to increased research with non-phenoxy alternatives. Several non-phenoxy herbicides are presently available for broadleafed weed control in turf, but these products lack efficacy on certain 2,4-D susceptible weeds. Therefore, one objective of these experiments was to compare non-phenoxy herbicide tank mixes with standard products for the control of common turfgrass weeds. A second objective was to evaluate treatments for the control of creeping speedwell (*Veronica filiformis*), a particularly difficult-to-control species.

Three experiments were conducted; two at Morrisville, N.Y. (designated as experiments A and B) and one in Ithaca, N.Y. (experiment C). Both turfgrass sites were predominantly Kentucky bluegrass. Experiments A and B were infested with common dandelion (*Taraxacum officinale*), broadleaf plantain (*Plantago major*), and creeping speedwell. Weeds present in Expt. C were dandelion, creeping speedwell, and white clover (*Trifolium repens*). Herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 60 gpa at 40 psi with flat fan nozzles.

Treatments varied between experiments but common (or similar) treatments were incorporated in each test. A sub-set of the herbicide treatments are presented in Table 1. Non-phenoxy herbicides evaluated included chlorflurenol, triclopyr, clopyralid, dicamba, and BAS 514 OOH. All BAS 514 OOH treatments included one quart per acre of a nonionic surfactant.

Dandelion control was adequate with combination treatments of chlorflurenol & BAS 514 OOH, triclopyr & BAS514 OOH, chlorflurenol & dicamba & triclopyr, 2,4-D & triclopyr, and chlorflurenol & clopyralid & triclopyr. Plantain control was generally less than desirable. One notable exception was triclopyr & BAS 514 OOH. Excellent clover control was obtained by any treatment containing clopyralid, chlorflurenol, BAS 514OOH, triclopyr, or dicamba. Creeping speedwell was controlled by BAS 514 OOH. Certain other treatments provided some speedwell suppression, but not commercially acceptable control.

In a mixed stand of weeds containing creeping speedwell, adequte control was obtained with BAS 514 OOH & triclopyr or BAS 514 OOH & 2,4-D. Other treatments provided less than desirable control of one or more species. Adequate control of dandelion and clover appear to be possible with presently available non-phenoxy herbicides; however, plantain control appears to be inadequate in the abscence of 2,4-D. Further testing is needed to develop alternative plantain control. Specifically, BAS 514 OOH & triclopyr appears to be a promising treatment for broad spectrum weed control in turf.

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Table 1. Efficacy evaluations for selected treatments.

		Weed control, by species and experiment								
		TAROF			VERFI			PLAMA		TRFRE
Chemical	Rate	A	B	C	A	B	C	A	B	C
Chlorflurenol	0.5	27	--	80	40	--	8	83	--	100
BAS 514 00H + surfactant	1.0	--	33	70	--	100	3	--	7	100
chlorflurenol + BAS 514 00H + surfactant	0.25-0.5 1.0	87	80	100	88	--	0	43	20	100
2,4-D amine + BAS 514 00H + surfactant	1.5-1 1.0	57	--	100	78	--	0	55	--	100
BAS 514 00H + triclopyr + surfactant	1.0 0.5	90	97	100	92	95	0	88	92	100
BAS 514 00H + dicamba + surfactant	1.0 0.5-0.125	88	--	100	60	--	0	43	--	100
chlorflurenol + dicamba	0.125 0.125	--	--	60	--	--	13	--	--	100
chlorflurenol + triclopyr	0.125 0.5	--	--	30	--	--	23	--	--	100
chlorflurenol + dicamba + triclopyr	0.125 0.125 0.125	--	--	80	--	--	16	--	--	100
chlorflurenol + clopyralid + triclopyr	0.125 0.125 0.125	--	--	90	--	--	12	--	--	100
Turflon II (2,4-D + triclopyr)	1.5	--	--	100	--	--	10	--	--	70
Trimec (2,4-D + MCPP + dicamba)	1.2	--	63	60	--	75	11	--	80	80
LSD 0.05		18	25	40	21	17	7	30	15	20

[a]Weed species are designated by Bayer codes for dandelion (TAROF), creeping speedwell (VERFI), broadleaf plantain (PLAMA) and white clover (TRFRE).

[b]Not all weeds or treatments occured in all tests. Test A, B and C refer to separate experiments as described in the text.

[c]Data for VERFI in experiment C are estimates of percent cover. Other evaluations are expressed as percent control.

POSTEMERGENCE BROADLEAF WEED CONTROL IN TURF WITH NON-PHENOXY HERBICIDE COMBINATIONS

Brian D. Olson and Anthony B. Hall[1]

ABSTRACT

Two field studies were conducted in 1987 to determine the efficacy of postemergence applications of triclopyr, clopyralid, dicamba, and chlorflurenol mixtures on broadleaf weeds in turf. Both studies were conducted in Geneva, New York. Site A was located at Seneca Lake Country Club and site B at Glenwood Cemetery. The predominant weed species at site A were white clover (Trifolium repens L.), narrow leaf plantain (Plantago lanceolata L.), dandelion (Taraxacum officinale Weber in Wiggers) and healall (Prunella vulgaris L.). At site B the predominant weed species were white clover, healall and ground-ivy (Glechoma hederacea L.). The weed pressure at sites A and B was heavy and moderate, respectively.

Each study was set up in a randomized complete block design with four replications of each treatment. Plots were 3 x 15 ft with one foot check (untreated) strips separating every other plot. Treatments were applied with a CO_2 backpack sprayer. The spray boom was held 9 inches above the ground and had three 8004 LP TeeJet (Spray Systems Company, Chicago, IL) nozzles spaced 12 inches apart and operated at 15 p.s.i. Wearing protective clothing, the researcher traveled with the sprayer at 2.5 mph to deliver 79.2 gal/A. At sites A and B the treatments were applied on 10 and 16 June, respectively, and the plots rated on 22 and 28 July, respectively. Percent control of each weed species was determined by comparing the plot area to the two nearest check (untreated) strips.

Chlorflurenol was applied in combination with the non-phenoxy compounds, triclopyr, clopyralid, dicamba, triclopyr plus dicamba, and triclopyr plus clopyralid. Each compound used in the above treatments was applied at 0.125 lb/A. Triclopyr at 0.375 and 0.5 lb/A with 0.063 and 0.125 lb/A of clopyralid were applied in combination in a two by two factorial arrangement. Triclopyr (amine and ester), clopyralid, and fluroxypyr ester were applied alone at different rates (Table 1). Commercially available phenoxy mixtures of triclopyr plus 2,4-D and 2,4-D plus mecoprop plus dicamba were applied at different rates (Table 1). The above formulations were amines unless noted.

The only treatments to provide consistent control (>90%) of white clover were those with clopyralid. None of the non-phenoxy mixtures offered greater than 80% control of ground-ivy as did the 2,4-D mixtures. Alone at 0.125 lb/A, none of the non-phenoxy compounds offered more than 60% control of more than one weed species, except fluroxypyr. The combinations of chlorflurenol and triclopyr or clopyralid, chlorflurenol plus triclopyr plus chlopyralid, and triclopyr plus clopyralid all controlled (>60%) two weed species. Chlorfluernol plus triclopyr plus dicamba was the only non-phenoxy treatment to provide control (>60%) of three weeds as did the commercial phenoxy mixtures. These results suggest that a combination of three or four non-phenoxy herbicides may be necessary to provide similar broadleaf weed control to commercially available phenoxy herbicide mixtures.

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Table 1. Postemergence broadleaf weed control in turf with non-phenoxy herbicide combinations.

		Percent Control[b]						
		Site A				Site B		
Treatment[a]	lb/A	TRFRE[c]	PLALA	TAROF	PRUVU	TRFRE	GLEHE	PRUVU
Triclopyr	0.125	3j [d]	5gh	0g	0e	23f	15gh	3jk
Triclopyr	0.250	5j	3gh	0g	0e	43e	20fgh	13h-k
Triclopyr	0.375	8ij	8gh	3fg	0e	48e	53cd	5jk
Triclopyr	0.500	15hij	5gh	0g	0e	78bcd	68bcd	15h-k
Triclopyr ester	0.125	3j	0h	0g	0e	13f	3gh	3jk
Triclopyr ester	0.250	8ij	10fgh	0g	0e	13f	3gh	3jk
Triclopyr ester	0.500	23g-j	13fgh	0g	0e	65d	43def	8ijk
Clopyralid	0.063	48d-g	13fgh	3fg	0e	85abc	3gh	0k
Clopyralid	0.125	90ab	25efg	23c-g	0e	98a	3gh	0k
Clopyralid	0.250	100a	50a-d	28b-f	3e	90ab	10gh	0k
Fluroxypyr ester	0.063	30g-j	8gh	0g	3e	40e	12gh	8ijk
Fluroxypyr ester	0.125	23g-j	8gh	3fg	3e	80a-d	65b-d	20h-k
Fluroxypyr ester	0.250	73a-d	8gh	3fg	15cde	98ab	85ab	65abc
Dicamba	0.125	48d-g	8gh	0g	20cde	45e	3gh	0k
Chlorflurenol	0.125	33f-i	25efg	5efg	18cde	68cd	23fgh	33e-h
Triclopyr + clopyralid	0.375/0.063	88ab	30def	23c-g	3e	100a	73abc	18h-k
Triclopyr + clopyralid	0.375/0.125	98a	55abc	50ab	18cde	98a	60bcd	25f-j
Triclopyr + clopyralid	0.500/0.063	90ab	35cde	5efg	13de	98ab	75abc	5jk
Triclopyr + clopyralid	0.500/0.125	100a	35cde	33bcd	20cde	100a	80ab	15h-k
Chlorflurenol + clopyralid	0.125/0.125	100a	65a	53ab	40bc	100a	28efg	30e-i
Chlorflurenol + triclopyr	0.125/0.125	45efg	50a-d	20c-g	60ab	100a	63bcd	58a-d
Chlorflurenol + dicamba	0.125/0.125	80abc	23e-h	30b-e	40bc	100a	13gh	46c-f
Chlorflurenol + triclopyr + dicamba	0.125/0.125/0.125	98a	60ab	63a	40bc	100a	45def	73ab
Chlorflurenol + triclopyr + clopyralid	0.125/0.125/0.125	100a	70a	43abc	50ab	100a	53cde	50cde
Triclopyr + 2,4-D	0.268/0.695	20g-j	35cde	23c-g	45b	68cd	78abc	23g-k
Triclopyr + 2,4-D	0.401/1.043	38fgh	43b-e	35bcd	48ab	98ab	98a	55bcd
Triclopyr + 2,4-D	0.535/1.390	65b-e	70a	63a	70a	93ab	95a	78a
2,4-D + mecoprop + dicamba	0.508/0.270/0.053	45efg	40b-e	15d-g	35bcd	95ab	62bcd	43d-g
2,4-D + mecoprop + dicamba	0.761/0.405/0.079	58c-f	58ab	45abc	60ab	100a	85ab	73ab
Check (untreated)		5j	0h	13d-g	0e	10f	0h	0k
Least Significant Difference (.05) =		23	19	22	21	17	23	20
Standard Deviation =		16.36	13.26	15.82	15.13	11.99	15.94	13.87
Coefficient of Variability =		32.04	46.66	82.54	75.66	16.06	36.54	54.62

[a] All treatment formulations are amines unless noted. Treatments were applied on 10 and 16 June 1987 to sites A and B, respectively. Each treatment was replicated four times.

[b] Sites A and B were rated for percent control of plants listed on 22 and 28 July 1987, respectively.

[c] TRFRE = white clover, PLALA = narrow leaf plantain, TAROF = dandelion, PRUVU = healall, and GLEHE = ground-ivy.

[d] Means in a column followed by the same letter are not significantly different at the five percent level as calculated by Duncan's Multiple Range test.

BROADLEAF WEED CONTROL IN TURF

G. W. Hamilton, Jr. and T. L. Watschke[1]

ABSTRACT

A field study was conducted to evaluate the control of dandelion (Taraxacum officinale Weber) and white clover (Trifolium repens L.) with experimental and commercial herbicides and selected combinations. The stand consisted of varying amounts of Kentucky bluegrass (Poa pratensis L.), perennial ryegrass (Lolium perenne L.), fine fescue (Festuca rubra L.), creeping bentgrass (Agrostis palustris Huds.), and annual bluegrass (Poa annua L.).

After four weeks good to excellent control of dandelion and white clover was accomplished by all treatments, except two: XRM-3724 + chlorflurenol and XRM-3972 + chlorflurenol provided only 33 and 38 percent control of dandelion, respectively. The highest rate of the combination of XRM-3724 + XRM-3972 (0.5 + 0.125 kg ai/ha), triclopyr + 2,4-D (ester), and MCPA + dicamba provided excellent control of dandelion. All treatments provided excellent control of dandelion. All treatments provided satisfactory control of white clover. XRM-3972 alone and in combination with XRM-3724, all chlorflurenol combinations (except with XRM-3972), and the combination of MCPA + MCPP + dicamba gave greater than 90 percent control of white clover.

The second rating was taken 17 weeks after treatment. Dandelion control for all treatments decreased while most white clover control increased, as compared to the first rating. All treatments containing XRM-3972, XRM-3724, or chlorflurenol, along with triclopyr + 2,4-D (amine) and MCPA + MCPP, provided 50 percent control or less of dandelion. MCPA + dicamba gave the highest control of dandelion (81 percent), and triclopyr + 2,4-D (ester) provided 75 percent control. XRM-3972 + chlorflurenol, XRM-3724 + chlorflurenol, triclopyr + 2,4-D (amine), and MCPA + MCPP were the only treatments that provided less than 90 percent control of white clover.

MCPP + dicamba provided the best control for both weeds, with 81 and 97 percent of dandelion and white clover, respectively. Triclopyr + 2,4-D, 2,4-D + MCPP + dicamba, and MCPA + MCPP + dicamba each gave greater than 65 percent control of both weeds.

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Table 1.0 Control of dandelion and white clover in turf with herbicides applied on June 26, 1987. Ratings were made July 23, 1987.

Treatments	Rate (kg ai/ha)	Dandelion	Clover
		-----% control------	
XRM-3972	0.14	81	100
XRM-3724 + XRM-3972	0.14 + 0.14	89	100
XRM-3724 + XRM-3972	0.42 + 0.07	72	100
XRM-3724 + XRM-3972	0.42 + 0.14	75	100
XRM-3724 + XRM-3972	0.56 + 0.07	75	98
XRM-3724 + XRM-3972	0.56 + 0.14	97	100
XRM-3724 + Chlorflurenol	0.14 + 0.14	33	69
XRM-3972 + Chlorflurenol	0.14 + 0.14	38	100
Dicamba + Chlorflurenol	0.14 + 0.14	50	100
XRM-3724 + Dicamba + Chlorflurenol	0.14 + 0.14 + 0.14	75	100
XRM-3724 + XRM-3972 _ Chlorflurenol	0.14 + 0.14 + 0.14	74	92
Triclopyr + 2,4-D (amine)	0.45 + 1.17	75	63
Triclopyr + 2,4-D (ester)	0.42 + 0.84	98	71
2,4-D + MCPP + Dicamba	1.03 + 0.55 + 0.09	90	77
2,4-D + 2,4-DP (amine)	1.12 + 1.12	70	60
MCPA + MCPP + Dicamba	1.35 + 0.62 + 0.13	90	100
MCPA + MCPP	1.35 + 1.35	90	66
MCPA + Dicamba	1.35 + 0.28	100	89
Check	0.00	0	0

Table 1.1 Control of dandelion and white clover in turf with herbicides applied on June 26, 1987. Ratings were made October 22, 1987.

Treatments	Rate (kg ai/ha)	Dandelion	Clover
		------% control------	
XRM-3972	0.14	0	97
XRM-3724 + XRM-3972	0.14 + 0.14	30	100
XRM-3724 + XRM-3972	0.42 + 0.07	10	100
XRM-3724 + XRM-3972	0.41 + 0.14	8	94
XRM-3724 + XRM-3972	0.56 + 0.07	20	100
XRM-3724 + XRM-3972	0.56 + 0.14	50	100
XRM-3724 + Chlorflurenol	0.14 + 0.14	0	63
XRM-3972 + Chlorflurenol	0.14 + 0.14	0	55
Dicamba + Chlorflurenol	0.14 + 0.14	0	100
XRM-3724 + Dicamba + Chlorflurenol	0.14 + 0.14 + 0.14	15	100
XRM-3724 + XRM-3972 + Chlorflurenol	0.14 + 0.14 + 0.14	31	100
Triclopyr + 2,4-D (amine)	0.45 + 1.17	33	73
Triclopyr + 2,4-D (ester)	0.42 + 0.84	75	97
2,4-D + MCPP + Dicamba	1.03 + 0.55 + 0.09	67	96
2,4-D + 2,4-DP (amine)	1.12 + 1.12	29	82
MCPA + MCPP + Dicamba	1.35 + 0.62 + 0.13	69	94
MCPA + MCPP	1.35 + 1.35	45	75
MCPA + Dicamba	1.35 + 0.28	81	97
Check	0.00	0	0

RESPONSE OF KENTUCKY BLUEGRASS TO DINITROANILINE HERBICIDES

Prasanta C. Bhowmik[1]

ABSTRACT

A field study was conducted on a mature stand of 'Baron' Kentucky bluegrass (Poa pratensis L.) in 1987. The objectives of the experiment were to: 1) compare the effectiveness of five dinitroaniline herbicides in large crabgrass [Digitaria sanguinalis (L.) Scop.] control, and 2) examine the effects of the preemergence application of herbicides on rooting, tiller production, and rhizome growth of Kentucky bluegrass over the growing season. All treatments were applied preemergence on April 22, 1987 to 1 by 3 m plots with a CO2 backpack sprayer at a pressure of 152 kPa in 473 L/ha. The treatments were arranged in a randomized complete block design with three replications. The experimental area was maintained at a height of 3.8 cm under low fertility. Turf injury, large crabgrass control, turf quality, tiller production, and rhizome growth were evaluated over the growing season.

Two cylindrical 5-cm-diameter plugs were removed randomly from each field plot 4, 8, and 12 weeks after herbicide application (WAA) on May 20, June 17, and July 15, 1987, respectively. Each treatment consisted of 6 plugs. Plugs were individually potted in 15.2-cm-diameter plastic pots containing coarse sand. The pots were arranged in a randomized complete block design on a greenhouse bench and were watered daily as needed. After 4 and 8 weeks of growth in the greenhouse, roots were carefully washed on a water screen and removed from plugs. Rhizome and tiller counts, and root regrowth were determined.

Benefin at 2.2 to 4.5 kg ai/ha, the premix combination (1:2 ratio) of trifluralin and benefin at 2.2 to 4.5 kg/ha, pendimethalin at 1.68 to 3.36 kg/ha, prodiamine at 0.56 to 2.24 kg/ha, and CGA-41065 at 0.84 to 3.36 kg/ha gave excellent large crabgrass control over the entire season. Maximum turf injury (38%) and thinning of Kentucky bluegrass was noted with the highest rate of the premix combination (1:2 ratio) of trifluralin and benefin at 4.5 kg/ha. Benefin at 4.5 kg/ha (highest rate) also injured Kentucky bluegrass.

In general, higher rates of benefin (3.3 and 4.5 kg/ha) and the premix combination of trifluralin and benefin (3.36 and 4.5 kg/ha) inhibited tiller production and rhizome growth of Kentucky bluegrass 4 and 8 WAA. Pendimethalin, prodiamine, and CGA-41065 did not inhibit either tiller production or rhizome growth. Prodiamine at 2.2 kg/ha reduced root regrowth (but not significantly) of Kentucky bluegrass.

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IMAZETHAPYR FOR LIMA BEANS

C. E. Beste[1/]

ABSTRACT

Prior to cancellation in October, 1986, dinoseb could be applied both preemergence (pre) and postemergence (post)to lima beans (Phaseolus lunatus L. and P. limensis L.) for control of broadleaf weeds. An alternative with the same crop rotation flexibility as dinoseb is needed to continue the economic production of lima beans on Delmarva.

In 1987, a herbicide trial was established with the preplant incorporated (ppi) treatments applied on June 16 with rotatiller incorporation to a 3 inch depth (Norfolk loamy sand, 1.0% O.M.). Baby lima beans (P. lunatus L. var. lunonnus, '8-87') were seeded to a 1.25 inch depth on June 17. Pre treatments were applied on June 17. Post treatments were applied July 15 or July 24 when the lima beans had 6 trifoliate leaves of 18 inch plant height and 8 trifoliate leaves of 22 inch plant height, respectively. On July 24, flower buds were enlarged to 1/4 inch length just prior to opening. Spray volume was 18.4 GPA. The trial was not cultivated. Yield was obtained on September 9 or 24.

Imazethapyr at 0.032, 0.047 and 0.063 lb/A ppi, alone did not provide acceptable grass or morningglory (Ipomoea spp.) control. Stinkgrass (Eragrostis cilianensis (All.) E. Mosher) was tolerant, whereas, fall panicum (Panicum dichotomiflorum Michx.) was commercially controlled. Common lambsquarters (Chenopodium album L.) was controlled by imazethapyr at the lowest rate. Pre imazethapyr was similar to ppi.

Pendimethalin, 0.5 lb/A, ppi alone provide acceptable weed control and yields with 90% morningglory control. However, tank mixtures of pendimethalin and imazethapyr had acceptable lima bean tolerance at the high rate of 0.094 lb/A imazethapyr. Imazethapyr at 0.032 lb/A tank mixed with pendimethalin 0.5, lb/A ppi did not improve weed control compared to pendimethalin alone. Imazethapyr at 0.047 lb/A or greater tank mixed with pendimethalin provided 98% morningglory control, whereas, morningglory control with metolachlor 1.25 lb/A tank mixed with imazethapyr at 0.063 lb/A or greater was marginally acceptable. Imazethapyr at 0.047 lb/A or greater was required for acceptable weed control as a tank mix with metolachlor 1.25 lb/A, ppi. Metolachlor, 1.25 lb/A, plus dinoseb, 3.0 lb/A, was inferior to metolachlor plus imazethapyr.

Pre tank mixes of metolachlor plus imazethapyr were similar to the ppi treatments. Post imazethapyr with 0.25% non-ionic surfactant caused 20 to 30% temporary chlorosis of lima bean terminal leaves. Although weed and morningglory control was outstanding, post imazethapyr at 0.032, 0.047, 0.063 and 0.094 lb/A caused 15, 50, 97 and 96% delay of full flowering, respectively, when applied at the 6th trifoliate stage; however, yields were not reduced. When applied at the eight trifoliate stage, 0.047, 0.063 and 0.094 lb/A imazethapyr, flowering was delayed 90, 100 and 100%, respectively, and delayed full-maturity harvest 15 days; however, yields were acceptable. Post imazethapyr did not kill 6 in height lambsquarters but they were non-competitive.

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EFFICACY, PHYTOTOXICITY, SOIL RESIDUAL OF IMAZATHEPYR ON PEAS AND LIMA BEANS

Ed Kee[1] & Lori Rider[2]

ABSTRACT

Five studies were initiated in 1987 to study weed efficacy, crop injury, and soil residual effects on imazathepyr alone and in combination with several grass herbicides in peas (Pisum sativum) and lima beans (Phaseolus lunatus). The results show acceptable crop safety and acceptable weed control in peas regardless of planting date or method of application. In lima beans, the results show no crop injury and excellent weed control. Pre-plant incorporated treatments of imazathepyr provided the best weed control in both crops. Rates of imazathepyr ranged from 0.032, 0.047, 0.063 to 0.094 lbs ai/acre. When imazathepyr was combined with trifluralin in peas significant crop injury was noted.

Double crop plantings after the pea experiment generally indicate severe phytotoxic effects on Sweet Corn (Zea mays var. saccharata) and pickling cucumbers (Cucumis sativus). Small grain plantings, three months after imazathepyr applications on lima beans, indicate no phytotoxic effects on wheat (Triticum aestivum), rye (Secale cereale), or barley (Hordeum vulgare).

INTRODUCTION

Peas and lima beans are major processing vegetable crops in Delaware, encompassing 20,000 acres. In October, 1986, the U.S. Environmental Protection Agency banned the use of dinoseb (2-sec-butyl-4-6-dinitrophenol), thus eliminating the only pre-emergence broadleaf herbicide labeled for these crops. Preliminary studies in 1986 at Delaware and New Jersey indicated that imazathepyr (5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid) had adequate crop safety and weed efficacy on lima beans to merit consideration as an emergency replacement material.[1,2] Section 18 requests were granted to Delaware as well as Virginia, Maryland, and New Jersey for imazathepyr use on lima beans and snap beans (Phaseolus vulgaris). Concurrent field research was needed to supplement the commercial experience and answer questions regarding imazathepyr use on peas, lima beans, and subsequently planted crops.

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MATERIALS AND METHODS

Weed control experiments to study imazathepyr on peas and lima beans were established in 1987 at the University of Delaware Research and Education Center, Georgetown, Delaware. Rates of imazathepyr used in all experiments were at or near the 0.032, 0.047, 0.063, and 0.094 lbs ai/acre (2, 3, 4, and 6 ounces of product/acre).

Concerns about differences in performance of cool soils as compared to warm soils led to two studies on peas, each drilled in 7 inch rows at 270 lbs of seed/acre. The first was planted March 12 with the "Early Freezer" variety; the second study was planted on April 16 with the "Bounty" variety. Each planting date received 500 lbs of 10-5-10 broadcast per acre. All herbicide treatments were sprayed in 32 gallons of water per acre at 62 psi with 8004 nozzles. Preemergence treatments on the March 12 study were made on March 16; post treatments were made on May 1. This study was harvested on June 1. Pre-plant incorporated treatments were made on April 15 for the April 16 study. Preemergence treatments were made on April 22; early post sprays (peas 2 inches high) were made on May 11; other post sprays were made on May 29 and June 4. This study was harvested on June 16. The early study was replicated 3 times and the later study replicated 4 times.

The April 16 planting of peas was disked 4 times after harvest. On July 7, sweet corn and pickles were planted across all the treatments to measure the phytotoxic effects of residual herbicides.

The baby lima bean variety was Ben Fish 8-78, planted in 30 inch rows on June 11. All preplant incorporated sprays were applied on June 11, preemergence sprays were applied on June 13, and post sprays were applied July 10. All sprays were applied in 32 gallons of water per acre. 500 lbs of 10-5-10 were broadcast prior to planting. This experiment was replicated 5 times.

The lima bean study was terminated after the last ratings were made. Two replicates of the study were disked; two were plowed. Wheat, barley, and rye were drilled in 7 inch rows over all the treatments and into each tillage method on September 15.

Ratings on weed control and phytotoxicity were made on a one to nine scale. Weed control ratings of one are equivalent to complete ground cover with weeds. At seven a few weeds are present, but there is no reduction in yield, quality or harvest efficiency (considered commercial control), and nine is complete absence of weeds. One on the phytotoxicity scale is equivalent to all crop plants killed, seven refers to moderately long lasting symptoms, but no yield or quality reduction and a rating of nine indicates no crop damage.

RESULTS AND DISCUSSION

Imazathepyr applied alone on the March 12 pea planting provided adequate weed control and essentially no phytotoxicity. This was true at all rates, ranging from 0.032, 0.047, 0.063, and 0.094 lbs ai/acre. When applied in combination with trifluralin (a,a,a,-trifluoro-2,6,-dinitro-N,N-dipropyl-p-toluidine), weed control increased but crop injury also increased (Table 1). Weeds rated in peas were chickweed (Cerastium vulgatum L.), henbit (Lamium amplexicaule L.) and common ragweed (Ambrosia artemisiifolia).

Imazathepyr applied alone on the April 16 pea planting provided good control and crop safety from both pre-plant incorporated and preemergence applications, regardless of rate. Pre-plant incorporated provided better weed control (Table 2). When imazathepyr was combined with trifluralin, some crop stunting was evident. When combined with metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide), stunting was not as noticeable as the trifluralin combinations, yet more noticeable than when imazathepyr was used alone.

Imazathepyr applied pre-plant incorporated on lima beans gave the best weed control, although preemergence and post treatments were accpetable (Table 3). Excellent crop safety was evident regardless of application method or rate. When combined with trifluralin, metolachlor, pendimethalin (N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobezenamine) excellent grass control was obtained. Redroot pigweed (Amaranthus retroflexus), Morningglory spp. (Ipomea spp.) and Common Lambsquarter (Chenopodium album) were rated. It is also noticeable that some suppression of grass species was obtained with imazathepyr alone.

Sweet corn and pickling cucumbers planted 83, 76, 57, 39, and 33 days after various applications of imazathepyr showed increasing degrees of crop injury as the time interval shortened. Pre-planted incorporated treatments of imazathepyr caused more crop injury than same rate preemergence treatments of imazathepyr applied at the same date (Figure 1). The preemergence treatments caused the least residual effects on these two crops.

Wheat, barley, and rye planted across all treatments in the lima bean study did not show any injury from any rate of imazathepyr applied at any date during the lima bean study. This result was not affected by either tillage method of moldboard plowing or double discing.

An application of 0.032 lbs ai of imazathepyr 83 days after and application of 0.032 lbs ai of imazathepyr did not cause any injury to lima beans. This simulates an application on peas in the spring, followed by a similar application after pea harvest for the newly planted lima beans.

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TABLE 1

MAIN EFFECTS OF IMAZATHEPYR ON SELECTED WEED SPECIES AND ON CROP INJURY ON PEAS, VAR. "EARLY FREEZER", PLANTED MARCH 12

		Timing	Lb ai/A	Product/A	Phyto Rating 4/27	Phyto Rating 5/7	Chickweed 5/7	Henbit 5/7	Ragweed 5/7	Yield, Lbs Shelled Peas/A
1.	Imazathepyr + trifluralin	Pre PPI	0.02 0.50	1.28 oz. 1 pt.	6.7	6.0	9	9	9	4,206
2.	Imazathepyr + trifluralin	Pre PPI	0.04 0.50	2.56 oz. 1 pt.	6.7	4.7	9	9	9	3,972
3.	Imazathepyr	Pre	0.02	1.28 oz.	8.3	9.0	7.6	7.0	8.7	5,393
4.	Imazathepyr	Pre	0.04	2.56 oz.	8.7	8.7	7.3	6.7	9.0	4,631
5.	Imazathepyr	Pre	0.08	5.12 oz.	8.7	8.7	7.3	7.7	8.7	5,143
6.	Imazathepyr	Post	0.02	1.28 oz.	8.7	8.7	8.3	7.0	8.7	4,929
7.	Untreated Check	----	----	----	8.7	8.7	8.3	7.0	8.7	5,319
										NSD

TABLE 2

EFFECTS OF IMAZATHEPYR ON SELECTED WEED SPECIES AND
ON CROP INJURY ON PEAS, VAR. "BOUNTY", PLANTED APRIL 16

Treatment No.	Trade Name	Lb ai/ Gal.	Timing	Lb ai/A	Product/A	Phyto Rating Avg. 5/5	Hen Avg. 5/12	Rag Avg. 5/12	LQ Avg. 5/12	Chick Avg. 5/12	Rag Avg. 6/11	LQ Avg. 6/11
1	Imazathepyr	2	PPI	0.032	2 oz.	7.75	8.5	8.3	9.0	8.8	7.3	9
	Trifluralin	4	PPI	0.500	1 pt.							
2	Imazathepyr	2	PPI	0.047	3 oz.	7.25	8.5	8.3	8.3	8.8	8.0	9
	Trifluralin	4	PPI	0.500	1 pt.							
3	Imazathepyr	2	PPI	0.094	6 oz.	7.75	8.5	8.8	8.8	9.0	8.5	9
	Trifluralin	4	PPI	0.500	1 pt.							
4	Imazathepyr	2	PPI	0.032	2 oz.	9	8.3	8.0	8.5	9.0	7.0	9
5	Imazathepyr	2	PPI	0.047	3 oz.	9	9	8.3	8.8	9	7.8	9
6	Imazathepyr	2	PPI	0.094	6 oz.	8.25	9	8.5	9.0	9.0	8.8	9
7	Imazathepyr	2	Pre	0.032	2 oz.	8	9.0	8.5	9.0	9.0	7.8	9
	Metolachlor	8	Pre	1.300	1.3 pt.							
8	Imazathepyr	2	Pre	0.047	3 oz.	8	9.0	8.8	9.0	9.0	8.5	9
	Metolachlor	8	Pre	1.300	1.3 pt.							
9	Imazathepyr	2	Pre	0.032	2 oz.	9	8.5	7.8	8.8	9.0	7.5	9
10	Imazathepyr	2	Pre	0.047	3 oz.	8.5	8.8	8.0	9.0	9.0	7.3	9
11	Imazathepyr	2	Pre	0.063	4 oz.	8.75	8.8	8.3	9.0	9.0	7.8	9
12	Imazathepyr	2	Pre	0.094	6 oz.	8.5	8.8	8.8	9.0	9.0	8.8	8.5
13	Untreated Check	-	---	-----	-----	9	7.8	7.0	7.5	8.3	5.8	6.8

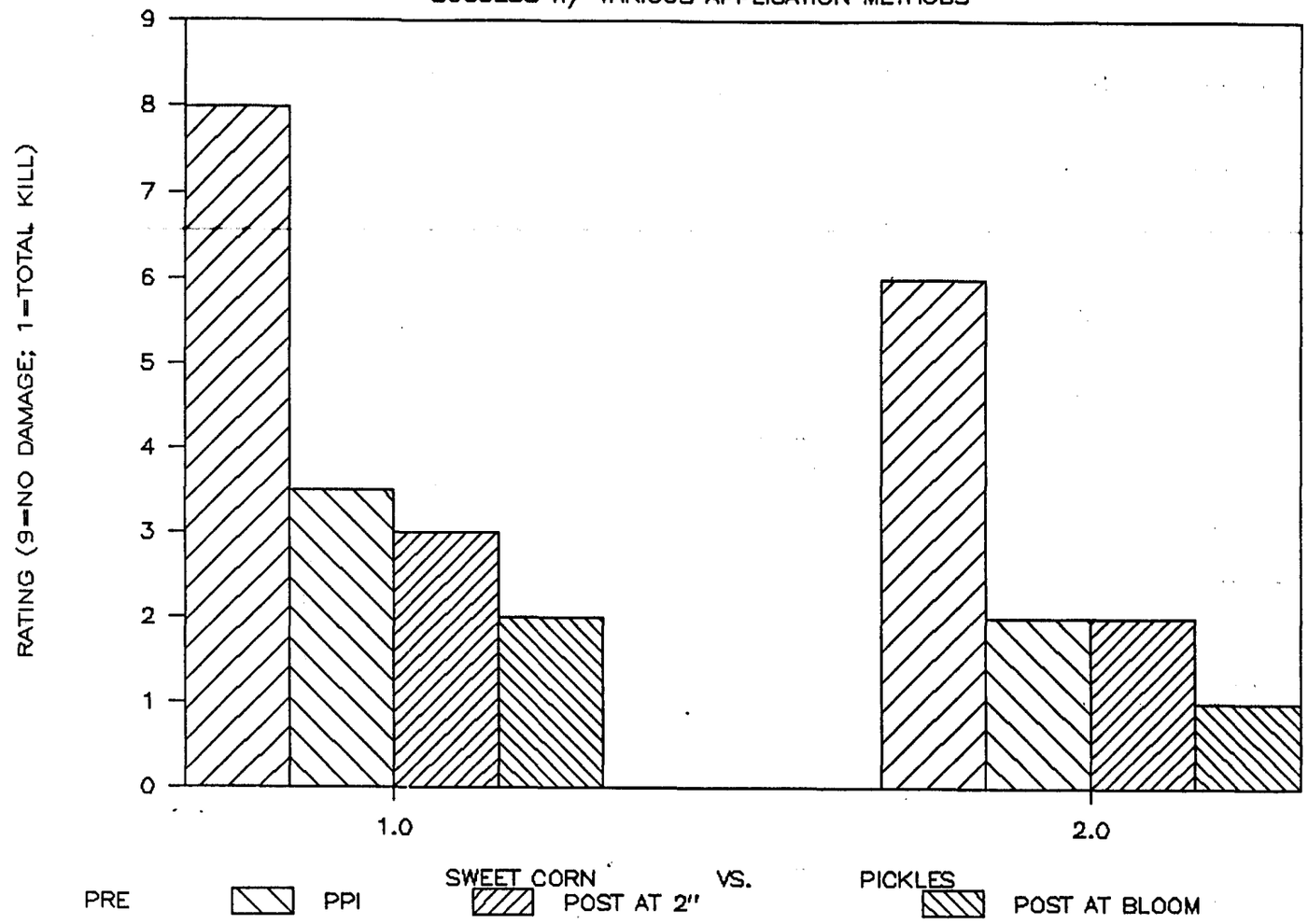
TABLE 3

EFFECTS OF IMAZATHEPYR ON SELECTED WEED SPECIES AND
ON CROP INJURY OF LIMA BEANS, VARIETY "8-78", PLANTED JUNE 11

Treatment No.	Trade Name	Lb ai/ Gal	Time	Lb ai/ Acre	Prod./ A	Phyto 7/8	Pig 7/8	MG 7/8	LQ 7/8	Grass 7/8	Phyto 7/30		Grass 7/30		MG 7/30		Pig 7/30	
											Cult.	Uncult.	Cult.	Uncult.	Cult.	Uncult.	Cult.	Uncult.
1	Imazathepyr	2	PPI	0.03	2 oz.	8.7	9.0	8.3	9.0	8.7	9.0	9.0	8.3	8.5	9.0	8.5	8.7	9.0
	Trifluralin	4	PPI	0.50	1 pt.													
2	Imazathepyr	2	PPI	0.09	6 oz.	9.0	9.0	8.7	9.0	8.7	9.0	9.0	9.0	9.0	9.0	8.5	9.0	9.0
	Trifluralin	4	PPI	0.50	1 pt.													
3	Imazathepyr	2	PPI	0.03	2 oz.	8.3	9.0	8.7	9.0	8.3	9.0	9.0	8.0	8.5	9.0	7.5	9.0	9.0
	Pendimethalin	4	PPI	0.50	1 pt.													
4	Imazathepyr	2	PPI	0.09	6 oz.	8.3	9.0	9.0	9.0	8.7	9.0	9.0	8.7	8.5	9.0	8.0	9.0	9.0
	Pendimethalin	4	PPI	0.50	1 pt.													
5	Imazathepyr	2	PPI	0.03	2 oz.	9.0	9.0	8.0	9.0	8.3	9.0	9.0	8.7	6.0	9.0	7.5	9.0	7.0
6	Imazathepyr	2	PPI	0.09	6 oz.	9.0	9.0	9.0	9.0	8.7	9.0	9.0	8.3	8.5	9.0	7.0	9.0	9.0
7	Imazathepyr	2	PE	0.03	2 oz.	9.0	8.7	8.0	9.0	7.7	9.0	7.5	7.3	6.5	9.0	9.0	8.3	9.0
	Metolachlor	8	PE	1.25	1.25 pt.													
8	Imazathepyr	2	PE	0.09	6 oz.	9.0	8.7	8.3	9.0	8.0	9.0	9.0	8.7	5.5	8.3	9.0	8.7	9.0
	Metolachlor	8	PE	1.25	1.25 pt.													
9	Imazathepyr	2	PE	0.03	2 oz.	9.0	7.3	8.3	8.7	7.0	8.0	7.5	6.7	5.0	9.0	9.0	8.7	9.0
10	Imazathepyr	2	PE	0.09	6 oz.	8.7	8.0	8.0	8.7	7.3	8.0	6.5	7.0	5.5	8.7	9.0	9.0	9.0
11	Imazathepyr	2	Post	0.03	2 oz.	---	---	---	---	---	8.0	8.5	5.3	6.0	8.7	9.0	9.0	9.0
12	Imazathepyr	2	Post	0.09	6 oz.	---	---	---	---	---	7.3	7.0	7.7	5.5	9.0	9.0	9.0	9.0
	Untreated Check					9.0	7.0	8.7	7.7	6.3	8.7	8.5	7.3	4.5	9.0	8.5	9.0	8.5

IMAZATHEPYR RESIDUAL STUDY

SUCCESS W/ VARIOUS APPLICATION METHODS



EVALUATION OF SC-0051, SC-0774, AND SC-0735 ON SWEET CORN

D.L. Kunkel*, R.R. Bellinder, and D.T. Warholic[1]

Several new experimental herbicides, SC-0051, SC-0774, and SC-0735 have proven to be safe and effective for use in field corn (Zea mays L.). Studies were conducted to determine the tolerance of sweet corn (Zea mays saccharata L.) to these new experimental herbicides.

SC-0051 was evaluated in four studies from 1985 to 1987. In 1985, postemergence applications of SC-0051 at 0.6 and 1.1 kg/ha caused significantly more injury than plots treated with atrazine plus metolachlor (0.6; 2.2 kg/ha). In 1986, SC-0051 was applied to four sweetcorn varieties: 'Sweet Sue', 'Seneca Horizon', 'Jubilee', and 'Silver Queen'. Preemergence and postemergence applications of 1.1 kg/ha caused 20 to 35 and 40 to 80% injury, respectively. When 0.6 kg/ha was applied at both applicaton times significantly less injury occurred. The variety 'Sweet Sue' was more sensitive to SC-0051 than the other varieties evaluated. In spite of the initial injury, crop recovery was rapid and yields compared favorably with those where atrazine plus metolachlor were applied preemrgence. In 1987, SC-0051 rates were reduced to 0.3 and 0.6 kg/ha and were combined with either atrazine (1.1 kg/ha) or metolachlor (2.2 kg/ha). No injury was observed and yields were consistantly equivalent when compared to the atrazine plus metolachlor treatment.

SC-0774 was applied preemergence to 'Jubilee' sweet corn in 1986 at rates of 0.8 and 1.7 kg/ha with and without the antidote R-29148 at 0.3 and 0.6 kg/ha. Although R-29148 afforded some safening, all treatments that included SC-0774 caused greater injury than did preemergence treatments of SC-0051 at 1.1 kg/ha or the standard treatment, atrazine plus metolachlor (0.6; 2.2 kg/ha).

In 1987, SC-0735 (0.6, 1.1 kg/ha) was combined with the antidote R-29148 (0.04; 0.09 kg/ha) and atrazine (1.1 kg/ha) and was applied preemergence to 'Jubilee' sweet corn. These treatments caused no injury or yield reductions.

Safe use SC-0051 in sweet corn will require preemergence applications at low rates (0.3 and 0.6 kg/ha). Sweet corn tolerated SC-0735 at rates of 0.6 and 1.1 kg/ha but injury resulting from SC-0774 was unacceptable. Effective weed control was obtained with all three herbicides.

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EVALUATION OF IMAZETHAPYR PERFORMANCE IN PEAS AND SNAPBEANS

William K. Vencill, Henry P. Wilson, Thomas E. Hines, and Kriton K. Hatzios [1/]

ABSTRACT

Field studies were conducted in 1987 to investigate efficacy, pea (Pisum sativum L. 'Progress #9') and snapbean (Phaesolus vulgaris L. 'Atlantic') response, and rotational crop response to preplant incorporated, preemergence, and postemergence applications of imazethapyr at rates of 36 to 125 g/ha. Low rates of imazethapyr preplant incorporated and preemergence provided good control of common lambsquarters (Chenopodium album L.), henbit (Lamium amplexicaule L.), and yellow nutsedge (Cyperus esculentus L.) and considerable activity on annual grasses. Although some crop response was observed to both peas and snapbeans, yields were not affected at the lower rates. Postemergence applications appeared to be relatively safe to peas but not to snapbeans. Sweet corn (Zea mays saccharata L. 'Merit'), cucumbers (Cucumis sativus L. 'Poinsett'), and grain sorghum [Sorghum bicolor (L.) Moench. 'Corral'] were planted into imazethapyr residue to determine rotational crop response by visual injury and fresh weight. The lowest rates of imazethapyr frequently caused visual estimates of growth reduction, reduction in fresh weight, or both. These studies indicated that the order of sensitivity of rotational crop response was sweet corn > cucumbers > grain sorghum.

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EVALUATION OF QUACKGRASS CONTROL WITH SELECTIVE POSTEMERGENCE HERBICIDES IN PEAS

Russell W. Wallace*, Donald T. Warholic and Robin R. Bellinder[1]

Preplow treatments of glyphosate (1.12, 2.24 and 3.36 kg ai ha^{-1}) and postemergence single and split applications of BASF 517 (0.34, 0.22 + 0.11 kg ai ha^{-1}), fluazifop-p-butyl (0.21, 0.21 + 0.21 kg ai ha^{-1}) and quizalofop (0.21, 0.21 + 0.21 kg ai ha^{-1}) were evaluated for control of rhizome quackgrass (Agropyron repens L. Beauv.) in English peas (Pisum sativa L. 'Bolero'). All postemergence treatments with the exception of glyphosate, were applied using 8003 flat fan nozzles delivering 176 L ha^{-1}. Glyphosate at 1.1 kg was applied at three volumes: 93, 186, and 280 L ha^{-1} using 8001, 8002 and 8003 flat fan nozzles, respectively. The 2.2 and 3.4 kg rates of glyphosate were applied with 8003 flat fan nozzles at a volume of 280 L ha^{-1}. Glyphosate treatments were applied 10 days prior to plowing on May 13 when the quackgrass had 4 leaves (38 cm). Single and first split applications were applied on June 24 when reemergent quackgrass shoots had 3 leaves (18 cm). The second of the split applications were applied on July 8.

Preplow treatments of glyphosate resulted in good control of quackgrass. No significant differences in weed control were observed for any herbicide treatment at 14 days after application. However, weed control observed 28 days after initial application showed that cloproxydim, fluazifop-p-butyl and BASF 517 required two applications to adequately suppress quackgrass regrowth, while quizalofop required one. Sethoxydim single and split application treatments failed to adequately control subsequent regrowth.

Pea yields were highest with the use of glyphosate at 3.36 kg ai ha^{-1}. Yields were significantly lower in both fluazifop-p-butyl treatments, BASF 517 at 0.34 kg ai ha^{-1}, and all treatments of cloproxydim, with the exception of the 0.14 kg ai ha^{-1} rate. Yield reduction in cloproxydim treatments was due to excessive crop injury. No injury symptoms were observed in any other treatment.

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EVALUATION OF HERBICIDES FOR BROADLEAVED WEED CONTROL IN DIRECT-SEEDED BROCCOLI

Kathleen A. Herbst and Jeffrey F. Derr[1/]

ABSTRACT

Field experiments were conducted to evaluate preemergence applications of oxyfluorfen and BAS 514, as well as postemergence applications of oxyfluorfen, BAS 514,and pyridate for broadleaved weed control in direct-seeded broccoli. Foliar treatments were applied at the three to six leaf stage. Crop injury and weed control were rated at approximately two and four weeks after application. Multiple harvests included head counts and weights from each treatment.

Broccoli plots treated preemergence with BAS 514 at 0.14, 0.28, and 0.56 kg ai/ha had no stand reduction, and yields were comparable to plots treated with napropamide at 1.1 kg ai/ha. All rates of oxyfluorfen (0.14, 0.28, 0.56 kg ai/ha) applied preemergence severely reduced broccoli stand and yield in comparison to the untreated check.

Broccoli plants injured initially by postemergence applications of oxyfluorfen at 0.06, 0.14, and 0.28 kg ai/ha demonstrated leaf crinkling and white speckling. Plants treated with pyridate at 0.50, 1.0, and 2.02 kg ai/ha developed at general yellowing. However, by the fourth week broccoli plants were able to outgrow this damage and produce acceptable yields. Foliar applications of BAS 514 (0.06, 0.14, 0.28, and 0.56 kg ai/ha) plus the adjuvant BAS 090 (0.8% v/v) caused malformation of leaves and heads with reduced yield. All rates of BAS 514 (0.14, 0.28, and 0.56 kg ai ha) applied without an adjuvant gave excellent common ragweed (*Ambrosia artemiisifolia* L.) control with no yield reduction. Oxyfluorfen at 0.28 kg ai/ha and pyridate at 4.0 kg ai/ha provided acceptable control of common ragweed.

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COMMON COCKLEBUR INTERFERENCE IN SNAP BEANS

Philip E. Neary & Bradley A. Majek[1]

ABSTRACT

The effect of common cocklebur (**Xanthium strumarium L.**) interference on snap bean (**Phaseolus vulargis L.**) was investigated at the Rutgers Research and Development Center, Bridgeton, New Jersey in 1987. Field experiments were conducted to determine the threshold level of common cocklebur, the critical period of common cocklebur competition, and the effect of planting date on the growth and competiveness of common cocklebur in snap beans.

Snap bean pod yield, average weight per pod, and average number of pods per plant were reduced with increasing weed densities. Yields were reduced 7% to 44% by common cocklebur at in-row densities between 1/2 and 8 m^2. Snap bean plant growth was initially reduced the 3 to 4 trifoliate leaf stage and the full bloom stage of bean growth by 1, 2, 4 and 8 weeds per m^2. One half weed per m^2 was determined to be the maximum tolerable level of common cocklebur in snap beans with full season competition. One common cocklebur per m^2 significantly reduced snap bean yields 24%.

The critical period of competition for common cocklebur emerging with the snap beans was between the bloom and harvest stage of snap bean growth. Common cocklebur removed at the full bloom stage of snap bean growth did not result in reduced snap bean yields.

Date of planting, mid-May, June or July affected common cocklebur growth, but not the competitive ability with snap beans. Common cocklebur planted in mid-May never reached a reproductive stage of growth prior to bean harvest. Common cocklebur planted in July was in the reproductive stage of growth from 3 to 4 trifoliate leaf stage of bean growth through harvest. This suggests that common cocklebur was equally competitive in a reproductive and a vegetative stage of growth.

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DETERMINATION OF SUMMER SQUASH'S TOLERANCE TO WEED INTERFERENCE: A CRITICAL PERIOD STUDY

Sister Jeanne-Yolaine Mallet, Richard A. Ashley[1/]

ABSTRACT

Yellow squash (Cucurbita pepo L.) c.v. 'Early Prolific' was grown on a Gloucester very stony sandy loam, 3 to 5% slope, uncultivated before the experiment. Seeds were planted June 5, 1987. Squash was maintained weed free or allowed to compete with weeds for 3, 6, 9 or 12 weeks after planting. Squash was harvested from July 23 to August 22. Number and weight of fruit was recorded. Effects of weed-removal treatments on the yield were significant. Critical period of weed interference based on the yield of squash occured during weeks 4 through 6. There was no significant difference between treatments where squash was kept weed free during this 3 week period.

INTRODUCTION

While all crops can withstand weed competition for some duration, the question is to determine when the yield-reducing competition is likely to occur (3). The specific minimum period of time during which the crop must be free of weeds in order to prevent loss in yields is referred to as the critical period. It represents the overlap of two separate components: the length of time weeds can remain in a crop before interference begins and the length of time that weed emergence must be prevented so that subsequent weed growth does not reduce the crop's yield (20). The critical period varies greatly with relative growth rates of a crop and its associated weeds (15, 16, 20), the environment (11, 14, 16), and cultural practices such as row spacing (4, 6, 14).

The critical period has been determined for a variety of crops: 3 or more weeks after planting for soybeans (5, 15); 5 to 7 weeks for field beans (7); 4 weeks after cotton emergence when competing with Johnsongrass (2), 2 to 6 weeks with yellow nutsedge (12) but more than 8 weeks with common cocklebur (18); and 12 to 36 days after cucumber emergence (8). While beans require only a 4 week weed free period, garlic needs 13 weeks (11). This last example illustrates that the duration of the critical period is closely related to the efficiency with which plants intercept light.

Results differ considerably from crop to crop and there seems to be little information on summer squash's competitive ability. The present experiment was designed to determine the critical period of weed interference with summer squash.

MATERIALS AND METHODS

The experiment was conducted in 1987 in Bethlehem, CT, on a Gloucester very stony, sandy loam with a 3 to 5% slope. This series developed on

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friable to very firm glacial till, well drained or moderately well drained. Its permeability is moderate to moderately rapid in the surface layer and subsoil. Before the experiment the area was uncultivated and mainly infested by quackgrass (Agropyron repens (L.) Beauv.), common milkweed (Asclepias syriaca L.), horse nettle (Solanum carolinense L.) and groundnut (Apios americana Medic).

The experimental area was cleared, plowed and rocks removed by hand. Fertilizer was applied according to soil test recommendations and disked in prior to sowing.

Individual plots consisted of 3 rows, 4.6 m long with 0.9 m between rows and 46 cm between plants within rows. Seeds of straight neck Yellow Squash (Cucurbita pepo L.) cv 'Early Prolific' were planted June 5, 1987. Seeds were covered with a mixture of four parts soil from the plot, two parts peat and one part vermiculite.

Treatments were arranged in a randomized complete block design with three replications. Weed-removal treatments were as follows. Weeds were removed for 3, 6 and 9 weeks after seeding after which weeds were allowed to grow (treatments 1, 2, 3 respectively). Weeds were allowed to grow for 3, 6 and 9 weeks after seeding after which weeds were removed and kept weed free (treatments 5, 6, 7 respectively). In treatment 4, plots were kept weed free throughout the season while in treatment 8, plots were weed infested throughout the season. (Table 1)

Weeds were removed by hand pulling and hoeing. Milkweed was removed as it emerged in every plot because of its possible allelopathic effect on crops (15). Weed density was taken at random at the end of the sixth week prior to applying treatment 6. Weeds were hand pulled, sorted by species, counted and weighed in the field. Quackgrass was the predominant weed with a density of 209 shoots/m^2. Other weeds present throughout the experimental area were: lambsquarter (Chenopodium album L.) (density of 29 shoots/m^2), ragweed (Ambrosia artemisiifolia L.) (density of 14 shoots/m^2) and groundnut (density of 22 shoots/m^2). Insect control practices were applied as required.

Squash were hand harvested fourteen times from July 23, to August 22, 1987. Number and weight of fruit were recorded. Data was taken from the center row of each plot and from the center 3 meters of the row.

RESULTS AND DISCUSSION

Table 1. Effect of weed free period on yield of summer squash

Treatment n°	Treatment		Squash Yield Per Plot
			kg
1.	Weed free week 0-3	weedy week 4-12	8.59
2.	Weed free week 0-6	weedy week 7-12	12.68
3.	Weed free week 0-9	weedy week 10-12	11.59
4.	Weed free week 0-12		14.18
5.	Weed free week 4-12	weedy week 0-3	13.41
6.	Weed free week 7-12	weedy week 0-6	10.27
7.	Weed free week 10-12	weedy week 0-9	9.64
8.		weedy week 0-12	7.27
LSD 5%			2.9

The yield was significantly greater in all treatments where plots were maintained weed-free during the weeks 4 to 6 (Treatments 2, 3, 4 and 5). There was no significant difference between treatments kept weed-free for 6 weeks (T.2), 9 weeks (T.3) and throughout the season (T.4) and treatments weed-infested for the first three weeks and then weeded (T.5). Therefore the actual yield reducing competition occurred in that period of time which corresponded, in the squash life cycle, to flower bud formation starting at the end of the fourth week and the opening of the first flowers during the sixth week. When weeds were not interfering during the critical period, yield was not significantly reduced. This finding seems to support Radosevich's statement (16): "The critical period during which competition occurs and crop yield reductions result may be a certain number of weeks after emergence. However, it is more likely that this critical period relates to particular stages of weed and crop development which are relative to one another". This would respond to Weaver's concern that (18): "the variability of crop and weed growth rates from year to year limits the practical value of the critical period concept". But if the critical period was determined also in relation to the growth cycle of a given crop, it could increase its practical value. Although this experiment does not allow to conclude absolutely this relation between life-cycle and critical period of interference, it seems that more research in that direction would be beneficial.

Squash not competing with weeds during the critical period (T. 2, 3, 4, 5) not only produced more total yield but also an earlier yield than the other treatments, suggesting that weed interference during the critical period delayed flowering.

Although Bleasdale (1) says that "the presence or absence of weeds during the first few weeks of a crop's growth is critical in determining the ultimate yield", it has been reported that the critical period for tomatoes was between the fifth and ninth weeks after seeding (20). The results obtained with squash support this finding. The critical period occured

during weeks 4 through 6 and there was no significant difference between treatments constantly weed infested (T.8) and treatments weeded only for the first three weeks (T.1) (Table 1). On the contrary, when squash were allowed to compete with the weeds only for the first three weeks (T.5), the yield was not reduced and was 60.6% greater than yield produced by squash weed-free for the same first three weeks (T.1).

There was no significant difference between the yield produced by squash weed-free for either the 3 weeks preceeding the critical period (T.1) or for the 6 weeks (T.6) and 9 weeks (T.7) following it. Yield when the plot was constantly kept weed-free (T.4) was twice the yield produced by squash weed infested throughout the season (T.8).

The normal row-spacing for summer squash is 1.2 to 1.5 m. The row spacing used in this experiment (0.9 m) likely increased the competitive ability of squash. Many experiments (4, 9, 10, 14, 19) have concluded that narrow-row cultural practices enhance crop competitiveness, resulting in less weed growth and shorter weed-free requirement for maximum crop yield.

The effects of shading on quackgrass as reported by Williams (21) are a reduction of the shoot, rhizome, total dry weight and a lack of flowering. In this experiment, quackgrass was not observed to produce seed heads indicating that close row spacing of squash might produce a shading effect even when weeds were not controlled. Quackgrass was the predominant weed (65% of the total weed-stand) and few broadleaved weeds emerged where quackgrass was never removed. However, broadleaved weeds emerged after the application of the first and second treatments. The allelopathic potential of quackgrass as reported by Rice (17) could explain the absence of broadleaved weeds.

CONCLUSION

Summer squash grown at 0.9 m row-spacing can tolerate weed interference for most of the growing season, without a yield reduction, if weeds are controlled during the fourth through sixth week.

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COMMON RAGWEED IN SNAP BEANS

G. K. Evanylo and H. P. Wilson[1/]

ABSTRACT

Effects of interference by common ragweed (*Ambrosia artemisiifolia* L.) at various soil K levels on yield and nutrient uptake by snap beans (*Phaseolus vulgaris* L. 'Provider') were investigated in field studies. Common ragweed treatments included: 1) full-season weed interference, 2) weed interference until flower initiation, 3) full-season weed-free plus trifluralin, and 4) full-season weed-free with no herbicide. Common ragweed interference decreased pod yields to a greater extent between flower initiation and harvest than during the period prior to flowering. A trend toward early season lowered snap bean dry matter production in weed-free plots with trifluralin was reversed by harvest when somewhat higher pod yields and nutrient uptake were noted in treatment 3) than in treatment 4). Pod yields and nutrient accumulation were increased with K rate under full-season weed interference only, whereas K decreased pod Ca and Mg uptake when weeds were removed at flower initiation. The proficiency with which common ragweed accumulated K, a nutrient demonstrated to aid plants in overcoming environmental stresses, may explain why certain weeds compete so efficiently with crop plants.

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ECONOMIC ASSESSMENT OF WEED MANAGEMENT SYSTEMS IN ONIONS

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ABSTRACT

Onions (*Allium cepa* L.) were once a major crop in the Pioneer Valley. Onions are still an important crop, but acreage in onion production has declined significantly. Two major reasons for this are the high cost of weed control and the lack of available labor.

Onions are a long season crop and compete poorly with weeds. Full season weed control is needed for good yields and for harvesting efficiency. Onion growers employ herbicides, mechanical cultivation, and hand weeding in their weed control systems. Herbicides alone are economical, but currently registered herbicides for onion production do not provide the full season and spectrum of weed control needed. Cultivation leaves a band of weeds over the onion that will reduce the yield to zero if left for the duration of the growing period. Hand labor, therefore, is a needed component in onion weed control.

This study was conducted to evaluate the cost and efficacy of several weed control systems. The two herbicides currently registered for onion production in New England: DCPA and oxyflourfen were utilized in several combinations with cultivation and handweeding to determine the most cost effective system. A treatment receiving two successive applications of DCPA at 6.72 kg/ha and one cultivation and handweeding produced onion yields greater than the handweeded control, but late season grass emergence in this treatment would interfere with harvesting practices. Oxyflourfen was applied at 0.0336 kg/ha applied after preemergence applications of DCPA at the three- to four-leaf stage of the onions. These treatments required either several applications of oxyflourfen or more than one cultivation and handweeding to produce marketable yields. The cost of weed control for the handweeded control was $9,259.00/ha. This cost was five to seven times more expensive than systems utilizing both herbicides in combination with cultivation and handweeding, which produced comparable yields.

A separate onion-weed competition experiment was conducted to evaluate the effects of weed duration on onion yields. This study concluded that onion yields were reduced by 62, 91 and 99% if weeds were allowed to persist for 1, 2, and 3 weeks, respectively, after onion emergence.

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POSTEMERGENCE HERBICIDES FOR PERENNIAL BROADLEAF WEED CONTROL IN TREE FRUIT

B. A. Majek [1]

ABSTRACT

Late spring applications of 0.56 kg ae/ha trichlopyr amine alone or in combination with 1.12 kg ae/ha 2,4-D amine effectively controlled several woody and herbacious perennial broadleaf weeds, including, Virginia creeper (**Parthenocissus quinquefolia** (L.) Planch.), Canada goldenrod (**Solidago canadensis** L.), and white heath aster (**Aster pilosus** Willd.). Canada thistle (**Cirsium arvense** (L.) Scop.) was not controlled by trichlopyr alone or in combination with 2,4-D. Clopyralid amine applied at the same time at 0.37 kg ae/ha effectively controlled Canada goldenrod, white heath aster, and Canada thistle. No crop injury to either apples or peaches was observed from any of the herbicides evaluated.

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VEGETATION MANAGEMENT OF ORCHARD MEDIANS

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ABSTRACT

Field experiments were conducted in 1987 to evaluate chemical suppression of Kentucky 31 tall fescue (Festuca arundinacea [Schreb.]) planted in 1978 as the ground cover for tree fruit orchard medians. The objective was to reduce the need for mechanical mowing while maintaining good ground cover.

Applications 9 April 1987 were: diuron at 0.56 and 1.12 kg/ha, fluazifop at 0.11 and 0.22 kg/ha, glyphosate at 0.56 and 1.12 kg/ha, paraquat at 0.28 and 0.56 kg/ha and terbacil at 0.56 and 1.12 kg/ha. Applications 21 May 1987 following mowing on 18 May 1987 were: mefluidide 2S at 0.14 + metsulfuron (DPX T6376) at 0.017 kg/ha and mefluidide 2S at 0.14 + DPX L5300 at 0.035 kg/ha.

A visual rating on the scale of 0 to 10 (0 = no response and 10 = all grass yellow or brown)was made eleven days posttreatment. Varying degrees of yellowing from the fluazifop and glyphosate treatments resulted in a rating of 2 and 3 at the low rate and 3 and 6 at the high application rate respectively. The mefluidide + metsulfuron and mefluidide + DPX L5300 had a visual rating of 3 and 2 respectively due to blade yellowing. The paraquat treatments had a visual rating of 10 since the vegetation was completely brown. No visual response was evident from the diuron and terbacil treatments. Observations twenty days posttreatment revealed that the fluazifop treatments had completely recovered from the blade yellowing. At the time of the first mowing, 36 days posttreatment, only the diuron and terbacil treatments failed to suppress grass blade and inflorescence growth (Table 1). Glyphosate 0.56 and 1.12 kg/ha, fluazifop 0.22, metsulfuron + mefluidide manifested the greatest suppression.

. The paraquat, glyphosate and metsulfuron + mefluidide treatments reduced the 100% live vegetation coverage in the median for too long a period and was especially noticeable 16 weeks posttreatment in the paraquat and metsulfuron + mefluidide treatments (Table 2). The 90 to 95% stand of tall fescue ground cover was severely injured from the glyphosate, paraquat, metsulfuron + mefluidide and DPX L5300 + mefluidide treatments. A 10 to 30% increase in the broadleaf weed population occurred in the paraquat and glyphosate treatments. The metsulfuron + mefluidide and DPX L5300 + mefluidide reduced the broadleaf weed population compared to the before treatment broadleaf population. The terbacil 0.56 kg/ha plot area had a pretreatment broadleaf population of 20% compared to 2 to 5% broadleaf population for all other treatments.

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Table 1. The effects of treatments on grass blade and inflorescence suppression 36 days posttreatment.

Material	Rate	Mean height[a]	
		Blade	Inflorescence
	kg/ha	(cm)	
Terbacil	0.56	36.83 d	56.83 c
	1.12	38.00 d	52.67 c
Diuron	0.56	40.00 d	58.67 c
	1.12	36.00 d	50.67 c
Fluazifop	0.11	18.00 bc	28.00 b
	0.22	11.83 a	0.00 a
Glyphosate	0.56	11.00 a	0.00 a
	1.12	10.00 a	0.00 a
Paraquat	0.28	14.17 ab	0.00 a
	0.56	19.50 c	30.67 b
Metsulfuron +	0.017		
mefluidide	0.15	11.50 a	0.00 a
DPX L5300 +	0.035		
mefluidide	0.15	13.17 a	0.00 a
Control	0.00	39.75 d	56.06 c

[a]Means within columns followed by the same letter are not significantly different at the 5% level using Duncan's multiply range test.

Table 2. Percent of total ground cover, broadleaf weeds and tall fescue and height (cm) of tall fescue (16 weeks posttreatment and 4 weeks postmowing).

Material	Rate	ground cover	Broadleaf weeds	Fescue	
	(kg/ha)	(%)			(cm)
Terbacil	0.56	99.0	20.0	75.0	37.4
	1.12	100.0	5.0	95.0	36.3
Diuron	0.56	100.0	5.0	95.0	35.8
	1.12	100.0	2.0	98.0	36.7
Fluazifop	0.11	100.0	8.0	90.0	32.0
	0.22	100.0	3.0	90.0	30.2
Glyphosate	0.56	98.0	15.0	65.0	26.8
	1.12	90.0	15.0	65.0	39.4
Paraquat	0.28	70.0	40.0	10.0	40.0
	0.56	70.0	25.0	79.0	35.5
Metsulfuron +	0.017				
mefluidide	0.15	50.0	1.0	20.0	16.9
DPX L5300 +	0.035				
mefluidide	0.15	80.0	2.0	60.0	17.0
Control	0.00	100.0	5.0	95.0	40.0

EFFECT OF SETHOXYDIM ON LITTLE BLUESTEM IN LOWBUSH BLUEBERRIES

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ABSTRACT

Little bluestem (Andropogon scoparius) Michx. is resistant to the preemergence herbicides used in lowbush blueberry fields so postemergence grass herbicides are being evaluated. Little bluestem is primarily found in the southern and western part of the state but is increasing in the major blueberry producing eastern region. Harvest of the field is difficult since rakers are reluctant to work where the grass is present and the grass binds in the raking heads of the mechanical harvesters. A commercial blueberry field in Surry, ME with a heavy stand of little bluestem was treated postemergence with sethoxydim at 0, 0.5 or 0.5 + 0.5 kg/ha ai plus 1 L/ha of crop oil concentrate in 187 L/ha water, with or without 2.8 kg/ha ammonium sulfate. Experimental design was a RCB, replicated six times with rates nested within ammonium sulfate treatment. Treatments were applied on July 16 and on August 17, 1986. Grass control ratings where 0 = no effect and 10 = complete control and the height of the clumps of grass per plot were made in August 1986 and July 1987. Stem density, length and number of flower buds were determined from blueberry stem samples cut in October 1986. Yields were obtained by mechanically harvesting the plots in August of 1987. Ammonium sulfate did not enhance the activity of sethoxydim on the grass in this experiment but blueberry buds increased from 44 to 66 per 0.1 m^2 with its addition. Good grass suppression was observed during the first year but the level of suppression of the carryover ratings were low, indicating the grass recovered from the postemergence applications (Table 1). Suppressing the grass the first year resulted in an increase in blueberry flower bud production but yields were not increased the following year. Differences in timing of herbicide application, rate, or additional applications made in the crop year may be needed to maintain the initial suppression and produce an increase in blueberry yield.

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Table 1. Effect of sethoxydim on little bluestem vigor and lowbush blueberry growth and yield in Surry, ME.

Rate Kg/ha	Little Bluestem[a] 1986 Rating	Little Bluestem[a] 1986 Height	Little Bluestem[a] 1987 Rating	Little Bluestem[a] 1987 Height	Blueberry Stand ($0.1m^2$)	Blueberry Buds	Blueberry Height (cm)	Blueberry Yield kg/ha
0	0	55	0	37	51	45	6.7	1558
0.5	5	21	1	36	64	57	5.7	1573
0.5+0.5	9	10	2	37	56	54	5.6	1618
F Test	**[b]	**	**	NS	NS	**	NS	NS

a 0 = no effect, 10 = complete control, grass height in cm.

b ** = significant at the 1 % level, NS = nonsignificant

COMPARISON OF FIVE HERBICIDE PROGRAMS FOR NO-TILLAGE SWEET CORN

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ABSTRACT

Five sweet corn (Zea mays L. 'Jubilee') herbicide programs were evaluated for efficacy, injury and yield potential in no-tillage (NT) and conventional tillage (CT) systems. All the herbicide programs resulted in weed control greater than or equal to 90% in both 1985 and 1986. Injury levels between treatments were also equivalent. Climatic conditions prior to spike stage applications in 1986 enhanced crop injury, however, this injury did not reduce yields. Total ear weight in both years was equivalent although plant populations and the number of harvested ears was significantly lower in CT plots in 1985.

INTRODUCTION

No-tillage cropping systems have not been widely accepted in New York. Unlike other production areas, moisture conservation is not a primary concern in the state and among vegetable producers the interest in soil conservation is growing only slowly.

Although feasibility has been adequately demonstrated in field corn studies in New York (1,2,3) little work has been done with sweet corn. Vegetable growers expressing an interest in no-tillage systems were particularly interested in the increased planting flexibility. They were however, also concerned about potential yield reduction and loss of herbicide efficacy, particularly in post-emergence herbicide programs.

These studies were undertaken to address the questions and concerns of growers. The objective was to compare efficacy, injury and yield potential of five selected herbicide programs in conventional and no-tillage production systems.

MATERIALS AND METHODS

These studies were conducted in 1985 and 1986 at the Homer C. Thompson Vegetable Research Farm in Freeville, NY. Soils were Howard Gravelly Loams (Glossoboric Hapludulf, loamy-skeletal, mixed mesic) having a pH of 6.3 and an organic matter content of 3.0.

Annual rye was planted in September of the year preceding the initiation of each study and was chemically killed with 1.1 kg ai/ha glyphosate [N-(phosphonomethyl)glycine] three weeks prior to planting. The height of the rye was 70 cm in 1985 and 50 cm tall in 1986. Conventionally tilled areas were plowed and disced one week prior to planting. Both studies received a uniform fertility program that consisted of 101 kg N, 45 kg P and 85 kg/ha K prior to planting and 67 kg/ha N as ammonium nitrate 5 weeks after planting. Sweet corn

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was subsequently planted into 4-row plots measuring 3.7 m by 9.0 m on June 6 and May 16 in 1985 and 1986, respectively.

Alachlor EC or ME [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide], bromoxynil (3,5-dibromo-4-hydroxybenzonitrile) or metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide] was applied with 0.6 kg ai/ha atrazine [2-chloro-4-(ethylamino)-6(isopropylamino)-s-triazine] either preemergence (PRE) or at spike (SPK) stage. Herbicides were applied with CO_2-backpack sprayer equipped with 4 flat fan 8003 nozzles, delivering 322 L/ha at 207 kPa.

Data were collected from the center two rows in each plot and included plant stand counts, estimates of early-season injury, mid- and late-season weed control and yields. Additionally, in 1986, weed counts were taken in 0.5 m^2 quadrats in the untreated check plots. The visual evaluation system was based on a 0 to 10 scale where 0 represented no control and no crop injury and 10 represented 100% weed control and injury.

The experimental design was a split-plot with tillage and herbicide programs as the main-plot and sub-plot effects, respectively. Data were subjected to analysis of variance and Student-Neuman-Kuel's multiple range procedures.

RESULTS AND DISCUSSION

All five herbicide programs gave equivalent control of redroot pigweed (*Amaranthus retroflexus* L.), common lambsquarters (*Chenopodium album* L.), and large crabgrass (*Digitaria sanguinalis* L.) (Table 1). In all cases, control was greater than or equivalent to 90% in both years of the study; there was no evidence of decreased efficacy when tillage was reduced. When weed counts were taken in the control plots (1986) the populations of redroot pigweed and common lambsquarters were significantly lower in NT plots than in CT plots (Table 2). Tillage had no effect however, on populations of large crabgrass or barnyardgrass (*Echinochloa crus-galli* L.).

Table 1. Control of redroot pigweed, common lambsquarters, and large crabgrass with five herbicide programs in no-till and conventional tillage sweet corn[a].

Herbicide Program	Form.	Rate	Timing	AMARE[b] NT	AMARE[b] CT	CHEAL NT	CHEAL CT	DISGA NT	DISGA CT
		(kg ai/ha)		----------	----------	%	----------	----------	----------
1. atrazine	90 WP	0.6	pre	96	96	98	99	97	96
metolachlor	8 EC	2.2	pre						
2. atrazine	90 WP	0.6	pre	99	99	99	95	96	95
metolachlor	8 EC	2.2	pre						
atrazine (1% COC)	90 WP	0.5	spike						
3. atrazine	90 WP	0.5	pre	99	96	97	93	95	94
metolachlor	8 EC	2.2	pre						
bromoxynil	4 EC	0.38	spike						
4. atrazine	90 WP	0.6	spike	96	94	96	95	88	94
alachlor (1% COC)	4 ME	2.2	spike						
5. atrazine	90 WP	0.6	spike	98	97	96	97	94	96
metolachlor (1% COC)	8 EC	2.2	spike						
6. untreated check									

[a] Data averaged across years.
[b] Bayer codes AMARE = redroot pigweed; CHEAL = common lambsquarters; DIGSA = large crabgrass

Table 2. Weed species establishment in a killed rye mulch in conventional and no-tillage systems in 1986[a].

Tillage	-Average Number of Plants/0.5m^2- AMARE	CHEAL	DIGSA	ECHCG
NT	12a[b]	8a	16a	21a
CT	30b	29b	10a	29a

[a] Data are the mean of the 5 herbicide programs.
[b] Mean separation within columns by Student-Neuman-Keul's procedure. Data were analyzed across herbicide programs.

Whereas injury in 1985 appeared as stunting and was slight in all cases, distinct injury was observed in 1986 (Table 3). The spike stage applications were particularly harmful in 1986. With the exception of the preemergence program (atrazine plus metolachlor) the degree of injury ranged from 27 to 33% and did not differ significantly among herbicide programs or between tillage

systems. Injury symptoms however, did vary; those observed in metolachlor and alachlor programs occurred as stunting while bromoxynil caused foliar necrosis.

Table 3. Early-season injury assessments of five herbicide programs for no-tillage sweet corn in 1985 and 1986[a].

Program	Timing	Injury 7-2-85	Injury 6-28-86
		(%)	
1. Atrazine + metolachlor	spike	7a[b]	32a
2. Atrazine + alachlor	spike	10a	27ab
3. Atrazine + metolachlor	pre	10a	22b
4. Atrazine + metolachlor + atrazine	pre spike	0a	27ab
5. Atrazine + metolachlor + bromoxynil	pre spike	10a	33a
6. untreated check			

[a] Data averaged across tillage system.
[b] Mean separation within columns by Student-Neuman-Keul's procedure with $\alpha = 0.05$.

As there were no significant differences among herbicide programs with regard to stand establishment, efficacy or yields the following discussion is based on data that has been analyzed across herbicide programs.

The sweet corn population density in NT plots was significantly greater than the density in CT plots in 1985 (Table 4). No difference was observed in 1986. This was largely attributable to precipitation occurring in the 6-day period prior to and following the planting dates of the two years, which was 2.6 cm in 1985 and 7.7 cm in 1986. The potential moisture retention under the mulch in 1985 may have enhanced germination and early seedling establishment. In 1986, the moisture was adequate and the mulch layer provided no additional benefit.

Table 4. The effect of tillage on sweet corn populations and yields in 1985 and 1986.

Year	Tillage	Density (No/ha)	Total Ears (No/ha)	Ear Weight (MT/ha)
1985	NT[a]	53,100a[b]	58,900a	15.7a
	CT	49,800b	52,800b	14.6a
1986	NT	50,700a	50,700a	15.2a
	CT	50,500a	50,900a	17.4a

[a] NT = no tillage; CT = conventional tillage
[b] Means within column and year having the same letter do not differ significantly at the $\alpha = 0.05$ level with Student-Neuman-Keul's mean separation procedure.

The number of ears harvested was lower in CT plots in 1985 as would be expected when populations were reduced (Table 4). Final harvest weights however, did not differ significantly indicating that ear size in NT plots was smaller than in CT plots. In 1986 the total number of ears and the total weight of the harvested crops were not different in the two tillage regimes. In spite of the high level of early injury that occurred in 1986 yields compared favorably with yields obtained in 1985.

It is apparent that the five herbicide programs evaluated in this study were equivalent in terms of efficacy and injury-causing potential. However, applications at spike stage should be made with caution and careful attention to local environmental conditions. The no-tillage system for sweet corn worked well under Central New York conditions and yields were equivalent to those of a conventional tillage system.

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RE-40885 FOR BROADLEAF WEED CONTROL IN SEVERAL VEGETABLE CROPS

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ABSTRACT

RE-40885 was evaluated for efficacy and phytotoxicity at 0.56 kg ai/ha to 1.1 kg ai/ha preplant incorporated or preemergence in carrots, acorn squash, lima beans, and cucumbers. The herbicide was also evaluated for efficacy at 0.56 kg ai/ha preemergence in an established weed nursery containing natural populations of a variety of summer annual weeds. No injury was observed to carrots or acorn squash at either rate evaluated. Lima beans and cucumbers treated with RE-40885 preplant incorporated or preemergence emerged, but the cotyledons were white and appeared completely devoid of chlorophyl. The seedlings died about one week after emergence. Summer annual weeds controlled by RE-40885, either in the vegetable experiments or in the weed nursery, included large crabgrass (**Digitaria sanguinalis** (L.) Scop), fall panicum (**Panicum dichotomiflorum** Michx.), stinkgrass (**Eragrostis cilianensis** (All.) E. Mosher), velvetleaf (**Abutilon theophrasti** Medik.), Smooth pigweed (**Amaranthus hybridus** L.), common lambsquarters, (**Chenopodium album** L.), common purslane (**Portulaca oleracea** L.), and common ragweed (**Ambrosia artemisiifolia** L.). Pennsylvania smartweed (**Polygonum pensylvanicum** L.) was suppressed in the weed nursery by 0.56 kg ai/ha applied preemergence. Common cocklebur (**Xanthium strumarium** L.), giant foxtail (**Setaria faberi** Herrm.), and goosegrass (**Eleusine indica** (L.) Gaertn.) were not controlled by RE-40885.

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THE EFFECT OF OXYFLUORFEN, PROPANIL, DIQUAT AND PARAQUAT ON POTATO VINE DESICCATION.[1]

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ABSTRACT

Oxyflourfen alone and in combination with diquat, propanil in combination with carbaryl, diquat alone and paraquat alone were evaluated as potato (Solanum tuberosum L.) vine desiccants. Leaf and stem desiccation ratings, total and 5-10 cm tuber yield, specific gravity and vascular discoloration ratings are presented. Diquat at 0.28 and 0.56 kg/ha and paraquat at 0.28 kg/ha effectively desiccated leaves 13 days after application but provided marginal stem desiccation. The addition of diquat at 0.28 kg/ha to oxyflurorfen improved desiccation but was not significantly better than diquat alone. The treatments that provided the best stem desiccation thirteen days after application were diquat at 0.28 and 0.56 kg/ha, paraquat at 0.28 kg/ha, and oxyfluorfen at 0.14 kg/ha in combination with diquat at 0.28 kg/ha. Yields were reduced when chemical vine desiccants were applied but there were no significant differences in yield between chemical treatments. Specific gravity and vascular discoloration ratings were not affected by vine desiccation treatments.

INTRODUCTION

The loss of dinoseb [2-(1-methylpropyl)-4,6-dinitrophenol] as a potato vine desiccant has renewed interest in the evaluation of compounds that could provide an effective substitute for it. Dinoseb has been the standard vine desiccant throughout the northern tier of states where vine desiccation is necessary. The purpose of this study is to evaluate the performance of oxyfluorfen [2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene] and propanil [*N*-(3,4-dichlorophenyl)propanamide] and compare the results to the standard potato vine desiccants, diquat [6,7-dihydrodipyrido [1,2-*a*:2',1'- *c*]pyrazinediium ion] and paraquat [1,1'-dimethyl-4, 4'-bipyridinium ion].

MATERIALS AND METHODS

Experimental treatments were applied to 'Katahdin' potatoes at the Long Island Horticultural Research Laboratory at Riverhead, New York. Potatoes were planted on May 13, 1987 in rows 86 cm apart. Within row spacing was 24 cm. Fertilizer was applied in bands 5 cm to the side and about the same depth as the seed pieces at a rate equivalent to 112 kg/ha of nitrogen and potash, 224 kg/ha of phosphate, and 56 kg/ha of magnesium oxide. An additional 90 kg/ha of nitrogen was applied when plants were approximately 15 cm tall. Plot size was 3 rows by 9 meters long. Harvest and quality data were collected from the center row by 7.6 meters long. Experimental design was a ramdonized complete block with 4 replications. Treatments were applied with a tractor-mounted sprayer delivering 374 l/ha at 2.8 kg/cm2. Vine desiccation treatments were applied on August 25th when the air temperature was 23° C. The plants were relatively green and vigorous at time of application.

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Plots were harvested on November 2nd, 1987. Yield data, size distribution, specific gravity and the amount of vascular discoloration will be presented in this report. Additional studies on storability and sprout development will be conducted through the storage season. Ratings on vine desiccation are based on a scale of 0 to 10. The 0 rating is equivalent to no desiccation and 10 represents complete desiccation. Ratings were collected separately on leaves and stems. The ratings were collected 3, 7, 13, 21 and 35 days after application.

Vascular discoloration ratings were made on 25 tubers from each treatment in each replication. Tubers were cut 3mm below the stem attachment. Vascular discoloration categories are: none, slight, moderate and severe.

Weather data showing the high and the low temperatures and precipitation are presented in table 1.

Table 1. Temperature [°C (°F)] and rainfall record [mm (in)], Long Island Horticultural Research Laboratory, Riverhead, NY.

Date	Temperature High	Temperature Low	Rainfall mm (in.)	Date	Temperature High	Temperature Low	Rainfall mm (in.)
August				*Sept*			
25	23 (74)	10 (49)	0	11	28 (82)	17 (62)	0
26	27 (80)	10 (52)	0	12	20 (68)	17 (62)	1 (t)
27	23 (74)	15 (59)	24 (0.9)	13	22 (73)	18 (65)	20 (0.8)
28	17 (63)	15 (59)	16 (0.6)	14	25 (77)	18 (65)	2 (0.1)
29	21 (70)	14 (58)	3 (0.1)	15	25 (77)	16 (60)	0
30	24 (77)	14 (58)	0	16	26 (78)	16 (60)	0
31	23 (75)	12 (54)	0	17	24 (75)	18 (65)	29 (1.1)
Sept				18	22 (71)	14 (58)	8 (0.3)
1	23 (74)	17 (62)	9 (0.4)	19	17 (62)	13 (56)	13 (0.5)
2	26 (78)	11 (52)	0	20	17 (62)	14 (57)	1 (t)
3	23 (74)	16 (61)	0	21	21 (69)	14 (57)	0
4	23 (74)	12 (54)	0	22	23 (74)	13 (55)	2 (0.1)
5	23 (74)	11 (51)	0	23	22 (72)	11 (51)	1 (t)
6	22 (73)	13 (55)	0	24	24 (75)	13 (56)	0
7	26 (79)	22 (68)	3 (0.1)	25	23 (74)	12 (54)	7 (0.3)
8	27 (80)	19 (67)	4 (0.2)	26	21 (69)	4 (39)	0
9	28 (82)	22 (71)	2 (0.1)	27	21 (70)	10 (50)	0
10	28 (83)	20 (68)	0	28	26 (70)	13 (55)	0

RESULTS AND DISCUSSION

Three days after application, the treatments that resulted in the fastest leaf desiccation were oxyfluorfen at 0.14 kg/ha in combination with diquat at 0.28 kg/ha and diquat alone at 0.56 kg/ha (Table 2). Seven days after application, diquat alone at 0.56 kg/ha or at 0.28 kg/ha in combination with oxyfluorfen at 0.14 kg/ha or paraquat alone at 0.28 kg/ha resulted in similar leaf desiccation readings. Thirteen days after application, diquat at 0.28

and 0.56 kg/ha; oxyfluorfen at 0.14 and 0.26 kg/ha in combination with diquat at 0.28 kg/ha; and propanil at 4.48 kg/ha in combination with carbaryl [1- Naphthyl *N*-methylcarbamate] at 0.75 kg/ha gave leaf desiccation readings greater than 9.0. These treatments were not significantly different from each other at the 5% level. Oxyfluorfen alone did not adequately desiccate leaves 13 days after treatment.

Stem desiccation was slight for all treatments one week after application. Thirteen days after application, diquat at 0.28 and 0.56 kg/ha, paraquat at 0.28 kg/ha, and oxyfluorfen at 0.14 kg/ha in combination with diquat at 0.28 kg/ha gave readings that were not significantly different from each other. The degree of stem desiccation 13 days after application was not adequate for commercial operations. None of the treatments provided 100% desiccation of the stem tissue 21 days after application. Treatments including diquat and paraquat had the highest ratings at that time.

The vine desiccation experiment conducted at the Long Island Horticultural Research Laboratory in 1987 was a severe test for the treatments included in the experiment. Potatoes were planted approximately one month later than normal and were fertilized with additional nitrogen to insure vigorous growth at the end of the season. The chemical treatments were applied earlier than normal to be sure to have green vines at time of application. The condition of plant growth and weather conditions after application definitely provided an extreme test for the vine desiccation treatments. Results showed that the two labeled vine desiccants, diquat and paraquat, resulted in relatively good leaf and stem desiccation. Oxyfluorfen by itself at rates ranging from 0.14 to 0.56 kg/ha gave marginal desiccation of leaves and poor desiccation of stems. When diquat was added to oxyfluorfen the leaf and stem desiccation improved but was not significantly better than diquat used alone. Propanil in combination with carbaryl at 4.48 and 0.75 kg/ha, respectivly, gave marginal leaf desiccation and poor stem desiccation 13 days after application.

Harvest results show that all chemical vine desiccation treatments reduced total yield and 5-10 tuber yield when compared to the untreated control. Yields were not significantly different between chemical treatments. Specific gravity and vascular discoloration were not affected by vine desiccation treatments.

Table 2. The effect of twelve vine desiccation treatments on leaf and stem desiccation of 'Katahdin' potatoes

		Leaves					Stems				
		Days after application					Days after application				
Chemical	Rate (kg/ha)	3	7	13	21	35	3	7	13	21	35
Control		0.3	1.0	2.3	2.3	9.3	0.0	0.0	0.0	0.0	4.0
oxyfluorfen	0.14	2.3	5.0	6.3	9.0	10.0	0.3	0.0	1.5	6.8	9.8
oxyfluorfen	0.28	2.3	3.8	5.5	9.3	10.0	0.0	0.0	0.5	4.8	10.0
oxyfluorfen	0.56	2.0	4.5	6.3	9.5	10.0	0.0	0.0	1.0	7.0	9.5
oxyfluorfen + diquat	0.14+0.14	4.5	6.8	8.3	10.0	10.0	0.0	0.8	2.8	8.3	10.0
oxyfluorfen + diquat	0.14+0.28	6.5	8.3	9.5	10.0	10.0	0.8	1.3	5.3	8.5	10.0
oxyfluorfen + diquat	0.28+0.28	5.3	8.0	9.3	9.8	10.0	0.0	0.8	4.3	8.8	10.0
diquat	0.28	4.3	8.0	9.8	9.8	10.0	0.0	0.8	7.0	8.3	10.0
diquat	0.56	7.3	8.8	10.0	10.0	10.0	0.3	1.8	8.0	9.3	10.0
propanil + carbaryl	2.24+0.38	0.5	2.3	5.8	9.5	10.0	0.0	0.0	0.8	5.5	9.5
propanil + carbaryl	4.48+0.75	1.0	4.0	9.0	9.8	10.0	0.0	0.0	1.5	7.5	9.5
paraquat	0.28	4.8	7.5	9.5	10.0	10.0	0.3	1.3	6.3	8.3	10.0
Waller-Duncan(0.05)		(1.6)	(1.3)	(1.6)	(0.8)	(ns)	(0.5)	(0.6)	(1.7)	(1.8)	(0.9)

Leaf and stem desication ratings are based on a scale of 0-10, 0 = no desiccation, 10 = total desiccation

Table 3 . The effect of twelve vine desiccation treatments on tuber yield and quality

Chemical	Rate(kg/ha)	Yield (t/ha) Total	Yield (t/ha) 5-10cm	% of Control 5-10cm	Spec Grav	Vascular discoloration None	Vascular discoloration Sl	Vascular discoloration Mod	Vascular discoloration Sev
Control		46	39	100	67	63	30	6	1
oxyfluorfen	0.14	35	30	76	64	64	28	6	2
oxyfluorfen	0.28	34	28	70	65	54	44	2	0
oxyfluorfen	0.56	31	25	64	66	46	44	7	3
oxyfluorfen +diquat	0.14+0.14	32	26	67	64	51	43	5	1
oxyfluorfen +diquat	0.14+0.28	32	26	66	63	68	26	5	1
oxyfluorfen +diquat	0.28+0.28	33	28	72	63	51	40	8	1
diquat	0.28	37	32	81	65	67	26	7	0
diquat	0.56	35	29	74	65	65	28	6	1
propanil +carbaryl	2.24+0.38	33	27	68	63	75	19	5	1
propanil +carbaryl	4.48+0.75	35	29	73	66	68	30	2	0
paraquat	0.28	33	27	68	61	59	32	8	1
Waller-Duncan(0.05)		(07)	(06)		(ns)	(ns)	(ns)	(ns)	(ns)

1.0 omitted from specific gravity readings
Vascular discoloration ratings based on 25 tuber sample for each treatment in each replication. Tubers were cut 3mm below stem attachment. Abbreviations: Sl = slight, Mod = moderate, Sev = severe.

IMAZETHAPYR RESIDUE EFFECTS ON SEVERAL VEGETABLE CROPS

B. A. Majek [1]

ABSTRACT

Imazethapyr has been safely and effectively used to control broadleaf weeds in several edible bean crops, including snap beans, lima beans, and peas when applied preplant incorporated or preemergence at 0.036 to 0.053 kg ai/ha. Herbicide residue in the soil following the use of imazethapyr has the potential to adversely affect certain crops planted after bean harvest. The residue problem is particularly serious in snap beans and peas which mature quickly and are frequently followed by a second crop the same season. Tomatoes, peppers, cucumbers, zucchini squash, and carrots were planted in June, one month after imazethapyr was incorporated at 0, 0.036, 0.053, 0.069, and 0.11 kg ai/ha. Cabbage, spinach, and lettuce were planted in August, three months after imazethapyr application. Cucumbers, spinach, and cabbage were injured by 0.036 kg ai/ha of imazethapyr. Significant injury to the peppers and carrots was observed at 0.053 kg ai/ha, and to tomatoes and zucchini at 0.069 kg ai/ha. Lettuce planted three months after application was not injured by any rate of imazethapyr applied.

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SMOOTH PIGWEED INTERFERENCE IN NONBEARING PEACHES

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ABSTRACT

The effect of smooth pigweed (**Amaranthus hybridus L.**) on the growth of newly planted peach trees was investigated at the Rutgers Research and Development Center, Bridgeton, New Jersey, in 1985 and 1986. A two-year field experiment was initiated to determine the effect of smooth pigweed planting date and density on the growth of peaches.

Smooth pigweed planted in May achieved greater height and dry matter accumulation than the June, July or August plantings in both 1985 and 1986. Smooth pigweed planted in May at 1.72 weeds per m^2 for two consecutive years reduced both tree trunk diameter and tree weight. Tissue analysis indicated that N, S, Fe and Cu decreased in concentration in trees growing in competition with smooth pigweed planted in May or June. P, Ca, Mg, B and Sr increased in concentration in the tissue of trees that were reduced in size by smooth pigweed competition, indicating that neither the weeds nor reduced tree size affected uptake of these nutrients. The concentration of K, Mn, Al, Zn and Pb were not affected by smooth pigweed competition.

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EFFECT OF GLYPHOSATE AND GLUFOSINATE SUCKER APPLICATIONS ON GRAPEVINES

R. M. Dunst and R. M. Pool[1/]

ABSTRACT

Application of glyphosate to the basal portion of profusely suckering grapevines (Vitis spp. 'DeChaunac'), at four developmental stages, caused injury symptom development following apparent translocation that confirmed the necessity for existing vineyard use limitations. Similar treatments with glufosinate were not associated with similar injury in the year of, or following, treatment. Glufosinate thus appears to have a much wider margin of safety in vineyards than does glyphosate. This suggests that a potential vineyard registration for glufosinate might be less restrictive than that of glyphosate.

INTRODUCTION

Previous research with glufosinate [ammonium-(3-amino-3-carboxyl-propyl)-methyl phosphinate] and glyphosate [(N-phosphonomethyl)glycine] involved selective placement to mature grape leaves during several developmental stages. Injury symptom development following uptake and apparent movement of glufosinate suggested symplastic translocation similar to, but less extensive than, that of glyphosate (1). Use of glyphosate in Eastern U.S. vineyards is restricted to developmental stages that restrict its contact with mature grape foliage (2,3). Because apparent movement of glufosinate to photosynthetic sinks following application to mature leaves paralleled that of treatment with glyphosate, we suggested that recommendations for glufosinate use in vineyards should minimize contact with mature grape foliage. The purpose of this experiment was to clarify the relative safety of glyphosate and glufosinate applications in vineyards, using commercial-type applications.

MATERIALS AND METHODS

All applications were made with an over-the-row boom in 470 l/ha. Glufosinate and glyphosate were applied at 2 kg ai/ha. We sprayed the basal portions (up to 30 cm from the soil surface) of 'DeChaunac' vines at four developmental stages; pre-bloom (May 24, 1986), during bloom (June 14), mid-way between bloom and veraison, the beginning of berry maturation (July 21), and at veraison (August 20). The variety 'DeChaunac', a complex interspecific hybrid of

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Vitis, was chosen due to its profuse suckering habit, which ensured that a large leaf area surface was sprayed relative to other grape varieties. Spraying the basal portion of the vines ensured that the leaves with greatest maturity, those most capable of symplastic translocation, were sprayed.

Three replicate vines were used per treatment. For the two post-bloom application dates, some foliage was tucked up into the trellis so that only sucker growth was contacted by the sprays. Also, sucker growth was separated from adjacent vines for these treatments. The vines were observed at two week intervals during1986 and 1987.

RESULTS

Table 1 summarizes the occurence and severity of injury symptom development from contact and from apparent herbicide translocation associated with these treatments. These are explained in detail below.

Table 1. Rating of injury symptom development on contacted foliage or from apparent translocation from basal vine treatment with glufosinate or glyphosate. X-slight injury, XX-significant injury, XXX-death of affected tissue.

	LOCATION AND SEVERITY OF INJURY SYMPTOM DEVELOPMENT FROM CONTACT AND APPARENT TRANSLOCATION					
	TREATMENT YEAR			YEAR FOLLOWING TREATMENT		
TREATMENT	contacted foliage	treated suckers	parent vine	new suckers	sprayed renewals	parent vine
glufosinate						
pre-bloom	XXX					
bloom	XXX	X				
post-bloom	XXX					
veraison	XXX					
glyphosate						
pre-bloom	XX	XX				
bloom	XX	XX	XX			
post-bloom	XXX	XX		XX	XX	
veraison	XX				XXX	XX

Pre-bloom applications. Glufosinate caused extensive damage to contacted foliage, but no translocation within the suckers or to other portions of the vine was evident. Renewed growth on severely damaged suckers was either absent or normal. There was no apparent injury in the year following treatment. Glyphosate caused less extensive damage to contacted foliage than did glufosinate. Symptoms of apparent acropetal translocation were evident on these suckers. There was no

apparent injury to the parent vine in the year of treatment, and no injury symptoms on the vine in the year following treatment.

Bloom applications. Glufosinate injury was similar to that of the previous application. On one replicate vine, foliage on some suckers above the spray zone showed injury similar to that of contacted foliage; this was judged to be due to herbicide translocation. There were no other symptoms of herbicide translocation in the year of, or following, treatment. Glyphosate injury to suckers was similar to that of the previous timing. Symptoms of apparent translocation of glyphosate appeared on lateral shoot growth on the parent vines four to six weeks following treatment. There were no injury symptoms from bloom applications of glyphosate in the year following treatment.

Post-bloom applications. Injury from glufosinate treatment was similar to that of the previous timings. There was no apparent translocation on treated suckers, and there were no injury symptoms on the parent vine in the year of, or following, treatment. Symptoms of apparent translocation of glyphosate in the suckers were similar to that of the previous timings. There was no apparent injury to the parent vine in the year of treatment. In the year following treatment, new sucker growth, and shoots arising from retained renewal canes (suckers that had been sprayed in the previous year), showed severe injury symptoms, including leaf chlorosis and malformations, and shortened internode length.

Veraison applications. Injury from glufosinate treatment was similar to that of the previous timings. Again, there was no indication of injury to the parent vine in the year of treatment or in the year following treatment. There was no apparent acropetal translocation of glyphosate in treated suckers, but these suckers failed to form any periderm (ripened wood); therefore none survived into the following year. There were no other injury symptoms associated with this treatment in the year the applications were made. In the year following treatment, injury symptoms from apparent translocation were noted on new sucker growth and throughout the parent vine. Glyphosate appeared to be translocated to the parent vine from about two weeks pre-bloom, until several weeks after bloom.

DISCUSSION

Previously, selected placement of glufosinate on grapevines resulted in injury symptom development that suggested symplastic translocation similar to that of glyphosate (1). In this work, applications to profusely suckering grapevines indicates that injury from translocation following treatment with glufosinate is much less extensive than that with glyphosate. There was no injury symptom development in the parent vines associated with glufosinate applications in the year of treatment or in the year following treatment over a range of developmental stages. Conversely, similar applications of glyphosate resulted in injury symptom

development that confirmed the necessity of the current restrictions to its use in Eastern U.S. vineyards.

We feel these results indicate glufosinate has a wider margin of safety for vineyard use than does glyphosate. A potential grape label for glufosinate might permit applications in vineyards beyond the cutoff date for glyphosate applications (the end of grape bloom), and beyond the cutoff date in unsuckered vineyards (the appearance of green grape tissue in the spray zone). Also, our data indicates that contact injury is greater with glufosinate than with glyphosate, so that chemical suckering of grapevines might be feasible. Further research should address the potential for grapevine injury from translocation of glufosinate due to contact with foliage on the parent vine.

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CONTROL OF FIELD VIOLET IN STRAWBERRIES WITH ACIFLUORFEN AND OXYFLUORFEN

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ABSTRACT

Field violet (Viola arvensis Murr.) has become a serious weed in strawberry (Frageria x ananassa Duch.) plantings in the eastern U.S. and Canada. It starts to emerge in late August or early September, flowers in the early spring and usually dies in the summer after producing abundant seeds. Currently registered herbicides for strawberry plantings have not given postemergence control of field violet and heavily infested fields have sometimes been abandoned because of the difficulty in harvesting. Since field violet commonly occurs in grain fields, it may have been brought into strawberry plantings with straw that is used for winter mulch. It also occurs in non-tilled crops such as Christmas trees where it does not appear to be highly competitive. Reports from North Carolina indicated that postemergence control of field violet could be obtained with acifluorfen in dormant strawberries.

Experiments were conducted during 1985 and 1986 in strawberry plantings on sandy loam soils to evaluate the effects of dosage, timing and added surfactant on the postemergence control of field violet and injury to strawberry plantings with acifluorfen and related herbicides. Sprays were applied with CO_2 - powered, hand-held, three-or four-nozzle booms calibrated to deliver 30 gal/A. In each experiment randomized complete block designs were used with four replicates.

September applications of acifluorfen at 1.0 lb/A with 0.25% v/v surfactant gave excellent control of 3/4 inch diameter field violet within 1 month but only fair control the following May, indicating that seedlings emerging later were not controlled (Table 1). October applications on 1 to 3 inch diameter field violet and early May applications on flowering field violet gave good to excellent control in late May. November applications followed by rainfall 4h later gave poor control. Surfactant sometimes improved control with acifluorfen without much effect on plant injury. Acifluorfen at 0.5 or 1.0 lb/A plus surfactant also gave good to excellent control of common dandelion (Taraxacum officinale Weber).

Acifluorfen caused less injury to dormant strawberries in late October than to actively growing plants in September, early October or May. Leaf injury in the fall, however, was less evident at harvest. Late spring frosts unfortunately prevented yield determinations.

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Lactofen at 0.15 or 0.3 lb/A in early May gave poor control of field violet and moderately injured strawberry plants.

Oxyfluorfen at 0.25 or 0.5 lb/A in late October gave almost complete control of field violet with little injury to 'Raritan' strawberries at harvest. Oxyfluorfen in May gave lesser control and increased injury (Table 1). In a second experiment with 'Raritan' and 'Kent' strawberries on a silt loam soil, oxyfluorfen at 0.25, 0.38 or 0.5 lb/A applied alone or in combination with terbacil at 0.25 lb/A on October 15 or 30 caused no significant reduction in strawberry vigor at harvest. Further studies will be directed at effects of fall-applied oxyfluorfen on strawberry yields.

Acifluorfen and especially oxyfluorfen offer promise for control of field violet in dormant strawberries.

Table 1. Control of field violet and injury to 'Raritan' strawberries with herbicides applied at different times with (+) and without (-) surfactant.

Herbicide	lb/A ai	Surf.[1]	Date Applied	Control of field violet (0-10) 1 mo	Control of field violet (0-10) May 28	Injury (0-10) 1 mo	Injury (0-10) May 28
untreated control		-	-	0	0	0	0
acifluorfen	0.25	+	Sept 13	8.8	3.3	3.0	0
	0.5	+	Sept 13	9.4	6.1	3.5	0.5
	1.0	+	Sept 13	9.8	7.1	4.0	0.8
	0.25	+	Oct 2	7.1	6.3	2.5	0.3
	0.5	+	Oct 2	6.5	8.7	3.0	1.7
		-	Oct 2	6.5	7.9	3.0	1.3
	1.0	+	Oct 2	8.5	8.9	3.3	1.5
		-	Oct 2	7.5	8.7	3.0	1.0
	0.25	+	Oct 30	5.8	3.7	1.0	0
	0.5	+	Oct 30	7.0	5.0	1.0	1.5
		-	Oct 30	7.3	5.1	1.0	0
	1.0	+	Oct 30	8.8	8.3	2.0	0
		-	Oct 30	8.1	8.0	1.8	1.3
	0.25	+	May 8	-	7.0	-	3.3
	0.5	+	May 8	-	7.4	-	3.0
		-	May 8	-	7.6	-	2.8
	1.0	+	May 8	-	9.0	-	4.3
		-	May 8	-	8.4	-	3.3
oxyfluorfen	0.25	-	Oct 30	8.5	9.6	1.0	0.3
	0.5	-	Oct 30	8.5	9.9	2.0	1.3
	0.25	-	May 8	-	5.5	-	2.3
	0.5	-	May 8	-	7.3	-	2.8
lactofen	0.15	-	May 8	-	5.0	-	2.3
	0.3	-	May 8	-	5.8	-	3.0

1) AG-98 surfactant at 0.25% v/v
2) 0=no control or injury; 10=100% control or dead plants.

BENTAZON AND BENTAZON/MCPB TANK MIXES FOR WEED CONTROL IN ENGLISH PEA

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ABSTRACT

Several alternatives to dinoseb were tested for effectiveness against broadleaf weeds infesting English pea (Pisum sativum L.). Experiments were conducted at eight locations in three northeastern states. Tank-mixes of bentazon with MCPB provided more consistent weed control than either herbicide alone under a wide range of conditions. Bentazon alone proved erratic in activity against common lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), and common ragweed (Ambrosia artemisiifolia L.). MCPB alone was consistently effective only against common lambsquarters. When tank-mixed, commercially acceptable control of all broadleaved weeds was obtained. Based on this study, the lower bentazon/MCPB tank-mix rate (0.56 and 0.25 to 0.56 kg ai/ha, respectively) should be used to minimize costs and phytotoxicity whenever possible. The higher tank-mix rate (0.84 and 0.56 to 0.84 kg ai/ha, respectively) was necessary for control of redroot pigweed after it passed the 2 to 4 leaf stage and also improved common ragweed control. The lower tank-mix rate proved equally effective against most other broadleaf weeds and provided better crop tolerance.

INTRODUCTION

In past years, the vast majority of northeastern pea acreage was treated with dinoseb [2-(1-methylpropyl)-4,6-dinitrophenol] for control of broadleaved weeds. Cancellation of the many products containing dinoseb has imposed a particular hardship on growers and processors of peas because few alternative herbicides exist and because several of these alternatives are potentially phytotoxic and may delay maturity. Delays in maturity are particularly troublesome in pea production because planting and harvest dates are carefully scheduled to maintain maximum pea quality. Scheduling is generally driven by accumulated degree days and any factor which interferes with the relationship between degree days and maturity of the pea crop may necessitate that fields be bypassed due to over-maturity. Delayed maturity is a particular problem with "phenoxy" herbicides, such as MCPA [(4-chloro-2-methylphenoxy)acetic acid]. Higher than optimal rates, improper timing, or unusual weather conditions can induce severe twisting and stunting of the pea crop while also delaying maturity (1,2,7). If left uncontrolled, early season weed competition can severely depress pea yields and delay maturation (4).

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Because of potential phytotoxicity problems with phenoxy herbicides, bentazon [3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide] may be a viable alternative to dinoseb for broadleaved weed control in peas. Available evidence suggests that excellent crop safety can be achieved once the pea crop passes the three node stage, excluding cotyledons. Because bentazon activity is known to be temperature-dependent, questions arise concerning efficacy of this herbicide under cool conditions. In addition, adjuvant use with bentazon is not recommended on peas due to phytotoxicity problems. While bentazon alone is known to effectively control many broadleaved weeds (8), control of some species is inconsistent when when crop oil concentrate is not used. In soybeans, control of common lambsquarters and redroot pigweed has been inconsistent (3,5).

The objectives of this study were to determine whether bentazon would effectively control broadleaved weeds under a wide range of northeastern conditions and to determine whether the addition of MCPB [4-(4-chloro-2-methylphenoxy)butanoic acid] to bentazon would enhance broadspectrum broadleaf weed control while maintaining crop safety.

MATERIALS AND METHODS

Field experiments were conducted at eight locations around the Northeast comprising varying soil and climatic conditions, cultural practices, and planting dates. Peas were generally drilled in rows 15.2 to 17.8 cm apart using standard cultural practices for the test area. Row spacing was 45.7 cm at Freeville, NY. Plot size varied with location from 0.9 to 3.7 m in width and from 3 to 9 m in length. Trial locations, experimental methods, crop variety, and additional application data are listed in Table 1. Treatments at each location consisted of an untreated check, MCPA and or MCPB alone at 0.42 to 1.12 kg/ha, bentazon alone at 1.12 kg/ha, a low rate tank mix containing 0.56 kg/ha bentazon plus 0.28 to 0.56 kg/ha MCPB, and a high rate tank mix containing 0.84 kg/ha bentazon plus 0.56 to 0.84 kg/ha MCPB. At the Connecticut site, MCPA was used as the tank-mix partner instead of MCPB. All treatment applications were applied postemergence at the crop and weed growth stages listed in Table 1. Phytotoxicity ratings were taken on a percent injury basis at 2 to 24 d after treatment depending on the location. Weed control ratings were taken on a percent control basis at 15 to 49 d after treatment. Commercially acceptable control levels were considered to be at 85 percent. Additional notes concerning type of injury, date of flowering, and date of maturity were recorded at each location. Subsamples were taken from each plot at approximately the time of commercial harvest for determination of crop biomass and pea yield. Number of peas/pod and pods/plant were also determined at the Maine locations.

RESULTS AND DISCUSSION

Populations and species of various weed types varied considerably among locations; therefore, control ratings have been broken into groupings by weed species in Tables 2 through 5 to facilitate discussion. No treatment failures were attributable to rainfall within 24 h of application. While we recognize that inconsistencies in weed species, weed growth stages at application, rating dates, climatic conditions, and

Table 1. Trial locations, experimental methods, planting and application dates, and plant growth stages for English pea (*Pisum sativum* L.) weed control experiments (1987).

Location Code	Trial Location	Pea Variety Planting Date	Application Methods	Exptl. Design	Applic. Date (Crop Growth Stage)	Max. Air Temp.[1] °C	Weed Growth Stage #leaves	Phyto/ Weed Rating Date[2]
CT[3]	UConn Research Farm, Mansfield	Olympia 5-13	tractor-mtd. spr. 225 l/ha@276kPa	RCB w/3 reps	6-16 (4 nodes)	30.5;27.3 24.4;26.7	4	6-25
ME1	Aroostook Farm Presque Isle	Bolero 5-26	backpack spr. 280 l/ha@207kPa	RCB w/4 reps	6-17 (4 nodes)	24.3;30.9 28.2;26.0	2-3	6-24/7-8
ME2[4]	Roope Farm Presque Isle	Bolero 5-14	backpack spr. 225 l/ha@138kPa	RCB w/4 reps	6-8 (5-6 nodes)	22.5;14.4 23.1;24.2	2-4	7-2
ME3	Harrison Farm Presque Isle	Bolero 5-17	same as ME2	RCB w/4 reps	6-8 (5-6 nodes)	same as ME2	2-4	7-2
NY1	Thompson Res. Farm, Freeville	Bolero 5-8	backpack spr. 280 l/ha@242kPa	RCB w/4 reps	6-5 (6 nodes)	21.8;22.4 18.5;21.3	CHEAL:1-6 OTHERS:2-4	6-11/7-22
NY2	Mulcahy Farm#1 Leroy	Bolero 4-18	backpack spr. 225 l/ha@276kPa	RCB w/3 reps	5-12 (3-4 nodes)	30.8;15.7 21.8;26.3	CHEAL:2-6 CYPES:2-6 OTHERS:2-4	5-18/6-25
NY3	Northrup Farm Bergen	Spring 4-20	same as NY2	RCB w/3 reps	5-27 (6-7 nodes)	22.4;21.3 31.9;33.0	CHEAL:6-14 AMARE:6-14 OTHERS:2-8	5-29/6-11
NY4	Mulcahy Farm#2 Leroy	Bolero 4-18	same as NY2	RCB w/3 reps	5-27 (6-7 nodes)	same as NY3	CHEAL,LAMAM:20+ AMBEL:4-18 AMARE:7-14	5-29/6-25

[1]Max. temp. are for applic. date and three subsequent dates. Data are from nearest avail. station: CT=UConn Research Farm, Mansfield; ME=Aroostook Farm, Presque Isle; NY1=Thompson Res. Farm, Freeville; NY2, 3 & 4=Rochester, NY.
[2]Data from additional rating dates may be available from individual researchers.
[3]Preplant trifuralin [2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine] was applied at 0.84 kg ai/ha to suppress a severe infestation of lg. crabgrass (*Digitaria sanguinalis* L.) at this site. MCPA was used as tank-mix partner instead of MCPB.
[4]Trifluralin (PPI) was applied at 0.56 kg ai/ha to suppress annual grasses.

treatments complicate broad cross-location conclusions, useful information for herbicide performance across a wide range of conditions can be gleaned from these data. Crop injury ratings and yield performance are summarized in Tables 6 and 7, respectively.

Common lambsquarters. Common lambsquarters was present at six locations in this study (Table 2). Consistent control of this weed species was obtained with MCPA, MCPB, and both tank mixes. High tank-mix rates did not improve lambsquarters control. Bentazon alone proved erratic, resulting in weak but acceptable control at four locations and poor control at two locations. Erratic control cannot be attributed entirely to weed growth stage at application, since acceptable control was obtained at NY3 where weeds were relatively large and poor control was obtained at NY2 where weeds were generally small (Table 1). Warm temperatures following treatment application at NY3 may have enhanced bentazon performance.

Table 2. Common lambsquarters control in English pea using MCPA, MCPB and bentazon alone and in tank mixes (1987).

Treatment		Percent common lambsquarters Control by Location[1,3]						
Herbicide	Rate (kg ai/ha)	CT	ME1	NY1	NY2	NY3	NY4	Mean ± SE
None	-	0	78	0	0	0	0	13 ± 13.0
MCPA	0.42	-	92	99	-	-	-	96 ± 3.5
MCPB[2]	0.84/1.12	-	98	99	99	100	99	99 ± 0.3
bentazon	1.12	90	90	93	17	93	63	74 ± 30.4
bentazon +MCPB[2]	0.84 0.56/0.84	100	98	99	99	100	90	98 ± 1.6
bentazon +MCPB[2]	0.56 0.28/0.56	100	95	99	99	99	99	98 ± 0.7

[1]Field locations were as indicated on Table 1.
[2]Higher MCPB rates were used at NY2, NY3, and NY4.
[3]Weeds/m^2 (where determined) were as follows: CT=22; ME1=16; NY2=5.

Redroot pigweed. Redroot pigweed occurred at five locations (Table 3). Commercially acceptable control of redroot pigweed was obtained with either MCPA or MCPB at all locations except NY2. Poor control by MCPB at this site may have resulted from poor competitive ability of the pea crop due to poor stands. Bentazon alone provided commercially acceptable control at only three of five sites. The low rate tank-mix treatment also failed at these locations. At both sites where poor control was observed, redroot pigweed plants had 6 to 14 leaves at the time of application which is considerably larger than recommended. Only the high tank-mix rate gave acceptable redroot pigweed control at all locations.

Table 3. Redroot pigweed control in English pea using MCPA, MCPB, and bentazon alone and in tank mixes (1987).

Treatment		Percent Redroot Pigweed Control by Location[1,3]					
Herbicide	Rate (kg ai/ha)	CT	NY1	NY2	NY3	NY4	Mean ± SE
None	-	0	0	0	0	0	0
MCPA	0.42	-	88	-	-	-	88
MCPB[2]	0.84/1.12	-	94	43	100	99	84 ± 13.7
bentazon	1.12	90	99	88	83	10	74 ± 16.2
bentazon +MCPB[2]	0.84 0.56/0.84	100	99	96	93	86	95 ± 2.5
bentazon +MCPB[2]	0.56 0.28/0.56	90	98	92	80	20	76 ± 14.3

[1]Field locations are as indicated in Table 1.
[2]Higher MCPB rates were used at NY2, NY3, and NY4.
[3]Weeds/m^2 (where determined) were as follows: CT=323; NY2=10.

Common ragweed. Common ragweed was present at three sites in this study (Table 4). Single applications of MCPB and bentazon provided adequate control of this weed species at only two sites. Common ragweed plants were not excessively large at any site; therefore, it is likely that herbicide failure was due to low temperatures following treatment at NY2. Both tank-mix treatments provided commercially acceptable control of common ragweed; however, the higher tank-mix rate proved more effective at all locations.

Table 4. Common ragweed and mustard control in English pea using MCPA, MCPB, and bentazon alone and in tank mixes (1987).

Treatment		Percent Weed Control by Location[1]						
		Common Ragweed[4]				Mustard species[2,4]		
Herbicide	Rate (kg ai/ha)	NY2	NY3	NY4	Mean ± SE	ME1	ME3	Mean ± SE
None	-	0	0	0	0	22	15	18 ± 3.5
MCPA	0.42	-	-	-	-	78	99	88 ± 10.5
MCPB[3]	0.84/1.12	78	90	96	88 ± 5.3	60	45	52 ± 7.5
bentazon	1.12	70	93	92	85 ± 7.5	92	100	96 ± 4.0
bentazon +MCPB[3]	0.84 0.56/0.84	99	100	99	99 ± 0.3	98	99	98 ± 0.5
bentazon +MCPB[3]	0.56 0.28/0.56	88	95	90	91 ± 2.1	95	100	98 ± 2.5

[1]Field locations are as indicated on Table 1.
[2]Mustard species were a mixed population of wild radish (*Raphanus raphanistrum* L.), wild mustard (*Brassica kaber* D.C.), and field mustard (*Brassica compestris* L.).
[3]Higher MCPB rates were used at NY2, NY3, and NY4.
[4]Weeds/m^2 (where determined) were as follows:
Common Ragweed: NY2=8. Mustard spp: ME1=162.

Mustard species. Weed pressure from mustard species appeared at two locations in Maine during this study. MCPB did not provide effective mustard control, while MCPA provided adequate control at only one site. Bentazon alone and both tank-mix treatments provided excellent mustard control at both locations. Control was relatively slow at ME2 due to cool temperatures following treatment.

Miscellaneous Broadleaved Weeds. None of the herbicides or tank mixes provided commercially acceptable control of the mixed broadleaf weed population present at ME1 (Table 5). Bentazon and both tank mixes provided effective control of common purslane (*Portulaca oleracea* L.), henbit (*Lamium amplexicaule* L.), and Pennsylvania smartweed (*Polygonum pensylvanicum* L.). MCPB proved quite ineffective against these weeds. Higher bentazon rates would be needed to control yellow nutsedge (*Cyperus esculentus* L.); however, it is unlikely that higher rates could be utilized without sacrificing crop safety on peas.

Table 5. Control of miscellaneous broadleaved weeds and sedges in English pea using MCPA, MCPB and bentazon alone and in tank mixes (1987).

Treatment		Percent Weed Control by Weed species Location[2,4]					
Herbicide	Rate (kg ai/ha)	Mixed Broadlv. ME1	POROL NY1	LAMAM NY2	CYPES NY2	POLPY NY3	Mean±
None	-	70	0	0	0	0	14±14.0
MCPA	0.42	80	55	-	-	-	68±12.5
MCPB[2]	0.84/1.12	72	23	27	0	30	30±11.7
bentazon	1.12	78	93	93	30	100	79±12.7
bentazon +MCPB[3]	0.84 0.56/0.84	82	99	93	30	100	81±13.1
bentazon +MCPB[3]	0.56 0.28/0.56	82	99	92	30	100	81±13.0

[1]Mixed broadleaved weeds included wild buckwheat (*Polygonum convolvulus* L.), hempnettle (*Galeopsis tetrahit* L.), cornspurry (*Spergula arvensis* L.), and common chickweed (*Stellaria media* L.); POROL=common purslane; CYPES=yellow nutsedge; POLPY=Pennsylvania smartweed; LAMAM=henbit
[2]Field locations are as indicated on Table 1.
[3]Higher MCPB rates were used at NY2, NY3, and NY4.
[4]Weeds/m^2 (where determined) were as follows:
Mixed broadleaves: ME1=44.
CYPES:NY2=40.

Crop Injury. MCPA caused the greatest degree of crop injury observed in these tests (Table 6). Injury symptoms were those typical of phenoxy-herbicides, i.e. twisting and curling of leaf petioles and some stunting of plants. MCPB caused similar but less severe symptoms. This observation is in agreement with the work of Vostral and Buchholtz (6). Bentazon injury, consisting of slight leaf chlorosis accompanied by occasional marginal necrosis, was observed only at ME1. As expected,

considerably higher injury ratings were recorded for the higher tank-mix rates than for the lower rates. Injury resulting from the lower tank-mix rates was intermediate between those of bentazon alone and MCPB alone. Measurable delays in flowering and maturity were caused by all treatments containing MCPA at the Connecticut site.

Table 6. Phytotoxicity in English pea following treatment with MCPA, MCPB and bentazon alone and in tank mixes (1987).

Treatment		Percent Crop Injury by Location[1]								
Herbicide	Rate (kg ai/ha)	CT	ME1	ME2	ME3	NY1	NY2	NY3	NY4	Mean±SE
None	-	0	0	0	0	0	0	0	0	0
MCPA	0.42	-	38	0	26	23	-	-	-	22±7.9
MCPB[2]	0.84/1.12	-	25	0	2	10	12	30	30	16±4.8
bentazon	1.12	0	18	0	0	0	0	0	0	2±2.2
bentazon +MCPB[2]	0.84 0.56/0.84	20	25	0	12	11	9	30	20	16±3.4
bentazon +MCPB[2]	0.56 0.28/0.56	0	20	0	0	10	3	18	20	9±3.3

[1]Field locations are as in Table 1.
[2]Higher MCPB rates were used at NY2, NY3, and NY4.

Crop Yields. When compared with weedy checks, the herbicide treatments used in this study generally resulted in significant yield increases (Table 7). Yield differences among herbicide treatments were generally nonsignificant. The exception occurred at the Connecticut site where injury resulting from the high tank-mix rate decreased yields. At this site, MCPA was used as the tank-mix partner instead of MCPB. Apparently, 0.56 kg ai/ha is an unacceptably high rate of MCPA for use on peas.

Number of pods/plant and peas/pod were measured at the three Maine sites (data not shown). At two of three sites, number of pods/plant was significantly reduced by weed competition. MCPB significantly reduced the number of pods/plant when compared to most herbicide treatments at ME1 (4.8 vs 6.1); however, this effect was probably due to increased weed competition resulting from poor control of mustards. The number of peas/pod for the high and low tank-mix rates were 5.3 and 4.9, respectively. Both differed significantly from those of the bentazon treatment which average 6.2 peas/pod. The latter number differed significantly from those of several other herbicide treatments. Whether these differences have any biological significance is unknown at this time.

Additional Observations. At NY1, additional treatments were included comparing MCPA and MCPB alone or tank-mixed with bentazon. In general, these treatments supported observations in Tables 2 through 7 which indicated that MCPA provides stronger weed control, but greater crop injury. When tank-mixes with bentazon were compared, weed control ratings were equal; however, MCPA tank-mixes caused considerably more injury (data not shown).

Table 7. Yield of English pea following weed control with MCPA, MCPB and bentazon alone and in tank mixes (1987).

Treatment		Yield by location[1] (MT/ha)								
		Plant Biomass				Unshelled Pods	Shelled Peas			
Herbicide	Rate (kg ai/ha)	ME1	ME2	NY1	NY2	NY2	CT	ME1	ME2	NY1
None	-	11	33	12	11	4.1	0.1	1.8	6.2	2.9
MCPA	0.42	28	34	16	—	—	—	5.1	6.8	4.2
MCPB[2]	0.84/1.12	24	36	15	22	9.1	—	4.8	6.9	4.2
bentazon	1.12	28	35	15	22	9.9	3.4	5.5	7.2	3.8
bentazon +MCPB[2]	0.84 0.56/0.84	32	36	19	19	8.6	1.5	4.7	6.8	3.5
bentazon +MCPB[2]	0.56 0.28/0.56	28	37	19	23	8.5	2.8	4.7	6.9	4.8
LSD 5%		8	NS	5	12	4.0	1.4	2.0	NS	1.6

[1]Field locations are as indicated on Table 1.
[2]Higher MCPB rates were used at NY2, NY3, and NY4.

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ABSTRACT

Growth Suppression of Peach Trees with Competition

William V. Welker, Jr., and D. Michael Glenn[1/]

The growth of young peach trees is adversely affected by weed competition. A study was established in 1983 and continued through 1986 to determine the relationship between the size of the weed-free area beneath young peach trees and tree growth. Peach trees were planted in 1983 in 6 different size weed-free squares (0.6, 1.2, 1.8, 2.4, 3.0, and 3.6 m/side) with a 6 x 4.5 m spacing. The squares were maintained weed-free with annual applications of diuron at 1.12 kg/ha plus terbacil at 1.12 kg/ha. The remainder of the field was maintained in a 'Kentucky 31' fescue sod established in 1981. Significant differences in trunk cross sectional area, canopy width and fruit yield were found between treatments. Tree growth and yield increased in a curvilinear manner as the size of the weed-free area increased up to the square 3.0 m/side. The two largest weed-free squares (3.0 and 3.6 m/side) yielded 65% more fruit than the 2.4 m/side square. The 2.4 m/side yielded 104% more fruit than the 1.8 m/side. This study indicates that the size of the weed-free area is critical to the growth and productivity of young peach trees from the time they are planted.

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TRIFLURALIN VS ETHALFLURALIN: A THREE YEAR COMPARISON IN PEAS

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Four preplant incorporated rates (0.5, 0.75, 1.0, and 1.25 lb/A) of trifluralin (2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine) and ethalfluralin (N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl)benzenamine) were evaluated between 1985 and 1987 on English Peas (Pisum sativum var. 'Spring'). Pea yields, injury evaluations, and plant biomass at 20 and 40 days after planting were recorded. Additionally, control of redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), and common purslane (Portulaca oleraccea L.) was evaluated. After harvest, fields were rotovated and replanted with oats at 90 or 120 days after herbicide application.

It was found that pea yields were inversely related to rates of trifluralin. These yield reductions were not always statistically significant but the trend toward lower yields occurred in all three years. In contrast, no yield reductions occurred with ethalfluralin at any rate of application.

Significant crop stunting occurred early in the season with all rates of trifluralin, and to a lesser extent with ethalfluralin. Early injury ratings, however, tended to overestimate the effect of this injury on crop yields. Subjective injury evaluations and plant biomass data taken 20 DAP were poor indicators of pea yield potential where trifluralin was used. There were no yield reductions when early injury was significant, yet yield losses occurred when early injury was not evident. Evaluations of ethalfluralin plots 40 DAP showed no signs of crop injury and no yield reductions. Both herbicides effectively controlled all three broadleaf weed species at the lowest rates applied.

In 1985 all rates of both herbicides, with the exception of ethalfluralin at 0.5 lb/A, significantly reduced cover crop growth. In 1986 all rates of trifluralin greater than 0.5 lb/A significantly reduced growth of the oat crop. In 1987 oat growth was retarded only by the 1.25 lb/A of trifluralin. Ethalfluralin did not affect oat crop establishment at any rate.

In all three years the 0.5 lb/A rate of trifluralin was both safe and effective. Increasing the rate did not substantially increase weed control but did increase the chance of carryover. Ethalfluralin, on the other hand, did not injure peas at the rates tested, and loss of efficacy and carryover did not occur.

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MOISTURE RELATIONS WITH CINMETHYLIN IN CUCUMBERS

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ABSTRACT

Cucumbers [Cucumis sativus (L.) 'Sprint 440 II'] were planted in early to mid-August of 1985, 1986, and 1987 and treated preemergence with cinmethylin. Rates varied somewhat with years but included 0.4 to 1.0 lb ai/A. In 1985 and 1987, cinmethylin was applied 1 day after planting but in 1986, applications were made 1, 3, or 5 days after planting. Rainfall (1.3 in) in 1985 or irrigation (1 in) in 1987 occurred 10 days after planting. In 1986, rainfall (1.65 in) 4 days after planting followed the first two application timings by 3 and 1 days respectively and preceded the third application timing. Control of annual grasses and several broadleaf weeds including common lambsquarters (Chenopodium album L.), smooth pigweed (Amaranthus hybridus L.), and purslane (Portulaca oleracea L.) was good. Some early cucumber growth reduction in 1985 and 1987 was quickly outgrown and cucumbers produced high yields. In 1986, cucumbers treated preemergence prior to rainfall failed to recover completely from cinmethylin injury and produced yields significantly lower than cucumbers treated preemergence after rainfall. These results indicate the importance of water relations in cucumber response to cinmethylin.

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