WHEAT TOLERANCE TO FENOXAPROP-ETHYL, A GRASS HERBICIDE[1]

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ABSTRACT

Corn was found to be very sensitive to fenoxaprop, 40 µM causing a 49% drop in shoot length, a 46% drop in shoot fresh weight, and a 41% drop in shoot dry weight. Wheat was much less sensitive to fenoxaprop. Even at 25 times the 40 µM concentration that severely inhibited corn growth, no herbicidal effect of fenoxaprop on wheat growth was observed. Chlorophyll and carotenoid production in etiolated corn leaf sections exposed to different periods of light was inhibited by fenoxaprop. Wheat tolerance to fenoxaprop suggests that grass weeds in wheat farming could be safely controlled by this herbicide.

INTRODUCTION

Fenoxaprop {(±)-2-[4[(6chloro-2-benzoxazolyl)oxy]phenoxy] propanoic acid} is a selective postemergence herbicide registered for use in soybean (Glycine max L.) and rice (Oryza sativa L.) for the control of a number of annual and perennial grasses. In addition to rice several other grass species have been shown to be tolerant of fenoxaprop. These include Poa sp., Bromus sp., Lolium sp., and quackgrass (Agropyron repens L.) (5,9,10,11).

The grass herbicide diclofop {(±)-2-[4-(2,4-dichlorophenoxy) phenoxy]propanoic acid} belongs to the same chemical group as fenoxaprop and it too exhibits differential acitivity among grasses. For example, wheat (Triticum aestivum L.) and barley (Hordeum vulgare L.) are tolerant of diclofop while ryegrass (Lolium multiflorum Lam.), wild oat (Avena fatua L.) and green foxtail (Setaria vividis L.) are susceptible (1,3,12).

In the present study the sensitivity of wheat and corn (Zea mays L.) to fenoxaprop was compared. In addition, the influence of fenoxaprop on pigment synthesis in corn was studied.

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MATERIALS AND METHODS

Corn and wheat seeds were soaked for 6 h in different concentrations of fenoxaprop. The imbibed seeds were sown in 8-cm styrofoam pots (15 seeds per pot) containing moist vermiculite to a depth of approximately one cm. Petri dish halves were used as holders for the pots to catch drainage and as an indirect method of providing water and nutrients. The plants were 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 ± 2°C in the light and 18 ± 2°C in the dark). After shoot emergence 30 ml of 1/2 strength Hoagland solution was applied daily to each pot. After 10 days (wheat) and 12 days (corn) the seedlings were removed and their roots thoroughly washed. The 10 largest seedlings (determined by shoot length) from each pot were selected and their shoot length, root length, fresh weight, and dry weight determined.

The influence of fenoxaprop on pigment synthesis in etiolated corn leaf sections exposed to different periods of light was determined according to the methods of Devlin et al. (2). All experiments were replicated four times and the data subjected to analysis of variance.

RESULTS

Corn was found to be very sensitive to fenoxaprop. For example, 40 µM fenoxaprop caused a 49% drop in shoot length, a 46% drop in shoot fresh weight, and a 41% drop in shoot dry weight. Corn root growth was similarly affected (Table 1).

Table 1. Effect of fenoxaprop on the growth of corn.

	Shoot			Root		
Fenoxaprop (µM)	Length (mm)	Fresh Wgt (mg/10pl)	Dry Wgt (mg/10pl)	Length (mm)	Fresh Wgt (mg/10pl)	Dry Wgt (mg/10pl)
0	201	7180	530	208	8592	525
5	188	6327	480	197	8597	520
10	187	6647	515	209	7603	497
20	164	6117	470	224	4850	388
40	103	3870	315	157	2487	283
80	68	2520	223	81	1625	230
LSD 5%	8.8	705	68	23.6	768	44
1%	12.0	965	93	32.3	1052	61

In contrast, wheat was much less sensitive to fenoxaprop. Even at 25 times the 40 µM rate that adversely affected corn growth, no herbicidal effect of fenoxaprop on wheat growth was observed (Table 2).

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

Fenoxaprop (µM)	Shoot Length (mm)	Shoot Fresh Wgt (mg/10pl)	Shoot Dry Wgt (mg/10pl)	Root Length (mm)	Root Fresh Wgt (mg/10pl)	Root Dry Wgt (mg/10pl)
0	140	1600	127	127	1060	93
10^{-1}	138	1585	128	127	1083	93
10^{0}	137	1570	143	125	1123	93
10^{1}	137	1485	123	133	1078	80
10^{2}	135	1513	123	122	1097	85
10^{3}	133	1547	130	118	1070	90
LSD 5%	5.7	137	15	7.3	118	13
1%	7.9	187	20	10.0	163	18

Chlorosis was one of the phytotoxic symptoms observed in corn plants treated with fenoxaprop. Accordingly, the effect of fenoxaprop on pigment synthesis in etiolated corn leaf sections exposed to different periods of light was tested. Etiolated leaf sections treated with 20 µM fenoxaprop and exposed to 8, 14, and 32 h light were found to have 36, 26, and 35% less chlorophyll than untreated leaf sections (Table 3). When exposed to 32 h light even 5 µM fenoxaprop was found to inhibit (27%) chlorophyll production. The chlorophyll a:b ratio was not significantly affected by fenoxaprop treatments (Table 3).

Table 3. Effect of fenoxaprop on chlorophyll synthesis in etiolated corn leaf sections exposed to different periods of light. Total chlorophyll (TChl) is recorded in µg/g fresh tissue.

Fenoxaprop (µM)	8 h Light (Chla:b)	8 h Light (TChl)	14 h Light (Chla:b)	14 h Light (TChl)	32 h Light (Chla:b)	32 h Light (TChl)
0	2.13	379	2.23	455	2.21	546
5	2.08	345	2.11	358	2.38	399
10	2.08	312	1.98	365	2.13	357
20	2.09	244	2.09	334	2.20	352
40	2.03	194	2.01	253	2.14	342
80	1.98	194	2.17	247	1.97	302
LSD 5%	--	84	--	103	--	119
1%	--	118	--	142	--	163

Inhibition of carotenoid synthesis was also observed in etiolated leaf sections that were treated with fenoxaprop and then exposed to light (Table 4). There was a 25% drop in carotenoid content in leaf sections treated with 20 µM fenoxaprop and

exposed to 8 h light. When exposed to 14 and 32 h light significant reduction (24 and 23%, respectively) of carotenoid content occurred in leaf sections treated with 5 µM fenoxaprop (Table 4).

Table 4. Effect of fenoxaprop on carotenoid synthesis in etiolated corn leaf sections exposed to different periods of light.

Fenoxaprop (µM)	8 h Light (µg/g)	(%)	14 h Light (µg/g)	(%)	32 h Light (µg/g)	(%)
0	177	100	210	100	236	100
5	148	84	160	76	182	77
10	152	86	158	75	163	69
20	132	75	157	75	164	69
40	116	66	137	65	159	67
80	115	65	126	60	145	61
LSD 5%	38	--	34	--	42	--
1%	52	--	46	--	57	--

DISCUSSION

Data presented in this study demonstrate tolerance of wheat to fenoxaprop, a phenomenon also exhibited when wheat is exposed to diclofop (1,3,12). Diclofop-methyl and fenoxaprop-ethyl belong to the same family of grass herbicides and it is generally accepted that hydrolysis of the commercial ester formulation is necessary for herbicidal activity by these compounds (4,6,7,8). Wheat irreversibly detoxifies diclofop by aryl hydroxylation followed by conjugation to an aryl glucoside (8). It is reasonable to assume that the metabolism of fenoxaprop in wheat could follow a similar or identical path, i.e., aryl hydroxylation followed by irreversible conjugation. Wheat farmers should give serious consideration to fenoxaprop as a control measure for grass weed problems.

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ANTIDOTAL EFFECTS OF DICHLORMID AND R-29148 ON THE HERBICIDAL ACITIVITY OF CHLORIMURON AND SULFOMETURON[1]

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ABSTRACT

The antidotal effect of dichlormid and R-29148 on the sulfonylurea herbicides chlorimuron and sulfometuron in corn was studied. Partial protection of corn from the phytotoxic effects of these herbicides was demonstrated by both antidotes. This was observed in shoot and root elongation and in fresh and dry weight analyses. It is suggested that the sulfonylurea herbicides as a group are susceptible to antidotal activity, a circumstance that could increase their use and broaden their spectrum of weed control.

INTRODUCTION

The sulfonylureas are highly active herbicides that, because of their low application rates and relatively rapid dissipation in the soil and in the plant, pose less of a hazard to the environment than many other herbicides. The selectivity and efficacy of the sulfonylurea can be improved through the use of certain herbicide antidotes. For example, a number of investigators have reported partial success with the antidotal protection of corn (Zea mays L.) and sorghum [Sorghum bicolor (L.) Moench.] from the herbicidal action of chlorsulfuron {2-chloro-N[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzenesulfonamide}, a sulfonylurea compound (1,2,3,4,5). Further study of the combined action of antidotes and sulfonylureas in crops such as corn and sorghum appears warranted.

The purpose of the present study was to evaluate and compare the antidotal activity of dichlormid (2,2-dichloro-N,N-di-2-propenylacetamide) and R-29148 (2,2-dimethyl-5-methyldichloroacetyloxazolidine) in protecting corn treated with the sulfonylurea herbicides chlorimuron and sulfometuron {2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid}.

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MATERIALS AND METHODS

Corn seeds were soaked for 6 h in different concentrations of dichlorimid and R-29148. The treated seeds were sown in 9-cm styrofoam pots (15 seeds per pot) containing moist vermiculite that had been previously treated on the surface with 5 ml of herbicide solution. For herbicide application a small atomizer was used at a pressure of 69 kPa. The bottom of the pots were punctured several times to allow good drainage and the seeds were covered with untreated moist vermiculite to a depth of about one cm. Petri dish halves were used as holders for the pots to catch drainage and as an indirect method of providing water and nutrients. The plants were grown in a growth chamber under constant conditions of light (152 $\mu E\ m^{-2}s^{-1}$, 16 h light, 8 h dark) and temperature (22±2°C). After shoot emergence 30 ml of 1/2 strength Hoagland solution was applied daily to each pot. After 12 days 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. All experiments were replicated four times and the data were subjected to analysis of variance.

RESULTS

Chlorimuron caused severe inhibition of corn growth. Shoot length of corn treated with 0.2,2, and 20 µM chlorimuron was reduced 11, 42, and 79%, respectively (Table 1). In the presence of 1.5 mM dichlormid inhibition to shoot length, fresh weight, and dry weight caused by 0.2 uM chlorimuron was completely erased (Table 1). Plants treated with 2 µM chlorimuron and 1.5 mM dichlormid showed much less decrease in shoot length (-27%), fresh weight (-16%), and dry weight (0%) compared to 2 µM chlorimuron alone (Table 1). However, much less antidotal effect was observed in plants treated with 20 uM chlorimuron. For example, shoot length was inhibited 79% by 20 µM chlorimuron and 64% when 1.5 mM dichlormid was also applied. (Table 1).

Dichlormid protected root growth from the herbicidal effects of chlorimuron in a manner similar to that of shoot growth. For example, root length inhibited 60% by 2 µM chlorimuron was only inhibited 32 and 19% when dichlormid at 0.5 and 1.5 mM, respectively, was also applited (Table 1).

The protection of corn against chlorimuron injury by R-29148 was similar to that of dichlormid. The only exception was that R-29148 offered slightly more protection at the highest rate (20 µM) of chlorimuron applied (Table 2).

Sulfometuron is herbicidally more active than chlorimuron and as such severely inhibited corn growth. Shoot length of plants treated with 0.1, 0.2, and 0.4 µM sulfometuron was reduced 48, 65, and 82%, respectively (Table 3). However, in the

Table 1. Antidotal influence of dichlormid on the herbicidal effect of chlorimuron on the growth of corn. Chlor= Chlorimuron.

		Shoots			Roots		
Chlor (µM)	Dichlormid (mM)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)
0	0	188	672	47	192	492	36
0.2	0	167	579	40	158	404	29
0.2	0.5	169	586	41	187	445	33
0.2	1.5	188	696	51	209	492	38
2.0	0	109	419	36	76	196	18
2.0	0.5	140	527	41	130	279	25
2.0	1.5	148	568	48	155	309	28
20.0	0	39	155	15	23	113	14
20.0	0.5	59	233	23	37	133	17
20.0	1.5	67	267	26	38	138	19
LSD	5%	7	43	3.2	20	31	3.3
	1%	10	57	4.4	27	42	4.4

Table 2. Antidotal influence of R-29148 on the herbicidal effect of chlorimuron on the growth of corn. Chlor = Chlorimuron.

		Shoots			Roots		
Chlor (µM)	R-29148 (mM)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)
0	0	212	791	48	166	453	34
0.2	0	185	712	42	139	388	30
0.2	0.5	200	750	46	171	419	31
0.2	1.5	213	782	48	181	427	32
2.0	0	128	528	36	59	172	14
2.0	0.5	165	638	43	127	265	19
2.0	1.5	185	761	49	129	267	24
20.0	0	50	239	18	18	86	12
20.0	0.5	101	415	35	26	131	14
20.0	1.5	119	486	39	31	149	15
LSD	5%	11	78	4.1	2.8	49	3.3
	1%	15	105	5.5	3.7	66	4.4

presence of 0.5 mM dichlormid, inhibition of shoot growth by the afore mentioned rates of sulfometuron was 26, 33, and 50% and with 1.5 mM dichlormid was 13, 22, and 39%, respectively (Table 3). The antidotal effects of dichlormid on the shoot length of corn treated with sulfometuron were also observed in shoot fresh and dry weight and in root growth.

Table 3. Antidotal influence of dichlormid on the herbicidal effect of sulfometuron on the growth of corn. Sulfo = Sulfometuron.

		Shoots			Roots		
Sulfo (µM)	Dichlormid (mM)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)
0	0	171	518	39	227	744	47
0.1	0	89	278	21	132	359	27
0.1	0.5	126	363	27	183	529	31
0.1	1.5	149	450	35	221	670	42
0.2	0	60	170	15	80	228	17
0.2	0.5	115	323	25	167	413	28
0.2	1.5	134	420	32	194	496	33
0.4	0	31	99	9	51	148	17
0.4	0.5	86	238	19	124	275	20
0.4	1.5	105	291	22	151	337	24
LSD	5%	11	55	4.2	23	70	3.6
	1%	14	74	5.6	32	95	4.9

Again, as with chlorimuron, the antidotal effect of R-29148 on sulfometuron was similar to that of dichlormid. For example, shoot elongation in corn treated with 0.1, 0.2, and 0.4 µM sulfometuron was inhibited 45, 73, and 85%, respectively (Table 4). However, with the use of 1.5 mM R-21948 these inhibitions were reduced to 13, 31, and 72%, respectively (Table 4).

DISCUSSION

As this study shows dichlormid and R-29148 can be used as antidotes for the sulfonylurea herbicides chlorimuron and sulfometuron in corn. Other studies (1,2,3,4,5) have shown partial antidotal protection of corn and sorghum from the phytotoxic effects of chlorsulfuron, another sulfonylurea herbicide. These studies suggest that sulfonylurea herbicides in general are susceptible to antidotal activity, a circumstance that could broaden the spectrum of control and use of these very active compounds.

Table 4. Antidotal influence of R-29148 on the hebicidal effect of sulfometuron on the growth of corn. Sulfo = Sulfometuron.

		Shoots			Roots		
Sulfo (µM)	R-29148 (mM)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)	Length (mm)	Fresh Weight (mg/pl)	Dry Weight (mg/pl)
0	0	203	731	52	202	546	41
0.1	0	112	399	31	120	299	25
0.1	0.5	137	499	37	139	315	27
0.1	1.5	176	693	50	149	393	30
0.2	0	55	196	17	66	136	16
0.2	0.5	106	384	32	97	209	19
0.2	1.5	140	550	47	105	275	26
0.4	0	31	107	11	36	100	14
0.4	0.5	34	133	13	37	107	16
0.4	1.5	56	199	19	48	117	18
LSD	5%	9	37	5.1	15	35	3.5
	1%	12	50	6.8	20	47	4.8

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ABSTRACT

RHIZOTRON STUDIES INVOLVING ROOT AND VEGETATIVE GROWTH OF PEACHES AS RELATED TO WATER AVAILABILITY AND COMPETITION WITH FESCUE SOD

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Peach tree growth is adversely affected by competition by either weeds or other vegetation present within its root zone. We examined the effect of tall fescue sod upon peach tree growth and root development using split root and whole root rhizotrons. The trees were grown in either the presence or absence of a fescue sod under varying levels of imposed water stress. Peach root length density was adversely affected by the presence of a fescue sod whenever any water stress was imposed in both split and whole root rhizotrons. In the split root studies, half of the peach root system was under bare soil and the other half was under sod. Peach root length density was not affected by the presence of tall fescue in our split root studies if the soil water content was maintained near field capacity. We found that the peach could maintain good growth, even when the sodded half was maintained under water stress, if the bare soil half was provided adequate water. When water availability was reduced (-60 cbars) in our whole root rhizotron studies, the fescue sod had a competitive advantage over the peach tree, resulting in both root length density and tree growth being reduced.

REDUCED RATES OF POSTEMERGENCE SOYBEAN HERBICIDES

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ABSTRACT

A field study was conducted in 1989 to evaluate the performance of reduced rates of several postemergence soybean herbicides. Fomesafen, chlorimuron, and a bentazon/acifluorfen premix, all in combination with sethoxydim, were applied at 1/4 their normal use rates, sequentially, 8 and 24 days after planting. These rates were compared to 1/2 use rates applied once, 8 days after planting and to full rates applied once, 14 days after planting. All treatments were in 4 replications.

Reductions in crop vigor were observed 6 weeks after planting from the applications of the full rate of chlorimuron and the premix combination of bentazon/acifluorfen at both the full and 1/4 use rates.

Weed control ratings taken 6 weeks after planting indicated that the 1/4 use rates of the herbicides were as effective as the full rates in controlling common ragweed (Ambrosia artemisiifolia L.), and a non-uniform mixture of annual grasses including fall panicum (Panicum dichotomiflorum Michx.), giant foxtail (Setaria faberi Herrm.), barnyardgrass (Echinochloa crus-galli (L.) Beauv.), and crabgrass (Digitaria sanguinalis (L.) Scop.). Weed control ratings on the 1/2 use rates were significantly lower than either the full or 1/4 rates. However, they were still acceptable.

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Table 1. The efficacy of reduced rates of postemergence soybean herbicides, Adelphia, NJ, 1989.

Herbicide[1]	Rate[2] (kg/ha)	Application DAP[3]	Soybean Injury[4]	Weed Control Ratings[5] AMBEL	GRASSES
Fomesafen + Sethoxydim	0.35 + 0.31 (F)	14	0	95	95
Fomesafen + Sethoxydim	0.18 + 0.16 (1/2)	8	0	83	76
Fomesafen + Sethoxydim	0.09 + 0.08 (1/4)	8, 24	0	96	95
Bentazon + Acifluorfen[6]+ Sethoxydim	0.56 + 0.28 + 0.31 (F)	14	5	93	88
Bentazon + Acifluorfen Sethoxydim	0.28 + 0.14 + 0.16 (1/2)	8	0	70	75
Bentazon + Acifluorfen + Sethoxydim	0.14 + 0.07 + 0.08 (1/4)	8, 24	1	95	91
Chlorimuron + Sethoxydim	0.013 + 0.31 (F)	14	10	91	86
Chlorimuron + Sethoxydim	0.007 + 0.16 (1/2)	8	0	80	81
Chlorimuron + Sethoxydim	0.003 + 0.08 (1/4)	8, 24	0	95	93
Linuron + Metolachlor[7]	0.56 + 1.68	1	0	68	94
Check	----	----	0	0	0
LSD (.05)			1	11	10

[1] All postemergence applications included oil concentrate at 1% v/v
[2] F = Full use Rate; 1/2 = 1/2 use Rate; 1/4 = 1/4 use Rate
[3] DAP = Days after planting
[4] Rated 6 weeks after planting. Represents a reduction in crop vigor based on a scale from 0 - 100%
[5] Rated 6 weeks after planting
Scale 0 - 100%; 0 = no control 100 = complete control
AMBEL = *Ambrosia artemisiifolia* L.
GRASSES = Non-uniform mixture of fall panicum, giant foxtail, barnyardgrass and crabgrass
[6] Prepackaged as STORM 4E
[7] Applied preemergence

HEXAZINONE WITH POSTEMERGENCE HERBICIDES FOR LITTLE BLUESTEM SUPPRESSION IN LOWBUSH BLUEBERRIES

David E. Yarborough 1/

ABSTRACT

Little bluestem (Andropogon scoparius Michx.) causes a reduction in yield and quality in lowbush blueberry (Vaccinium angustifolium Ait.). The grass makes it more difficult to harvest blueberries by binding in the hand rakes or heads of mechanical harvesters. Little bluestem is not adequately suppressed by hexazinone or postemergence herbicides alone, so a combination of rates of hexazinone combined with spot treatments of glyphosate, sethoxydim or fluazifop-P were evaluated in a commercial blueberry field in Surry, ME. Hexazinone was applied preemergence on May 6, 1988 at 0, 2.2 or 4.4 kg/ha. Glyphosate, sethoxydim with crop oil concentrate (COC) or fluazifop-P with COC were sprayed broadcast as a 1% v/v solution on the grass clumps within the hexazinone treatments on July 25, 1989. Ten additional clumps were spot sprayed with the treatments above on July 7, August 30 or September 29, 1989 on a portion of the field that received 2.2 kg/ha hexazinone. Experimental design for the broadcast treatments was a split-block with four replications of each postemergence treatment within each of the three hexazinone treatments. Spot treatments were completely randomized. Grass clump number was counted in 1988 and height was measured in 1988 and 1989. Blueberry injury was rated in 1988 and 1989 and cover and yield was obtained in 1989. The 4.4 kg/ha rate of hexazinone provided the best grass suppression but resulted in unacceptable injury and reduction in cover and yield of lowbush blueberry (Table 1). Postemergence treatments reduced the number of clumps but did not provide additional grass suppression or affect yield. Spot treatment of little bluestem resulted in considerable grass suppression and height reduction (Table 2). Glyphosate provided the best suppression, and a reduction in suppression of fluazifop-P was seen at the later dates. A combination of 2.2 kg/ha of hexazinone and postemergence sprays of glyphosate will provide the best suppression of little bluestem in lowbush blueberry fields. However, the July treatments of sethoxydim or fluazifop-P were also effective and would have less potential for blueberry injury.

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Table 1. Effect of hexazinone and spot treatment on bunchgrass and blueberries.

Treatment	Bunchgrass				Blueberry			
Hexazinone (Kg/ha) 1988	Clump (No.) 1988	Cover (%) 1989	Height (cm) 1988	1989	Injury (0-10) 1988	1989	Cover (%) 1989	Yield kg/ha 1989
0	25	62	47	57	0	0	20	1635
2.2	16	19	27	37	1	1	57	2480
4.4	3	3	5	12	6	6	27	1197
Significance	**	**	**	**	**	**	**	**
Broadcast spray within hexazinone treatments.								
Untreated	20	33	28	40	2	2	16	1498
Glyphosate	10	24	25	32	2	2	39	1644
Sethoxydim	13	28	25	34	2	2	39	1835
Fluazifop-P	16	26	25	36	2	2	33	2106
Significance	*	NS	NS	NS	NS	NS	NS	NS

Rating 0=no effect, 10=dead, **=highly significant, *=significant, NS=nonsignificant.

Table 2. Effect of timimg of spot treatment on injury and cover of bunchgrass.

	Grass								
	Injury (0-10)	Height (cm) 1988	1989	Injury (0-10)	Height (cm) 1988	1989	Injury (0-10)	Height (cm) 1988	1989
Timing	Glyphosate			Sethoxydim			Fluazifop-P		
Untreated	0.8	49	30	0.8	49	30	0.8	49	30
7/25/88	8.9	53	5	5.5	49	15	6.8	51	12
8/30/88	8.8	68	7	4.9	54	19	4.2	68	20
9/29/88	8.5	68	7	5.7	66	16	1.3	64	26
Significance	Injury	Height 1988		Height 1989					
Treatment	**	NS		**					
Time	*	*		*					
Treatment by Time	**	NS		NS					

Rating 0=no effect, 10=dead, **=highly significant, *=significant, NS=nonsignificant.

WEED CONTROL IN FIELD CORN USING POST DIRECTED PARAQUAT

Yolonda A. Grant, Frank Webb and Mark Causey[1]

ABSTRACT

The field experiment was conducted in 1989 to evaluate weed control effectiveness and crop injury of post directed paraquat in field corn. Fifteen treatments were applied, 7 of which were applied by drop nozzles, and 7 were applied by crop guard sprayer and a no treatment check. The field was treated overall with alachlor at 1.25 lbs a.i./A to achieve a weed crop height differential. Paraquat was applied to the corn at the nine leaf stage. Control ratings were obtained for common lambsquarters (Chenopodium album) and common ragweed (Ambrosia artemisiifolir). Crop injury ratings were taken to indicate the level of crop injury caused by the two application methods.

The tall common lambsquarter and common ragweed were not controlled because overtop coverage was not achieved as there was no height differential between them and the corn. Total control was obtained for pitted morningglory and ivyleaf morningglory in all chemical treated plots as total plant coverage was obtained with both types of application. There was no significant difference between visual crop injury ratings between the two spray methods, however, corn injury ratings were high. There was no significant difference in corn yields that occurred in this study.

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Weed Control in Field Corn Using Post Directed Paraquat

	Rate lb./ a.i./A	Crop Injury	Rating Date - 7/12/89 Common Ragweed Between Row	Common Lambsquarter Between Row	Common Lambs-quarter In Row	Common Rag-weed In Row	Yield
1. Check		0.0f	0.0b	0.0c	0.0e	0.0e	91.7ab
2. Crop Guard Sprayer		30.9cde	95.5a	86.0ab	45.0cd	90.0abc	100.5ab
paraquat	.12						
surfactant	.25%						
3. Drop Nozzle		18.8ef	84.3a	82.0b	30.0de	83.5bcd	95.5ab
paraquat	.12						
surfactant	.25%						
4. Crop Guard Sprayer		22.5ef	96.8a	93.0ab	53.8a-d	90.8abc	102.5ab
paraquat	.25						
surfactant	.25%						
5. Drop Nozzle		23.8def	96.8a	96.8a	62.5a-d	91.0abc	98.7ab
paraquat	.25						
surfactant	.25%						
6. Crop Guard Sprayer		31.3b-e	99.0a	99.0a	85.0ab	95.5ab	100.5ab
paraquat	.38						
surfactant	.25%						
7. Drop Nozzle		48.8abc	96.8a	94.3ab	49.5a-d	92.3ab	100.6ab
paraquat	.38						
surfactant	.25%						
8. Crop Guard Sprayer		52.5abc	99.0a	99.0a	47.5bcd	98.0a	94.3ab
paraquat	.50						
surfactant	.25%						
9. Drop Nozzle		47.5a-d	99.0a	99.0a	77.3abc	98.0a	93.0ab
paraquat	.50						
surfactant	.25%						
10. Crop Guard Sprayer		62.5a	99.0a	98.5a	56.0a-d	93.3ab	105.7a
paraquat	.625						
surfactant	.25%						
11. Drop Nozzle		68.8a	96.8a	96.8a	60.0a-d	95.3ab	97.1ab
paraquat	.625						
surfactant	.25%						
12. Crop Guard Sprayer		62.5a	99.0a	99.0a	70.0abc	95.5ab	100.5ab
paraquat	.75						
surfactant	.25%						
13. Drop Nozzle		66.3a	99.0a	98.5a	52.5a-d	94.3ab	105.5a
paraquat	.75						
surfactant	.25%						
14. Crop Guard Sprayer		55.0abc	98.8a	98.8a	80.8abc	98.0a	102.2a
paraquat	.50						
dicamba	.25						
15. Crop Guard Sprayer		56.3ab	99.0a	99.0a	83.5abc	89.8abc	108.9a
paraquat	.50						
2,4-D	.50						
LSD (.05)		22.3	14.2	13.0	32.8	10.3	19.3
Standard Dev.		15.602	9.9021	9.0712	22.946	7.237	13.485
CV		40.42	10.91	10.05	38.25	8.42	13.60

EFFECTS OF NORFLURAZON AND PRODIAMINE ON WEED CONTROL AND YIELD IN ESTABLISHED ALFALFA

Chester L. Foy and Harold L. Witt[1]

ABSTRACT

Field studies were conducted to evaluate norflurazon and prodiamine for selective weed control in alfalfa (Medicago sativa L.) in Virginia. Late-winter or early-spring applications of norflurazon alone suppressed common chickweed [Stellaria media L.) Vill.] and combinations with simazine or diuron provided excellent control after one month. Excellent control was achieved with norflurazon alone by the first cutting, approximately two months after treatment. Prodiamine also suppressed, but did not cause albinism or browning of common chickweed plants as did norflurazon. Excellent control with prodiamine at 1.12 kg/ha occurred by the first cutting. Slight chlorosis and albinism on the sprayed leaves of alfalfa were observed early with norflurazon, but alfalfa yields were not adversely affected by norflurazon or prodiamine. Both herbicides were highly effective against summer annual grasses through the final cutting for the season, resulting in increased alfalfa yields in some plots.

INTRODUCTION

Alfalfa has the highest yield potential of the perennial forage crops available in Virginia; however, weeds continually pose a serious threat to production. Common chickweed is very common in alfalfa during fall through spring. Currently, several residual-type herbicides are registered for the control of common chickweed and other weed species (1). Low rates of some of these herbicides are required for selective use in alfalfa and applications are made in the fall or early-spring. As a result, such annual grasses as large crabgrass [Digitaria sanguinalis (L.) Scop.], barnyardgrass [Echinochloa crusgalli (L.) Beauv.], fall panicum (Panicum dichotomiflorum Mich.) and giant foxtail (Setaria faberi Herrm.) which germinate in late-spring and during the summer months, often are not effectively controlled. Two non-registered herbicides, norflurazon [4-chloro-5-(methylamino)-2-(3-trifluoromethyl)phenyl) -3(2H)-pyridazinone] and prodiamine [2,4-dinitro-N^3,N^3 dipropyl-6-(trifluoromethyl)-1,3-benzenediamine] have been tested in Nebraska with favorable results (2). The purpose of these studies was to evaluate norfluazon and prodiamine for season-long weed control in alfalfa in Virginia.

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MATERIALS AND METHODS

General. Herbicides were applied in 252 L/ha in preliminary experiments prior to 1989 and in 187 L/ha during 1989 using a CO_2-charged hand sprayer equipped with a four-nozzle boom. Individual plots were 1.8 to 3.6 m wide by 6.1 m long and all treatments were replicated four times. Visual estimates of percent ground covered by alfalfa and weed species or percent weed control and crop injury were recorded approximately one month after treatment. Fresh weights of alfalfa and weed species from a 2.7-m^2 area in each plot were recorded at each cutting.

Preliminary experiments. Norflurazon was applied alone at rates of 1.7, 2.2, and 2.8 kg/ha or at 2.2 kg/ha in combination with simazine (6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine) at 1.1 kg/ha at two locations in Virginia prior to 1989. Experiments were conducted on silt loam soils (pH 6.9 and 7.4; organic matter 3.2 and 1.7%). At one location, the herbicides were applied February 21 to a dormant, three-year-old stand of 'Alfa Green 411' alfalfa. At a second location where the alfalfa had been seeded the previous fall, applications were made March 4 in 'Saranac' alfalfa with 2.5 to 4.0 cm growth.

Experiment 1 - 1989. Norflurazon was applied alone at rates of 1.34, 1.79, and 2.24 kg/ha alone or at 1.34 kg/ha in combination with diuron [N'-(3,4-dichlorophenyl)-N,N-dimethylurea] at 1.34 kg/ha. Prodiamine was applied at rates of 0.56 and 1.12 kg/ha. Two registered compounds, diuron at 1.34 kg/ha and terbacil [5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H-pyrimidinedione] at 0.34,0.56, and 0.90 kg/ha, were included for comparison. Treatments were applied to a one-year-old stand of 'Cimmaron' alfalfa with 5.0 to 7.5 cm growth on March 28. This experiment was located on Groseclose-Poplimento loam/silt loam soils with a pH of 7.1 and 3.4% organic matter, at Blacksburg, Va.

Experiment 2-1989. The same treatments as in Experiment 1 were applied to a two-year-old stand of 'Cimmaron' alfalfa with up to 10 cm growth on March 29. This experiment was located on Duffield-Ernest silt loam soil with a pH of 6.7 and 3.7% organic matter, at Price's Fork, Va.

RESULTS AND DISCUSSION

Preliminary experiments. Norflurazon and norflurazon plus simazine provided excellent control of fall panicum, giant foxtail, and large crabgrass at the fourth cutting on September 17 at one location (data not shown). Alfalfa yields were increased significantly with norflurazon at 2.8 kg/ha. At a second location one month after treatment, common chickweed was suppressed with norflurazon alone while excellent control was achieved with norflurazon plus simazine. Norflurazon caused some early yellowing and stunting of alfalfa (up to 25% injury). Control of common chickweed was excellent with significant increases in crop yields at the first cutting with norflurazon alone or plus simazine. Weeds were sparse at the second and third cuttings, and the test area was only lightly infested with fall panicum and giant foxtail at the fourth cutting. No annual grasses were present in plots treated with norflurazon alone or plus simazine.

Experiment 1-1989. Common chickweed control one month after treatment with norflurazon at 1.34 to 2.24 kg/ha ranged from 69 to 80% (Table 1). Prodiamine at rates of 0.56 and 1.12 kg/ha provided 55 and 77.5% control, respectively. Excellent control (100%) was achieved with terbacil, diuron, or norflurazon plus diuron. Only slight crop injury occurred with norflurazon alone and little to no injury occurred with prodiamine. The untreated check plots and plots treated with diuron or terbacil were heavily infested with barnyardgrass at the third and fourth cuttings. Norflurazon and prodiamine were very effective against barnyardgrass through the fourth cutting which resulted in higher alfalfa yields, particulally at the fourth cutting.

Experiment 2-1989. Slight chlorosis and albinism on the sprayed leaves of alfalfa were observed one month following the application of norflurazon. The tops of common chickweed plants were white or brown and growth was stopped; however, plants were green at the base. Common chickweed control increased but more injury to alfalfa occurred with norflurazon plus diuron than with norflurazon alone (Table 2). Only slight injury at the leaf tips of alfalfa plants occurred with prodiamine. Common chickweed was green, but suppressed below the alfalfa canopy with prodiamine. Terbacil provided excellent control of common chickweed, but caused chlorosis, leaf dieback of sprayed leaves, and stunting of alfalfa plants at the high rates. Diuron alone was effective as well, but also caused 26.3% crop injury. All treatments were effective against common chickweed at the first cutting; however, alfalfa yields were significantly higher than in untreated plots only in plots treated with norflorazon at 2.24 kg/ha. Alfalfa yields were not affected by herbicide treatments in most instances at the second or third (final) cutting. Fall panicum was predominant by the third cutting and was controlled effectively with norflurazon (with or without diuron) and prodiamine.

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Table 1. Effect of herbicides on weed control, crop injury and yield of established alfalfa. Blacksburg, Virginia. Treatments applied March 28, 1989. Data are averages of four replications[a].

Herbicide	Rate	April 25		May 29 (1st cutting)		June 27 (2nd cutting)		July 31 (3rd cutting)		September 5 (4th cutting)	
		Common chickweed control	Crop injury	Fresh wt		Fresh wt		Fresh wt		Fresh wt	
				Alfalfa	Common chickweed	Alfalfa	Barnyard-grass	Alfalfa	Barnyard-grass	Alfalfa	Barnyard-grass
	(kg/ha)	(%)		(kg/2.7m^2)							
Norflurazon	1.34	69 c	6.5 de	4.4 ab	0.00 b	4.1 a	0.00 b	2.0 a	0.07 c	2.3 a	0.05 c
Norflurazon	1.79	80 b	6.5 de	4.4 ab	0.00 b	3.6 ab	0.00 b	2.1 a	0.00 c	2.0 a	0.00 c
Norflurazon	2.24	80 b	13.8 c	4.6 a	0.00 b	3.1 bc	0.00 b	1.6 ab	0.01 c	1.8 a	0.00 c
Norflurazon + diuron	1.34 + 1.34	100 a	25.0 b	3.7 a-c	0.00 b	3.2 a-c	0.00 b	1.5 ab	0.08 c	2.0 a	1.09 c
Diuron	1.34	100 a	26.3 b	3.6 a-c	0.00 b	3.0 bc	0.02 ab	0.9 b	1.54 b	1.1 c	1.88 c
Terbacil	0.34	100 a	9.3 cd	3.7 a-c	0.00 b	3.3 a-c	0.02 ab	0.8 b	2.41 a	1.0 c	2.29 a
Terbacil	0.56	100 a	25.0 b	3.4 bc	0.00 b	3.1 a-c	0.01 ab	0.8 b	2.68 a	1.2 bc	1.94 ab
Terbacil	0.90	100 a	42.5 a	3.2 c	0.00 b	2.7 c	0.02 ab	0.8 b	1.06 b	1.0 c	1.54 b
Prodiamine	0.56	55 d	1.3 e	3.0 c	0.02 ab	3.2 a-c	0.00 b	1.2 ab	0.22 c	1.7 ab	0.37 c
Prodiamine	1.12	78 b	1.0 e	4.7 a	0.00 b	3.4 a-c	0.00 b	1.6 ab	0.04 c	2.1 a	0.06 c
Untreated	--	0 e	0.0 e	3.6 a-c	0.06 a	3.6 ab	0.04 a	0.8 b	2.67 a	1.1 c	1.76 ab

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

Table 2. Effect of herbicides on weed control, crop injury and yield of established alfalfa. Price's Fork, Virginia. Treatments applied March 29, 1989. Data are averages of four replications[a].

		April 25		May 30 (1st cutting) Fresh wt		July 27 (2nd cutting) Fresh wt		September 8 (3rd cutting) Fresh wt	
Herbicide	Rate	Common chickweed control	Crop injury	Alfalfa	Common chickweed	Alfalfa	Barnyard-grass	Alfalfa	Fall panicum
	(kg/ha)	(%)		(kg/2.7m^2)					
Norflurazon	1.34	77.5 c	15.0 c	3.2 ab	0.01 b	2.0 ab	0.04 b	0.9 a	0.28 c
Norflurazon	1.79	81.3 bc	17.5 c	3.1 ab	0.00 b	2.4 a	0.02 b	1.0 a	0.10 c
Norflurazon	2.24	86.3 a-c	16.3 c	3.5 a	0.00 b	2.3 a	0.00 b	0.9 a	0.01 c
Norflurazon + diuron	1.34+1.34	98.0 a	33.8 a	2.9 a-c	0.00 b	1.8 ab	0.01 b	0.8 a	0.04 c
Diuron	1.34	90.8 ab	26.3 b	1.8 cd	0.02 b	1.5 b	0.14 b	0.5 a	0.63 bc
Terbacil	0.34	85.8 a-c	7.5 d	2.7 a-d	0.02 b	2.2 ab	0.79 a	0.6 a	1.82 a
Terbacil	0.56	95.5 a	22.5 b	1.4 d	0.01 b	1.8 ab	0.04 b	0.9 a	0.16 c
Terbacil	0.90	98.0 a	35.0 a	3.1 ab	0.00 b	1.7 ab	0.09 b	0.6 a	0.72 bc
Prodiamine	0.56	74.5 c	2.5 d	2.3 a-d	0.10 b	1.8 ab	0.01 b	0.7 a	0.09 c
Prodiamine	1.12	78.8 bc	3.3 d	2.5 a-d	0.00 b	2.4 a	0.02 b	0.9 a	0.06 c
Untreated	--	0.0 d	0.0 e	2.1 b-d	0.71 a	2.3 a	0.11 b	0.7 a	1.21 ab

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

Solarization As A Weed Control Alternative for Connecticut

by Richard A. Ashley[1]

ABSTRACT

Solarization is defined as the use of transparent covers as solar energy traps for magnifying soil temperature. It has been demonstrated effective in destroying weed seeds in the soil in warmer climates. Experiments were conducted at the University of Connecticut, Mansfield, CT to assess the effectiveness of solarization as a weed control technique in northern latitudes.

A Woodbridge fine sandy loam soil was plowed and disked July 29, 1988 and divided into six plots 7M square. Three plots were randomly chosen and covered with 6-mil polyethylene film with infra-red blocker. Another series of plots was established on October 27, 1988 using the same procedures. On June 2, 1989 the covers were removed and snapbeans (*Phaseolus vulgaris* L. 'Provider') and summer squash (*Cucurbita pepo* L. 'Early Prolific Straightneck') were no-till planted in all plots.

On July 5, 1989 weed counts were taken from $1M^2$ quadrants randomly selected from each plot. Data were analyzed using the t-test.

Where solarization treatments were applied in July, significant reductions in weed counts were observed with large crabgrass [*Digitaria sanguinalis* (L.) Scop.], redroot pigweed (*Amaranthus retroflexus* L.), common lambsquarters (*Chenopodium album* L.), Austrian field cress [*Rorippa austriaca* (Crantz) Bess.], and common ragweed (*Ambrosia artemisiifolia* L.). None of these species persisted in the solarized plots. Common purslane (*Portulaca oleracea* L.) was present in large numbers in solarized plots and was absent from control plots.

When solarization treatments were applied in October significant reduction in weed counts were recorded for large crabgrass. No significant differences were noted with the other species.

Yields of both snapbeans and squash were significantly greater in solarized plots.

Solarization has potential as a weed control technique in the Northeast. Some shift in weed species may result from the use of solarization. Solarization appears to have potential for use in combination with stale seedbed techninques as where weeds were not controlled by solarization their emergence was concentrated.

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Mile-a-minute Weed on the Move

W.L. Mountain and N.L. Hartwig[1/]

ABSTRACT

Mile-a-minute (*Polygonum perfoliatum* L.), a spiny annual vine native to Asia is rapidly colonizing non-crop areas in Pennsylvania. This legislated noxious weed was initially recorded in 1946 in southern York County and is presently known to occur in 11 counties - York, Lancaster, Adams, Cumberland, Dauphin, Perry, Chester, Delaware, Berks, Bedford and Westmoreland. Maryland and West Virginia are the only other states reporting this plant.

Typical habitats are road banks (especially in crownvetch), edge of woods and thickets, nurseries, reforestation clear-cuts, utility right-of-ways and damp areas such as low meadows and stream banks.

Mile-a-minute vine may reach 7 meters long. The leaf shape is triangular from 2.5 - 7.5cm across, sheaths (ocrea) are saucer-shaped, completely encircling the stem (perfoliate) at the nodes. Numerous downward-curving spines are present on the stem, petiole and main leaf veins. The outside of the fruit is fleshy, spherical, about 5mm in diameter and irridescent blue when mature. Each fruit contains a single black "seed-like" achene about 3mm in diameter.

Mile-a-minute prefers sunny locations but will survive in light shade. Germination begins about April 1st in southern Pennsylvania and the first mature blue "berries" appear around August 1st. In greenhouse trials, germination was completed in 2-3 weeks, after first undergoing a cool/moist (stratification) treatment.

The rapid, rank, climbing growth of mile-a-minute forms a canopy over most vegetation less than 3 meters and has the ability to outcompete many species of native and exotic flora.

This is definitely a weed that will command the attention of weed scientists as it extends its range.

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A COMPARISON OF PRE-EMERGENCE HERBICIDES FOR GIANT FOXTAIL CONTROL

Arthur E. Gover, Larry J. Kuhns, Gregory T. Lyman[1/]

ABSTRACT

Foxtail species often invade sites where applications of herbicides such as bromacil, imazapyr, sulfometuron methyl, and tebuthiuron are mades for total vegetation control. As part of a cooperative project with the Pennsylvania Department of Transportation, a field study was initiated to evaluate several pre-emergence herbicides for their ability to provide season-long control of giant foxtail (Setaria faberi Herrm.).

Twelve treatments (Table 1) were applied May 22, 1989, using a CO_2 powered backpack sprayer delivering the equivalent of 318 l/ha at 172 kpa using Spraying Systems 8004 flat fan nozzles. The experimental design was a randomized complete block with three replications and plot size of 1.8 by 7.6 m. The site, mapped as a Hagerstown silt loam, has not been tilled for at least 10 years, was used for corn herbicide research in 1987, and laid fallow in 1988. Surface residue was up to 2 cm deep in the plot area. Diquat was added to each treatment to kill existing giant foxtail, which was up to 5 cm tall, and all treatments included surfactant at 0.25% (v/v). Visual ratings for percent giant foxtail cover were taken July 19 and October 16, 1989, 8 and 21 weeks after treatment, respectively. Results are reported in Table 1.

Diuron applied at 7.2 or 14.3 kg ai/ha provided the best giant foxtail control at both 8 and 21 WAT, with 6 and 18 percent giant foxtail cover at the low rate, and 0 and 3 percent at the high rate. A commercial premix of atrazine and pendimethalin applied a 4.5 plus 4.5 kg ai/ha was rated as the third best treatment with 8 and 45 percent cover, respectively. Oxadiazon was applied as either a WP or an EC formulation at 2.2 kg ai/ha. There was no difference between the efficacy of the two formulations as the WP and the EC were rated at 13 and 15 percent, and 50 and 55 percent at 8 and 21 WAT, respectively. Oryzalin applied at 3.4 kg ai/ha was less effective than when applied at 4.5 kg ai/ha at 8 WAT, but at 21 WAT, there was no difference between rates. Plots treated with pendimethalin applied at 3.4 and 4.5 kg ai/ha was rated at 33 and 30 percent cover respectively, at 8 WAT. At 21 WAT, the low rate of pendimethalin was rated better than the high rate, 55 versus 78 percent cover, but difference was not significant. Linuron at 1.1 kg ai/ha and diquat alone at 0.56 kg ai/ha did not show any effect on giant foxtail at either 8 or 21 WAT, and were very similar to the untreated check, which was rated at 83 and 92 percent cover at 8 and 21 WAT, respectively.

Two possible reasons diuron provided better control than the other herbicides are its solubility and mode of action. It is much more soluble in water than the others,so it could wash through the plant residue and into the soil faster. Then, since it is root absorbed it could move into the germinated seedlings and kill them. By the time oryzalin or pendimethalin reached the zone of weed seed germination the roots of the seedlings may have been too well established to be controlled. The oxadiazon may have been tied up on the plant residue.

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Table 1: Visual ratings for giant foxtail cover 8 and 21 weeks after treatment (WAT). Each value is the mean of three replications.

Treatments	Application Rate	Giant Foxtail Cover 8 WAT	Giant Foxtail Cover 21 WAT
	(kg/ha)	(%)	(%)
1. pendimethalin + atrazine[1/] + diquat	4.5 + 4.5 + 0.56	8	45
2. oryzalin + diquat	3.4 + 0.56	57	55
3. oryzalin + diquat	4.5 + 0.56	30	48
4. pendimethalin + diquat	3.4 + 0.56	30	55
5. pendimethalin + diquat	4.5 + 0.56	33	78
6. diuron + diquat	7.2 + 0.56	6	18
7. diuron + diquat	14.3 + 0.56	0	3
8. oxidiazon WP + diquat	2.2 + 0.56	13	50
9. oxidiazon EC + diquat	2.2 + 0.56	15	55
10. linuron + diquat	1.1 + 0.56	82	87
11. diquat	0.56	82	87
12. untreated check	- - -	83	92
Significance Level (P)		0.0001	0.0011
Coefficent of Variation (%)		36	39
LSD (P=0.05)		22	37

1/ Commercial premix, Prozine, American Cyanamid Company, Wayne, NJ

FENCELINE VEGETATION CONTROL

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ABSTRACT

Penn State and the Pennsylvania Department of Transportation have been involved in a cooperative vegetation management project. One of the objectives of this project is to evaluate total vegetation control treatments for use along highway guiderails and sign posts. In this study, ten treatments were applied to a fenceline to evaluate the residual activity of these materials in fine textured soils where off-site movement due to leaching or surface flow was less likely than on roadside sites.

Ten treatments were applied to the perimeter fence of the Penn State Agronomy Research Farm in Rock Springs on June 23, 1989 (Table 1). The treatments were applied to 0.038 ha plots measuring either 0.9 by 152 or 0.6 by 229 m, arranged in a randomized complete block with two replications. The treatments were applied with a CO_2 pressurized sprayer with a single Spraying Systems OC-12 nozzle delivering 371 l/ha at 138 kpa. The applicator rode in a utility vehicle to maintain constant ground speed. All treatments included surfactant at 0.25% (v/v) except for those with HOE 861-01H, which is premixed with a surfactant. Visual ratings of percent control and recordings of species present in each plot were taken August 14, 1989.

Imazapyr plus diquat, the pre-mix of bromacil and diuron plus diquat, and diuron plus diquat provided at least 95 percent weed control. Only small specimens of perennial species were present in these plots, the majority of which were stunted and chlorotic.

Glyphosate plus oxadiazon EC, sulfometuron methyl plus diquat, and bromacil plus diquat provided between 80 and 88 percent weed control. The species found in these plots were primarily perennial, and ranged from vigorous to stunted and chlorotic. Nimblewill (Mulhlenbergia schreberi J.F. Gmel.) was prominent in areas treated with sulfometuron methyl, and mouseear chickweed (Cerastium vulgatum L.) was the most prominent species in the glyphosate plus oxadiazon EC plots.

Tebuthiuron plus diquat provided 75% weed control, but had little activity on nimblewill, orchardgrass (Dactylis glomerata L.), or quackgrass [(Agropyron repens (L.) Beauv.)]. Glyphosate plus oxadiazon WP rated at 53% control, also provided poor control of perennial grasses.

Treatments containing HOE 866-01H and oxadiazon did not control the perennial weeds that were present at treatment, were rated lowest for weed control, and had the greatest variety of species present.

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Table 1: Treatments applied on June 23, 1989, visual weed control ratings, and species observations made on August 14, 1989. Each value is the mean of two replications.

Treatment[1/]	Application Rate (kg ai/ha)	Weed Control (%)	Species Present [2/]
1. imazapyr diquat	0.42 0.56	99	Canada thistle, Rubus spp., red sorrel, dandelion
2. sulfometuron methyl diquat	0.21 0.56	86	nimblewill, Canada thistle, quackgrass, orchardgrass, common yellow toadflax
3. bromacil diquat	4.5 0.56	80	Canada thistle, quackgrass, tumble pigweed, dandelion, common milkweed, common yellow toadflax, common burdock, Virginia creeper
4. bromacil diuron diquat	4.5 4.5 0.56	98	Canada thistle, dandelion, quackgrass, smooth groundcherry
5. diuron diquat	14.3 0.56	95	dandelion, orchardgrass, Canada thistle, Virginia creeper, broadleaf plantain, quackgrass
6. tebuthiuron diquat	3.6 0.56	75	nimblewill, orchardgrass, Canada thistle, quackgrass, wirestem muhly, dandelion, alfalfa, giant foxtail, smooth groundcherry
7. HOE 866-01H oxadiazon WP	1.2 2.2	25	red sorrel, dandelion, tall fescue, Canada thistle, orchardgrass, nimblewill, quackgrass, hemp dogbane, common ragweed, smooth groundcherry,
8. HOE 866-01H oxadiazon EC	1.2 2.2	50	orchardgrass, quackgrass, perennial ryegrass, tall fescue, hemp dogbane, Canada thistle, red sorrel, broadleaf dock, common yellow toadflax, Virginia creeper
9. glyphosate oxadiazon WP	1.1 2.2	53	quackgrass, tall fescue, nimblewill, dandelion, orchardgrass, tumble pigweed, hemp dogbane,common chickweed
10. glyphosate oxadiazon EC	1.1 2.2	88	mouseear chickweed, Rubus spp., quackgrass, red sorrel, dandelion, ground ivy, nimblewill, Virginia creeper
Significance Level (P)		0.0707	
Coefficient of Variation (%)		28	
LSD (P=0.10)		38	

1/ All treatments except 7 and 8 included the non-ionic surfactant Cidekick II, JLB International, Vero Beach Fla. at 0.25% (v/v).

2/ Weeds are listed in the order of prevelance.

PREEMERGENCE HERBICIDES ON CONIFERS IN 1989

Larry J. Kuhns and Joanne E. Loose 1/

ABSTRACT

The treatments listed in Table 1 were applied at two sites in Pennsylvania in 1989. On April 19, they were applied in York County (site 1) to 3-2 Douglas fir [Pseudotsuga menzesii (Mirb) Franco] transplants and 3-0 Scotch pine (Pinus sylvestris L.) seedlings newly planted into a clay loam soil. At the time of application, the soil surface temperature was 10°C and the wind speed was 11 to 16 km/hr. Hard fescue [Festuca ovina var. duriuscula (L.) W.D.J. Koch] had been broadcast seeded in the field the previous fall. Also present were wild carrot (Daucus carota L.), henbit (Lamium amplexicaule L.), Canada thistle [Cirsium arvense (L.) Scop.], common chickweed [Stellaria media (L.) Vill.], yellow rocket (Barbarea vulgaris R. Br.) and quackgrass (Agropyron repens (L.) Beauv.). On May 5 application was made in Centre County (site 2) to Colorado spruce (Picea pungens Engelm.) and Fraser fir [Abies fraseri(Pursh) Poir] transplants that had been established for one year in a silty-clay-loam soil. This site had been treated with glyphosate plus simazine at 1kg ai/ha each in October, 1988 to reduce the perennial weed population and eliminate winter annuals. By the time of application there were many weed seedlings of 1cm or less growing throughout the plots. There was no wind and the air and soil temperatures were 10° and 4°C, respectively. Experimental procedures were the same at both sites. A randomized complete block design with three replications per species was used. Plots were 9 m by 0.8 m. The treatments were applied over the top with a CO_2 pressurized test plot sprayer at 30 psi through an 8008E nozzle in the equivalent of 290 l/ha water. Weed control and phytotoxicty were evaluated 4 and 17 weeks after treatment (WAT) at site 1 and 9 and 14 WAT at site 2 (Table 1).

Douglas fir and Fraser fir were not injured by any of the treatments. No injury symptoms were evident on the other species at the first evaluation time. The injury ratings for the Scotch pine are based on stunting and slight chlorosis that was observed late in the season. This was probably the result of weed competition, especially from the hard fescue cover crop. The only symptom observed on the Colorado spruce was a slight yellowing of some tips. There is a strong possibility this was not treatment related, as other untreated trees scattered throughout the same field exhibited similar symptoms.

The weed control at site 2 was excellent, with all treatments providing close to 90% control for 14 weeks. All treatments must have killed the small weed seedlings that were present at the time of application. The predominant weeds at the site were yellow foxtail [Setaria glauca (L.) Beauv.], green foxtail [Setaria viridis (L.) Beauv.], yellow woodsorrel (Oxalis stricta L.), Pennsylvania smartweed (Polygonum pensylvanicum L.), and tumble pigweed (Amaranthus alba L.).

At site 2 the hard fescue dominated the plots. It limited the germination and growth of other weeds and almost totally eliminated yellow nutsedge (Cyperus esculentus L.), which invaded most of the plots in which the weeds were controlled. Treatments with

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simazine killed most of the hard fescue and reduced the population of winter annual weeds. They provided very good to excellent weed control early. Simazine plus atrazine provided excellent season long weed control. However, by 17 WAT nutsedge, green foxtail, yellow foxtail, Johnsongrass, Canada thistle, and redroot pigweed had invaded plots treated with simazine alone. Adding pendimethalin to the simazine greatly improved the control of annual grasses, but overall weed control ratings were held down by the invasion of nutsedge, Canada thistle, and quackgrass. Adding oxyfluorfen to the combination did not improve the control.

Oxadiazon injured the hard fescue and winter annuals early, but did not kill them. They recovered and by 17 WAT the hard fescue was thinner than in the control plot, but well established. Plots treated with oxadiazon had few annual grasses, but had low weed control ratings because the hard fescue and nutsedge covered most of the treated areas. Only oxadiazon plus metolachlor provided more than 50% weed control 17 WAT because of the nutsedge control provided by the metolachlor.

Isoxaben plus oryzalin alone, or in combination with oxyfluorfen, provided weak control of the hard fescue, and injured the winter annuals only enough to thin them out. Nutsedge, hard fescue, and foxtails dominated the plots at 17 WAT.

Table 1. Preemergence herbicide treatments applied over-the-top of Douglas fir and Scotch pine (site 1) on April 19, 1989 and Colorado spruce and Fraser fir (site 2) on May 5, 1989. Weed control and injury ratings were made 4 and 17 weeks after treatment (WAT) at site 1 and 14 WAT at site 2. Neither Douglas fir or Fraser fir showed any signs of injury, so no data is shown for them

		SITE 1 1/		SITE 2 2/	INJURY RATINGS 3/	
	Rate	4 WAT	17 WAT	14 WAT	SITE 1	SITE 2
Treatment	kg ai/ha	%W. C.	%W. C.	%W. C.	Scotch pine	Colo. spruce
Control	-	0	0	0	2.0	0
Simazine	2.8	87	52	90	1.3	0
Simazine	1.7	75	48	97	0	0
+ Pendimethalin	3.3					
Simazine	1.7	85	33	88	0.7	1.0
+ Pendimethalin	3.3					
+ Oxyfluorfen	0.4					
Oxadiazon	2.2	47	15	92	2.0	0.7
Oxadiazon	4.5	60	20	98	1.7	1.0
Oxadiazon	2.2	70	58	97	1.0	1.7
+ Metolachlor	3.3					
Oxadiazon	2.2	62	18	98	2.0	0.7
+ Pendimethalin	3.3					
Oxadiazon	2.2	58	18	87	2.0	0
+ Oxyfluorfen	0.2					
Isoxaben	1.1	47	36	93	2.0	0.3
+ Oryzalin	3.3					
Isoxaben	1.1	60	45	97	2.0	1.0
+ Oryzalin	3.3					
+ Oxyfluorfen	0.2					
Simazine 4/	2.2	99	74		0	
+ Atrazine	2.2					
Isoxaben 5/	2.2			97		1.0

1/ Weed control data represents an average for three plots at 4 WAT and an average of six plots at 17 WAT.

2/ Weed control data for the two species combined, so that each rating represents an average of 6 plots

3/ Rated on a cale of 0 - 10, with 0 = no injury and 10 = dead. Each number represents an average for three plots. These represent latest rating period at each site.

4/ Applied only at Site 1.

5/ Applied only at Site 2.

PREEMERGENCE HERBICIDES IN CONIFERS IN 1988

Larry J. Kuhns and Joanne E. Loose 1/

ABSTRACT

The treatments listed in Table 1 were applied at two sites in Pennsylvania in 1988. On April 27 they were applied in Centre County (site 1) to Colorado spruce (Picea pungens Englm.) and eastern white pine (Pinus strobus L.) transplants that had been established for one year in a silty-clay-loam soil. This site had been treated with glyphosate plus simazine at 1 kg ai/ha each in October, 1987 to reduce the perennial weed population and eliminate winter annuals. By the time of application some weed seedlings, primarily common ragweed (Ambrosia artemisiifolia L.) and Pennsylvania smartweed (Polygonum pensylvanicum L.), had emerged 2-4 cm. The spruce buds were swelling and the pine candles were expanded to 2-4 cm. During application there was little wind, the air temperature was 18°C, and rain began to fall immediately after the application ended. On May 4 application was made in Schuylkill County (site 2) to Colorado spruce and Fraser fir [Abies fraseri Pursh) Poir.] transplants newly planted into a shaly loam soil. At the time of application there was little wind and the air temperature was 17°C. The plants were dormant- there was no bud swell. The soil had been plowed and disced and was weed free. Heavy rains fell during the three weeks after application. Experimental procedures were the same at both sites. A randomized complete block design with three replications per species was used. Plots were 9 m by 0.8 m. The treatments were applied over-the-top with a CO_2 pressurized sprayer at 30 psi through an 8004E nozzle in the equivalent of 374 L/ha water. Weed control and injury were rated 14 weeks after treatment (WAT) at site 1 and 10 WAT at site 2. After the initial rains that followed each application, the summer of 1988 turned into one of the hottest and driest on record.

None of the treatments caused any observable injury to either species at either site. However, all Fraser firs in the untreated control plots were dead. The weed competition in the hot, dry summer was apparently to much for them to survive. This was a perfect example of one of the benefits provided by chemical weed control.

At site 1 herbicide combinations including atrazine or isoxaben plus oryzalin, oxyfluorfen, or pendimethalin provided excellent weed control for 14 weeks. The predominant weeds in plots receiving these treatments were yellow nutsedge (Cyperus esculentus L.) and quackgrass [Agropron repens (L.) Beauv]. Isoxaben alone and oxadiazon treatments did not control the common ragweed which had already germinated prior to application. Yellow nutsedge and dandelion (Taraxacum officinale Weber) were also prevelant in these plots. At the time of evaluation, broadleaved weed seedlings were germinating in plots treated with oxadiazon at 1.1 and 2.2 kg ai/ha, and those treated with atrazine plus oryzalin or pendimethalin. The other treatments were apparently still effectively providing preemergence weed control.

At site 2 the results varied greatly with the two fields treated. The field in which the Colorado spruce were planted had few perennial weeds. The predominant weeds

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were common ragweed, buckhorn plantain (Plantago lanceolata L.), common yellow woodsorrel (Oxalis stricta L.), and yellow foxtail [Setaria glauca (L.) Beauv]. All of the preemergence herbicide treatments provided excellent weed control, with none of the treated plots having more than 5% weed cover. The field in which the Fraser fir were growing was badly infested with perennial weeds, including Canada thistle [Cirsium arvense (L.) Scop], quackgrass, perennial ryegrass (Lolium perenne L.), common milkweed (Asclepias syrica L.), and hedge bindweed (Calystegia sepium L.). The predominant annual weeds in the area were common ragweed and yellow foxtail. All of the treatments provided excellent control of the annual weeds. The weed cover ratings in Table 1 represent primarily perennial weeds which grew through the treatments.

Table 1. Preemergence herbicide treatments applied over-the-top of Colorado spruce and white pine (site 1) on April 27, 1988 and Colorado spruce and Fraser fir (site 2) on May 4, 1988. Weed control ratings were made 14 weeks after treatment (WAT) at site 1 and 10 WAT at site 2.

		% WEED COVER		
	RATE		Site 2	
TREATMENT	kg a.i/ha	Site 1	Colo. spruce	Fraser fir
Control	--	95	65	100
Oxadiazon 50W	1.1	75		
Oxadiazon 50W	2.2	57	2	50
Oxadiazon 50W	4.4	69	1	28
Oxadiazon 50W	2.2	59	2	32
+ Oryzalin 4AS	2.2			
Isoxaben 75W	1.1	48	5	27
Isoxaben 75W	1.1	11		
+ Oryzalin 4AS	3.3			
Isoxaben 75W	1.1	7		
+ Oxyfluorfen 1.6E	0.3			
Isoxaben 75W	1.1	5	1	25
+ Oryzalin 4AS	3.3			
+ Oxyfluorfen 1.6E	0.3			
Atrazine 4L	2.2	4		
+ Oryzalin 4AS	2.2			
Atrazine 4L	2.2	3		
+ Pendimethalin 4E	3.3			
Simazine 4L	2.8		1	30
Simazine 4L	2.8		1	17
+ Oxyfluorfen 1.6E	0.3			
Simazine 4L	2.8		1	17
+ Oryzalin 4AS	2.2			
Simazine 4L	2.8		1	22
+ Oryzalin 4AS	2.2			
+Oxyfluorfen 1.6E	0.3			
Simazine 4L	2.8		1	17
+ Pendimethalin 4E	3.3			
+ Oxyfluorfen 1.6E	0.3			
Simazine 4L	2.8		2	10
+ Metolachlor 8E	3.3			
+ Oxyfluorfen 1.6E	0.3			

THE TOLERANCE OF FRAXINUS, JUGLANS AND QUERCUS SEEDLINGS TO IMAZAQUIN AND IMAZETHAPYR

Larry J. Kuhns and Joanne E. Loose 1/

ABSTRACT

The experiment was conducted at a state forest nursery in Potters Mills, Pennsylvania. Imazaquin at 0.28 and 0.56 kg ai/ha and Imazethapyr at 0.14 and 0.28 kg ai/ha were applied over the top of actively growing seedlings of white ash (Fraxinus americana L.), black walnut (Juglans nigra L.), and red oak (Quercus rubra L.) to determine their tolerance to these materials. The seedlings were planted in fall, 1988 and the treatments were applied on June 8, 1989. At the time of application the ash were 5-10 cm, walnut 5-20 cm, and oak 7-15 cm tall. The ash seedlings were dense but were thinned with battery operated shears just prior to application. The walnut seedlings were sparse but uniformly distributed. The oak seedlings were well spaced, but their large leaves formed a dense canopy over the soil. The beds were essentially weed-free.

Plots were 1.5 m by 1.2 m with a 0.7 m buffer between each treatment. There were two replications of each treatment on each species. The treatments were applied with a CO_2 pressurized test plot sprayer at 30 psi through an 8008E nozzle in the equivalent of 400 L/ha of water. The weather was sunny with a light wind of 3-7 km/hr, occasionally gusting to 10 km/hr. Soil moisture was near field compacity. Air, soil surface, and soil (at 5 cm) temperatures were 25, 39, and 29°C, respectively. The seedlings were rated for phytotoxicity 4 and 12 weeks after application (Table1). Weed control ratings were not taken because the weed population in the treatment area was extremely low.

Both herbicides caused severe injury to ash and walnut seedlings, and moderate injury to oak seedlings. All ash were severely stunted 4 weeks after treatment (WAT). The high rate of imazethapyr also caused the death of some terminal shoots. Except for limited recovery of the plants treated with the low rate of imazethapyr, the ash did not recover by 12 WAT.

The walnuts were also severely injured 4 WAT by all treatments. However, they showed varying degrees of injury within the treatments. Some plants were severely stunted and distorted, with yellow new growth, while others in the same treatment were simply stunted. By 12 WAT all plants were severely injured. Symptoms included severe stunting of growth, chlorosis, tip kill, development of clustered growth or multiple leaders below dead terminal growth, and death of many plants.

The oak were much more tolerant of imazaquin and imazethapyr. Oaks treated with the low rates exhibited some leaf curling and distortion 4 WAT. The high rates also caused some leaf burn. At 12 WAT, imazaquin at the low rate caused slight stunting and a small reduction in second flush bud break. At the high rate it stunted growth, caused some leaf curling and yellowing, and greatly reduced second flush budbreak. Imazethapyr slightly stunted growth and caused slight leaf curl and chlorosis.

It is not known if the dense canopy at the time of application may have limited injury of the oaks by limiting the amount of chemical that reached the soil, and in turn the roots.

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Table 1. Injury ratings of ash, walnut, and oak seedlings treated with imazaquin and imazethapyr, 4 and 12 weeks after treatment (WAT).

		INJURY RATING 1/					
	RATE	Ash		Walnut		Oak	
CHEMICAL	kg a.i./ha	4 WAT	12 WAT	4 WAT	12 WAT	4 WAT	12 WAT
Control	-	1	1	1	1	1	1
Imazaquin	0.28	8	8	7.5	7	2	2
Imazaquin	0.56	8	9	8.5	9	3	6
Imazethapyr	0.14	8	6	7.5	9	2	3
Imazethapyr	0.28	8	8	8.5	9.5	3.5	4

1/ Rated on a scale of 1-10; 10 = dead.

MON 15151 - TURF HERBICIDE: EXPERIMENTAL USE PERMIT UPDATE

K.E. Kackley, D.C. Riego, T.E. Dutt, S.H. Bundschuh, and N.E. Jackson [1/]

ABSTRACT

The performance of MON 15151 1EC for pre- and postemergence control of crabgrass [Digitaria ischaemum (Schreb.) Muhl., D. sanguinalis (L.) Scop. and D. ciliaris (Retz.) Koel.] was evaluated in 1989 under a United States Environmental Protection Agency (EPA)-approved Experimental Use Permit (EUP). MON 15100 is 3,5-Pyridinedicarbothioic acid, 2-(difluromethyl) -4-(2-methylpropyl)-6-(trifluromethyl)-S, S-dimethyl ester; the common name is dithiopyr. The proposed trade name for turf uses is Dimension™ herbicide.

Trials were established, under commercial use conditions, throughout the United States on both warm and cool-season turfgrasses. Total EPA-approved EUP allocations for the United States were 4000 quarts (3785 L) of product and 1333 acres (540 ha) treated. MON 15151 1EC was distributed to selected golf courses, lawn care companies, landscape companies and municipal and industrial organizations within approved states and was applied through commercial equipment. Performance was evaluated on sites up to one half hectare in size.

MON 15151 provided excellent season-long preemergence control of crabgrass. Rates required for season-long control with a single spring application were 0.43 to 0.56 kg ha^{-1} for the Northeast, Midwest and CA and 0.56 to 0.84 kg ha^{-1} for the South and Southeast.

Rates of MON 15151 required to provide postemergence of crabgrass in the 1 to 3 leaf stage are 0.28 to 0.43 kg ha^{-1} in CA, 0.43 to 0.56 kg ha^{-1} in the Northeast and Midwest and 0.56 to 0.84 kg ha^{-1} in the South and Southeast. Control of plants with 1 to 3 tillers was improved with the addition of MSMA. Effective rates are 0.28 kg ha^{-1} MON 15151 plus 0.56 to 1.12 kg ha^{-1} MSMA for the Northeast, Midwest and CA, and 0.56 kg ha^{-1} MON 15151 plus 1.12 to 2.24 kg ha^{-1} MSMA for the South and Southeast.

Excellent turf safety was demonstrated on both cool-season and warm-season turfgrasses (Table 1). Cool-season turfgrasses demonstrating tolerance to MON 15151 include bentgrass (Agrostis spp. L.), Kentucky bluegrass (Poa pratensis L.), tall fescue (Festuca arundinacea Schreb.) and perennial ryegrass (Lolium perenne L.). Warm-season turfgrasses demonstrating tolerance include bahiagrass (Paspalum notatum Flugge), bermudagrass [Cynodon dactylon (L.) Pers.], St. Augustinegrass [Stenotaphrum secundatum (Walt.) Kuntze.] and Zoysiagrass (Zoysia japonica Steud.).

MON 15151 also provides preemergence control or suppression of a number of other annual grass and broadleaf weeds (Table 2).

The EPA has granted an EUP extension for MON 15151 1EC and MON 15104 1EC, an alternate formulation, for expanded evaluation in 1990. Total allocations approved under the extension are 6320 quarts (5981 L) of product and 3960 acres (1603 ha) treated.

[1/] Product Development Representatives, Industrial, Greens and Residential, Monsanto Company, c/o 3015 Blueford Rd. Kensington, MD 20895-2724.

Table 1. Turf Species Demonstrating Tolerance to MON 15151 1EC at rates recommended for crabgrass control.

Common Name	Scientific Name
Cool-Season	
Bentgrass	*Agrostis* spp.
Kentucky bluegrass	*Poa pratensis*
Tall Fescue	*Festuca arundinacea*
Perennial ryegrass	*Lolium perenne*
Fine fescues**	*Festuca rubra*
	Festuca ovina
	Festuca longifolia
Warm-Season	
Bahiagrass	*Paspalum notatum*
Bermudagrass	*Cynodon dactylon*
Buffalograss	*Buchloe dactyloides*
Centipedegrass	*Eremochloa ophiuroides*
Kikuyugrass	*Pennisetum clandestinum*
St. Augustinegrass	*Stenotaphrum secundatum*
Zoysiagrass	*Zoysia japonica*

** Certain subspecies and cultivars of fine fescues have shown tolerance to MON 15151, while others have not.

Table 2. Annual Grass and Broadleaf Weeds Controlled or Suppressed by MON 15151 1EC.

Common Name	Scientific Name
Annual bluegrass	*Poa annua*
Crabgrass	*Digitaria* spp.
Foxtail	*Setaria* spp.
Goosegrass	*Eleusine indica*
Chickweed	*Stellaria* spp.
Spurge	*Euphorbia* spp.
Lespedeza	*Lespedeza* spp.
Oxalis	*Oxalis* spp.
Purslane	*Portulaca oleracea*

POSTEMERGENCE WEED CONTROL IN CORN WITH CGA-136872

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D. B. Vitolo, J. R. Cantwell, and S. W. Pruss[1]

ABSTRACT

CGA-136872 has been evaluated for postemergence weed control in corn (Zea mays L.) since 1984. Weed control has been influenced by species, stage of growth at application, and environmental conditions.

Season long control of shattercane (Sorghum bicolor (L.) Moench), redroot pigweed (Amaranthus retroflexus L.), cocklebur (Xanthium strumarium L.), common ragweed (Ambrosia artemisiifolia L.), giant ragweed (Ambrosia trifida L.), and seedling johnsongrass (Sorghum halapense (L.) Pers.) at application rates of 20-40 G AI/HA has been confirmed. Control of fall panicum (Panicum dichotomiflorum michx.), velvetleaf (Abutilon theophrasti Medik.) and common lambsquarters (Chenopodium album L.) has varied from excellent when CGA-136872 was applied very early to poor when applied late. Excellent growth suppression and significant reductions in populations have been noted on rhizome johnsongrass, quackgrass (Agropyron repens (L.) Beauv.), horsenettle (Solanum carolinense L.), and Canada thistle (Cirsium arvense (L.) Scop.). Split applications have provided the best control of rhizome johnsongrass. Control of all weeds was best when CGA-136872 was applied with an nonionic surfactant at 0.25% V/V or crop oil concentrate at 1.0% V/V.

Corn tolerance has been excellent in most cases where the corn was between 15 and 54 CM. Phytotoxicity varies with some cultivars being very susceptible to injury while most varieties are extremely tolerant to rates as high as 120 G AI/HA. Soil insecticides such as terbufos and dyfonate have been shown to increase the potential for corn injury with CGA-136872.

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Postemergence Combinations with Imidazolinone and Sulfonylurea Herbicides in Soybeans

J. W. Wilcut, D. N. Horton, and L. D. Fortner[1]

Field experiments were conducted in 1989 to evaluate imidazoline and sulfonylurea herbicides applied alone postemergence, tank-mixed with 2,4-DB, acifluorfen, and acifluorfen plus 2,4-DB. Soybean variety was Pioneer 9581. All herbicide treatments were applied with a tractor-mounted sprayer in a total diluent volume of 20 gpa using 11003 flat fan nozzle tips, and 28 PSI. Predominant weed species in the experimental area included large crabgrass (Digitaria sanguinalis L. DIGSA, common ragweed, Ambrosia artemisiifolia L. AMBEL, common lambsquarters, Chenopodium album L. CHEAL, and morningglory species, Ipomoea sp. IPOZZ. Trifluralin was applied preplant incorporated (PPI) to all plots at 0.5 lb ai/ac except the weedy and hand weeded checks. The first sixteen postemergence herbicide treatments consisted of a factorial arrangement of chlorimuron at 0.004 lb/ac, thiameturon at 0.002 lb/ac, imazethapyr at 0.063 lb/ac, and imazaquin at 0.125 lb/ac alone, and in combination with 2,4-DB (0.031 lb/ac), acifluorfen at 0.25 lb/ac, or acifluorfen plus 2,4-DB at the aforementioned rates. The remaining six postemergence treatments consisted of acifluorfen alone or tankmixed with 2,4-DB, acifluorfen plus bentazon with and without 2,4-DB, and thiameturon plus chlorimuron with and without 2,4-DB. Three additional treatments for comparative purposes included trifluralin PPI, and a weedy and hand weeded check. All postemergence treatments were applied with a nonionic surfactant at 0.125% v/v of the total spray volume.

Thiameturon and two thiameturon tank mixtures provided at least 96% control of CHEAL. However, thiameturon tank mixed with acifluorfen plus 2,4-DB provided only 67% control. AMBEL control with thiameturon (27%) was improved when tank mixed with either acifluorfen (79%) or acifluorfen plus 2,4-DB (94%). AMBEL control from thiameturon plus 2,4-DB was 20%. Chlorimuron alone or tank mixed with acifluorfen plus 2,4-DB provided approximately 70% control of CHEAL while tank mixtures with 2,4-DB or acifluorfen provided 98 and 90% control, respectively. AMBEL control was greatest with chlorimuron tank mixed with acifluorfen (86%) or acifluorfen plus 2,4-DB (82%). Chlorimuron alone provided 81% IPOZZ control while all tank mixtures provided at least 93% control.

Imazethapyr control of CHEAL and IPOZZ was equivalent with all treatments (>85% and >88%, respectively). AMBEL control was 62% with imazethapyr or 75% with imazethapyr plus 2,4-DB. Tank mixtures of imazethapyr with acifluorfen or acifluorfen plus 2,4-DB controlled AMBEL at least 92%. Imazaquin efficacy on CHEAL (90%), AMBEL (81%), and IPOZZ (86%) was not enhanced with the addition of other herbicides.

Acifluorfen or acifluorfen plus 2,4-DB provided at least 88%, 87%, and 91% control of CHEAL, AMBEL, and IPOZZ, respectively. Acifluorfen plus bentazon with or without 2,4-DB provided control comparable to acifluorfen alone. These data indicate that many postemergence options are available for Virginia soybean producers. Caution should be exercised to choose the appropriate tank mixture. These data also illustrate the good utility of acifluorfen or acifluorfen tank mixtures for postemergence broadleaf weed control in Virginia soybeans.

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POSTEMERGENCE LACTOFEN WITH BENTAZON, CHLORIMURON, OR IMAZAQUIN IN SOYBEANS[1]

M. Waters, R.D. Ilnicki, K.G. Hoffman, and A.J. Enache[2]

ABSTRACT

Much progress has been made in the development of herbicides for postemergence use in soybeans (Glycine max L. Merr.). Diphenylethers, a benzothiadiazin, sulfonylureas, and imidazolinone herbicides have proved to be effective for weed control when applied after soybean emergence. Combinations of herbicides, to broaden the spectrum of weed control, offer researchers a challenge to determine whether combinations will be effective, particularly with some of the more recently released herbicides.

A study was established to determine the effectiveness of lactofen alone, and in combination with several herbicides for weed control and soybean tolerance. Lactofen, bentazon, chlorimuron, and imazaquin were applied alone and combinations of lactofen with these other herbicides, when soybeans were in the first trifoliate stage and weeds three to twelve centimeters tall, with two to six leaves each.

None of the herbicides or combinations had any effect on soybean stand, and only the lactofen plus imazaquin treatment had a slightly negative effect on soybean vigor. Fall panicum (Panicum dichotomiflorum Michx.) control was not effective with any of the treatments, except imazaquin alone and in combination with lactofen, and with higher rates of lactofen plus chlorimuron. All of the herbicides and combinations controlled giant foxtail(Setaria faberi Hermm.), with the exception of bentazon alone. Control of lambsquarters (Chenopodium album L.) was nearly complete with all treatments. Barnyardgrass [Echinochloa crus-galli (L.) Beauv.] was not controlled by bentazon or as effectively by a low rate of lactofen plus chlorimuron as by all other treatments.

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PREEMERGENCE AND POSTEMERGENCE LACTOFEN COMBINATIONS IN SOYBEANS[1]

R.D. Ilnicki, A.J. Enache, K.G. Hoffman, and M. Waters[2]

ABSTRACT

There are many herbicides available for use in soybeans (Glycine max L.), including those used preemergence and those used postemergence. Alachlor is one herbicide that has been used successfully for many years. More recently, lactofen, a diphenylether, has been introduced and, in addition to its preemergence activity, shows promise for postemergence use, particularly for late season broadleaf weed control. An experiment was established to determine the effectiveness and safety of lactofen in combination with alachlor applied preemergence then followed by later applications of lactofen in combination with other postemergence herbicides.

Soybeans were planted June 28, 1989 and preemergence treatments applied the following day. Three weeks later, postemergence applications of lactofen, lactofen plus bentazon, lactofen plus chlorimuron, lactofen plus cloproxydim, and bentazon plus acifluorfen were sequentially applied to previously-treated alachlor or alachlor plus lactofen plots.

Soybeans were in the first trifoliate leaf stage and giant foxtail (Setaria faberi Hermm.), fall panicum (Panicum dichotomiflorum Michx.), barnyardgrass [Echinochloa crus-galli (L.) Beauv.], wild mustard [Brassica kaber (DC.) L.C. Wheeler], and lambsquarters (Chenopodium album L.) were three to twelve centimeters tall with two to six leaves.

Preemergence alachlor was effective on all weeds save lambsquarters, but an addition of lactofen improved control of this weed with no difference in control whether lactofen was applied together with alachlor or as a sequential. Sequential applications of lactofen in combination with bentazon, chlorimuron, or cloproxydim did not improve weed control over, that produced by preemergence alachlor plus lactofen or alachlor preemergence followed by lactofen postemergence.

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V-53482 IN SOYBEANS

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

ABSTRACT

Soybeans [Glycine max (L.)Merr.] are planted conventionally and no-till in Virginia with approximately 50% of the acreage produced by each tillage method. Although weed control in conventionally planted soybeans must be achieved only from planting until harvest, control in no-till soybeans involves control of existing vegetation at planting in addition to the requirement for control of weeds emerging after planting. V-53482 is an experimental herbicide which has shown promise as both a non-selective and preemergence herbicide in soybeans. This research investigated both uses and was conducted at the Eastern Shore Agric. Exp. Stn. in 1988 and 1989. In no-till soybeans, 0.022 to 0.067 lb ai/A V-53482 controlled hairy vetch (Vicia villosa Roth.) but caused only transient effects on horseweed [Conyza canadensis (L.)Cronq.] and prickly lettuce [Lacunosa serriola (L.)]. Combinations of chlorimuron + linuron and a preemergence grass herbicide with V-53482 resulted in good horseweed, prickly lettuce and residual annual grass control. Combinations of V-53482 with glufosinate, glyphosate, or paraquat also improved horseweed control. In conventional soybeans, V-53482 alone and in combinations with alachlor caused early-season soybean growth reductions. Preemergence control of smooth pigweed (Amaranthus hybridus L.), and common lambsquarters (Chenopodium album L.) were above 90% from V-53482 but control of common cocklebur (Xanthium strumarium L.) annual morningglories (Ipomoea spp.), and large crabgrass (Digitaria sanguinalis (L.)Scop.] was low. It is concluded that V-53482 must be combined with other non-selective and residual herbicides if broad-spectrum weed control is to be achieved from this herbicide in both no-till and conventional soybeans.

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Preplant and Postemergence Herbicide Combinations for Weed Control in Soybeans

J. W. Wilcut and F. R. Walls[1]

Field experiments were conducted in 1989 to evaluate method of application and herbicide combinations for weed control in soybeans Glycine max (L.) Merr. 'Pioneer 9581'. All herbicide treatments were applied with a tractor-mounted sprayer in a total diluent volume of 20 gpa using 11003 flat fan nozzle tips and 28 PSI. Soil incorporated treatments were incorporated with two passes of a 7 ft. field cultivator with dual rolling baskets. Predominant weed species in the experimental area included large crabgrass (Digitaria sanguilanis L. DIGSA, common ragweed, Ambrosia artemisiifolia L. AMBEL, common lambsquarters, Chenopodium album L. CHEAL, and morningglory species, Ipomoea sp. IPOZZ. Trifluralin was applied at 0.5 lb ai/ac preplant incorporated (PPI) to all plots except the weedy and weed free checks. The first sixteen herbicide treatments consisted of a factorial arrangement of chlorimuron plus metribuzin at 0.03 and 0.18 lb/ac, chlorimuron plus linuron at 0.021 and 0.25 lb/ac, imazethapyr at 0.063 lb/ac, and imazaquin at 0.125 lb/ac applied either PPI or preemergence (PRE), and these 8 treatments were either alone, or followed by a postemergence (POE) application of acifluoren (0.25 lb/ac) plus bentazon (0.5 lb/ac). The remaining four herbicide treatments consisted of metribuzin PPI at 0.105 lb/ac, metribuzin PPI followed by a POE application of acifluorfen, trifluraline PPI alone, or followed by a POE application of acifluorfen plus bentazon. For comparative purposes, a weedy and hand weeded check were included. Acifluorfen plus bentazon was applied with a crop oil concentrate at 1.25% v/v of the total spray volume.

All herbicide systems provided greater than 91% control of DIGSA and 95% CHEAL control. Averaged across all treatments, PRE applications of imazaquin, imazethapyr, chlorimuron plus metribuzin, and chlorimuron plus linuron provided greater AMBEL control (90%) than PPI applications (78%). When averaged across all treatments, morningglory control was unaffected by method of application. Imazaquin provided greater AMBEL and IPOZZ control (98% and 87%, respectively) as a PRE compared to a PPI application (73% and 66%, respectively). Imazethapyr provided equivalent control of AMBEL regardless of method of application while IPOZZ control was greater PPI (65%) than PRE (47%). Method of application did not influence chlorimuron plus linuron effecacy on AMBEL or IPOZZ. Chlorimuron plus metribuzin provided 79% control PRE and 49% PPI on IPOZZ with AMBEL control being equivalent. Metribuzin PPI provided the least control of AMBEL (54%) and IPOZZ (57%).

Averaged across all common treatments, acifluorfen plus bentazon POE provided complete AMBEL control compared to control (84%) with no POE treatment. IPOZZ control was improved from 65% to 92% with acifluorfen plus bentazon POE. Metribuzin PPI and acifluorfen plus bentazon POE provided 100% AMBEL control and 68% for IPOZZ. Trifluralin followed by acifluorfen plus bentazon provided 77% AMBEL and 79% IPOZZ control. Yield data and corn yields from carryover plots established in 1988 will also be presented.

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LATEST TECHNOLOGY FOR RESEARCH PLOT SPRAYERS

Mark S. Causey and Frank J. Webb[1]

ABSTRACT

A new sprayer system was designed and put into service in 1989 at the University of Delaware. The concern for a more accurate, efficient, as well as a system that could be built economically led to the design of this sprayer system. This sprayer is used for herbicide research and is functional on a JD850 tractor. This spray system utilizes a twin piston PTO driven air compressor for spray solution propulsion. The other components of the sprayer are built around the compressor. The system will spray up to ten treatments at a time and utilize ten solution containers. The stainless steel solution container is equipped with three quick disconnects in the top of the can. One for compressed air inlet through a drop tube connected to a four pronged circular outlet[2] near the bottom of the container. This allows the air to be released in a circular motion at the bottom of the container creating a swirling action so the solution can be constantly agitated during the entire spraying operation. A second quick disconnect is attached to a bled-off manifold which allows air to be released from the container continuously for agitation. The third quick disconnect is equipped with a long drop tube which allows the solution to be forced from the bottom of the solution container. After the solution leaves the container it runs through the spray line leading to the proper boom. The sprayer is equipped with ten booms which utilize diaphragm check valve nozzle assemblies. Each boom utilizes a solenoid valve which controls the on and off action of the boom. The solenoid valves are electrically connected to an electronic control unit[3] which is powered by the tractor's[1] twelve volt electrical system. The control unit is pre-randomized by the operator for up to ten plots with four replications prior to entering the study area. The control unit is equipped with a purge button which allows the operator to pre-charge all booms at once prior to spraying the first plot. After purging, the control unit is switched to spray mode which activates the electronic control unit to start the pre-randomized sequence. As the sprayer moves from plot to plot the operator changes treatments by pushing a start button at the beginning of each plot. The electronic control unit activates the proper boom solenoid which follows pre-randomization program. At the end of each replication the sprayer automatically shifts to a standby mode when the operator activates the start button for the last plot in the replication. At this time the operator can choose to spray additional replications or start clean out procedure. Clean out is achieved by flushing all booms at one time. A pressurized clean water container is mounted on the front of the tractor that supplies water for this operation. At this time the next set of treatments can be loaded and the sequence of operations are repeated.

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WEED CONTROL PRACTICES OF ALFALFA PRODUCERS IN PENNSYLVANIA

Sidney C. Bosworth[1]

ABSTRACT

Weed control is an important factor in optimizing alfalfa production and quality and is especially important during establishment of the crop. There are several strategies used in controlling weeds in alfalfa both cultural and chemical.

The Pennsylvania Alfalfa Growers Program (PAGP), a program initiated in 1977 and sponsored by Penn State Cooperative Extension and the Pennsylvania Forage and Grassland Council, was developed to monitor production fields in order to measure alfalfa yield, quality, nutrient removal and cost of production. The objective of this paper is to summarize some of the weed control practices of farmer participants from the past four years.

Most alfalfa fields were measured during their first or second full harvest years. Yield determination was made during each harvest. Additional information collected included date of cut, stage of maturity, botanical composition (visual assessment) and insect and disease levels. Information pertaining to establishment was also collected. All field data collection was under the direct supervision of local county agricultural extension agents.

There were 182 completed records from the 88 and 89 PAGP representing fields seeded between 1985 and 1988. Of these, 73% were stands of pure alfalfa. Only 14% were planted with a small grain companion crop. Of the 89% that were directed seeded, 50% received a preplant incorporated herbicide, 24% a postemergence herbicide, 8% both, 3% a "burndown" treatment, and 34% received no herbicide during establishment. Twenty-seven percent were alfalfa-grass mixtures of which 28% were seeded with a small grain companion crop. Twenty-eight percent of the other alfalfa-grass mixtures did receive a post emergence herbicide usually 2,4-DB.

From 1986 to 1988, forty-one fields in the PAGP were assessed during their establishment year. None were planted with a companion crop. Seventy-six percent were pure alfalfa stands. Visual assessments of botanical composition during the yield checks found that there was little difference in weed content between the pure alfalfa stands and the alfalfa-grass mixtures. Within the pure stands, fields which received no herbicide had an average of 27% weeds in the first cutting while herbicide treated fields had 10%. Crude protein content was approximately one percentage unit less in the none herbicide treated fields. Total digestible nutrients were about the same. There was less difference during the second harvest.

Cost of production data was collected on approximately 80% of the fields in the program. The cost of spray materials (herbicide and insecticide) used at establishment was relatively small both in terms of establishment costs and overall annual production costs (Figure 1).

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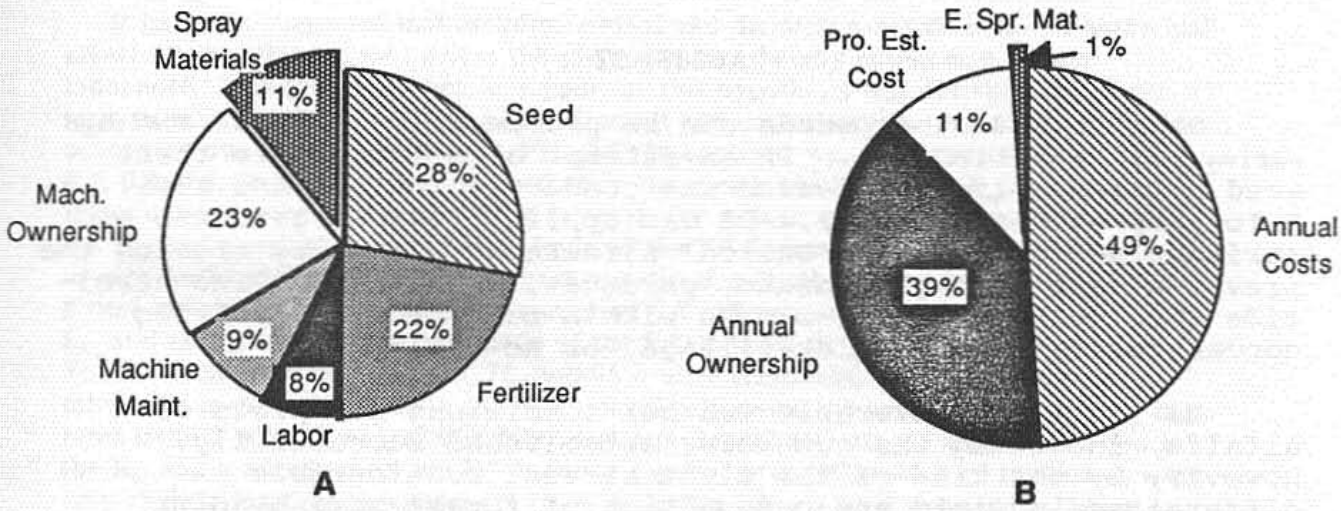

Figure 1. A - The cost of spray materials used at establishment of alfalfa relative to other establishment costs. B - The prorated cost of spray materials used during the establishment relative to other the total costs of production and harvest. Source: Pennsylvania Alfalfa Growers Program.

HALOXYFOP AND OTHER HERBICIDES FOR CONTROL OF WEEDS IN SEEDLING ALFALFA[1]

Dean L. Linscott and Richard H. Vaughan[2]

ABSTRACT

Grasses and other weeds can be problems in alfalfa (*Medicago sativa* L.) establishment. In an attempt at solutions to these weed problems field research was conducted in 1988 and 1989. Haloxyfop combined with 2,4-DB was applied postemergence to spring planted seedling 'Oneida' alfalfa across plots treated the previous fall with glyphosate, paraquat, or nothing. The herbicide treatments were sub-blocks within main blocks involving conventional-tillage, disk-tillage, or no-tillage.

As result of favorable weather conditions all plots of alfalfa, including the controls, established successfully. However, by the time of the first harvest considerable differences in yield and composition of forage were evident. In 1988, the highest first cutting alfalfa yields were obtained with postemergence haloxyfop(0.2, 0.4 kg/ha)-2,4-DB (1 kg/ha) combinations which followed glyphosate (1 kg/ha) applied the previous autumn. The superior yields following the fall-spring combined treatments carried over to the next year. Second in order of alfalfa produced over two years were haloxyfop-2,4-DB combinations following fall-applied paraquat (0.5 kg/ha). Third in order were the haloxyfop-2,4-DB combinations with no previous fall treatments. In general, yield of alfalfa was inversely related to yield of weeds.

Yield of alfalfa in the conventionally-tilled and disk-tilled plots was equivalent. By comparison, the no-tillage plots yielded significantly less both the year of establishment and the following year. Less control of both grass and broadleaf weeds was obtained in the no-tillage entries.

Portions of the 1988 study were repeated in 1989. A fall application of glyphosate followed by haloxyfop-2,4-DB or haloxyfop alone resulted in excellent alfalfa establishment and weed control. There were no significant differences in legume establishment among the tillages or haloxyfop-2,4-DB combinations in the 1989 plantings.

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EVIDENCE AGAINST THE MODE OF ACTION OF DICLOFOP-METHYL AS A PROTONOPHORE

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It has been suggested that diclofop-methyl and diclofop exert their initial herbicidal effect by shuttling protons across the plasmalemma, thereby acting as a proton ionophore. However, evidence in support of this hypothesis was derived from short term experiments on excised and peeled wheat and oat coleoptiles exposed to herbicide concentrations ranging from 10 to 100 μM. In contrast, we compared the effects of 0.2, 0.4, 0.8, or 2.0 μM diclofop-methyl on the membrane potential (E_m) of roots of intact oat and corn seedlings at 24 h intervals for 4 days. A gradual depolarization of the E_m and a reduction in the magnitude of the K^+-induced depolarization in oat roots at each herbicide concentration suggest that diclofop-methyl may act as a weak protonophore. However, diclofop-methyl at 0.8 μM caused a hyperpolarization of the E_m and an increase in the magnitude of the K^+-induced depolarization in corn roots. These results were observed 48, 72, and 96 h after treatment, despite a complete inhibition in corn root growth by 24 h after diclofop-methyl exposure. Moreover, corn roots treated with 50 nM of CCCP (a known protonophore) caused a depolarization in the E_m and a reduction in the K^+-induced depolarization after 24 h of treatment, while only slightly inhibiting root growth (32% inhibition after a 96 h treatment). When roots of oat seedlings were exposed to 100 μM diclofop acid, a dramatic depolarization of the E_m resulted. The E_m response in 100 μM diclofop acid treated roots of pea seedlings (resistant to diclofop-methyl and diclofop acid) was very similar to that of oats, despite no inhibitory effect on pea root growth following a 4 day exposure to 0.8 μM diclofop-methyl. These results suggest that the effect of diclofop-methyl on the E_m in oat is probably unrelated to the primary inhibitory effect of the herbicide on plant growth.

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DIFFERENTIAL EFFECTS OF DICLOFOP-METHYL ON FATTY ACID BIOSYNTHESIS IN LEAF AND ROOT TISSUES OF CORN SEEDLINGS

A. E. Stowe, J. M. DiTomaso, P. H. Brown[1] and D. L. Linscott[2]

Diclofop-methyl has been shown to block the synthesis of fatty acids by inhibiting the activity of a plastid associated enzyme, acetyl-CoA carboxylase. This study was designed to compare the effect of diclofop-methyl on the synthesis of fatty acids in tissues of corn seedlings differing in plastid content. Root tip meristems and leaf tissues, both known to be high in plastids, were compared with mature root tissues, which possess fewer plastids. In addition, we examined the effect of diclofop-methyl on the distribution of specific radiolabeled lipids in each tissue type. Incorporation of ^{14}C-acetate into lipids was greatly reduced by diclofop-methyl in leaves and 1-cm root tips. However, the overall rate of ^{14}C-acetate incorporation into fatty acids was not inhibited in mature root tissues following exposure to 0.8 mM diclofop-methyl. This lack of response in mature root tissues was evident 24, 48, 72 and 96 h after treatment, despite a complete reduction in root growth 24 h after herbicide exposure. Although there was a similar reduction in fatty acid synthesis in root meristems and leaf tissues, damage to root tips was observed long before any visual injury to treated leaves. These results indicate that meristematic regions of sensitive plants are considerably more sensitive to a reduction in fatty acid synthesis than are leaf tissues. Thin layer chromatographic separation and subsequent quantification of radiolabeled lipids indicate that diclofop-methyl only inhibited the synthesis of di- and triglycerides in root tissues. However, the incorporation of ^{14}C-acetate into several other lipids, including both glycolipids and phospholipids was stimulated in mature root tissues treated with diclofop-methyl. These results suggest that overall fatty acid synthesis in meristematic regions with a higher number of plastids are more sensitive to diclofop-methyl than mature tissues with fewer plastids.

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QUINCLORAC (BAS 514 00H) INDUCED ETHYLENE SYNTHESIS IN SUSCEPTIBLE AND TOLERANT SPECIES

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ABSTRACT

Quinclorac is a recently developed herbicide which provides control of a broad range of monocot and dicot weeds in turf and rice. In susceptible dicots the symptoms of injury resemble those of a synthetic auxin herbicide. Additionally, quinclorac has tested positively in several auxin bioassays including wheat coleoptile elongation, cucumber root inhibition, and soybean leaf disk ethylene evolution. It has been suggested that, in susceptible dicots, quinclorac's mode of action is similar to other synthetic auxins, such as 2,4-D. To test this hypothesis, a series of experiments was conducted in which ethylene evolution was measured as an indicator of auxin-like herbicide action induced by quinclorac in dandelion (Taraxacum officinale Weber in Wiggers) (susceptible) and broadleaf plantain (Plantago major L.) (tolerant).

Dandelion and plantain seedlings were grown in a greenhouse maintained with a minimum night temperature of 18 C. Natural daylight was supplemented with HID lamps for a 16 h photoperiod. Herbicides were applied when plants had 10 to 12 leaves. In time-course studies, treated plants were harvested 6, 12, 24, 36, 48, and 60 hours after treatment. Based on these results, subsequent experiments utilized only "peak" harvest times. Quinclorac rate response between 0.2 and 1.1 kg/ha was evaluated at the 12 hour harvest interval. Tissue gases were extracted from the above-ground plant parts under vacuum, 56 cm Hg, for three minutes. Ethylene content was determined by gas chromatography. Each experiment contained three to four replicates in a completely random design and was repeated.

In dandelion, tissue ethylene content peaked at 6 h for 2,4-D and at 12 h for quinclorac. At the peak, 2,4-D caused a 17 to 26 fold increase in tissue ethylene, compared to untreated plants. Quinclorac consistently induced a 3 to 4 fold increase in ethylene content. However, this increase was statistically significant in only one of three tests. In plantain treated with 2,4-D, tissue ethylene content peaked at 12 h with an 8 fold increase over the untreated plants. Ethylene levels in plantain were not elevated by quinclorac.

In field tests, dandelion control with 0.84 kg/ha quinclorac was equal or superior to 2,4-D at 1.7 kg/ha. In the greenhouse, rate response studies showed that >90% dandelion control was obtained by 0.9 kg/ha of quinclorac. However, ethylene evolution induced by 1.1 kg/ha of quinclorac was about 20% of that induced by 1.1 kg/ha of 2,4-D. Clearly, the magnitude of tissue ethylene content does not correlate with the comparative phytotoxicity of the two herbicides in a susceptible species. However, in plantain, tissue ethylene content was a good indicator of herbicide selectivity. These data suggest two possibilities: (a) that quinclorac may have a different mode of action than 2,4-D or (b) that auxin stimulated ethylene synthesis is not involved in the phytotoxic action of the synthetic auxin herbicides. Further tests are in progress to test these hypotheses.

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INFLUENCE OF SC-0774 ON CHLOROPHYLL AND CAROTENOID BIOSYNTHESIS[1]

P.C. Bhowmik and U.B. Nandihalli[2]

ABSTRACT

The influence of SC-0774 (ICI) on chlorophyll and carotenoid biosynthesis was investigated in cucumber (Cucumis sativus L.) cotyledon greening system. The herbicidal activity of SC-0774 on pigment synthesis was dependent upon concentration and light intensity. When the etiolated tissue was incubated with SC-0774 in darkness for 20 h and exposed to light for 72 h, there was a concurrent reduction in both pigment levels. However, when the green tissue was treated with SC-0774 and exposed to light for 48 h, there was a greater reduction in the initial rate of carotenoid synthesis than in the initial rate of chlorophyll synthesis. Exogenously supplied ∂-aminolevulinic acid was unable to reverse the SC-0774-reduced chlorophyll synthesis, suggesting that SC-0774 did not inhibit chlorophyll synthesis directly. This research suggests that SC-0774 induced bleaching is due possibly to the inhibition of the synthesis of carotenoid pigments which are known to protect chlorophyll from photooxidation.

INTRODUCTION

SC-0774 is an experimental herbicide being developed for broad spectrum weed control in corn. In our field and greenhouse experiments, SC-0774 treated weedy plants showed chlorosis and severe bleaching symptoms. The mode of action of herbicidal bleaching has been attributed to (a) inhibition of carotenoid biosynthesis which leads to the peroxidation of lipids resulting in chloroplast membrane degradation (7) and (b) interference with chlorophyll synthesis by means of interfering with the synthesis of tetrapyrrole precursors (6).

Carotenoid pigments with at least nine conjugated double-bonds are known to prevent chlorophyll photodestruction by quenching triplet-state chlorophyll molecules and by removing oxygen from excited chlorophyll-oxygen complex via a carotenoid-epoxide cycle (1). Apparently, carotenoids are also broken down in this process preceeding the destruction of chlorophylls. The formation of ∂-aminolevulinic acid (ALA), an important precursor of tetrapyrroles, is considered to be the rate-limiting step in chlorophyll biosynthesis in higher plants. When the etiolated cucumber cotyledons were pre-treated with ALA, the inhibitory action of fluridone on chlorophyll formation was reversed (3).

The objective of this research was to determine whether SC-0774 induces bleaching by interfering with chlorophyll and carotenoid biosynthesis.

MATERIALS AND METHODS

Cucumber 'Wisconsin SMR 18' seeds were planted in flats (24 by 16 by 8 cm) containing soil:perlite (1:1 v/v) medium and germinated in darkness for five daysat 28 C. Cotyledons from seedlings of approximately 15 cm height were excised under greensafe light (0.02 $\mu E.m^{-2}.s^{-1}$) without their hypocotyl hooks.

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Groups of 10 cotyledons were placed in 3-cm petri dishes containing 3 ml of distilled water or test chemicals. The petri dishes were placed in darkness at 28 C for 20 h. Following dark incubation, the cotyledons were exposed to a constant light intensity of 60 $\mu E.m^{-2}.s^{-1}$, unless stated otherwise, provided from cool-white fluorescent bulbs. This relatively low light intensity was used to minimize photooxidation of chlorophyll. At harvest, the cotyledons were blotted dry to remove excess surface moisture and ground in a 'Virtis 23' tissue grinder at full speed for 1 min in 10 ml of 80% aqueous acetone. The extract was centrifuged at 2500 g at 0 C for 10 min in IEC Centra-7 Refrigerated Centrifuge. The volume of supernatant was adjusted to 15 ml with aqueous acetone. The absorbance of supernatant was determined at 480, 645, and 663 nm with a Beckman double-beam spectrophotometer. Chlorophyll *a*, chlorophyll *b*, and total chlorophyll estimations were made from a nomogram (4). The carotenoid content was calculated from the formula (5):

$$\Delta A^{CAR} = A_{480} + 0.114\ A_{663} - 0.638\ A_{645}$$

Statistical analysis. All experiments were conducted twice, each time with three replications. Data were subjected to combined analysis of variance and the means were separated by Duncan's multiple range test at the 5% level of significance.

RESULTS AND DISCUSSION

Herbicide concentration and light intensity. The inhibition of pigment synthesis in cucumber cotyledons by SC-0774 was dependent upon herbicide concentration and light intensity (Figure 1). At each concentration the

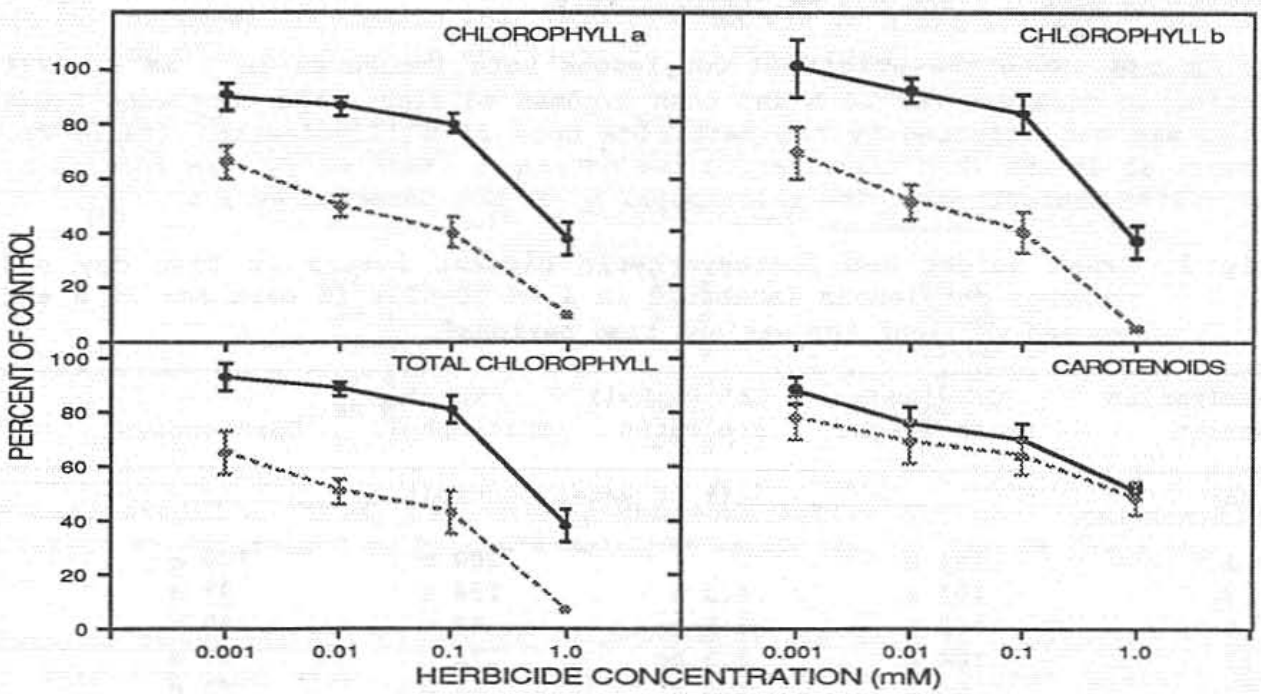

Figure 1. Chlorophyll *a*, chlorophyll *b*, total chlorophyll, and carotenoid levels in five day old cucumber cotyledons incubated in SC-0774 solutions of various concentrations in dark for 20 h, and then exposed to light intensities of 60 (solid lines) and 210 $\mu E.m^{-2}.s^{-1}$ (broken lines) for 24 h. Vertical bar at each data point denotes standard deviation.

pigment levels were reduced greater at 210 $\mu E.m^{-2}.s^{-1}$ than at 60 $\mu E.m^{-2}.s^{-1}$ light intensity. The chlorophylls *a* and *b* were reduced by the same degree when herbicide concentration and light intensity were varied. The results from Figure 1 show that the total chlorophyll content was reduced more than the carotenoid content when the light intensity was increased. This was supported by the I_{50} data which indicate the herbicide concentration giving 50% reduction in pigment contents (Table 1). At lower light intensity, the I_{50} values for chlorophyll and carotenoids were 0.76 and 1.01 mM, respectively,

Table 1. Concentration of SC-0774 giving 50% inhibition (I_{50}) of chlorophyll *a*, chlorophyll *b*, total chlorophyll, and carotenoid pigment contents in five day old cucumber cotyledons illuminated with 60 and 210 $\mu E.m^{-2}.s^{-1}$ light intensity.

Pigment	I_{50} 60 $\mu E.m^{-2}.s^{-1}$	I_{50} 210 $\mu E.m^{-2}.s^{-1}$
	(mM)	
Chlorophyll *a*	0.74	0.09
Chlorophyll *b*	0.76	0.11
Total chlorophyll	0.76	0.10
Carotenoids	1.01	0.90

whereas at higher light intensity, the I_{50} values for total chlorophyll and carotenoids were 0.1 and 0.9 mM, respectively.

Time course. When the etiolated cotyledons were incubated in 1 mM SC-0774 solution in darkness for 20 h and then exposed to light, the cotyledon fresh weight was not affected by the herbicide upto 24 h illumination (Table 2). However, at 48 and 72 h illumination the cotyledon fresh weight was reduced by 15 and 31%, respectively. The chlorophyll *b* was not detected at 1 h

Table 2. Fresh weight and photosynthetic pigment levels in five day old cucumber cotyledons incubated in 1 mM SC-0774 in dark for 20 h and exposed to light for various time periods[a].

Illumination period	Cotyledon fresh weight	Chlorophyll *a*:*b* ratio	Total chlorophyll	Carotenoids
(h)	(% of water control)			
1	101 a		100 b	100 a
3	101 a	4.3 a	126 a	97 a
6	103 a	2.5 b	82 c	80 b
12	104 a	2.3 bc	70 d	67 c
24	99 a	2.0 c	64 d	62 c
48	85 b	2.1 c	47 e	51 d
72	69 c	1.9 c	33 f	45 d

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

illumination. The chlorophyll *a*:*b* ratio decreased continuously as the illumination period progressed, suggesting that the inhibitory effect of SC-0774 on chlorophyll *b* formation was decreased with increase in illumination time. The total chlorophyll and carotenoid contents were not affected by SC-0774 at 1 h illumination. By 3 h illumination, the carotenoid level was dropped by only 3%, but surprisingly the total chlorophyll level was 26% greater than the water control. Though we do not have satisfactory explanation for this phenomenon it is possible that SC-0774 might have stimulatory effect on enzyme systems responsible for either ALA synthesis or ALA conversion to chlorophylls during the lag phase. This lag phase is known to last for 1 to 3 h when the etiolated tissue is exposed to light. At 6 h and thereafter, the herbicide reduced both the chlorophyll and carotenoid contents continuously and concurrently. Similar observation has been reported in corn plants treated with SC-0774 (2).

Effect on pre-existing pigments. To determine the effect of SC-0774 on pre-existing pigments, five day old cotyledons were greened for 14 h and then incubated in 1 mM SC-0774 solution in the light for various time periods upto 48 h. This procedure was followed in order to simulate the postemergence treatment of SC-0774. The cotyledon fresh weight was not reduced by the herbicide until 24 h in the light (Table 3). Similarly, the total chlorophyll content was not reduced appreciably until 12 h illumination period. On the other hand, the carotenoid level was reduced by 12% as early as after 1 h illumination. However, from 12 to 48 h illumination periods both total chlorophyll and caroteiods were reduced at the same rate.

Table 3. Fresh weight and photosynthetic pigment levels in five day old cucumber cotyledons that were greened for 14 h and incubated in 1 mM SC-0774 solution in the light for various time periods[a].

Illumination period	Cotyledon fresh weight	Total chlorophyll	Carotenoids
(h)	(% of water control)		
1	104 a	96 a	88 a
3	99 a	97 a	85 ab
6	99 a	95 a	83 ab
12	101 a	82 b	78 b
24	90 b	73 c	65 c
48	82 b	63 d	65 c

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

Effect of exogenous ALA treatment. ∂-aminolevulinic acid is considered to be the rate-limiting step in chlorophyll biosynthesis in higher plants. We investigated whether the inhibitory effect of SC-0774 on chlorophyll formation could be reversed by supplying ALA to cotyledons exogenously. To this effect 100 uM ALA was added to the soaking medium in various combinations as indicated in Table 4. Results indicated that the exogenously supplied ALA did not reverse the SC-0774-reduced chlorophyll biosynthesis.

Table 4. Effect of 100 µM ∂-aminolevulinic acid in overcoming the inhibitory effects of 1 mM SC-0774 on chlorophyll and carotenoid synthesis in excised five day old cucumber cotyledons[a].

Treatment during		Total	
20 h Dark	24 h Light	chlorophyll	Carotenoids
		(% of water control)[b]	
H2O	SC-0774	69 a	68 a
ALA	SC-0774	71 a	72 a
SC-0774	H2O	71 a	70 a
SC-0774	ALA	71 a	70 a
SC-0774	SC-0774	46 b	55 c
SC-0774 + ALA	SC-0774 + ALA	50 b	59 c

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

[b]Cotyledons were incubated in water during both dark incubation and illumination periods.

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Increasing Corn Tolerance to Metolachlor with CGA-154281

D.L. Kunkel and R.R. Bellinder[1]

Using acetanilide herbicides for weed control in corn (Zea maize) often results in crop injury. This injury has especially been observed when soils are cool and wet, a situation which often occurs in the early spring during seedling establishment. Field and greenhouse studies were conducted to determine if the experimental safener CGA-154281 would increase the tolerance of corn treated with metolachlor. Field trials were conducted on two soils having organic matter contents of 2.8% and 3.9%. Metolachlor was applied a rates ranging from 2.2 kg ai./ha to 9.0 kg/ha, with and without CGA-154281 at a 7:1 ratio (herbicide:safener). Metolachlor applications of 6.7 and 9.0 kg/ha resulted in significant stand reduction and injury on soils with lower organic matter, when compared to corn in plots treated with atrazine applied at 1.1 kg/ha. Some injury persisted throughout the season, however, yields were not significantly reduced at either location. When CGA-154281 was applied with metolachlor as CGA-180937 corn stands were not reduced and no crop injury occurred. Greenhouse studies evaluated the potential for CGA-154281 to increase corn herbicide tolerance under soil temperatures ranging from 12 to 37 C. There was no reduction in corn height or dry weight when CGA-154281 was applied with metolachlor at 2.2 and 4.5 kg/ha rates, at all temperatures evaluated, compared non-treated control plants. By contrast, metolachlor reduced height and dry weight of corn at both herbicide rates, especially at 4.5 kg/ha at temperatures ranging from 17 to 37 C. Under the conditions examined in these studies CGA-154281 consistently increased corn tolerance to metolachlor.

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USE OF SUBTERRANEAN CLOVER AS A MULCH FOR WEED CONTROL IN SUMMER SQUASH[1]

M. Waters and R.D. Ilnicki[2]

ABSTRACT

Subterranean clover or subclover (Trifolium subterraneum L.) has been used successfully in research trials as a "living" mulch to control annual weeds in field corn, sweet corn, and soybeans. Whether it could be used successfully in vegetable crops as well offered a research challenge. A field experiment was established for summer squash (Cucurbita sp. 'Senator').

'Mt. Barker' subclover was seeded in late summer 1988 and the experiment initiated in a well-established stand in the spring of 1989. Treatments included (1) mowed subclover, (2) mowed subclover followed by an application of glyphosate in a band, (3) disked subclover, (4) bare soil treated with bensulide plus chloramben preemergence, and (5) bare soil with no herbicide or subclover present. Squash was hand-seeded in rows marked with a no-till planter. The herbicides were applied immediately after planting, with the exception of the glyphosate, which was used to kill the clover in a band three weeks prior to planting.

Although the squash germination and seedling emergence occurred at approximately the same time in all treatments, subsequent growth was retarded in all plots containing subclover. This reduction was also reflected in the total yield of harvestable fruit. Total squash plant vegetative biomass at the end of the growing season was greatest in the herbicide-treated plots, intermediate in the subclover plots, whether treated in the band or untreated, and lowest in the untreated and disked clover plots. Weed control by the subclover was comparable to that provided by the herbicide treatment; however, numbers and dry weights of weeds in the rows treated with glyphosate were comparable to the untreated check. Soil-incorporated subclover resulted in no weed control.

Early competition from the subclover to the squash may have been reduced had the squash been planted later, when subclover senescence was more complete.

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[1]NJ Agr. Exp. Stn. Publication No. 5-15274-1-89.
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A PRELIMINARY REPORT ON THE ECOLOGY OF REDROOT (Lacnanthes tinctoria)[1]

F.E. Katz[2] and D.N. Riemer[3]

ABSTRACT

Redroot (Lacnanthes tinctoria Ell.) belongs to the Bloodwort (Haemadoraceae) family. Redroot grows in low wet areas commonly colonized by low growing herbaceous vegetation and occurs along the coastal plain from Massachusetts to Florida and Louisiana. It grows in many of the cranberry bogs and wetlands of the New Jersey Pine Barrens. Cranberry producers are concerned with damage associated with wild swans which feed on the rhizomes of redroot during winter months, frequently uprooting cranberry plants in the process.

Redroot reproduces by both rhizome and seed. The vegetative shoots emerge from late April to early May. Flowering occurs during July which coincides with the flowering period of cranberry (Vaccinium macrocarpon Ait.) thereby competing for pollinating insects. This may be a very important aspect of competition between the two species since bees seem to prefer redroot flowers. On average a redroot cyme bears 41.6 capsules with 11.1 seeds per capsule or 462.9 seeds per plant where the plant density is 531.2 plants per square meter.

It was observed that where redroot had become established in a recently renovated bog, cranberry cuttings failed to become established and vines were excluded from the area. Therefore a series of bioassays using lettuce seed (Lactuca sativa L. cv. Buttercrunch) as a test species were run to evaluate redroot plant extracts for possible allelopathic properties. Water extracts of both underground and above-ground portions reduced lettuce seed germination and radicle elongation.

All efforts to germinate redroot seeds collected in the fall of 1989 have so far failed. This includes various cold periods, scarification with varying concentrations of acid, several media, and the removal of ethanol-soluble materials from the seed coat prior to placement in a germination chamber. It is likely that dormancy is not seed coat related, and it is possible that more than one mechanism exists. Further work is being carried out to better understand the mechanism(s) of seed dormancy in redroot.

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INTERACTIONS OF BENTAZON AND *PUCCINIA CANALICULATA* ON CONTROL OF YELLOW NUTSEDGE

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ABSTRACT

Research was conducted during 1986 and 1987 at Cheltenham, MD and in 1989 at Salisbury, MD on combining the rust fungus, *Puccinia canaliculata* (Schw.) Lagh., and the herbicide, bentazon, for yellow nutsedge control. Bentazon was applied at 0.6 kg/ha alone or in combination with the rust fungus at 0.7, 7.0 and 70.0 g of urediniospores/ha. Each site was laid out in a randomized complete block design with four replications. Each plot was 2 m x 5 m. Parameters measured throughout the growing season were phytotoxicity, % weed cover, % nutsedge cover, nutsedge density/m^2, and % disease severity. Tubers were harvested, counted, and weighed at the end of each growing season. The main effect observed from the research at Cheltenham was a 50% reduction of tuber density with the combination of rust at 7 or 70 g/ha and bentazon. Mean tuber weight was not affected by any of the treatments. Significant reductions in nutsedge stand count at Cheltenham were related to the bentazon treatments and were not affected by the rust treatments. Interactions observed at Cheltenham regarding tuber density did not occur at Salisbury. The reason for this is not clear. Soil at Salisbury has a higher clay content than that at Cheltenham, and rainfall was greater in 1989 than in previous seasons. Other factors may be involved in the explanation, as well.

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CONTROLLING RASPBERRY AND RED MAPLE IN NOVA SCOTIA WITH LOWER THAN RECOMMENDED RATES OF GLYPHOSATE

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INTRODUCTION

Glyphosate (given the trade name Vision® by Monsanto Company Ltd[2]) is a herbicide that will provide control of a variety of broadleaf species (Anon, 1988; Sutton, 1978). Currently, Vision® is registered in Canada for site preparation and conifer release by ground and aerial applications (CPPA, 1986).

Previous trials carried out in Nova Scotia (NSLF, 1988) indicated that various target species could be controlled at lower than recommended rates of Vision®. The product label recommends using 6.0 litres of product per hectare for maple and *Rubus* species and 3.0 to 6.0 l/ha for the control of other species. To determine the minimum rate of Vision® (as well as other herbicides) required to adequately control various species of competition, a series of aerial and ground experiments have been established over the past 10 years at various locations in Nova Scotia. The purpose of this report is to summarize the interim results of one such experiment established in the fall of 1984. Results from the other experiments will be summarized in future reports following remeasurement and analyses of the data.

SITE DESCRIPTION

The experimental site is located adjacent to Vanderveens Road, in west-central Pictou County and is characterized by a dense cover of raspberry and hardwood sprouts (primarily red maple and sugar maple). A portion of this site (Area 1) was clearcut during 1982 and brush raked, burned and planted with black spruce multipot stock in 1983. Another portion of this site (Area 2) was clearcut in 1983 and brush raked, burned and planted with black spruce multipot stock in 1984.

METHODS

On both areas, seven blocks of two hectares each were selected for treatment with one of seven different application rates of Vision® ranging from 1.17 litres of product per hectare to 4.67 l/ha. The increment between treatments was 0.58 l/ha (Table 1). Non-sprayed control blocks were also established in each area. Both areas were treated by helicopter on September 19 and 23, 1984. The swath width was 22 m and the total solution applied in single passes was 56.2 l/ha. The temperature ranged from 3 to 12° C and wind speeds from 0 to 6 km/hr during application.

Vegetation was assessed during the summers of 1985 and 1986. Only results from the 1986 assessment will be discussed in this report. Twenty assessment plots were established systematically within each treatment block starting at a randomly selected point. Concentric plots having radii of 1.78 m and 0.58 m were used to assess woody vegetation and non-woody types of vegetation respectively. At the time of assessment the mean heights and percent cover of each species of competing vegetation were recorded. In addition the height, root collar diameter (RCD), vigour and leader length of the closest planted seedling to the centre of each plot was measured.

1. Nova Scotia Dept. of Lands and Forests, Research Section, P.O. Box 68, Truro, N.S., B2N 5B8

2. Trade name was changed from Roundup® to Vision® as of 1987.

Table 1. Rate of Vision® applied, by block number and year cut.

Block	Rate (litres/ha)	Year Cut
1	1.17	1982
2	1.75	1982
3	2.33	1982
4	2.92	1982
5	3.50	1982
6	4.08	1982
7	4.67	1982
C1	Control *	1982
C2	Control *	1982
8	1.17	1983
9	1.75	1983
10	2.33	1983
11	2.92	1983
12	3.50	1983
13	4.08	1983
14	4.67	1983
C4	Control **	1983

* There were 10 plots in each of the 1982 controls.
** There were 20 plots in the 1983 control.

The ability of the various treatments to control overhead competing vegetation was evaluated by the following competition index:

$$CI = H \times C$$

where CI = Competition Index
H = Average height of competing vegetation (expressed in metres)
C = % of ground covered by competing vegetation

To assess the competitive effects of shorter vegetation (e.g. grass, goldenrod, hemp nettle, ferns and moss), percent cover was used.

RESULTS AND DISCUSSION

Early results (two years after application) indicate that lower than recommended rates of Vision® were effective in controlling the major species of competing vegetation at the Vanderveens site, i.e. raspberry and red maple.

TARGET SPECIES

Raspberry

Raspberry was the predominant competitor prior to treatment. All treatments resulted in a substantial reduction in the competition index for this species (Figure 1). With the exception of the highest treatment rates, the greater the amount of Vision® applied, the greater the control provided. However, observations indicated that application rates of 1.75 l/ha and greater will provide good control of raspberry.

Red Maple

The effect of the different rates of Vision® on red maple was similar to that of raspberry (Figure 2). In the older cut (1982), the average CI ranged from 2.0 to 10.5 in the control plots and from 0.0 (3.50 l/ha) to 2.0 (4.08 l/ha) in the treated plots. In the 1983 cut, the competition indices were considerably lower than those of the 1982 cut due to the shorter height of the one year younger red maple. These results, together with observations, indicate that adequate control can be achieved with treatment rates of 2.33 l/ha and greater. The reason(s) for the increase in the CI for the highest rates applied is unknown.

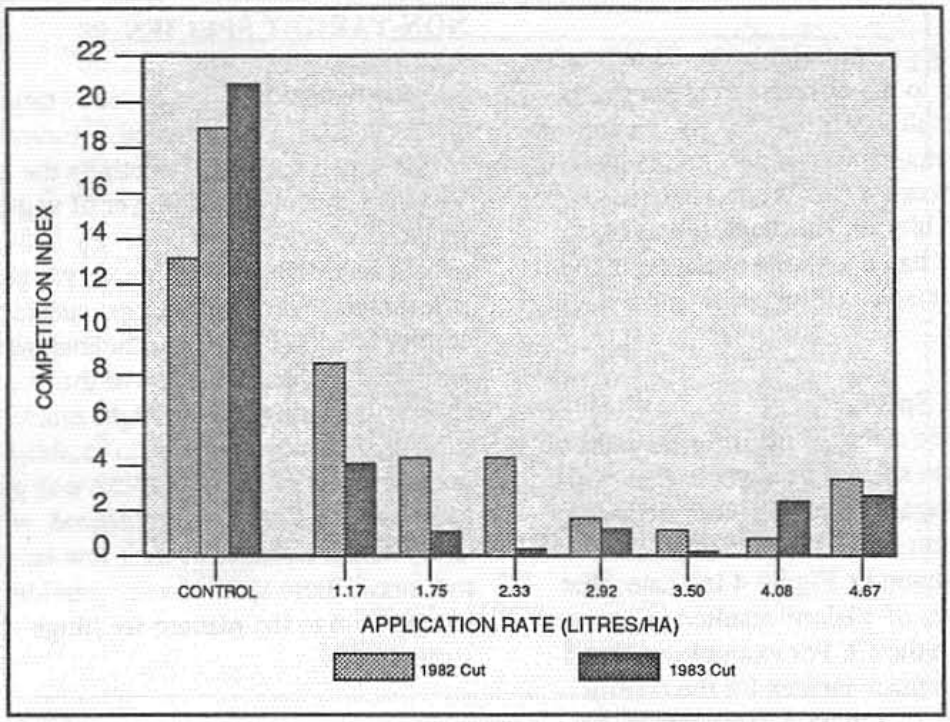

Figure 1. Competition index for raspberry, two years after treatment.

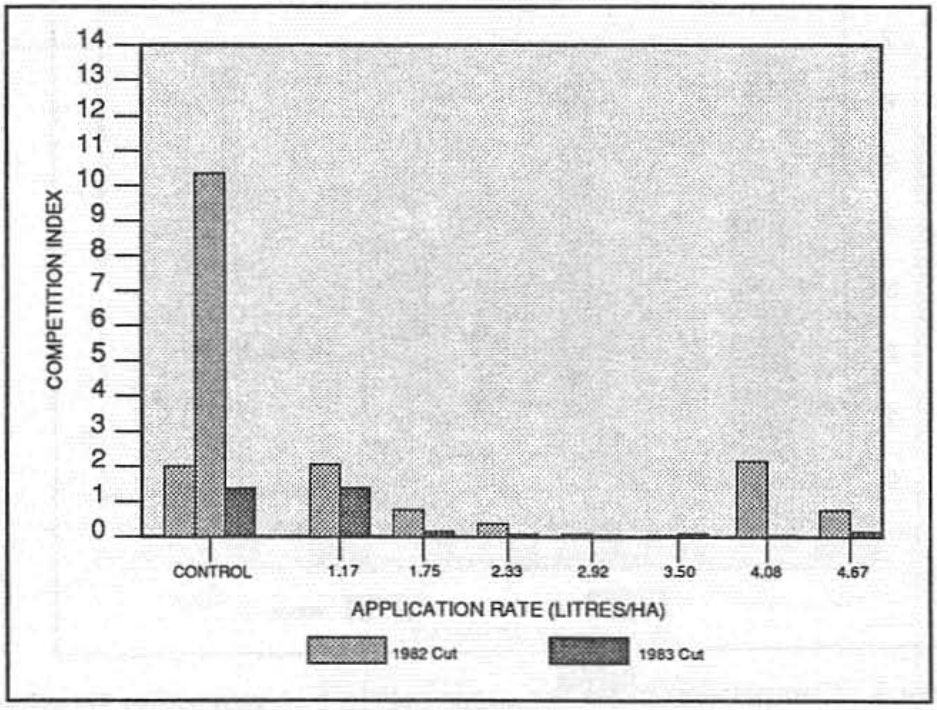

Figure 2. Competition index for red maple, two years after treatment.

Sugar Maple

There was no apparent trend in the CI for sugar maple with respect to the different treatment rates (Figure 3). This result is attributed to the greater tolerance of sugar maple to Vision® and the uneven and scattered distribution of this species in the control and treated blocks. However, it was observed that Vision® had a variable effect on individual stems of sugar maple, killing some and reducing the vigour of most.

Combined Target Species

To determine the effect of the different rates of Vision® on the target species as a whole (i.e. raspberry, red maple, sugar maple and other tree species), the competition indices for the main overhead competitors were summed. Figure 4 indicates that even the lowest rates of Vision® resulted in a substantial reduction in the CI. For example, in the 1982 cut, the competition indices for the control blocks ranged from 15.3 to 31.5 compared to 1.6 (3.50 l/ha) and 11.9 (1.75 l/ha) for the treated blocks.

NON-TARGET SPECIES

The reduction in the cover of target species was accompanied by a considerable increase in the cover of non-target species. Essentially the application of Vision® resulted in a tall layer of vegetation being replaced with a shorter layer. By 1986, most of the treated blocks had a considerably higher average percentage cover of non-target species than the control blocks (Figure 5). The increased cover is attributed to the defoliation of the overstory (target species) resulting in more light reaching the ground surface. The major species to establish and/or proliferate on all treated blocks was grass with lesser amounts of moss, goldenrod, willow herb and hemp nettle. Because of their low height and light root mass, these species were providing minimal competition to the planted seedlings.

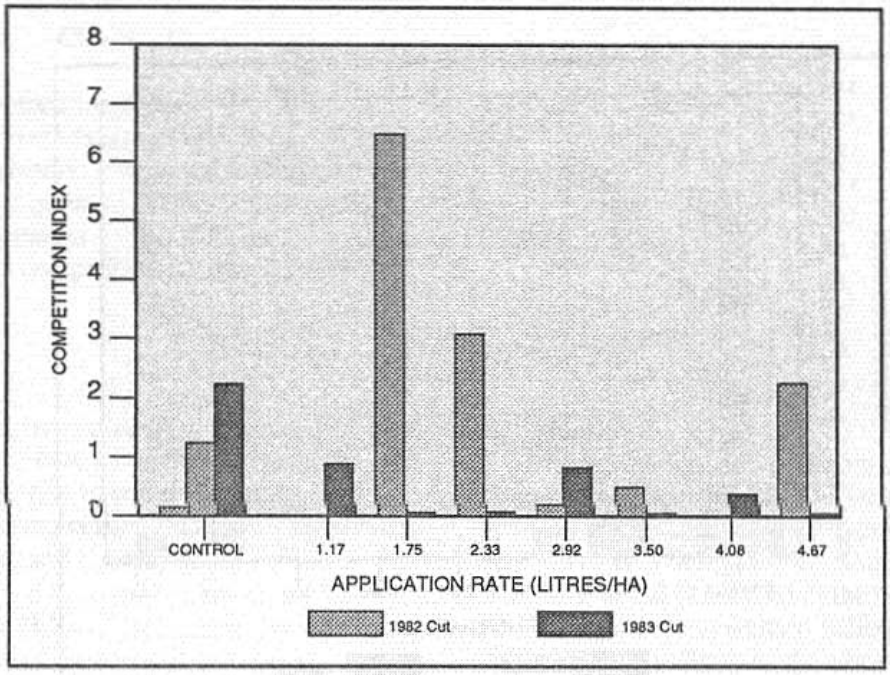

Figure 3. Competition index for sugar maple, two years after treatment.

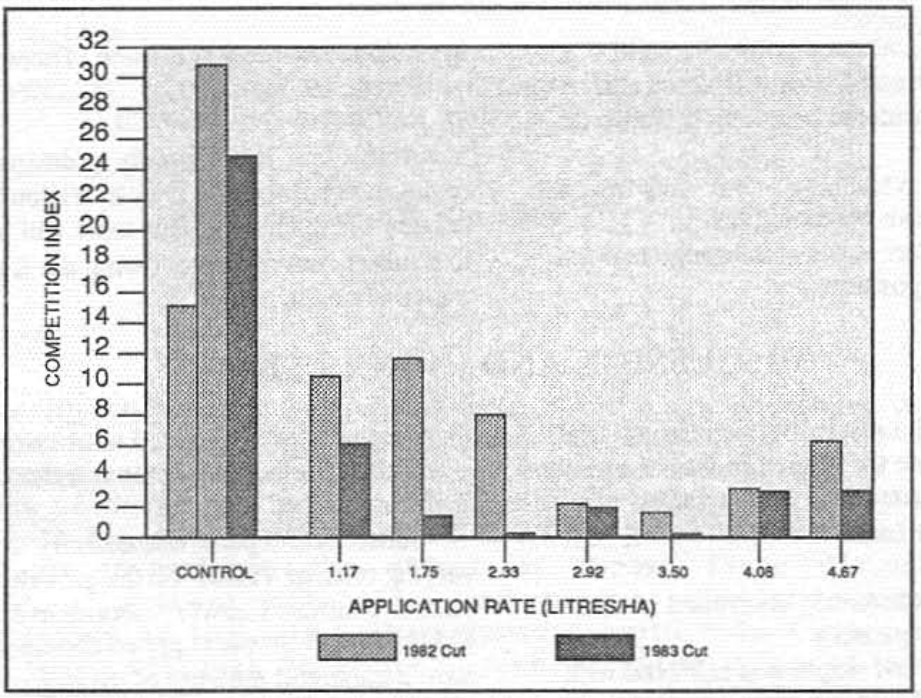

Figure 4. Total competition index for target species, two years after treatment

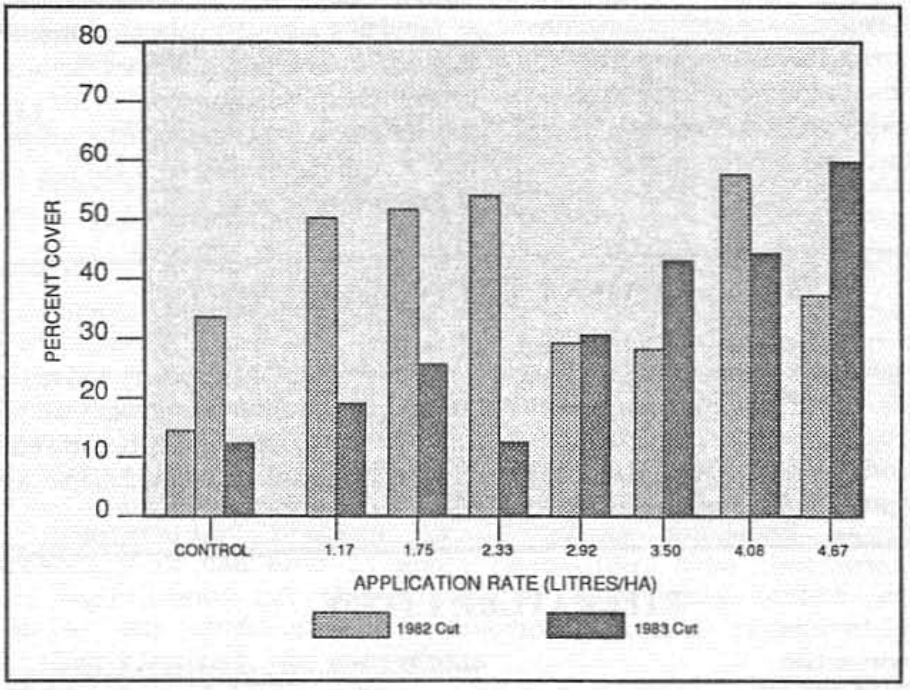

Figure 5. Percent cover of non-target vegetation, two years after treatment.

From an ecological stand point, the rapid colonization of the treated sites with these non-target species is considered beneficial because they:

1) reduce the loss to leaching of nutrients from the upper soil horizons by root uptake,
2) add organic matter to the soil through leaf fall and root decomposition; and
3) help to impede soil erosion (Thompson and Troeh, 1978).

At this time it is too early to determine the effect of different application rates of Vision® on seedling heights and diameters. This topic will be addressed in a subsequent report following the fifth year remeasurement.

DISCUSSION AND CONCLUSIONS

The major interim results of this research trial, designed to determine the minimum rate of aerially applied Vision® required to control a variety of target species, are as follows:

1) Raspberry was adequately controlled with rates of 1.75 l/ha and greater.
2) Good control of red maple was achieved with rates of 2.33 l/ha and greater.
3) Control of sugar maple was minimal, even at the higher rates, although observations indicated that the vigour and height of the scattered clumps of sugar maple were substantially reduced.
4) Grass and other non-target species of vegetation increased in quantity due to the greater amount of light reaching ground level, resulting from the defoliation of the overtopping target species. However, in this experiment, the impact of these species on the growth and survival of the planted trees is expected to be minimal because of their limited root mass and shoot height.

Subsequent reports will quantify the effects of varying rates of Vision® on the growth of the planted conifers. Growth response in relation to CI and the rate of product applied should provide the most meaningful measure of the degree of control required. In forestry, adequate control of the competing species is achieved when their height, vigour and root competition are reduced to the point where the conifers achieve and remain in an overtopping, free growing position. Perhaps this type of criteria could be adopted by the "Regulatory Agencies" as a basis to determine if a forestry herbicide is capable of providing adequate control. Currently, according to generally accepted guidlines, herbicide labels cannot specify adequate control for a particular species unless experimental data shows that a product can produce an 80% kill rate on that species at recommended rates.

MANAGEMENT RECOMMENDATION

The results of this experiment indicate that one to two year old raspberry and red maple treated with Vision® late in the growing season can be controlled with lower than recommended rates. However, until these results are substantiated by other trials, the rates outlined in Nova Scotia's Forestry Field Handbook i.e. 4.7 litres of product/ha for red maple, and 3.2 l/ha for raspberry will remain in effect.

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CONTROLLING GRASS AND SEDGE IN ALLEGHENY HARDWOOD STANDS WITH GLYPHOSATE-RESIDUAL HERBICIDE TANK MIXES

Stephen B. Horsley[1]

ABSTRACT

Grasses (Brachyelytrum erectum Schreb., Danthonia compressa Aust., and others) and sedges (Caryx spp.) originating in the forest floor seed bank sometimes revegetate Allegheny hardwood stands and interfere with the establishment of desirable hardwood regeneration after understory treatment with glyphosate followed by shelterwood cutting. A small plot experiment was established to investigate the effect of forest floor disturbance on establishment of grasses and sedges and to test whether addition of a residual herbicide in tank mix with glyphosate could reduce grass and sedge reinvasion. Seven residual herbicides, each at three rates of application (kg ai/ha), were tested against a glyphosate control (1.12). The herbicides were bromacil (1.12, 2.24, 4.48), napropamide (1.12, 2.24, 4.48), diuron (0.90, 1.79, 3.58), sulfometuron methyl (0.05, 0.10, 0.21), fluorochloridone (R-40244) (2.24, 3.36, 4.48), oryzalin (1.12, 2.24, 4.48), and terbacil (0.45, 0.90, 1.79). Herbicides were applied on three dates of application (July 1, August 1, and September 1) at two northwestern Pennsylvania sites. Half of each plot was disturbed to simulate logging disturbance. Response data were collected for 3 (site 1) or 2 (site 2) years after treatment application. Soil disturbance promoted emergence of grass and sedge from the forest floor seed bank during the first growing season after treatment; little grass or sedge germinated on undisturbed plots. There was little grass or sedge germination on any plot in years two and three. Inclusion of bromacil or diuron in the tank mix reduced control of vegetation present at the time of treatment. It was not possible to determine the basis of the antagonism from this experiment. The most effective treatments for reducing grass and sedge ground cover on disturbed plots were tank mixes of glyphosate (1.12 kg ai/ha) plus oryzalin (2.24 or 4.48 kg ai/ha) or sulfometuron methyl (0.10 or 0.21 kg ai/ha). The effects of oryzalin were present for at least 3 years and those of sulfometuron methyl for at least 2 years. Regeneration present at the time of herbicide application was killed, but none of the herbicides interfered with establishment of new regeneration of black cherry (Prunus serotina Ehrh.) or red maple (Acer rubrum L.). By using glyphosate-residual herbicide tank mixes in conjunction with overstory cutting, forest land managers can minimize the impact of grass and sedge on the forest regeneration process in Allegheny hardwood stands. Three scenarios presently in use are: 1) apply herbicide, then shelterwood cut the overstory, 2) shelterwood cut the overstory, then apply herbicide, 3) apply herbicide, delay any cutting in the overstory until regeneration becomes established, then clearcut the overstory.

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EFFECT OF IMAZETHAPYR ON DEVELOPMENT OF PYTHIUM ROOT-ROT ON SNAP BEAN

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ABSTRACT

Field observations made by researchers and growers suggest that imazethapyr may increase the occurrence of Pythium root-rot on snap bean (Phaseolus vulgaris L.) and soybean (Glycine max L. Merr.). A field study was conducted in 1989 to evaluate a potential interaction between imazethapyr and Pythium root-rot on snap bean 'Labrador'.

A randomized complete block design with four replications was used in the study. Plots were 1.5 m by 4.6 m and consisted of two rows of snap beans spaced 0.76 m apart. All treatments were preplant incorporated. Treatments were 1) untreated control; 2) metalaxyl, 1.12 kg ai/ha; 3) imazethapyr, 0.1 kg ae/ha; and 4) a tank mix of metalaxyl + imazethapyr.

Weather and soil conditions during the first two weeks following planting were conducive to Pythium damping-off.
Wilted and desiccated plants with Pythium root-rot were observed in plots during the third week. Plant population counts indicated that metalaxyl applied alone or with imazethapyr reduced loss of viable plants.

Stunted growth of snap beans was observed with imazethapyr treatments at three to four weeks following planting. Three times the recommended rate of imazethapyr was used in this study in an attempt to injure the plants and to possibly render them more susceptible to Pythium root-rot. Imazethapyr treatment did not appear to influence the occurrence of Pythium root-rot by reducing plant populations. Imazethapyr, however, decreased yield when applied alone and in combination with metalaxyl. This decrease in yield probably resulted from imazethapyr-phytotoxicity. Results from this study indicate that imazethapyr did not influence the occurrence of Pythium root-rot.

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ALTERNATIVE WEED CONTROL PROGRAMS FOR SNAP BEANS

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ABSTRACT

Cancelation of dinoseb in 1986, followed by voluntary withdrawal of chloramben in 1989 has severely restricted growers' abilities to control annual broadleaf weeds in edible legumes. In response to this situation, three studies were conducted in 1989 to evaluate alternative herbicide programs for control of redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), and hairy galinsoga [Galinsoga ciliata (Raf.) Blake] in snap beans (Phaseolus vulgaris L. var 'Bush Blue Lake 47') and yellow wax beans (P.vulgaris L. var 'Goldrush'). Treatments included preemergence (PRE) applications of acifluorfen (0.56 and 1.1 kg ai/ha); postemergence (PO) applications of fomesafen (0.28, 0.43 and 0.56 kg ai/ha) following a PRE application of metolachlor (1.68 kg ai/ha); and imazethapyr (0.036, 0.052 and 0.07 kg ai/ha) applied preplant-incorporated (PPI) PRE and PO. Additionally 0.032 kg/ha imazethapyr was tank-mixed either with pendimethalin (1.1 kg ai/ha PPI) or metolachlor (1.68 kg ai/ha PRE).

PRE acifluorfen treatments resulted in less than 10% crop injury and greater than 93% control of all three weeds at harvest. Yields were equivalent to those of the handweeded controls. Fomesafen, applied at the 2nd to 3rd trifoliate leaf stage, caused injury that ranged from 12 to 20% but was not directly related to the rate of application. The highest yields however, were obtained with the metolachlor plus fomesafen herbicide program. Control of redroot pigweed, common lambsquarters, and hairy galinsoga was 97% at harvest. When applied PPI or PRE imazethapyr caused stunting that became apparent 3 to 4 weeks after crop emergence. This injury did not reduce yields. Late-season control of redroot pigweed and common lambsquarters was greater than 90% with the PPI and PRE treatments. Control of hairy galinsoga was consistently poor with imazethapyr. Applied PO only redroot pigweed control was adequate. The metolachlor plus imazethapyr tank mixture controlled 97% of all three weed species. 'Goldrush' appeared to be slightly less sensitive than BBL 47 to all three herbicides.

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THE EFFECT OF ROW SPACING, NO-TILL CULTURE, AND HERBICIDE PROGRAMS ON WEED CONTROL IN BABY LIMA BEANS

Ed Kee and Tracy Wootten[1]

ABSTRACT

Baby lima beans (Phaselous lunatus) is a major vegetable crop in Delaware. Largely planted for processing, the crop is mechanically harvested. Most previous research indicates that yield responses occur with narrow (15 to 20 inch) rows when compared to wider row spacings. Prior to the development and widespread use of the Pod Stripper type combine, standard harvest machinery could not harvest crops in narrow rows. Dinoseb was the standard broadleaf weed control material and did not provide season long control in a no-till situation.

No-till culture could provide significant advantages in erosion control, conserving moisture, and favorably altering the microclimate around the lima bean plant and enhance pod set and retention. Imazethapyr has proven to provide effective broadleaf control in conventionally planted lima beans.

Results of two studies conducted in 1989 indicate no-till lima beans in narrow rows do have promise. Weed control problems still exist in a no-till situation, although significantly better control was obtained with imazethapyr than any previous work in Delaware with dinoseb. It is apparent that post-emergence herbicides are needed, especially for morningglory species (Ipomea sp.). Aciflourfen did injure lima beans, but the injury may be acceptable. Fordhook types of lima beans are more susceptible than baby types to aciflourfen. The best no-till yield was significantly lower than the best conventionally planted treatment, but not significant different than most other treatments.

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CLOMAZONE IN VEGETABLE CROPS

Lewis M. Walker, IV, Henry P. Wilson and T. E. Hines[1]

ABSTRACT

Control of annual broadleaf weeds in many vegetable crops grown in Virginia has evolved into a systems approach utilizing dinoseb for initial control followed by cultivation to control escaped weeds and weeds germinating after herbicide dissipation. Cancellation of dinoseb registration by the U.S. E.P.A. in 1986 resulted in removal from the marketplace of the only "broadleaf" herbicide for these vegetables. Clomazone controls many broadleaf weeds and annual grasses in soybeans at 0.5 to 1.0 lb ai/A and in some studies was effective at 0.25 lb/A. It was therefore decided to investigate low rates of clomazone for weed control in peas (*Pisum sativum* L.), snap beans (*Phaseolus vulgaris* L.), cucumbers (*Cucumis sativus* L.), and summer squash (*Cucurbita pepo* L.). Research was conducted during 1988 and 1989 near Painter, Va. on a State sandy loam soil (Typic Hapludults). Clomazone rates and application methods varied with study but included 0.06 to 0.5 lb/A preplant incorporated and preemergence. In general, applications preemergence were more effective than preplant incorporated and frequently resulted in less crop response. Crop injury was manifested as transient bleaching of the first true leaves and occasionally a temporary reduction in initial growth. The degree of crop injury and level of early weed control was dependent on timely rainfall events with frequent rainfall producing the highest level of activity. In one instance, however, when soils where saturated for a 2- to 3-day interval, weed and grass control was low. Clomazone rates of 0.19 to 0.25 lb/A generally provided adequate control of several broadleaf weeds and annual grasses without risk of excessive crop injury. Combinations of clomazone with other herbicides were also evaluated and appear to have the most potential in snap beans where metolachlor may be the companion herbicide of choice because of efficacy of this latter herbicide against yellow nutsedge (*Cyperus esculentus* L.) and smooth pigweed (*Amaranthus hybridus* L.), both of which escape control by clomazone. Additional research should confirm the application rate range and investigate the potential of clomazone use in additional vegetable crops.

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CLOMAZONE FOR WEED CONTROL IN SEVERAL CUCURBIT CROPS

Bradley A. Majek[1] and Philip E. Neary[2]

ABSTRACT

Clomazone was applied preplant incorporated and evaluated for phytotoxicity in several cucurbit crops including species of Citrullus, Cucumis, and Cucurbita. Watermelon (Cucumis lanatus) was the most sensitive cucurbit crop evaluated to clomazone. Significant injury to watermelon was observed when 0.42 kg ai/ha was applied before seeding. Cucumber (Cucumis sativus) was intermediate in sensitivity to clomazone. Significant injury was observed when .84 kg ai/ha was applied. Squash including zucchini, pumpkins, and acorn squash (Cucurbita pepo), butternut (Cucurbita moschata), and hubbard squash (Cucurbita maxima)were least sensitive to clomazone. Only slight temporary injury was observed in Cucurbita species when 0.84 kg ai/ha was applied, Significant injury was observed when rates exceeded 0.84 kg ai/ha. Injury, when observed, was similar in all species. Whitening on leaf margins or in leaf segments bordered by veins was observed soon after emergence. Poor incorporation or excessive rainfall, especially when followed by cold weather, seemed to increase the possibility of crop injury. Stunting was also observed when whitening was severe, affecting more than half the leaves of a plant. Recovery usually occurred within two to three weeks unless injury was severe or above average rainfall occurred. The fruit as well as the leaves of early maturing squash varieties have been injured when high rates were applied.

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MODIFIED STALE SEEDBED TECHNIQUE FOR PUMPKIN WEED CONTROL

Andrew Senesac[1]

ABSTRACT

The purpose of this study was twofold: to determine if the stale seedbed technique can be used as a viable weed control measure in commercial pumpkin production and to examine several combinations of preplant cultural practices and registered residual and nonresidual herbicides for efficacy and crop safety. Field studies were established in 1988 and 1989 on Riverhead sandy loam employing a split-plot design, 3 x 4 factorial arrangement with four replications. The main plots consisted of three pre-plant seedbed preparation techniques. The entire test area was plowed and dragged late April. The main plots were either: double disced approximately six weeks later or there was no further secondary tillage prior to planting but glyphosate or paraquat was applied at 1.1 kg/ha three days before planting. Over each of these main plots, the following subplots were superimposed: 1) untreated after planting, 2) paraquat at1.1 kg/ha delayed pre, 3) chloramben at 3.4 kg/ha pre or 4) clomazone 1.1 kg/ha applied in 100 cm strips and incorporated by rototiller just prior to planting. The plots were seeded with the semibush cultivar 'Spirit' and irrigated the following day, the only irrigation applied during the season. Stand counts, weed cover and pumpkin number diameter and weight were recorded.

The results indicate that pumpkins are very good competitors with annual weeds. They can withstand end-of-season weed cover of up to 63 percent and still produce an acceptable yield. In 1989, despite the moderate to heavy weed infestation, there was no significant effect of treatment on pumpkin number, weight or diameter. Weed cover evaluations indicate that the post plant treatment of paraquat was a necessary combination with either the pre-plant paraquat or glyphosate treatment in order to control common lambsquarters. Clomazone caused typical 'bleaching' injury on pumpkin plantsearly in the season, but this injury did not result in a yield reduction. The results of 1988 study were similar except that clomazone did cause significant yield reduction The results indicate that a range of weed control programs are suitable for pumpkin production, but that a stale seedbed technique which does not require a residual herbicide can be used to produce a quality crop.

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The Effect of Light Transmittance of Plastic Mulches on the Growth and Development of Yellow Nutsedge

Philip E. Neary & Brad A. Majek[1]

ABSTRACT

Plastic mulch is used in the production of many vegetables in South Jersey. Black plastic mulch is the most widely used with some white and clear mulch being used for specific crops. Also a limited amount of degradable mulches are being used.

Yellow nutsedge (**Cyperus esculentus** L.) is a major weed problem in both bareground and mulched crops. It tends to puncture black plastic mulch when it is not effectively controlled by herbicides. However, yellow nutsedge that emerges under clear plastic mulch usually does not punch through the plastic. The competiveness of yellow nutsedge has not be determined for these two situations but there appears to be a detrimental effect on the crop.

Field and greenhouse studies were conducted to determine the effect of various plastic mulches on the growth of yellow nutsedge. The number of yellow nutsedge shoots and the total dry weight of these shoots was greater with standard black than with either clear mulch or with black degradable mulches, that transmitted small amounts of light.

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POSTEMERGENCE WEED CONTROL WITH METRIBUZIN AND LINURON IN CARROTS

Russell W. Wallace and Robin R. Bellinder[1]

ABSTRACT

Two field experiments were conducted to evaluate metribuzin and linuron for postemergence control of redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), and hairy galinsoga [Galinsoga ciliata (Raf.) Blake], as well as carrot (Daucus carota) injury and yield. Treatments included both herbicides applied at 0.14, (3-lf); 0.28, (5-lf); 0.56, (5-lf); and 0.14 (3-lf) + 0.14 (5-lf) kg ai/ha. Redroot pigweed, common lambsquarters, and hairy galinsoga were approximately 6 cm and 40 cm in height at 3- and 5-leaf stage of carrots, respectively.

In a timing response study (var. Scarlet Nantes), greater than 85% control of all three weeds occurred when metribuzin was applied at either the 3- or 5-leaf stage of carrots. When applied at 0.14 kg ai/ha, control of the three weeds with linuron was similar (83 to 88%). A significant reduction in weed control (37 to 52%) was observed when linuron was applied to the larger weeds (5-leaf stage of carrots), even though the higher rates were used. Split-applications of the herbicides gave increased control only in the case of linuron, indicating that the single low rate application of metribuzin at the 3-leaf stage gave adequate control. Yields of linuron- and metribuzin-treated plots decreased significantly when compared with the handweeded control. Although no foliar injury was observed to 3-leaf carrots treated with the lowest rate of either herbicide, yields decreased an average 45%. Yields decreased 70% at the highest rates when applied at the 5-leaf stage.

In the second study, four carrot varieties (Mark II, Centennial, Scarlet Nantes, and PY60) were evaluated for crop injury and yield response to metribuzin and linuron when applied at the 3- and 5-leaf stages. At the 3-leaf stage, only metribuzin at 0.28 kg ai/ha caused significant crop injury with Centennial having the least injury (18%) and Mark II having the greatest injury (40%). The lower rate and application of herbicdes at the 5-leaf stage resulted in less visible crop injury. However, within each variety, only linuron applied at 0.28 kg ai/ha at the 5-leaf stage significantly reduced yields.

In both studies, excellent control of weeds occurred when metribuzin was applied at either crop stage. Reduced weed control occurred when linuron was applied at the 5-leaf carrot stage. Although significant crop injury occurred in the variety study with metribuzin at 0.28 kg ai/ha (3-leaf stage only), yields did not decrease. Significant yield reductions at the higher rate of linuron was consistant over both tests. The decreased yields associated with all herbicide treatments in the timing study may have been due to weed competition late in the season.

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CONTROL OF WEEDS IN GARLIC (ALLIUM SATIVUM L.)

L. E. Lanfranconi and R. R. Bellinder [1]

ABSTRACT

A field experiment was conducted in 1989 to evaluate several herbicides, alone and in combination for spring and summer weed control in fall-planted garlic. Single treatments included: oxyfluorfen (0.02 and 0.07 kg ai/ha); DCPA (9.0 kg ai/ha); bromoxynil (0.28 kg ai/ha); and pendimethalin (0.84 and 1.7 kg ai/ha). Combination treatments included two applications of both rates of oxyfluorfen applied alternately with two applications of DCPA and a single, separate application of DCPA followed by bromoxynil.

Bromoxynil, DCPA, and pendimethalin caused no observable crop injury whether applied alone or in combinations. Injury (18 to 28%) did result with oxyfluorfen at both timings and this injury was directly related to rate of application. When used in conjunction with DCPA, oxyfluorfen injury decreased after the second application when compared to similar rates of oxyfluorfen applied singly. Yields were reduced only where oxyfluorfen, at both rates, was used alone. Yields from all other treatments were equivalent to those from handweeded controls.

Control of redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), and shepardspurse (Capsella bursa-pastoris (L.) Medic.) was superior when oxyfluorfen was applied alone, particularly at 0.07 kg ai/ha. When applied with DCPA, control of redroot pigweed and common lambsquarters was excellent for 60 days but diminished during the month before harvest. Pendimethalin, bromoxynil, and DCPA plus bromoxynil generally provided good control of redroot pigweed and common lambsquarters but control of shepardspurse was poor one month after application. Although weed control was definitely superior with oxyfluorfen, the degree of injury and the resulting yield reductions offset that potential advantage.

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WEED CONTROL IN HEAD LETTUCE RESEARCH PLOTS WITH IMAZETHAPYR

G.L. JORDAN, T.J. JOHNSON, AND S.F. GORSKI [1]

ABSTRACT

Three field studies evaluated imazethapyr for crop safety and weed control in head lettuce (Lactuca sativa L. var. capitata) at Sodus, NY and Phelps, NY during the 1988 and 1989 growing seasons. 'Ithaca' head lettuce was direct seeded in 15 inch rows on a muck soil in Sodus and a sandy loam soil in Phelps on July 14, 1988, and in 18 inch rows on a muck soil in Sodus on June 9, 1989. Imazethapyr was applied at 0.032, 0.047, and 0.063 lb ai/A pre and postemergence in 1988 and at 0.032 lb ai/A with various pre and postemergence combinations in 1989. X-77 at .25% v/v was used with all postemergence application in 1988, while postemergence activity was compared with and without X-77 in 1989. Chloramben applied preemergence at 2 lb ai/A in 1988 and 1 lb ai/A in 1989 was used as a standard for comparison. Yields were not obtained in either year.

In 1988 slight early season crop injury (yellowing) was observed with all postemergence treatments on the muck. However, this visual injury was outgrown by normal harvest. None of the treatments resulted in any crop injury in the 1988 sandy loam trial or in the 1989 muck trial.

Weeds present in 1988 were redroot pigweed (Amaranthus retroflexus L.) at both sites, common purslane (Portulaca oleracea L.) at the muck site, and hairy nightshade (Solanum sarrachoides Sendtner) at the sandy loam site. The standard, chloramben, did not provide acceptable weed control at either location. Except for the low postemergence rate, all imazethapyr treatments provided excellent redroot pigweed control. Common purslane control with all imazethapyr treatments was poor, and acceptable hairy nightshade control was only obtained with the highest postemergence rate of imazethapyr. Size of the weeds (2 to 6 inches across for purslane and 4 to 6 inch tall nightshade) probably was the cause of poor control with the postemergence treatments.

Imazethapyr treatments in 1989 were set-up to evaluate sequential applications of either pre/post combinations or sequential postemergence treatments (starting at the cotyledon stage of crop and weed growth). The weeds present were common purslane and common lambsquarter (Chenopodium album L.). The best weed control was obtained with early and multiple applications of imazethapyr with X-77. Early season weed control was excellent for both weeds, but dropped off to only fair control at normal harvest. A preemergence application of chloramben or imazethapyr followed by a single postemergence application of imazethapyr with X-77 or postemergence applications of imazethapyr without X-77 did not provide acceptable weed control.

At the present time, there are only a few registered herbicides available for use in lettuce, and chlorprophan has recently been dropped from production. The remaining materials have little activity on broadleaf weeds. Although additional weed control research is needed, imazethapyr demonstrates excellent crop safety and encouraging results on broadleaf weeds.

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EFFECT OF TRIAZINE RESIDUE ON WINTER WHEAT FOLLOWING FIELD CORN

Frank Webb and Mark Causey[1]

ABSTRACT

This study was established in 1985 at two locations. The northern location was at Middletown, Delaware on a Matapeake silt loam soil and the southern location was at the University of Delaware research farm at Georgetown on a sassafras sandy loam soil. The total atrazine rates applied were lower on the sandy soil location. Corn was established and treatments applied as in Table 1 and 2. The treatments were repeated for four consecutive corn (Zea mays L.) and wheat (Triticum aestivium) seasons at Middletown and two corn and wheat seasons at Georgetown. Each year's treatments were superimposed over the same treatments. Metolachlor plus dicamba (treatment 12) was used as a check or a no triazine treatment. Excellent weed control was achieved in all plots over the period of this study. Visual crop injury ratings were taken at both locations in the fall after wheat establishment and again during active spring growth. No abnormal growth symptoms were visually identified at either location during the period of this study. No visual injury symptoms were recorded on the double crop soybeans that followed the wheat. There was no significant difference between any of the wheat yields between the high rate triazine plots and the no triazine check at either location, except for treatment 10 at Middletown in 1988. This variability cannot be explained.

From this study one could conclude that triazine carry-over to wheat following corn is not likely to occur under these specific soil types and at normal triazine application rates.

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Table 1. Effect of Triazine Residue on Wheat Yields Following Field Corn (Middletown location)

Trt. No.	Treatment Name	Rate lb a.i./A	Wheat Yield bu/A Middletown 1986	1987	1988	1989	Avg. 3 Yrs.
1	Atrazine	1.50					
1	melotachlor	1.50	56.9	58.7	69.9	31.6	53.4
2	Atrazine	2.00					
	melotachlor	1.50	46.2	66.6	54.6	33.0	51.4
3	Atrazine	3.00					
3	melotachlor	1.50	46.7	66.7	62.0	32.8	53.8
4	Atrazine	4.00					
4	melotachlor	1.50	43.2	63.7	67.7	30.3	53.9
5	Atrazine	5.00					
5	melotachlor	1.50		63.3	64.2	31.7	53.1
6	Atrazine	6.00					
6	melotachlor	1.50		59.4	61.0	33.0	51.1
7	Atrazine	1.50					
7	Simazine	1.50	52.4	55.8	62.5	34.9	51.1
8	Atrazine	2.00					
8	Simazine	1.50		63.0	65.6	32.8	53.8
9	Atrazine	2.00					
9	Simazine	2.00	52.3	67.0	66.5	37.5	57.0
10	Atrazine	3.00					
10	Simazine	3.00		67.6	60.5	34.9	54.3
11	Atrazine	1.50					
11	alachlor	1.50		61.4	68.4	34.1	54.6
12	melotachlor	1.50					
12	dicamba	0.25	53.9	66.0	74.8	34.8	58.5
LSD (.05) =			12.06	20.5	13.2	4.6	
Standard Dev. =			7.07	14.21	9.12	3.18	
CV =			14.44	22.46	14.07	9.53	

Table 2. Effects of Triazine Residue on Wheat Yields Following Field Corn (Georgetown location)

Trt. No.	Treatment Name	Rate lb a.i./A	Wheat Yield Bu/A 1986	1988	Avg. 2 Yrs.
1	Atrazine	1.00	50.5	32.0	41.3
1	metolachlor	1.50			
2	Atrazine	1.50	47.4	30.6	39.0
2	metolachlor	1.50			
3	Atrazine	2.00	48.3	32.5	40.4
3	metolachlor	1.50			
4	Atrazine	2.50	50.8	32.7	41.8
4	metolachlor	1.50			
5	Atrazine	3.00	53.8	32.7	43.3
5	metolachlor	1.50			
6	Atrazine	4.00	51.9	32.9	42.4
6	metolachlor	1.50			
7	Atrazine	1.00	47.9	30.9	39.4
7	Simazine	1.00			
8	Atrazine	1.50	57.7	33.7	45.7
8	Simazine	1.00			
9	Atrazine	1.50	56.8	34.3	45.6
9	Simazine	1.50			
10	Atrazine	2.00	53.9	33.1	43.5
10	Simazine	2.00			
11	metolachlor	1.50	56.8	33.5	45.2
11	dicamba	0.25			
LSD (.05) =			8.0	3.6	
Standard Dev. =			5.526	2.4831	
Cv =			10.56	7.61	

LONG-TERM WEED MANAGEMENT IN CONSERVATION TILLAGE CORN WITH SC0051

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

ABSTRACT

Effects of continuous corn (Zea mays L.) and annual herbicide treatments on crop-weed interactions were investigated for six years in a conservation tillage system. Preemergence herbicide treatments in 1984 and 1985 included (1) atrazine plus simazine (2.8 + 2.2 kg ai/ha, respectively), (2) atrazine plus alachlor (2.8 kg ai/ha, each) and (3) atrazine plus cyanazine (2.8 + 2.2 kg ai/ha, respectively). Dominant weeds in all treatments were smooth pigweed (Amaranthus hybridus L.) and fall panicum (Panicum dichotomiflorum Michx.). Two-year mean smooth pigweed densities, expressed as percent groundcover, were 55% for treatments 1 and 3, and 30% for treatment 2. Mean fall panicum densities were 3% for all treatments. Smooth pigweed densities increased in all treatments from 1984 to 1985, consequently herbicide treatments were amended in 1986 to target smooth pigweed and investigate the effects of reduced atrazine rates on total weed management. Treatment 1 was split to include atrazine at 2.8 and 1.7 kg ai/ha, combined with SC0051 at 1.1 and 1.7 kg ai/ha, respectively. Treatment 2 was changed to cyanazine plus SC0051 at 2.2 and 1.1 kg ai/ha, respectively. Treatment 3 was split to cyanazine plus SC0051 at 1.7 kg ai/ha each, and to atrazine plus metolachlor at 2.8 and 2.2 kg ai/ha, respectively. Paraquat at 0.56 kg ai/ha was included in all treatments. Smooth pigweed was eliminated in 1986 in all plots treated with SC0051, and did not reappear through 1989. Smooth pigweed densities were reduced from 60% in 1985 to 30% in 1986 by atrazine plus metolachlor treatments, and were nearly equivalent to SC0051 treatments from 1987 through 1989. Fall panicum densities were not changed by the new herbicide treatments. Foxtails (Setaria spp.), which had not been present in 1984 and 1985, became established in all 1986 treatments except atrazine plus metolachlor. Cyanazine plus SC0051 treatments averaged 15% foxtail whereas atrazine plus SC0051 treatments averaged 6%. Combinations of atrazine plus SC0051, each at 1.7 kg ai/ha had lower total weed covers each year than atrazine at 2.8 kg ai/ha combined with SC0051 at 1.1 kg ai/ha (15% and 5%, respectively four year means). Three year mean corn yields ranged from 3950 to 4400 kg/ha, with lowest yields associated with plots treated with cyanazine plus SC0051 and no differences among the other treatments.

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DICAMBA + ATRAZINE COMBINATIONS FOR WEED CONTROL IN CORN[1]

A. J. Enache, R. D. Ilnicki and M. Waters[2]

ABSTRACT

An experiment was conducted in 1988-1989 to evaluate the effect of various application schedules of dicamba + atrazine in combination with metolachlor, alachlor, pendimethalin or cyanazine on weed control in corn (Zea mays L.).

The design was a complete randomized block design with three replications. Corn variety 'Agri-Pro 710' was planted on June 6, 1988 and 'Hardy 797' on May 30, 1989, in Freehold Sandy Loam with pH 6.1 and 1.5% organic matter. Treatments were applied on June 8 (PRE) and June 21 (POST) in 1988; on May 31 (PRE), June 5 (PO1) and June 19 (PO2) in 1989. Weed species included velvetleaf (Abutilon theophrasti L.), lambsquarters (Chenopodium album L.), ivyleaf morningglory (Ipomoea hederacea L. Jacq.), and common ragweed (Ambrosia artemisiifolia L.) in 1988, and velvetleaf, lambsquarters, ivyleaf morningglory, redroot pigweed (Amaranthus retroflexus L.), giant foxtail (Setaria faberi Herrm.) and fall panicum (Panicum dichotomiflorum Michx.) in 1989. Weed control ratings were made on August 5, 1988 and August 3, 1989.

Results indicated that in 1988, the combination of metolachlor (PRE) with dicamba + atrazine applied either pre or postemergence greatly improved the control of lamsquarters and ivyleaf morningglory compared to metolachlor alone. The combinations alachlor (PRE) or pendimethalin (PRE) with dicamba + atrazine (POST) resulted in excellent weed control, however, small corn injury was observed.

In 1989, the combination metolachlor + (dicamba + atrazine) applied preemergence resulted in good control of all weeds, the degree of control increasing with increased rate of metolachlor. Excellent weed control with no crop injury resulted with metolachlor (PRE) followed by dicamba + atrazine (PO2). Pendimethalin (PRE) followed by dicamba + atrazine (PO2) resulted in better velvetleaf control than the two herbicides applied together preemergence. No differences in weed control were recorded between preemergence alachlor + (dicamba + atrazine) and alachlor (PRE) followed by dicamba + atrazine (PO2). The combination of dicamba + atrazine with cyanazine was comparable.

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[1] New Jersey Agric. Exp. Stn. Publication No. J-289-15173-3-89.

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CANADA THISTLE CONTROL IN FIELD CORN

Mark Causey and Frank Webb[1]

ABSTRACT

Field experiments were conducted in 1987, 1988 and 1989 to evaluate twelve herbicide combinations for their activity on Canada Thistle (Cirsium arvense Scop.) in field corn (Zea mays L.). Control ratings were obtained only for Canada Thistle (Table 1). The corn crop was planted no-till in corn stubble each year. Each year's study was superimposed over the previous year's plots. The plot design was a Random Complete Block with three replications. Of the twelve treatments tested, four treatments provided in excess of 95% control of Canada Thistle after three years. Two pounds of atrazine[2] applied preemergence with one pound of atrazine plus one pound of bentazon applied postemergence (treatment 9) provided 98% control while two pounds of atrazine applied preemergence plus two pounds atrazine applied postemergence (treatments 10, 11) provided 97% control of Canada Thistle after two years. Four pounds of atrazine applied preemergence (treatment 12) provided similar control levels after two years.

Treatments with three or more pounds of atrazine provided the most commercially acceptable control of Canada Thistle. The atrazine, whether applied in one preemergence treatment or as a split application, provided essentially equal control of Canada Thistle.

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Table 1. Canada Thistle Control in Field Corn

Treatments	Rate lbs./a.i.	Crop Growth Stage	8-4-8 1987	9-13-88 1988	8-25-89 1989
1. Check			0.0e	0.0e	0.0f
2. paraquat	.50	PE	90.0a	56.7c	65.0cde
cyanazine	2.00	"			
metolachlor	2.00	"			
Surf	.25%	"			
dicamba	.50	Post			
3. paraquat	.50	PE	90.0a	43.3c	60.0de
cyanazine	2.00	"			
metolachlor	2.00	"			
Surf	.25%	"			
*dicamba	.137	Post			
*atrazine	.262	"			
4. paraquat	.50	PE	91.7a	41.7c	70.0bcd
cyanazine	2.00	"			
metolachlor	2.00	"			
Surf	.25%	"			
*dicamba	.275	Post			
*atrazine	.525	"			
5. paraquat	.50	PE	53.3d	18.3d	51.7e
cyanazine	2.00	"			
metolachlor	2.00	"			
Surf	.25%	"			
6. paraquat	.50	PE	76.7bc	81.7ab	80.0bc
cyanazine	2.00	"			
atrazine	2.00	"			
Surf	.25%	"			
7. *alachlor	3.70	PE	66.7c	76.7b	81.7b
*glyphosate	2.00	"			
Surf	.25%	"			
atrazine	1.20	"			
8. glyphosate	2.00	PE	65.0cd	76.7b	83.3ab
Surf	.25%	"			
*metolachlor	1.50	"			
*atrazine	1.20	"			
9. paraquat	.50	PE	76.7bc	89.7ab	98.0a
2,4-D ester	.25	"			
cyanazine	2.00	"			
atrazine	2.00	"			
Surf	.25%	"			
*bentazon	1.00	Post			
*atrazine	1.00	"			
COC	1.00%	"			
10. paraquat	.50	PE	80.0ab	98.3a	97.0a
2,4-D ester	.25	"			
cyanazine	2.00	"			
atrazine	2.00	"			
Surf	.25	"			
atrazine	2.00	Post			
COC	1.00	"			
11. cyanazine	2.00	PE	85.0ab	98.7a	97.0a
2,4-D ester	.25	"			
atrazine	2.00	"			
COC	1.00	"			
atrazine	2.00	Post			
COC	1.00	"			
12. cyanazine	2.00	PE	73.3bc	97.7a	98.0a
2,4-D ester	.25	"			
atrazine	4.00	"			

*Prepack

LSD =	11.7	15.6	13.8
Standard Dev. =	6.9831	9.2756	8.2376
CV =	9.71	13.39	11.16

Means followed by same letter do not signfiicantly differ (Duncan's MRT, P=.05)

JOHNSONGRASS CONTROL IN CORN WITH CGA-136872

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

ABSTRACT

Johnsongrass [Sorghum halepence (L.)Pers.] is widely distributed throughout the eastern U.S. and can be found in most of the corn (Zea mays L.) and soybean [Glycine max (L.)Merr.] growing areas of Virginia. Selective postemergence herbicides have been effective against this species in soybeans but have not been available for use in corn. For this reason, johnsongrass populations often increase when corn is planted into fields containing this weed. Since the experimental herbicide CGA-136872 had displayed activity against johnsongrass, studies were conducted in 1988 and 1989 to determine the effectiveness of foliar applications of this herbicide against johnsongrass and safety to 'Pioneer 3378' (R) corn in eastern Virginia. For the first study, johnsongrass seed was broadcast and disked into the soil prior to planting corn in 1988. Postemergence applications of CGA-136872 at 0.018 to 0.036 lb ai/A were made to seedling johnsongrass on June 2, 1988 and to rhizome johnsongrass on May 25, 1989 in no-till corn planted into the same plots. In 1988 all rates provided a minimum of 72% control but differences between rates were not significant and counts of johnsongrass plants emerging from rhizomes in the spring of 1989 were lower than in the check for all treatments but did not otherwise differ with rate. In 1989, corn was injured by all treatments and control of rhizome johnsongrass was low. Yields of treated corn were generally similar to those of the check in 1988 but were higher than the check in 1989. A second study in 3 to 18 in johnsongrass in 1989 resulted in partial control and somewhat erratic but high corn injury. Corn injury in 1989 may have been a result of varietal sensitivity, environmental conditions, soil pH, or disease. Additional research is required to elucidate the factors influencing corn and johnsongrass response to CGA-136872.

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VOLUMES OF AND ADDITIONS TO ALACHLOR-ATRAZINE-GLYPHOSATE SPRAYS IN NO-TILL CORN[1]

R.D. Ilnicki, A.J. Enache, M. Waters, and K.G. Hoffman[2]

ABSTRACT

Conservation tillage is popular in New Jersey, particularly with no-till double-crop soybeans (Glycine max L. Merr.). However, the concept of growing no-till corn (Zea mays L.) is gaining acceptance with progressive growers. The herbicides used are glyphosate or paraquat as knockdown materials and alachlor and atrazine as preemergence residual herbicides. Other residual herbicides are also gaining acceptance. A study was initiated to determine the effectiveness of two formulations of alachlor (emulsifiable concentrate and micro-encapsulated) in combinations with atrazine These were applied in spray volumes of 68 L/ha and 271 L/ha one day after planting, on June 1, 1989. The lower volume applications included at least one rate of the micro-encapsulated preparation with additions of a surfactant (0.5% v/v), a nitrogen solution (3.8 L of 28% N/380 L of spray) or a combination of the surfactant plus ammonium sulfate (2% v/v).

Weeds in the experimental area included redroot pigweed (Amaranthus retroflexus L.), common ragweed (Ambrosia artemisiifolia L.), horsenettle (Solanum carolinense L.), ivyleaf morningglory [Ipomoea hederacea (L.) Jacq.], yellow nutsedge (Cyperus esculentus L.), and fall panicum (Panicum dichotomiflorum Michx.).

From this study it was found that (1) applications of the herbicides were more effective at the lower spray volume, (2) increases in the rate of glyphosate above 0.56 kg/ha did not improve weed control at the low volume but there were slight increases in control at the higher volume, (3) control of ivyleaf morningglory and fall panicum was greater with the preparation containing micro-encapsulated alachlor, and (4) there were no differences in weed control produced by the various spray additions.

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QUACKGRASS CONTROL IN FIELD CORN WITH CGA-136872 AND DPX-V9360

P. C. Bhowmik and B. M. Bahnson[1]

ABSTRACT

Controlling quackgrass [Elytrigia repens (L.) Nevski.] in field corn is a challenge because of its perennial and tenacious habit. This task would be simple when two new highly active postemergence compounds become available for use. Experiments were conducted to determine the growth stage of quackgrass for maximum activity of the compounds and to assess their effects on corn yields.

In one experiment, CGA-136872 (Ciba-Geigy) at 20 and 40 g ai/ha was applied at two leaf stages of quackgrass. Split applications of each rate of CGA-136872 were made at both growth stages of quackgrass. In the second experiment, four rates of DPX-V9360 (duPont) at 35, 52, 70 and 105 g/ha were compared alone and in split applications. The surfactant X-77 at 0.25%(v/v) was added to all treatments in both experiments.

Each plot was 2.0 by 4.6 m and treatments were replicated three times in a randomized complete block design. Corn 'Agway 584S' was planted June 5, 1989. Treatments were applied on June 12 and June 26 when the quackgrass was at the three- to four-leaf and five- to seven-leaf stage, respectively. A CO_2-backpack sprayer was used with a pressure of 152 kPa in 187 L/ha. Corn injury was determined four weeks after treatment (WAT) and quackgrass control was rated 4 and 8 WAT. Quackgrass shoots per 400 cm^2 were counted 8 WAT.

Slight injury (5-10%) to the corn was noted when CGA-136872 was applied at the five- to seven-leaf stage of quackgrass. At 3 WAT, treatments applied at the five- to seven-leaf stage showed significantly less control than those treated at the three- to five-leaf stage, but this control increased to acceptable levels by 8 WAT. Hand cultivation at 4 weeks following the application of CGA-136872 at 20 and 40 g/ha, either at the three- to five-leaf or five- to seven-leaf stage did not improve quackgrass control. At 4 WAT, quackgrass control from split applications of CGA-136872 was similar to the control obtainted with the single application of CGA-136872 at each rate.

In the second study, DPX-V9360 gave excellent control of quackgrass at all rates. At 5 WAT, DPX-V9360 at 35 g/ha resulted in better quackgrass control than CGA-136872. By 9 WAT the increased quackgrass control by DPX-V9360 no longer existed. Split applications of DPX-V9360 at 14-day interval, applied either at 35 or 52 g/ha did not improve quackgrass control compared to the single application. All treatments significantly reduced quackgrass shoot numbers compared to the untreated check plot. In both experiments, corn grain and silage yields were not affected by any rates of DPX-V9360 and CGA-136872.

Residual control of quackgrass in the second year was determined in plots treated with DPX-V9360 and CGA-136872. In general, quackgrass control was better with DPX-V9360 than with CGA-136872.

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QUACKGRASS CONTROL PROGRAMS FOR FIELD CORN

Russell R. Hahn[1]

ABSTRACT

Field experiments were conducted to compare the effectiveness of quackgrass [*Agropyron repens* (L.) Beauv.] control programs using atrazine and glyphosate in conventional and no-tillage field corn (*Zea mays* L. 'Pioneer 3925'), to evaluate the effect of tank-mixing different formulations of atrazine or cyanazine with glyphosate for quackgrass control, and to evaluate the effectiveness of CGA-136872 and DPX-V9360 for quackgrass control. These experiments were conducted on a Fredon silt loam (mixed, nonacid, mesic aeric haplaquepts) with 4.2% organic matter in Tompkins County, New York in 1988 and 1989. The plot area had been plowed and seeded to a legume-grass mixture in the summer of 1987, however the seeding was a failure due to a heavy infestation of quackgrass. Seedbed preparation for conventionally-tilled blocks included spring plowing and discing. A split-plot design with tillage treatments as main plots and herbicide treatments as subplots was used for the experiment comparing quackgrass control programs in conventional and no-tillage cropping systems while a randomized complete-block design was used in all other experiments. Each experiment had four replications. Herbicide treatments were applied in water to 10 by 25 ft plots using 8002 flat spray tips mounted on a compressed air bicycle sprayer calibrated to deliver 30 gpa of spray solution.

Quackgrass control with either an atrazine or a glyphosate control program was better in tilled blocks than in no-tillage blocks at the end of the first growing season. Control was also better with 2 lb ai/A than 1 lb/A of glyphosate in the no-tillage blocks but not in the tilled blocks. There was no difference in quackgrass control between the 1 lb/A rate of glyphosate and the split application of 4 lb ai/A atrazine. Quackgrass control with 1 or 2 lb/A of glyphosate in no-tillage corn was less when the glyphosate was tank-mixed with wettable powder formulations of atrazine or cyanazine than when the triazine herbicides were applied separately after planting. Wettable powder, dry flowable, and liquid formulations of atrazine or cyanazine were equally antagonistic to glyphosate activity on quackgrass. Although quackgrass control with 2 lb/A of glyphosate was better than with 1 lb/A when tank-mixed with atrazine or cyanazine, the increased rate of glyphosate did not provide acceptable (80%) quackgrass control in no-tillage corn.

Neither CGA-136872 or DPX-V9360 provided acceptable early-season quackgrass control when applied postemergence in no-tillage corn in 1988. Late-season control ratings revealed that DPX-V9360 at rates of 0.063 to 0.078 lb ai/A had eventually provided good (85 to 90%) quackgrass control that was still evident in the spring of 1989. Late-season control with CGA-136872 was unacceptable at rates of 0.018 to 0.036 lb ai/A. Single postemergence applications of CGA-136872 or DPX-V9360 at rates of 0.016 to 0.031 lb/A provided good (80 to 85%) quackgrass control in conventionally-tilled corn in 1989.

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EFFICACY OF METOLACHLOR AND ATRAZINE DUE TO THE TIME OF APPLICATION IN CORN PRODUCTION

Francis X. Mangan, Herbert V. Marsh, Jr. and Stephen J. Herbert[1]

Two experiments were implemented in 1988 and 1989 at the University Research Farm in South Deerfield, Massachusetts, to study the effect of the time of application of Metolachlor and Atrazine on weed control and corn (Zea mays L. cv. 'Sprite') yields. The experiments were set up as completely-randomized block designs having 4 replications with plot sizes of 2.7 meters (three corn rows) by 6.1 meters. The rates applied in the herbicide treatments were 0.78 kg/ha active ingredient of Metolachlor, 0.45 kg/ha active ingredient of Atrazine, and 1 liter/ha of a photobland crop oil (Booster + E, Agway). In 1988, these compounds were applied 1, 4, 8, and 17 days after planting (with 17 being the 'spike stage' of the corn - approximately 3 days after emergence). In 1989, these compounds were applied 0, 7, 14, 21, and 28 days after planting (with 0 being the day of planting). In both experiments there was a control in which no herbicides or other means of weed suppression were employed. There was a strong correlation between weed pressure and the time of herbicide application. The later the application was delayed after the corn was planted the greater the decrease in weed pressure. This was especially true for grass control. Corn yield increased as weed pressure decreased. In 1989, weed pressure increased and corn yield decreased when the herbicide was applied 28 days after planting. This was approximately 1 week after the corn and many of the weeds had emerged. Reduced effectiveness of herbicide applied at planting compared to increased weed control with delayed application at the spike stage may be related to water solubility and soil affinity of the compounds together with microbial degradation. When these compounds are applied at or near corn emergence a higher percentage of the compounds would be available to the germinating weed species than when applied at planting.

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INFLUENCE OF A CROWNVETCH LIVING MULCH AND PREVIOUS CROP ON CORN YIELDS IN A DRY YEAR

N. L. Hartwig[1]

ABSTRACT

Crownvetch (Coronilla varia L.) for this study was seeded on April 20, 1976. A number of research studies related to the use of crownvetch as a living mulch for agronomic crop production have been done in this area since. In 1985 a study was set up to look at a number of different cover crops for a four year crop rotation of corn-corn-oats-winter wheat/soybeans with three levels of nitrogen applied to corn when it appeared in the rotation. The trial was large enough so all crops in the rotation were represented each year. Due to the extreme drought in 1988, these results are a chance observation of the influence of crownvetch and the previous crop of corn (Zea mays L.) or soybeans () on corn yields in a very dry year.

It was expected that the presence of crownvetch living mulch would have a detrimental effect on corn growth and yield but yields were the same when the competitive effect of dandelion and grass were removed regardless of the previous crop or amount of sidedressed nitrogen. This would indicate that even in an extremely dry year, crownvetch producing up to about 500 lb/A of dry matter does not result in increased competition for moisture.

Dandelion were much more of problem when the previous crop was corn rather than soybeans and corn yields were drastically reduced by dandelion. Dandelion appears to be extremely competitive for moisture and in a dry year. When the competitive effects of both dandelion and grass were removed, the adjusted corn yields were virtually the same whether grown with or without crownvetch for comparisons between corn or soybeans as a previous crop respectively.

Even after removing the competitive effects of dandelion and grass, corn tended to yield less when the previous crop was corn rather than soybeans. This was very likely due to better soil structure and perhaps some carryover nitrogen where the soybeans had been grown. Sidedressed nitrogen had little or no effect on corn yields whether planted with or without crownvetch and regardless of the previous crop. Since virtually no rain fell for six weeds after sidedressing, most of this nitrogen was lost or left on the soil surface where it was unavailable.

INTRODUCTION

Research on the use of crownvetch as a living mulch for agronomic crop production was started at Penn State in 1975 (1). Corn yields when grown in crownvetch were generally suppressed by 10 to 15% for the first six years after crownvetch establishment (2). This was partially due to the lack of adequate weed control since a good weed control program for corn in crownvetch had not yet been worked out. By 1983, the first dry year after research with crownvetch was started, it had been determined that crownvetch would tolerate almost any herbicide labeled for corn with the possible exception of 2,4-D and still recover enough to provide groundcover by late summer or fall (1). In 1983 the herbicide program included atrazine @ 2.2 kg/ha on April 22 followed by atrazine + metolachlor @ 2.2 + 1.4 kg/ha applied preemergence and dicamba @ 0.22 kg/ha post. This resulted in excellent weed control and corn yields in crownvetch were 20 to 55% greater than corn yields without crownvetch when 168 kg/ha or no N was applied (2). Every year since 1983 corn grown in crownvetch outyielded corn without crownvetch; including 1988 when Pennsylvania had its driest June and July in 100 years (2,4). The research data presented in this paper was a chance observation of the influence of crownvetch and the previous crop of corn or soybeans on corn yields in a very dry year (1988).

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MATERIALS AND METHODS

The crownvetch for this study was seeded on April 20, 1976 on a Murrill silt loam soil containing about 16% sand, 67% silt, 14% clay and 2.5% organic matter. The area was limed to a pH of 7.0 before seeding and it has been limed since to maintain a pH of about 7.0. A number of trials involving various crop rotations and herbicide treatments have been conducted in this trial area since 1976.

Corn 'Pioneer 3475' was planted in 76 cm rows with a 6-row John Deere Max-emerge no-till planter on May 9, 1988. A row fertilizer (110 kg ha^{-1} of 10-30-10) was applied with the planter followed by 0, 77, and 154 kg ha^{-1} of nitrogen sidedressed as UAN in a band between each corn row on June 14. There was no significant rainfall to leach the nitrogen in for six weeks after sidedressing.

In anticipation of needing bentazon [3-(1-methylethyl)-(1H)-2,13-benzothiadiazin-4(3H)-one 2,2-dioxide] + atrazine [6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine] post for Canada thistle (Cirsium arvense (L.) Scop.) control, a low residual treatment of cyanazine + metolachlor at 1.1 + 1.1 kg ha^{-1} was applied May 10 preemergence to the corn. This treatment had virtually no effect on the dandelion which was especially heavy in the corn plots where corn had been the previous crop and without a crownvetch living mulch so 2,4-D amine at 0.275 kg ha^{-1} was added to 0.75 kg/ha^{-1} each of bentazon and atrazine applied on June 2 when the corn was in the five leaf stage and Canada thistle 20 to 30 cm. Due to the most severe drought in 100 years, the dandelion recovered but the more 2,4-D sensitive crownvetch was virtually wiped out. The 2,4-D was left out of the treatment where soybeans had been the previous crop since dandelion was only a minor problem. Out of fear of losing the trial, it was irrigated once with 50 l m^{-2} of water with an overhead irrigation system in late June.

The dandelion, grass, and crownvetch yields were determined by harvesting all top growth from a 0.5 m^2 area from each plot in August 1988. A sub-sample was saved from random plots for dry weight determination. Corn stand and grain yields were measured for three of the four middle rows of a six row plot 4.6 by 6.7 m in size. Corn leaf nitrogen was determined on 12 ear leaves randomly stripped from the harvest rows in each plot when corn was in silk. Percent nitrogen was determined on the oven dried (65°C) and ground ear leaf samples using near infrared analysis (NIR). ANOV was run on dandelion, grass and crownvetch dry matter yields and corn stand, grain yields and percent N in the ear leaf with the SAS statistical package as a split-split-split plot design. The adjusted corn yields were calculated by determining the linear regression equation for the influence of dandelion, grass and crownvetch on corn yields and then subtracting out these effects to determine what the corn yield would have been in the absence of weeds or a ground cover.

RESULTS AND DISCUSSION

Corn growth and yields were drastically reduced in 1988 due to the driest growing season in 100 years. Subsoil moisture was available since the rainfall for the previous five years was reasonably normal. If the corn was able to get off to a good start and develop a root system deep enough to tap into this subsoil moisture, corn yields of 100 bu/A were still possible without irrigation. With one irrigation of 50 l m^{-2} of water in late June, potential yields were probably increased to 125 bu/A.

It was expected that the presence of crownvetch living mulch would have a detrimental effect on corn growth and yield in a dry year but from data collected in 1983, a previous dry summer in central Pennsylvania, corn grown in a crownvetch living mulch yielded 20 to 55% greater than corn yields without crownvetch when 168 kg/ha or no N was applied (2). In 1988 corn grown in a crownvetch living mulch did not yield more than corn grown without crownvetch, but yields were the same when the competitive effect of dandelion and grass were removed regardless of the previous crop or amount of sidedressed nitrogen (Table 1). This would indicate that even in an extremely dry year, crownvetch producing up to about 500 lb/A of dry matter does not result in increased competition for moisture.

It would appear from examining the actual corn yields when the previous crop was corn that corn grain yields when grown in crownvetch were indeed much greater than for corn without crownvetch. The reason for this however seems to be due to less dandelion in plots having a crownvetch living mulch relative to those without a crownvetch living mulch (3). When the competitive effects of both dandelion and grass were removed, the adjusted corn yields were virtually the same whether grown with or without crownvetch for comparisons between corn or soybeans as a previous crop respectively. Dandelion appears to be extremely competitive for moisture and in a dry year can have drastic effects on corn yields. Regression equations indicated that for every 7 lbs of dandelion top growth dry matter, corn yields were reduced one bu/A.

Corn yields were significantly less when corn was the previous crop which in part was due to greater dandelion and grass weed problems when the previous crop was corn. Even after removing the competitive effects of dandelion and grass, corn tended to yield less when the previous crop was corn rather than soybeans. This was very likely due to better soil structure and perhaps some carryover nitrogen where the soybeans had been grown which allowed the corn to get off to a better start and possibly root deeper to tap some of the subsoil moisture. Generally the percentage of leaf nitrogen for corn following soybeans was less than corn following corn which would also indicate it was able to make better growth and dilute the nitrogen. Corn following corn very likely suffered more for lack of moisture than lack of nitrogen.

Sidedressed nitrogen had little or no effect on corn yields whether planted with or without crownvetch and regardless of the previous crop. There was a significant difference in corn ear leaf nitrogen between zero and 140 lb/A applied nitrogen only for corn planted in crownvetch when soybeans was the previous crop. This is perhaps to be expected since virtually no rain fell for six weeks after sidedressing and most of the nitrogen was either lost or left on the soil surface where it was unavailable.

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Table 1. Corn stand, yield, ear leaf nitrogen and dandelion, grass, crownvetch dry matter yields for living mulch, previous crop and nitrogen rate treatment combinations for no-till corn in 1988.

Living Mulch	Previous Crop	Nitrogen Rate	Corn Stand	Dandelion Yield	Grass Yield[1]	Crownvetch Yield	Corn Yield	Adj. Corn Yield[2]	Leaf Nitrogen	
		lb/A	plants/A	<------lbs dry matter/A------->			bu/A	bu/A	%	
Crownvetch	Corn	0	21,296	112	249	6	47	75	2.59	b-g[3]
Crownvetch	Corn	70	20,944	54	164	11	63	77	2.96	abc
Crownvetch	Corn	140	21,032	66	128	2	79	94	2.42	b-h
Crownvetch	Soybean	0	23,672	0	181	558	100	108	1.71	ijk
Crownvetch	Soybean	70	24,024	0	46	530	89	90	2.07	f-j
Crownvetch	Soybean	140	24,288	39	50	169	122	125	2.47	b-h
None	Corn	0	21,736	451	46	0	11	78	2.35	d-h
None	Corn	70	22,968	374	21	0	28	83	3.22	a
None	Corn	140	21,648	444	36	0	18	83	2.92	a-d
None	Soybean	0	24,200	108	31	0	83	88	2.31	d-i
None	Soybean	70	24,464	4	16	0	99	100	1.93	h-k
None	Soybean	140	21,912	54	10	0	124	126	2.51	b-h
Significance level (P)			0.8821	0.8528	0.9039	0.0795	0.7138		0.0029	
LSD (P = 0.05)			2787	178	161	140	37		0.61	

[1] Grass yields were primarily fall panicum with a little quackgrass and yellow nutsedge.

[2] Adjusted corn yields are actual corn yields with the negative effects of dandelion and grass removed through regression analysis.
Regression equation; previous crop corn - Adj. corn yield = Act. corn yield + (0.144 * dandelion dry wt.) + (0.037 * grass dry wt.)
Regression equation; previous crop soyb - Adj. corn yield = Act. corn yield + (0.042 * dandelion dry wt.) + (0.031 * grass dry wt.)

[3] Column means followed by the same letter are not significantly different at the 5% level (P=0.05) according to Fisher's Protected LSD Test.

EFFECTS OF SULFOMETURON ON THE GERMINATION AND GROWTH OF SEEDED TREE SPECIES

Larry H. McCormick [1]

ABSTRACT

Herbaceous weed competition is a major factor limiting the successful establishment of desired tree seedlings following the harvesting of oak stands in Pennsylvania. The major competitors are hayscented fern (Dennstaedtia punctilobula Michx.) and various native grasses. Applications of sulfometuron alone or in combination with glyphosate following harvesting are currently being considered for control of this competing vegetation. Early field observations suggest that sulfometuron has little or no effect on the germination of certain tree species when applied at recommended rates six to eight months prior to germination. On the other hand, sulfometuron appears to reduce the germination and early development of some tree species.

In 1987, a field experiment was initiated to test the effects of sulfometuron applied alone or as a tank mix with glyphosate on the germination and initial development of northern red oak (Quercus rubra L.), white ash (Fraxinus americana L.), yellow-poplar (Liriodendron tulipifera L.) and white pine (Pinus strobus L). Five herbicide treatments plus an untreated control were replicated four times at two sites. The herbicide treatments consisted of glyphosate at 1.12 kg ai/ha, sulfometuron at .105 and .210 kg ai/ha, and sulfometuron + glyphosate at .105 + 1.12 and .210 + 1.12 kg ai/ha applied in September 1987. Treatment plots were seeded in March 1988 with seeds of northern red oak, white ash, yellow-poplar and white pine. The number of new germinants, number of dead seedlings, and seedling heights of the four species were measured monthly during the growing season in 1988 and in June 1989.

Results showed no effect of sulfometuron at either the .105 or .210 kg ai/ha rate on the cumulative percent germination of red oak and white ash through June of the second growing season. The germination of white pine was reduced slightly by both rates of sulfometuron, however, the height growth of white pine was not affected by either rate. Sulfometuron at the higher rate did reduce the height growth of red oak and white ash. The effect on yellow-poplar could not be evaluated because of very low rates of germination in all treatments. Glyphosate alone or in combination with sulfometuron had no effect on the germination or seedling growth of red oak, white ash or white pine.

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CONTROL OF RASPBERRY AND GRASS IN NOVA SCOTIA WITH LIQUID HEXAZINONE

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INTRODUCTION

Velpar ® L (active ingredient: Hexazinone 240 grams/litre) is a herbicide currently registered in Canada for site preparation by broadcast ground application and conifer release with undiluted spot treatments (CPPA, 1986). This herbicide provides both pre- and post-emergent control of various weed species. It can be absorbed through foliage but since translocation is primarily upward through the xylem, root absorption is more effective (WSSA, 1983; Alm and Whorton, 1988). Campbell (1983) stated that hexazinone can effectively control raspberry, grass and other herbaceous weeds for up to four growing seasons.

In the spring of 1984, two trials were established to determine the efficacy of three different rates of Velpar ® L in controlling raspberry and grass under Nova Scotia conditions. One trial was located at Delaney Settlement, Colchester County (45°28'N, 63°18'W), on a site dominated by raspberry; the other at Mt. Thom, Pictou County (45°30'N, 62°58'W), on a site dominated by grass.

SITE HISTORY AND METHODS

The Delaney Settlement site supported a mixedwood stand prior to clearcutting during the winter of 1981. In 1982 this well drained sandy loam site was prepared with a Craig Roller and Velpar ® L was applied in the spring of 1984.

The Mt. Thom site, a medium textured, well drained old hay field, had no site preparation prior to the Velpar ® L treatments in the spring of 1984.

Both experimental sites were divided into 12, 0.04 ha (0.1 ac) blocks. These blocks were chosen based on their uniformity of site and target vegetation. At Delaney Settlement, before treatment, the target vegetation (raspberry) covered between 80 and 100% of the ground surface in each block. Lesser amounts of grass, red maple, bunchberry, goldenrod and pearly everlasting were also present. At Mt. Thom, the target vegetation (grasses) formed a continuous cover in all the blocks: minor amounts of goldenrod, aster and chickweed were also noted. Three replicates of four treatments (Control, 9.38, 13.54 and 17.71 l/ha) were assigned randomly to the 12 blocks at each site. The selected treatment rates were chosen to fall within the recommended rates of 9-18 l/ha as indicated on the product label for areas of woodland management. One additional block was manually weeded at Delaney Settlement. The three different rates of Velpar ® L were applied using a carbon dioxide pressurized backpack sprayer with eight 80015 Tee-Jet flat fan nozzles on a 3.2 m boom. The total solution applied was 292 l/ha.

All blocks were assessed during the summers of 1985 and 1987 and additionally in 1986 at the Delaney Settlement site. Four assessment plots, each three metres away from the block centre were established in the north, south, east and west directions within each tenth-acre block. Concentric plots having radii of 1.78 m and 0.58 m, respectively, were used to assess woody and non-woody vegetation.

In each plot, the height and percent cover of the various species of vegetation were measured. These measures were then combined to form a competition index:

$$CI = H \times C$$

where
CI = Competition Index
H = Average height (metres) of a given species
C = % of ground covered by the same species

The CI, percent cover and height were then averaged over all plots treated with a given rate of Velpar ® L. The average CI was used to represent the effect of treatment on the larger vegetation (i.e. raspberry, shrubs and tree species) while average percent cover was used to assess the shorter vegetation (i.e. grass, bunchberry, chickweed, etc.).

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RESULTS AND DISCUSSION

DELANEY SETTLEMENT

Raspberry

All blocks sprayed with Velpar ® L had a much lower CI, compared to the control and manually treated blocks (Figure 1). In fact, in the first year following treatment with Velpar ® L, raspberry averaged less than 1% cover and 11 cm in height for all treatment blocks compared to 77% cover and 78 cm in the control (Appendix I). Three years after treatment (1987) good control of the raspberry was still being maintained. The percentage cover averaged from 6% to 10% in the treated blocks as compared to 65% for the control. Alternately, the manually weeded block had a higher raspberry competition index for the first two years following treatment compared to the control (Figure 1).

Because of the excellent control, even at the lowest rate, experiments were subsequently established to determine the minimum rate of Velpar ® L required to adequately control raspberry. These trials will be reported on at a later date.

Non-Target Species

Remeasurement of plots one year after treatment indicated that the higher the rate of Velpar ® L applied, the greater the reduction in the cover of non-target species (i.e., bunchberry, grass, hemp nettle and moss Figure 2 and Appendix I). In the second year the percent cover of these species increased, and by the end of the third year it exceeded the control values in all but the highest-rate treatment plots. This increase is attributed to the reduced raspberry competition.

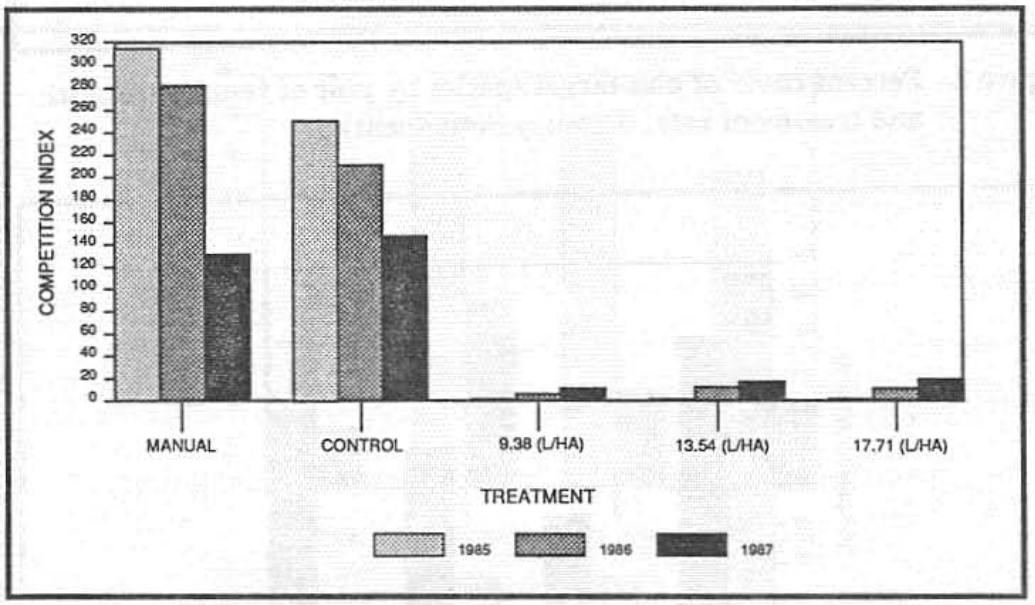

Figure 1. Competition index for raspberry by treatment rate and year of measurement. (Delaney Settlement)

MT. THOM

Grass

All three treatment rates provided excellent grass control for the first year (Figure 3). The greatest reduction occurred in the block treated with the highest rate of Velpar ® L (17.71 l/ha). In this block the percentage cover averaged 7% compared to 97% in the control block. Three years after treatment (1987) the percent cover of grass in the block receiving 17.71 l/ha had increased to 62%, (Figure 3 and Appendix II). Even so, observations indicated that the root density was low in the treated blocks in comparison to that of the controls. The reduced root density should result in faster tree growth due to decreased competition for moisture and nutrients.

Non-Target Species

In the fall of 1984 all of the treated blocks were virtually bare of vegetation. During the spring and summer of the following year, however, the treated blocks were rapidly invaded by hemp nettle and to a lesser extent goldenrod. By the fall of 1985, 80 to 90% of the treated blocks were covered primarily by these two species. The invasion of the treated blocks was not uniform: the higher rates favoured hemp nettle, the lower rates goldenrod. In fact, no goldenrod was found in the plots treated with the highest rate of Velpar ® L, i.e. 17.71 l/ha. Three years after treatment (1987) the percentage of non-target species had decreased due to the (re)establishment of grass species (Figure 4).

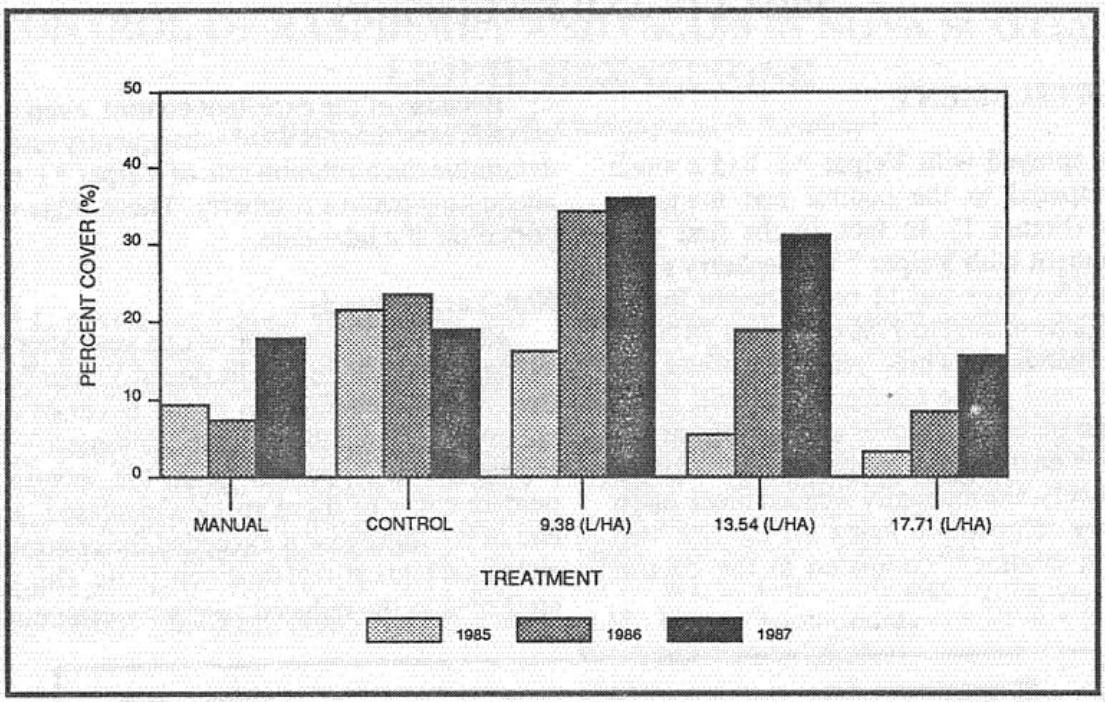

Figure 2. Percent cover of non-target species by year of remeasurement and treatment rate. (Delaney Settlement)

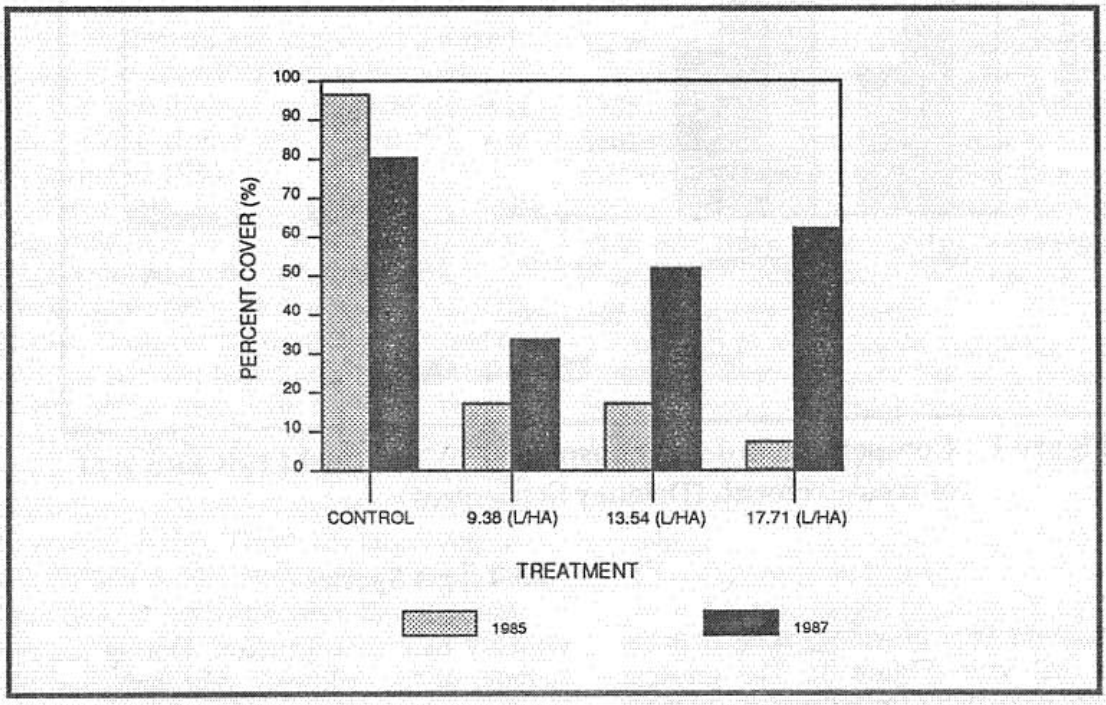

Figure 3. Percent cover of grass by year of remeasurement and treatment rate. (Mt. Thom)

SUMMARY

The major findings of this research trial to determine the efficacy of spring applied Velpar ® L at three different rates on two sites are as follows:

1) Raspberry can be controlled with treatment rates of 9.38 l/ha and greater for at least four growing seasons after treatment.
2) Grass can be controlled for at least two to four growing seasons after spring application with treatment rates of 9.38 l/ha and greater. One important observation is that even after four years the density of grass roots in the treated blocks was considerably less than in the controls.
3) Because of the effective control provided by the lowest treatment rate applied, additional experiments have been established to determine the minimum rates of Velpar ® L required to control various target species.
4) The major species to (re) establish on the raspberry site were bunchberry, hemp nettle and scattered grass. Because of their short height and low root density on this site, these species are weak competitors.
5) On the grass site, the predominant species to (re)establish was hemp nettle with lesser quantities of goldenrod and sorrel.
6) Due to the prolific sprouting capability of raspberry, manual weeding increased rather than decreased the quantity of raspberry on the site. For two years after treatment the CI for the manually weeded plot was higher than for the control.

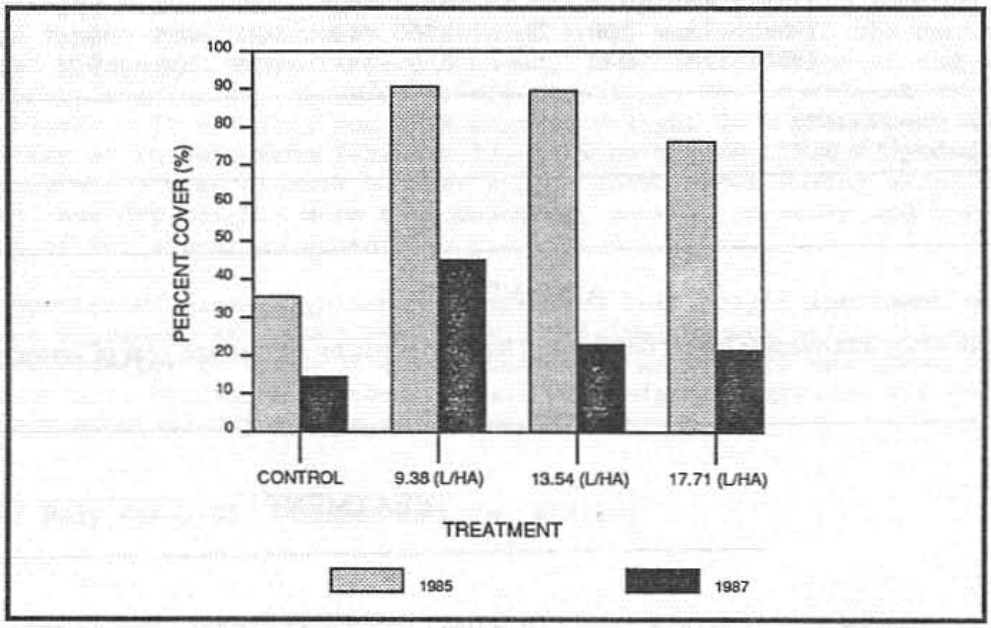

Figure 4. Percent cover of non-target species by year of remeasurement and treatment rate. (Mt. Thom)

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APPENDIX 1

Average percent cover and average height on the Delaney Settlement raspberry site by species and year of assessment.

SPECIES	YEAR	TREATMENT									
		MANUAL		CONTROL		9.38 (l/ha)		13.54 (l/ha)		17.71 (l/ha)	
		PC%	HT	PC%	HT	PC%	HT	PC%	HT	PC%	HT
Raspberry	1985	93.8	0.83	77.5	0.78	0.5	0.10	0.5	0.11	0.8	0.11
	1986	100.0	0.70	80.4	0.63	2.0	0.26	6.8	0.27	14.3	0.27
	1987	57.5	0.58	64.6	0.55	6.3	0.30	10.2	0.31	10.4	0.37
Trees and Shrubs	1985	2.8	0.58	10.8	0.65	3.2	0.38	4.7	0.35	4.2	0.41
	1986	0.8	0.76	13.9	0.92	2.8	0.46	6.8	0.44	8.1	0.41
	1987	1.3	0.82	13.8	0.89	2.0	0.52	8.1	0.51	8.3	0.67
Other Ground Vegetation	1985	8.8	0.35	21.6	0.27	16.3	0.18	5.2	0.15	2.8	0.14
	1986	7.5	0.50	23.4	0.30	34.2	0.22	18.5	0.20	8.3	0.19
	1987	17.8	0.40	19.0	0.30	35.7	0.25	30.9	0.24	15.3	0.36

PC% - Average percent cover.
HT - Average height in metres.

APPENDIX II

Average percent cover and average height on the Mt. Thom grass site by species and year of assessment.

SPECIES	YEAR	TREATMENT							
		CONTROL		9.38 (l/ha)		13.54 (l/ha)		17.71 (l/ha)	
		PC%	HT	PC%	HT	PC%	HT	PC%	HT
Grass	1985	97.5	0.33	15.9	0.34	16.5	0.36	6.7	0.16
	1987	80.0	0.32	32.9	0.34	51.3	0.38	61.7	0.36
Other Ground Vegetation	1985	55.2	0.31	89.5	0.34	91.2	0.28	76.1	0.23
	1987	13.8	0.27	46.4	0.25	22.7	0.24	21.5	0.21

PC% - Average percent cover.
HT - Average height in metres.

THE EFFECTS OF SIX GRASS SPECIES ON BLACK SPRUCE SEEDLING GROWTH

Paula Dalgaard Armstrong[1]

This pot experiment compared the effects of six boreal grass species on growth of paperpot over-winter nursery-produced black spruce (Picea mariana (Mill.) BSP) seedlings. I was particularly interested in diameter increment effects since many grasses are held to suppress spruce seedlings through an inadequate diameter increment making them vulnerable to being bowed down by dead grass tops over fall and winter.

Grass species used were Agrostis stolonifera, Agrostis scabra, Bromus ciliatus, Bromus inermis, Cinna latifolia, and Calamagrostis canadensis. Twelve replicates of each of these were created, as well as 12 controls (no grass). The grass seedings had been started from seed that I gathered the previous fall in Bragg Township, Cochrane District, northern Ontario. They were transplanted as 5 tiny seedlings each to 5" plastic pots in sandy loam soil several weeks before an individual black spruce seedling (from a tray shipped frozen from a northern Ontario nursery) was added to the centre of each pot. Paperpot wrappers were removed. Root collar diameter and height of each spruce seeding was recorded before planting. The experiment was arranged in 12 blocks. It was then run with augmented light in a greenhouse at the University of Toronto from February 17, 1986 to May 20, 1986 (3 months & 3 days), by which time grasses had set seed. Spruce root collar diameters, heights, and dry weights were then measured, as well as above and below-ground weights of the air-dried grasses.

Species of grass significantly affected both height increment and diameter increment of spruce seedlings. Original spruce height-diameter ratio affected diameter increase of spruce seedlings grown with one grass species (alpha = .01), but not with the others. Dry weight of grasses did not appear to affect eventual dry weight of spruce seedlings.

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FIELD-GROWN AZALEA AND CUT-FLOWER TOLERANCE TO ISOXABEN

C. E. Beste and J. A. Scott[1/]

ABSTRACT

Newly-set liners of azalea 'Helen Curtis' were tolerant to broadcast isoxaben (75DF), at 0.75 and 1.0 lb/A, as a foliar spray of 22 gal per A spray volume as field-grown plants in a Matapeake silt loam modified with 350 T/A fresh wt of decomposed pine bark and wood mulch. A 2 inch mulch layer of pine shavings was applied after planting and before treatment. 'Helen Curtis' azalea was tolerant to isoxaben in combination with trifluralin or oryzalin. Isoxaben at 1.0 or 2.0 lb/A caused unacceptable injury to transplanted snapdragons, aster, Matsumoto rose, gazinnia, scabiosa dwarf, scabiosa, tithonia and hybrid zinnia in a Norfolk loamy sand (0.6% O.M.). Acceptable tolerance to isoxaben occurred with cosmos and gomphrena. Aster Matsumoto scarlet appeared to be moderately tolerant. Isoxaben controlled annual grasses and sedges and ivyleaf morningglory (Ipomoea hederacea).

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THE TOLERANCE OF FIELD GROWN CORNUS AND MALUS TO COMBINATIONS OF PREEMERGENCE HERBICIDES

Larry J. Kuhns, John Pope, and Scott Guiser [1/]

ABSTRACT

Properly selected combinations of preemergence herbicides provide broader spectrum weed control than any one individual herbicide. This study was designed to determine the efficacy and tolerance of Kousa dogwood (Cornus kousa Hance.) and Sargent crabapple (Malus Sargentii Rehd.) to combinations of the herbicides most commonly used in nurseries, and one new herbicide in a premixed formulation. The treatments are listed in Table 1.

A randomized complete block design with three replications was used. The plot size was 13 m by 1.3m. All treatments were applied on March 27, 1989 with a CO_2 pressurized sprayer through an OC04 nozzle at 30 psi in the equivalent of 255 L/ha. Each side of the row was sprayed. At the time of application the trees were 1 - 1.5 m tall. The sky was sunny and the air temperature was around 13° C and the wind speed was between 10-16 km/hr. Weed control and injury were rated 8 weeks after treatment (WAT) and the plants were rated for injury again 18 WAT.

Attempts to compare the weed control provided by the different treatments was futile because of a high mixed population of perennial weeds which are not commonly controlled by preemergence herbicides. To complicate the situation further, different types of perennial weeds were not spread uniformly throughout the field, but were found in scattered pockets. These included Canada thistle [Cirsium arvense (L.) Scop.], quackgrass [Agropyron repens (L.) Beauv.], yellow nutsedge (Cyperus esculentus L.), and goldenrod (Solidago spp.). Very few annual weeds were found in the plots.

None of the treatments injured any of the treated trees. There was no sign of injury at either rating date.

Table 1. Herbicide combinations applied as directed sprays to the base of dormant Kousa dogwoods and Sargent crabapples on March 27, 1989.

TREATMENTS			RATES (kg a.i./ha)
Control		--	
Isoxaben	+	oryzalin [a]	1.1 + 3.3
Simazine	+	oryzalin	2.2 + 2.2
Simazine	+	napropamide	2.2 + 3.3
Simazine	+	metolachlor	2.2 + 3.3
Oxadiazon	+	oryzalin	2.2 + 2.2
Oxadiazon	+	napropamide	2.2 + 3.3
Oxadiazon	+	metolachlor	2.2 + 3.3
Oxyfluorfen	+	oryzalin	0.8 + 2.2
Oxyfluorfen	+	napropamide	0.9 + 3.3
Oxyfluorfen	+	metolachlor	0.9 + 3.3

[a] A premixed combination sold under the name of Snapshot

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FIVE YEAR SUMMARY OF BEDDING PLANTS TOLERANCE TO PREEMERGENCE HERBICIDES

A.F.Senesac[1/], J.C. Neal [2] and A. Bing[3]

ABSTRACT

Studies have been conducted at Riverhead and Ithaca, New York since 1984 investigating several aspects of weed control for annual bedding plants. Over the years, many ornamental species, cultivars and herbicides have been tested. In five of those years, a common subject of investigation has been the effects that napropamide and trifluralin have on fibrous rooted begonia (B.x semperflorens-cultorum) and impatiens (I. wallerana) cultivars. Both of these herbicides and bedding plants species are widely used in the landscape installation and maintenance industry, and therefore it is important to know of their compatibility.

The field studies were conducted on sandy loam at Riverhead or clay loam in Ithaca. In all the studies, the chemical treatments were applied immediately after transplanting and incorporated by irrigation with 24 hours. All plots were maintained weed free to avoid confounding the effect of weed interference with treatment effect. The studies were evaluated periodically during the growing season and plant fresh weights were measured at the end of the season.

Although in some years, many cultivars of each species were evaluated, there are four begonia and three impatiens cultivars that are common in at least two or more years. These are begonia 'Pink Tausendschon', 'Derby', 'Vodka' and 'Gin' and impatiens 'Novette Red', 'Novette White' and 'Novette Rose and White'. The results indicate that, in general, the impatiens cultivars tolerate trifluralin to a greater degree than napropamide. However, probably the most important finding of these studies was the enormous degree of variability in response from year to year and location to location. For example, each of the cultivars had a significantly different response to either herbicide in at least one of the three years that they were commonly tested. Some of this variability in response may be explained by differences in location, soil type, climate and transplant age and condition. Also, these herbicides tend to injure by inhibiting root growth which in turn causes overall plant stunting. This kind of injury can often be enhanced or ameliorated by different edaphic and climatic conditions. The variability experienced in these studies suggests that the use of either of these herbicides in landscape situations on these species would produce similarly variable and thus, undesirable results.

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TOLERANCE OF CONTAINER-GROWN CONIFERS AND BROADLEAF EVERGREENS TO BROADCAST APPLICATIONS OF CHLORIMURON

C. E. Beste and J. R. Frank[1/]

ABSTRACT

Production of container nursery crops must utilize herbicides because hand weeding is expensive and can damage the crop. In the first experiment chlorimuron at 0.011, 0.020 and 0.039 kg/ha was applied once per year in 1988 and again in 1989 on plants of *Ilex crenata* 'Helleri', *Juniperus conferta* 'Blue Pacific', and *Rhododendron catawbiense* 'Roseum Elegans'. In a second experiment, chlorimuron was applied once (1989) on the same three species and also on *Taxus media* 'Wardii' and *Photinia* X 'Fraseri' Dress. All applications were made as a topical broadcast spray (206 L/ha) two weeks after transplanting in June. The container media was 82% pine bark, 11% peat and 7% washed sand by volume. No phytotoxicity was observed on any crop species in these experiments. However, chlorimuron at 0.039 kg/ha reduced the size of *Ilex crenata* 'Helleri' in the second experiment. Weed cover was reduced by 50% at the two higher rates of chlorimuron in both experiments. However, several weeds were not controlled at any rate including: prostrate spurge (*Euphorbia humistrata* Engelm. ex. Gray), yellow woodsorrel (*Oxalis stricta* L.), common groundsel (*Senecio vulgaris* L.), common chickweed [*Stellaria media* (L.) Vill.], carpetweed (*Mollugo verticillata* L.), and Pennsylvania bittercress (*Cardamine pensylvanica*) Muhl. ex. Willd.

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THE TOLERANCE OF BETULA, THUJA, AND VIBURNUM LINERS TO PREEMERGENCE HERBICIDES

Larry J. Kuhns, Scott Guiser, and John Pope [1/]

ABSTRACT

Liners are plants that are grown at relatively close spacing for a year or two prior to being dug and replanted at wider spacing to be grown on for final harvest and sale. Most liners are small rooted cuttings or seedlings that are especially sensitive to herbicide injury because of their size and limited root system. The objectives of this study were to compare the efficacy of several standard nursery herbicides with some relatively new ones, and to determine the tolerance of white birch (Betula papyrifera Marsh), American arborvitae (Thuja occidentalis L. var. Nigra), and Allegheny viburnum (Viburnum X rhytidophylloides Suring. var. Allegheny) to them.

On March 27, 1989 the herbicides listed in Table 1 were applied with a CO_2 pressurized test plot sprayer through an 8006E nozzle at 30 psi in the equivalent of 338 L/ha of water. The soil was a clay-loam. A randomized complete block design was used with three replications per species. Plot size was 3 m by 1m. The sky was sunny and the air temperature was around 12° C. The arborvitae and viburnum had been planted as rooted cuttings the previous year and were 15-30 cm tall. The birch had been planted as seedlings the prior year and were about 1m tall. At the time of application there was a well established stand of winter annual weeds which were primarily Virginia pepperweed (Lepidium virginicum L.) and yellow rocket (Barbarea vulgaris R. Br.). Plots were rated for weed control and injury 8 weeks after treatment. They were rated again for injury 26 weeks after treatment.

It was not possible to accurately compare the summer annual weed control provided by the different herbicides because the winter annual weeds that had been present at the time of application dominated many of the plots. What was evident was the ability of some of the chemicals to reduce the population of the winter annuals. Simazine was the best providing 93% control at 2.2 kg a.i./ha and almost total control at the 4.4 kg rate. Isoxaben also provided good postemergence control of the winter annuals, with 65% control at the low rate and 78% at the high rate. Oxyfluorfen burned a lot of leaves and resulted in about 50% control, but many of the weeds were too large to be killed by this material and they continued to grow. The control of the established winter annuals provided by oxadiazon, oryzalin, napropamide, and metolachlor was below acceptable levels.

None of the herbicides except simazine caused injury symptoms on any of the plants. Simazine caused some foliar chlorosis and necrosis on the birch and viburnum 8 weeks after application. At the 2.2 kg a.i./ha rate the injury was slight and barely perceptible. At the higher rate it was easy to see, and it caused a slight stunting of the plants. By the end of the season the chlorosis was no longer visible and the stunting was barely perceptible.

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Table 1. Weed control and injury ratings of preemergence herbicides applied to Betula, Thuja and Viburnum liners, 8 weeks after application. Winter annual weeds dominated the plots at the time of application.

CHEMICAL	RATE kg a.i./ha	% WEED CONTROL	INJURY RATING 1/ Betula	Viburnum
Control	-	0	0	0
Simazine 4L	2.24	93	0.3	0
Simazine 4L	4.48	99	3.3	4.3
Oxadiazon 50W	2.24	26	0	0
Oxadiazon 50W	4.48	35	0	0
Oxyfluorfen 1.6E	0.84	46	0	0
Oxyfluorfen 1.6E	1.68	58	0	0
Isoxaben 75W	1.12	65	0	0
Isoxaben 75W	2.24	78	0	0
Oryzalin 4AS	4.48	11	0	0
Napropamide 50W	5.60	13	0	0
Metolachlor 8E	4.48	3	0	0

1/ Rated on scale of 0-10; 10=dead.

SELECTIVITY OF SULFOMETURON METHYL IN WHITE PINE, COLORADO SPRUCE AND BALSAM FIR

J.F. AHRENS[1]

ABSTRACT

Experiments were conducted with sulfometuron methyl from 1985 to 1989 in plantations of white pine (Pinus strobus L.), balsam fir (Abies balsamea [L.] Mill.) and Colorado spruce (Picea pungens Engelm.) that had been established for at least one growing season. The white pine were growing in a fine sandy loam with 3.4% OM and the fir and spruce were growing in silt loams with 5.6% OM. Sprays were applied over-the-top or with off-center nozzles to spray the lower 30 to 36 cm of the conifers from either side of the row, applying 281 L/ha.

In the white pine sulfometuron methyl at 0.105 kg/ha in September followed by oryzalin at 3.4 kg/ha in April or sulfometuron methyl at 0.053 and 0.105 kg/ha in June for two consecutive years gave excellent weed control and caused very little injury. However, 0.21 kg/ha in September sometimes caused moderate injury in the form of distorted needle and terminal growth.

In the Colorado spruce and balsam fir sulfometuron methyl at 0.053 and 0.105 kg/ha was applied in June, July, August or September for two consecutive years. Oryzalin was applied in April at 3.4 kg/ha. The 0.053 kg/ha rate gave excellent control of weeds including yellow nutsedge (Cyperus esculentus L.) and field horsetail (Equisetum arvense L.). Sulfometuron methyl caused no injury to balsam fir but it injured Colorado spruce at both rates and all times of application. Injury was chronic, with reductions of color and vigor.

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POSTEMERGENCE HERBICIDES ON CONIFERS

Larry J. Kuhns and Joanne E. Loose [1/]

ABSTRACT

The treatments in Table 1 were applied on Fraser fir [Abies fraseri (Pursh) Poir] and Colorado spruce (Pices pungens Engelm.) June 8, 1989. The trees had been established at the site for one year, were 25-40 cm tall, and had 5-8 cm of new growth. The soil was a silt-clay-loam. A randomized complete block design with three replications was used. The plot size was 9 m by 1 m. Treatments were applied with a CO_2 pressurized test plot sprayer through an 8006E nozzle at 30 psi in the equivalent of 230 L/ha of water. The sky was clear and the air, soil surface, and soil (at 5 cm) temperatures were 26, 33, and 28°C, respectively. A wide range of grasses and broadleaved weeds were present at the time of application.

The predominant weeds in the control plots were yellow foxtail [Setaria glauca (L.) Beauv.], green foxtail [Setaria viridis (L.) Beauv], common yellow woodsorrel (Oxalis stricta L.), Pennsylvania smartweed (Polygonum pensylvanicum L.), dandelion (Taraxacum officinale Weber), and Virginia pepperweed (Lepidium virginicum L.). Few of the weeds in the test area were sensitive to clopyralid. Treated areas were dominated by the foxtails and yellow woodsorrel, but also included Pennsylvania smartweed and tumble pigweed (Amaranthus albus L.). Sethoxydim, alone or in combination, killed all of the grasses present at the time of application. By 13 weeks after treatment (WAT) the grasses were regrowing in treated areas. Since grasses were the predominant weeds in the area, the overall ratings were higher for treatments including sethoxydim than clopyralid. Including oxyfluorfen and the high rate of Dash with the sethoxydim resulted in almost total weed control 4 WAT and good control 13 WAT. Control with clopyralid plus sethoxydim was only slightly better than sethoxydim alone. Imazaquin and imazethapyr provided excellent control 4 WAT. At 13 WAT imazethapyr still provided over 90% control while the imazaquin was allowing more regrowth of annual grasses. Fall panicum (Panicum dichotomiflorum Michx.) did not appear in other plots, but did develop in the areas treated with imazaquin and imazethapyr.

Imazaquin was the only herbicide that caused injury symptoms on Colorado spruce 4 WAT. It caused yellow tips. At 4 WAT clopyralid caused some needle twisting and slight foliar chlorosis on the Fraser fir. Imazaquin caused some dead tips and chlorosis on fir, while imazethapyr caused needle twisting and chlorosis. By 13 WAT all of the spruce, including the untreated controls, had developed some yellow tips. This may have been caused by triazine herbicide carryover from the extemely dry 1988 season. Imazaquin was the only material that caused additional chlorosis of treated spruce. At 13 WAT there was more yellowing and needle curling of Fraser fir treated with clopyralid than there was at 4 WAT, but it was still not severe. Fraser fir treated with imazaquin were stunted, chorotic, and some plants had bent stems. Imazethapyr caused all of the same symptoms plus it had a definite effect on bud development. Buds were much smaller and poorly developed on treated plants.

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Table 1. Postemergence herbicide treatments applied over-the-top of actively growing Colorado spruce and Fraser fir on June 8, 1989. Weed control and injury ratings were made 4 and 13 weeks after treatment (WAT).

						INJURY RATINGS[1]			
	Rate	4 WAT		13 WAT		Colo. spruce		Fraser fir	
Treatment	kg ai/ha	%W. C.[2]	%G[3]	%W. C.	%G	4 WAT	13 WAT	4 WAT	13 WAT
Control	-	0	78	0	65	0	1.0	0	0
Clopyralid	0.34	17	95	14	75	0	1.3	1.3	2.7
Clopyralid	0.67	19	92	12	78	0	1.0	1.0	2.0
Sethoxydim	0.56	68	0	31	23	0	0.7	0	0
+ Booster+E (2.5%)[4]									
Sethoxydim	0.45	58	0	28	18	0	0.3	0	0
+ Dash (2.5%)[5]									
Sethoxydim	0.45	56	0	34	29	0	0.3	0	0.3
+Dash (5%)									
Sethoxydim	0.56	99	0	77	73	0	0.7	0	0.3
+ Oxyflurofen	0.56								
+ Dash (10%)									
Clopyralid	0.34	68	0	26	42	0	0.7	1.3	2.3
+ Sethoxydim	0.56								
Imazaquin	0.56	98	85	67	88	1.3	3.3	4.3	5.0
Imazethapyr	0.28	99	25	92	68	0	1.3	2.3	5.7

1/ Injury was rated on a scale of 0-10, with 0 = no injury, 10 = dead; represent an average of 3 plots.
2/ Percent weed control; represent the average of 6 plots.
3/ Percent of the weeds in each plot that were grasses.
4/ Booster plus E is a crop oil concentrate made by BASF Corporation, Research Triangle Park, North Carolina.
5/ Dash adjuvant is a product of BASF Corporation.

THE EFFECTS OF SELECTED PREEMERGENCE HERBICIDES ON GRASS SPECIES

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

ABSTRACT

Two field experiments were conducted to evaluate long-term effects of preemergence crabgrass herbicides on grass germination. The objectives were: (1) evaluate the reinfestation of smooth crabgrass (Digitaria ischaemum (Schreb.) Muhl.) in plots treated in the spring of the previous year with preemergence crabgrass herbicides; (2) evaluate the effects of MON 15177 0.25G on perennial ryegrass (Lolium perenne L.) overseeded two weeks after treatment.

Treatments in the first study were divided into sprays and granulars. The liquid treatments were applied to 0.91 by 3.05 m plots with a CO_2 powered, hand-held boom delivering 702 l/ha through two 6504 flat fan nozzles spaced 18 inches apart. The granular treatments, in both studies, were combined with 200 cubic centimeters of sand and applied by hand with a shaker jar. The granular plots were 0.91 by 1.53 m in the first study and all the plots in the second study were 0.91 by 1.83 m. Treatments were applied April 28, 1988, to the first study and July 17, 1988, to the second study. Both studies were treated with 5.6 kg/ha of glyphosphate on October 14, 1988. Four days after the glyphosphate application the second study was verti-cut in two directions and overseeded with perennial ryegrass at a rate of 244 kg/ha.

The liquid treatments in the first study that provided significant control of smooth crabgrass were DCPA, pendimethalin, prodiamine, MON 15151, and CGA-41065. Percent crabgrass cover for these treatments ranged from 25.0 to 53.3 percent. Of the granular treatments, DCPA, benefin, oxadiazon, benefin + trifluralin on fertilizer, and MON 15177 provided significant control of smooth crabgrass. Percent crabgrass cover for these treatments ranged from 3.3 to 66.7 percent and three of the four rates of MON 15177 provided significantly better control than the others.

In the overseeding study, three of the four rates of MON 15177 severely effected the establishment rate of the perennial ryegrass stand. Rates of 1.1, 1.7, 2.2 kg ai/ha resulted in perennial ryegrass stands 69.1, 85.7, and 94.3 percent thinner than the check, respectively. The effect of the 0.56 kg ai/ha rate was less severe (23.8%).

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Table 1.0. Percent smooth crabgrass cover of sprayed treatments applied April 28, 1988 and rated July 18, 1989

Treatment	Rate (kg ai/A)	Crabgrass Cover (%)
Cinmethylin 7EC	1.68	83.3 ab*
Cinmethylin 7EC	2.24	61.7 abcd
DCPA 75W	11.77	53.3 bcdef
DCPA 6F	11.77	65.0 abcd
Pendimethalin 60WDG	1.68	50.0 cdef
EL-107 + Benefin	0.67 + 2.69	56.7 abcde
Benefin 60DF	2.69	68.3 abcd
CGA-41065 1.2EC	1.12	71.7 abcd
CGA-41065 1.2EC	2.24	25.0 f
Prodiamine 65WDG	0.56	45.0 def
Prodiamine 65WDG	0.84	30.0 ef
EL-107 + Benefin + Trifluralin	0.56 + 1.49 + 0.75	61.7 abcd
Oxadiazon 50W	0.56	80.0 abc
Oxadiazon 50W	0.84	81.7 ab
Oxadiazon 50W	1.12	61.7 abcd
Oxadiazon 50W	2.24	71.7 abcd
Oxadiazon 2ME	1.12	75.0 abcd
Oxadiazon 2ME	2.24	75.0 abcd
MON 15151 1EC	0.14	68.3 abcd
MON 15151 1EC	0.28	60.0 abcd
MON 15151 1EC	0.56	56.7 abcde
MON 15151 1EC	1.12	28.3 ef
Check	0.00	86.7 a

Table 1.1. Percent smooth crabgrass cover of granular treatments applied April 28, 1988 and rated July 18, 1989.

Treatment	Rate (kg ai/A)	Crabgrass Cover (%)
Oxadiazon 2G	2.24	60.0 b*
DCPA 5G	11.77	66.7 b
Benefin 2.5G	2.24	65.0 b
Benefin + Trifluralin	1.49 + 0.75	73.3 ab
Benefin + Trifluralin + Fert.	1.49 + 0.75	58.3 b
MON 15177 0.25G	0.14	78.3 ab
MON 15177 0.25G	0.28	63.3 b
MON 15177 0.25G	0.56	30.0 c
MON 15177 0.25G	0.84	8.3 cd
MON 15177 0.25G	1.12	3.3 d
Pendimethalin + Fert.	1.68	80.0 ab
Check	0.00	95.0 a

Table 1.2. Percent thinning of newly seeded perennial ryegrass with MON 15177.

Treatment	Rate (kg ai/ha)	% Thinning
MON 15177 0.025G	0.56	24.0 c
MON 15177 0.025G	1.12	75.0 b
MON 15177 0.025G	1.68	85.0 ab
MON 15177 0.025G	2.24	99.0 a

*Treatments followed by the same letter are not significantly different according to Duncan's New Multiple Range Test at the 5% level.

SENSITIVITY OF BAS 514 TO TEMPERATURE AND SOIL MOISTURE FOR CONTROL OF SOUTHERN CRABGRASS (DIGITARIA ADSCENDENS)

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

ABSTRACT

BAS 514 (proposed common name quinclorac) is presently registered in Asia for weed control in rice. It shows good potential for selective control of large crabgrass (Digitaria sanguinalis (L.) Scop) and southern crabgrass (D. adscendens (Retz.) Koel.) in turf. Many articles have shown that environmental influences can significantly affect postemergence grass herbicide performance. This research was designed to look at the influence of temperature and soil moisture on the control of southern crabgrass by BAS 514.

The research was conducted in growth chambers on 3- to 5-true leaf crabgrass plants. All treatments received an 18 hour photoperiod with full light of 690 $uM/m^2/s$. Temperatures tested were 15/10°C, 25/20°C, and 35/30°C. Soil moisture was maintained at 20, 40, 60, 80, and 100% of evapo-transpiration demand. Based on this work, temperature and soil moisture significantly influenced the response of southern crabgrass to BAS 514.

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Evaluation of Goosegrass Control Strategies for Creeping Bentgrass Putting green Turf.

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ABSTRACT

The lack of herbicides available to control goosegrass (*Eleusine indica* (L.) Gaertn.) on creeping bentgrass (*Agrostis palustris* HUDS.) putting green turf poses a unique problem for turfgrass managers. Preemergent herbicides for use on putting greens, as well as postemergent compounds, produce significant injury accepted by turf managers due to lack of non-phytotoxic alternatives. Our objectives for this study were to evaluate experimental and commercially available herbicides at various rates, application intervals, and formulations for safety on five varieties of creeping bentgrass (Emerald, Prominent, Seaside, Penneagle, and Penncross) maintained as putting green turf. Preemergent applications included dithiopyr as a 0.25G (MON 15175) and a 1EC (MON 15104) at 0.14, 0.28, and 0.56 kg ai/ha, quinchlorac 50WP at 0.56, 0.84, and 1.12 kg ai/ha, oxadiazon 2G at 0.84, 1.68, and 2.52 kg ai/ha, and the commercial formulation of oxadiazon + bensulide a 6.56G (supplying 1.68 kg ai/ha oxadiazon and 6.72 kg ai/ha of bensulide). Generally, injury from preemergent applications was most evident 30 days after treatment, except for quinchlorac which produced objectionable injury 12 days after application at all rates on all varieties. Varietal differences were most evident with regard to ability to recover from injury, Penneagle and Emerald being the least able. At 30 days after treatment dithiopyr produced slight reddening of leaf sheaths; however, injury was not considered to be objectionable. Oxadiazon at 2.52 kg ai/ha injured all varieties; 0.86 kg ai/ha injured none. The 1.62 kg ai/ha rate of oxadiazon alone caused objectionable injury, but the same rate of the commercial combination of oxadiazon + bensulide did not. Postemergent applications were made at 14 day intervals and included MSMA at 0.56, 1.12, and 2.24 kg ai/ha with and without a safener, fenoxaprop at 0.04 and 0.09 kg ai/ha delivered at 997 l/ha, and fenoxaprop at 0.04 kg ai/ha tank mixed with dithiopyr or quinchlorac. The 1.12 kg ai/ha rate of MSMA applied with the safener did not produce injury and the safener significantly reduced MSMA phytotoxicity at all rates on all varieties. Fenoxaprop at 0.04 kg ai/ha applied at high volume did not cause phytotoxicity; however, 0.09 kg ai/ha and lower volume applications at 0.04 kg ai/ha did cause injury considered to be objectionable. This study suggests that there are viable strategies for control of goosegrass in creeping bentgrass putting green turf that include dithiopyr, oxadiazon + bensulide premix combination, applied preemergent and fenoxaprop at 0.04 kg ai/ha at 997 l/ha, or MSMA at 1.12 kg ai/ha with a safener for postemergent control.

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The Use of Herbicides and Growth Regulators in Low Maintenance Turf[1]

K. G. Hoffman and R. D. Ilnicki[2]

ABSTRACT

Several herbicides and plant growth regulators (PGRs) were evaluated alone and in various combinations for use in Kentucky bluegrass (Poa pratensis L. a mixture of 'Glade', 'Columbia' and 'Merit'), tall fescue (Festuca arundinacea Schreb. 'Rebel II'), and perennial ryegrass (Lolium perenne L. 'Palmer'). Treatments were applied on May 12, 1989 at the Adelphia Research Center, Adelphia, NJ. A CO_2- propelled backpack sprayer was used with water as the carrier. The experimental design for each turfgrass species was a randomized complete block with three replications.

Materials included in the study were herbicides: BAS-514, CGA 136872, and triasulfuron; and PGRs: amidochlor, CGA 163935, a combination of imazethapyr & imazapyr (27:1), maleic hydrazide, melfluidide, and paclobutrazol. The herbicides were evaluated for PGR activity as well as for general weed control. Data collected were weekly heights, seedhead counts, weed control ratings, turf grass quality ratings, and clipping weights.

Treatments were applied after complete turfgrass green-up, and no injury to the tall fescue was observed. In the Kentucky bluegrass and perennial ryegrass however, some treatments resulted in slight turf discoloration. This was particularly noticable with imazethapyr & imazapyr at 0.128 kg/ha, and with the combination treatments: triasulfuron + CGA 163935 at 0.045 + 0.78 kg/ha, respectively, and CGA163935 + (imazethapyr & imazapyr) at 0.4 + 0.114 kg/ha, respectively. Suppression of turfgrass heights and seedhead emergence were exceptional for several treatments. Six weeks following treatment, height suppression was still evident by triasulfuron + CGA163935 at 0.045 + 0.78 kg/ha, respectively, and CGA 163935 + (imazethapyr & imazapyr) at 0.4 + 0.114 kg/ha, respectively, by more than 50% in the Kentucky bluegrass and tall fescue, and by more than 60% in the ryegrass.

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[1] New Jersey Agricultural Experiment Station Publication No. J-15173-1-89

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SAFETY AND OVERSEEDING EFFECTS OF CHLORSULFURON IN TURFGRASSES

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ABSTRACT

These field studies were conducted to assess the influence of chlorsulfuron on the following parameters: (1) germination and establishment of overseeded tall fescue (Festuca arundinacea Schreb., TF), perennial ryegrass (Lolium perenne L., PRG) and Kentucky bluegrass (Poa pratensis L., KBG); (2) spring green-up of 'Meyer' zoysiagrass (Zoysia japonica Steud.) and 'Midiron' bermudagrass (Cynodon dactylon L.); and (3) tolerance of fall, 1988 seeded Kentucky bluegrass treated in spring, 1989. In all studies, plots were 5.0 by 5.0 ft in size, and arranged in a randomized complete block with four replications. Data were subjected to analysis of variance and significantly different means were separated using the Bayes LSD at P = 0.05. Herbicides were applied in 50 gpa at 38 psi.

Overseeding Study Chlorsulfuron was applied at 0.14 lb/A on 9 Aug 1988, and three turf species were disked seeded at conventional rates in separate plots 30 days (8 Sept) and 60 days (3 Oct) after treatment (DAT). Prior to disk seeding, the chlorsulfuron-treated KBG site was sprayed with glyphosate to kill the 7 year stand. The site was fertilized with 1.5 lb N/1000 ft^2 from urea on 27 Oct 1988 and the area was kept moist throughout the germination period.

Cover data for all three species disk seeded 30 DAT showed that chlorsulfuron, in general, had reduced establishment rate from 4 Oct to 15 Nov (Table 1). No statistical differences were observed in turf cover for chlorsulfuron and untreated plots among all species on 3 Dec, but cover ratings were lower where the herbicide was applied. Between 4 Oct and 3 Dec, plants of all three species disk seeded into chlorsulfuron-treated plots exhibited suppressed growth. It appeared that reduced cover was related more to foliar growth suppression than reduced seed germination. Chlorsulfuron, however, provided preemergence control of winter annuals. By May 1989, there were no differences in cover between chlorsulfuron and untreated plots. Similar results occurred 60 DAT. There was a trend for reduced TF cover; however, PRG cover was reduced significantly between 4 Nov and 22 Dec in chlorsulfuron-treated plots. Germination of KBG was slower than TF and PRG, and turfgrass cover was restricted more by low temperatures of late autumn than the herbicide. On 3 May 1989, cover data revealed that chlorsulfuron had no long-term effects on establishment as there were no differences in cover between herbicide-treated and untreated plots.

Zoysiagrass and Bermudagrass Chlorsulfuron was applied 26 Apr 1989 to Meyer at 15% green-up and Midiron at 5% green-up. Both chlorsulfuron rates initially reduced spring green-up of Meyer (Table 2), but not Midiron (data not shown). By 25 May, all Meyer plots were at 98% green-up, but a severe chlorosis had developed in chlorsulfuron treated plots. Chlorosis, and therefore significantly reduced color ratings, persisted from 25 May to 20 June; by 6 July the chlorosis had dissipated. Chlorsulfuron, at the rates tested, caused no apparent injury to Midiron.

Fall Seeded KBG Chlorsulfuron (0.09 and 0.19 lb/A), MON 15104 (0.25, 0.33, and 0.50 lb/A) and fenoxaprop (0.09, 0.18 and 0.25 lb/A) were applied 18 May 1989 to a KBG blend (Gnome + Merit + Columbia) seeded 9 Sept 1988. Bluegrass plants were in the 3 to 4 tiller stage on 18 May 1989. All rates of chlorsulfuron and MON 15104 were safe, causing no visual injury to the KBG. Fenoxaprop (0.09 lb/A) slightly reduced cover, but significantly reduced quality from 31 May to 5 July. Higher fenoxaprop rates, however, significantly reduced cover and overall quality throughout the data collection period, which was concluded 5 July 1989.

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Table 1. Influence of chlorsulfuron on germination of three turfgrass species disk seeded 30 or 60 days after herbicide application.

Treatment[a]	Cover Winter annuals	Area Turfgrass Cover[e]										
		Seeded 30 days after treatment						Seeded 60 days after treatment				
		1988					1989	1988				1989
	4 Oct	4 Oct	19 Oct	4 Nov	15 Nov	3 Dec	3 May	4 Nov	15 Nov	3 Dec	22 Dec	3 May
	(%)											
Tall Fescue[b]												
Untreated	21a[+]	46a	65a	90a	96a	94a	89a	49a	60a	80a	87a	81a
Chlorsulfuron	5b	36a	50b	73b	82b	84a	90a	41a	46a	65b	78a	78a
Perennial Ryegrass[c]												
Untreated	23a[+]	58a	86a	97a	99a	99a	95a	20a	36a	45a	70a	96a
Chlorsulfuron	<1b	38b	59b	75b	83b	89a	95a	13b	26b	32b	54b	95a
Kentucky Bluegrass[d]												
Untreated	26a[+]	38a	62a	86a	94a	97a	95a	*	*	14a	19a	48a
Chlorsulfuron	<1b	29a	51a	70b	78b	86a	95a	*	*	11a	17a	48a

[a]/Chlorsulfuron was applied 9 August 1989 to mature Kentucky bluegrass at 0.14 lb ai/A. On 1 August the entire area was treated with glyphosate and the three species were disk seeded into separate plots 30 days (8 Sept) and 60 days (3 Oct) after herbicide treatment.
[b]/Tall fescue was an equal blend of Cimmeron + Bonanza + Apache.
[c]/Perennial ryegrass was an equal blend of Citation II + Birdie II + Omega II.
[d]/Kentucky bluegrass was 50% Julia + 25% Classic + 25% Glade.
[e]/Turfgrass cover and weed cover (henbit + chickweed) were visually assessed on a 0 to 100% scale.
[+]/Means between treatments within a species were separated at P = 0.05 using the t-distribution curve.
[*]/Cover data were not obtained due to delayed germination of the Kentucky bluegrass.

Table 2. Influence of chlorsulfuron on spring green-up and foliar color of Meyer zoysiagrass.

Chlorsulfuron rate[a]	Cover[b]				Chlorosis[c]	Turf color[d]		
	15 May	25 May	5 June	6 July	25 May	5 June	20 June	6 July
(lb ai/A)	(%)				(0-5)	(0-10)		
0.09	65b[+]	98a	98a	99a	2.8a	4.0b	7.2b	7.6a
0.19	62b	98a	98a	100a	2.5a	3.5b	6.4c	7.7a
Untreated	84a	98a	99a	100a	0.5b	8.1a	8.2a	7.7a

[a]/Chlorsulfuron was applied 20 April 1989 when Meyer was at 15% green-up.
[b]/Cover was visually assessed on a 0 to 100% scale where 0 = entire plot area brown and 100 = entire plot area green.
[c]/Chlorosis was visually assessed on a 0 to 5 scale where 0 = entire plot area green and 5 = entire plot area yellow.
[d]/Color was visually assessed on a 0 to 10 scale where 0 = entire plot area brown; 7.5 = lowest acceptable color; 10 = optimum greenness.
[+]/Means in a column followed by the same letter are not significantly different at P = 0.05 according to the Bayes LSD.

CGA-163935 - A NEW PLANT GROWTH REGULATOR FOR USE IN NORTHERN TURF

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ABSTRACT

CGA-163935 is a new plant growth regulator being evaluated for use in northern turfgrasses. Field trials throughout the United States in 1987, 1988, and 1989 showed CGA-163935 has excellent activity and safety on tall fescue (Festuca arundinacea Schreb.), Kentucky bluegrass (Poa pratensis L.), perennial ryegrass (Lolium perenne L.), and creeping bentgrass (Agrostis palustris Huds.).

CGA-163935 inhibits internode elongation. Uptake is primarily foliar with little or no soil activity. The addition of various surfactants to the spray solution or carrier volumes ranging from 200 to 1,600 L ha^{-1} has not influenced activity. CGA-163935 inhibited foliar growth when applied within four days before or after mowing. CGA-163935 does not eliminate seedhead production in cool season turf species.

Effective use rates of CGA-163935 vary with turf species, ranging from 200 to 800 g ai ha^{-1}. Up to 4,000 g ai ha^{-1} per year have been tolerated by several turf species without adverse effects. Environmental conditions influence the duration of activity of CGA-163935, with the duration of inhibition ranging from two to eight weeks. Multiple applications of the optimum rate at two to four week intervals enhanced the degree and duration of activity.

Cool season turf injury due to vehicular traffic was not influenced by CGA-163935. Turf discoloration was more common when the turf was growing under stress, including low fertility or moisture, and temperature extremes. Tank-mixing with certain nitrogen- or iron-containing products reduced or eliminated discoloration occurring under stress.

In addition to northern turf species, CGA-163935 has reduced foliar growth of several warm season turf species, including St. Augustinegrass (Stenotaphrum secundatum [Walt.] Kuntz), bahiagrass (Papsalum notatum Fluegge), and bermudagrass (Cynodon dactylon [L.] Pers.). CGA-163935 is also being investigated for lodging prevention in small grains and rape.

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RESPONSE OF 'KENTUCKY 31' AND TURF-TYPE TALL FESCUE TO PLANT GROWTH REGULATOR TREATMENTS

Arthur E. Gover, Thomas L. Watschke, Gregory T. Lyman[1/]

ABSTRACT

As part of a cooperative project with the Pennsylvania Department of Transportation (PennDOT), a field study was initiated to determine whether there was a differential response to plant growth regulators (PGR) between 'Kentucky 31' and turf-type tall fescues (Festuca arundinacea Schreb.). PennDOT currently specifies 'Kentucky 31' for its primary seeding mixture, but other species and turf-type tall fescue are being evaluated as possible alternatives. Knowledge of different responses would be essential to determining the proper PGR treatment for roadside areas.

The study was initiated May 9, 1989, but due to rainfall immediately after application, the treatments were reapplied to a new site on May 18, 1989. This second site had been mowed twice prior to application at a height of eight cm. The treatments applied were mefluide at either 210 or 315 g ai/ha plus 560 g ai/ha dicamba, mefluidide plus metsulfuron methyl at 140 plus 5.2 g ai/ha, mefluidide plus chlorsulfuron at 140 plus 13.1 g ai/ha, mefluidide at either 70 or 140 g ai/ha plus a premix of imazethapyr and imazapyr at 49.2 and 1.9 g ai/ha, and an untreated check. These treatments were applied to a two year old stand of 'Kentucky 31' and a two year old stand of 'Transition Blend'[2/] turf-type tall fescue using a CO_2 powered backpack sprayer delivering 309 l/ha at 207 kpa with Spraying Systems 6504 flat fan nozzles. Plots were 0.9 by 4.6 m and arranged in a randomized complete block with three replications. Visual ratings for percent seedhead suppression were taken on June 1 and July 3, two and five weeks after treatment (WAT) respectively. These ratings were taken by replication, relative to the untreated check. Turf color and quality ratings and a clippings harvest were also taken 5 WAT.

Mefluidide at either 210 or 315 g ai/ha plus dicamba were the least effective treatments for both varieties. Seedhead suppression with both treatments was significantly greater than the check in 'Kentucky 31', while only the 315 g/ha rate was significantly different than the check in 'Transition Blend'. The 'Kentucky 31' untreated check was rated better for turf color than the mefluidide plus dicamba treatments, but was rated significantly lower in turf quality due to more seedheads. Both mefluidide plus dicamba treatments had signifcantly better color and quality than the untreated check in the 'Transition Blend' plots. Dry matter production per plot was not significantly different between rates or from the untreated check for either tall fescue stand.

Mefluidide plus metsulfuron methyl provided excellent seedhead suppression on both tall fescue stands at both 2 and 5 WAT. Turf color was rated lower than the untreated check, but not significantly, in 'Kentucky 31' plots, while turf quality was significantly better due to effective seedhead suppression. In the 'Transition Blend' plots, turf color and quality were significantly better than the untreated check. The plots treated with mefluidide plus metsulfuron methyl produced the least amount of dry matter for both stands.

The combinations of mefluidide plus chlorsulfuron, and mefluidide at 70 or 140 g ai/ha, plus the pre-mix of imazethapyr plus imazapyr provided excellent seedhead suppression, the highest ratings for turf color and quality, and significantly less dry matter than the untreated check for both tall fescue stands.

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2/ A blend of 'Cimarron', 'Bonanza', and 'Olympic' turf-type tall fescues.

Table 1: Percent seedhead suppression, turf color and quality ratings, and plot dry weights for 'Kentucky 31' and 'Transition Blend' tall fescue stands treated May 18, 1989.

Treatment	Application Rate	Seedhead Suppression 2 WAT	Seedhead Suppression 5 WAT	Turf[1/] Color 5 WAT	Turf[1/] Quality 5 WAT	Dry Weight 5 WAT
	(g ai/ha)	(%)	(%)	(0-9)	(0-9)	(kg/2.3 m^2)
'KENTUCKY 31' TALL FESCUE						
1. mefluidide	210	33	60	6.3	4.0	0.434
dicamba	560					
surfactant	0.25% (v/v)					
2. mefluidide	315	38	67	5.3	4.3	0.445
dicamba	560					
surfactant	0.25% (v/v)					
3. mefluidide	140	90	100	6.3	7.0	0.195
metsulfuron methyl	5.2					
4. mefluidide	140	90	100	7.7	7.7	0.268
chlorsulfuron	13.1					
5. mefluidide	70	88	100	8.0	8.0	0.316
imazethapyr[2/]	49.2					
imazapyr	1.9					
6. mefluidide	140	88	100	8.0	8.0	0.305
imazethapyr	49.2					
imazapyr	1.9					
7. untreated check	- - -	0	0	7.0	3.0	0.554
Significance Level (P)		0.0001	0.0001	0.0068	0.0001	0.0037
Coefficient of Variation (%)		21	7	11	5	24
LSD (P=0.05)		23	9	1.3	0.5	0.152
'TRANSITION BLEND' TALL FESCUE						
1. mefluidide	210	10	17	7.0	6.0	0.317
dicamba	560					
surfactant	0.25% (v/v)					
2. mefluidide	315	22	37	6.7	6.0	0.340
dicamba	560					
surfactant	0.25% (v/v)					
3. mefluidide	140	95	100	6.3	6.7	0.114
metsulfuron methyl	5.25					
4. mefluidide	140	92	100	7.0	7.0	0.134
chlorsulfuron	13.1					
5. mefluidide	70	92	100	7.3	7.7	0.187
imazethapyr	49.2					
imazapyr	1.9					
6. mefluidide	140	93	100	6.7	7.3	0.181
imazethapyr	49.2					
imazapyr	1.9					
7. untreated check	- - -	0	0	5.3	5.0	0.324
Significance Level (P)		0.0001	0.0001	0.0314	0.0003	0.0004
Coefficient of Variation (%)		11	24	9	7	23
LSD (P=0.05)		11	27	1.1	0.9	0.092

1/ Rated on 0 to 9 scale, with 0 = dead turf, 9 = superior turf, and 6 considered the minimum for acceptability.
2/ Imazethpyr and imazapyr are a premix, Event, American Cyanamid Company, Wayne, NJ.

DISSIPATION RATE OF FOLIAR DISLODGEABLE RESIDUES OF PESTICIDES APPLIED TO LAWN TURFS

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ABSTRACT

Public concern over exposure to pesticides following commercial lawncare applications to residential lawn turfs prompted this study to assess levels of pesticides dislodged from treated lawn areas. In this study commercial formulations of two herbicides and three insecticides used in lawncare were applied using equipment and procedures employed in the industry by commercial lawncare operators.

Field research studies were conducted to determine the influence of posttreatment irrigation (0 vs 7 DAT) on dislodgeable residues of DCPA 75W, pendimethalin 60DG, chlorpyrifos 4EC, diazinon 4EC, and isophenfos 2F following applications at labeled use rates to a Kentucky bluegrass turf maintained at 7.6 cm, irrigated, and fertilized to supply 195 kg N ha^{-1} annually. Pesticides were applied individually as a tank mixture with fertilizers (22 g N kg^{-1}) at 1627 L ha^{-1} spray volume using a ChemLawn® 4GPM spray gun calibrated at 63 ml s^{-1} flow rate. Turfgrass clippings were harvested 0, 1, 2, 3, 7, and 14 DAT using a rotary mower set at 5 cm. Clippings were analyzed for detergent-stripped (dislodgeable) pesticide residue. Total residue concentration was also determined 1 HAT. Irrigation (1.3 cm) was applied to two of four replicated pesticide plots 2 HAT, afterwhich water was withheld from all plots until after the 7 DAT harvest. All plots were then mowed and irrigated.

Total pesticide residue retained on clippings harvested 1 HAT averaged 21.3 $\pm$ 8.3% of the applied rate. Irrigation 2 HAT reduced concentrations of F-, DG-, and WP-formulated pesticides 45%, but had no significant affect on reducing concentration of EC-formulated insecticide residues retained on foliage. Dislodgeable residues as measured by detergent stripping foliage, averaged 5.6% of the applied rate 0 DAT, and dissipated exponentially over time to 3.3% 1DAT, 2.7% 2 DAT, 1.9% 3 DAT, 1% 7DAT, and to 0.3% by 14 DAT. Dissipation rates varied among pesticide treatments but not between irrigation treatments.

Mean dislodgeable foliar residues of pesticides retained on foliage 3 DAT for irrigated versus non-irrigated were: for pendimethalin at 2.2 kg ha^{-1} levels were 0.04 vs 0.12 $\mu g\ cm^{-2}$ ($p = .02$); for DCPA at 11.2 kg ha^{-1} levels were 0.80 vs 2.02 $\mu g\ cm^{-2}$ ($p = .06$); for chlorpyrifos at 1.1 kg ha^{-1} levels were 0.02 vs 0.01 $\mu g\ cm^{-2}$ ($p = .13$); for diazinon at 6.2 kg ha^{-1} levels were 0.52 vs 0.50 $\mu g\ cm^{-2}$ (ns); and for isophenfos applied at 2.2 kg ha^{-1}, dislodgeable residue levels were 0.19 vs 0.29 $\mu g\ cm^{-2}$ ($p = 0.03$) leaf tissue.

These results suggest that a very low percentage of lawn-applied pesticides are dislodgeable, and that these levels decrease rapidly with time. Secondly, irrigation can further reduce levels depending upon formulation of pesticide applied.

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EPIDEMIOLOGY, TOXICOLOGY AND 2.4-D

Wendell R. Mullison[1] and Gregory G. Bond[2]

ABSTRACT

Although 2,4-D has been in extensive usage world wide for over 40 years and documented published medical records of 2,4-D causing ill health in humans are few, questions still continue to be raised about its safety. Some of the most recent queries have been raised in connection with the interpretation and meaning of epidemiological data. To better interpret this information, the strengths and weaknesses of different types of epidemiological research studies are discussed and illustrated with 2,4-D.

Epidemiology is an observational science that studies the distribution of a disease and its determinants in human populations. This is done by obtaining environmental and human data thought to be pertinent to the study. Thus epidemiology is a way to get human data without actual experimentation since most of the time it is considered unethical to directly experiment on humans.

As is well known, very extensive animal toxicological studies are conducted to determine whether a compound is suitable to be used as a pesticide. Some people often complain about the problem of how to interpret animal toxicological test data and apply it to humans. Epidemiological studies are one way to get information about humans that can be used to supplement these animal toxicological studies,although they are difficult and time consuming to carry out.

The strength of epidemiology is its relevance to humans and to real-life exposures. Its weakness arises from the fact that it is not an experimental but a descriptive science and much data is obtained from indirect observational approaches. Therefore before an association found by epidemiology can be considered to be a valid cause and effect, the association must be found repeatedly in a variety of studies of different designs, preferably by different investigators as well as being in accord with biological knowledge. Thus it is usually not possible to accept the conclusion of any one study as being valid until these conditions are met.This is even more true if there are several well designed and conducted epidemiological studies that do not agree with each other. If the conclusions of the majority are in agreement they are probably correct.

Ten epidemiological studies in six different countries have not found an association between the use of 2,4-D and non-Hodgkin's lymphoma. Two studies in two different countries disagree with each other on two important points but agree on associating 2.4-D with non- Hodgkin's lymphoma. Non-Hodgkin's lymphoma is one kind of a relatively rare type of cancer and it is not diagnosed per se in chronic animal toxicological studies. However, animal toxicological studies do test for lymphomas and none of these chronic toxicological studies with 2,4-D show that it causes a lymphoma type of cancer.

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THE IDENTIFICATION AND CONTROL OF PERENNIAL Veronica SPECIES IN TURF

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ABSTRACT

The genus Veronica, Scrophulariaceae, includes many species which are troublesome weeds in turf. Twelve species inhabit NY state, the most familiar being slender speedwell, (Veronica filiformis Sm., VERFI). The recommended control of VERFI, DCPA at 13.5 kg/ha, does not provide adequate control. Little research has been conducted on control of the other weedy members of this genus. The focus of this paper is two-fold: 1) to distinguish among four weedy, stoloniferous perennials of Veronica, common speedwell (V. officinalis L., VEROF), germander speedwell (V.chamaedrys L., VERCH), thymeleaf speedwell (V. serpyllifolia L., VERSE), and VERFI and 2) to develop control recommendations for each species.

Characteristics such as leaf shape, degree of leaf blade serration, leaf pubescence, presence/absence of flowers and fruit, bloom time and flower morphology have been used to develop a key to this genus.

A greenhouse screening of control of VEROF, VERFI, VERSE, and VERCH was conducted in winter 1989. The treatments included quinclorac at 0.11, 0.34, and 0.56 kg/ha, 2,4-D amine at 0.22, 0.68, and 1.1 kg/ha, triclopyr amine at 0.11, 0.34, and 0.56 kg/ha, 2,4-D amine plus quinclorac at (1.1 plus 0.56 kg/ha, respectively), and triclopyr amine plus 2,4-D amine at (0.45 plus 1.0 kg/ha, respectively).

At 6 weeks after treatment, 2,4-D (1.1 kg/ha) provided good control of VEROF and VERSE, but poor control of VERFI and VERCH. Quinclorac at 0.56 kg/ha provided >90% control of VERFI, VEROF, and VERSE and in combination with 2,4-D offered greater then 95% control of all species. Ninety percent control of VEROF, VERSE, and VERCH was obtained with triclopyr at 0.56 kg/ha, while the combination of triclopyr and 2,4-D provided excellent control of VERSE and VEROF, 84% control of VERCH, and poor control of VERFI.

A field study was conducted at The LI Hort. Res. Lab, Riverhead, NY in June 1989 with herbicide treatments similar to the greenhouse study. Herbicide efficacy was lower in the field study than in the greenhouse. At 68 days after treatment (68 DAT), quinclorac at 0.43 kg/ha provided >90% control of VERFI and VERSE, 75% VEROF, 58% VERCH. Ninety-eight DAT, control was maintained at 80, 100, 55, and 26, respectively. 2,4-D provided 85% control of VEROF 68 DAT, but <50% control of the other spp. Quinclorac efficacy was not increased significantly by tank mixing with 2,4-D. Triclopyr did not control of any of the species; however, when combined with 2,4-D, VEROF was controlled 73% 68 DAT and 55% 98 DAT. In addition, this combination provided better control of VERSE than did either product applied alone.

Overall, the Veronica spp. differed in susceptibility to the labeled herbicides. Control recommendations must be tailored to the species, making correct identification essential to successful control. The labeled herbicides provided inadequate control of all 4 spp. However, quinclorac controlled VEROF, VERFI, and VERSE in the greenhouse and field. No treatment provided better than 58% control of VERCH in the field study.

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BASAL BRUSH CONTROL WITH HERBICIDE MIXTURES IN MINERAL OIL

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ABSTRACT

Basal bark herbicide applications provide economical brush control with greater application flexibility than aerial or dilute spray applications. Basal application also reduces the potential for off-target pesticide movement and environmental exposure. Use of petroleum distillate mixtures as herbicide carrier/penetrants for basal applications can result in objectionable odor, skin irritation, and sprayer gasket failure. Refined mineral oil is being evaluated as an alternative to currently used carrier\penetrants. It is not volatile, is low odor, and does not attack gaskets.

Several field experiments were established in 1989 to evaluate herbicide and mineral oil combinations for basal bark brush control applications. All combinations contained a ratio of 20% herbicide (v/v) and 80% mineral oil (v/v). Herbicide treatments consisted of Access^R (1 lb ai/gallon picloram ester + 2 lbs ai/gallon triclopyr ester) used alone or in combination with WEEDONE^R 170 (1.85 lbs ai/gallon 2,4-D ester + 1.85 lbs ai/gallon 2,4-DP ester). Brush species evaluated were pin cherry (Prunus pensylvanica L.), locust (Robinia pseudoacacia L.), sassafras (Sassafras albidum Nutt.), white oak (Quercus alba L.), red maple (Acer rubrum L.), white pine (Pinus strobus L.), staghorn sumac (Rhus typhina L.), and ailanthus (Ailanthus altissima Mill.).

Applications of 80% mineral oil in combination with 20% Access^R, 7% Access^R + 13% WEEDONE^R 170, or 5% Access^R + 15% WEEDONE^R 170 provided excellent control of all evaluated brush species. A combination of 3% Access^R + 17% WEEDONE^R 170 did not provide acceptable control of pin cherry, white pine, and red maple but did control all other species in the trials. These results show that mineral oil is an effective carrier for basal applications and that combinations of WEEDONE^R 170 + Access^R are effective, economical alternatives to Access^R applied by itself.

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THISTLE CONTROL IN A CROWNVETCH ROADSIDE GROUND COVER

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ABSTRACT

Crownvetch that had been overrun with Canada and plumeless thistles on a roadside in State College, PA was treated with hexazinone, atrazine + bentazon, and bentazon alone in both September, 1988 and the following June, 1989. Crownvetch showed some temporary yellowing and leaf burn from all treatments for a month to six weeks. After this crownvetch appeared to be totally recovered.

Only hexazinone applied in September appeared to provide some Canada thistle control into the following summer. September applied atrazine + bentazon, or bentazon alone didn't show any evidence of C. thistle control the following summer. All June applied treatments gave initial C. thistle top growth control but only hexazinone maintained 98% control to August 26.

Data for plumeless thistle control was not analyzed but the unanalyzed data would indicate that all treatments, whether applied in September or June gave 94 to 100% control of the second year flower stalks when rated in July or August of 1989. Only hexazinone applied in June appeared to have enough soil residue to control the establishment of new rosettes in 1989.

INTRODUCTION

Crownvetch (Coronilla varia L. 'Penngift') has been widely used as a ground cover along roadsides in Pennsylvania over the past thirty years. Although established crownvetch is an excellent competitor with herbaceous weeds and brush, there are certain weeds that will invade crownvetch in due time. A couple of such weeds are Canada thistle (Cirsium arvense (L.) Scop.) and plumeless thistle (Carduus acanthoides L.). Canada thistle is a perennial weed that once established, gets off to a faster start in the spring and due to its erect growth habit stays above crownvetch all season. Canada thistle patches tend to increase in size and gradually crowd out the crownvetch. This weed is on the noxious weed list in Pennsylvania and many other states. Plumeless thistle is a biennial that has only recently become a major problem in non-cropland areas as well as permanent pastures and roadsides. The first years growth is a rosette that can be up to 1 m in diameter, commonly found interspersed among the second year flower stalks. Due to competition from both the flower stalks that can be up to 2 m in height and the first year rosettes, crownvetch is slowly crowded out. The purpose of this research was to find a way to control the thistle without hurting the crownvetch too much so the crownvetch could retake the areas from which it had been crowded out by the thistle.

MATERIALS AND METHODS

This trial was conducted in 1988-'89 on a west facing embankment of the "Mt. Nittany Expressway" that bypasses State College, PA on the east. The crownvetch was hydroseeded about ten years ago and probably had some thistle in the area from the very beginning. In recent years the thistle had become so dense in some areas that the crownvetch was totally smothered out.

Three herbicide treatments found to provide good to excellent thistle control in previous studies (1,2,3) and also reasonably safe on established crownvetch were used in this study. Hexazinone [3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione], atrazine [6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine] + bentazon [3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide] premix and split applications of bentazon were all applied on September 7, 1988 when crownvetch and some interspersed hard fescue were nice and green after late summer rains. Canada thistle flower stalks were dead but there was about 15 to 20 cm of new growth from the root stocks. The second year flower stalks of Plumeless thistle were also dead but new rosettes were 15 to 30 cm in diameter.

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The same treatments were applied to different plots on June 6, 1989 when crownvetch was 45 to 60 cm and both Canada and plumeless thistle flower stalks were 60 to 100 cm in height. Bentazon treatments were split between fall and spring or three weeks apart on June 6 and 28, 1989. The June 28 treatment of bentazon was applied to crownvetch that had been burned back to 15 to 50 cm by the June 6 treatment and both Canada and plumeless thistles were now 60 to 120 cm. All atrazine and bentazon treatments were applied with 2.34 l/ha of crop oil concentrate.

All treatments were applied with a tractor mounted small plot sprayer with 80015 extended range flat fan nozzles at 187 kPa and 187 l/ha of water. This is 1/2 to 1/5 the carrier volume commonly used for roadside spraying.

Visual crownvetch, grass, and thistle percent injury ratings were made on July 3 and August 26, 1989. August ratings included an estimate of control of both the second year flower stalks and new rosettes of plumeless thistle. An ANOV was run on all ratings except those for plumeless thistle with the SAS statistical package as a randomized complete plot design with 2 replications.

RESULTS AND DISCUSSION

Crownvetch showed no injury from September applied hexazinone, atrazine + bentazon or bentazon alone when rated the following July (Table 1). These herbicides commonly cause some temporary yellowing and leaf burn but crownvetch usually recovers within a month to six weeks. There was still evidence of injury from these same treatments when applied on June 6, four weeks before the rating. The split bentazon treatment showed the most injury since the second part of the treatment had been applied only five days earlier. By August 26, there was no longer any evidence of crownvetch injury from any of the treatments.

The top growth of Canada thistle is usually killed by any of these treatments as has been shown by Gover, Olsen and Vollmer (1,2,3). When these treatments were applied on September 7, the top growth of Canada thistle was already dead but there was some regrowth from the root stocks. Due to extreme variation and the use of only two replications, the LSD (5% level) for percent control ratings on July 3 was 59% and August 26, 87%. So any treatments that gave less than 59 or 87% control were not significantly better than no control. Consequently, September applied hexazinone or atrazine + bentazon did not provide a significant amount of Canada thistle control when rated on July 3 of the following year. If the split bentazon treatment had been rated before the second part was applied on June 6, there would have been no evidence of control either. All treatments applied on June 6 did give significant C. thistle control of 69 to 98% but only hexazinone maintained a significant control rating of 98% to August 26. Bentazon split between September and June as well as atrazine + bentazon applied at either time did not show any evidence of Canada thistle control by the following August 26. September applied hexazinone and bentazon split between June 6 and 28, 1989 still showed 45 and 49% control respectively on August 26 but this was not significantly better than no control.

Plumeless thistle was not present in several plots so a statistical analysis could not be done. From the unanalyzed data, it would appear that all treatments, whether applied in September or June gave excellent (94 to 100%) flower stalk control when rated the following July or August. The September treatments would have controlled the rosettes and the June 6 treatments the young flower stalks. None of the treatments except hexazinone applied on June 6 apparently had enough soil residue to prevent the establishment of new rosettes from seed. As a result, except for this one treatment, plumeless thistle will have reinvaded the same areas where the rosettes or flower stalks had been so effectively controlled the year before.

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Table 1. Percent injury or control of crownvetch, Canada thistle, or plumeless thistle following three different herbicide treatments applied in September or June.

Treatment			Rate	Crownvetch		C. thistle		P. thistle		(Rosette)
No.	Herbicide	Timing	lb ai/A	7/3	8/26	7/3	8/26	7/3	8/26	8/26
				<----------% Control---------->						
1.	hexazinone	9/7/88	1.0	0.0 d[2]	0.0	50.0 ab	45.0 ab	98	98	0
2.	hexazinone	6/6/89	1.0	20.0 bc	0.0	98.0 a	98.0 a	98	99	98
3.	atrazine + bentazon (Laddock)[1]	9/7/88	1.0 + 1.0	0.0 d	0.0	0.0 b	0.0 b	95	100	0
4.	atrazine + bentazon (Laddock)[1]	6/6/89	1.0 + 1.0	25.0 ab	0.0	69.0 a	0.0 b	94	98	0
5.	bentazon[1] Split	9/7/88-6/6/89	0.75 + 0.75	5.0 cd	0.0	65.0 a	0.0 b	95	95	0
6.	bentazon[1] Split	6/6/89-6/28/89	0.75 + 0.75	40.0 a	0.0	95.0 a	49.0 ab	97	99	0
Significance level (P)				0.0129	ns	0.0542	0.1485			
LSD (P = 0.05)				19	ns	59	87			

[1] Included crop oil conc.(COC) @ 1 qt/A

[2] Column means followed by the same letter are not significantly different at the 5% level (P=0.05) according to Fisher's Protected LSD Test.

FALL BRUSH TREATMENTS FOR ROADSIDES

Gregory T. Lyman, Larry J. Kuhns, and Arthur E. Gover [1/]

ABSTRACT

Fosamine ammonium was applied alone and in combination with imazapyr, metsulfuron methyl, triclopyr, and glyphosate to a mixed stand of roadside brush on September 2, 1988. The application was performed with a Cibolo[2/] Model A spray rig using a swinglok spray head. The area calculations were based on a 5.5 m (18') vertical swath width. The herbicides were injected into the delivery system and applied in the equivalent of 515 liters of water per hectare (55 gpa). The treatments are listed in Table 1. The brush growing in the treatment area included sassafras (Sassafras albidum, Nutt.), hackberry (Celtis occidentalis L.), black walnut (Juglans nigra L.), oak (Quercus spp.), red maple (Acer rubrum L.), black cherry (Prunus serotina, Ehrh.), blackhaw viburnum (Viburnum prunifolium L.), American elm (Ulmus americana L.) and flowering dogwood (Cornus florida L). All species treated within each plot area were rated for control using a 1-7 scale on September 15, 1989. All species were not present in every plot area.

Fosamine ammonium (FA) at 6.7 kg ai/ha had no effect on sassafras and only slightly injured hackberry. Most of the contacted area of walnut was controlled, but some minor resprouting occured. All of the contacted area of elm was controlled. Control of viburnum ranged from complete control of contacted stems to control beyond the contacted area. Oak was controlled beyond the contacted area.

All treatments which contained FA plus imazapyr provided equal or better control than FA applied alone. Control of sassafras with all imazapyr treatments ranged from activity well beyond contacted stems to complete control of the plant. Several stems in these treatments were over six meters (20') tall. Hackberry treated with FA (3.3 kg ai/ha) plus imazapyr (.07 kg ai/ha) displayed some minor resprouting in the contacted area When FA was increased to 5.0 kg ai/a, control of hackberry ranged from minor resprouting in the contacted area to control beyond the contacted area. Walnut was controlled within the contacted area by FA (5.0 kg ai/ha) plus imazapyr (.04 kg ai/ha). When the rate of imazapyr was increased to .07 kg ai/ha, the entire stem was killed. Oak was controlled beyond the contacted area with FA (5.0 kg ai/ha) plus imazapyr (.04 kg ai/ha). When imazapyr was increased to .07 kg ai/ha, oak control ranged from injury beyond the contacted area to complete kill of the plant. Maple was controlled beyond the contacted area with FA (3.3 kg ai/ha) plus imazapyr (.07 kg ai/ha.). When FA was increased to 5.0 kg ai/ha, control increased and some maple stems were completely controlled. FA (5.0 kg ai/ha) plus imazapyr (.07 kg ai/ha) provided complete kill of all maple stems. Walnut was controlled within the contacted area with FA (5.0 kg ai/ha) plus imazapyr (.04 kg ai/ha), and when imazapyr was increased to .07 kg ai/ha, complete control of the stem was achieved. FA (3.3 kg ai/ha) plus imazapyr (.07 kg ai/ha) provided total control within the contacted area of elm and caused injury beyond the contacted area of viburnum.

FA (3.3 kg ai/ha) plus metsulfuron methyl (MSM) (.042 kg ai/ha) provided complete control contacted stems of walnut and cherry. Treated stems of hackberry and viburnum were severely injured, while sassafras was totally killed. Injury to maple varied from slight to severe. When FA was increased from 3.3 to 5.0 lb. kg ai/ha in combination with MSM, the degree of control increased for maple, cherry, viburnum, and walnut, decreased for sassafras, and was unchanged for hackberry.

FA plus triclopyr ester provided control of all stems within the contacted area of sassafras, cherry, and viburnum, and provided control past the contacted area of walnut and elm.

FA plus glyphosate provided control of the contacted area of walnut and oak. Control past the contacted area was achieved on sassafras, hackberry, and dogwood, and complete control was achieved on elm. Control of maple ranged from control within the contacted area to beyond the treated area.

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2/ Cibolo Mfg. Inc., Jourdanton, Texas

Table 1: Control ratings of brush treatments applied September 2, 1988 with a Cibolo Model A spray rig with a swing lock head using a 5.5 m (18') vertical swath width for the area calculation. The total spray volume was approximately 515 l/ha (55 GPA). Treatments were rated on August 15, 1989.

Treatment	Rate Kg Ai/Ha	Rate Lb - Oz Ai/A	CONTROL 1/ Sass-afrass	Hack-berry	Walnut	Oak	Maple	Cherry	Vib-rnum	Elm	Dog wood
Fosamine ammonium	6.7	6.0 lb	1	1-2 2/	4	6	X 3/	X	5-6	5	X
Fosamine ammonium Imazapyr	3.3 0.07	3.0 lb 1.0 oz	6-7	4	7	7	6	6	5	5	6
Fosamine ammonium Imazapyr	5.0 0.04	4.5 lb 0.5 oz	6-7	4-6	5	6	6-7	7	X	X	6
Fosamine ammonium Imazapyr	5.0 0.07	4.5 lb 1.0 oz	6-7	4-6	7	6-7	7	X	X	X	X
Fosamine ammonium Metsulfuron methyl	3.3 0.042	3.0 lb 0.6 oz	7	4	5	X	2-6	5	4	X	X
Fosamine ammonium Metsulfuron methyl	5.0 0.042	4.5 lb 0.6 oz	4-6	4	6	5	5-6	6-7	6	X	X
Fosamine ammonium Triclopyr ester	5.0 1.7	4.5 lb 1.5 lb	5	X	6	X	X	5	5	6	X
Fosamine ammonium Glyphosate	5.0 1.7	4.5 lb 1.5 lb	6	6	5	5	5-6	X	X	7	6

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 of contacted branches are dead
6 - Some branches not contacted by the treatment are injured or dead
7 - Entire plant is dead

2/ - A hyphenated rating describes the range of treatment activity on multiple plants within a plot area.

3/ - Species not present in plot area.

CONTROLLING BRUSH WITH BROADCAST DORMANT STEM TREATMENTS

Gregory T. Lyman, Larry J. Kuhns, and Arthur E. Gover [1/]

ABSTRACT

Five treatments combining triclopyr ester with emulsifiable crop oil (ECO)[2/] were applied to a mixed stand of roadside brush on April 6, 1989 (Table 1). Application was performed with a Cibolo Jr. spray rig equipped with a Swinglock nozzle. The treatments were injected into the spray stream and area calculations were based on a 3.6 m (12') vertical swath width. The total solution applied was approximately equivalent to 700 l /ha (75 gpa). Plots were 61 meters (200') long and brush present within the treatment area included oak (Quercus spp.), sassafras (Sassafras albidum, Nutt.), red maple (Acer rubrum L.), striped maple (Acer pensylvanicum L.), common witchhazel (Hamamalis virginiana Ehrh.), black cherry (Prunus serotina, Ehrh.), honeysuckle (Lonicera spp.), American beech (Fagus grandifolia Ehrh.), and flowering dogwood (Cornus florida L.). Not all brush species were present within each plot area. The understory was a mixed stand of herbaceous broadleaves, grasses and ferns. All brush was dormant at the time of application and temperatures of the air, soil surface, and soil at 15 cm were 5°, 4°, and 2° C, respectively. All species within each plot area were rated for control on a 1-7 scale on October 3, 1989. A "1" indicates no treatment effect and a "5" indicates complete control of all branches contacted by the treatment. A "6" indicates injury in portions of the plant that were not contacted by the treatment and a "7" indicates control of the whole plant.

Triclopyr at 4.5 kg ai/a plus ECO at 18.7 l/ha provided control of all contacted branches on oak. Stems within the contacted area of red maple, striped maple, and sassafras were severely injured, but not totally controlled. Control of witchhazel ranged from severe injury to total control of contacted stems. Control of dogwood ranged from severe injury to control past the contacted area. Control of beech ranged from moderate to severe injury within the contacted area. Honeysuckle was the least affected by this treatment and control ranged from no effect to moderated injury within the contacted area.

Triclopyr at 4.5 kg ai/ha plus 37.4 l/ha ECO provided control similar to triclopyr at 4.5 kg ai/ha plus 18.1 l/ha ECO on oak, witchhazel, honeysuckle, and dogwood. Control of red and striped maple increased to complete control of all contacted branches. Control of beech also increased to range from severe injury within the contacted area to control beyond the contacted area.

Triclopyr at 9.0 kg ai/a plus 18.7 l/ha ECO controlled all contacted portions of oak, red maple, and witchhazel. Honeysuckle was severely injured, but not all contacted stems were completely controlled. Control of beech ranged from severe injury of contacted stems to injury beyond the contacted area. Dogwood control ranged from complete control within the contacted area to injury beyond the contacted area.

Triclopyr at 9.0 kg ai/ha plus 37.4 l/ha ECO controlled all contacted stems of oak and witchhazel. A range from complete control of contacted area to control beyond the contacted area was displayed on red maple, beech, and dogwood.

ECO at 37.4 l/ha applied alone had no effect on oak, red maple, sassafras, witchhazel, honeysuckle, beech, or dogwood. Severe understory damage was noted on all treatments containing triclopyr.

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2/ Emulsifiable crop oil utilized was Clean Cut Plus Pine, Arborchem Products Co., Fort Washington, PA

Table 1: Control ratings of brush treatments applied April 6, 1989 with a Cibolo JR. spray rig and a swing lock nozzle using a 3.6 m (12') vertical swath width as the area calculation. The total spray volume was approximately 700 l/ha (70 GPA). Treatments were rated on October 3, 1989.

Treatment	Rate Kg AI / hA	CONTROL 1/ Oak	Red Maple	Striped Maple	Sass-afrass	Witch-hazel	Honey-suckle	Beech	Dog wood
Triclopyr ester ECO 2/	4.5 18.7 l /ha 3/	5	4	4	4	4-5 4/	1-3	3-4	4-6
Triclopyr ester ECO	4.5 37.4 l /ha	5	5	5	X 5/	4-5	1-3	4-6	4-6
Triclopyr ester ECO	9.0 18.7 l /ha	5	5	X	X	5	4	4-6	5-6
Triclopyr ester ECO	9.0 37.4 l /ha	5	5-6	X	X	5	X	5-6	5-6
Triclopyr ester ECO	0.0 37.4 l /ha	1	1	X	1	1	1	1	1

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 of contacted branches are dead
6 - Some branches not contacted by the treatment are injured or dead
7 - Entire plant is dead

2/ - ECO - Emulsifiable Crop Oil utilized was Clean Cut Plus Pine, Arborchem Products Co., Fort Washington, PA

3/ - ECO rates are referred to in units of product per acre.

4/ - A hyphenated rating describes the range of treatment activity on multiple plants within the plot area.

5/ - X = Species not present in plot area.

PRE-EMERGENCE TOTAL VEGETATION CONTROL UNDER GUIDERAILS

Larry J. Kuhns, Arthur E. Gover, Gregory T. Lyman

ABSTRACT

Thirteen total vegetation control treatments were applied April 18, 1989, to a roadside guiderail on U.S. Route 220, near Unionville, PA, as part of a cooperative project with the Pennsylvania Department of Transportation. The treatments were applied with a CO_2 pressurized sprayer delivering the equivalent of 252 l/ha at 172 kpa with two Spraying Systems OC-04 nozzles spraying the same swath. One nozzle was angled forward, the other back, to provide complete coverage around the guiderail posts. Plots were 0.9 by 7.6 m, and arranged in a randomized complete block design with four replications. Visual ratings for percent cover were taken August 15 and October 30, 17 and 28 weeks after treatment (WAT). Predominant species found in the plots 17 WAT included goldenrod (Solidago spp.), common ragweed (Ambrosia artemisiifolia L.), giant foxtail (Setaria faberi Herrm.), and yellow toadflax (Linaria vulgaris Hill.). A flush of wild garlic (Allium vineale L.) was observed in many plots 28 WAT. Treatments and results are listed in Table 1.

All treatments were significantly better than the untreated check, which was rated at 90 and 91 percent cover at 17 and 28 WAT respectively. Imazapyr plus a premix of pendimethalin and atrazine was rated among the best treatments at both dates. It provided significantly better weed control than imazapyr alone or in combination with either oryzalin or pendimethalin at 17 WAT. At 28 WAT, imazapyr plus pendimethalin and atrazine provided significantly better control than imazapyr alone or in combination with pendimethalin, while imazapyr plus oryzalin was not significantly different from any of the other three imazapyr combinations.

Sulfometuron methyl plus the premix of pendimethalin and atrazine provided control similar to imazapyr plus the pendimethalin and atrazine combination. It was rated better than sulfometuron methyl alone or in combination with oryzalin or pendimethalin at both dates, but the difference was not significant.

Diuron at 14.3 kg ai/ha, bromacil at 4.5 kg ai/ha, a premix of bromacil plus diuron at 4.5 kg ai/ha each, and tebuthiuron at 3.6 kg ai/ha were rated between 9 and 13 percent cover 17 WAT, and 10 and 20 percent cover 28 WAT. These four treatments, along with either imazapyr or sulfometuron methyl with the premix of pendimethalin and atrazine, were the most effective treatments under the conditions of this study.

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Table 1: Percent weed cover present in treatments applied April 18, 1989, and rated August 15 and October 30, 17 and 28 weeks after treatment. Each value is the mean of four replications.

Treatment	Application Rate (kg ai/ha)	Weed Cover 17 WAT (%)	Weed Cover 28 WAT (%)
1. imazapyr	0.84	46	46
2. imazapyr + pendimethalin + atrazine[2/]	0.84 + 4.5 + 4.5	11	18
3. imazapyr + oryzalin	0.84 + 3.4	37	28
4. imazapyr + pendimethalin	0.84 + 4.5	39	46
5. sulfometuron methyl	0.21	28	28
6. sulfometuron + pendimethalin + atrazine[2/]	0.21 + 4.5 + 4.5	13	19
7. sulfometuron + oryzalin	0.21 + 3.4	38	38
8. sulfometuron + pendimethalin	0.21 + 4.5	30	30
9. diuron	14.3	11	20
10. bromacil	4.5	11	10
11. bromacil + diuron[1/]	4.5 + 4.5	13	19
12. tebuthiuron	3.6	9	20
13. untreated check	- - -	90	91
Significance Level (P)		0.0001	0.0001
Coefficient of Variation (%)		48	48
LSD (P=0.05)		20	22

1/ Bromacil plus diuron is a premix, Krovar I, E.I. DuPont, Wilmington, DE.
2/ Pendimethalin plus atrazine is a premix, Prozine, American Cyanamid, Wayne, NJ.

POSTEMERGENCE TOTAL VEGETATION CONTROL UNDER GUIDERAILS

Arthur E. Gover, Larry J. Kuhns, Gregory T. Lyman[1/]

ABSTRACT

As part of a cooperative project with the Pennsylvania Department of Transportation, a field study was initiated to compare 11 postemergence treatments for total vegetation control under highway guiderails. The treatments were applied May 22, 1989, along U.S. Route 220, near Unionville, PA. The site featured coarse textured soils, with a gravelly surface due to accumulation of anti-skid material. This site experiences significant surface flow due to runoff from the adjacent highway. Plots were 0.9 by 7.6 m, arranged in a randomized complete block design with four replications. The treatments were applied with a CO_2 pressurized backpack sprayer delivering the equivalent of 252 l/ha at 172 kpa, using two Spraying Systems OC-04 nozzles spraying the same swath. One nozzle was angled forward, the other back, to provide uniform coverage around the guiderail posts. Visual ratings of percent ground cover were taken August 15, and October 30, 12 and 23 weeks after treatment (WAT). The most common species present 12 WAT included goldenrod (Solidago spp), common evening primrose (Oenothera biennis L.), common burdock (Arctium minus (Hill) Bernh.), common ragweed (Ambrosia artimisiifolia L.), and buckhorn plantain (Plantago lanceolata L.). A significant flush of wild garlic (Allium vineale L.) was present in many plots 23 WAT.

All treatments were significantly different from the untreated check (Table 1), which was rated at 81 and 84 percent cover at 12 and 23 WAT. There were no significant differences between imazapyr applied alone or in combination with diquat or glyphosate at either rating period. The ratings ranged from 22 to 29 percent cover at 12 WAT, and 30 to 41 percent cover at 23 WAT.

Ratings for sulfometuron methyl applied alone, or in combination with diquat or glyphosate were 28, 8, and 13 percent cover, respectively, at 12 WAT, but were not significantly different. At 23 WAT, sulfometuron methyl plus diquat was rated significantly better than sulfometuron methyl alone, at 15 versus 41 percent cover, while sulfometuron methyl plus glyphosate was not significantly different from either at 29 percent cover.

Diuron alone at 14.3 kg ai/ha, or a premix of bromacil plus diuron at 4.5 kg ai/ha each, rated at 7 and 14 percent cover, respectively, provided significantly better weed control than bromacil alone at 4.5 kg ai/ha, rated at 44 percent cover, 12 WAT. At 23 WAT, bromacil plus diuron was again significantly better than bromacil alone, 10 versus 35 percent cover, while diuron alone was not significantly different than either at 16 percent. Tebuthiuron at 3.6 kg ai/ha provided 31 and 39 percent cover at 12 and 23 WAT.

Bromacil plus diuron, diuron alone, and sulfometuron methyl with diquat or glyphosate provided adequate control of the emerged weeds at this treatment site, based on the 12 WAT rating. Imazapyr, bromacil, and tebuthiuron apparently needed to be combined with higher rates of the postemergence herbicides to get better initial control of the tough perennial weeds on the site.

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Table 1: Weed cover present in treatments applied May 22, 1989 and rated August 15 and October 30, 12 and 23 weeks after treatment (WAT). Each value is the mean of four replications.

Treatment[1/]	Application Rate (kg ai/ha)	Weed Cover 12 WAT (%)	Weed Cover 23 WAT (%)
1. imazapyr	0.84	27	41
2. imazapyr + glyphosate	0.84 + 1.1	22	30
3. imazapyr + diquat	0.84 + 0.56	29	36
4. sulfometuron methyl	0.21	28	41
5. sulfometuron + glyphosate	0.21 + 1.1	13	29
6. sulfometuron + diquat	0.21 + 0.56	8	15
7. diuron	14.3	7	16
8. bromacil	4.5	44	35
9. bromacil + diuron[2/]	4.5 + 4.5	14	10
10. tebuthiuron	3.6	31	39
11. untreated check	- - -	81	84
Significance Level (P)		0.0001	0.0001
Coefficient of Variation (%)		55	48
LSD (P=0.05)		22	24

1/ All treatments included surfactant at 0.25% (v/v).
2/ Commercial premix, Krovar I, E.I. DuPont, Wilmington, DE

FENOXAPROP AND BENTAZON TANK MIXES FOR POSTEMERGENCE WEED CONTROL IN COOL SEASON TURF[1]

A. J. Enache, R. D. Ilnicki, J. Grande and K. G. Hoffman[2]

ABSTRACT

Phytotoxicity of fenoxaprop to spring-seeded cool season turf grasses is well established. Alleviation of injury with tank mixes with herbicides may be a viable option. An experiment was conducted in 1989 to determine the effect of fenoxaprop and bentazon tank mixes on 1) alleviating the turf injury, and 2) postemergence weed control.

The experiment was a randomized block design with three replications. Three perennial grasses, Kentucky bluegrass (Poa pratensis L.), tall fescue (Festuca arundinacea Schreb.) and ryegrass (Lolium perene L.) were planted on May 4, 1989. Treatments were applied on June 20 (PO1) and August 3 (PO2) using a CO_2-propelled backpack sprayer. The soil was silt-loam with pH 6.0 and OM 2.1%. Fenoxaprop was applied either alone (0.07, 0.1, 0.13, 0.2 kg ai/ha), or with surfactant at 0.25% (0.13 kg ai/ha), and in combination with bentazon (0.13 + 0.84 kg ai/ha). Two weeks after each application stand, vigor, and color of turf grasses as well as control of the weeds present, fall panicum (Panicum dichotomiflorum Michx.) and yellow nutsedge (Cyperus esculentus L.) were rated.

Results indicated that fenoxaprop alone applied early injured Kentucky bluegrass, severity increasing with rate. The later application resulted in less injury. Slight injury was observed in tall fescue and ryegrass with either application. Addition of surfactant to fenoxaprop decreased the phytotoxic effect on Kentucky bluegrass but not on tall fescue and ryegrass. Tank mixes of fenoxaprop with bentazon reduced significantly the toxicity on Kentucky bluegrass, the later application resulting in less injury than the early one. No injury was observed in tall fescue and ryegrass with either application of fenoxaprop + bentazon.

Fall panicum was better controlled with the late application of fenoxaprop + bentazon in all three grasses. Overall, fall panicum control was greatly improved by the addition of bentazon to fenoxaprop compared to the control by fenoxaprop alone or with surfactant. Nutsedge was better controlled with the tank mix of fenoxaprop + bentazon than bentazon alone.

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[1] New Jersey Agric. Exp. Stn. Publication No. J-289-15173-2-89.

2 Graduate Student, Res. Prof. of Weed Sci., Res. Farm Superv., and Graduate Student respectively, Crop Science Dept., Cook College - Rutgers Univ., New Brunswick, NJ 08903.

CRABGRASS CONTROL AND BENTGRASS TOLERANCE WITH MULTIPLE LOW-RATE APPLICATIONS OF FENOXAPROP

M. J. Mahoney and P. H. Dernoeden[1/]

ABSTRACT

Multiple fenoxaprop treatments were applied to creeping bentgrass (Agrostis palustris Huds. 'Penncross') mowed at putting green height at Easton, MD and at Silver Spring, MD beginning on April 26 and May 8, 1989, respectively. Concurrent fenoxaprop applications were made to perennial ryegrass (Lolium perenne L.) infested with smooth crabgrass (Digitaria ischaemum (Schreb) Muhl.) at both sites. Crabgrass was in the 1-2 leaf stage during the initial applications. All experiments were arranged in a randomized complete block with 4 replications per treatment. Treatments were applied with 8003 nozzles in 40 gallons/acre at Easton, and with 8004 nozzles in 50 gallons/acre at Silver Spring. Visual quality bentgrass data were collected weekly during the studies and crabgrass control data expressed as percent cover compared with untreated plots were collected 2 weeks and 1 week following the last fenoxaprop application at Easton and Silver Spring, respectively.

Efficacy data indicates that fenoxaprop rates of 0.032 and 0.04 lb/A applied at 2 or 3 week intervals provided excellent season-long cragbrass control, as presented in Table 1. Fenoxaprop applied at 0.024 lb/A on 2 and 3 week intervals provided fair-good crabgrass control. Four week application intervals however, provided crabgrass control that was generally inferior to the 2 or 3 week interval at all rates.

Table 2 shows bentgrass quality data from selected dates. Bentgrass quality varied throughout the study period and between study locations. Fenoxaprop applied at 0.024 lb/A resulted in acceptable quality at all intervals. Fenoxaprop applications at 0.032 lb/A applied at 2 or 3 week intervals resulted in bentgrass quality that varied from acceptable to unacceptable throughout the course of the studies. With a 4 week interval, 0.032 lb/A fenoxaprop reduced quality, but the level of injury would be considered marginally acceptable for putting greens. The 0.04 lb/A fenoxaprop treatments generally reduced quality to unacceptable levels at all intervals at both locations. At Easton, however, bentgrass treated on a 4 week interval had recovered to an acceptable level by 10 WAT.

Further research is necessary to define bentgrass variety tolerance, how bentgrass cutting height affects tolerance, and if tank mixing other pesticides with fenoxaprop alters bentgrass tolerance.

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Table 1 - Crabgrass control with multiple low-rate fenoxaprop applications.[1/]

Fenoxaprop Rate lb/A	Spray Interval[5/]	Crabgrass Control Silver Spring, MD 16WAT[6/]	Crabgrass Control Easton, MD 11WAT
		(%)	
.024	2 wk[2/]	72	85
.024	3 wk[3/]	86	80
.024	4 wk[4/]	50	77
.032	2 wk	93	95
.032	3 wk	92	92
.032	4 wk	55	90
.040	2 wk	96	95
.040	3 wk	97	89
.040	4 wk	74	87
	LSD (0.05)	19.1	14.3

1/ - Crabgrass was in 1-2 leaf stage at first application.
2/ - Four applications in Easton and five in Silver Spring.
3/ - Three applications in Easton and four in Silver Spring.
4/ - Two applications in Easton and three in Silver Spring.
5/ - Due to continued crabgrass germination, all treatments received an additional application on July 24, 1989 at Silver Spring.
6/ - WAT = Weeks After Initial Treatment

Table 2 - Quality of penncross creeping bentgrass treated with multiple fenoxaprop applications

Fenoxaprop Rate lb/A	Spray Interval	Quality[1/] Silver Spring 4WAT[5/]	Silver Spring 7WAT	Silver Spring 10WAT	Easton 4WAT	Easton 7WAT	Easton 10WAT
.024	2 wk[2/]	8.7	7.0	7.5	7.8	6.9	8.5
.024	3 wk[3/]	7.7	7.8	7.4	7.3	7.9	8.5
.024	4 wk[4/]	9.0	7.8	8.5	8.0	8.0	9.0
.032	2 wk	8.1	6.6	7.7	7.0	6.9	7.8
.032	3 wk	7.3	6.8	6.8	6.9	6.8	8.6
.032	4 wk	8.4	8.0	8.0	7.1	7.0	7.4
.040	2 wk	7.2	5.1	5.3	6.8	5.5	6.3
.040	3 wk	5.1	5.3	4.6	6.3	6.1	7.4
.040	4 wk	8.2	7.2	6.5	6.6	7.8	8.4
Untreated	----	8.8	8.8	8.5	8.4	8.4	9.0
	LSD(0.05)	0.7	0.66	0.61	0.9	0.82	1.33

1/ - Overall quality was visually assessed on a 0 to 10 scale where 0 = brown or dead turf, and 10 = optimum color and density.
2/ - Four applications in Easton and five in Silver Spring
3/ - Three applications in Easton and four in Silver Spring
4/ - Two applications in Easton and four in Silver Spring
5/ - WAT = Weeks After Initial Treatment

PRE-EMERGENCE CONTROL OF SMOOTH CRABGRASS WITH FALL APPLICATIONS OF OXADIAZON

T.E. Vrabel[1], W.F. Evans[2] and J.E. Merrick[3]

ABSTRACT

Field studies were conducted in New Jersey, Pennsylvania, and Ohio to evaluate the efficacy of fall applications of granular and wettable powder oxadiazon formulations for smooth crabgrass (Digitaria ischaemum Schreb.) control the following spring. Turfgrass species in the trials included tall fescue (Festuca arundinacea Schreb.), red fescue (Festuca rubra L.), Kentucky bluegrass (Poa pratensis L.), and creeping bentgrass (Agrostis palustris Huds.).

Fall applications of granular oxadiazon at 3.36 and 4.48 kg ai/ha provided excellent control of smooth crabgrass at 10 months post-treatment that was comparable to spring applications of 3.36 kg ai/ha of oxadiazon granular or pendimethalin. Fall application of oxadiazon granular at 2.24 kg ai/ha or oxadiazon wettable powder at 2.24 - 4.48 kg ai/ha failed to provide acceptable (80% or better) smooth crabgrass control at 10 months after treatment. Split applications of granular or wettable powder oxadiazon formulations consisting of 2.24 kg ai/ha in the fall followed by 1.12 kg ai/ha in the spring prior to crabgrass germination also provided excellent control. Lower rates were erratic in performance.

No phytotoxicity was observed from oxadiazon granular applications to tall fescue, red fescue, or Kentucky bluegrass. Fall application of oxadiazon granular to creeping bentgrass caused objectionable discoloration that was temporary and was not evident at spring greenup. Fall applications of greater than 1.68 kg ai/ha of oxadiazon wettable powder resulted in unacceptable injury to red fescue and creeping bentgrass that was still evident the following spring. No objectionable phytotoxicity was observed on tall fescue or Kentucky bluegrass.

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PRE-POST COMBINATIONS FOR WEED CONTROL IN TURF

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

ABSTRACT

A study was conducted on a mixed cool season turf practice area at the Pennsylvania State University "Blue" golf course to evaluate various single and combination herbicides for the control of smooth crabgrass (Digitaria ischaemum (Schreb.) Muhl. when applications were made after germination had occurred (June 23, 1989). Commercial and experimental materials were included in the study as well as sequential treatments for selected treatments. The treatments in the study and the control ratings are provided in Table 1. Treatments that provided 85% control or better were considered to have commercial acceptance.

When fenoxaprop-ethyl was applied alone, the lowest rate (0.12 lbs. ai/A) did not provide acceptable control, but the two higher rates did. When pendimethalin was applied alone, very poor control resulted at both rates, however, when tank mixed with fenoxaprop-ethyl, control became acceptable. All combinations and timings of DCPA and MSMA produced acceptable control. However, treatments including MSMA caused a noticeable, but temporary discoloration to the fine fescue (Festuca rubra L.) in the mixed cool season grass stand. MSMA applied at the label rate, at a two week interval provided excellent control (97%), but injury to fine fescue was noted. The combination of oxadiazon and fenoxaprop-ethyl did not provide acceptable control. At the time of rating, the crabgrass in plots treated with this combination was immature which indicated that germination probably occurred following treatment (the rates of wettable oxadiazon were kept low to reduce the potential for injury). The MON 15151 provided acceptable control even at 0.38 lbs. ai/A. The 15104 formulation did not provide satisfactory control at 0.38 lbs. ai/A, but did at all other rates. When used in combination with either MSMA or fenoxaprop-ethyl (even at the lowest rate, 0.38 lbs. ai/A) the control provided was excellent. Granular formulations provided excellent control even at the lowest rate (slightly better when formulated on fertilizer). An experimental formulation of fenoxaprop-ethyl (HOE-360) did not provide acceptable control at any rate applied. Combination of prodiamine and fenoxaprop-ethyl provided acceptable control at all rates.

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Table 1. Pre-, pre- + post, and postemergence crabgrass control rates on August 18, 1989.

Treatment	Formulation	Rate	Control (%)
Fenoxaprop-ethyl	1 ec	0.12 lbs ai/A	74
Fenoxaprop-ethyl	1 ec	0.15 lbs ai/A	85
Fenoxaprop-ethyl	1 ec	0.18 lbs ai/A	85
Pendimethalin	60 wdg	1.50 lbs ai/A	30
Pendimethalin	60 wdg	1.80 lbs ai/A	57
Fenoxaprop-ethyl +	1 ec	0.12 lbs ai/A	94
Pendimethalin	60 wdg	1.00 lbs ai/A	
Fenoxaprop-ethyl +	1 ec	0.12 lbs ai/A	97
Pendimethalin	60 wdg	1.56 lbs ai/A	
Fenoxaprop-ethyl +	1 ec	0.15 lbs ai/A	91
Pendimethalin	60 wdg	1.00 lbs ai/A	
Fenoxaprop-ethyl +	1 ec	0.15 lbs ai/A	73
Pendimethalin	60 wdg	1.50 lbs ai/A	
DCPA + MSMA	6 f + 6 s	7.50 + 2.00 lbs ai/A	90
DCPA + MSMA	6 f + 6 s	7.50 + 2.00 lbs ai/A	85
DCPA + MSMA +	6 f + 6 s	7.50 + 2.00 lbs ai/A	98
MSMA +	6 s	2.00 lbs ai/A	
2plus2		2.50 pts/a	
DCPA + MSMA	75 wp + 6 s	7.50 + 2.00 lbs ai/A	87
DCPA + MSMA +	75 wp + 6 s	7.50 + 2.00 lbs ai/A	98
MSMA	6 s	2.00 lbs ai/A	
MON 15151	1 ec	0.38 lbs ai/A	88
MON 15151	1 ec	0.50 lbs ai/A	96
MON 15104	1 ec	0.38 lbs ai/A	79
MON 15104	1 ec	0.50 lbs ai/A	93
MON 15104	1 ec	0.75 lbs ai/A	88
MON 15175	0.25 g	0.38 lbs ai/A	93
MON 15175	0.25 g	0.50 lbs ai/A	97
MON 15189 (F)	0.22 g	0.38 lbs ai/A	96
MON 15190 (F)	0.3 g	0.50 lbs ai/A	96
MON 15190 (F)	0.3 g	0.75 lbs ai/A	97
MON 15104 +	1 ec	0.25 lbs ai/A	98
Fenoxaprop-ethyl	1 ec	0.12 lbs ai/A	
MON 15104 +	1 ec	0.38 lbs ai/A	93
Fenoxaprop-ethyl	1 ec	0.12 lbs ai/A	
MON 15104 +	1 ec	0.38 lbs ai/A	96
Fenoxaprop-ethyl	1 ec	0.18 lbs ai/A	
MON 15104 + MSMA	1 ec + 6 s	0.38 + 2.00 lbs ai/A	98
MON 15104 + MSMA	1 ec + 6 s	0.38 + 2.00 lbs ai/A	98
HOE-360	0.46 ec	0.06 lbs ai/A	42
HOE-360	0.46 ec	0.09 lbs ai/A	50
HOE-360	0.46 ec	0.13 lbs ai/A	67
HOE-360	0.46 ec	0.18 lbs ai/A	68
Prodiamine +	65 wdg	0.50 lbs ai/A	89
Fenoxaprop-ethyl	1 ec	0.09 lbs ai/A	
Prodiamine +	65 wdg	0.50 lbs ai/A	94
Fenoxaprop-ethyl	1 ec	0.12 lbs ai/A	
Prodiamine +	65 wdg	0.50 lbs ai/A	95
Fenoxaprop-ethyl	1 ec	0.18 lbs ai/A	
MSMA + MSMA	6 s + 6 s	2.00 + 2.00 lbs ai/A	97
Oxadiazon +	50 wp	0.38 lbs ai/A	52
Fenoxaprop-ethyl	1 ec	0.13 lbs ai/A	
Oxadiazon +	50 wp	0.50 lbs ai/A	77
Fenoxaprop-ethyl	1 ec	0.18 lbs ai/A	

CRABGRASS CONTROL WITH MON-15151 IN COOL-SEASON TURFGRASS

P. C. Bhowmik, K. M. Urban, and B. M. Bahnson[1]

ABSTRACT

Two field experiments were conducted at the University of Massachusetts Turfgrass Research Center, South Deerfield. The objective of the experiments was to compare the pre- and early postemergence activity of five formulations of Mon-15151 (Monsanto) for the control of smooth crabgrass [*Digitaria ischaemum* (Schreb. ex. Schweig.)Schreb. ex Muhl.] in perennial ryegrass (*Lolium perenne* L.).

Both experiments were conducted on established perennial ryegrass turf maintained at a height of 5 cm under low fertility. Mon-15151 EC and Mon-15104 EC each at 0.43 to 0.84 kg ai/ha and Mon-15175 G, Mon-15189 SCU, and Mon-15190 SCU each at 0.28 to 0.84 kg/ha were applied to 1 by 3 m plots. Each treatment was replicated three times in a randomized complete block design. Sprayable treatments were applied with a CO_2-backpack sprayer at a pressure of 152 kPa with a 11004 flat fan nozzle, giving 470 L/ha. Granules were applied by hand with a shaker bottle. Preemergence treatments were applied on April 28, 1989. Early postemergence treatments were applied on June 12, 1989, when the crabgrass was at the 3- to 4-leaf stage. Crabgrass control and turf injury were determined on May 22, July 13, and August 14, 1989.

Regardless of the formulation, all treatments applied preemergence (Experiment 1) effectively controlled (95%) crabgrass 11 weeks after application (WAA). All treatments provided season-long (15 WAA) crabgrass control, except Mon-15175 G at 0.28 kg/ha which only gave 60% control. All preemergence treatments were safe to perennial ryegrass except Mon-15104 EC at 0.43 kg/ha which gave slight injury (13%).

All treatments (Experiment 2), applied in early postemergence controlled crabgrass 95% or better 4 WAA. At 8 WAA, crabgrass control was excellent (90% or better) in all treatments except Mon-15189 SCU at 0.43 kg/ha, which provided significantly less control (60% control). At 8 WAA, Mon-15104 EC at 0.84 kg/ha and Mon-15175 G at 0.56 kg/ha, applied at the 3- to 4-leaf stage of crabgrass resulted in slight turf injury (20%) and all other treatments were safe to perennial ryegrass.

Excellent preemergence control of smooth crabgrass was obtained with all formulations and rates except Mon-15175 G at 0.28 kg/ha which resulted in poor residual control. Postemergence control was excellent with all treatments except Mon-15189 SCU at 0.43 kg/ha which had poor residual control. In general, there was no stand thinning of perennial ryegrass due to any treatments.

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MARYLAND SMOOTH CRABGRASS CONTROL

EVALUATIONS FOR 1989

P.H. Dernoeden and J.M. Krouse[1/]

ABSTRACT

Three, spring 1989 and one fall 1988 preemergence, and two 1989 postemergence herbicide evaluations are summarized below. All herbicides were applied in 50 gpa at 30 psi, and test sites treated with preemergence herbicides were irrigated within 24 hrs of application. Plots were 5 by 5 ft in size and were arranged in a randomized complete block with four replications. Percent of plot area covered by smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.] was visually determined in all tests using a 0 to 100% scale on 1 Sept 1989. Excellent crabgrass control was considered to be >90%. Data were subjected to analysis of variance and significantly different means were separated by Bayes LSD at P = 0.05.

Fall 1988 Preemergence herbicides were applied 3 Nov 1988, and sequential treatments were applied 18 Apr 1989. Oxadiazon 2G or 50W applied on 3 Nov at 2.0 or 3.0 lb/A provided 26 to 55% crabgrass control (data not shown). Plots treated with oxadiazon 50W at 2.0 lb/A on 3 Nov and retreated 18 Apr with oxadiazon 2G at 0.5 or 1.0 lb/A exhibited 26 to 40% crabgrass control. Pendimethalin 65DG (3.0 lb/A), prodiamine 60DG (1.0 lb/A), MON 15151 1EC (1.0 lb/A), and MON 15179 0.5G (0.75 lb/A) applied 3 Nov 1988 provided 94 to 99% crabgrass control when plots were rated 1 Sept 1989.

Spring 1989 Preemergence herbicides were applied between 5 and 7 Apr 1989. In Study I, AC2200 (0.08 or 0.16 lb/A) alone or tank mixed with AC1900 (0.08 lb/A); AC183,545 (1.0, 2.0 or 4.0 lb/A); or imazethapyr (0.08 lb/A) did not provide a significant reduction in crabgrass (data not shown). AC183,545 (8.0 lb/A) gave 74% control; whereas, MON 15151 1EC (0.5 lb/A) and pendimethalin 60DG (3.0 lb/A) provided 100 and 97% control, respectively.

In Study II, only MON 15151 1EC (0.38 lb/A) provided less than excellent (83%) crabgrass control. All other dithiopyr formulations (i.e. MON 15151 1EC and MON 15104 1EC at 0.38, 0.50 and 0.75 lb/A; MON 15175 0.25G and MON 15189 0.22G at 0.25, 0.38 and 0.50 lb/A; and MON 15190 0.30G at 0.50 or 0.75 lb/A); prodiamine 65DG (0.65 lb/A); and oxadiazon 50WP (3.0 lb/A) provided >93% crabgrass control. None of the aforementioned treatments significantly reduced prostrate spurge [Euphorbia supina Raf.] populations.

In Study III (Table 1), all treatments except oxadiazon 2G (3.0 or 4.0 lb/A) and LESCO 012510 0.286G provided a satisfactory (>89%) level of crabgrass control. Only pendimethalin (3.0 lb/A) had reduced spurge significantly.

Postemergence In the early postemergence study (Table 2), MON 15104 (0.38 lb/A) and sequential quinclorac (0.75 + 0.75 or 1.0 + 1.0 lb/A) provided >95% season-long crabgrass control. Good, season-long crabgrass control (79 to 85%) was provided by all other treatments, except quinclorac applied at 0.75 lb/A (65% control).

Fenoxaprop 1EC (0.18 lb/A) and HOE 360-14H (0.06, 0.09, 0.125, or 0.18 lb/A), applied 7 July 1989 to 4-leaf to 2-tiller stage smooth crabgrass, provided 90 to 98% control (data not shown). Fenoxaprop 50DG (tank-mixed with 1.0 pt/A of surfactant) provided 84% crabgrass control.

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Table 1. Preemergence control of smooth crabgrass in perennial ryegrass (Lolium perenne L.).

Herbicide*	Rate	Smooth Crabgrass Cover***	Smooth Crabgrass Control	Spurge Plants***
	(lb ai/A)	-------- (%) --------		(no./plot)
Oxadiazon 50W	3.00	4d+	95	8bc
Oxadiazon 2G	3.00	22b	70	8bc
Oxadiazon 2G	4.00	16bc	78	7bc
Prodiamine 65DG	0.50	8cd	89	16ab
Prodiamine 65DG	0.65	3d	94	12abc
Pendimethalin 60DG	3.00	1d	99	4c
**LESCO 012510 0.286G	0.50	16bc	78	15ab
**LESCO 012547 0.58G	1.50	8cd	89	12abc
**LESCO 011353 0.14G	0.25	<1d	99	6bc
**LESCO 017110 0.21G	0.375	1d	99	8bc
**LESCO 017133 0.285G	0.50	0d	100	6bc
MON 15151 1EC	0.38	3d	96	13abc
MON 15151 1EC	0.50	3d	96	19a
Untreated	---	74a	--	15ab

*Herbicides were applied 4 April 1989 and 0.67 inches of rain occurred 3 hrs after application.
**Herbicide was formulated with nitrogen fertilizer.
***Crabgrass cover was visually determined on a 0 to 100% scale, and the number of prostrate spurge plants per plots were counted, on 1 September 1989.
+Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

Table 2. Early postemergence and subsequent preemergence control of smooth crabgrass in perennial ryegrass turf.

*Treatments	Rate	Smooth Crabgrass Cover	Smooth Crabgrass Control
	(lb ai/A)	---------- (%) ----------	
**Quinclorac 50W	0.75	29b++	63
**Quinclorac 50W	1.0	12cde	85
**Quinclorac 50W	0.75 + 0.75***	1e	99
**Quinclorac 50W	1.0 + 1.0***	<1e	99
Pendimethalin 60DG + fenoxaprop 1EC	1.5 + 0.12	16cd	80
DCPA 6F + MSMA 6L	8.0 + 2.0	14cd	82
DCPA 6F + MSMA 6L + MSMA 6L	8.0 + 2.0 + 2.0+	17bc	79
MON 15104 1EC	0.38	4de	95
Untreated	---	79a	--

*All treatments were applied 26 May 1989 when crabgrass was in the 1-3 leaf stage, and crabgrass cover was assessed 1 Sept 1989.
**Quinclorac was applied with BAS 090 crop oil concentrate at a rate of 2.0 pts/A.
***Second application was applied 23 June 1989.
+Second application of MSMA alone was applied 10 June 1989.
++Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

Turfgrass Phytotoxicity and Annual Grassy Weed Control[1]

Robert W. Duell and Dirk A. Smith[2]

ABSTRACT

Reports indicate excellent control of warm-season annual grassy weeds following pre and postemergence applications of various formulations of the experimental herbicide Mon 1500 (Proposed name is DITHIOPYR). Phytotoxicity to turfgrass was, however, noticed on some fine fescues during 1988 from both pre and post emergence applications of this herbicide.

Four-year-old mono-stands of nine turfgrasses were sprayed with rates of Mon 15104 which bracketed recommended rates for pre and post emergence control of crabgrass (Digiteria spp.). In addition, at the postemergence application date, three PGRs were applied at their recommended rates, alone, and with 0.5 kg/ha Mon 15104. Treatments were replicated three times in a randomized complete block with plots measuring 1.2 x 6.3m. Sprays were applied at 200 l/ha from a single even-edge nozzle broadcasting 1 m. wide.

Data from four fine fescue species and two turf type tall fescues were subjected to analyses of variance and are presented as histograms representing responses to chemical treatments. Responses are in terms of foliar color at three stages during the growing season, clipping dry weights, and percent weed control in 'Jazz' perennial ryegrass (not considered in other parameters).

In comparison with untreated check plots, only minor deviations in color resulted from rates and timing of mon 15104. The PGR, mefluidide, consistently reduced color quality while amidochlor and fluriprimidol tended to discolor somewhat less than mefluidide at the first rating. At the second color rating, and to a lesser extent at the third color rating, the mefluidide treatments significantly depressed color quality. Fluriprimidol did not enhance turf color.

Dry weights of grasses differed more under five treatments with Mon 15104 than under five treatments with PGRs. 'Reliant' hard fescue and 'Bighorn' sheeps fescue, which generally appear low growing, were particularly dense and high yielding under certain Mon 15104 treatments. No phytotoxicity to the nine cool-season turfgrasses could be detected. Data presented here indicate that under these conditions the fine fescues are no more sensitive to reasonable rates, at appropriate application times, than are turf-type tall fescues.

Control of yellow foxtail (Setaria lutescens) by Mon 15104 was excellent regardless of rate and timing initially, and reflected diminishing control as rate decreased and time of application was delayed, as one would expect at the later rating. Control was as good, however, from fluriprimidol.

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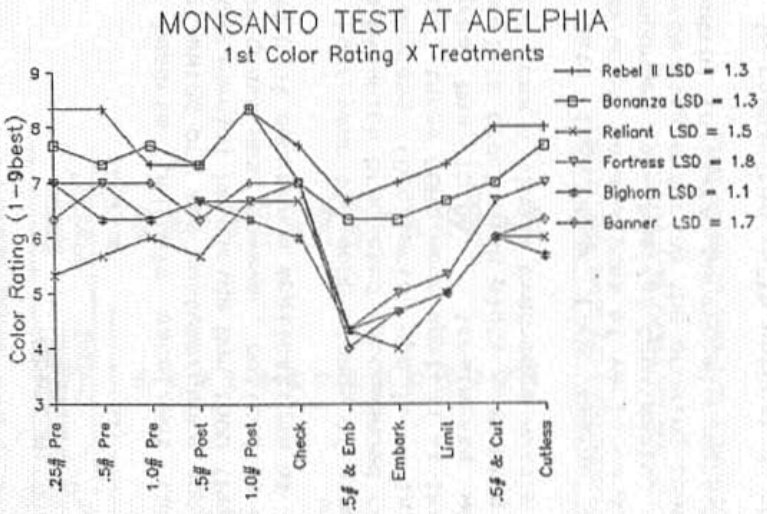
[1] New Jersey Agric. Expt. Sta. Publication No. K-1-15264-1-89

[2] Assoc. Res. Professor & Research Technician, respectively. Crop Sci. Dept., Cook College-Rutgers, The State University of New Jersey, New Brunswick, NJ 08903.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Bonanza LSD = 1.3
Reliant LSD = 1.5
Fortress LSD = 1.8
Bighorn LSD = 1.1
Banner LSD = 1.7
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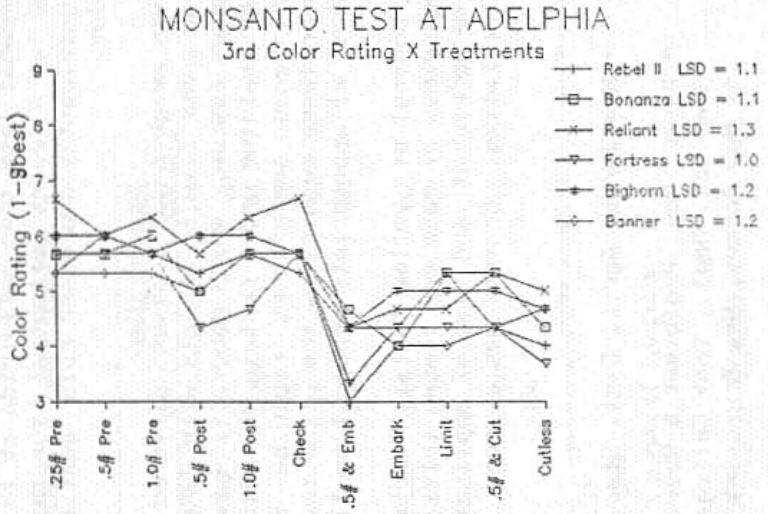
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Fortress LSD = 1.0
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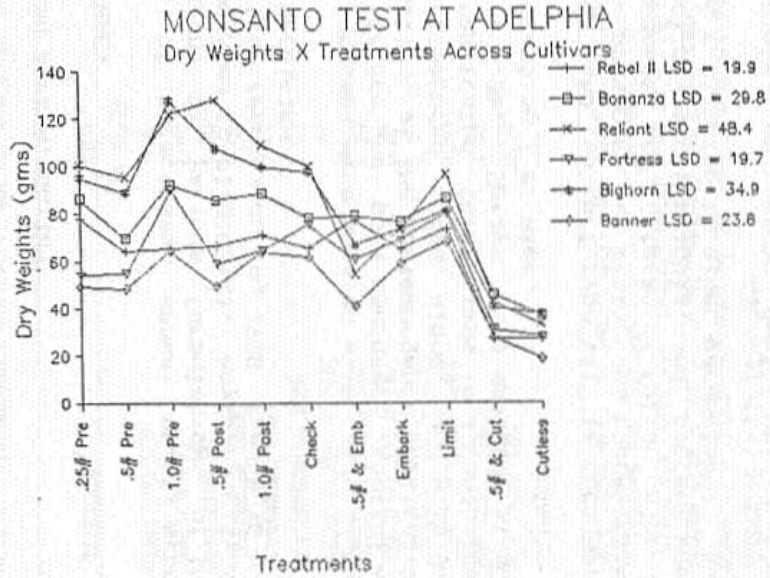
MONSANTO TEST AT ADELPHIA
Dry Weights X Treatments Across Cultivars
Dry Weights (gms)
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Bonanza LSD = 29.8
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Fortress LSD = 19.7
Bighorn LSD = 34.9
Banner LSD = 23.8
.25# Pre
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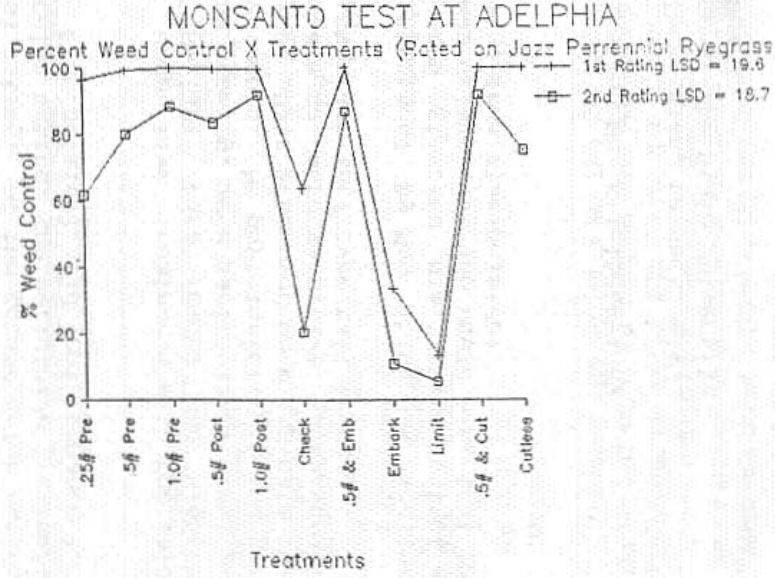
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Percent Weed Control X Treatments (Rated on Jazz Perrennial Ryegrass
% Weed Control
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.5# Pre
1.0# Pre
.5# Post
1.0# Post
Check
.5# & Emb
Embark
Limit
.5# & Cut
Cutless
Treatments

PREEMERGENCE CRABGRASS CONTROL IN 1989

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

ABSTRACT

An experiment was conducted during 1989 to evaluate several preemergence herbicides and combinations for their efficacy on smooth crabgrass (Digitaria ischemum) (Schreb.) Michx. in a stand of perennial ryegrass (Lolium perenne L.). Control ratings of 85% or higher were considered to be commercially acceptable.

For the commercially available materials, the wettable powder, flowable, and granular formulations of DCPA provided acceptable control. Benefin did not control crabgrass at an acceptable level (85%) from any formulation or when combined with EL-107. However, the combination of benefin and trifluralin (TEAM) provided acceptable control from both granular formulations. Both formulations of oxadiazon provided acceptable control as did bensulide applied at 12.5 lbs. ai/A and pendimethalin at 1.5 lbs. ai/A.

For the experimental materials evaluated, those fertilizers (Lebanon, Vigro, and Lesco) formulated with undisclosed amounts of undisclosed experimental compounds provided excellent control (93 to 98 percent). Various formulations of MON experimental (15151, 15104, 15175, 15111(F), 15112(F), and 15177) all provided excellent control at all rates tested. Prodiamine sprayed at 0.5 lbs. ai/A and spread at 0.75 lbs. ai/A provided excellent control, but the granular formulation provided only 80% control when applied at 0.5 lbs. ai/A. The experimental material AC 183545 only provided acceptable control at the highest rate (8.0 lbs. ai/A) applied.

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Table 1. Preemergence control of smooth crabgrass as a result of the application of preemergence herbicides on April 28, 1989). Control was rated on September 20, 1989.

Treatment	Formulation	Rate	Control (%)
DCPA	75 wp	10.500 lbs ai/A	93
DCPA	6 f	10.500 lbs ai/A	88
Bensulide	4 ec	12.500 lbs ai/A	98
Prodiamine	65 wdg	0.500 lbs ai/A	97
Pendimethalin	60 wdg	1.500 lbs ai/A	85
EL-107	60 df	0.600 lbs ai/A	68
Benefin +	60 df	2.400 lbs ai/A	
Benefin	60 df	2.500 lbs ai/A	72
AC 183545	47 wp	1.000 lbs ai/A	33
AC 183545	47 wp	2.000 lbs ai/A	42
AC 183545	47 wp	4.000 lbs ai/A	83
AC 183545	47 wp	8.000 lbs ai/A	88
MON 15151	1 ec	0.380 lbs ai/A	96
MON 15151	1 ec	0.500 lbs ai/A	97
MON 15104	1 ec	0.380 lbs ai/A	97
MON 15104	1 ec	0.500 lbs ai/A	98
DCPA	5 g	10.500 lbs ai/A	88
Benefin	2 g	2.000 lbs ai/A	77
Team (F)	1 g	2.000 lbs ai/A	88
Team	2 g	2.000 lbs ai/A	85
Oxadiazon	2.5 g	2.000 lbs ai/A	98
MON 15175	0.25 g	0.380 lbs ai/A	98
MON 15175	0.25 g	0.500 lbs ai/A	98
MON 15111 (F)	0.27 g	0.500 lbs ai/A	98
MON 15112 (F)	0.35 g	0.500 lbs ai/A	94
Lebanon 89-001		0.380 lbs ai/A	97
Lebanon 89-002		0.500 lbs ai/A	98
Vigro A-1		5.000 lbs/m	96
Vigro A-2		5.000 lbs/m	97
Vigro A-3		5.000 lbs/m	97
Vigro A-4		5.000 lbs/m	97
Vigro A-5		5.000 lbs/m	98
Vigro A-6		5.000 lbs/m	0
Vigro B-1		4.170 lbs/m	98
Vigro B-2		4.170 lbs/m	98
Vigro B-3		4.170 lbs/m	96
Vigro B-4		4.170 lbs/m	98
Vigro B-5		4.170 lbs/m	0
Lesco 012510		0.500 lbs ai/A	93
Lesco 012547		0.500 lbs ai/A	97
Lesco 011353		0.250 lbs ai/A	97
Lesco 017110		0.375 lbs ai/A	98
Lesco 017133		0.500 lbs ai/A	97
Prodiamine	0.5 g	0.500 lbs ai/A	80
Prodiamine	0.5 g	0.750 lbs ai/A	91
MON 15177	0.25 g	0.500 lbs ai/A	97
Oxadiazon	2.5 g	2.000 lbs ai/A	87

PHYTOTOXICITY OF SEVERAL POSTEMERGENCE HERBICIDES TO PEACHES

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ABSTRACT

Peach trees were planted in April of 1986, two years prior to the initiation of the experiment. The trees were pruned in March of 1987 and 1988 following standard techniques to leave three or four scaffold limbs. Herbicides were applied in June, 1988 to one scaffold limb of each tree. The other limbs of the treated trees were shielded from the spray by a plastic sheet. Triclopyr, 2,4-D, clopyralid, or glyphosate were sprayed as a percent solution to the drip point, simulating a spot treatment misapplication. Trees were evaluated for two growing seasons after application, then were harvested in the fall of 1989. Trees with one limb treated with glyphosate died within one to two months of the herbicide application. Injury symptoms were observed on the treated limb within one to two weeks, and on the untreated limbs of treated trees within one month. Scaffold limbs treated with 2,4-D or triclopyr also died within one to two months of treatment, but no affect was observed in the untreated parts of the tree in 1988 or 1989. Clopyralid caused no injury to untreated limbs and only slight temporary injury to the treated limb of trees sprayed. Foliage on the limb sprayed seemed to curve downward along the midrib, causing the leaves to appear to fold slightly, but no chlorosis or defoliation occurred. No effect was observed on the treated limbs or on other parts of the trees sprayed with clopyralid the year after application.

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PREEMERGENCE CONTROL OF LATE GERMINATING ANNUAL WEEDS IN VINEYARDS

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ABSTRACT

Long term reliance on diuron and simazine in some New York vineyards has led to increasing amounts of weeds germinating late in the season. Giant foxtail (*Setaria faberi* Herrm.) and velvetleaf (*Abutilon theophrasti* L.) are common escape weeds which often germinate beyond the window of opportunity for applications of postemergence herbicides. Norflurazon, oryzalin, and prodiamine are preemergence herbicides with long residual activity that provided season-long control of giant foxtail. Velvetleaf did not germinate after early August, and was controlled with norflurazon, oryzalin, diuron, simazine, and oxyfluorfen.

JUSTIFICATION/RATIONALE

Diuron and simazine have been used extensively for preemergence weed control in New York vineyards for the past 30 years. Weeds not controlled by these herbicides are usually controlled with postemergence herbicides. In recent years, late germinating weeds have become more of a problem. Applications of postemergence herbicides late in the season to control these weeds are often not possible because of product restrictions which prohibit contact with green grape tissue. The downward growth habit of American grape varieties (*Vitis labruscana*, Bailey.) such as 'Concord' results in early canopy fill and limits the window of opportunity for application of postemergence herbicides.

Giant foxtail and velvetleaf are becoming common escapes of standard weed control practices in New York vineyards. Studies documenting their competitive effects in vineyards are lacking, but their tall growth habit results in competition for sunlight, reduced pesticide penetration into vine canopies, and restricted air movement through the canopy which can encourage fungal infection. Their tall stature also results in contamination of mechanically harvested fruit by weed seeds and plant parts.

PROCEDURES

Three commercial vineyards near Westfield, New York, were selected in 1988 as sites for tests to evaluate the efficacy of preemergence herbicides for control of giant foxtail or velvetleaf. Most herbicide applications were made using an over-the-row tractor mounted boom using typical commercial water volumes and pressures. Granular dichlobenil was applied by hand. Plot lengths varied according to location; plot width was 0.9 m. All experiments utilized randomized complete block designs with four or five replications. Rainfall within 72 hours of all applications was sufficient to ensure that herbicide losses due to volatility or photodecomposition were not significant. Soil samples were taken to a depth of 15 cm. in the weed spray band for determination of pH and soil organic matter (SOM) in September, 1989.

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GIANT FOXTAIL EXPERIMENT - CANANDAIGUA SILT LOAM

The soil in this bearing 'Concord' vineyard had a pH of 6.2 and SOM of 5.4%. This site was chosen for study because the grower reported inadequate giant foxtail control following long term use of diuron and simazine. Ten herbicide treatments were applied to separate plots in the fall and spring. Fall applications were made on November 18, 1988, and spring applications were made on April 17, 1989. Simazine at 4.8 lb. ai/A (4.8 simazine) was added to all treatments to insure adequate control of annual broadleaf weeds. Percent ground cover of weeds was scored on June 7, July 27, and September 19, 1989. All annual grass species present were grouped for scoring at all dates. The predominant annual grass species was giant foxtail, which was rated separately on the final scoring date.

GIANT FOXTAIL EXPERIMENT - CHENANGO GRAVELLY LOAM

The soil in this bearing 'Aurore' vineyard had a pH of 6.8 and SOM of 2.6%. Plots were selected in an area where giant foxtail had not been adequately controlled by diuron in the previous year. Four herbicide treatments were applied in the fall and in the spring. Application dates and scoring dates were the same as for the previous experiment, except the final scoring date was September 5. Glyphosate was applied over the plots by the grower in mid June.

VELVETLEAF EXPERIMENT - NIAGARA SILT LOAM

The soil in this young 'Concord' vineyard had a pH of 4.9 and SOM of 4.9%. This site was chosen because the grower had reported difficulty controlling velvetleaf. Prior to planting the vineyard, this site had been used for corn production. Treatments were initiated in 1988 when the vineyard was in its third growing season. The treatments were repeated in 1989, except that the pendimethalin treatment, which is currently labelled only for non-bearing vineyards, was replaced by norflurazon. Applications were made on April 5, 1988, and April 24, 1989. Glyphosate was applied on April 5, 1988 to eliminate perennial grasses, and by the grower in mid-June, 1989 to eliminate velvetleaf and other weeds. Velvetleaf plants in the 0.8 m. x 5 m. area in the center of the plots were counted on September 9, 1988, and on August 4 and September 22, 1989. The plots were scored for percent ground cover of weeds on September 5, 1989.

Mean separations were by Duncan's multiple range test at the 5% level of significance.

RESULTS

No visual injury symptoms to grapevines were observed from any herbicide treatment at any location.

GIANT FOXTAIL EXPERIMENT - CANANDAIGUA SILT LOAM

Best season long control of giant foxtail was obtained with fall or spring applications of 4 lb. ai/A prodiamine (4 prodiamine), 4 and 2 norflurazon, or 6 and 4 oryzalin, in combination with 4.8 simazine (Table 1.) On June 7, only fall treatment of 4.8 simazine alone provided less annual grass control than the best treatments. By July 27, 4.8 simazine applied in the spring, and 4 dichlobenil in combination with 4.8 simazine applied in the fall or in the spring, were providing less control than the best treatments. Giant foxtail continued to germinate following a period of rainfall in early August. By September 19, 4 napropamide and 1.5 oxyfluorfen in combination with 4.8 simazine applied in the fall or spring, and 4.8 diuron + 4.8 simazine applied in the spring, were providing less control than the ten best treatments listed above. Giant foxtail was the predominant weed in this experiment; other weeds present included large crabgrass (*Digitaria*

sanguinalis, (L) Scop., dandelion (*Taraxacum officinale,* (Weber), velvetleaf, redroot pigweed (*Amaranthus retroflexus,* L.), and pennsylvania smartweed (*Polygonum pensylvanicum*, L.). Scoring for total weed cover on September 19 indicated that the ten treatments that provided the best control of giant foxtail also provided the best overall weed control. The ten consisted of fall and spring applied norflurazon, prodiamine and oryzalin combined with simazine.

Table 1. Effect of herbicide treatment and time of application on % cover of annual grasses, giant foxtail (SETFA), and all weeds. Canandaigua silt loam soil.

Treatment[z]	Time of Application	Annual Grass 6/7/89	Annual Grass 7/27/89	Annual Grass 9/19/89	SETFA 9/19/89	All Weeds 9/19/89
4 norflurazon +	fall	0 d	0 e	1 d	1 e	12 de
4.8 simazine	spring	0 d	1 e	3 d	2 e	8 e
2 norflurazon +	fall	1 d	2 e	14 d	14 e	33 d
4.8 simazine	spring	0 d	2 e	12 d	11 e	24 de
4 prodiamine +	fall	1 d	0 e	2 d	2 e	9 e
4.8 simazine	spring	0 d	1 e	3 d	3 e	6 e
6 oryzalin +	fall	0 d	1 e	3 d	3 e	13 de
4.8 simazine	spring	0 d	2 e	4 d	4 e	17 de
4 oryzalin +	fall	1 d	2 e	9 d	9 e	18 de
4.8 simazine	spring	0 d	2 e	9 d	4 e	22 de
4 napropamide +	fall	0 d	18 cde	53 c	45 bcd	59 c
4.8 simazine	spring	0 d	11 de	60 bc	50 abcd	74 bc
1.5 oxyfluorfen +	fall	0 d	18 cde	78 ab	55 abc	89 ab
4.8 simazine	spring	0 d	11 de	66 abc	43 cd	80 ab
4.8 diuron +	fall	1 d	45 b	75 ab	65 ab	85 ab
4.8 simazine	spring	0 d	9 de	54 c	35 d	68 bc
4 dichlobenil +	fall	4 d	33 bc	78 ab	60 abc	88 ab
4.8 simazine	spring	0 d	30 bc	76 ab	59 abc	83 ab
4.8 simazine	fall	13 c	29 bc	79 a	58 abc	89 ab
	spring	0 d	24 cd	65 abc	54 abcd	76 abc
control	fall	36 b	43 b	75 ab	58 abc	88 ab
	spring	50 a	60 a	76 ab	69 a	98 a

[z] Number refers to application rate in lbs/acre ai.

GIANT FOXTAIL EXPERIMENT - CHENANGO GRAVELLY LOAM

Results obtained on this deep, well-drained soil (Table 2) were generally in agreement with those obtained on the heavier soil. By the end of July, annual grasses had begun to germinate in plots treated in the fall or in the spring with 4.8 simazine alone or in combination with 4.8 diuron. On September 19, 4 norflurazon applied in the spring or in the fall, and 4 oryzalin applied in the fall, all in combination with 4.8 simazine, provided greater control of giant foxtail than did 4.8 diuron + 4.8 simazine applied in the fall, as well as 4.8 simazine applied alone in the spring or in the fall. Intermediate control of giant foxtail was obtained with spring applications of 4 oryzalin or 4.8 diuron in combination with 4.8 simazine. Weeds other than giant foxtail in this experiment included small amounts of large crabgrass, redstem filaree (*Erodium cicutarium*, L.), and common mallow (*Malva neglecta*, Wallr.).

Table 2. Effect of herbicide treatment and time of application on % cover of annual grasses, giant foxtail (SETFA), and all weeds. Chenango gravelly loam soil.

Treatment[z]	Time of Application	Annual Grass 6/7/89	Annual Grass 7/27/89	Annual Grass 9/19/89	SETFA 9/19/89	All Weeds 9/19/89
4 norflurazon +	fall	0 b	0 c	0 d	0 b	11 c
4.8 simazine	spring	0 b	0 c	2 cd	2 b	28 bc
4 oryzalin +	fall	0 b	3 c	6 cd	6 b	22 bc
4.8 simazine	spring	0 b	3 c	27 bc	24 ab	43 abc
4.8 diuron +	fall	5 a	14 bc	48 ab	43 a	53 ab
4.8 simazine	spring	0 b	26 ab	37 b	27 ab	40 abc
4.8 simazine	fall	3 ab	14 bc	45 ab	37 a	48 a
4.8 simazine	spring	0 b	38 a	67 a	54 a	69 a

z. Number refers to application rate in lbs/acre ai.

VELVETLEAF EXPERIMENT - NIAGARA SILT LOAM

Results of this experiment are summarized in Table 3. In 1988, all treatments significantly reduced number of velvetleaf except for 4 pendimethalin. Norflurazon at 4 lb. ai/acre provided better control of velvetleaf than did 1 oxyfluorfen; other treatments (4.8 diuron, 4.8 simazine, 4 oryzalin, and 2 oxyfluorfen) provided intermediate control. In 1989, all herbicide treatments provided some control of velvetleaf. Norflurazon at 4 lb. ai/acre (applied both years) provided significantly greater control of velvetleaf than did 4.8 simazine or 1 oxyfluorfen, while the other treatments provided intermediate control. Velvetleaf counts made on August 4, 1989 were very similar to the counts made on September 22 (data not shown), indicating this weed did not germinate to any extent after August 4. Weeds other than velvetleaf in these plots included groundsel (*Senecio vulgaris*, L.) and horse-nettle (*Solanum carolinense*, L.). The presence of groundsel was associated mainly with oryzalin treatment.

Table 3. Effect of herbicide treatment on velvetleaf (ABUTH) plant number in 1988 and 1989, and % cover velvetleaf and % cover all weeds in 1988 and 1989. Niagara silt loam soil.

1988 Treatment[z]	no. ABUTH per plot 9/9/88	1989 Treatment	no. ABUTH per plot 9/22/89	% ABUTH 9/5/89	% all weeds 9/5/89
Control	213 a	Control	85 a	43 a	71 a
4.8 diuron	72 bc	4.8 diuron	11 cd	2 cd	14 d
4.8 simazine	57 bc	4.8 simazine	18 bc	9 c	16 d
4 norflurazon	12 c	4 norflurazon	1 d	0 d	3 e
4 oryzalin	57 bc	4 oryzalin	4 cd	2 cd	46 b
4 pendimethalin	260 a	4 norflurazon	5 cd	1 cd	11 de
2 oxyfluorfen	68 bc	2 oxyfluorfen	15 bcd	5 cd	16 d
1 oxyfluorfen	96 b	1 oxyfluorfen	26 b	20 b	28 c

z. Number refers to application rate in lbs/acre ai.

DISCUSSION

Diuron and simazine have been valuable tools of the vineyardist for many years. Their low cost and broad spectrum efficacy has led to continuous long term use in New York vineyards. The result has been increasing amounts of weeds which escape control by germinating later in the summer.

These experiments indicate that escape weeds can be controlled by preemergence application of herbicides which are less soluble and have longer residual activity than diuron or simazine. Norflurazon, prodiamine, and oryzalin provided season-long control of giant foxtail when applied in the fall or spring. The success of spring applications of these herbicides is probably dependent on adequate rainfall to move them into the soil. Diuron, simazine, dichlobenil, napropamide, and oxyfluorfen did not provide sufficient residual activity to control giant foxtail germinating late in the season. Velvetleaf did not germinate later than early August in our 1989 plots, and norflurazon, oryzalin, diuron, simazine, and oxyfluorfen all provided good to excellent control of this weed.

Metribuzin and Paraquat Combinations for Control of Broadleaf Weeds and Quackgrass in Maine Potatoes

Gregory A. Porter and Jonathan A. Sisson[1]

ABSTRACT

The availability of postemergence grass herbicides adds flexibility to weed management approaches for potato (Solanum tuberosum L.) producers; however, since they act slowly and must be applied considerably later than the optimum period for control of broadleaved weeds, grass weeds may not be controlled until after they have competed with the crop for a substantial period of time. Thus, it may be desirable for potato growers to control or suppress grass weeds such as quackgrass (Agropyron repens L.) at the same time that broadleaved weeds are being controlled.

Metribuzin/paraquat combinations were studied in field experiments from 1987 to 1989 in Maine. Weed pressure consisted of a heavy infestation of mustard spp. (primarily Brassica campestris L.) and quackgrass. The potato variety used was 'Katahdin'. Metribuzin (0.28 to 0.56 kg ai/A) timings ranged from preemergence (PE) to 7 to 10 days after crop emergence (EPOST). Paraquat (0.28 to 0.56 kg ai/A) timings ranged from groundcrack (GCK) to EPOST. Tank-mix and sequential applications of the herbicides were compared.

On a rating scale from 0 to 10, metribuzin provided mustard control ranging from 6.0 to 10.0 compared with 2.9 for untreated checks. During 1987, when soil moisture conditions permitted rapid weed growth, mustard control ratings declined from 9.8 to 7.8 as application was delayed from PE to GCK. Delayed application proved advantageous during dry spring conditions in 1988. Control ratings increased from 6.0 to 9.7 as application was delayed from PE to EPOST. Regardless of timing, metribuzin proved ineffective versus quackgrass with average August control ratings of 5.7 versus 5.5 for untreated checks. Tank-mixed metribuzin and paraquat applied at GCK provided excellent control of mustard in all growing seasons. Mustard control ratings ranged from 9.8 to 10.0. Tank-mixes provided acceptable quackgrass control from early through midseason and allowed the potato canopy to suppress subsequent quackgrass growth. July control ratings ranged from 7.5 to 8.3. EPOST tank-mixes resulted in average August control ratings that were 8.6 versus 7.2 for GCK applications; however, this combination was unacceptable because mustard was allowed to compete with the crop immediately after emergence and because of unacceptable crop injury. Sequential applications of metribuzin applied PE followed by paraquat applied EPOST provided very good season-long mustard and quackgrass control, but seriously injured the crop. Past studies and those reported here have demonstrated that 'Katahdin' potatoes can recover from the injury caused by this late an application of paraquat; however, this may not be true for all potato varieties. In these studies, GCK tank-mixes provided broadspectrum weed control which equaled or exceeded that obtained with metribuzin followed by sethoxydim plus crop oil. Properly timed, metribuzin and paraquat tank-mixes provide a moderate cost means of assuring control of heavy infestations of broadleaved weeds and early to midseason suppression of quackgrass.

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UPDATE ON POTATO VINE DESICCATION IN MAINE

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ABSTRACT

Several plot studies have been conducted in Maine in 1988 and 1989 to determine more efficacious potato (Solanum tuberosum L.) vine desiccation treatments with registered and experimental materials. Since the loss of dinoseb, diquat has been the material of choice for vine desiccation, in Maine and elsewhere. While diquat has performed well in most cases, farmers can be dissatisfied with the poor desiccation which results on difficult to kill potato varieties or when environmental conditions or cultural practices are unfavorable.

Recent research continues decades of potato vine desiccation studies at Aroostook Farm in Presque Isle, Maine. Under warm and sunny weather conditions of late summer, endothall provided the most effective treatment in 1989 plots. While diquat is more effective over a range of weather conditions, the author often recommends an initial application of endothall on early, hard to kill varieties. This practice allows the applicator to still make the two applications allowed on the diquat label when necessary. In addition, recent studies have shown varying levels of effectiveness as diquat and endothall treatments have been compared at different times of the day. In 1988 and 1989, diquat applications were most effective in the evening while this was the least effective application time for endothall in 1989. Finally, evaluations with experimental compounds indicate that one, C4243, shows promise as an alternative vine desiccant.

Table 1. Diquat and endothall comparison on 'Kennebec' - 1989.

Treatment[a] kg ai/ha in 280 l/ha	Percent Desiccation leaf 3 dat[b]	leaf/stem 8 dat		leaf/stem 14 dat		leaf/stem 20 dat	
Check	0	1	0	5	0	33	10
0.28 diquat (twice)	29	31	5	75	19	96	66
0.28 diquat + 17 bisodium sulphate	26	18	2	31	4	65	30
0.28 diquat + 1 ammonium sulphate	15	16	2	28	4	61	28
1.19 endothall (twice)	24	54	10	98	38	100	84
LSD(0.05)	4	13	4	11	14	10	13

[a] Conditions: Four replicated plots, 2 rows by 7.6 m. Diquat and endothall treatments included 0.125% v/v nonionic surfactant and 0.38 l of crop oil concentrate/ha, respectively. First treatment-9/8/89, 5:30PM, 19°C, 90%RH, clear sky, soil and plants dry, 8 km/hr south wind. Second treatment-9/16/89, 11AM, 21°C, 55%RH, soil wet, clear sky, 3 km/hr south wind.

[b] dat=days after treatment.

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Table 2. Effect of the time-of-day of diquat and endothall treatments on 'Delta Gold' (1988) and 'Kennebec' (1989).

Treatment[a] kg ai/ha in 280 l/ha	Percent Desiccation leaf/stem 4 dat[b]		leaf/stem 7 dat		leaf 4 dat	leaf/stem 8 dat	
0.28 diquat, morning	11	1	15	8	21	30	3
0.28 diquat, midday	36	3	38	10	26	33	3
0.28 diquat, evening	39	4	45	14	29	34	3
1.19 endothall, morning	-	-	-	-	26	41	5
1.19 endothall, midday	-	-	-	-	31	50	5
1.19 endothall, evening	-	-	-	-	11	19	1
LSD(0.05)	5	3	6	8	6	11	2

[a]Conditions: Four replicated plots, two rows by 7.6 m. Diquat and endothall treatments included 0.125% v/v nonionic surfactant and 0.38 l crop oil concentrate/ha, respectively. 9/9/88 - 6:30AM- 8°F, 96%RH, fog, leaves wet, soil damp, 6 km/hr south wind. 1:30PM- 21°C, 46%RH, clear, plants dry, 16 km/hr south wind. 6:30PM- 16°C, 70%RH, clear, plants dry, 6 km/hr south wind. 9/7/89 - 7:30AM, 16°C, clear, leaves nearly dry, soil dry, 3 km/hr south wind. 3:30PM, 22°C, clear, plants dry, soil dry, 10 km/hr south wind. 7:30PM, 20°C, clear, plants dry, 10 km/hr south wind.

[b]dat=days after treatment.

Table 3. Evaluation of C4243 on 'Katahdin' - 1989.

Treatment[a] kg ai/ha in 280 l/ha	Date	Percent Desiccation leaf 9/11	leaf/stem 9/16		leaf/stem 9/22		leaf/stem 9/28	
0.067 C4243 + coc[b]	9/16	0	0	0	35	5	79	29
0.14 C4243 + coc	9/16	0	0	0	35	5	81	31
0.28 C4243 + coc	9/16	0	0	0	34	5	85	34
0.28 C4243	9/16	0	0	0	36	5	89	33
0.28 diquat + nis[c]	9/16	0	0	0	39	5	81	31
check	--	0	0	0	4	0	34	4
0.067 C4243 + coc	9/7+							
+ 0.14 C4243 + coc	9/16	20	44	4	80	10	100	66
0.14 C4243 + coc	9/7+							
+ 0.067 C4243 + coc	9/16	23	51	5	78	11	100	65
LSD(0.05)		2	4	1	6	2	8	11

[a]Conditons: Four replicated plots, two rows by 7.6 m. 9/7/89 - 6:30PM, 20°C, 85%RH, clear, plants and soil dry, 3 km/hr south wind. south wind. 9/16 - 11AM, 21°C, 55%RH, clear, plants dry, soil wet, 3 km/hr south wind.

[b]coc=crop oil concentrate at 0.38 l/ha.

[c]nis=nonionic surfactant at 0.125% v/v.

INTERACTION OF BENTAZON, METRIBUZIN, AND SETHOXYDIM WITH OTHER PESTICIDES ON POTATOES.

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ABSTRACT

The experiments evaluating the effects of postemergence applications of *bentazon*, *metribuzin* and *sethoxydim* were conducted in 1988 and 1989 at the Long Island Horticultural Research Laboratory, Riverhead, New York. Results show that preemergence applications of *metribuzin* at 0.56 kg/ha and *metolachlor* at 1.12 kg/ha provided broad spectrum weed control. Properly timed postemergence applications of *bentazon* or *metribuzin* with *sethoxydim* resulted in similar control. The addition of *chlorothalonil* and *cryolite* to *sethoxydim* with or without *metribuzin* had no effect on phytotoxicity ratings or weed control. Postemergence applications of *bentazon* and *metribuzin* were more phytotoxic on the potato cultivar 'Superior' then on 'Katahdin'. Plant injury was short lived and did not affect tuber yield.

INTRODUCTION

Barnyardgrass (*Echinochloa crus-galli L.*) control in potato (*Solanum tuberosum L.*) fields is a major problem in the northeastern United States (3). On Long Island, barnyardgrass and smartweed (*Polygonum pensylvanicum L.*) are considered the principal annual weed problems (5). In addition to lower yields, increased difficulty in harvesting is associated with poor weed control. The introduction of preemergence applied *metolachlor* {2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide} and *metribuzin* {4-Amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4*H*)-one} have somewhat diminished the problem, but dry weather at time of weed emergence and/or cultural practices in the potato field after herbicide application may result in a number of weed escapes. Also weed-crop competition studies show that barnyardgrass is not significantly affecting potato yields for the first 6-8 weeks after crop planting (1, 4, 6). This has lead to a search for a combination of effective postemergence broadleaf weed and grass controls. The components of this tank-mix already exist, but their combined application may result in increased phytotoxicity and/or decreased weed control (2). The purpose of these studies was to evaluate the performance of *metribuzin*, *bentazon* {3-(1-methylethyl)-1*H*-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide, sodium salt} and *sethoxydim* {2-(1-[Ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one}, alone and in combination with other pesticides, to determine if adverse effects occur when these combinations are applied to actively growing potatoes and to compare their effectiveness with preemergence-applied herbicides.

MATERIALS AND METHODS

Three potato weed control experiments were established in 1988 and 1989 at the Long Island Horticultural Research Laboratory, Riverhead, New York. The objective of 1988 study (Experiment 1) was to evaluate the effect of standard preemergence herbicides, *metribuzin* and *metolachlor*, and compare their effectiveness to postemergence applications of *sethoxydim*, *metribuzin* and *bentazon*. Two 1989 experiments studied the interaction of *sethoxydim* with *metribuzin*, *chlorothalonil* (tetrachloroisophthalonitrile) and *cryolite* (sodium aluminofluoride) (Experiment 2) and the effect of *bentazon* and *metribuzin* (Experiment 3) on weed control in potatoes. In both years potatoes were planted on a Haven loam soil using a commercial potato planter. Fertilizer was applied at a rate of 1121 kg/ha of 10-20-10 at time of planting. Nitrogen was sidedressed at a rate of 67 kg/ha when plants were approximately 15 to 20 cm tall. Herbicide treatments were applied with a hand held CO_2 pressurized sprayer delivering 374 l/ha at 2.7

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kg/cm^2. Two potato cultivars, 'Katahdin' and 'Superior' were grown in all experiments. Experimental design for all studies was a randomized complete block with four replications. As rows of each cultivar were planted in a non-random pattern, yield data for 'Katahdin' and 'Superior' were analyzed separately.

In Experiment 1 plot size was four rows (3.45 m) by 6.1 meters, two rows for each cultivar. Potatoes were planted on April 13, 1988. Preemergence applications were made on May 3, 1988, to a moist soil surface prior to ground cracking and potato emergence. Only a few wild radish (*Raphanus raphanistrum L.*) plants were present and were approximately 1-1.5 cm tall. Postemergence applications of *sethoxydim*, *bentazon* or *metribuzin* and combinations of *sethoxydim* and *metolachlor* were made on June 14, 1988. On the same day a tank-mix application of *sethoxydim* and *bentazon*, replicated four times but not included in the random design, was made in the same general area as the experiment. At time of postemergence application 'Katahdin' plants were 35 cm tall and 'Superior' plants were 55 cm tall. Grasses and smartweed were reaching the height of 7.5-10 cm. Plants and soil were dry.

Plot size of both 1989 experiments was two rows (1.7 m) by 6.1 meters. Both were planted on April 19, 1989. The entire area of Experiment 2 was oversprayed on April 28, 1989 with a combination of *metribuzin* and *metolachlor* at the rates of 0.56 kg/ha and 1.12 kg/ha, respectively, using a tractor-mounted PTO sprayer. Postemergence applications were made on June 14, 1989. All applications were applied to dry potato foliage in a 1.25% v/v dilution of Booster plus E crop oil. At this time 'Katahdin' plants averaged 25 cm high and 'Superior' plants 35 cm.

In Experiment 3, the preemergence treatment was applied on May 4, 1989, on moist soil in the absence of potato emergence, ground cracking and weeds. Postemergence applications of *bentazon* and/or *metribuzin* were made on May 25, 1989, onto dry plants . At this time 'Katahdin' just reached 50% emergence with plants 2-3 cm tall, 'Superior' emergence was 95% with plants 7-8 cm tall. The second and third postemergence applications of *bentazon* were made 11 (cv 'Katahdin' 15 cm tall, cv 'Superior' 25 cm tall, plants dry) and 21 (cv 'Katahdin' 25-30 cm tall, cv 'Superior' 35-40 cm tall, plants moist) days later.

Ratings on phytotoxicity and weed control were made on a zero to ten scale, 1, 3, 7 and 14 days after treatment applications. For phytotoxicity the most vigorously growing plants of the entire test area received a **'ten'** rating. A rating of **'five'** represented plants with 50% reduction in vigor compared to the **'ten'**. A rating of **'zero'** represented dead plants. In weed control, a rating of **'ten'** represented 100% weed control (clean plots), and **'zero'** indicated no apparent weed control. Plot which had 50% fewer weeds than the weediest plots in the test received a rating of **'five'**.

Plants were vine killed with *paraquat* (1,1'-dimethyl-4,4'-bipyridinium ion) on September 9 in 1988 and on August 28 in 1989. Yield data were collected from 4.6 meters of the center two rows on October 7, 1988 for Experiment 1 and from the center 4.6 meters of each row on September 14, 1989 for Experiments 2 and 3.

RESULTS AND DISCUSSION

Experiment 1 (Table 1.): Results show that the best weed control was obtained from preemergence applications. Near perfect weed control was achieved by each of the three preemergence treatments. Very slight phytotoxicity was observed on 'Superior' from postemergence applications of *bentazon*. Phytotoxicity did not increase when *sethoxydim* and crop oil concentrate were added. Postemergence applications of *bentazon* provided excellent control of smartweed and when combined with *sethoxydim*, annual grass control was also good. Combinations of *sethoxydim* and *metribuzin* with crop oil concentrates were effective in controlling smartweed and annual grasses. The exclusion of *metribuzin* reduced the effectiveness

of control on both weed types. Postemergence application of *metribuzin* by itself was not effective in controlling smartweed or annual grasses. There were no differences between Booster plus E and Dash, when used as additives, in grass control or phytotoxicity ratings. Tuber yield of 'Superior' was higher than that of 'Katahdin'. Yields of both cultivars were highest in plots with the least weed pressure. The plots that received preemergence applications gave the highest yields.

Experiment 2 (Table 2.): Phytotoxicity was not observed in plots treated with *sethoxydim* and its combinations with pesticides other than *metribuzin*. The use of *metribuzin*, alone or in combination, with other pesticides caused foliar injury, lasting the longest on plants treated with a combination of all four pesticides used in this experiment. The injury appeared as slight general chlorosis and leaf cupping, not typical of *metribuzin*. 'Katahdin' plants recovered faster than 'Superior'. Weed control ratings (primarily smartweed) were not significantly affected by chemical treatment. The best weed control ratings, however, were in treatments that included postemergence applications of *metribuzin*. The addition of *chlorothalonil* or *cryolite* had no effect on the efficacy of *sethoxydim*. Tuber yields of both potato cultivars were not significantly affected by chemical treatment and the highest in the plots with the best weed control.

Experiment 3 (Tables 3 and 4.): Preemergence application of *metribuzin* at 0.56 kg/ha and *metolachlor* at 1.12 kg/ha provided the best control of broadleafed weeds and annual grasses. Similar control was achieved from postemergence treatments including *metribuzin*. Postemergence application of *bentazon* provided good control of smartweed, but was weak on annual grasses. Initial postemergence applications of *bentazon* caused slight but statistically significant foliar injury to 'Superior', leaving 'Katahdin' virtually unaffected. The phytotoxic effect was visible for 7 days after application, but was gone two weeks after application. The second application of *bentazon* caused foliar injury on both potato cultivars when plants were 15-25 cm tall. Plants of both cultivars appeared to be more resistant to the third application, where the injury was slight and lasted less than three days. Phytotoxicity of postemergence-applied *metribuzin* was evident and significant only on 'Superior'. Tuber yields of both cultivars were not significantly different between treatments that consisted of herbicides. The no chemical control plots produced the lowest yields.

Results of 1988 and 1989 studies show, that properly timed postemergence herbicides applied in combinations can provide weed control in potato fields comparable to that achieved with preemergence herbicides. The addition of *chlorothalonil* and *cryolite* to *sethoxydim* with or without *metribuzin* had no effect on phytotoxicity ratings or weed control. Phytotoxicity that resulted from postemergence applications of *bentazon* or *metribuzin* was short lived and did not result in yield reductions. The cultivar 'Superior' is more susceptible than 'Katahdin' to injury. Foliar injury from *bentazon* was greatest when plants were 15 to 25 cm tall.

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Table 1. Experiment 1. The effect of preemergence applications of metribuzin and metolachlor and postemergence applications of sethoxydim, metribuzin and bentazon on weed control and potato yield.

			Weed Control Rating*								Total yield (t/ha)	
			Smartweed				Annual grasses					
CHEMICAL**	Rate (kg/ha)	Timing	6/08	6/28	8/02	9/20	6/08	6/28	8/02	9/20	Katahdin	Superior
control			5.5	2.8	0.0	0.5	8.8	6.5	7.3	8.3	23.4	38.7
metribuzin+metolachlor	0.56+2.24	Pre	10.0	10.0	10.0	9.8	9.8	9.8	9.3	5.8	37.9	52.1
metribuzin	0.56	Pre	9.3	10.0	9.3	7.5	10.0	10.0	10.0	10.0	35.9	51.3
metolachlor	2.24	Pre	10.0	10.0	10.0	9.5	10.0	10.0	10.0	9.8	37.2	52.0
sethoxydim+COC	0.22+2.34L	Post	5.3	3.5	2.0	0.3	7.5	8.0	9.5	9.5	20.0	40.7
sethoxydim+COC+metribuzin	0.22+2.34L+0.28	Post	4.5	6.8	7.5	5.8	8.5	10.0	10.0	10.0	29.2	43.9
sethoxydim+DASH	0.22+2.34L	Post	5.8	2.3	0.8	0.3	7.8	10.0	10.0	9.8	21.3	43.4
sethoxydim+DASH+metribuzin	0.22+2.34L+0.28	Post	5.5	8.0	8.0	3.5	6.3	10.0	9.8	8.3	30.2	49.2
metribuzin	0.28	Post	2.8	4.8	5.0	1.5	6.5	6.5	7.3	6.3	29.8	47.2
bentazon	1.12	Post	4.8	9.0	8.5	6.8	8.0	4.3	5.5	2.8	34.8	45.4
Waller-Duncan (0.05)			(1.4)	(1.1)	(1.6)	(1.0)	(2.2)	(2.3)	(1.8)	(2.1)	(7.5)	(7.9)
sethoxydim+COC+bentazon†	*0.22+2.34L+1.12*	*Post*	*2.3*	*9.5*	*8.3*	*6.8*	*8.3*	*9.3*	*9.5*	*9.5*	*34.9*	*47.5*

** Based on a scale of 0 to 10; 0=no control, 10=complete control.*

*** COC = crop oil concentrate; DASH = Booster plus E crop oil.*

† Sethoxydim+COC+bentazon applied outside the experimental area. Therefore data were not included in the ANOVA. Four replications.

Table 2. Experiment 2. The effect of postemergence applications of sethoxydim alone or in combination with metribuzin, chlorothalonil, and/or cryolite on potato phytotoxicity, weed control and yield.

		PHYTOTOXICITY RATINGS**								WEED CONTROL RATINGS**	TOTAL YIELD (t/ha)	
		Days after application										
		1 (6/15/89)		3 (6/17/89)		7 (6/21/89)		14 (6/28/89)				
CHEMICAL*	Rate (kg/ha)	Superior	Katahdin	Superior	Katahdin	Superior	Katahdin	Superior	Katahdin	8/28/89	Superior	Katahdin
control		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	7.3	50.2	36.9
sethoxydim	0.22	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	7.3	48.8	33.9
sethoxydim+metribuzin	0.22+0.28	10.0	10.0	8.5	8.5	9.3	10.0	10.0	10.0	9.8	52.0	39.7
sethoxydim+chlorothalonil	0.22+1.3	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	8.0	47.0	37.4
sethoxydim+cryolite	0.22+13.45	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	8.3	49.5	37.9
metribuzin	0.28	10.0	10.0	8.8	8.8	9.3	10.0	9.8	9.8	9.5	46.9	38.4
chlorothalonil	1.3	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	7.8	48.1	37.9
cryolite	13.45	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	7.0	49.4	39.4
sethoxydim+metribuzin+ +chlorothalonil+cryolite	0.22+0.28+ +1.3+13.45	10.0	10.0	8.3	8.3	8.3	9.3	9.3	9.8	9.0	46.8	36.1
Waller-Duncan (0.05)		*(ns)*	*(ns)*	*(0.5)*	*(0.6)*	*(0.4)*	*(0.2)*	*(0.4)*	*(ns)*	*(ns)*	*(ns)*	*(ns)*

** Metribuzin at 0.56 kg/ha and metolachlor at 1.12 kg/ha were applied to the entire experimental area before potato emergence (4/28/89). Booster plus E crop oil at 1.25% v/v was included in all treatments.*

*** Ratings based on a scale of 0 to 10; 0=no weed control or dead plants, 10=100% weed control or no crop injury.*

Table 3. Experiment 3. The effect of preemergence application of metribuzin and metolachlor and postemergence applications of bentazon and sethoxydim on potato phytotoxicity.

		PHYTOTOXICITY																			
	Rate	5/26		5/28		6/01		6/06		6/08		6/12		6/17		6/19		6/23		6/30	
CHEMICAL	(kg/ha)	Sup	Kat	Sup	Kat	Sup	Kat	Sup	Kat	Sup	Kat	Sup	Kat	Sup	Kat	Sup	Kat	Sup	Kat	Sup	Kat
control		10.0	10	10.0	10	9.5	10	10	10.0	10.0	10.0	9.8	10.0	10.0	10.0	10	10	10	10	10	10
bentazon*	0.56	10.0	10	9.5	10	8.3	10			10.0	9.8									10	10
bentazon*	0.84	9.8	10	9.3	10	8.8	10			10.0	9.8									10	10
bentazon+sethoxydim*	0.56+0.28	9.5	10	9.3	10	8.3	10			10.0	9.5									10	10
bentazon+sethoxydim*	0.56+0.56	9.3	10	8.3	10	7.8	10			9.8	9.5									10	10
bentazon+sethoxydim*	0.84+0.28	9.0	10	9.0	10	8.8	10			10.0	9.8									10	10
bentazon+sethoxydim	0.84+0.28	9.3	10	8.5	10	7.5	10			9.3	9.0									10	10
sethoxydim*	0.28	10.0	10	9.0	10	8.0	10			9.8	10.0									10	10
sethoxydim	0.28	9.3	10	8.5	10	9.0	10			10.0	10.0									10	10
bentazon**	0.84	9.5	10	8.8	10	7.8	10	8	8.8	8.5	9.0	9.0	9.5					9	9	10	10
bentazon***	0.84	9.8	10	9.0	10	8.3	10	8	8.5	8.8	9.0	9.3	10.0	9.8	9.3	10	10	10	10	10	10
sethoxydim+metolachlor†	0.56+1.12	9.8	10	10.0	10	9.3	10			10.0	9.3									10	10
Waller-Duncan (0.05)		*(0.7)*		*(1.2)*		*(1.6)*		*(a)*	*(0.9)*	*(0.5)*	*(ns)*	*(ns)*	*(ns)*	*(ns)*	*(ns)*			*(a)*	*(a)*		

a) Highly significant, however a Waller - Duncan could not be calculated since error mean square = 0

Table 4. Experiment 3. The effect of preemergence application of metribuzin and metolachlor and postemergence applications of bentazon and sethoxydim on weed control and potato yield.

		WEED CONTROL		TOTAL YIELD (t/ha)	
CHEMICAL	Rate (kg/ha)	8/25 broadleaves	8/25 grasses	Superior	Katahdin
control		0.0	0.0	36.5	31.3
bentazon*	0.56	9.3	6.3	51.7	40.8
bentazon*	0.84	9.5	4.8	53.8	39.2
bentazon+sethoxydim*	0.56+0.28	9.5	7.8	53.8	37.5
bentazon+sethoxydim*	0.56+0.56	9.8	9.3	54.4	45.4
bentazon+sethoxydim*	0.84+0.28	10.0	8.5	53.8	40.6
bentazon+sethoxydim	0.84+0.28	9.8	8.5	46.9	36.0
sethoxydim*	0.28	10.0	8.3	53.2	44.3
sethoxydim	0.28	10.0	7.5	54.5	39.6
bentazon**	0.84	10.0	6.8	49.6	39.7
bentazon***	0.84	9.8	5.8	57.7	41.5
sethoxydim+metolachlor†	0.56+1.12	9.8	9.8	57.1	38.9
Waller-Duncan (0.05)		*(0.6)*	*(2.4)*	*(14.5)*	*(11.9)*

Comments on Tables 3 and 4.

Single asterisk (*) indicates treatment, which received 2.34 L/ha of Booster plus E crop oil.

Double asterisk (**) indicates two postemergence bentazon applications were made (5/25/89 and 6/05/89) with 2.34 L/ha of Booster plus E crop oil.

Triple asterisk (***) indicates three postemergence bentazon applications were made(5/25/89, 6/05/89 and 6/15/89) with 2.34 L/ha of Booster plus E crop oil.

Dagger (†) indicates preemergence herbicide treatment.

Phytotoxicity and weed control ratings based on a scale of 0 to 10: 0 = no weed control or dead plants, 10 = 100% weed control or no crop injury.

CHANGES IN APPLICATION EQUIPMENT IN MAINE POTATO PRODUCTION

L.S. Morrow[1]

ABSTRACT

As public scrutiny and regulatory pressure have increased regarding pesticide applications, many farmers and applicators in Maine have sought to limit chemical drift and environmental impact. As a result, a number of them have adopted the use of low drift nozzles or even purchased new row-crop sprayers equipped with controlled droplet application (CDA) technology. Research and demonstration work in Maine suggest that such equipment can perform as well as traditional equipment while reducing the amount of spray material that has the potential to drift off-target. Adaptation of this new equipment has not been without inherent problems, some of which can be overcome and some which must be accepted.

INTRODUCTION

In January of 1988, state drift reduction regulations took effect. A major component of the regulations disallows chemical trespass onto adjoining sensitive areas. Specifically, a chemical trespass is defined as a deposit which is 20 percent or more than residue which would be found at the target site. These regulations have caused applicators to investigate possible methods for limiting drift without sacrificing efficacy. In anticipation of such legislation and in search of more effective potato (Solanum tuberosum L.) vine desiccation, drift reduction nozzles were evaluated in the early 1980's in replicated studies.

In addition, CDA equipment was acquired in 1987 for the University of Maine Agricultural Experiment Station (UMAES) with partial funding by the Maine Department of Agriculture, Food and Rural Resources. This spray equipment has been used for three years at Aroostook Farm to evaluate its potential. This report summarizes this research and demonstration work.

PROCEDURES

Drift reduction nozzle research: In 1981, Raindrop[2] nozzles were compared to conventional flat fan nozzles in a replicated small plot study with a potato vine desiccant, diquat (6,7-dihydrodipyrido 1,2-a:2',1'-c] pyrazinediium ion). Desiccant was applied to single row, 6 meter plots which were replicated five times. A compressed air sprayer was used with two nozzles on a hand-held boom which delivered 746 l/ha at 310 kPa.

In 1983, Raindrop nozzles were again compared to flat fan nozzles and hollow cone nozzles, but on commercial size application equipment. Plots were four rows by 15 meters and

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replicated four times. Nozzles were spaced on 48 cm and delivered 373 l of water/ha. Nozzle types were compared at 414 and 1379 kPa.

CDA equipment demonstration: In 1987, a 10-row CDA sprayer was acquired for field work at the UMAES. The equipment had hydraulically driven CDA nozzles spaced 1 meter apart. Beneath each nozzle was a factory-mounted propeller with adjustable blade pitch to allow variable amounts of down-draft. Non-replicated demonstration plots were established to compare herbicide, fungicide and vine desiccant applications made on the farm with conventional and CDA equipment. While blight pressure was insufficient to eventually make comparisons, herbicide and desiccant plot observations were useful. Herbicide plots were populated with broadleaved weeds and volunteer grain, thus a tank mix of metribuzin [4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one] plus sethoxydim [2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] was applied. Diquat was applied to the vine desiccant plots.

Observations were also noted concerning unusual mechanical aspects associated with the CDA sprayer.

RESULTS AND DISCUSSION

Drift reduction nozzle research: The RD3 Raindrop was evaluated in the 1981 trial and did not compare favorably to a conventional 8003 flat fan nozzle. Excessively coarse droplet sizes were produced by the RD3 at the 310 kPa test pressure.

Table 1. Comparison of flat fan and Raindrop nozzles for potato vine desiccation in 'Katahdin' - 1981.

Nozzle Type	Percent Desiccation[a]			
	leaf/stem 4 dat[b]		leaf/stem 10 dat	
Flat Fan 8003	44	20	86	21
Raindrop RD3	36	14	78	17

[a]Applications of 0.56 kg ai of diquat/ha plus 0.125% v/v nonionic surfactant were made on 9/8/81.
[b]dat=days after treatment.

In 1983 the RD2 nozzle was evaluated at two pressures and at 373 l/ha instead of 746 l/ha. At 1379 kPa, the Raindrop nozzle compared well to flat fan and hollow cone nozzles but not at 414 kPa.

These trials and subsequent demonstration work has led us to the recommendation that the smallest Raindrop nozzle, the RD1, be utilized for drift control and that the minimum application pressure should be in the range of 551 to 690 kPa for foliage treatments. Spray droplet sizes are substantially increased from the traditional pesticide application method with small hollow

cone nozzles used between 1034 to 1379 kPa, yet efficacy has been maintained. It is estimated that 100 of Maine's 700 potato farmers have switched to this type of low drift nozzle.

This adoption has been hampered for more than one reason. Some of the first nozzle sets purchased here were the RD3. This nozzle has a flow rate 166% of the RD1 and considerably greater than what most farmers have used for a carrier rate in recent

Table 2. Comparison of flat fan, hollow cone and Raindrop nozzles at low and high pressure for potato vine desiccation in 'Katahdin' - 1983.

Pressure and Nozzle Types	Percent Desiccation[a] leaf 3 dat[b]	leaf/stem 7 dat		leaf/stem 14 dat		Specific Gravity	Yield mt/ha
414 kPa:							
Raindrop RD2	35	59	13	85	73	1.078	17.4
Flat Fan LE3 80°	43	80	31	95	86	1.078	19.9
Hollow Cone NH20	39	71	28	90	84	1.078	21.7
1379 kPa:							
Raindrop RD2	39	76	23	92	84	1.079	18.3
Flat Fan LE3 80°	39	73	25	89	79	1.079	21.3
Hollow Cone NH20	38	75	26	92	81	1.079	20.2
LSD(0.05)						ns	ns

[a]Applications of 0.56 kg ai diquat/ha plus 0.125% v/v nonionic surfactant were made on 9/7/83.
[b]dat=days after treatment.

years. The most usual result was for the application rate to be adjusted by decreasing the pressure too low or increasing the nozzle spacing too wide. The only effective solution has been to replace the nozzles with the RD1.

A second recurring problem has been the destruction of a plastic washer supplied with each nozzle by excessive torque during installation. The flattening of this washer or discarding it has caused spray patterns to be nonuniform. Farmers that properly installed the correct nozzles have been very satisfied with their performance. Note that similar low drift hydraulic nozzles are being produced by other companies and this report is not intended to be an endorsement of this product. What is important to realize is that adjustment of nozzle size can result in a good compromise between efficacy and drift control.

CDA equipment demonstration: Label rates of metribuzin and sethoxydim were applied in a tank mix with the CDA sprayer and conventional flat fan nozzles. The carrier rate was 47 and 373 l/ha respectively. The side by side plots of 5 rows each were observed for weed control during the summer. Although weed pressure was initially great, control was equally satisfactory behind both types of application equipment.

A slight difference was evident in the vine desiccant plots however. The label rate of diquat was applied in 37 l of water/ha with the CDA sprayer versus in 238 l of water/ha with hollow cone nozzles. Percent leaf/stem desiccation ratings made two days later were: CDA - 60 to 85%/15% and hollow cone - 45 to 50%/10%. The CDA equipment performed slightly better.

Due to the difficulty in duplicating the application conditions of this CDA equipment with small plot equipment, it has been necessary to rely on observations of field operations to evaluate the effectiveness of this technology. More than 30 farmers have purchased this type of CDA sprayer and most have been satisfied. Problems have arisen however. One such problem has been the inability to apply high-rate dry materials with the low carrier volume and another has been the great weight of the predominant design in our area. Still, the time and labor savings acquired through less refilling, the drift reduction and the retention of pesticide efficacy has caused most to overlook these problems.