Influence of V-53482 on Monocot and Dicot Plant Growth[1]

Stanislaw J. Karczmarczyk[2], Irena I. Zbiec[2], and Robert M. Devlin[3]

Abstract

The effect of V-53482 on the growth of wheat (Triticum aestivum L.), corn (Zea mays L.), barley (Hordeum vulgare L.), pea (Pisum sativum L.), and radish (Raphanus sativus L.) was studied. Of the three grass crops barley was the most sensitive to V-53482. For example, barley shoot length was inhibited 56% by 10 uM V-53482. At the same rate wheat and corn shoot lengths were inhibited 32 and 39%, respectively. Of the two dicots treated, radish was much more sensitive to V-53482 than pea. The extreme sensitivity of radish to V-53482 suggests that the herbicide may effectively control weeds in the Brassicaceae family.

Introduction

The experimental herbicide V-53482 {7-fluoro-6-[(3,4,5,6-tetrahydro)phthalimido]-4-(2-propynyl)-1,4-benzoxazin-3(2H)-one} was developed by Sumitomo Chemical Co. for the control of important broadleaf weeds and some grasses in soybean (1) and corn cultures. In the present study the effects of V-53482 on the growth of wheat, corn, barley, radish, and pea were determined.

Methods and Materials

Seeds of test plants were imbibed for 6 h in solutions of V-53482 formulation (50% WDG). The imbibed seeds were sown in 8-cm styrofoam pots containing moist vermiculite and grown in a growth chamber under constant conditions of light (152 uE $m^{-2}s^{-1}$, 16 h light and 8 h dark) and temperature (22±2°C). After shoot emergence 40 ml of 1/2 strength Hoagland solution was applied daily to each pot. After 10 days (wheat and barley), 11 days (corn), 12 days (pea), and 18 days (radish) the seedlings were removed from the pots and the 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. All experiments were replicated four times.

1/ Paper No.3028. Massachusetts Agricultural Experiment Station, University of Massachusetts at East Wareham. This research project is supported from Experiment Station Project No. 629.

2/ Visiting scientist, Academy of Agriculture, Szczecin, Poland.

3/ Professor, Laboratory of Experimental Biology, Cranberry Experiment Station, University of Massachusetts, East Wareham, MA 02538.

Results and Discussion

Growth in length and fresh weight of wheat shoots was inhibited 32 and 28%, respectively, by 10 uM V-53482. Shoot dry weight was not affected (Table 1). At 40 uM, V-53482 caused a 60% drop in wheat shoot length, a 61% drop in shoot fresh weight, and a 43% drop in shoot dry weight (Table 1). Wheat root growth was less sensitive to V-53482 but was also inhibited by the herbicide (Table 1).

Table 1. Effect of V-53482 on the growth of wheat.

	SHOOTS			ROOTS		
V-53482 (uM)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)
0	116	102	11.5	115	127	12.7
10	79	73	11.0	102	101	9.8
20	65	60	10.5	99	94	8.3
30	58	50	8.0	84	77	7.0
40	46	40	6.5	80	69	6.5
LSD 5%	5.9	0.9	1.8	14.8	14.3	1.3
1%	8.2	1.1	2.5	20.4	19.7	1.8

Shoot growth in length, fresh weight, and dry weight of corn treated with 10 uM V-53482 was inhibited 39, 34, and 11%, respectively (Table 2). At 40 uM, V-53482 caused a 57% drop in corn shoot length and fresh weight. Shoot dry weight was inhibited 46% (Table 2). As with wheat, corn root growth was less sensitive to V-53482 compared to shoot growth (Table 2).

Table 2. Effect of V-53482 on the growth of corn.

	SHOOTS			ROOTS		
V-53482 (uM)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)
0	108	325	28	129	418	34
10	66	215	25	121	350	29
20	60	193	21	115	326	28
30	56	177	20	107	302	26
40	46	140	15	103	261	22
LSD 5%	5.0	20.4	3.1	8.8	41.8	3.8
1%	6.9	28.2	4.4	12.2	57.8	5.3

Barley was much more sensitive to V-53482 than either wheat

or corn. At 5 uM V-53482 shoot growth in length, fresh weight, and dry weight was reduced 47, 35, and 29%, respectively (Table 3). At 50 uM V-53482 barley shoot length was reduced 63%, fresh weight reduced 53%, and dry weight reduced 50% (Table 3). Again, as shown with wheat and corn, barley root growth was less sensitive to V-53482 compared to shoot growth (Table 3).

Table 3. Effect of V-53482 on the growth of barley.

	SHOOTS			ROOTS		
V-53482 (uM)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)
0	160	127	14	123	75	8
0.5	148	123	14	127	66	8
1.0	127	104	11	108	63	7
5.0	85	82	10	95	55	6
10.0	70	71	9	84	45	4
50.0	59	60	7	77	47	4
100.0	53	52	6	64	44	4
200.0	41	43	6	54	34	3
LSD 5%	7.4	11.3	2.0	12.1	10.1	1.2
1%	10.0	15.4	2.8	16.5	13.7	1.6

Of the two dicot plants treated with V-53482, radish was much more sensitive to the herbicide than pea. For example, 1 uM V-53482 had no effect on the shoot and root growth of pea (Table 4). However, the shoot length, fresh weight, and dry weight of radish treated with 0.1 uM V-53482 (a ten-fold dilution) were reduced 27, 31, and 32%, respectively (Table 5).

Table 4. Effect of V-53482 on the growth of peas.

	SHOOTS			ROOTS		
V-53482 (uM)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)
0	97	709	71	128	708	43
1	95	689	70	121	725	43
5	80	573	59	112	657	40
10	75	466	46	112	595	38
50	68	454	46	106	605	38
100	61	365	35	109	577	37
200	42	270	24	104	513	36
LSD 5%	6.8	57.1	7.6	11.6	75.4	5.0
1%	9.2	77.7	10.3	15.9	102.6	6.8

Table 5. Effect of V-53482 on the growth of radish.

	SHOOTS			ROOTS		
V-53482 (uM)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)	Length (mm)	Fresh Wgt. (mg/pl)	Dry Wgt. (mg/pl)
0.00	49	455	44	36	109	10
0.02	47	499	45	36	99	9
0.05	49	476	45	34	97	9
0.10	36	316	30	25	68	6
0.20	17	135	13	10	33	2
0.40	12	84	8	9	26	2
LSD 5%	3.4	47.3	3.2	3.3	12.4	1.9
1%	4.7	64.8	4.4	4.5	17.0	2.6

The extreme sensitivity of radish to V-53482 suggests that this herbicide might be effective against weeds found in the Brassicaceae family. For example, weeds such as wild mustard (Sinapis arvensis), wild radish (Raphanus raphanistrum), field penny-cress (Thlaspi arvense), and shepherd's purse (Capsella bursa-pastoris) all may be sensitive to V-53482.

Literature Cited

1. Sakaki, M., R. Sato, T. Haga, E. Nagano, H. Oshio, and K. Kamoshita. 1991. Herbicide efficacy of S-53482 and factors affecting the phytotoxicity and the efficacy. WSSA Abstr. No. 34, 31:12.

Influence of Clopyralid on Cranberry Fruit[1] Growth and Development

Robert M. Devlin[2] & Irena I. Zbiec[3]

Abstract

The effects of clopyralid on cranberry fruit volume, yield, acidity, percent soluble solids concentration (%SSC), total flavonols, and anthocyanin development were studied. Clopyralid applied before bloom at 0.42 and 0.84 kg/ha caused reductions in yield of 20 and 44%, respectively. When applied 30 days after fruit set there was no reduction in yield. Double applications of clopyralid, before bloom and after fruit set, caused large reductions in yield and some vine injury. Single applications of clopyralid either before bloom or after fruit set, had very little effect on the growth and development of the cranberry fruit. Of the systems measured only anthocyanin development was affected. This study suggests that only single applications of clopyralid should be used on cranberry bogs.

Introduction

Our studies have shown that the herbicide clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) can provide very efficient postemergence control for a number of troublesome weeds on cranberry bogs. For example in preliminary work clopyralid at 0.42 kg/ha gave excellent postemergence control of wild bean (*Apios americana* Medic.) and good control of narrowleaf goldenrod (*Solidago graminifolia* L.) and asters (*Aster* sp.) on cranberry bogs (Table 1). Also there is reason to believe that clopyralid could be used as a postemergence control for numerous other weeds found on cranberry bogs that belong to the Polygonaceae, Compositae, and Leguminosae families (2,4). For example, the composites Joe-Pye weed (*Eupatorium dubium* Willd.), ragweed (*Ambrosia artemisiifolia* L.), and pitchfork (*Bidens frondosa* L.), are probably sensitive to this herbicide. In contrast, cranberry vines are not sensitive to clopyralid.

The purpose of this study was to determine the effect of clopyralid on the growth and development of the cranberry (*Vaccinium macrocarpon* Ait cv Early Black) fruit. The effects of the herbicide on cranberry fruit volume, yield, acidity, %SSC, total

---

1/ Paper no.3020. Massachusetts Agricultural Experiment Station, University of Massachusetts at East Wareham. This research project is supported from Experiment Station Project No. 629.

2/ Professor, Laboratory of Experimental Biology, Cranberry Experiment Station, University of Massachusetts, East Wareham, MA 02538.

3/ Visiting scientist, Academy of Agriculture, Szczecin, Poland.

flavonols, and anthocyanin development were determined.

Table 1. Percent control of three important cranberry bog weeds with postemergence applications of clopyralid. No cranberry vine injury was observed.

Clopyralid (kg/ha)	Wild Bean	Narrowleaf Golden Rod	Aster sp.	Vine Injury
0.21	49	20	25	0
0.42	95	87	88	0
0.84	100	100	98	0

Methods and Materials

Three sections of cranberry bog free of weeds and having a relatively consistent number of uprights over a large area were chosen for treatment. Clopyralid was applied to the first section on June 20 prior to bloom and to the second section on August 1, thirty days after fruit set. Clopyralid was applied twice to the third section, once on June 20 and the second time on July 20, twenty days after fruit set. Clopyralid was applied as an aqueous spray to plots $6m^2$ in area, each being replicated four times and the plots randomized within replicates. Applications were made with a hand held knapsack sprayer as a fine mist at the rates of 0, 0.21, 0.42, and 0.84 kg/ha. At harvest berries were hand scooped and yield and berry volume determined. A sub-sample was taken from each plot and frozen for chemical analysis at a later date.

After 30 days the frozen berries were removed from the freezer and their acidity, %SSC, anthocyanin content, and total flavonols determined. Standard methods for determining acidity and %SSC were employed. Anthocyanins were determined according to the methods of Deubert (1) and flavonols according to the methods of Lee and Francis (3).

Results

Single applications of clopyralid prior to bloom caused significant reductions in yield. A 20% reduction at the 0.42 kg/ha rate and a 44% at the 0.84 kg/ha rate were observed (Table 2). However, when single applications of clopyralid were made 30 days after fruit set no reduction in yield was observed (Table 2).

Significant reductions in yield and vine injury occurred when double applications of clopyralid were made, one application prior to bloom and the second application 20 days after fruit set. Clopyralid at rates of 0.21, 0.42, and 0.84 kg/ha applied twice caused reductions in yield of 20, 40, and 71%, respectively (Table 2). Double applications also caused slight vine injury (leaf burn and curl) at all three rates.

Table 2. Data from three studies showing the effect of clopyralid (Herb) on yield when applied to cranberry bogs. In study #1 clopyralid was applied before bloom (6/20/91). In study #2 clopyralid was applied 30 days after fruit set (8/1/91). In study #3 clopyralid was applied twice, before bloom (6/20/91) and 20 days after fruit set (7/20/90).

Herb (kg/ha)	Study #1 (kg/ha)	%	Study #2 (kg/ha)	%	Study #3 (kg/ha)	%
0.00	12,525	100	6,426	100	10,125	100
0.21	12,250	98	6,300	98	8,075	80
0.42	10,075	80	6,300	98	6,025	60
0.84	7,000	56	6,100	95	2,925	29
LSD 5%	1,681	-	1,612	-	1,342	-
1%	2,356	-	2,259	-	1,882	-

Clopyralid applied once before bloom had very little effect on the growth and development of the cranberry fruit. The only significant difference noted was an increase (28%) in the anthocyanin content of berries from vines treated with 0.84 kg/ha clopyralid (Table 3). Clopyralid applied 30 days after fruit set also had very little effect on cranberry growth and development. Again the only difference observed was in the anthocyanin content of the berries. Clopyralid at 0.42 and 0.84 kg/ha caused anthocyanin reductions of 18 and 16%, respectively (Table 4).

Table 3. Effect of clopyralid (Herb) on cranberry fruit quality when applied before bloom (6/20/90 - Study #1). Acidity is in ml of 0.1 N NaOH/100g of berries. Berries were harvested 9/4/90.

Herb (kg/ha)	Vol (ml)	Acidity (ml)	SSC (%)	Anthocyanin (ml/100g)	Total Flavonols (mg/100g)
0.00	1.24	489	4.95	6.02	15.7
0.21	1.26	496	5.00	7.36	16.1
0.42	1.26	535	5.00	7.36	16.3
0.84	1.29	509	5.20	7.70	16.5
LSD 5%	0.08	57.3	0.23	1.59	1.36
1%	0.11	80.3	0.32	2.23	1.90

Table 4. Effect of clopyralid (Herb) on cranberry fruit quality when applied 30 days after fruit set (8/1/90 - Study #2). Acidity is in ml of 0.1 N NaOH/100g of berries. Berries were harvested 9/14/90.

Herb (kg/ha)	Vol (ml)	Acidity (ml)	SSC (%)	Anthocyanin (ml/100g)	Total Flavonols (mg/100g)
0.00	1.57	532	5.20	5.53	11.6
0.21	1.60	540	5.15	5.22	11.8
0.42	1.58	550	5.65	4.56	11.7
0.84	1.53	531	5.45	4.64	11.6
LSD 5%	0.06	18.0	0.55	0.71	1.80
1%	0.09	25.2	0.77	1.00	2.53

Increases in %SSC, anthocyanin content, and total flavonols were observed in berries from vines given a double application of clopyralid. At 0.42 and 0.84 kg/ha small but significant increases in the %SSC were observed (Table 5). All rates of clopyralid tested caused increases in anthocyanins and the highest rate (0.84 kg/ha) caused a 27% increase in total flavonols (Table 5).

Table 5. Effect of clopyralid (Herb) on cranberry fruit quality when applied twice (6/20/90; 7/20/90 - Study #3), once before bloom and once 20 days after fruit set. Acidity is in ml of 0.1 N NaOH/100g of berries. Berries were harvested 9/4/90.

Herb (kg/ha)	Vol (ml)	Acidity (ml)	SSC (%)	Anthocyanin (ml/100g)	Total Flavonols (mg/100g)
0.00	1.16	510	4.75	4.17	15.6
0.21	1.18	496	4.90	5.64	17.1
0.42	1.20	477	5.10	5.83	17.1
0.84	1.01	472	5.15	6.57	19.9
LSD 5%	0.05	40.7	0.21	1.10	1.8
1%	0.07	57.1	0.29	1.55	2.5

Discussion

This study demonstrates that a single application of clopyralid, either before bloom or 30 days after fruit set, has very little effect on the growth and development of the cranberry

fruit. Of the systems measured only anthocyanin development was influenced by the herbicide. When applied before bloom cranberry color (anthocyanins) was enhanced at the highest rate (0.84 kg/ha) of clopyralid used. When applied 30 days after fruit set there was a small decrease in color at the two highest rates (0.42 and 0.84 kg/ha) used.

Since there is a direct relationship between color development in the cranberry and its commercial value, growers must guard against any herbicide that might retard color development. However, when applied before bloom color development was enhanced by clopyralid and when applied after fruit set there was only a slight drop in color. If harvest is delayed one week the negative effect of the later application of clopyralid on color development could be corrected.

It is apparent that clopyralid when applied once, either before bloom or after fruit set, could be an effective herbicide for cranberry growers. Double application of the herbicide, however, cannot be recommended because it causes severe drops in yield and some vine damage.

Literature Cited

1. Deubert, K.H. 1978. A rapid method for the extraction and quantitation of total anthocyanin of cranberry fruit. J. Ag. & Food Chem. 26(6): 1452-1453.

2. Hall, J.C. and W.H. Vanden Born. 1988. The absence of a role of absorption, translocation, or metabolism in the selectivity of picloram and clopyralid in two plant species. Weed Sci. 36: 9-14.

3. Lee, D.H. and F.J. Francis. 1971. Quantitative methods for anthocyanins. 6. Flavonols and anthocyanins in cranberries. J. Food Sci. 36: 1056-1060.

4. Weed Science Society of America. 1989. Herbicide Handbook. 6th ed. Weed Sci. Soc. Am., Champaign, Il. 301 pp.

Effect of V-53482 on the Activity of Four Enzymes in Pea and Barley[1]

Irena I. Zbiec[2], Stanislaw J. Karczmarczyk[2], and Robert M. Devlin[3]

Abstract

The influence of V-53482 on the activity of acid phosphatase, alkaline phosphatase, nitrate reductase, and peroxidase in barley (Hordeum vulgare L.) and pea (Pisum sativum L.) leaf tissue was studied. In barley leaf tissue the activity of all four enzymes was stimulated by V-53482. This was especially true for nitrate reductase and peroxidase. In pea leaf tissue acid phosphatase activity was not affected by V-53482. Alkaline phosphatase, nitrate reductase, and peroxidase activity was stimulated by V-53482 but not to the extent found in barley.

Introduction

The experimental herbicide V-53482 {7-fluoro-6-[(3,4,5,6-tetrahydro)phthalimido]-4-(2-propynyl)-1,4-benzoxazin-3(2H)-one} has been shown to provide effective preemergence control of a number of broadleaf weeds and some grasses in soybean (1) and corn cultures. Sakaki et al. (1) determined that V-53482 was mainly absorbed by the germinating shoot. However, the mode of action of V-53482 is still unknown.

In the present paper the influence of V-53482 on the activity of nitrate reductase, peroxidase, acid phosphatase, and alkaline phosphatase in pea and barley was studied.

Materials and Methods

Pea and barley seeds were imbibed for 6 h in different suspensions of V-53482. The seeds were than sown in 8-cm styrofoam pots containing moist vermiculite and transferred to a growth chamber where they were allowed to grow under controlled conditions of light (152 uE $m^{-2}s^{-1}$, 16 h light, 8 h dark) and temperature (22±2°C). After shoot emergence 40 ml of 1/2 strength Hoagland solution was applied daily to each pot. After 10 days (barley) and 13 days (pea) of growth 2 g of leaf tissue was ground in a chilled mortar with 10 ml of phosphate buffer (pH 7.8) containing 0.005 M cysteine and 0.0025 M EDTA. The sample was filtered through Whatman No. 4 filter paper and the extract

---

1/ Paper No.3029. Massachusetts Agricultural Experiment Station, University of Massachusetts at East Wareham. This research project is supported from Experiment Station Project No. 629.

2/ Visiting scientist, Academy of Agriculture, Szczecin, Poland.

3/ Professor, Laboratory of Experimental Biology, Cranberry Experiment Station, University of Massachusetts, East Wareham, MA 02538.

centrifuged for 5 min at 13,000 G at 18°C. The supernatant (crude extract) was collected and used to assay the activity of acid phosphatase, alkaline phosphatase, nitrate reductase, and peroxidase.

To assay for nitrate reductase activity 1 ml of crude extract was diluted with 0.4 ml of 0.1 N KNO_3 and 1 ml of 0.001 N NADH (as an H^+ donor) and then incubated for 1 h at 27°C. The reaction was terminated by adding 1 ml of 6% zinc acetate, the sample cooled for 10 min at -10°C in a freezer, and then centrifuged for 5 min at 13,000 G. After 1 ml of the supernatant was diluted with 0.5 ml H_2O, 2 ml of reagent mixture (1 ml of 1% sulfanilic acid + 1 ml of 0.02% N-naphtylethylenediamine) was added and allowed to stand for 30 min. The release of NO_2^- was determined at 540 nm with a Perkin-Elmer double beam spectrophotometer. One unit equals the amount of NO_2^- in uM released in 1 h by 1 g of fresh tissue.

To assay for peroxidase activity 0.1 ml of crude extract was diluted with 1.9 ml phosphate buffer (pH 7), 0.1 ml of 1% p-phenylenediamine, and 0.1 ml of 0.04% hydrogen peroxide. The hydrogen peroxide is added to the reaction mixture just before being read with the spectrophotometer. The optical density (OD) of the reaction mixture was read at 485 nm every 30 sec for 2 min. One unit of activity equals the increase in OD in 1 sec caused by 100 g of fresh tissue.

To assay for acid phosphatase activity 0.05 ml of crude extract was diluted with 0.95 ml of buffer (pH 4.8) substrate containing 0.165% p-nitrophenylphosphate and incubated for 30 min at 40°C. After 5 ml of 0.02 N NaOH was added to the reaction mixture the OD was read at 405 nm. The addition of NaOH stops the reaction and the p-nitrophenol liberated by the phosphatase (both acid and alkaline) forms a yellow anion. One phophatase unit is the amount of enzyme in 100 g of fresh tissue which liberates 1 mM p-nitrophenol at 40°C.

To assay for alkaline phosphatase activity 0.1 ml of crude extract was diluted with 0.9 ml of buffer (pH 10.5) substrate containing glycine and 0.165% p-nitrophenylphosphate and incubated for 30 min at 40°C. After 5 ml of 0.02 N NaOH was added to the reaction mixture the OD was read at 405 nm. See definition of phosphatase unit above.

Peroxidase activity was determined according to the methods of Luck (2) and the phosphatases activity according to the methods of Linhardt and Walter (3). All experiments were replicated four times.

Results and Discussion

Phosphatases, which are classified as "acid" or "alkaline" according to their pH optimum, catalyze the hydrolytic cleavage of phosphoric esters. They are ubiquitous to plants and are essential participants in many important metabolic reactions. Both acid and alkaline phosphatase activity in barley leaves was stimulated by V-53482 and the stimulation was dose related (Table 1). At the highest rate applied (100 uM), V-53482 caused an 84% increase in acid phosphatase activity and a 39% increase in alkaline phosphatase activity (Table 1).

Nitrate reductase, found in the cell cytoplasm, is the first enzyme involved in the nitrate assimilation pathway. It is essential for the conversion of nitrogen from an oxidized state to a reduced state so that it can be incorporated into numerous important organic compounds. Nitrate reductase activity in barley leaves was dramatically increased by the presence of V-53482. For example, at 10 uM V-53482 there was four times as much activity compared to the control and at 100 uM V-53482 there was a ten fold increase in nitrate reductase activity (Table 1).

Peroxidase occurs in plant cells where it catalyzes the oxidation of certain organic compounds by hydrogen peroxide. Peroxidase in barley leaves is strongly stimulated by V-53482. For example, 10 and 100 uM V-53482 caused increases in peroxidase activity of 289 and 387%, respectively (Table 1).

Table 1. Effect of V-53482 on enzyme activity in barley.
Phos = phosphatase and U = unit.

V-53482 uM	Acid Phos (U/100g)	(%)	Alkaline Phos (U/100g)	(%)	Nitrate Reductase (uM NO_2^-/g/h)	(%)	Peroxidase (ΔE/sec/100g)	(%)
0	6.1	100	0.69	100	14.8	100	46.9	100
1	7.6	125	0.73	106	21.0	142	61.0	130
5	8.2	134	0.79	114	30.9	209	75.2	160
10	10.7	175	0.82	119	58.9	398	182.4	389
50	11.1	182	0.80	116	57.7	390	186.8	398
100	11.2	184	0.96	139	150.1	1014	228.3	487
LSD 5%	0.40	-	0.05	-	12.3	-	23.1	-
1%	0.55	-	0.07	-	16.9	-	31.7	-

Acid phosphatase activity was not stimulated in pea leaves by the presence of V-53482 (Table 2). However, alkaline phosphatase activity was, the herbicide at 5, 10, 50, and 100 uM causing increases of 18, 23, 27, and 34%, respectively (Table 2).

Table 2. Effect of V-53482 on enzyme activity in pea.
Phos = phosphatase and U = unit.

V-53482 uM	Acid Phos (U/100g)	(%)	Alkaline Phos (U/100g)	(%)	Nitrate Reductase (uM NO_2^-/g/h)	(%)	Peroxidase (ΔE/sec/100g)	(%)
0	11.0	100	1.09	100	43.5	100	32.6	100
1	11.5	105	1.11	102	42.9	99	34.5	106
5	11.8	107	1.29	118	44.4	102	36.9	113
10	11.8	107	1.34	123	52.4	120	49.4	151
50	11.0	100	1.38	127	58.0	133	49.9	153
100	11.7	106	1.46	134	60.7	140	55.7	171
LSD 5%	1.86	-	0.23	-	10.3	-	7.12	-
1%	2.54	-	0.32	-	14.1	-	9.76	-

Nitrate reductase and peroxidase activity in pea leaves was stimulated by V-53482 (Table 2). However, the stimulation of the activity of these enzymes in pea leaves by V-53482 was much less than that found in barley leaves. For example, 50 uM V-53482 caused a 29% increase in nitrate reductase activity and a 298% increase in peroxidase activity in barley leaves (Table 1). However, in pea leaves 50 uM V-53482 caused increases in activity of nitrate reductase and peroxidase of only 40 and 71%, respectively (Table 2).

Literature Cited

1. Linhardt, K. and K. Walter. 1963. Phosphatases (phosphomonoesterases). In Methods of Enzymatic Analysis, H. Bergmeyer, ed. Academic Press, N.Y.

2. Lück, H. 1963. Peroxidase. In Methods of Enzymatic Analysis, H. Bergmeyer, ed. Academic Press, N.Y.

3. Sakaki, M., R. Sato, T. Haga, E. Nagano, H. Oshio, and K. Kamoshita. 1991. Herbicide efficacy of S-53482 and factors affecting the phytotoxicity and the efficacy. WSSA Abstr. No. 34, 3:12.

VARIABILITY IN THE EFFICACY OF BAS 514..H ON CRABGRASS

S. J. Koo, N. D. Webber and J. C. Neal [1/]

ABSTRACT

BAS 514..H (quinclorac) is regarded as a promising herbicide for the control of crabgrass (*Digitaria* spp.) in turf. However, the efficacy of BAS 514 on crabgrass has been inconsistent among several different field locations. The causes of this variability are unclear. The effects of the potential variables such as irrigation schedule, drought, spray coverage, biotype differences in susceptibility, and growth stages of smooth crabgrass [*Digitaria ischaemum* (Schreb. ex Schweig.) Schreb. ex Muhl] were investigated.

The influence of irrigation was examined in the field which was under drought, from June to July 1991. BAS 514 (0.8 kg/ha) was sprayed at -2, -1, 0, 1, 2 or 4 days after irrigation and the efficacy was visually evaluated 4 wk after application. The effect of drought and/or spray coverage was studied in lysimeters, once in a rain exclusion shelter and repeated in a growth chamber at 25°C. Smooth crabgrass seedlings were transplanted into lysimeters at the 2-leaf stage. Plants were grown until the 2-tiller stage. Two watering regimes were compared: (1) field capacity and (2) dried to about -15 bars plant water potential. BAS 514 was applied at 0.6 or 0.8 kg/ha to either the foliage, soil, or both, by soil surface coverage with vermiculite, plant coverage with small test tubes, or no coverage, respectively. Seven or three days after BAS 514 application (in the rain exclusion shelter or in the growth chamber, respectively), drought treatments were watered and thereafter maintained at field capacity. The efficacy was visually evaluated at 1 wk intervals. Seed from two sources, Ithaca, New York and Columbus, Ohio were compared for differences in 50 % or 90 % inhibition rates (I_{50} or I_{90}). Two-leaf, 3-leaf, 1-tiller and 2-tiller stage plants of both biotypes were sprayed with several rates of BAS 514. After 2 wk, remaining green shoots were excised for the fresh weight measurement, and the I_{50} and I_{90} for each biotype and stage were calculated.

Irrigation schedule under drought conditions greatly affected the efficacy of BAS 514. When applied after irrigation, good to excellent control was obtained, however, when applied before irrigation, virtually no control was observed. The optimum time of irrigation was 2 to 4 days before BAS 514 treatment. Drought decreased the efficacy of BAS 514 significantly in the lysimeter experiments. The efficacy decreased more with foliar applications than with soil applications. Regardless of the water regime, the efficacy of foliar applications was greatest 2 wk after application, and then decreased. Control with soil applications was much slower, with symptoms beginning about 2 wk after application and increasing to a maximum 4 wk after treatment. Biotype differences in susceptibility were not significant up to the 1-tiller stage. However, at the 2-tiller stage, the New York biotype was more tolerant than the Ohio biotype with I_{90} of 472 and 400 g/ha for New York and Ohio biotypes, respectively. The application rate to achieve 90 % control increased as growth stage advanced.

These results show that the efficacy of BAS 514 is greatly affected by drought. BAS 514 efficacy was also affected by application method, biotype, and growth stage of smooth crabgrass. To overcome this variability, pre-irrigation is suggested to enhance the efficacy under drought conditions. Further research is needed to define methods for enhancing BAS 514 efficacy where scheduled irrigation is not possible. These data suggest that when irrigation is not available, root-targeted treatments or application methods which enhance foliar activity should be investigated.

1/ Graduate Students and Assoc. Professor, respectively, Cornell University, Ithaca, NY 14853.

Cover Crop and Tillage Effects on Weed Populations and Cabbage Yield

Francis X. Mangan, Stephen J. Herbert, and Gerald V. Litchfield[1]

ABSTRACT

A Field experiment was initiated at the Research Farm of the University of Massachusetts in South Deerfield to study the effects of cover crops and tillage on weed pressure and cabbage yield. There were four cover crop combinations seeded August 8, 1990: Oat (*Avena sativa*) alone, oat in combination with lana vetch (*Vicia villosa*), oat in combination with Austrian winter field pea (*Pisum arvenu*), and no cover crop seeded. Each cover crop treatment was combined factorially with two spring tillage regimes (soil incorporated or no-till) and the absence or presence of spring weed control. Weed control consisted of the herbicide DCPA at 11.2 kg/ha ai followed by hand-weeding as necessary. Cabbage (*Brassica oleracea*, Capitata group cv. "Early Action") plants were transplanted April 17, 1991, and the herbicide was applied April 18. Tillage had a much greater effect on weed pressure and cabbage growth than cover crops. Horseweed (*Erigeron canadensis*) and Shepherd's purse (*Capsella bursa-pastoris*) were completely controlled by tillage while these species were serious problems in the no-till treatments. The cabbage plants in the conventionally tilled plots had a greater yield and matured earlier than no-till treatments. No-till treatments without weed control gave almost no yield. The tilled plots without weed control gave poor yield without cover crops and an acceptable to good yield with cover crops. This may be attributed to the addition of organic matter and nitrogen from the cover crops, competition of the cover crops with weed species in the fall and spring, and possibly the release of allelopathic compounds that inhibited the growth and germination of weed species.

---

[1]Research Assistant, Professor and Technical Assistant, Dept. Plant and Soil Sciences, Bowditch Hall, University of Mass., Amherst, Mass. 01003.

EVALUATION OF BROADCAST DORMANT STEM APPLICATIONS FOR ROADSIDE BRUSH CONTROL

Arthur E. Gover, Larry J. Kuhns, and David A. Batey[1/]

ABSTRACT

As part of a Pennsylvania Department of Transportation sponsored project to evaluate brush control methods for highway roadsides, studies evaluating broadcast dormant stem applications were established on April 8 and 19, 1991. Both studies were applied with a Cibilo Swinglok Jr. computerized injection sprayer using a Radiarc spray head. The Radiarc was configured with ten 2.56 mm (0.101 in) nozzles delivering a total of 22.7 l/min at 172 kpa to a 2.5 m horizontal spray swath. At the target speed of 2.2 m/sec, spray volume was 700 l/ha. The April 8 study was applied to 185 m plots on a farm hedgerow in Benner Township, Centre County, PA. Predominant species were brambles (Rubus spp.), gray dogwood (Cornus racemosa Lam.), staghorn sumac (Rhus typhina L.), black cherry (Prunus serotina Ehrh.), tatarian honeysuckle (Lonicera tatarica L.), and autumn olive (Eleagnus umbellata Thunb.). The four treatments applied were triclopyr at 6.7 kg/ha plus emulsifiable spray oil [2/] at 7.0 l/ha, triclopyr at 3.4 kg/ha plus emulsifiable spray oil at 21 l/ha, triclopyr at 3.4 kg/ha plus emulsifiable spray oil at 14 l/ha, and triclopyr at 3.4 kg/ha plus a non-emulsifiable oil[3/] at 14 l/ha. The April 19 study was applied to roadside brush along I-80 in Union County, PA. The most common species were red maple (Acer rubrum L.), oak (Quercus spp.), mountain laurel (Kalmia latifolia L.), witch hazel (Hamamelis virginiana L.), and blueberry (Vaccinium spp). The six treatments consisted of triclopyr at 3.4, 5.0, and 6.7 kg/ha, each applied with emulsifiable spray oil at 14 or 21 l/ha, and were applied to 60 m plots. Visual injury ratings were taken at both sites on July 3, 1991, using a scale of 0 to 7, where '0' indicates no visible injury, '1' through '4' are for increasing levels of injury up to '5', which indicates complete control of treated branches; '6' is given when plants show injury above the treated branches; and '7' indicates the plant is completely killed. Results for the April 8 study are reported in Table 1, and results from the April 19 study are reported in Table 2.

At the April 8 site, gray dogwood and brambles were effectively controlled by all treatments. Tatarian honeysuckle and cherry were not controlled by any treatments. Most treated branches of staghorn sumac were controlled by triclopyr plus spray oil at 3.4 kg/ha plus 21 l/ha, or 6.7 kg/ha plus 7 l/ha. Sumac showed almost no injury from the other treatments. Triclopyr at 3.4 kg/ha plus spray oil at 21 l/ha provided control of all treated species equivalent to triclopyr at 6.7 kg/ha plus 7 l/ha oil. There was no difference in control provided by the different spray oils.

At the site treated on April 19, red maple and the oak species showed increasing injury with increasing rates of both triclopyr and spray oil. Adequate control of maple was provided by triclopyr at 6.7 kg/ha with 14 l/ha of spray oil, and 5.0 and 6.7 kg/ha with 21 l/ha of spray oil. Oaks were effectively controlled with 6.7 kg/ha triclopyr plus 14 l/ha spray oil , and all rates of triclopyr with 21 l/ha of spray oil. Mountain laurel showed more response to triclopyr rate than adjuvant rate, and was effectively controlled at the high rates of triclopyr. Blueberry also showed a response to triclopyr rate, and was controlled at the high rate, but was present only in the plots treated with 14 l/ha of spray oil.

[1/] Project Associate, Professor of Ornamental Horticulture, and Research Technologist, respectively, The Pennsylvania State University.

[2/] Clean Cut + Pine, Arborchem Products, Inc., Ft. Washington, PA.

[3/] Hy-Grade, CWC Chemical Inc., Roanoke, VA.

TABLE 1: Injury ratings taken July 3 for broadcast dormant stem treatments applied April 8, 1991. Treatments were applied with a Cibilo Jr. sprayer using a Radiarc spray head delivering 700 l/ha. Hyphenated ratings indicate a range of injury, and '- -' indicates the species was not present.

triclopyr (kg/ha)	6.7	3.4	3.4	3.4
spray oil (l/ha)	7	14	14 (non-emulsifiable)	21
	(Injury (0-7)[1/])			
gray dogwood	5	4-5	5	5
brambles	5	5	5	5
sumac	3-5	1	1	3-5
honeysuckle	- -	1	1	1
cherry	1	- -	1	2
autumn olive	4-5	- -	- -	4

1/ Injury was rated on a 0 to 7 scale with '0' being no injury, '5' is complete control of contacted branches, '6' indicates translocation beyond the treated branches, and '7' indicates complete control of the plant.

TABLE 2: Injury ratings taken July 3 for broadcast dormant stem treatments applied April 19, 1991. Treatments were applied with a Cibilo Jr. sprayer using a Radiarc spray head delivering 700 l/ha. Hyphenated ratings indicate a range of injury, and '- -' indicates the species was not present.

triclopyr (kg/ha)	3.4	5.0	6.7	3.4	5.0	6.7
spray oil (l/ha)	14	14	14	21	21	21
	(Injury (0-7)[1/])					
red maple	1	1-2	3-6	2-3	4-5	4-6
oak	1-4	3-4	3-5	4-5	4-5	4-6
mountain laurel	3	4-5	4-5	3-4	4	5
blueberry	3-4	4	4-5	- -	- -	- -
witch hazel	- -	- -	3-5	- -	4-5	4-5

1/ Injury was rated on a 0 to 7 scale with '0' being no injury, '5' is complete control of contacted branches, '6' indicates translocation beyond the treated branches, and '7' indicates complete control of the plant.

SEEDBANK AND PLANT POPULATION CHANGES FOLLOWING CONSERVATION TILLAGE IN THE MARYLAND PIEDMONT

S. Mills[1], T.J. Tworkoski[2], C.B. Coffman[3], and G.R. Leather[2]

ABSTRACT

Effects of zero, one, or five contiguous years of conservation tillage were compared at Frederick and Beltsville, Maryland. Field evaluations of broadleaf weed density, frequency, and dominance were made during the 1990 growing season following herbicide application and no-till planting of Zea mays. Seedbank composition was evaluated on the basis of bimonthly identification of seedlings which had germinated from soil samples removed from field plots and maintained in a greenhouse for one year.

In all treatments in the field, perennial broadleaf plants were generally dominant at the beginning of the growing season but their dominance decreased over time as annual broadleaf plants and grass became more important. Similar trends were observed in the greenhouse as the number of germinating perennial broadleaf plants decreased rapidly in contrast to the number of germinating annual plants. Five years of conservation tillage reduced the importance of perennial broadleaf plants compared to one year and control. Dandelion (Taraxacum officinale Weber) and Canada thistle (Cirsium arvense L.) were the domiant perennial broadleaf weeds in both field and greenhouse. Pennsylvania smartweed (Polygonum pensylvanicum L.), smooth pigweed (Amaranthus hybridus L.) chickweed (Stellaria media L.), and henbit (Lamium amplexicaule L.) were predomiant annual broadleaf weeds.

---

[1]Dept. of Biology, Hood College, Frederick, MD 21701; [2]Foreign Disease-Weed Science, USDA-ARS, Fort Detrick, Frederick, MD 21702; [3]Weed Science Laboratory, USDA-ARS, BARC-West, Beltsville, MD 20705

BIOLOGICAL CONTROL OF ANNUAL BLUEGRASS (POA ANNUA VAR. REPTANS) WITH XANTHOMONAS CAMPESTRIS PV. POANNUA

N.D. Webber, E.B. Nelson, and J.C. Neal[1/]

ABSTRACT

In New York, annual bluegrass (Poa annua L.) is one of the most wide-spread and difficult-to-control weeds of highly maintained turf. The bacterium, Xanthomonas campestris pathovar poannua, is a facultative parasite isolated by Michigan State University researchers from diseased Poa annua in golf course turf. Preliminary experiments have shown this bacterium to be pathogenic on annual bluegrass, to have a very narrow host range, and to require a wound (mowing) for infection. To further understand the interaction between annual bluegrass and X. c. pv. poannua, our research was designed to determine the efficacy of Xanthomonas campestris pv. poannua on the perennial biotype of annual bluegrass, Poa annua var. reptans, under controlled (growth chamber) and field conditions.

For all growth chamber tests, approximately 4-wk-old annual bluegrass plants with 2- to 5-tillers were used. To evaluate the effect of wounding on pathogenicity, bacterial suspensions were sprayed or drenched on the foliage before or after clipping. Clipping heights were maintained at about 2.5 cm. Cells were applied at the rate of 1.0 ml of 10^9 cfu/ml suspension per 10-cm-diameter pot. The growth chamber was maintained at a constant 27°C with a 12 hr photoperiod. The experimental design was a randomized complete block with three replications. Pathogenicity was determined by visual estimation of percent reduction of living tissue.

In field tests, Poa annua var. reptans was seeded with native New York Poa annua seed 7 wk prior to inoculation. A mixed sod, composed of creeping bentgrass (Agrostis palustris) and annual bluegrass was transplanted to the test area approximately 11 wk prior to inoculation. Application rates were 750 ml each of 3.3×10^9, 3.3×10^8, 3.3×10^7, and 3.3×10^6 cfu/ml suspensions, applied to 4.2 m^2 plots. Treatments were applied three times at 2 wk intervals beginning 25 July 1991. Bacterial treatments were compared to an untreated control and an antibiotic treatment (Agri-Strep at 11.36 g/m^2). Plots were mowed at 6.5 mm following treatment. The experimental design was a randomized complete block with four replications. Pathogenicity was evaluated visually as in the previous tests.

In growth chamber tests, the disease progressed more rapidly when plants were drenched or sprayed before cutting, compared to applications after cutting (Figure 1). Drench treatments were slightly superior to spray applications. However, by 50 days after treatment (DAT), all treatments provided 100% control. In field tests, control of annual bluegrass was less satisfactory than in growth chamber tests. At 42 DAT, the maximum control obtained was about 18%. By 56 DAT, the annual bluegrass had begun a gradual recovery. These results demonstrate that multiple applications may be necessary and timing of applications may be critical for satisfactory control of annual bluegrass.

Xanthomonas campestris pv. poannua was pathogenic on Poa annua var. reptans. From these results it can be concluded that under growth chamber conditions, annual bluegrass can be effectively controlled with this bacterium. These data also demonstrate the need for continued research under field conditions.

1/Graduate Student, Asst. Professor, and Assoc. Professor, respectively, Cornell University, Ithaca, NY 14853.

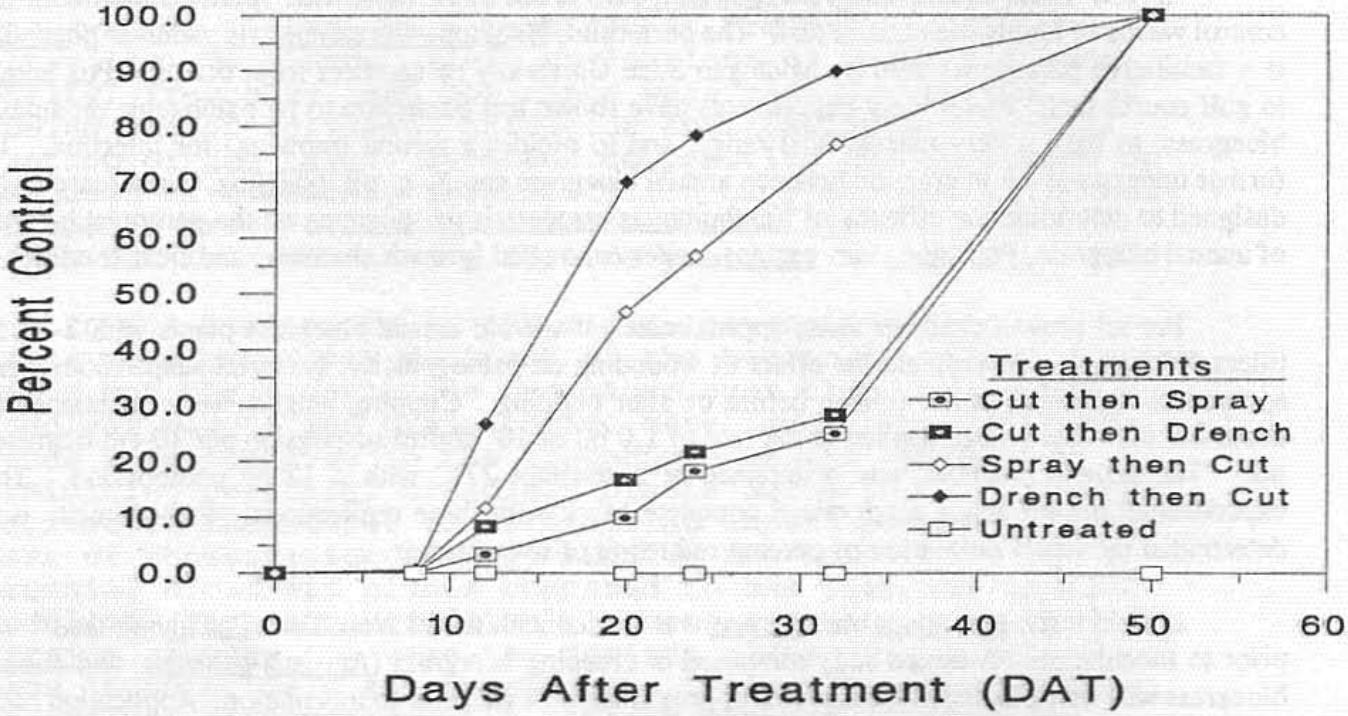

Figure 1. Biological control of annual bluegrass (*Poa annua* var. *reptans*) with *Xanthomonas campestris* pv. *poannua* under controlled conditions.

Evaluation of sulfonylurea herbicides for bunchberry suppression in lowbush blueberry fields.

David E. Yarborough 1

ABSTRACT

The sulfonylurea herbicides, chlorimuron, chlorsulfuron, and sulfmeturon methyl were applied at 0, 50, 100 and 200 gm ai/ha preemergence and presenescent and at 0, 25, 50, 100 gm ai/ha at blueberry tip-dieback on lowbush blueberry (*Vaccinium angustifolium)* fields with bunchberry (*Cornus canadensis*). Treatments were applied in 1989 blueberry and bunchberry stems were counted, and blueberry length, buds and yield obtained. The experiment was repeated on a adjacent field in 1990. Preemergence applications of chlorsulfuron decreased bunchberry and increased blueberry in 1989, but reduced it in 1990; chlorimuron reduced bunchberry in 1990 and sulfmeturon methyl stimulated blueberry stand and buds in 1989. Tip-dieback applications of all herbicides did not affect blueberry or bunchberry. The presenescent applications of chlorimuron suppressed bunchberry in 1989 but not in 1990, chlorsulfuron suppressed bunchberry both years but also reduced blueberry stand, buds and yield and sulfmeturon methyl reduced bunchberry without affecting blueberry both years. Selective suppression of the bunchberry may be obtained with the sulfonylurea herbicides but the timing and rates need to be better defined.

---

1 Assistant Professor of Horticulture, Deptartment of Plant, Soil and Environmental Sciences, University of Maine, Orono, ME 04469

MUSTARD DENSITY EFFECTS ON POTATO YIELD AND TUBER SIZE

Gregory A. Porter, Jonathan A. Sisson[1] and Michele C. Marra[2]

ABSTRACT

Increased availability of selective, postemergence herbicides will improve the potential for developing integrated pest management strategies for weed control in potato (Solanum tuberosum L.). If economic threshold models are to be adopted by producers as part of an integrated pest management strategy, information concerning the underlying crop-pest relationships must be accurate. Information needs will include reliable information on the effects of weeds on crop yield, quality, and monetary value. Information will also be needed on the reliability of postemergence herbicides for weed control, as well as short- and long-term effects of varying weed infestations on harvest costs and crop rotation alternatives.

Field experiments were performed during 1990 and 1991 to relate varying mustard (Brassica Kaber L. and Brassica campestris L.) densities to potato, cv. 'Katahdin', yield and quality losses. Potato tuber yields, above-ground biomass, and leaf area were strongly reduced as mustard density increased. Tuber size was also strongly reduced by weed competition, while other crop quality attributes were not affected. Total tuber yield at the highest weed density during 1990 (340 weeds m^{-2}) averaged only 42% those in weed-free checks. Percentage of yield in the large size classes (6.4 to 10.2 cm diameter) was reduced from 68 to 27 as weed density increased. Most of the observed yield and quality loss occurred as weed density increased from 0 to 50 weeds m^{-2}, indicating that this density range is of greatest interest for developing economic threshold data. Relative leaf area and weed densities are being evaluated as to their usefulness in measuring weed pressure for economic threshold calculation.

[1]Assoc. Professor and Assistant Scientist; Dept. of Plant, Soil and Environmental Sciences, University of Maine, Orono, ME 04469.

[2]Assoc. Professor; Department of Agricultural and Resource Economics, University of Maine, Orono, ME 04469.

GLYPHOSATE APPLICATIONS TO THE BARK OF NINE TREE SPECIES

Larry J. Kuhns[1]

ABSTRACT

Trees with thin bark or bark with some pigment in it are capable of absorbing glyphosate. Glyphosate absorbed through the bark can cause slight cracks at the site of absorption to severe cankers that can reach from the ground line up into the canopy of the tree. Symptoms may not be evident until one to two years after application. This project was designed to examine how rate of application, placement, and species affects the probability that an application of glyphosate will cause injury. The following trees were planted in spring, 1988 at the Penn State Horticulture Research Farm at Rock Springs: Northwood red maple (Acer rubrum L. cv. Northwood), green ash (Fraxinus pennsylvanica Marsh.), thornless honeylocust (Gleditsia triacanthos L. var. inermis Willd.), Cortland apple (Malus cv. Cortland), Montmorency cherry (Prunus cv. Montmorency), M.A. Blake peach [Prunus Persica (L.) Batsch cv. M.A. Blake], Cleveland Select flowering pear (Pyrus Calleryana Decne cv. Cleveland Select), English oak (Quercus robur L.), and littleleaf linden (Tilia cordata Mill.). At the time of treatment they were between 1.8 and 4.3 cm diameter, 30 cm above the ground. On August 25, 1989 the following glyphosate treatments were appliedto the tree trunks: control, 4.4 kg/ha on soil only, 1.1 or 4.4 kg/ha to the lower 15 cm of trunk on both sides, and 1.1 or 4.4 kg/ha to the lower 45 cm of trunk on one side. When applying the treatments to 15 cm of the trunk the nozzle was held about 30 cm away from the trunk. When applying the treatments to 45 cm of the trunk the nozzle was held within 10 cm of the trunk. Trees were evaluated for damage to foliage or bark in 1989, 1990, and 1991.

No signs of foliar damage from any of the glyphosate treatments have been observed. None of the treatments damaged the bark of ash, honeylocust, maple, oak, pear, or apple. One linden that received the glyphosate at the 4.4 kg/ha rate at 45 cm had a sunken canker that looked like it could have been caused by the treatment. On one other linden that received the same rate, but at 15cm on both sides of the trunk, the bark from 10 to 30 cm all around the trunk was crinkled but alive. It is uncertain whether or not this injury was caused by the glyphosate. Among the cherries and peaches, dead trees and bark splitting were scattered throughout the treatments so it is not possible to definitively attribute any of the injury to the glyphosate treatments. Glyphosate applied at 4.4 kg/ha with the nozzle held close to the trunks of young trees was the most likely treatment to cause injury. It was a high rate, applied directly to the trunks of young trees that still had pigment in their bark. Yet it did not injure young ash, honeylocust, maple, pear, oak or apple; and it only definitely damaged one of the lindens. It is apparent that these trees tolerate limited amounts of glyphosate applied to their bark even when it is thin and pigmented.

INTRODUCTION

Glyphosate [*N*-(phosphonomethyl)glycine] is a nonselective, translocated, postemergence herbicide that has been labelled for use in ornamental plantings for over 15 years under the trade name Roundup[2]. Throughout this paper all of the glyphosate referred to or used was in the formulated product Roundup.

When glyphosate comes in contact with soil it is inactivated and rapidly decomposed by soil microorganisms. It has no residual activity in the soil and is only absorbed by living cells. These characteristics have made it an especially useful material for controlling weeds around trees.

---

[1] Professor of Ornamental Horticulture, Department of Horticulture, The Pennsylvania State University, University Park, PA 16802

[2] 480g/l isopropylamine salt of N-(phosphonomethyl)glycine formulated with in-can surfactant, Monsanto, St. Louis, MO 63167

Paper towels were taped around the trees to prevent application above the target height. All treatments were applied with CO_2 powered test plot sprayer at 207 kPa in the equivalent of 140 L/ha of water. Treatments applied through the 8002E nozzles were applied to both sides of the tree row. The treatment to soil only was not allowed to contact any bark. When applying the treatments to 15 cm of the bark the nozzle was held about 30 cm from the trunk and each side of the tree was sprayed. This was to simulate an application to control weeds directly in the tree row, in which some overlap would be needed and some bark would be contacted.

Table 1. Trees planted in replicated plots in spring, 1988; their height range or average caliper at planting, and their average caliper just prior to treatment in August, 1989. Caliper was measured at 30 cm.

	Size	
Variety/Species	At Planting (ht. or cal.)	When Treated (caliper)
Northwood Red Maple	0.6-0.9 m	1.8 cm
Green Ash	1.2-1.5	3.0
Thornless Honeylocust	1.8-2.1	3.3
Cleveland Select Flowering Pear	1.2-1.5	3.0
English Oak	0.9-1.2	2.3
Littleleaf Linden	0.9-1.2	2.0
Cortland VF Apple	1.9 cm	2.8
Montmorency VF Cherry	1.9	3.0
M.A. Blake Peach	1.9	4.3

When applying the treatments to 45 cm of the bark the nozzle was held within 10 cm of the trunk and only one side of the tree was sprayed. This was to simulate an application in which both sides of the tree row are sprayed with one pass. These treatments were applied to the north side of the trees to minimize confusion with naturally occurring bark splitting that normally occurs on the south or west sides of trees.

The treatments were arranged in a randomized complete block design with six replications. All trees were fertilized and pruned and problem insects were controlled. The trees were examined each year after treatment for any signs of foliar or bark damage.

RESULTS

No signs of foliar damage from any of the glyphosate treatments have been observed.

None of the treatments damaged the bark of ash, honeylocust, maple, oak, pear, or apple.

One linden that received the glyphosate at 4.4 kg/ha rate at 45 cm had a sunken canker that looked like it could have been caused by the treatment. It was on the north side of the tree, 1.3 to 2.5 cm wide, and began 30 cm above the ground and ended at 60 cm. Callus growth around the edge of the canker indicated that the injury had occurred some time earlier and that wound closure had begun sometime in the previous year. On one other linden that received the same rate, but at 15 cm on both sides of the trunk, the bark from 10 to 30 cm all around the trunk was crinkled but alive. It is uncertain whether or not this injury was caused by the glyphosate.

It can be applied to weeds growing over the root systems of trees without fear of the roots absorbing it. Glyphosate will not penetrate bark that is mature and has a layer of dead cells outside. Trees at this stage generally have a light gray to very dark bark.

A problem exists though because glyphosate can be absorbed into bark if the outer layer of cells is alive. Trees that still have some pigment in their bark are capable of absorbing glyphosate. Most young trees have pigment in their bark; including oaks with green bark and lindens with green, yellow, or reddish colored bark.

Glyphosate injury has been difficult to diagnose because it has several symptoms and they may not be evident in the plant for 6 to 24 months after application. Foliar symptoms include stunting and clustering of growth, chlorosis, and distortion of leaves similar to the injury caused by the hormone herbicides 2,4-D [(2,4-dichlorophenoxy)acetic acid] and dicamba (3,6-dichloro-2-methoxybenzoic acid). If applied in the spring, symptoms will be evident in the summer. If applied after the growth is fully extended and mature, the injury may not be seen until the following spring. Glyphosate absorbed through the bark can cause slight cracks at the site of absorption to severe cankers that can reach from the ground line up into the canopy of the tree. Symptoms may not be evident until one to two years after application.

Though many people involved in landscape maintenance have reported observing these symptoms in trees, it has been difficult to define the exact conditions under which injury will occur. This project was designed to examine how rate of application, placement, and species affects the probability that an application of glyphosate will cause injury.

MATERIALS AND METHODS

The following trees were planted in spring, 1988 at the Penn State Horticulture Research Farm at Rock Springs: Northwood red maple (Acer rubrum L. cv. Northwood), green ash (Fraxinus pennsylvanica Marsh.), thornless honeylocust (Gleditsia triacanthos L. var. inermis Willd.), Cortland apple (Malus cv. Cortland), Montmorency cherry (Prunus cv. Montmorency), M.A. Blake peach [Prunus Persica (L.) Batsch cv. M.A. Blake], Cleveland Select flowering pear (Pyrus Calleryana Decne cv. Cleveland Select), English oak (Quercus robur L.), and littleleaf linden (Tilia cordata Mill.). Forty-eight plots including one of each of the species were planted.

The preemergence herbicides oxyfluorfen [2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene]and oryzalin [4-(dipropylamino)-3,5 dinitrobenzenesulfonamide] were used to prevent weed growth in the rows. Neither are root or bark absorbed and would produce no injury symptoms that could be confused with Roundup damage.

Just prior to treatment the caliper of the trees was measured at 30 cm above the ground. Trunks were also examined and any existing bark damage was noted. Their size at the time of planting and treatment are listed in Table 1. On August 25, 1989 the following glyphosate treatments were applied:

Rate(kg/ha)	Nozzle	Bark Contacted
Control		
4.4	8002E	None (soil only)
1.1	8002E	15 cm, both sides
4.4	8002E	15 cm, both sides
1.1	8004E	45 cm, one side
4.4	8004E	45 cm, one side

Among the cherries and peaches, dead trees and bark splitting were scattered throughout the treatments so it is not possible to definitively attribute any of the injury to the glyphosate treatments (Table 2). However there are several bits of data that are worth considering. Among the trees that received the high rate of glyphosate directly on the trunk at 45 cm, 4 of the 6 cherries died and one developed a canker, and 5 of the 6 peaches treated developed severe cankers. When the high rate was applied on both sides of the trunks of peach at 15 cm, 2 of the 6 plants died and 2 others developed cankers. Finally, 3 of the 6 cherries that had glyphosate applied over the roots, with no bark contact, developed cankers.

Table 2. The number of cherry and peach trees that were dead or had basal cankers in their trunks in August, 1991. Six trees of each species were planted spring 1988 and treated in August, 1989.

Rate (kg/ha)	Treated Height (cm)	Cherry		Peach	
		Dead	Cankers	Dead	Cankers
0		1	1	0	2
4.4	0	1	3	0	3
1.1	15	2	1	0	3
4.4	15	1	1	2	2
1.1	45	2	1	0	0
4.4	45	4	1	0	5

DISCUSSION

Glyphosate applied at 4.4 kg/ha with the nozzle held close to the trunks of young trees was the most likely treatment to cause injury. It was a high rate, applied directly to the trunks of young trees that still had pigment in their bark. Yet it did not injure young ash, honeylocust, maple, pear, oak or apple; and it definitely damaged only one of the lindens. It is apparent that these trees tolerate limited amounts of glyphosate applied to their bark.

It is the opinion of the author that the severe damage seen in nurseries and landscape sites that is due to glyphosate occurs as a result of the following errors in application: application at too high a rate intentionally or due to poor or no calibration of equipment; soaking of the bark with the spray solution during spot applications of weeds growing around or on the trunk, or by trying to spray both sides of a tree row with one pass of the sprayer; or repeat applications of glyphosate alone, rather than including preemergence herbicides in the weed control program to limit the need to one application per year.

Growers and landscape maintenance professionals can minimize the risk of injuring trees by calibrating application equipment and applying only the amount of glyphosate needed to control the weeds present. For annual weeds or easy to control perennials 1 kg/ha is sufficient to kill or severely stunt them. For tough to control perennial weeds 2 kg/ha is sufficient. Also, when applying to trees in rows, the spray should be directed to the base of the trees and two passes should be made so that each side of the row is sprayed. Attempting to spray both sides of the row with one pass requires the applicator to hold the nozzle too high and too close to the tree trunks. Finally, extra caution should be used when spraying around trees with thin, pigmented bark.

VARIETAL RESPONSES TO CLOMAZONE

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

ABSTRACT

Greenhouse studies were conducted between March and June 1991 to determine if varieties of snapbeans, (Phaseolus vulgaris L.); cucumbers, (Cucumis sativus L.); summer squash, (Cucurbita spp.); and watermelons (Citrullus lanatus Thunb.) responded differently to clomazone. Commercial seed companies furnished varieties of their choice including standards and new releases for inclusion in these studies. After planting in styrofoam cups, clomazone was applied preemergence at 175 or 560 g/ha. Injury ratings, height measurements, fresh and dry weights were determined at appropriate intervals after studies were initiated. The response of all four crops to 175 g/ha clomazone was so low that only the high rate was useful to compare varieties. Although varietal responses to 560 g/ha clomazone were significantly different within the four crops, it was concluded that high rates could probably injure most varieties. Relating these results to those observed in field studies and grower use, it was concluded that low rates of clomazone applied in a band area over the row would result in very little injury to most varieties of these four vegetables and reduce the quantity of clomazone that might otherwise be lost from preemergence broadcast applications.

---

[1]Agric. Res. Sci. A and Prof., Eastern Shore Agric. Exp. Stn., Va. Polytech. Inst. and State Univ., Painter, VA 23420.

PRIMISULFURON COMBINATIONS FOR BROADLEAF WEED CONTROL IN CORN

M.G. Schnappinger, C.M. Moseley, J.D. Abbott, and S.W. Pruss[1]

ABSTRACT

Primisulfuron was evaluated alone and in combination with 2,4-D, dicamba, and bromoxynil for postemergence control of broadleaf weeds in corn (Zea mays L.). Weeds tested included Canada thistle [Cirsium arvense (L.)Scop.] , velvetleaf (Abutilon theophrasti Medik.), field bindweed (Convolvulus arvensis L.), redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), and giant ragweed (Ambrosia trifida L.).

Control of velvetleaf, Canada thistle, and redroot pigweed, was very good to excellent where primisulfuron was applied at 20-40 gr ai/ha and there was no increase in control from the combinations. Giant ragweed was controlled very effectively with primisulfuron at 10-20 gr ai/ha while some increase in control was noted where a combination of primisulfuron + 2,4-D was applied at 10 + 140 gr ai/ha.

Under the hot and dry conditions experienced in 1991, primisulfuron applied alone at 20-40 gr ai/ha gave poor to fair control of both common lambsquarters and field bindweed. The addition of 2,4-D at 140-280 gr ai/ha or dicamba at 70-140 gr ai/ha to primisulfuron at 20 gr ai/ha gave excellent control. In the case of lambsquarters, control with the combinations was superior to that obtained with either herbicide applied alone. Combinations with bromoxynil gave variable control of lambsquarters depending on location and weather conditions.

The use of tank mixes has several advantages including lower herbicide rates, broader spectrum of weeds controlled, better control under a wide range of conditions, and as a strategy to prevent herbicide resistance.

[1] *Field Research Representatives and Regional Manager, Agricultural Division, Ciba-Geigy Corp., Washington,PA 15301*

TEACHING WEED IDENTIFICATION WITH VIDEOTAPE

B. Marose, N. Anderson, L. Kaufman-Alfera and T. Patton[1]

ABSTRACT

Successful weed, insect or disease management requires correct pest identification and sampling techniques combined with wise management decisions. Unfortunately, many growers and their advisors are unable to identify the most common pests or evaluate their economic impact and too readily turn to pesticides as the only solution.

With these concerns in mind, the Maryland Cooperative Extension Service aided by grants from the Environmental Protection Agency's Pesticide Applicator Certification and Training Program and the Maryland Department of Agriculture decided to create a videotape entitled 'Integrated Pest Management for Corn and Soybeans.'

Closed bids were requested from professional video producers and independently evaluated on the basis of creative ability, quality of equipment and previous productions, and cost. After awarding a fixed price contract, a draft script was written based on Maryland's Integrated Pest Management manual. Filming was spread over thirteen days from May to September with ten days devoted to pest identification and sampling shots and with two and one half days for on-camera speakers.

The final product is a 65 minute video divided into three segments: Part I - Corn Insects and Diseases; Part II - Soybean Insects and Diseases; and Part III - Weeds of Corn and Soybeans. The 24 minute weed segment shows 30 important species in seedling and mature stages. Life cycles, sampling techniques and management strategies are also covered. Economic thresholds are included for common annual species. For perennials and new or difficult to manage annuals, the focus shifts to prevention or elimination.

Although packaged as a single tape, acceptance and retention are better when the three parts are viewed separately. Viewers can watch the entire tape for an overview of the contents and then during the growing season refer back to specific pests as they become problems. Included is a time-coded table of contents which makes locating specific segments easier and a water- and tear- proof pocket guide summarizing the economic thresholds.

Cooperative Extension is using the video to train traditional clientele groups such as growers, pesticide applicators, IPM scouts, Master Gardeners and homeowners, as well as, new county agents. Several growers and private consultants have purchased copies for personal use. Agribusinesses such as commercial applicators, suppliers and sales representatives are using it to train old and new personnel and utilizing portions to support grower meetings. Other educational groups such as vocational agriculture teachers and college professors in entomology and weed science are showing the tape in class and putting it on reference lists in libraries.

[1]IPM Coordinator, Technician and Extension Assistants, Dept. of Entomology, University of Maryland, College Park, MD 20742

EFFECTIVENESS OF SOME NEWER HERBICIDES ON SELECTED BROADLEAF PERENNIAL WEEDS IN CORN

T. J. Fritz, W.S. Curran, and N. L. Hartwig[1]

ABSTRACT

Perennial weeds in corn seem to be increasing in Pennsylvania. Nicosulfuron, primisulfuron, clopyralid, and dicamba were evaluated on horsenettle (Solanum carolinense L.), and canada thistle (Cirsium arvense L.) during the 1991 growing season. In addition, the efficacy of these materials excluding clopyralid were also evaluated in 1990 and 1991 on dewberry (Rubus sp.).

Extension agents in Erie, Montgomery and York counties located fields with moderate horsenettle infestations and conducted identical trials. Each location was a randomized complete block design with 4 replications. Identical treatments were applied postemergence at a early and late timing. Rates applied (lb/A) were as follows: nicosulfuron, 0.031 and 0.062; primisulfuron, 0.036 and 0.071; clopyralid, 0.125 and 0.25; and dicamba, 0.25 and 0.5, respectively. The York County results were poor due to drought and insect damage. Erie and Montgomery County results were more similar to one another (Figure 1.). Primisulfuron and dicamba provided the best control, while nicosulfuron and clopyralid did not show much activity. Optimum application timing could not be determined by these trials. Late applications performed better at Erie, while the early applications preformed better at Montgomery. Higher rates generally performed better than lower rates, although not consistently.

A postemergence randomized complete block design with 3 replications was used to evaluate control of canada thistle. Clopyralid (0.094 and 0.25 lb/A) was applied at an early and late timing at both rates. Dicamba was applied at the high rate (0.5 lb/A) during the early application and at the low rate (0.25 lb/A) during the late application timing. Nicosulfuron (0.031 lb/A) and primisulfuron (0.036 lb/A) were applied during the late timing. Trends were as follows: clopyralid applied during the late application performed the best, dicamba applied at the high rate early performed better than the low rate applied later, primisulfuron was fair, and nicosulfuron was poor (Figure 2.).

A randomized complete block design with 3 replications was used to evaluate control of dewberry in 1990 and 1991. Postemergence treatments of nicosulfuron (0.031 and 0.047 lb/A), atrazine (2.0 lb/A), dicamba (0.25 lb/A), and primisulfuron (0.036 and 0.054 lb/A) were applied. None of the herbicides were very effective the year of application. In the second year evaluation of the 1990 application year, nicosulfuron provided excellent control, while atrazine control was fair (Figure 3.). Control of dewberry was poor for dicamba and primisulfuron.

---

[1]Assistant Extension Agent, Penn State Cooperative Extension, 1015 Rt. 113, PO Box 20, Creamery, PA 19430, Assistant Professor and Professor of Weed Science, Department of Agronomy, The Pennsylvania State University, University Park, PA 16802, respectively.

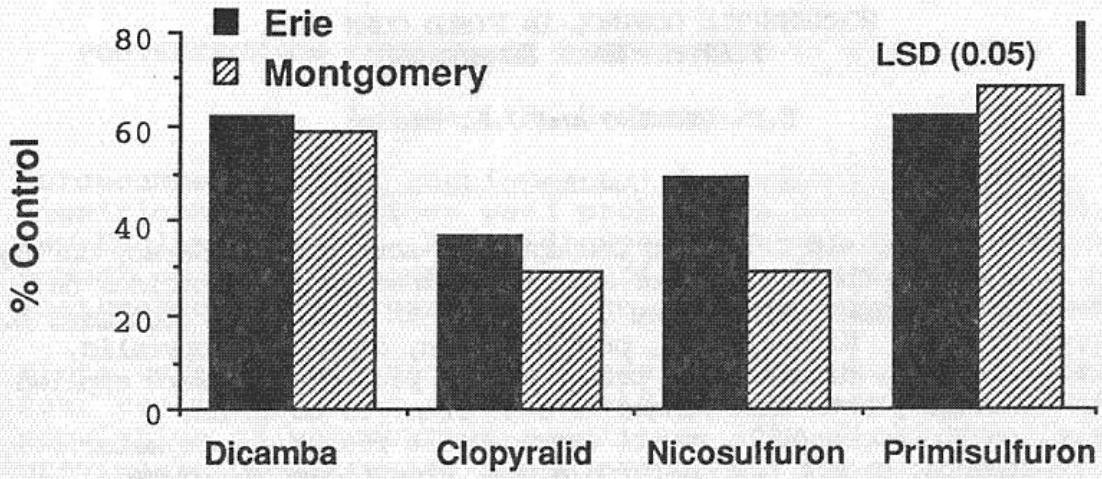

Figure 1. Effect of herbicide on horsenettle control at Erie and Montgomery counties. (Averaged over two rates and application timings. Evaluated at 4 and 3 weeks after the last application at Erie and Montgomery, respectively).

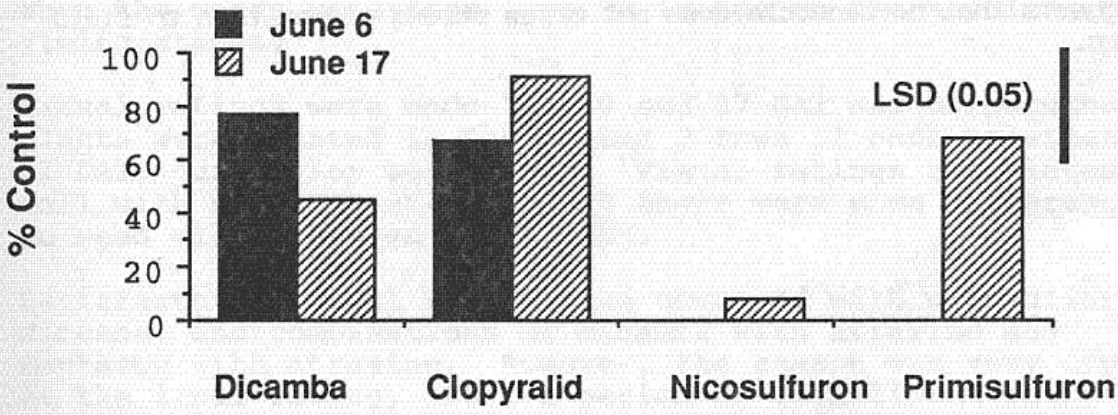

Figure 2. Effect of herbicide on Canada thistle control in corn. Dicamba applied at 0.5 and 0.25 lb ai/A on June 6 and June17, respectively. (Evaluation taken about 90 days following last application).

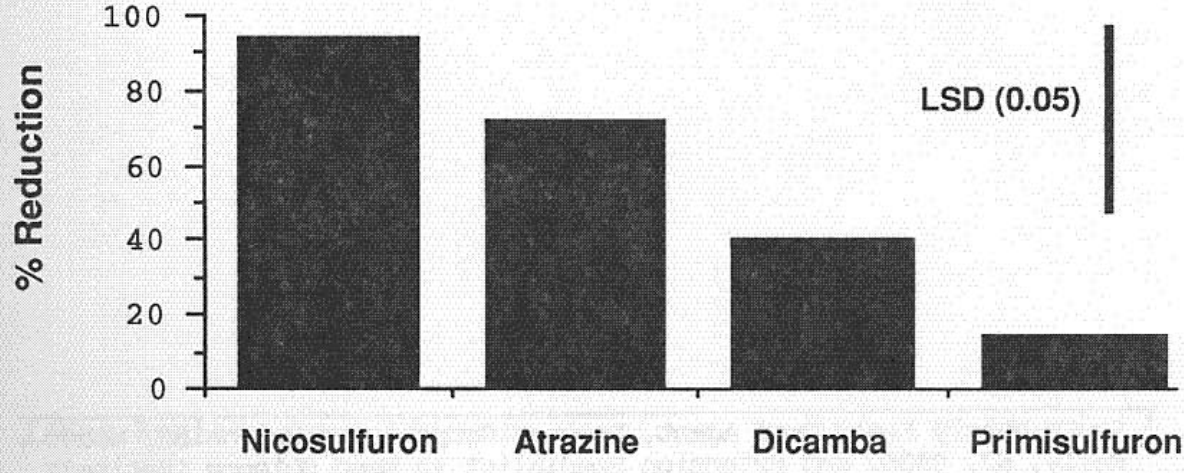

Figure 3. Percent reduction in dewberry biomass one year after application. (Average of nicosulfuron and primisulfuron application rates).

HORSENETTLE CONTROL IN FIELD CORN WITH POSTEMERGENCE HERBICIDES

E.P. Prostko and J.A. Meade[1]

Abstract

An on-farm field trial was conducted in southern New Jersey during 1991 to evaluate the efficacy of several postemergence herbicides on horsenettle (Solanum carolinense L.) control in field corn (Zea mays L. 'Pioneer 3358'). Nicosulfuron, primisulfuron, dicamba, clopyralid, nicosulfuron plus dicamba, and primisulfuron plus dicamba were applied to horsenettle plants that ranged in size from 7.5 to 25 cm. Preapplication horsenettle counts averaged 8.6 plants/square meter. All treatments, except nicosulfuron alone, significantly reduced horsenettle vigor and above ground horsenettle biomass. Only two treatments, nicosulfuron alone and primisulfuron plus dicamba, had a significant effect on grain yields. Yields in these plots were 8% and 15% higher than the untreated check. The data from this research suggests that horsenettle does not offer strong competition to field corn.

[1] South Jersey Field Crop Agent, Rutgers Cooperative Extension, Mount Holly, NJ, 08060 and Extension Specialist in Weed Science (Retired), Rutgers Cooperative Extension, New Brunswick, NJ, 08903.

POSTEMERGENCE CONTROL OF BURCUCUMBER IN FIELD CORN

Robert R. Hedberg1/

Burcucumber (Sicyos angulatus L.) is rapidly becoming a significant and serious weed problem in field corn in the New England States. A field experiment was conducted in the summer of 1991 to compare the efficacy of several postemergence corn herbicides to control this weed.

Plots were established in a randomized block design with four replications in a corn field with a very high population of burcucumber seedlings. The field had previously been treated preemergence with a combination of pendimethalin, dicamba and atrazine. Plots were 12 feet by 30 feet containing 4 rows of corn planted in 36 inch rows. Treatments were applied with a hand held plot sprayer when the corn was in the fifth leaf stage and 5 inches tall and when the weeds were from 1 to 30 inches in the seedling to vining stages.

Visual ratings were made 10, 50 and 87 DAT and burcucumber plants were counted in the center 2 rows of each treatment 87 DAT, just prior to harvest. Visual ratings correlated well with plant counts although there were some differences in weed vigor between treatments.

Satisfactory control (> 80%) was obtained with nicosulfuron, dicamba, and combinations of dicamba with atrazine and bentazon with atrazine. However, the season was very dry. At the final rating, after a period of significant rain, newly emerged seedlings were found in the plots. This indicates that control may not be as good in a season when adequate moisture encourages subsequent weed flushes.

1/New England Crop Advisory Services, Reading, VT 05062

MON 12000: A NEW HERBICIDE FOR BROADLEAF WEED CONTROL IN CORN

T. E. Dutt and S. S. Adams

ABSTRACT

MON 12000 is a new sulfonylurea herbicide under development by Monsanto Company for broadleaf weed control in corn (Zea mays L.). MON 12000 can be highly effective applied preemergence, preplant incorporated, or early preplant in both conventional and reduced tillage systems. Season-long control can be obtained at low use rates of 70 - 105 g ai/ha (0.063 - 0.094 lb ai/A). Susceptible weeds include velvetleaf (Abutilon theophrasti), cocklebur (Xanthium strumarium), lambsquarters (Chenopodium album), and pigweed spp. (Amaranthus spp.). Mixtures of MON 12000 with various grass herbicides have demonstrated excellent broadspectrum weed control. Ongoing studies have shown no evidence of resistance in major weed species.

Product Development Associates, Monsanto Agricultural Company, an operating unit of Monsanto Company, Bangor, PA, and Holtwood, PA, respectively.

CORN-WEED INTERACTION IN 91 AND 46 CM ROWS AND SELECTED HERBICIDE COMBINATIONS

C. Benjamin Coffman and J. Ray Frank [1]

ABSTRACT

Field investigations were initiated in 1991 at Frederick, Maryland, to evaluate the responses of no-till field corn (Zea mays L.) and weeds to (1) two different row spacings and (2) preemergence applications of recent and established herbicides in selected tank mixtures. Corn was sowed in adjacent fields in 91 and 46 cm rows . The site had been in no-till crop production for the previous 10 yr. The experimental design was a randomized complete block with three replications. Residues from the previous season were mowed and left in the field, resulting in approximately 80 to 90% coverage of the soil surface when herbicide treatments were applied. The same selected combinations and rates of the following herbicides were applied in both row spacings with a bicycle-wheel sprayer in a volume of 374 L ha^{-1}: atrazine, primisulfuron, ICIA-5676, V53482, metolachlor, DPX-V9360, cyanazine and imazamethabenz. Visual estimates of weed cover and crop response were obtained in the early fall. Weed covers were estimated and averaged over all herbicide treatments , and were 70 and 33% for the 91 and 46 cm rows, respectively. Herbicide treatments that differed only by row spacing had numerically lower weed covers in the 46 cm spacing than in the 91 cm spacing for 10 of the 11 treatments. The most frequently observed weed in all treatments of both row spacings was giant foxtail (Setaria faberi Herrm.). Giant foxtail contributed 50% or more of the total weed cover to 92% of the 91 cm plots. Only 19% of the 46 cm plots had similar giant foxtail contributions. Grain yields ranged from 400 to 4200 kg ha^{-1} in the 91 cm row plots and from 3000 to 7200 kg ha^{-1} in the 46 cm row plots across all herbicide treatments. Additional studies are underway to characterize long-term relationships among row spacings, herbicides, herbicide rates, application methods, and corn yields.

---

[1] Research Agronomist and Weed Scientist, respectively, USDA, ARS,Beltsville and Frederick MD.

QUACKGRASS CONTROL IN FIELD CORN WITH PRIMISULFURON APPLIED EARLY PREPLANT

J. D. Abbott, D. B. Vitolo, J. R. Cantwell and C. M. Moseley[1]

ABSTRACT

Field trials were conducted in PA, NY, and MI during 1991 to further evaluate the use of primisulfuron applied early preplant for quackgrass control [Elytrigia repens (L.) Nevski.] and crop safety in no-till field corn (Zea mays L.). Primisulfuron was applied at 20 and 40 g ai/ha early preplant (EPP), early post (EP) or postemergence (PE) and as split applications combining two of these timings. Primisulfuron was applied alone or combined with metolachlor + atrazine (Bicep 6L, 3528 g ai/ha) when applied EPP or preemergence (PRE). Crop oil at 2 l/ha was added to all primisulfuron applications.

Evaluations taken approximately one and two and one-half months after the EPP applications provided relatively consistent results across locations. An EPP application of metolachlor + atrazine provided 53% quackgrass control when averaged across all locations and ratings. The addition of 20 g ai/ha of primisulfuron to metolachlor + atrazine improved quackgrass control to 89%. Increasing the rate of primisulfuron to 40 g ai/ha in this tank-mix provided 96% control which decreased slightly to 92% after 2 and one-half months. Primisulfuron applied EPP at 40 g ai/ha alone, controlled 85% of the quackgrass early and maintained 82% control following the PRE application of metolachlor + atrazine. Metolachlor + atrazine applied PRE followed by a PE application of primisulfuron at 40 g ai/ha provided 71% control across locations. Overall, the most effective control was observed when metolachlor, atrazine and primisulfuron (20 g ai/ha) were applied EPP followed by an additional 20 g ai/ha of primisulfuron applied PE which provided 95% control for the length of the test.

Crop injury was visually evaluated approximately two months after the EPP application, one month after planting, with extremely consistent results across locations. A major factor influencing crop growth was the level of weed competition. Plots that had no herbicide applied EPP exhibited very poor crop growth, although all treatments exhibited crop injury/competition to some degree. Commercially unacceptable herbicide injury was observed only when the treatment included 40 g ai/ha of primisulfuron applied EPP by itself.

In conclusion, under no-till corn production, metolachlor + atrazine with primisulfuron at 20 g ai/ha provided acceptable control of quackgrass and had good crop safety when applied EPP. This treatment also allows for an additional 20 g ai/ha of primisulfuron to be applied PE if conditions warrant it.

---

[1] CIBA-GEIGY Corp., Agricultural Division, PO Box 18300, Greensboro, NC 27419-8300.

ASSESSMENT OF LEAF COVER AS AN INDICATOR OF WEED THRESHOLDS IN FIELD CORN

Janice Degni, Russell R. Hahn and Jane Mt. Pleasant[1]

ABSTRACT

A field experiment was established to evaluate relative leaf cover as a predictor of crop yield loss due to weeds. An ocular point frame was used to measure percent leaf cover of the crop; corn (*Zea mays* L.) and the weed; velvetleaf (*Abutilon theophrasti* Medik. #[2] ABUTH). Velvetleaf densities of 0, 2, 4, 8, and 16 m^{-2} were established to provide the differing weed covers. Leaf cover readings were begun 2 weeks after corn emergence and taken for 4 weeks. Analysis of variance and regression were used to determine the relationship between leaf cover and grain, stover and silage yields. Velvetleaf cover predicted grain and silage yields better than it predicted stover yield. The percent velvetleaf cover readings explained a high percentage of the variation in yields while the cover ratio of velvetleaf to corn had a poor predictive ability on the first reading (R^2 = 33) but improved greatly for the final three readings (R^2 = 71 to 77). Grain and stover followed a similar trend. Corn cover readings were not different among treatments and therefore had low predictive ability (R^2 = 7).

INTRODUCTION

This study was motivated by the need to reduce the research necessary to determine weed thresholds. Studies to determine economic threshold levels for weeds generally rely on an additive design (2, 7) or area of influence study (5, 8). However, results vary according to the conditions under which the studies were conducted. In addition, these studies are time and resource intensive. Thresholds are usually determined for individual weeds but under field conditions weed populations consist of several to many weed species competing with the crop. It has been hypothesized that the relative leaf cover of a weed in comparison to that of the crop could be used to predict yield loss (1, 6). Aldrich (1) suggests that the sum of the factors for which competition occurs: light, water, or nutrients, will be reflected in the canopy growth. Therefore, a yield prediction method based on the relative portion of the canopy that weeds and the crop occupy should more accurately predict yield reduction than methods based on area influenced or weed densities since neither directly measures the growth factors responsible for competition. Aldrich (1) further suggests that canopy measurements would capture all of the components involved in weed competition, including weed species, size, population and relative time of emergence. If relative leaf cover provides consistent estimates of yield loss, the efficiency of threshold research would be greatly improved.

---

[1]Grad. Student, Plant Protection, Assoc. Prof., and Asst. Prof., Dept. of Soil, Crop and Atmospheric Sci., Cornell Univ., Ithaca, NY 14853.

[2]Letters following this symbol are a WSSA-approved computer code from Composite List of Weeds, Revised 1989. Available from WSSA, 309 W. Clark St., Champaign, IL 61820.

The objective of this study was to evaluate the effectiveness of crop and weed leaf cover measurements as a predictor of yield loss. Corn (*Zea mays* L.) and velvetleaf (*Abutilon theophrasti* Medik.) were chosen as the crop and weed. The percent cover readings and their ratio were regressed against yield to determine predictive ability.

MATERIALS AND METHODS

A field experiment was established in Cayuga County, NY on a silt loam soil. After plowing, the field was disced and cultimulched to provide an even seedbed. Corn 'Pioneer 3737' was planted on 30 in rows on May 17, 1991 at 27,700 plants per acre. Metolachlor at 2 lb ai/A was applied preemergence to suppress weeds other than velvetleaf. Hand weeding throughout the season insured maintenance of the velvetleaf densities and eliminated other weeds. Inherent soil fertility was high and the field received 20 T/A of manure prior to plowing. In addition, 213 lb/A of 6-24-24 starter fertilizer was banded at planting. Chlorpyrifos was banded over the row at .65 lb ai/A to control corn rootworm.

A randomized block-design with four replications was used. Plots were 10 by 30 ft, consisting of four corn rows. A weed-free plot in each replication provided a control. Velvetleaf densities were established at 2, 4, 8, and 16 plants m^{-2} (10). A 1 m^2 frame was placed in the plot and velvetleaf plants within the frame were randomly selected to establish the velvetleaf densities. The frame was moved across the plot until the desired velvetleaf population was established over the entire plot. Excess velvetleaf were hand thinned. Since the native velvetleaf population was high the treatments were established with no additional seeding.

An optical point frame (9) was used to measure leaf cover since it provides a method of sampling with a dimensionless point (3). Point sampling, commonly used in vegetation surveys, provides an estimate of relative cover since the probability of a point landing on a species is directly proportional to the area covered by that species (4). The optical point frame measured 30 by 30 in with crosshairs every 1.5 in for a total of 361 intersections. Siting down through the crosshairs on the double grid provided a straight, dimensionless vertical line. When this imaginary line intersected vegetation it was recorded as a hit.

Corn emerged 5 to 7 days after planting. Velvetleaf began to emerge several days later. Leaf cover readings were initiated 2 weeks after corn emergence and were taken for 4 consecutive weeks. The frame was centered over one of the center two corn rows at a random location in each plot and two samples were taken per row. Sampling dates and the growth stages of corn and velvetleaf are summarized in Table 1.

Corn grain and stover yields were determined by hand harvesting 28 ft of the center two rows in each plot on September 27 and October 2, 1991, respectively. Two weeks prior to the corn grain harvest velvetleaf dry matter was determined by harvesting three 1 m^2 quadrants in each plot. All corn and velvetleaf samples were oven dried and are expressed on a dry matter basis. Analysis of variance and linear regression were used to analyze the percent cover readings to yields.

Table 1. Cover sampling dates and growth stages of corn and velvetleaf.

Reading	Date	Mean height of corn	Mean stage of corn	Mean stage of velvetleaf	Mean height of velvetleaf
		in			in
1	June 7	7	2-3 leaf	seedling-2 leaves	5-1
2	June 14 and 15	10	4-5 leaf	2-4 leaves	1-2.5
3	June 19 and 20	12	5-6 leaf	>4 leaves	6-8
4	June 26, 17, and July 1	23	8+ leaves mid-whorl		12-15

RESULTS AND DISCUSSION

Corn yields decreased with increasing velvetleaf density, as expected. The greater the velvetleaf density the greater the yield loss as compared to the weed-free check. With no velvetleaf, grain and stover yields were 7661 and 4176 lb/A respectively. Grain and stover yields decreased to 3983 and 2402 lb/A respectively with 16 velvetleaf m^{-2}. Corn grain, stover, and silage yields are summarized in Table 2.

Table 2. Mean dry matter yields of corn grain, stover and silage by velvetleaf density.[a]

Velvetleaf density	Grain	% of Control	Stover	% of Control	Silage	% of Control
m^{-2}	lb/A	%	lb/A	%	lb/A	%
0	7661 a		4176 a		12791 a	
2	6487 b	85	3625 ab	87	10906 b	85
4	5356 c	70	3023 bc	73	9017 c	71
8	5159 c	67	2633 cd	63	8341 c	65
16	3983 d	52	2402 d	58	6814 d	53
LSD (.05)	764		609		1275	

[a]Means within a column followed by the same letter are not significantly different at the 5% level.

Velvetleaf cover readings followed a trend consistent with their densities, with percent leaf cover estimates increasing as velvetleaf density increased. Corn cover readings did not change among treatments. The mean cover readings for velvetleaf, corn, and their ratio on each of the four reading dates are summarized in Table 3.

Table 3. Percent mean leaf cover readings by velvetleaf density.[a]

	Treatment	ABUTH	Corn	Ratio
	m^{-2}	- - - - - - - - - - - - - - - - % - - - - - - - - - - - - - - - -		
Reading 1 2 weeks after emergence	0	0.00 a	2.79 a	0.00 a
	2	.28 ab	3.63 a	6.98 ab
	4	.51 b	3.21 a	20.28 b
	8	1.11 c	4.18 a	36.53 b
	16	2.00 d	3.38 a	81.99 c
	LSD = .05	.310	1.91	3.30
Reading 2 3 weeks after emergence	0	0.00 a	11.70 a	0.00 a
	2	.76 ab	11.62 ab	6.35 ab
	4	1.46 b	9.91 ab	19.85 bc
	8	3.94 c	13.50 ab	30.86 c
	16	6.98 d	12.88 b	60.07 d
	LSD = .05	.870	3.36	14.16
Reading 3 4 weeks after emergence	0	0.00 a	22.12 a	0.00 a
	2	2.31 a	20.88 ab	9.47 a
	4	4.36 a	16.34 b	33.99 b
	8	11.98 b	22.03 b	62.62 c
	16	24.66 c	23.23 b	111.04 d
	LSD = .05	5.31	5.56	20.40
Reading 4 5 weeks after emergence	0	0.00 a	23.76 a	0.00 a
	2	6.77 ab	27.81 a	37.25 ab
	4	15.68 bc	24.89 a	98.07 bc
	8	22.13 c	23.14 a	107.76 c
	16	48.78 d	23.10 a	250.25 d
	LSD = .05	12.85	7.83	67.37

[a]Means within a column followed by the same letter are not significantly different at the 5% level.

Analysis of variance and linear regression were used to analyze the relationship of leaf cover to yield. At the first reading, 2 weeks after crop emergence, velvetleaf cover explains 71% of the variability in silage yield, but the ratio of velvetleaf to corn cover accounts for only 33% of the variation in silage yields (Table 4). By the second reading, 3 weeks after crop emergence, velvetleaf cover and the ratio of velvetleaf to corn cover had similar R^2 values (58 and 71 respectively) when regressed against silage yield. These results remain consistent for the third and fourth readings and the trends are similar for grain and stover yields. Table 4 summarizes the percent cover readings for velvetleaf, corn, and their ratio when regressed against silage and grain yields. The regressions of velvetleaf cover against silage and grain yields and of the ratios against silage yields for Readings 1 and 2 are shown in Figure 1.

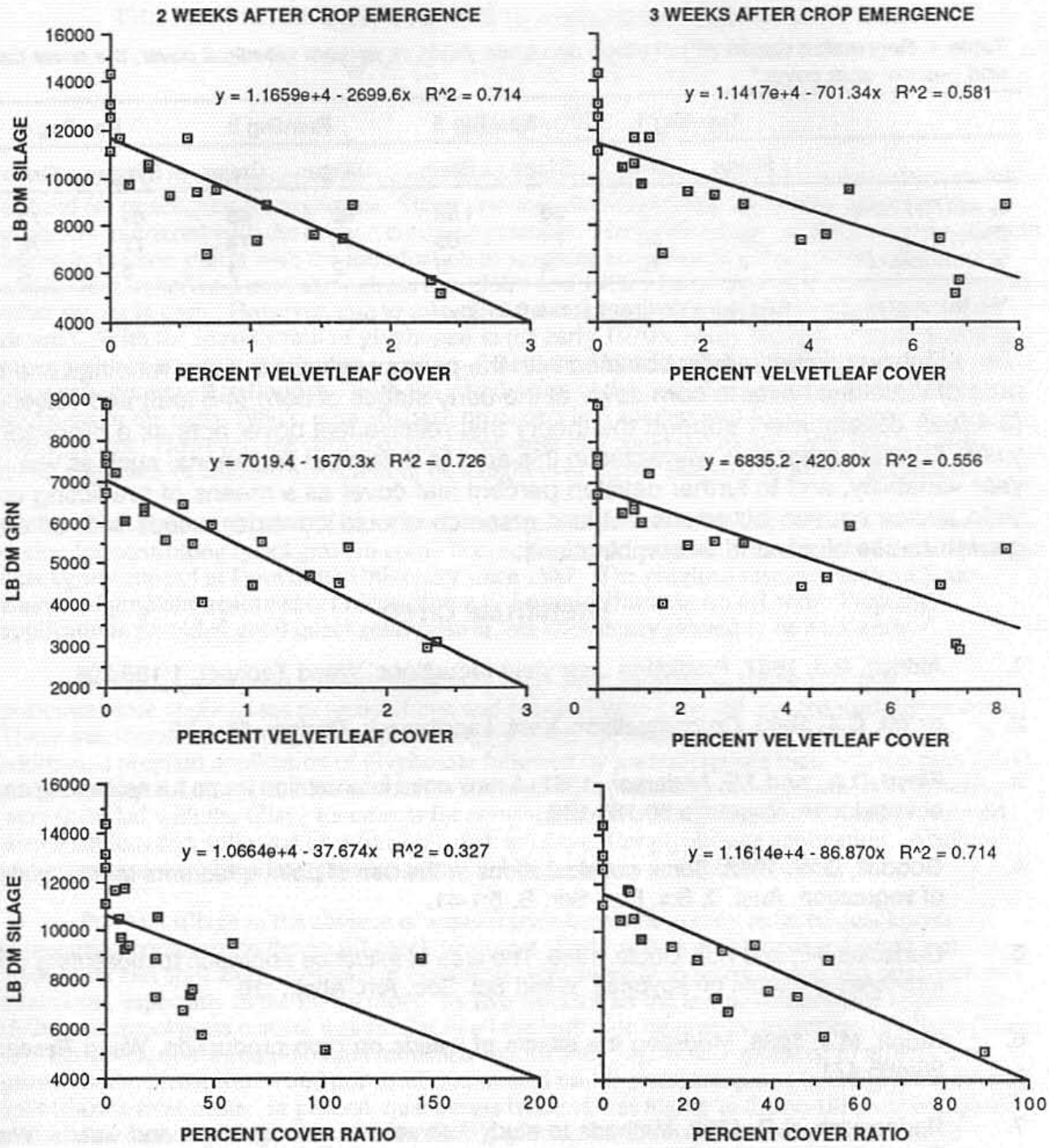

Figure 1. The relationship of velvetleaf cover to silage and grain yields and of the leaf cover ratio to silage at Reading 1 and 2.

Table 4. Regression results (R^2) of silage and grain yields vs percent velvetleaf cover, the cover ratio and percent corn cover.[a]

	Reading 1		Reading 2		Reading 3		Reading 4	
	Silage	Grain	Silage	Grain	Silage	Grain	Silage	Grain
% ABUTH cover	72	73	58	56	60	63	69	72
Ratio	33	30	71	69	74	74	77	76
% Corn cover	7	10	4	5	2	1	5	2

[a]All the regression results are significant at the 0.01 level.

The significant results obtained with the percent velvetleaf cover readings and the ratio of velvetleaf cover to corn cover at the early stages of corn (4-5 leaf) and velvetleaf (3-4 leaf) development support the theory that relative leaf cover acts as a predictor of yield. Further research is warranted in this area to define the limitations, such as year-to-year variability, and to further develop percent leaf cover as a means of predicting crop yield losses caused by weeds. Future research should consider weeds with different growth habits alone and in combinations.

LITERATURE CITED

1. Aldrich, R.J. 1987. Predicting crop yield reductions. Weed Technol. 1:199-205.

2. deWit, C.T. 1960. On competition. Vers. Landbouwk. Onderz. 66:1-82.

3. Floyd, D.A., and J.E. Anderson. 1982. A new point interception frame for estimating cover of vegetation. Vegetatio 50:185-186.

4. Goodall, D.W. 1952. Some considerations in the use of point quadrants for the analysis of vegetation. Aust. J. Sci. Res. Ser. B, 5:1-41.

5. Gunsolus, H., and H.D. Coble. 1986. The area of influence approach to measuring weed interference effects on soybean. Weed Sci. Soc. Am. Abstr. :10.

6. Kropff, M.J. 1988. Modeling the effects of weeds on crop production. Weed Research 28:465-471.

7. Radosevich, S.R. 1987. Methods to study interactions among crops and weeds. Weed Technol. 1:190-198.

8. Radosevich, S.R. 1988. Methods to study crops and weed interactions, in weed management. p 121-143 in M.A. Altieri and M.A. Liebman, eds. Plant competition and other ecological approaches to weed control in agriculture. CRC Handbook. Boca Raton, FL.

9. Stanton, F.W. 1960. Ocular point frame. J. Range Management 13(3):153.

10. Zanin, G., and M. Sattin. 1988. Threshold level and seed production of velvetleaf (*Abutilon theophrasti* Medicus) in maize. Weed Res. 28:347-352.

THE FUTURE OF QUACKGRASS (Eritrigia repens) CONTROL IN CORN

W. S. Curran and N. L. Hartwig[1]

ABSTRACT

Prior to the introduction of organic herbicides, cultural control practices were most widely utilized for quackgrass management. These practices did not provide acceptable control and generally interfered with the desired cropping practices. Herbicide use for quackgrass management began in the late 1950's with the introduction of simazine and atrazine. These herbicides were widely researched and used throughout the 1960's and 1970's for control of quackgrass as well as other weeds in corn. However, due to their persistence in soil, alternative herbicides were still desired. With the introduction of glyphosate in the early 1970's, many felt quackgrass as well as other problem weeds might become a thing of the past. However, these beliefs proved false and the weeds continued to flourish. With the introduction of the postemergence graminicides for soybeans in the early 1980's, corn-soybean producers had another tool for quackgrass management. However, the corn-livestock producers that could not rotate, were still left with using high rates of triazine herbicides or distraught over glyphosate cost or timing problems.

With the introduction of nicosulfuron and primisulfuron in 1990, producers have one more option for controlling quackgrass in corn. Nicosulfuron and primisulfuron have been evaluated for quackgrass control at Penn State University since 1988. The previous research at Penn State examined preplant treatments of nicosulfuron and primisulfuron in no-till corn. Preplant applications provided good quackgrass control, but corn injury proved to be a concern.

In 1991, quackgrass control research at Penn State focused on single and split postemergence applications of nicosulfuron and primisulfuron in no-till and reduced tillage corn. These treatments were compared to preplant glyphosate applications with or without tillage. In addition, a preplant application of glyphosate followed by postemergence nicosulfuron plus 2,4-D, and an early preplant application of atrazine followed by a preemergence application of simazine were included with the tillage treatments for comparison. The tillage treatments were performed with a tandem disk followed by a finishing disk ten days after glyphosate application. Alachlor and cyanazine were broadcast preemergence at 2 lb/A each over the entire study .

Preplant tillage in the absence of a quackgrass herbicide greatly reduced quackgrass competition compared to the no-till check treatment. Early season evaluations indicated that glyphosate and split atrazine/simazine treatments were superior to nicosulfuron and primisulfuron treatments, especially in the no-till plots. By two weeks after the last postemergence application (6/26), the quackgrass control was similar in all the herbicide treatments regardless of tillage (Table 1.). However, quackgrass biomass remained significantly higher and appeared to affect corn growth in the nicosulfuron and primisulfuron treated no-till plots, compared to the glyphosate and split triazine treatments. In general, quackgrass biomass was higher in the no-till plots compared to the tilled treatments. By late summer (8/21), quackgrass control levels were similar in all treatments, but biomass still remained higher in some of the sulfonylurea no-till treatments (Table 2.). Nicosulfuron appeared slightly better than primisulfuron on controlling quackgrass and little difference was observed in single versus split applications of the two herbicides. Herbicide treatments did not significantly influence corn yield, but grain yield was lower in the no-till compared to the tilled plots.

Nicosulfuron and primisulfuron performed best in a preplant tillage program. Their use in no-till appears linked to a fall or preplant glyphosate application or possibly in conjunction with a triazine herbicide program.

---

[1]Assistant Professor and Professor of Weed Science, respectively, Department of Agronomy, The Pennsylvania State University, University Park, PA 16802.

Table 1. Effect of herbicide on quackgrass control in corn.

Herbicide	Rate	Timing[1]	6/26	8/21
	(lb/A)		----------(% Control)---------	
Glyphosate	1.0	Preplant	94	89
Primisulfuron	0.036	Early post	90	79
Primisulfuron +	0.018	Early post +	92	86
Primisulfuron	0.018	late post		
Nicosulfuron	0.031	Early post	91	88
Nicosulfuron +	0.016	Early post +	94	92
Nicosulfuron	0.016	late post		
Glyphosate +	1.0	Preplant +	90	90
Nicosulfuron +	0.016	early post +		
2,4-D	0.5	early post		
Atrazine +	2.0	Early preplant +	95	92
Simazine	1.0	preemergence		
LSD (0.05)			3	8

[1] Quackgrass growth stage 2 to 3 leaf (2 to 5 inch) at early preplant, 2 to 4 leaf (3 to 6 inch) at preplant, 8 to 10 inch at preemergence, 6 to 18 inch at early post, and 3 to 23 inch at late post applicaton times.

Table 2. Effect of herbicide and tillage on quackgrass biomass and corn yield.

Herbicide	Rate	Tillage	Timing[1]	Biomass		Yield
				6/26	8/21	
	(lb/A)			------(g/ft^2)-----		(bu/A)
Glyphosate	1.0	Reduced	Preplant	0.9	0.8	105
		No-till		0.9	0.9	115
Primisulfuron	0.036	Reduced	Early post	0.9	0.7	119
		No-till		8.5	2.6	83
Primisulfuron +	0.018	Reduced	Early post +	1.4	0.3	133
Primisulfuron	0.018		late post			
		No-till		7.3	1.8	77
Nicosulfuron	0.031	Reduced	Early post	1.6	0.5	103
		No-till		9.6	0.5	90
Nicosulfuron +	0.016	Reduced	Early post +	1.0	0.3	91
Nicosulfuron	0.016		late post			
		No-till		8.7	0.3	97
Glyphosate +	1.0	Reduced	Preplant +	0.2	0.3	96
Nicosulfuron +	0.016		early post +			
2,4-D	0.5		early post			
		No-till		1.6	1.1	104
Atrazine+	2.0	Reduced	Early preplant +	0.3	0.3	103
Simazine	1.0		preemergence			
		No-till		0.7	0.8	88
Untreated	0.0	Reduced		7.1	4.5	113
	0.0	No-till		22.2	10.0	26
LSD (0.05)				4.6	1.5	44

[1] Quackgrass growth stage 2 to 3 leaf (2 to 5 inch) at early preplant, 2 to 4 leaf (3 to 6 inch) at preplant, 8 to 10 inch at preemergence, 6 to 18 inch at early post, and 3 to 23 inch at late post application times.

DE-498 A NEW BROAD-SPECTRUM HERBICIDE FOR CORN, SOYBEAN AND OTHER CROPS

B. D. Olson[1], B. C. Gerwick[2] and W. A. Kleschick[2]

ABSTRACT

DE-498 is a new herbicide discovered and developed by DowElanco. It is the first commercial representative of a new family of herbicides, the triazolopyrimidine sulfonanilides.

Crops with high levels of tolerance to DE-498 include soybean (Glycine max [L.] Merr.), corn (Zea mays L.) and wheat (Triticum aestivum L.). DE-498 is highly effective following soil or foliar applications on a range of broadleaf species important to Northeast agriculture including common lambsquarter (Chenopodium album L.), redroot and smooth pigweed (Amaranthus retroflexus L. and A. hybridus L., respectively) and velvetleaf (Abutilon theophrastis L.). The anticipated use rate range is 17-70 g/ha.

DE-498 demonstrates extremely low acute toxicity, low sub-chronic toxicity and low toxicity to fish, invertebrates, and wildlife. It is negative in mutagenicity and teratology assays and has favorable environmental behavior and dissipation.

1 DowElanco, P.O. Box 753, Geneva, NY, 14456-0753
2 DowElanco, 2001 West Main St., P.O. Box 708, Greenfield, IN, 46140-0708

INTEGRATED WEED CONTROL PROGRAMS FOR ONTARIO HIGHWAYS - RESEARCH DIRECTIONS

N.P. Cain[1] and S. Monet[2]

ABSTRACT

A 1990 review of the Ontario Ministry of Transportation's vegetation management program focused on the need to reduce herbicide use where possible and to respond to public interest in more natural landscapes while coping with continuing reductions in resources. Integrated weed management was suggested as one way to achieve these goals and a literature review was done to identify integrated weed management options for roadside vegetation.

One focus of this review was the planting or natural development of vegetation that has low maintenance requirements but that is competitive with noxious weeds or brush. For example, wildflower mixtures are being developed and evaluated with these criteria in mind.

The grass mixtures that are planted following road construction should be reevaluated with focus on low maintenance situations and in terms of stand density and competitiveness with invading weeds or brush. There are a number of new cultivars that may be suitable for low maintenance situations. Following establishment, maintenance practices should improve the competitive ability and health of grasses. Current research is evaluating the role of fertility and higher mowing heights on roadside grasses.

Mowing can play an important role for mechanical control of noxious weeds such as wild carrot, milkweed or thistles in turf areas. The use of repeated mowing along with renovation or simply fertilization of the desired vegetation may be able to replace or augment chemical control.

In more northern Districts, different methods of brush control are being compared to broadcast spraying in terms of effectiveness, cost of manpower, materials and retreatment as well as input of pesticides. In selected situations, basal bark and cut surface herbicide treatments may help reduce herbicide use. Another question is whether non-chemical methods such as manual or mechanical cutting can provide an acceptable period of control in comparison with broadcast or directed chemical treatments.

Other non-chemical approaches such as biological control may be useful in the future for selective control of roadside weeds. In the meantime, the Ministry's vegetation management research program has focused on development of more competitive roadside vegetation and methods of weed and brush control that optimize the use of herbicides and other inputs.

---

[1]Research Scientist, Ont. Ministry of Transportation, Downsview, Ont. M3M 1J8
[2]Project Manager, Ecological Services for Planning Ltd., Guelph, Ont. N1G 3M5

EVALUATION OF HERBICIDES FOR SELECTIVE CONTROL OF CANADA THISTLE IN ROADSIDE CROWNVETCH

Arthur E. Gover, Nathan L. Hartwig, and David A. Batey[1/]

ABSTRACT

Since 1985, research on selective broadleaf weed control in crownvetch (Coronilla varia L.) has been supported by the Pennsylvania Department of Transportation, which maintains about 20,000 ha of crownvetch on its right-of-ways. The primary weed problem in crownvetch is Canada thistle (Cirsium arvense Scop.), which is a noxious weed in Pennsylvania. Studies were initiated in 1991 to screen untried herbicides with currently recommended treatments, and to compare the effectiveness of hexazinone and bentazon, alone and in combination. Both studies were established at the Park Avenue interchange of SR 322, near State College, PA, in a mixed stand of crownvetch and Canada thistle, using a CO_2 powered, hand-held sprayer delivering 161 l/ha at 207 kpa using Spraying Sytems 8002 flat fan spray tips. Treatments for both studies were arranged in a randomized complete block design with three replications using 1.8 by 5.5 m plots. The screening study was established May 21. Canada thistle was in a late vegetative/early bud growth stage. The herbicide treatments were hexazinone at 1.1 kg/ha; clopyralid at 0.52 kg/ha; two rates of a commercial premix of imazethapyr and imazapyr, 0.049 plus 0.0017, and 0.099 plus 0.0035 kg/ha, respectively; primisulfuron at 0.035 kg/ha; chlorimuron at 0.052 kg/ha; and bentazon plus UAN (28% N) plus crop oil at 0.84 kg/ha plus 9.3 l/ha plus 2.3 l/ha. Except for the bentazon treatment, all herbicides treatments included a spray adjuvant oil at 0.25% v/v. A study evaluating hexazinone alone at 1.1 kg/ha, bentazon plus UAN plus crop oil at 0.84 kg/ha plus 9.3 l/ha plus 2.3 l/ha, and bentazon in combination with hexazinone at 0.84 plus 0.28, 0.84 plus 0.56, and 0.56 plus 0.19 kg/ha, respectively, was established May 31,when Canada thistle was at bud stage. All combination treatments included 2.3 l/ha of crop oil. Both studies were visually rated July 9 for injury to crownvetch, and injury and regrowth of Canada thistle. Crownvetch was rated on a 0 to 3 scale, with '0' being no injury, '1' slight injury, '2' moderate injury, and '3' severe injury. Canada thistle was rated on a scale of 0 to 5, with '0' indicating no injury, '1' slight injury, '2' moderate injury, '3' severe injury with stem survival likely, '4' severe injury with stem death likely, and '5' dead stems. Both studies were evaluated October 17 for Canada thistle regrowth. Results are reported for the herbicide screening study in Table 1, and the bentazon/hexazinone study in Table 2.

Clopyralid completely controlled Canada thistle and crownvetch, and almost no regrowth of either species was present when rated July 7. Hexazinone severely injured Canada thistle while slightly injuring crownvetch, but some treated stems exhibited axillary and basal regrowth, and new shoots were present in all plots. Canada thistle stems treated with primisulfuron, chorimuron, or bentazon did not flower, but vigorous axillary regrowth was observed on most treated stems. Canada thistle regrowth was present in all plots on October 17.

When rated July 7, combinations of hexazinone and bentazon provided better Canada thistle control than bentazon alone. The combinations provided control equal to hexazinone alone, and could be used to reduce material costs. Canada thistle regrowth was present in all plots October 17.

[1/] Project Associate, Professor of Weed Science, and Research Technologist, respectively, The Pennsylvania State University.

TABLE 1: Visual injury ratings for crownvetch and Canada Thistle taken on July 7 for treatments applied on May 21, 1991. Each value is the mean of three replications.

Treatments	Application Rate	Canada thistle Injury	Crownvetch Injury
	(kg/ha)	(0-5)[1/]	(0-3)[2/]
1. hexazinone	1.1	3.7	0.7
2. clopyralid	0.52	5.0	3.0
3. imazethapyr + imazapyr[3/]	0.049 + 0.0017	1.3	0.7
4. imazethapyr + imazapyr	0.099 + 0.0035	1.0	0.7
5. primisulfuron	0.035	2.0	1.3
6. chlorimuron	0.052	2.0	2.0
7. bentazon + UAN + crop oil	0.84 + 9 l/ha + 2.3 l/ha	2.3	0.5
8. untreated check	- - -	0.0	0.0
Significance Level (P)		0.0001	0.0001
LSD (P = 0.05)		0.9	0.7

[1/] Canada thistle injury ratings: 0 = no injury, 1 = slight, 2 = moderate, 3 = severe, recovery likely, 4 = severe, recovery not likely, and 5 = dead.

[2/] Crownvetch injury ratings: 0 = no injury, 1 = slight , 2 = moderate, and 3 = severe.

[3/] Commercial premix, Event, American Cyanamid Co., Wayne, NJ.

TABLE 2: Visual injury ratings for crownvetch and Canada thistle taken on July 7 for treatments applied on May 31, 1991. Each value is the mean of three replications.

Treatments	Application Rate	Canada Thistle Injury	Crownvetch Injury
	(kg/ha)	(0-5)[1/]	(0-3)[2/]
1. hexazinone	1.1	5.0	1.0
2. bentazon + UAN + crop oil	0.84 + 9 l/ha + 2.3 l/ha	2.5	1.0
3. bentazon + hexazinone + crop oil	0.84 + 0.28 + 2.3 l/ha	4.5	1.0
4. bentazon + hexazinone + crop oil	0.84 + 0.56 + 2.3 l/ha	5.0	0.5
5. bentazon + hexazinone + crop oil	0.56 + 0.19 + 2.3 l/ha	4.0	0.0
Significance Level (P)		0.0122	0.6480
LSD (P=0.05)		1.1	n.s.

[1/] Canada thistle injury ratings: 0 = no injury, 1 = slight, 2 = moderate, 3 = severe, recovery likely, 4 = severe, recovery not likely, and 5 = dead.

[2/] Crownvetch injury ratings: 0 = no injury, 1 = slight, 2 = moderate, and 3 = severe.

CONTROL OF ROADSIDE BRUSH WITH BROADCAST FALL FOLIAR TREATMENTS

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

ABSTRACT

As part of a cooperative project with the Pennsylvania Department of Transportation, brush control treatments were applied to a roadside in Centre County, PA, to evaluate fosamine ammonium (fosamine) alone and in combination with other herbicides for fall foliar applications. Treatments were applied to a vertical swath 4.6 m high on both sides of approximately 1.0 km long plots on SR 2010 near Spring Mills on September 17, 1990, using a Cibilo Swinglok Model A sprayer applying 408 l/ha at 207 kpa. The treatments were fosamine alone at 10.8 kg/ha, and fosamine at 8.1 kg/ha in combination with each of the following: imazapyr at 0.053 kg/ha, metsulfuron methyl at 0.070 kg/ha, triclopyr ester at 1.7 kg ae/ha, and glyphosate at 2.2 kg/ha. The most prevalent brush species were green ash (Fraxinus pennsylvanica Marsh.), staghorn sumac (Rhus typhina L.), elm (Ulmus spp.), hickory (Carya spp.), boxelder maple (Acer negundo L.), black cherry (Prunus serotina Ehrh.), black locust (Robinia pseudo-acacia L.), sugar maple (Acer saccharum Marsh.), black walnut (Juglans nigra L.) and oak (Quercus spp.). Visual injury ratings were taken July 12, 1991, using a scale of 0 to 7, where '0' indicates no visible injury, '5' indicates complete control of contacted branches, '6' indicates injury above the treated area, and '7' denotes complete control of the plant. Injury ratings for the predominant species are reported in Table 1.

Fosamine alone provided complete control of contacted branches of elm, cherry, and oaks; and control of most contacted branches of staghorn sumac, boxelder, and black walnut. Results on sugar maple varied from control of most contacted branches to complete control, while hickory, and particularly ash showed considerable variation in response, ranging from incomplete control of contacted branches to injury above treated branches. The addition of imazapyr to fosamine increased brush injury in all species except black walnut, which along with black locust was the only species where complete control of the treated branches was not observed. Injury beyond the treated branches was seen in ash, elm, hickory, cherry, oak, and sugar maple. Fosamine plus metsulfuron methyl provided consistent control above the treated branches in sumac, elm, and black locust. Cherry showed variable injury, ranging from incomplete control of treated branches to control of the entire plant. This combination provided complete control of treated branches in ash, black walnut, and sugar maple, and control of most treated branches in hickory and boxelder. The combination of fosamine and triclopyr ester resulted in injury beyond the treated branches in black locust and boxelder. Ash injury was extremely variable in this plot, with some stems showing incomplete control of treated branches, while some 9 to 12 m trees were dead. In the majority of ash stems, however, control of treated branches was complete without injury above the treatment zone. Fosamine and glyphosate provided complete control of treated branches in sumac, elm, and oak. Injury above the treated branches was observed in ash, cherry, and black locust. Results on boxelder were more variable, ranging from incomplete control of treated branches to control of the entire plant.

Combining imazapyr, metsulfuron methyl, triclopyr, or glyphosate improves the spectrum of trees controlled and the degree of control attained. The best combination to use will depend on the site to be treated, with tree species present and protection of undergrowth primary considerations in the selection process.

[1/] Project Associate, Professor of Ornamental Horticulture, Research Technologist, and former Project Assistant, respectively, The Pennsylvania State University.

TABLE 1: Injury ratings on July 12, 1991 for broadcast foliar treatments applied September 17, 1990. Treatments were applied with Cibilo Model A sprayer delivering approximately 408 l/ha at 207 kpa treating a 4.6 m vertical swath. Numbers in parentheses following herbicide names indicate application rate (kg ai/ha).

	fosamine (10.8)	fosamine (8.1) imazapyr (0.053)	fosamine (8.1) metsulfuron (0.07)	fosamine (8.1) triclopyr (1.7)	fosamine (8.1) glyphosate (2.2)
	(		Injury (0 - 7)[1/]		)
ash	3-6	5-7	5	4-7	5-6
sumac	4	5	6-7	5	5
elm	5	6	6	- -	5
hickory	4-6	6	4	5	6
cherry	5	5-6	4-7	- -	5-7
boxelder	4	- -	4	5-6	3-7
black locust	- -	4	6-7	5-7	5-6
oak	5	5-6	- -	5	5
walnut	4	4	5	4-5	- -
sugar maple	4-5	6-7	5	3-5	- -

1/ Injury was rated on a 0 to 7 scale with '0' being no injury, '5' is complete control of contacted branches, '6' indicates translocation beyond the treated branches, and '7' being complete control of the plant. '- -' indicates the species was not present in the treatment area.

EVALUATION OF HERBICIDES FOR TOTAL VEGETATION CONTROL UNDER GUIDERAILS

David A. Batey, Larry J. Kuhns, and Arthur E. Gover[1/]

ABSTRACT

Two bareground studies were done as part of a cooperative project with the Pennsylvania Department of Transportation to evaluate herbicides for total vegetation control under highway guiderails. The treatments were applied May 13, 1991 along Interstate 80 (I-80) near Bellefonte, PA and June 27, along SR 3007 near University Park, PA. Due to the accumulation of highway antiskid material both sites had a coarse, gravelly surface creating the potential for runoff of herbicides from the treated areas.

Plots along I-80 were done on an operational scale with a Cibolo Swinglok Model "A" delivering 374 l/ha at 207 kpa. Each treatment was applied to 0.4 ha of guiderail with a 1.5 m wide pattern. Subsequent observation indicated that up to 1.2 m of the 1.5 treatment swath was actually paved with a 2 to 4 cm covering of anti-skid material. Treatments were imazapyr at 0.84 kg ai/ha, sulfometuron methyl at 0.16 kg ai/ha, bromacil at 4.5 kg ai/ha, and tebuthiuron at 3.9 kg ai/ha, all applied in combination with diuron at 9.7 kg ai/ha; while norflurazon at 3.9 kg ai/ha was applied with diuron at 3.9 kg ai/ha.

Plots along SR 3007 were 0.9 by 15.2 m arranged in a randomized complete block design with three replications. Treatments were applied June 27, with a CO_2 pressurized backpack sprayer delivering 323 l/ha at 207 kpa using one Spraying Systems OC-08 spray tip. Treatments were imazapyr at 0.84 kg ai/ha, sulfometuron methyl at 0.16 kg ai/ha, tebuthiuron at 3.9 kg ai/ha, bromacil at 4.5 kg ai/ha, diuron at 9.7 kg ai/ha, and norflurazon plus diuron each at 3.9 kg ai/ha.

Visual ratings of percent ground cover were not recorded for treatments applied to I-80, due to very low weed pressure, however the plots were evaluated for off-site herbicide movement on July 25 and October 14, 73 and 150 days after treatment (DAT), respectively. On SR 3007 visual ratings of percent ground cover were taken July 24 and October 13, 27 and 108 DAT, respectively. Common ragweed (Ambrosia artimisiifolia L.), yellow sweetclover (Melilotus officinalis L.), and wild parsnip (Pastinaca sativa L.) were the most common species present before treatment. The most common species present 27 DAT included giant foxtail (Setaria faberi Herrm.), chicory (Cichorium intybus L.), and spotted knapweed (Centaurea maculosa Lam.). The predominant species 108 DAT were white heath aster (Aster pilosus Willd.), spotted knapweed, and crownvetch (Coronilla varia L.). Treatments and results are reported in Table 1.

At 73 DAT very little vegetation was observed growing in the treated segments along I-80. Bromacil and tebuthiuron were the only treatments that moved off-site significantly. Tebuthiuron moved the farthest, with injury up to 2.4 m beyond the edge of the treatment pattern. Observations 150 DAT did not reveal additional off-site movement, and regrowth of crownvetch was observed within the off-site areas that showed previous injury.

At both rating periods for plots along SR 3007, all treatments were significantly different from the untreated check (Table1) which was rated at 48 and 43 percent ground cover 27 and 108 DAT, respectively. Ratings at 27 and 108 DAT were similar, with imazapyr, sulfometuron methyl, tebuthiuron, bromacil, and diuron treated plots providing acceptable control. The combination of norflurazon plus diuron did not provide acceptable control. At 27 DAT off-site movement was observed in both the tebuthiuron and bromacil plots. Once again tebuthiuron moved the farthest, with injury up to 1.8 m beyond the edge of the treatment pattern. No evidence of off-site movement existed 108 DAT for tebuthiuron or bromacil.

[1/] Research Technologist, Professor of Ornamental Horticulture, and Project Associate, respectively, The Pennsylvania State University

TABLE 1: Visual ratings of percent ground cover taken on July 24 and October 13, 27 and 108 DAT, respectively, for herbicide treatments applied June 27, 1991, to sections of guiderail near University Park, PA. Each value is the mean of three replications.

Treatment	Application Rate (kg ai/ha)	Ground Cover 27 DAT (%)	Ground Cover 108 DAT (%)
1. imazapyr	0.84	9	11
2. sulfometuron methyl	0.16	14	12
3. tebuthiuron	3.6	7	9
4. bromacil	4.5	14	17
5. diuron	9.0	8	14
6. norflurazon + diuron	3.6 + 3.6	22	28
7. Check	---	48	43
Significance Level (P)		0.0004	0.0103
LSD (P=0.05)		14	17

MILE-A-MINUTE (POLYGONUM PERFOLIATUM): A SPREADING NOXIOUS WEED

L. H. McCormick, N. L. Hartwig, L. J. Kuhns[1], and W. L. Mountain[2]

ABSTRACT

Mile-a-minute, Polygonum perfoliatum L., is a spiny annual vine native to eastern Asia that is rapidly colonizing non-crop areas in Pennsylvania and Maryland.. It is believed to have been accidentally introduced into York County, Pennsylvania in the late 1930's or early 1940's. It now occurs in 19 counties in Pennsylvania, 11 counties in Maryland, and two counties in West Virginia. It very likely has also spread into Delaware and Virginia. Birds feeding on the plant's berry-like fruits are believed to be responsible for its spread.

Mile-a-minute produces vines up to 7 meters in length and forms dense canopies over vegetation up to 3 to 4 meters tall. In southcentral Pennsylvania, many recently harvested forest sites are heavily infested with mile-a-minute. Following harvesting and site preparation, dense populations of the weed become established, and quickly overtop and smother existing or planted tree seedlings and other native flora. In recognition of the problems created by this weed and in an effort to limit its spread, mile-a-minute has been added to Pennsylvania's Noxious Weed List. Unfortunately information about the biology and control of mile-a-minute is sparse. Research is being initiated at Penn State to learn more about the spread, growth requirements, and control of this noxious weed.

1 Assoc. Prof. of Forest Resources, Prof. of Weed Science, and Prof. of Ornamental Horticulture The Pennsylvania State University, University Park, PA 16802.
2 State Botanist, The Pennsylvania Department of Agriculture, Harrisburg, PA 17120.

FOLIAR APPLICATIONS OF TRICLOPYR, PICLORAM AND DICAMBA COMBINATIONS WITH VARIOUS SPRAY ADDITIVES

T. HAAGSMA[1] AND M.M. MIHAJLOVICH[2]

ABSTRACT

Consistent control of northern conifer species on Canadian rights-of-way has been a major concern for vegetation managers. Currently registered products such as triclopyr, dicamba and picloram plus 2,4-D provide inconsistent control of conifer species. To achieve consistent control of conifer species NaTCA at a rate of 8 to 12 Kg ai/ha is mixed with the above herbicides. NaTCA is very corrosive to spray equipment, is irrating to skin of applicators and at these high rates is non-selective to native grass species that provide a desirable ground cover. The addition of certain surfactants, such as SILWET[R], SYLGARD[R], and ASSIST (CROP OIL CONCENTRATE) when added to herbicide spray solutions may provide increased herbicide penetration into treated foliage. Trials conducted in Canada also indicate that triclopyr tank mixed with dicamba showed excellent control of conifer species.

Field experiments were established in three Canadian provinces from 1988-91 to evaluate herbicide and surfactant combinations for the control of northern conifer species. Herbicide treatments consisted of TORDON 22K[R] (240 gm ai/l picloram) alone and in combination with GARLON 4 (480 gm ae/l of triclopyr) or NaTCA (85% active sodium salt of trichloracetic acid), TORDON 101[R] (65 GM AI/L PICLORAM + 240 GM AI/L 2,4-D) alone or in combination with NaTCA, SILWET[R] , GARLON 4[R] alone or in combination with DYCLEER (480 gm ai/l dicamba), NaTCA or ASSIST.

Brush species evaluated were black spruce (Picea mariana (Mill.) B.S.P.), white spruce (Picea glauca (Moench) Voss), and balsam fir (Abies balsamea (L.) Mill).

All applications were made with backpack sprayers operated at 220 kPa with 2504 flat fan nozzles to simulate brushgun application. Individual trees were sprayed to the oint of runoff. Ten trees constituted one treatment. In the 1988 trial the herbicide treatments were also applied by a commercial sprayer equipped with an adjustable handgun operated at 2000 kPa.

In the Quebec based trial established in Baie Comeau (See Table 1), one year after treatment, NaTCA and SYLGARD did enhance the efficacy of picloram + 2,4-D in controlling both black-spruce and balsam fir. For black spruce, NaTCA increased defoliation by 35% while SYLGARD and NaTCA increased balsam fir defoliation by 13% and 4% respectively. SILWET did not appear to enhance the efficacy of picloram plus 2,4-D, but a 19% increase in black spruce defoliation was observed when combined with the triclopyr + dicamba mixture.

[1]FIELD DEVELOPMENT SPECIALIST, DowElanco Canada Inc. 275 Exmouth St., Sarnia, Ontario Canada N7T 5N8

[2]DEVELOPMENT FORESTER, DowElanco Canada Inc. 801-58 St. East, Saskatoon, Saskatchewan Canada S7K 5Z4

Three years after treatment in a trial established at Anse Pleureuse (See Table 2), regardless of early or late application, triclopyr/dicamba, picloram/NaTCA, and picloram/2,4-D/NaTCA combinations provided greater than 80% defoliation of black spruce, white spruce and balsam fir. When applied as an early treatment, picloram/2,4-D and dicamba 2,4-D/2,4-DP provided similar conifer control. The triclopyr treatment, provided less than 6% defoliation of black spruce when applied either late or early in the season. Balsam fir and white spruce are susceptible to early application of triclopyr. However, tolerance increases with later applications. Conifer susceptibility increases with the addition of NaTCA, dicamba and picloram.

In the Manitoba trial (See Table 3), all combinations with NaTCA and the higher rate of crop oil concentrate and picloram, produced black spruce defoliation similar to the commercial standard (picloram + 2,4-D).

In Alberta trial black spruce control (See Table 4) was variable and only triclopyr plus picloram (0.4 + 0.4%) gave more than 70% defoliation. Triclopyr combined with either the highest rate of dicamba and crop oil concentrate or all rates of picloram gave 80% or greater defoliation of white spruce. Control of balsam fir was variable and only triclopyr plus the higher rates of 1.0 or 1.5% (v/v) crop oil concentrate produced acceptable control.

TABLE 1
CONIFER CONTROL - BAIE COMEAU, QUEBEC
APPLIED JULY 18/1990
ASSESSMENT DATE JUNE 27, 1991

Treatment	Conc. % v/v	BLACK SPRUCE % Defoliation	BALSAM FIR % Defoliation
Triclopyr Dicamba	0.40 0.50	45	89
Picloram/2,4-D	1.00	65	87
Picloram/2,4-D Organosilicone fluid	1.00 0.25	69	86
Picloram/2,4-D Organosilicone fluid	1.00 0.50	53	80
Picloram/2,4-D Silicone glycol	1.00 0.50	84	100
Picloram/2,4-D NaTCA	1.00 80g/101	100	91
Triclopyr Dicamba Organosilicone fluid	0.50 0.50 0.50	64	88
Control		0	0

TABLE 2

CONIFER CONTROL - ANSE PLEUREUSE, QUEBEC
APPLIED JULY 6-7/88 (EARLY) AUG 11/88 (LATE)
ASSESSMENT DATE: JUNE 25/91

		Black Spruce		White Spruce		Balsam Fir	
Treatment	Rate (Prod./100 1)	E	L	E	L	E	L
				Percent Defoliation			
Triclopyr (480g/1)	0.75 1	5	4	49	0	50	10
Picloram (240g/1)	0.50 1	56	58	87	77	94	53
Picloram & 2,4-D	1.00 1	80	63	98	81	79	71
Triclopyr & Picloram	0.375 1 0.25 1	89	50	73	53	73	73
Triclopryr & Dicamba	0.375 1 0.55 1	83	89	100	100	100	100
Picloram & NaTCA	0.25 1 1.25 kg	100	82	83	97	88	95
Picloram, 2,4-D & NaTCA	1.00 1 1.25 kg	90	90	87	87	94	90
Dicamba & 2,4-D/2,4-DP	0.50 1 0.71 1	93	68	79	69	92	85
Triclopyr & NaTCA	0.75 1.25 kg	70	33	87	61	99	75
Control	0.00	0	0	0	0	0	0

E - Early Application using backpack sprayers (July)

L - Late application using Muskeg vehicle equipped with FMC gun (August)

TABLE 3
CONIFER CONTROL THE PAS, MANITOBA
APPLIED JUNE 20, 1990
ASSESSMENT DATE JUNE 20, 1991

TREATMENT	RATE[1]	BLACK SPRUCE Percent Defoliation[2] (1 year after application)
picloram		
2,4-D	1.0	99a
triclopyr	0.4	44c
dicamba	0.2	
triclopyr	0.4	62bc
dicamba	0.38	
triclopyr	0.4	81a
dicamba	0.5	
triclopyr	0.4	53c
picloram	0.2	
triclopyr	0.4	100a
picloram	0.3	
triclopyr	0.4	81ab
picloram	0.4	
triclopyr	0.6	100a
NaTCA	0.8	
triclopyr	0.6	96a
NaTCA	1.0	
triclopyr	0.6	100a
NaTCA	1.2	
triclopyr	1.0	53c
crop oil	0.5	
triclopyr	1.0	89a
crop oil	1.0	
triclopyr	1.0	78ab
crop oil	1.5	
untreated		Od

1. All rates are percent volume to volume except NaTCA which is percent weight to volume.
2. Numbers in the same column followed by the same letter are not significantly different (alpha=.05) according to Duncan's multiple range test.

TABLE 4
CONIFER CONTROL JUDY CREEK, ALBERTA
APPLIED JUNE 20, 1990
ASSESSMENT DATE JUNE 20, 1991

TREATMENT	RATE[1]	Conifer control (% defoliation, 1 year)		
		Black Spruce	White Spruce	Balsam Fir
picloram				
2,4-D	1.0	38bcd	98ab	49bc
triclopyr	0.4	18de	59d	32cd
dicamba	0.2			
triclopyr	0.4	28cd	73bcd	52bc
dicamba	0.38			
triclopyr	0.4	30bcd	97ab	46bc
dicamba	0.5			
triclopyr	0.4	40bcd	99a	48bc
picloram	0.2			
triclopyr	0.4	58ab	84abc	47bc
picloram	0.3			
triclopyr	0.4	73a	94ab	54bc
picloram	0.4			
triclopyr	0.6	40bcd		52bc
NaTCA	0.8			
triclopyr	0.6	40bcd		46bc
NaTCA	1.0			
triclopyr	0.6	46a-d		30cd
NaTCA	1.2			
triclopyr	1.0	58ab	58d	57bc
crop oil	0.5			
triclopyr	1.0	52abc	64cd	100a
crop oil				
triclopyr	1.0	34bcd	97ab	89ab
crop oil	1.5			
untreated		0e	0e	2d

1. All rates are percent volume to volume except NaTCA which is percent weight to volume.
2. Numbers in the same column followed by the same letter are not significantly different (alpha=.05) according to Duncan's multiple range test.

CHEMICALS

TRADE NAME	COMMON NAME	CONCENTRATION
TORDON[R] 22K	PICLORAM	240 g/L
TORDON [R] 101 HERBICIDE	PICLORAM + 2,4-D	65 g/L 240 g/L
GARLON[R] 4	TRICLOPYR	480 g/L
DYCLEER[R]	DICAMBA	480 g/L
SODIUM TCA GRASS KILLER	TRICHLORO ACETIC ACID	85% SOLUBLE GRANULE
SILWET[R] L-77	ORGANOSILICONE FLUID	99%
SYLGARD[R] 309	SILICONE GLYCOL	99%
ASSIST	MINERAL OIL SURFACTANT BLEND	83% MINERAL OIL 17% SURFACTANT BLEND

PROGRESS REPORT ON LOW VOLUME AERIAL APPLICATIONS TO FOREST SITES

R. R. Johnson and J. E. Waldrum[1]

ABSTRACT

Low volume aerial applications were made to forest sites in Virginia, Maryland, and Delaware in 1991 using a TVB[R] Thru Valve Boom™ equipped with .020" Wedge nozzles, mounted on a Bell G47 Soloy helicopter[2]. The TVB is an aerial application device designed to minimize spray drift. To provide drift control and minimize the effects of low humidity on small spray droplets, an application system was developed to maintain the drift control characteristics of the TVB and reduce evaporation losses through the use of Thinvert™, a thin water-in-oil (invert) emulsion[3].

In a trial on Virginia Division of Forestry land in Cumberland State Forest, site preparation applications were made to a commercially clearcut area on July 16, 1991. Three nine acre treatments were applied comparing triclopyr amine plus surfactant in water solution, triclopyr ester emulsified in water, and triclopyr amine in a thin, water-in-oil invert emulsion. A nine acre untreated check was delineated. Application rate was 4 lb/A on all treatments. Spray volume was 4 gal/acre on all treatments. Three additional treatments were applied to a clearcut site on Buckingham-Appomattox State Forest using the same spray equipment and spray volume on the same day. Treatments on this site were triclopyr amine + imazapyr at 3 + 0.25 lb/A applied as a water solution, triclopyr amine at 3 lb/A applied as a thin water-in-oil emulsion and imazapyr applied at 0.25 lb/A as a thin water-in-oil emulsion. The Cumberland site had a 10% residual overstory, while the Buckingham site had no residual overstory. Both sites had been logged in 1990.

Addition applications of thin water-in-oil emulsions were made to a private forest site in Worcester County, MD and to a site on Redden State Forest, DE. At both sites, a thin water-in-oil emulsion of imazapyr applied at 4 gal/A spray volume was compared to imazapyr plus a 90/10 oil/surfactant blend applied at 8 gal/A spray volume. Imazapyr was applied at the 0.5 lb/A rate on the MD site and at 0.375 lb/A on the DE site. Plots on both sites were approximately nine acres in size and were applied in September 1991.

Treatments at the Cumberland and Buckingham sites in Virginia were evaluated for necrosis on August 6 & 7, 1991, prior to burning. Results are shown in Table 1. Vegetation on all plots will be evaluated in 1992 and 1993.

1/ Waldrum Specialties, Inc., Doylestown, PA 18901
2/ Operated by Helicopter Applicators Inc., Frederick, MD 21701
3/ TVB, Thru Valve Boom, and Thinvert are trademarks of Waldrum Specialties, Inc.

TABLE 1: Mean necrosis ratings to red maple (*Acer rubrum* L.), white ash (*Fraxinus americana* L.), and hickory (*Carya spp.* L.) from aerial sprays of triclopyr applied as an amine solution, an ester emulsion, and as an amine thin water-in-oil emulsion, expressed as a percentage. Ratings made 22 days after application, prior to burning. Each value is the mean of ten observations.

Herbicide	Formulation	Carrier	Percent Necrosis			
			red maple	white ash	hickory	Overall
triclopyr	amine[1]	solution	77	32	60	40
triclopyr	ester[2]	emulsion	97	45	53	70
triclopyr	amine[1]	thin invert[3]	94	51	88	80

1/ Garlon 3A, containing the acid equivalent of 360 g/l triclopyr as the triethylamine salt.
2/ Garlon 4, containing the acid equivalent of 480 g/l triclopyr as the butoxyethyl ester.
3/ Thinvert Deposition Aid, adjuvant, Waldrum Specialties, Inc.

AERIAL SIDE TRIMMING JUST MIGHT BE THE ANSWER TO YOUR SIDE TRIMMING NEEDS

Joe Hartung

Abstract

As the cost and need for Rights - of - Way side trimming maintenance are becoming more and more significant, and operating budgets are not adjusted accordingly to accommodate the "preferred" Right - of - Way maintenance program, today's Rights - of - Way maintenance manager has to consider all available options to realize the optimum benefit to his program. Aerial Solutions, Inc. has successfully developed and is currently operating the Aerial Power Saw, specifically designed to side trim trees on the edge of Rights - of - Way:

Description - The Aerial Power Saw consists of an engine driven series of circular saws suspended underneath a helicopter, uniquely designed to trim tree limbs up to 10 inches in diameter.

Development - The Aerial Power Saw was developed and is patented by Aerial Solutions, Inc., a Louisiana based helicopter operator. Aerial Solutions, Inc. currently operates three helicopters throughout the Eastern United States. The Aerial Power Saw was first used successfully in 1985 and has since accumulated over 10,000 hours of accident free helicopter side trimming operations for the utility and pipeline industry.

Certification - The Aerial Power Saw is approved by the Federal Aviation Administration for its designed operations. In addition, a ten million dollar liability insurance policy is in place.

Advantages - The Aerial Power Saws greatest asset is its accessibility. In addition it is much faster and in many cases considerably more economical than conventional tree trimming devices. Other benefits such as minimal landowner problems, much less erosion to the Right - of - Way, reduced supervision time, total sidewall trimming and alternative tree trimming options are direct benefits, but hard to put a dollar value on.

Limitations - The Aerial Power Saw is designed for cross country operations. Urban areas and houses should be avoided. High, gusty winds also limit the operation. In addition, when heavy overhang prevails, the average cost will rise sharply.

Current Users - Appalachian Power Co., Monongahela Power Co., Potomac Edison Power Co., Columbus Southern Power, Indiana Michigan Power, South Carolina Electric and Gas, Santee Cooper, Gulf States Utilities, Exxon Pipeline, Tenneco Pipeline, Chevron Pipeline, Mobil Pipeline.

Conclusion: The Aerial Power Saw is a proven tool to side trim commercial Rights - of - Way. When used to its best advantage it is very hard to beat, and well worth considering.

GLYPHOSATE INJECTION RESULTS AND FOLLOW-UP

Lawrence W. Jackson[1]

ABSTRACT

In fall 1988, Glyphosate (n-phosphonomethyl glycine, in the form of the isopropylamine salt) was injected into a representative sample of five tree species of varying diameter on an upland northern hardwood site in Albany County, New York. Tree condition was evaluated over a three year period with retreatment applied to remaining and additional trees in the summer of 1990. Topkill and ultimate death of American hop-hornbeam (Ostrya virginiana), white ash (fraxinus americana), and white birch (Betula papyrifera) approached 100% while mortality of basswood (Tilia americana) and sugar maple (Acer saccharum) varied considerably from tree to tree. Summer treatments appeared more effective than fall treatments for basswood and sugar maple, but both were equally effective on hop-hornbeam. Factors affecting the extent of topkill and duration for mortality to occur include tree diameter, extent of crown and root system, available moisture, type and depth of soil and depth to bedrock.

INTRODUCTION

Stem injection of chemicals to control undesirable trees has been employed by foresters as an accepted practice in timber stand management and right-of-way treatment for many years (Brinkman, 1970; Voeller and Holt, 1973; Holt, 1975; Ferguson and Lawson, 1975 and Ulrich, 1981). One of the most effective herbicides employed for this technique by both foresters and right-of-way managers was 2,4,5-triclorophenoxyacetic acid (2,4,5-T). When 2,4,5-T was banned in 1978, triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid) and picloram (4-amino-3,5,6-trichloro-picolinic acid) were found to be most effective for a variety of species when employed in combination during the growing season (Geyer and Chandler, 1979). Other workers found triclopyr (amine) effective in controlling hardwoods for conifer release (Warren, 1980). Picloram, injected with a hypohatchet, was effective in killing certain northern hardwoods, particularly sugar maple and quaking aspen (Populus tremuloides) (Shipman, 1984; Jackson, 1986a and 1986b) and Jackson (1987) found triclopyr and picloram in

---

1. Associate Transmission Facilities Analyst, Office of Energy Efficiency and Environment, NYS Department of Public Service, Three Empire State Plaza, Albany, NY 12223.

combination most effective when employed as a post-leaf emergent application. In this latter study only two species succumbed the first year, white ash and American beech (fagus grandifolia), but several other species died over a two year period.

While the herbicides discussed above are effective in controlling several northern hardwood species, their toxicity levels and ability to move in solution through groundwater, especially picloram, restrict their usefulness around land uses such as residential backyards, gardens and public or private drinking water sources. Glyphosate, first registered for use in forestry and right-of-way applications in 1987, appears to be a likely alternative to earlier herbicides. This herbicide's advantages are minimal movement in soil and water and an allowable toxicity level of >5000/mg/kg for rats and rabbits which makes it practically non-toxic. Its main disadvantage is that it is non-selective, killing all vegetation indiscriminately. This disadvantage can be overcome through employment of the injection technique, whereby chemical comes in contact with nothing but the individual stem to which it is applied.

Objectives of this study were to determine: 1) the effectiveness of glyphosate in killing a variety of northern hardwoods, and 2) the time during the growing season when optimum control can be achieved. Previous studies (Jackson, 1986a, 1986b and 1987) showed that poor results are likely when injection is done pre-leaf emergence or during the dormant season (generally October 1 - May 15).

SITE DESCRIPTION

The treatment site was established in the Town of Berne, Albany County, N.Y. in northern hardwoods on a slope of 10-15% at 1,970 feet elevation. The slope and exposure is to the northwest at the site near the top of West Mountain. Soils are silt-clay loams with a 1-3" depth A-Horizon of leaf litter and humus with a depth to shale bedrock of less than 3'. The site is divided between an old growth sugar maple forest of trees 70-90' high and up to 200 years old and an overgrown pasture with a variety of pioneer species ranging from 15-40' high and up to 35 years of age. The basswood and hop-hornbeam are located along the old forest edge while the sugar maple, white ash and white birch are in the overgrown pasture.

PROCEDURES AND METHODS

Injection can be accomplished through various means, including the hypohatchet or tubular chemical injections under various trade names. For simplicity, I used the hack and squirt method since my sample sizes were small. Incisions through the bark into the cambium of each tree were made with a hatchet at about 2" intervals. Each incision was about 2" long and tree diameters ranged from 1.5-9.0" (typical of right-of-way vegetation)

so 2-7 incisions were made. Open incisions were immediately squirted until the wound was saturated with an 18% solution of glyphosate diluted 50-50 with water. Initially, 10 individual sugar maples, American hornbeams, white ashes and white birches and 9 basswoods were treated on September 19, 1988. An evaluation of treatment results was made one year later. Another evaluation was made in July of 1990, following which the remaining live stems of basswood and sugar maple were retreated with the same application of glyphosate, along with the following additional trees: 5 basswood, 2 sugar maples and 5 hop-hornbeam. Follow-up evaluations of this latter treatment and any remaining live stems were made in August of 1990 and May of 1991. Observed topkill (visual estimate) and ultimate mortality (checked by examining the cambium) were documented for each stem, by species, in Tables 1-5.

Table 1. Results from injection of basswood.

Tree Number	DBH in inches	Injection Date	Percent topkill			
				Retreated or treated		
		9/19/88	9/29/89	7/10/90	8/27/90	5/29/91
1	9	0	20[2]	10[2]	20[2]	40[2]
2	3 7/8	0	20	25	60	100
3	2 1/2	0	70	Dead[1]	---	---
4	7 1/2	0	30	30	65	90
5	6	0	30	40	100	100
6	5	0	100[2]	Dead[1]	---	---
7	3 7/8	0	100	Dead[1]	---	---
8	6 7/8	0	10	10	80	100
9	7	0	40	20	80	100
10	9	---	---	0	25	60
11	8 1/4	---	---	0	60	95
12	6 3/4	---	---	0	65	100
13	6	---	---	0	65	100
14	6 1/2	---	---	0	70	100

1. Cambium was observed to determine if stems were dead.

2. No evident translocation of chemical to an adjoining crotch stem located below the point of injection.

Table 2. Results from injection of sugar maple.

Tree number	DBH in inches	Injection date	Percent topkill					DBH in inches
					Retreat or treat			
		9/19/88	9/29/89	7/6/90	7/10/90	8/27/90	5/29/91	5/29/91
1	5 3/4	0	100	5	5	25	40	5 3/4
2	9	0	80	5	5	70	75	9
3	8	0	95	5	5	70	90	8
4	6	0	100	10	10	55	70	6 1/4
5	6 1/8	0	100	5	5	50	100	6 1/4
6	5 1/4	0	20	5	5	60[1]	85[1]	5 1/4
7	4	0	15	5	5	80	90	4 3/4
8	5 3/4	0	5	0	0	5[2]	30[2]	6 1/2
9	3 5/8	0	70	5	5	90	100	3 5/8
10	4 3/4	0	85	0	0	70	75	5 1/8
11	4 3/4	---	---	---	0	80	100	4 3/4
12	5 1/4	---	---	---	0	70	90	5 1/4

1. No evident translocation of chemical to adjoining stems in a clump of three.

2. No evident translocation of chemical to adjoining stem in a clump of two.

Table 3. Results from injection of American hop-hornbeam.

Tree Number	DBH in inches	Injection Date 9/19/88	Percent topkill 9/29/89	7/6/90	treated 7/10/90	8/27/90	5/29/91
1	2 3/8	0	100	100	Dead		
2	3 1/2	0	100	100	Dead		
3	2 3/8	0	100	100	Dead		
4	3 7/8	0	100	100	Dead		
5	3	0	100	100	Dead		
6	4	0	100	100	Dead		
7	3 1/4	0	100	100	Dead		
8	2 1/2	0	95	100	Dead		
9	4 1/2	0	100	100	Dead		
10	2 1/2	0	100	100	Dead		
11		---	---	---	0	100	100
12		---	---	---	0	100	100
13		---	---	---	0	100	100
14		---	---	---	0	100	100
15		---	---	---	0	100	100

Table 4. Results from injection of white ash.

Tree Number	DBH in inches	Injection Date 9/19/88	Percent topkill 9/29/89	7/6/90	8/27/90	5/29/91
1	1	0	0[1]	100	100[2]	100[2]
2	3 1/2	0	0[1]	20	30	30
3	1 1/2	0	100	100	100[2]	100
4	2 1/8	0	100	100	100	100
5	3 1/4	0	100	100	100	100
6	2 1/4	0	100	100	100	100[2]
7	1 3/8	0	100	100	100	100[2]
8	1 1/4	0	100	100	100	100[2]
9	1 1/8	0	100	100	100	100[2]
10	2 1/4	0	40[1]	80	85	100[2]

1. Leaves all 1/2 normal size.

2. Basal sprouts heavily foraged by deer.

Table 5. Results from injection of white birch.

Tree Number	DBH in inches	Injection Date 9/19/88	Percent topkill 9/29/89	7/6/90	8/27/90
1	1 1/2	0	100	100	Dead[3]
2	4	0	100	100[1]	Dead
3	2 3/4	0	100	100	Dead
4	2 7/8	0	100	100	Dead
5	4 1/4	0	95	100	Dead
6	5 1/4	0	80	100	Dead
7	6	0	80	100	Dead
8	4	0	98	100[2]	Dead
9	3 3/4	0	60	100	Dead
10	3 1/8	0	99	100	Dead

1. No translocation of chemical evident in topkill to adjoining 2 1/2 inch diameter trunk.

2. No translocation of chemical evident in topkill to adjoining 2 inch diameter trunk.

3. Cambium was observed to determine if stems were dead.

RESULTS

Evaluations of topkill and mortality are summarized by species over a three year period.

Table 6. Treatment effectiveness by species.

Species	Month Treated	Stems 100% topkilled after: 1 Year	2 Years	3 Years & re-treat	Total Stems Treated
Basswood	July	2	3	7	9
Sugar maple	July	3	0	2	10
Hop-hornbeam	July	9	10	-	10
				without retreatment	
White ash	July	7	8	9	10
White birch	July	4	10	-	10
Basswood	September	3	-	-	5
Sugar maple	September	1	-	-	2
Hop-hornbeam	September	5	-	-	5

Obviously, the most vulnerable species was hop-hornbeam with 90% topkill and no sprouting 2-4 weeks after treatment, either in July or September. White birch was next most vulnerable but took up to 2 years to die following the September treatment. Unfortunately, no trees were injected in July to see if mortality would occur faster. White ash revealed 80% topkill in 2 years for the September treatment and one surviving stem was still alive after 3 years without benefit of a July follow-up treatment. Basswood showed 33% topkill after 2 years and 78% topkill after 3 years and a follow-up July treatment. The most resistant tree was sugar maple; it showed 30% topkill after 1 year and only 20% topkill after 3 years and a follow-up July retreatment. Trees treated in July showed 50% topkill but the sample was small. Furthermore, all maples that had topkill the first year almost completely recovered in the second year and survived retreatment in July of the 3rd year although in a weakened condition.

Three observations are noteworthy. With the exception of hop-hornbeam (no specimens over 4" were treated), larger-sized trees (4" diameter or larger) generally took longer to die. Secondly, topkill, as I have documented in earlier studies, is not indicative of mortality until over a year has passed with neither resurgence of crown foliage nor sprouting from the stem or root crown. While white ash had 70% topkill the first year, 60% of the stems still had live sprouts 3 years later . These sprouts were not gaining size, since deer were browsing them all. Also, while 70% of the treated sugar maples showed 70-100% crown die-back, all resurged to provide 90-95% full crowns the following year. Finally, in six instances on three different species there was no evidence of chemical injury to adjoining stems with a common root system which emanated below the point of injection.

DISCUSSION

Preliminary findings suggest that glyphosate introduced by injection is a viable technique for controlling unwanted trees of certain species. At least for hop-hornbeam, white birch and white ash it was very effective (90% kill) when injected in either early or late summer. It may also prove effective for early summer treatment of sugar maple and basswood, as well as other species, but more testing is needed. Careful observation and checking of discoloring of cambium cells for mortality of the entire tree system is necessary, since this chemical does not translocate as readily as other herbicides, particularly picloram, and, if roots are not killed, the tree can recover.

Apparently, physical response varies greatly among tree species. This is suggested by the wide range in time necessary for full defoliation (2-4 weeks for hop-hornbeam and up to three or more years for other species). Future experiments with glyphosate injection will have to be watched closely to determine the most effective treatment time(s) for any target species.

While each species responds differently, based on its unique physiology, other environmental factors will affect final application results. On my test site, poor soil and shallow depth-to-bedrock may have resulted in some trees, particularly hop-hornbeam, being under stress prior to treatment. Soil moisture was also a factor. The summer of 1988, when the initial treatments were made, was one of the driest and hottest on record in the Albany area. Disease appeared not to be a factor, since all trees were healthy when treated; however, competition may have been a factor since the hop-hornbeam, white ash and white birch were growing in dense stands, with competing overstory vegetation. The basswood and sugar maples were in edge situations with commensurate room to grow and with the advantage of more sunlight. All of these variables can and will affect herbicide treatment results to a certain extent and should be considered when setting up experiments and evaluating results. My overall judgment is that the individuals selected for treatment were representative of fellow species stems in the vicinity.

The hack and squirt technique has been adopted by many foresters and right-of-way managers as an alternative to the hypohatchet because of its simplicity. There is no gun to take apart and clean at the end of the day and no chance that equipment will clog. Herbicide concentrates can easily be diluted to the desired concentration in the field. One quart squirt bottle can be easily carried in one hand and a hatchet in the other. Additional bottles can be attached to one's belt or carried in a backpack, and are easily cleaned and stowed at the end of the day.

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

Glyphosate is another herbicide which can be added to the right-of-way/forestry tool box for injection use. High rates of mortality (90%+) can be achieved and efficacy is rapid in certain species. Translocation and toxicity of this chemical are low, which should make it readily acceptable to the public. Its application, particularly the hack and squirt method, can be done by anyone with minimal training. Use of glyphosate by injection appears particularly promising for killing selected trees in difficult-to-get-to locations, and on special sites where tree removal is costly or dangerous and chemical movement and toxicity are a concern.

More research is needed regarding the effectiveness of glyphosate injection on other hardwoods before it can be generally endorsed. Also, its apparent effectiveness in early summer applications, post-leaf emergence, should be validated by replication and further evaluation.

LITERATURE CITED

Brinkman, K. A. 1970. Picloram in spaced stem injections to control Lake States Hardwoods. U.S. For. Ser. Res. Note NC-94, St. Paul, MN, p. 4.

Ferguson, E. R. and E. R. Lawson. 1975. Chemical injections for thinning pole-sized hardwoods in the Ozarks. U.S. For. Ser. Res. Note SO-189, New Orleans, LA, p. 3.

Geyer, W. A. and P. Chandler. 1979. Tree control with injection of GARLON and TORDON brand herbicides. Down to Earth 35:3 (9-13)

Holt, H. A.; J. E. Voeller and J. F. Young. 1975. The hypohatchet injector and timber stand improvement. Herbicides and forestry Department For. and Nat. Res. Purdue University, West Lafayette, IN, pp. 93-107.

Jackson, L. W. 1986a. Picloram injected and picloram pellets broadcast - a seven-year study in eastern New York. Proc. Northeastern Weed Science Society Vol. 46, pp. 243-247.

Jackson, L. W. 1986b. Effectiveness and vegetation response to triclopyr tree injection on selected plots in eastern New York, Northeastern Weed Science Society, Vol. 40, pp. 243-247.

Jackson, L. W. 1987. Picloram and Triclopyr injection - Results and Followup. Proc. Northeastern Weed Science Society Vol. 41, pp. 158-162.

Shipman, R. D. 1984. Selective herbicide treatment of striped maple. Down to Earth 40(1): 25-28.

Ulrich, R. 1981. Metropolitan Edison adopts frill cut method with Tordon 101 for right-of-way maintenance. Industrial Vegetation and Pest Management. Vol. 13 (1): 8-9.

Voeller, J. E. and H. A. Holt. 1973. Continued evaluation of the hypohatchet for woody species control. Proc. 26 annual Meeting Southern Weed Society, pp. 354-360.

Warren, L. E. 1980. Control of tan oak and associted species with cut surface treatments of Garlon 3A herbicide. Down to Earth 36: 2(8-13).

A COMPARISON OF GLUPHOSINATE, ENDOTHALL, AND DIQUAT FOR POTATO VINE DESICCATION

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

ABSTRACT

Potato (Solanum tuberosum L.) vines must usually be mechanically or chemically removed prior to potato harvest for long-term storage in the Northeast. Recently, diquat and endothall have been the only chemical alternatives available for this purpose. Chemical desiccation, particularly of stem tissue, can be particularly difficult with these materials under the cool, moist conditions often prevalent in the Northeast. This study was conducted to evaluate rates, split applications, and adjuvants which might enhance the performance of these standard materials and also to compare these materials with a new candidate desiccant, gluphosinate.

Diquat, endothall, and gluphosinate were applied at several rates and in single or split applications in field experiments from 1989 to 1991 at Presque Isle, Maine. Several treatment combinations with diquat and endothall compared use of these materials with or without adjuvants. Leaf and vine desiccation were recorded at 4, 7, 14, and 21 days after treatment (DAT). The potato variety used was 'Katahdin'. A standard treatment included in all experiments was 0.28 kg ai ha^{-1} diquat plus adjuvant followed by a repeat application five to seven days later.

Although chemical treatments differed in their initial rate of leaf desiccation, diquat and gluphosinate resulted in essentially complete leaf desiccation by 14 DAT. Endothall provided complete leaf desiccation by 14 to 21 DAT. Speed of stem desiccation varied greatly among growing seasons with stems being particularly difficult to desiccate during 1989 and 1991. Stem desiccation at 14 and 21 DAT was generally improved by split applications of diquat or gluphosinate when compared to single applications. Diquat applied at 0.56 kg ai ha^{-1} plus adjuvant followed by 0.28 kg ai ha^{-1} five to seven days later generally improved vine desiccation relative to the standard treatment. Gluphosinate applied at 0.56 kg ai ha^{-1} followed by a repeat application five to seven days later was comparable to the standard diquat treatment by 14 DAT during 1990 and 21 DAT during 1991. Endothall was consistently slower for stem desiccation than diquat. The two formulations of endothall tested performed similarly. Adjuvant choice had no consistent effect on stem desiccation by diquat. Adjuvant rate did not affect stem desiccation by diquat.

In summary, diquat applied at 0.56 kg ai ha^{-1} plus adjuvant followed by 0.28 kg ai ha^{-1} five to seven days later was the only treatment that consistently improved stem desiccation relative to the standard treatment. Gluphosinate, applied in two 0.56 kg ai ha^{-1} applications, appears to be a viable alternative to the standard diquat treatment; however, it did not improve stem desiccation relative to the standard.

[1]Assoc. Professor and Asst. Scientist; Dept. of Plant, Soil and Environmental Sciences, University of Maine, Orono, ME 04469.

ALTERNATIVE WEED CONTROL STRATEGIES IN A REDUCED-TILLAGE CABBAGE SYSTEM

T. A. Blomgren and R. R. Bellinder[1]

ABSTRACT

Integrating mulches and mechanical and/or chemical weed control measures is critical in developing reduced-tillage (RT) systems consistent with agricultural sustainability. The objective of this study was to investigate "as-needed" postemergence weed control and mulch performance in a RT cabbage production system. Weed control treatments included cultivation versus full- and half-rate applications of pyridate (1.0 and .50 kg ai./ha, respectively), and weedy and weed-free controls. Mulches included oats (O), rye, crimson clover (CC), hairy (HV) and lana vetch (LV) and Austrian winter peas (AWP), grown alone and in polycultures, and a conventionally-tilled (CT) control. Data were subjected to analysis of variance and orthogonal contrasts.

Contrast 1: cultivation vs. herbicides. Weed pressure was generally not different between cultivation and pyridate treatments. Percent weed cover in LV was significantly lower in cultivation than pyridate in both years. Weed biomass was not significantly affected by treatment; and weed numbers differed only in AWP (1990), where pyridate was superior. Cultivation and herbicide treatments resulted in similar marketable yields. However, pyridate treatments resulted in higher yields in CC and O&HV in 1990, and rye in 1991. Cultivation yielded more cabbage in LV in 1990, and oats, LV and O&HV in 1991.

Contrast 2: full- vs. half-rate herbicides. Full- and half-rate pyridate treatments resulted in no significant differences in percent weed cover except in 1991, where the full-rate was better in CT and AWP. No differences in weed numbers and biomass (except in CC, 1990) were found between the two herbicide rates. The number of marketable cabbage heads was not affected by herbicide rate. Cabbage biomass was similar in all but CC and LV in 1990, and CT, AWP and O&CC in 1991, where the full-rate was superior.

Treated plots resulted in significantly more marketable heads and cabbage biomass than weedy controls. In 1991 a weed-free check was utilized to better assess the efficacy of the weed control treatments. A single hand weeding four weeks after transplanting was sufficient to maintain the check free of weeds all season. Yields in weed-free mulch plots were significantly greater than those in other treatments. The data indicates that weed control treatments investigated in this study perform similarly with respect to weed suppression and cabbage yield, however, improvements in application methodology and timing will be required to obtain optimal yields.

---

[1]Graduate Research Asst. and Assoc. Prof., Dept. of Fruit and Vegetable Science, Cornell University, Ithaca, NY 14853

HERBICIDE PROGRAMS FOR TRANSPLANTED PEPPERS

J. A. Ackley, H. P. Wilson, and T. E. Hines[1]

ABSTRACT

Peppers (Capsicum annuum L.) are grown throughout the U.S. including the middle-Atlantic region where they are planted for both summer and fall harvest. As recently as the summer of 1991 only three herbicides were labeled for soil application to peppers and all are mitotic poisons. These labeled herbicides are primarily active against annual grasses. These field studies were conducted in 1990 and 1991 to evaluate the two newer herbicides clomazone and MON 13202 for weed control in transplanted peppers. Peppers were not injured by either herbicide. Both herbicides controlled annual grasses. Clomazone was consistently effective as a preemergence herbicide while MON 13202 was not clearly superior as either a preemergence or preplant incorporated herbicide. Although populations of broadleaf weeds were generally low, clomazone and MON 13202 controlled common lambsquarters (Chenopodium album L.) but had little effect against smooth pigweed (Amaranthus hybridus L.). Studies in other crops have found that clomazone controls numerous broadleaf weeds that may be present in many pepper fields. For this reason clomazone should be an excellent herbicide for peppers. Additional research with MON 13202 should continue to support the use of this new chemistry in peppers.

---

[1]Grad. Res. Asst., Prof., and Agri. Res. Sci. A., Eastern Shore Agric. Exp. Stn., Va. Polytech. Inst. and State Univ., Painter, VA 23420.

BENSULIDE AND ETHALFLURALIN IN TRANSPLANT WATER FOR CANTALOUPE

Janice P. Donohoe, Debra A. Dinkel, and C. Edward Beste[1]

ABSTRACT

"Plant Setter" machines, which have a large floating wheel with wedges on the wheel surface that forms a soil depression for setting transplants, are utilized for planting into plastic mulch or bare ground. The large wheel contains water that is supplied from a reservoir tank on the machine and a regulated amount of water flows into the soil depression as it is formed when the wheel rotates along the soil surface to provide moisture for the newly-set plants. The objective of this study was to determine if a small amount of herbicide applied with the transplant water was efficacious for weed control adjacent to transplants.

Growth chamber studies were conducted with cantaloupe (Cucumis melo L., 'Superstar') transplanted at the one leaf stage (bare roots) into 480 ml size containers filled with dry Norfolk loamy sand soil and drenched with 100 ml of water containing 5, 10 or 20 mg ai of bensulide which corresponded to 4.4, 8.8 or 17.6 kg/ha. Cantaloupe growth was slightly reduced by the 17.6 kg/ha bensulide drench and seeded large crabgrass (Digitaria sanguinalis (L.) Scop.), was controlled by all bensulide rates.

Field studies were conducted on black plastic mulch in a Norfolk loamy sand, 0.9% OM and one leaf stage, 'Superstar' cantaloupe in peat pellets were transplanted on May 9, 1991. The 355 ml water volume added for each plant contained bensulide at 5, 10 or 20 mg/plant which corresponded to 4.4, 8.8 or 17.6 kg/ha. A treatment of ethalfluralin at 1.3 mg/plant (i.e. 1.2 kg/ha) was included. Cantaloupe growth was significantly reduced by ethalfluralin but not by bensulide. However, yields during the first and second weeks of harvest and total yields were not significantly different for all treatments. Average melon diameter and weight were unaffected by the herbicide treatments. Weeds did not occur in this study.

Bensulide appears efficacious as a soil drench in the transplant water at 5 mg ai/plant and requires only 0.038 kg ai/ha for a typical cantaloupe planting on black plastic mulch, which represents a >100-fold reduction of the broadcast rate.

[1] Ag Aide, General Technician, and Associate Professor, *Department of Horticulture, Salisbury Facility, LESREC,* University of Maryland, Salisbury, MD 21801

HERBICIDES AND SOIL SOLARIZATION FOR HERB PRODUCTION

A.F.Senesac[1/] and D. Wilcox-Lee[2]

ABSTRACT

There is considerable interest among New York multi-crop vegetable growers in the production of herbs for roadside market sale. One of the greatest limits to greater production is the almost complete lack of herbicides registered for use on some of the most popular herb species. Our goal was to evaluate crop safety of several herbicides on five herb species and to determine if a modified soil solarization technique is feasible for these low acreage, but high value crops.

Two field studies were conducted in 1991 on freshly fitted Riverhead sandy loam with a pH 5.7 and 2.0 % O.M. Hardened plants of chive (Allium schoenoprasum L.), basil (Ocimum basilicum L.), dill (Anethum graveolens L.), marjoram (Origanum marjorana L.), and Thyme (Thymus vulgaris L.) were transplanted on June 14, 1991 into raised beds. The herbicide treatments and application timings were as follows: napropamide, posttransplant at 2.2 and 4.5 kg/ha, metolachlor, posttransplant at 1.7 and 3.4 kg/ha, oxyfluorfen, pretransplant at 0.28 and 0.56 kg/ha and sethoxydim, 28 days after plant at 0.56 and 1.1 kg/ha. Above ground fresh and dry weights were measured six weeks after planting. The results indicate that metolachor caused significant yield reduction in thyme, margoram, basil and dill . Napropamide injured thyme only. Sethoxydim and oxyfluorfen were apparently safe on all five species at these rates.

In another study, raised beds were formed on May 20, 1991 and clear plastic (4 mil) was laid over some plots. The plastic was removed 20 days later and glyphosate was applied at 0.84 or 1.68 kg/ha. Three days later, the herbs were hand transplanted into these 'stale' beds with as little soil disturbance as possible. Soil temperature, measured 2.5 cm under the soil surface, reached a maximum of 40 degrees centigrade and was 5 degrees greater under the plastic than in no-plastic plots. The combination of clear plastic and subsequent glyphosate application at 0.84 kg/ha was equivalent in eventual weed control to that achieved with 1.68 kg/ha glyphosate without plastic. Although there were weeds in all plots, the only treatment which resulted in a significant yield loss was 0.84 kg/ha glyphosate without plastic. This rate of glyphosate did not control the initial flush of common lambsquarters(Chenopodium album L.), the dominant weed species in the study.

[1/]Weed Science Specialist, Cornell Cooperative Extension, Long Island Horticultural Research Laboratory, Riverhead, NY 11901.

[2/]Associate Professor, Dept. of Fruit and Vegetable Science, Cornell University, Long Island Horticultural Research Laboratory, Riverhead, NY 11901.

BROCCOLI AND SNAP BEAN TOLERANCE TO CLOMAZONE

C. Edward Beste, Janice P. Donohoe, and Debra A. Dinkel[1]

ABSTRACT

Efficacy studies with clomazone herbicide were conducted in 1991 on snap bean (Phaseolus vulgaris L., 'Miranda') and transplanted broccoli (Brassica oleracea L., var. Italica, 'Green Comet') in a Norfolk loamy sand, 0.7% OM. In 1988 transplanted 'Green Comet' broccoli was evaluated with clomazone on a Norfolk sandy loam, 1.0% OM. The 1991 studies were planted in unreplicated strips of 5.5 by 23 M for snap beans and 8 by 30 M for the broccoli. The broccoli study in 1988 was a randomized complete block design with four replications and plot size of 3.6 by 7.6 M.

The snap bean study was a comparison of 0.28, 0.42 and 0.56 kg/ha clomazone applied shallow preplant incorporated (ppi) or preemergence (pre) treatment. Shallow incorporation of clomazone to a 3.0 cm depth was obtained with a single pass of a crowfoot cultipacker at seven km/hr on May 15, 1991. 'Miranda' snap beans were planted 3.7 cm deep on May 15 and the preemergence treatments were applied on May 16, 1991. Snap bean population and plant size were reduced by all treatments of clomazone. Greater chlorosis of the snap beans occurred with preemergence application than preplant incorporation of clomazone. Preemergence clomazone was slightly more phytotoxic than preplant incorporated; however, all clomazone treatments delayed snap bean maturity. Snap beans were harvested at optimum maturity, which required harvest delays of 4 to 19 days over all the treatments. The sequence of harvest was untreated control, 0.28 kg/ha-ppi, 0.42 kg/ha-ppi, 0.28 kg/ha-pre, 0.56 kg/ha-ppi, and 0.42 and 0.56 kg/ha-pre. The delayed harvest yields were significantly reduced only for clomazone, 0.42 and 0.56 kg/ha preemergence.

Clomazone was evaluated for broccoli at 0.56 and 1.1 kg/ha in 1988 and at 0.28 and 0.56 kg/ha in 1991 with incorporation at a six cm depth. 'Green Comet' broccoli had significant chlorosis of 8, 30 and 45%, at 0.28, 0.56 and 1.1 kg/ha, respectively during early harvest. Plant population was unaffected by clomazone. The broccoli head color was unaffected by clomazone at 0.56 kg/ha although foliage chlorosis was >50%. Broccoli head size was significantly reduced only by clomazone 0.56 or 1.1 kg/ha. Broccoli yields with clomazone 0.28 kg/ha were not significantly different from the untreated controls, whereas higher rates significantly reduced yields.

Clomazone for snap beans should be evaluated at rates less than 0.28 kg/ha; however, transplanted broccoli yields were acceptable at 0.28 kg/ha.

[1] Associate Professor, Ag Aide, General Technician, Department of Horticulture, Salisbury Facility, LESREC, Rt 5 Box 246, Salisbury, MD 21801.

CLOMAZONE FOR WEED CONTROL UNDER CLEAR PLASTIC MULCH

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

ABSTRACT

Clomazone was evaluated for crop safety and weed control in transplanted muskmelons and eggplant grown with clear plastic mulch and seeded cucumbers grown with 'Climagro' wavelength selective mulch in 1991.

Clomazone applied at 0.28 kg ai/ha in combination with bensulide at 5.6 kg ai/ha as either a preplant incorporated or preemergence treatment resulted in slight injury to muskmelons. The injury was characterized by whitening of the leaves without any plant stunting and was only temporary. These treatments controlled stinkgrass and resulted in significantly higher early and total yields compared to the untreated check. Clomazone applied at 0.84 kg ai/ha with bensulide at 5.6 kg ai/ha as either a preplant incorporated or preemergence treatment resulted in moderate injury to muskmelons. This injury affected a higher percentage of leaf area than the low rate of clomazone and temporarily stunted the plants. The crop injury resulted in lower early yield but the total yield was not affected by the crop injury early in the season.

Clomazone applied at 0.28 kg ai/ha in combination with bensulide at 5.6 kg ai/ha as a preemergence treatment under 'Climagro' wavelength selective mulch resulted in slight and temporary crop injury to seeded cucumbers. Clomazone applied at 0.84 kg ai/ha in combination with bensulide at 5.6 kg ai/ha as a preemergence treatment under the 'Climagro' plastic mulch resulted in moderate to severe crop injury to seeded cucumbers. The injury caused by the higher rate of clomazone resulted in a reduction in the total yield of cucumbers. Clomazone at either rate applied in combination with bensulide did not control yellow nutsedge but the 'Climagro' plastic mulch suppressed yellow nutsedge compared to either clear or black plastic mulch.

Clomazone applied alone at 0.28 kg ai/ha preemergence under clear plastic mulch controlled goosegrass and common purslane and caused slight and temporary injury to transplanted eggplant. Clomazone applied alone at 0.56 kg ai/ha and 1.12 kg ai/ha controlled goosegrass and common purslane but resulted in moderate to severe crop injury.

Clomazone has the potential to provide weed control under plastic mulch in muskmelons, cucumbers, eggplant, and other vegetable crops at .28 kg ai/ha. Additional studies need to be conducted to further evaluate effective use rates with respect to weed control and crop injury for specific crops. Additional work is also needed to determine optimum application techniques for both seeded and transplanted vegetable crops.

---

[1] Gloucester County Agricultural Agent, Rutgers Cooperative Extension, Clayton, NJ 08312 and Associate Professor, Dept. of Crop Science, Rutgers University, Bridgeton, NJ 08302

INFLUENCE OF PEA VARIETY AND SEED TREATMENT ON CLOMAZONE PHYTOTOXICITY

Bradley A. Majek[1]

ABSTRACT

Several pea varieties were evaluated in the field for tolerance to clomazone. Bolero was most sensitive to the herbicide. Slight crop injury was observed when 0.56 kg ai/ha was incorporated before planting. Injury to 'Bolero' was moderate when the rate was increased to 1.12 kg ai/ha, and severe when 2.24 kg ai/ha was applied. 'Spring' was most tolerant to clomazone. Injury was slight at 1.12 kg ai/ha, and moderate when 2.24 kg ai/ha was incorporated. Injury to 'Freezer 680' was intermediate between 'Bolero' and 'Spring.' Common lambsquarter was controlled by 0.28 kg ai/ha. The application of NAA as a seed treatment applied at 0.5% (wt/wt) reduced clomazone injury to 'Bolero' and 'Spring,' but did not reduce the injury observed to 'Freezer 680.' Pea stand and yields were not reduced by clomazone at any rate applied or by the NAA seed treatment.

[1] Associate Professor, Dept. of Crop Science, Rutgers University, Bridgeton, NJ 08302

EFFECTS OF CLOPYRALID APPLICATIONS ON CRANBERRY (*Vaccinium macrocarpon* Ait.) VINES AND YIELD[1]

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

ABSTRACT

Clopyralid, a postemergence herbicide for the control of composites and legumes, is currently in the process of being registered for use in cranberry. A field study was conducted to evaluate the effects of clopyralid on cranberry vines and yield. The experiment was carried out at the Rutgers Cranberry/Blueberry Experiment Station at Oswego, NJ. A randomized complete block design with five replications was used for this study. Plots measured 9.3m^2. Herbicide applications were made utilizing a CO_2 propelled backpack sprayer with an output of 230l/ha. Plots were rated throughout the growing season and yields were taken in early September. Two subsamples of 0.125m^2 were hand harvested from each plot. Berries were counted and weighed to determine yield.

Clopyralid was applied at two rates (0.2063 and 0.4125 kg ai/ha) on May 7th, May 15th, June 14th, and July 15th. There were two split applications, where plots received 0.4125 kg ai/ha on May 7th, followed by 0.2063 kg ai/ha on either June 14th or July 15th.

Applications of clopyralid made early in the growing season (May 7th and May 15th) resulted in moderate damage to cranberry vines. Vine damage was not as great when clopyralid was applied later in the season. The higher rate of application tended to result in increased damage, and this was statistically significant for some of the rating dates.

Split applications, where the high rate was applied on May 7th and followed by the low rate, on either June 14th or July 15th resulted in severe and moderate damage, respectively. Where the split application was made on June 14th, additional damage was detected compared with the high rate alone, applied on May 7th. Where the split application was made on July 15th, the ratings were not statistically different than the May 7th application of 0.4125 kg ai/ha alone.

Yield (both berry number and weight) was reduced significantly by the May 7th application of 0.4125 kg ai/ha of clopyralid. There was no additional loss from either of the split applications when compared with the may 7th application of 0.4125 kg ai/ha. Average weight per berry was reduced by the high rate applied on May 15th and the split rate consisting of the high rate on May 7th followed by the low rate on June 14th.

---

[1]NJ Agric. Exp. Stn. Publication No. K-15181-1-91.
[2]Graduate Student and Associate Professor, respectively, Dept. of Crop Science, Rutgers Univ., New Brunswick, NJ 08903.

Effect of timing and formulation of hexazinone in wild blueberries.

David E. Yarborough[1]

ABSTRACT

Hexazinone was applied at 0, 1.7 or 3.3 kg/ha ai, preemergence in May and at early and late postemergence in June 1990, as either liquid Velpar L or as a granular 75 ULW formulation mixed with fertilizer at 33.3 kg/ha to allow for even distribution. The experimental design is a split-plot, randomized complete block with 2 formulations, 3 dates of application, 2 rates of herbicide and 4 replications for a total of 24 plots. Visual injury to both blueberry and bunchberry increased with later application dates of velpar. The granular formulation resulted in less injury to both blueberry (Vaccinium angustifolium) and bunchberry (Cornus canadensis) on the postemergence application dates and had greater yield as compared to the liquid (Table 1). Blueberry length and buds decreased as a result of later hexazinone applications and stems, length and height and yield was reduced by the 3.3 kg/ha hexazinone treatment. Blueberry length and buds were greater on the granular vs the liquid hexazinone treatments. Bunchberry stems were not effected by timing, rate or formulation of hexazinone. Hexazinone applied postemergence or at high rates did not suppress bunchberry. Late applications of the granular provided more crop safety than the liquid application.

---

1 Assistant Professor of Horticulture, Department of Plant, Soil and Environmental Sciences, University of Maine, Orono, ME 04469

Table 1. Main effects of hexazinone on bunchberry and blueberry, 1990-1991.

Effect	Bunchberry Stems	Blueberry Stems	Blueberry Length (cm)	Blueberry Buds	Blueberry Yield (kg/ha)
Application date					
5-17-90	5	33	9.1	3.5	2268
6-7-90	6	36	8.9	3.1	2245
6-18-90	5	37	7.9	1.9	1777
Significance	NS	NS	*	*	NS
Hexazinone (Kg/ha)					
1.7	6	42	9.3	3.2	2456
3.3	6	28	7.9	2.4	1737
Significance	NS	*	*	*	**
Formulation					
Liquid	6	34	8.3	2.6	1815
Granular	5	36	9.1	3.0	2378
Significance	NS	NS	*	**	**

* = Significant at 5%, ** = Significant at 1%, NS = non-significant

APPLE BARK TOLERANCE TO HOE39866 AS AFFECTED BY AGE AND VARIETY

M.J. Mahoney[1]

ABSTRACT

HOE39866 is a nonselective, postemergence herbicide which shows potential in orchard weed control programs. Studies have indicated however, that HOE39866 may injure fruit tree bark. This study was designed to determine if tree age and variety play a role in HOE39866 tolerance.

To investigate tree age as a variable two, five, and eleven year old 'York Imperial' apples on M111 rootstocks were treated twice with 1.12 and 2.24 Kg ai/ha HOE39866, and 1.12 Kg ai/ha paraquat. To investigate variety as a variable ten varieties of one year old apples on M111 rootstocks were treated once with 1.12 and 2.24 Kg ai/ha HOE39866.

In the age study bark injury was nonexistant at two, six, and fourteen WAT(weeks after treatment) on five and eleven year old trees in any treatment. On two year old trees slight injury was apparent fourteen WAT in the 2.24 Kg ai/ha HOE39866 treatment only.

Bark injury did occur in the variety study. A significant HOE39866 dose response occured with 2.24 Kg ai/ha causing the greatest injury. There was also a significant varietal response at two WAT and fourteen WAT, but not at six WAT. Response varied with some varieties such as 'Spur Winesap' which exhibited low injury ratings early, but high ratings late relative to other varieties. At fourteen WAT 'Klein McIntosh', 'Tydesman', and 'Boyer Jonathan' exhibited the least bark injury, 'L. Spur Rome', 'Boyer Red Cortland', 'Smokehouse', and 'Roth Spur Yellow Delicious' exhibited moderate bark injury, and 'Spur Winesap', 'Turley Winesap', and 'C. Red York' exhibited the most bark injury. At fourteen WAT cambial necrosis was not evident in any treatment or on any variety.

---

[1]Field Technical Representative, Hoechst Roussel Agri-Vet Company, Oxford, MD 21654

PHYTOTOXICITY OF GLUFOSINATE TO APPLES

Bradley A. Majek and Winfred P. Cowgill, Jr.[1]

ABSTRACT

Glufosinate, glyphosate, 2,4-D, and clopyralid were applied to the trunk of five-year-old apple trees on June 26, 1991. Glufosinate was applied at 0.84 and 1.12 kg ai/ha. Glyphosate, 2,4-D, and clopyralid were applied at 4.48, 1.12, and 0.84 kg ai/ha respectively. All treatments were applied with an OC-16 nozzle to one side of the tree. The opposite side of the row was left untreated. Two rootstocks, M-7 and M-26, were evaluated as the main plots in a split plot design. Root suckers were abundant under the trees on the M-7 rootstock, but not under the trees on the M-26 rootstock. All the herbicides except clopyralid effectively controlled the root suckers that were sprayed. No injury was observed on the foliage of the trees in any treatment, indicating herbicide translocation from the root suckers into the tree. Only glufosinate injured the trunk of the trees. The injury appeared as a dark sunken area where the spray contacted the bark. The cambium beneath the injured area appeared to be severely injured or killed. The injury was more severe when suckers or weeds were not present to intercept the spray and shield the trunk. The reduced injury to the trees on the M-7 rootstock appeared to be due to shielding by the root suckers, rather than to a higher tolerance of the trees to the herbicide.

---

[1] Associate Professor, Dept. of Crop Science, Rutgers University, Bridgeton, NJ 08302 and Hunterdon County Agricultural Agent, Rutgers Cooperative Extension, Flemington, NJ 08822

EFFICACY AND PHYTOTOXICITY OF THREE LANDSCAPE HERBICIDES WITH AND WITHOUT A LIGHT MULCH

Larry J. Kuhns[1]

ABSTRACT

Seedling geranium (Pelargonium X hortorum), Discovery Orange marigold (Tagetes erecta L. cv. Discovery Orange), White Madness petunia (Petunia X hybrida Hort. Vilm.-Andr. cv. White Madness), Pulcino Mix zinnia (Zinnia elegans Jacq. cv. Pulcino Mix), purple wintercreeper euonymus [Euonymus Fortunei (Turcz.)Hand.-Mazz.], English ivy (Hedera helix L.), vinca (Vinca minor L.), Meyer lilac (Syringa Meyeri C.K.Schneid.), and Burkwood viburnum (Viburnum X Burkwoodi Hort. Burkw. & Skipw.) were planted on May 20-21, 1991. On May 22-23 the following treatments were established: control, oxadiazon at 4.4 kg/ha, simazine + metolachlor at 1.1 + 3.3 kg/ha, and oxyfluorfen + oryzalin at 2.2 + 1.1 kg/ha; each on bare soil or lightly covered with a mulch. The mulch was coarsely ground wood chips spread to a depth of 1.5 cm or less. The percent weed control provided by each treatment was rated on July 4 and September 6, 1991. All plots were handweeded by July 9 to minimize the effects of weed competition on plant growth. All flower plants were harvested and weighed August 14-16; woody plants were harvested and weighed Oct. 9-10. On July 4 both control plots were covered with weeds, but the mulched control appeared to have a higher density of weeds. It was obvious that the thin layer of mulch was not inhibiting weed growth, but may in fact have enhanced it. The herbicide treatments without mulch provided total weed control. In plots with mulch, the oxyfluorfen + oryzalin combination provided almost total weed control, while the oxadiazon and the simazine + metolachlor provided 90% control. Applying a light layer of mulch reduced the effectiveness of the herbicides. On September 6 the herbicide treatments without mulch still provided close to total weed control. With mulch, the oxyfluorfen + oryzalin combination provided over 80% weed control. The oxadiazon or simazine + metolachlor combination provided close to 70% weed control. There was no difference in crop plant size between the controls with and without mulch. Geranium, marigold, petunia, and viburnum plants in the simazine + metolachlor plots without mulch were smaller than those in the plots with mulch. The geranium, marigold, petunia, zinnia, lilac, viburnum, and vinca were smaller in the oxadiazon treated plots without mulch than in those with mulch. The euonymus and ivy are apparently resistant to oxadiazon activity because they grew equally well in the mulched and unmulched plots. In the oxyfluorfen + oryzalin treated plots, the geranium, marigold, petunia, zinnia, and vinca were smaller in the plots without mulch than in those with mulch. The growth of none of the other woody plants in the unmulched plots was reduced by this treatment.

INTRODUCTION

Oxadiazon {3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one} and oxyfluorfen {2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene} have low solubilities in water and form a chemical barrier on the soil surface. Weed seedlings are killed through contact activity as they grow through this barrier. The author has observed injury to ornamental plants growing in treated areas when soil particles have splashed onto soft, new growth. It was believed that some of the herbicide bound to the soil was responsible for the injury.

When establishing test plots with these materials, in which efficacy and crop tolerance are to be evaluated, the presence of a light mulch limiting soil splash may minimize the risk of injury to the crop plants. However, the mulch could be expected to affect the degree of weed control achieved. The objective of this study was to evaluate the effect of a light organic mulch on the

---

[1] Professor of Ornamental Horticulture, Department of Horticulture, The Pennsylvania State University, University Park, PA 16802

efficacy and phytotoxicity of oxadiazon; Rout[2], a commercially formulated herbicide combination containing oxyfluorfen and oryzalin {4-(dipropylamino)-3,5 dinitrobenzenesulfonamide} ; and Derby[3], a formulated combination containing simazine {6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine} and metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide], two herbicides with no contact activity.

MATERIALS AND METHODS

The test site had an actively growing crop of winter wheat (Triticum aestivum L.) about 1 m tall. It was plowed, disced, and rototilled and the 2.5 by 5.5 m test plots were arranged in a randomized complete block design with three replications. Buffer strips 30 cm wide surrounded each plot, and shallow trenches were dug with hoes between all plots to prevent runoff of herbicides into adjacent plots.

The following plants, with size at the time of planting, were planted on May 20-21, 1991: seedling geranium, 13-18 cm (Pelargonium X hortorum); Discovery Orange marigold, 13-18 cm (Tagetes erecta L. cv. Discovery Orange); White Madness petunia, 10-15 cm (Petunia X hybrida Hort. Vilm.-Andr. cv. White Madness); Pulcino Mix zinnia, 10-15 cm (Zinnia elegans Jacq. cv. Pulcino Mix); purple wintercreeper euonymus, 10-15 cm [Euonymus Fortunei (Turcz.)Hand.-Mazz.]; English ivy, 10-15 cm (Hedera helix L.); vinca, 10-15 cm (Vinca minor L.); Meyer lilac, 15-20 cm (Syringa Meyeri C.K.Schneid.); and Burkwood viburnum, 15-20 cm (Viburnum X Burkwoodi Hort. Burkw. & Skipw.). Six plants of each of the woody species and five of each of the flowers were planted in each plot.

On May 22-23 the following treatments were established: control, oxadiazon 2G at 4.4 kg/ha, Derby 5G at 4.4 kg ai/ha (simazine at 1.1 kg/ha + metolachlor at 3.3 kg/ha) and Rout 3G at 3.3 kg ai/ha (oxyflourfen at 2.2 kg/ha + oryzalin at 1.1 kg/ha); each on bare soil or lightly covered with a mulch. The amount of herbicide for each plot was preweighed and hand applied. The mulch was coarsely ground wood chips. It was spread as thinly as possible with a final depth of 1.5 cm or less.

The plots received about 2 cm of overhead irrigation following planting and prior to the herbicide application. At the time of application it was sunny and 28-30°C. On May 24, following establishment of all the treatments, 2.5 cm of overhead irrigation was applied to incorporate and activate the herbicides. The growing season was hot and exceptionally dry, and the plots were irrigated again on June 19 and August 8.

The percent weed control provided by each treatment was visually rated on July 4 and September 6, 1991. All plots were handweeded by July 9 to minimize the effects of weed competition on plant growth. Canada thistle [Cirsium arvense (L.) Scop.] was scattered throughout the plots. It was handpulled and not included in any weed control ratings because none of the herbicides in the study could be expected to control it, and it was not uniformly distributed. All flower plants were harvested and weighed August 14 to 16; woody plants were harvested and weighed October 9 to 10. One month prior to harvesting the flower plants, all mature or dead flowers were removed.

RESULTS AND DISCUSSION

The predominant weeds in the plots on July 4 were common purslane (Portulaca oleracea L.), hairy galinsoga (Galinsoga ciliata (Raf.) Blake), common groundsel (Senecio vulgaris L.), and wild buckwheat (Polygonum convolvulus L.). Also distributed throughout the area were common chickweed [Stellaria media (L.) Cyrillo], Pennsylvania smartweed (Polygonum pensylvanicum L.),

---

[2] Grace/Sierra Crop Protection Co., Milpitas, CA 95035

[3] Ciba-Geigy, Greensboro, NC 27419

tumble pigweed (Amaranthus albus L.), shepherd's purse [Capsella bursa-pastoris (L.) Medic.], and curly dock (Rumex crispus L.). Both control plots were covered with weeds, but the mulched control appeared to have a higher density of weeds. It was obvious that the thin layer of mulch was not inhibiting weed growth, but may in fact have enhanced it. The high population of annual grasses normally found growing in test plots at the research farm were almost totally absent. An examination of the use of the land for the two previous growing seasons eliminated the possibility of herbicide carryover from prior experiments. A possible explanation is that the actively growing winter wheat crop that was plowed under just prior to establishment of the plots could have had an alleleopathic effect on the annual grasses.

On July 4, the herbicide treatments without mulch provided total weed control (Table 1). They even spread laterally and controlled the weeds in the 30 cm strips separating the plots. In plots with mulch, the oxyfluorfen + oryzalin combination provided almost total weed control, while the oxadiazon and the simazine + metolachlor provided 90% control. The few weeds in the oxyfluorfen + oryzalin plots included shepherd's purse, common groundsel, curly dock, wild buckwheat, and severely stunted common purslane. Common purslane, common groundsel, hairy galinsoga, and shepherd's purse were the most common weeds in the plots treated with oxadiazon or the simazine + metolachlor combination.

Table 1. Weed control ratings on July 4, 1991, 43 days after treatment (DAT), and on September 6, 107 DAT. Numbers represent an average of three replications.

Herbicide	Rate (kg/ha)	Mulch[a]	% Weed Control July 4	% Weed Control Sept 6
Control		+	0	0
		-	0	0
Oxadiazon	4.4	+	90	68
	4.4	-	100	97
Derby 5G[b]	4.4	+	90	67
Derby	4.4	-	100	99
Rout 3G[c]	3.3	+	97	82
Rout	3.3	-	100	93

[a] A coarsely ground wood chip mulch 1.5 cm or less deep

[b] Commercially formulated combination equivalent to 1.1 kg/ha simazine + 3.3 kg/ha metolachlor

[c] Commercially formulated combination equivalent to 2.2 kg/ha oxyflourfen + 1.1 kg/ha oryzalin

Applying a light layer of mulch obviously reduced the effectiveness of the herbicides. This may have been because the mulch limited their dispersal. The buffer strips around the treated and mulched plots had weeds growing in them, indicating the herbicides were staying where they were applied, as opposed to the unmulched plots, in which the herbicides spread over the buffer zones. Perfectly uniform applications are hard to accomplish by hand, and the spread that occurred on the bare soil may have evened the distribution, whereas on mulched soils gaps in the coverage would persist. Adsorption of the herbicides by the mulch should not have been a factor because the mulch was a coarse, fresh wood that would not be as chemically active as a well composted material containing more humic exchange sites.

The predominant weeds in the plots on September 6 were common purslane and hairy galinsoga. They dominated the test area. Other weeds present at this time were common yellow woodsorrel (Oxalis stricta L.), common dandelion (Taraxacum officinale Weber), common chickweed, and Pennsylvania smartweed. The herbicide treatments without mulch still provided close to total weed control 15 weeks after application. The control was better than expected

because the herbicides were exposed to hot, sunny, dry conditions throughout the summer; conditions which promote photodecomposition and volatilization.

With mulch, the oxyfluorfen + oryzalin combination provided over 80% weed control on September 6. The oxadiazon or simazine + metolachlor combination provided close to 70% weed control. Hairy galinsoga, common purslane, common dandelion, and common yellow woodsorrel were present in these plots. The weed control was difficult to rate at this time because the plant density in the treated plots was low, but each weed plant was large; especially the hairy galinsoga and common purslane.

There was no difference in crop plant size between the controls with and without mulch (Table 2). Early in the season, before there was much weed growth, the plants in the plots without mulch had mud splashed onto their lower leaves during irrigation and were not as attractive as those in the mulched plots.

Geranium, marigold, petunia, and viburnum plants in the simazine + metolachlor plots without mulch were smaller than those in the plots with mulch. Metolachlor is a general growth inhibitor that can be absorbed through shoots at soft growing points. It is possible that some metolachlor was carried onto the plants with the soil that splashed on them during irrigation. The stage and condition of growth at the time and place the herbicide contacted the plant would determine the extent of injury that occurred. It is unlikely that the simazine caused the reduction in growth because it is not as likely to be absorbed through the foliage, and no characteristic chlorosis of the foliage was observed. Conversely, the vinca were larger in the simazine + metolachlor plots without mulch. There is no obvious expanation for this.

The geranium, marigold, petunia, zinnia, lilac, viburnum, and vinca were smaller in the oxadiazon treated plots without mulch than in those with mulch. Oxadiazon has a low solubility in water, is adsorbed onto soil particles, and kills weeds through contact activity. The soil splashed onto soft foliage carried enough herbicide with it to burn the foliage and result in reduced growth for the season. The euonymus and ivy are apparently resistant to oxadiazon activity because they grew equally well in the mulched and unmulched plots.

In the oxyfluorfen + oryzalin treated plots, the geranium, marigold, petunia, zinnia, and vinca were smaller in the plots without mulch than in those with mulch. Like oxadiazon, oxyfluorfen has a low solubility in water, is adsorbed onto soil particles, and kills weeds through contact activity. It too burned the soft foliage it contacted when splashed onto the plants during irrigation. Though no data was recorded on this, during the harvest of the plants it was observed that the vinca did not form as many adventitious roots on the creeping stems. Oryzalin is a root inhibitor with a low solubility in water that could be expected to inhibit development of these roots. The growth of the other woody plants in the unmulched plots was not reduced by this treatment. This seemed unusual because the degree of injury and reduction in growth that did occur on the geranium, petunia, and zinnia was far more severe than those same plants in the unmulched oxadiazon plots, yet the oxadiazon injured three more woody plants than the oxyfluorfen + oryzalin.

SUMMARY

The herbicides used in this study have the potential to injure crop plants through splashing onto their foliage during a heavy rainfall or irrigation if the soil is uncovered. In the landscape they would best be used in combination with a mulch if they are to be used around annual flowers or woody plants with soft foliage close to the ground. In a companion study it was found that for maximum effectiveness oxadiazon should be applied on top of a mulch, while simazine + metolachlor should be applied under the mulch. Also, when establishing herbicide test plots to determine crop tolerance to herbicides with contact avtivity, researchers should consider using a light mulch around the crop plants.

Table 2. Plant weights (g) on August 14 to 16, 1991 (geranium, marigold, petunia, and zinnia) and October 9 to 10 (all others). Weights are an average of four plants per treatment. Means with the same letter within a column are not different at the .05 level.

Treatment	Rate (kg/ha)	Mulch[a]	Geranium	Marigold	Petunia	Zinnia	Euonymus	Ivy	Vinca	Lilac	Viburnum
Control		+	161bc	292bc	80cd	308b	8b	10b	6d	9c	10b
Control		-	123cd	239c	54d	322b	10b	9b	9cd	8c	8b
Oxadiazon	4.4	+	225a	406a	143ab	462a	20a	17a	24a	12b	17a
Oxadiazon	4.4	-	151bc	307bc	51d	171c	22a	18a	10cd	7c	7b
Derby 5G[b]	4.4	+	187ab	447a	178a	333b	19a	14ab	12cd	11b	17a
Derby	4.4	-	121cd	277bc	107bc	347b	23a	14ab	21ab	12b	7b
Rout 3G[c]	3.3	+	134c	448a	171a	301b	24a	16a	22a	15a	18a
Rout	3.3	-	86d	337b	6e	66d	20a	20a	15bc	16a	16a

[a] A coarsely ground wood chip mulch 1.5 cm or less deep

[b] Commercially formulated combination equivalent to 1.1 kg/ha simazine + 3.3 kg/ha metolachlor

[c] Commercially formulated combination equivalent to 2.2 kg/ha oxyfluorfen + 1.1 kg/ha oryzalin

THE EFFECTIVENESS OF PREEMERGENCE HERBICIDES UNDER, ABOVE, OR WITHOUT MULCH

Larry J. Kuhns and Alan Michael[1]

ABSTRACT

Herbicides are often used in combination with organic mulches in landscape plantings. This study was conducted to compare the efficacy of simazine + metolachlor at 1.1 + 3.3 kg/ha, napropamide at 4.4 kg/ha, oxadiazon at 3.3 kg/ha, isoxaben at 1.1 kg/ha, oryzalin at 3.3 kg/ha, and isoxaben + oryzalin at 1.1 + 3.3 kg/ha when applied to bare soil, under an organic mulch, or on top of the mulch. Orange Appeal geranium (Pelargonium X hortorum L.H. Bailey cv. Orange Appeal), Carpet Red petunia (Petunia X hybrida Hort. Vilm.-Andr. cv. Carpet Red), and Cortez Yellow marigold (Tagetes patula L. cv. Cortez Yellow) were planted into the plots to determine if the herbicide placement in relation to the mulch would affect the tolerance of the flowers to the herbicides. In the two and eight week periods following application only 0.5 and 7.9 cm rain fell, and irrigation was not available. In addition; May, June, and July averaged 4.1, 2.1, and 1.7°C above normal. On June 6, 24 days after treatment (DAT), weed cover was rated. On July 30, 78 DAT, all weeds were handpulled and counted. On July 30 the flower plants in each plot were assigned a quality rating.

Simazine + metolachlor provided better control when on bare soil or under the mulch than when on top. Napropamide under the mulch was the outstanding treatment in the study, providing almost total weed control throughout the season. The napropamide treatments on bare soil and on top of the mulch also provided very good control. Oxadiazon provided very good control when on bare soil and fair control when on top of the mulch. It provided no control when under the mulch. Isoxaben provided better than expected control of annual grasses. It was most effective when on bare soil, and moderately effective when under the mulch. Isoxaben did not provide any control when on top of the mulch. Like isoxaben, oryzalin provided very good control of annual grasses when on bare soil, fair control when under the mulch, and no control when on top of the mulch. The control of annual grasses provided by isoxaben plus oryzalin was similar to oryzalin alone on bare soil, but better than either alone under the mulch or on top. Flower plant quality on July 30 was reduced most by weed competition, with the lowest rated plants in the controls. Overall, the flowers were less tolerant of the oxadiazon on bare soil than any of the other treatments.

INTRODUCTION

Herbicides are often used in combination with organic mulches in landscape plantings. Landscape managers have often asked whether it is better to apply the mulch on top of the herbicide or the herbicide on top of the mulch. This information is not available on the labels of many of the most commonly used materials.

Several factors which could affect the performance of herbicides used in combination with organic mulches would be the temperature- and photo-stability of the herbicide, its tendency to be bound by organic matter, and its mode of action. Information on the following herbicides was taken from the Herbicide Handbook of the Weed Science Society of America, Sixth Edition.

Derby[2] is a commercially formulated combination of simazine (6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine), and metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide]. Simazine is a photosynthetic inhibitor that has a low solubility in water (3.5 ppm at 20°C) and is readily adsorbed by organic matter, limiting its downward movement after application. It is also stable and very little is lost to photodecomposition or volatilization. Metolachlor is a general growth inhibitor, especially of

---

[1] Professor of Ornamental Horticulture and Horticulture Extension Agent, Department of Horticulture, The Pennsylvania State University, University Park, PA 16802

[2] Ciba-Geigy, Greensboro, NC 27419

roots. It has a high solubility in water (530 ppm at 20°C) but is readily adsorbed by organic matter. When organic matter content of the soil approaches 2%, no significant leaching would be expected. Metolachlor is sensitive to photodecomposition and volatilization under high sunlight and temperature conditions. Under such conditions it has a half-life of eight days.

Oxadiazon {3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one} kills weeds through contact action by affecting the young shoot as it grows through the treated area. It has a solubility of 0.7 ppm at 20°C and is strongly adsorbed by organic matter so it strongly resists leaching. Little oxadiazon is lost to photodecomposition or volatilization.

The modes of action of isoxaben {N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide}, napropamide [N,N-diethyl-2-(1-naphthalenyloxy)propanamide], and oryzalin [4-(dipropylamino)-3,5-dinitrobenzenesulfonamide] are not known. Isoxaben has a solubility of 1 ppm at 25°C and leaches very little. Loss from photodecomposition or volatilization is not significant under field conditions. Napropamide has a solubility of 73 ppm at 20°C. Very little is lost to volatilization, but under high sunlight intensity, slightly over 50% can be lost to photodecomposition in four days. Oryzalin has a solubility of 2.6 ppm at 25°C and is adsorbed by organic matter, limiting its movement in the soil. Volatilization is minimal, but limited photodecomposition occurs.

This study was conducted to compare the efficacy of the herbicides described when applied to bare soil, under an organic mulch, or on top of the mulch. Three species of flowers were planted into the plots to determine if the herbicide placement in relation to the mulch would affect the tolerance of the flowers to the herbicides.

MATERIALS AND METHODS

Test plots were established at the Penn State Agricultural Research Farm at Landisville. The area was plowed and disced prior to lining out the plots and planting the flowers on May 13, 1991. The flowers were Orange Appeal geranium (Pelargonium X hortorum L.H. Bailey cv. Orange Appeal), Carpet Red petunia (Petunia X hybrida Hort. Vilm.-Andr. cv. Carpet Red), and Cortez Yellow marigold (Tagetes patula L. cv. Cortez Yellow) . There were 48 plants per flat, and at the time of planting the flowers were 10 to 15 cm tall. Each plant received 500 to 1000 ml of water after planting but before the herbicide or mulch was applied.

The herbicides selected for the study were chosen because they are commonly used in landscapes and have different modes of action and environmental stability. Derby 5G was applied at 4.4 kg ai/ha (1 kg/ha simazine + 3 kg/ha metolachlor), napropamide (50 WP) at 4.4 kg/ha, oxadiazon (2 G) at 3.3 kg/ha, isoxaben (75 WP) at 1.1 kg/ha, oryzalin (4L) at 3.3 kg/ha, and a combination of isoxaben and oryzalin at the same rates. Herbicides in the granular formulation were spread by hand, those in sprayable formulations were applied with a CO_2 powered test plot sprayer at 207 kPa, through 8004E nozzles in the equivalent of 580 L/ha of water.

Using these herbicides and rates and a coarse textured composted hardwood bark, the following treatments were established: control, bare soil; control + mulch; each herbicide on bare soil; each herbicide under mulch; each herbicide over mulch. The maximum depth of the mulch in the plots was 5 cm. An attempt was made to keep the depth as uniform as possible, but there was some variation due to the unevenness of the soil. The granular herbicides stuck to the hairy leaves of the petunias and gathered in the cup shaped leaves of the geraniums, so a special effort had to be made to knock the herbicide off of each plant by hand.

The plot size was 2 by 2.5 m and each treatment was replicated three times. At the time of application the soil was dry, there was hazy sunshine, and the temperature was 29°C. In the two and eight week periods following application only 0.5 and 7.9 cm rain fell, and irrigation was not available. In addition; May, June, and July temperatures averaged 4.1, 2.1, and 1.7°C above normal.

On June 6, 24 days after treatment (DAT), the percent weed cover and percentage of the weeds that were grasses in each plot were rated. On July 30, 78 DAT, all weeds were handpulled; divided into grasses, broadleaves, and yellow nutsedge (Cyperus esculentus L.), and counted. There were patches of Canada thistle [Cirsium arvense (L.) Scop] in the test area, but they were not included in the count because none of the herbicides in the test could be expected to control Canada thistle, and it was not uniformly distributed throughout the area. The yellow nutsedge was also scattered in patches in the area, but it was included in the ratings because it is sensitive to metolachlor and napropamide, two of the herbicides in the study. On July 30 the flower plants in each plot were assigned a quality rating.

RESULTS

The predominant weed in the area was giant foxtail (Setaria faberi Herrm.). Yellow nutsedge and Canada thistle were dense in patches. The annual broadleaf weed population was very low. On June 6 broadleaved weeds were included in the percent cover ratings, but they consisted primarily of Canada thistle. On July 30 when all weeds were pulled and counted, Canada thistle was not included. Only a few common lambsquarters (Chenopodium album L.), Pennsylvania smartweed (Polygonum pensylvanicum L.), and redroot pigweed (Amaranthus retroflexus L.) plants were scattered throughout the plots. There were not enough to make any comparisons between treatments.

On June 6, 24 DAT, the unmulched controls averaged only 23% weed cover, with 78% of the weeds being annual grasses, primarily giant foxtail (Table 1). The next most common weed was yellow nutsedge. In a year with normal precipitation, close to 100% weed cover would be expected. The mulched controls averaged 8% weed cover with 57% of the weeds annual grasses. The remainder were yellow nutsedge, Canada thistle, and a few annual broadleaved weeds. At this time the weed cover in all other plots varied only from 1 to 6%, and it was not possible to make any clear distinctions between treatments.

On July 30, 78 DAT, there were more distinct differences between treatments. The mulch alone provided over 50% control of annual grasses. Simazine + metolachlor on bare soil and simazine + metolachlor under mulch provided better control of annual grasses than when placed on top of the mulch. Under the mulch it provided about 50% more control of annual grasses than mulch alone, and above the mulch about 25% more control. Simazine + metolachlor provided excellent control of yellow nutsedge when on bare soil, and very good control either under or on top of the mulch.

Napropamide was far more effective when covered by the mulch. It was the outstanding treatment in the study, providing almost total control of annual grasses and yellow nutsedge, and total control of the few annual broadleaved weeds present in the area. Napropamide on top of the mulch provided about 50% more control of annual grasses than the mulch alone; on bare soil it controlled about 70% of the annual grasses compared to the unmulched control. Neither treatment controlled yellow nutsedge.

Oxadiazon on bare soil and on top of the mulch provided much better control of annual grasses than when placed under the mulch. On bare soil it provided about 80% control of annual grasses compared to the unmulched control; on top of the mulch it provided about 50% more control of annual grasses than mulch alone. Oxadiazon under the mulch appears to provide excellent control of the yellow nutsedge, but since oxadiazon has not been reported to control it in the past, it is likely that nutsedge did not happen to occur in the three plots receiving this treatment. Oxadiazon on bare soil or on top of the mulch did not control the nutsedge.

Though isoxaben is not noted for providing control of annual grasses, when on bare soil it provided 70% control of them when compared to the unmulched control. When placed under the mulch it provided 40% more control than the mulch alone. It provided no control of annual grasses when placed on top of the mulch. It did not control yellow nutsedge regardless of placement.

Table 1. Weed cover ratings on June 6, 1991, 24 days after treatment (DAT), and weed counts on July 30, 78 DAT. Numbers represent an average of three replications.

Herbicide	Rate (kg/ha)	Placement [a]	June 6 % Weed Cover	June 6 % Grasses	July 30 Weed Numbers Grasses	July 30 Weed Numbers BL's	July 30 Weed Numbers Nutsedge
Control		No mulch	23	78	96	2	27
		Mulch	8	57	41	4	43
Derby (5G)[b]	4.4	Bare	2	50	18	1	1
		Under	1	12	18	1	6
		On top	2	27	32	4	9
Napropamide(5G)	4.4	Bare	3	50	27	1	32
		Under	1	0	2	0	2
		On top	2	34	18	4	88
Oxadiazon(2G)	3.3	Bare	2	62	19	0	22
		Under	4	72	69	1	3
		On top	4	48	21	2	48
Isoxaben(75 W)	1.1	Bare	4	48	28	5	28
		Under	6	42	24	1	31
		On top	2	58	44	3	27
Oryzalin(4L)	3.3	Bare	4	60	19	1	29
		Under	1	30	20	1	96
		On top	3	35	45	2	79
Isoxaben(75W) + Oryzalin(4L)	1.1 3.3	Bare	4	45	19	0	45
		Under	2	35	9	0	72
		On top	3	27	29	1	29

[a] The herbicide treatments were on bare soil or under or on top of 5 cm of coarse, composted hardwood bark.

[b] Commercially formulated combination equivalent to 1.1 kg/ha simazine and 3.3 kg/ha metolachlor.

Oryzalin on bare soil provided 80% control of annual grasses compared to the unmulched control. When under the mulch it provided 50% more control than the mulch alone. It provided no control of annual grasses when placed on top of the mulch. It did not control yellow nutsedge regardless of placement.

Isoxaben plus oryzalin on bare soil provided 80% control of annual grasses compared to the unmulched control. When under the mulch they provided 75% more control than the mulch alone; on top of the mulch they provided 25% more control of annual grasses. They did not control yellow nutsedge regardless of placement.

Flower plant quality on July 30 was reduced most by weed competition, with the lowest rated plants in the controls (Table 2). Plants in the control plots were consistently rated very low. Though some of the treatments had as many weeds growing in them at the end of the season as the mulched control, the weed pressure began earlier in the control plot than the plots treated with herbicide.

The herbicide/mulch treatments that had uniformly lower ratings across all three species than the other treatments were oxadiazon on bare soil or under mulch and isoxaben on bare soil or under mulch.

Table 2. Plant quality ratings on July 30, 1991, 78 days after treatment. Ratings represent an average of three replications. 1=lowest quality, 5=highest quality.

Herbicide	Rate (kg/ha)	Placement a/	Geranium	Marigold	Petunia
Control		No mulch	2.3	2.0	1.0
		Mulch	2.0	2.3	1.3
Derby(5G)b/	4.4	Bare	3.0	3.3	3.7
		Under	5.0	4.0	4.3
		On top	3.7	3.3	3.3
Napropamide(5G)	4.4	Bare	3.3	3.0	2.7
		Under	4.0	4.3	4.3
		On top	3.0	3.3	3.3
Oxadiazon(2G)	3.3	Bare	2.7	2.0	2.0
		Under	3.0	2.7	2.0
		On top	3.3	3.0	4.0
Isoxaben(75W)	1.1	Bare	2.7	3.0	2.0
		Under	3.7	2.7	3.0
		On top	3.3	3.0	3.3
Oryzalin(4L)	3.3	Bare	3.7	4.3	3.3
		Under	4.7	4.0	5.0
		On top	4.0	3.0	3.0
Isoxaben(75W)	1.1	Bare	3.3	3.3	3.3
+ Oryzalin(4L)	3.3	Under	4.7	3.7	5.0
		On top	4.3	3.3	4.0

a/ The herbicide treatments were on bare soil or under or on top of 5 cm of coarse, composted hardwood bark.
b/ Commercially formulated combination equivalent to 1.1 kg/ha simazine and 3.3 kg/ha metolachlor.

DISCUSSION

The results of this test must be interpreted with the understanding that it was conducted during one of the hottest and driest growing seasons on record in the test area. Though the results cannot be used to describe how these herbicides will perform under more normal conditions, they do provide very good information on how they will perform when conditions are optimal for photodecomposition and volatilization. The study should be repeated in an area with access to irrigation to determine how the results may vary with incorporation of the herbicides into the soil and mulch with water.

The growth of the flowers under the hot, dry conditions was remarkably good. It was very surprising that the mulch had little effect on growth compared to unmulched plots. One would think that the moisture retention and soil temperature moderation provided by the mulch would have resulted in better growth in the mulched plots. A possible reason why it didn't is the few periods of rain that did occur were light rains that could have soaked into the bare soil, but would have been absorbed by the bark mulch before reaching the soil in the mulched plots.

Simazine + metolachlor provided better control when on bare soil or under the mulch than when on top. Simazine has a low solubility in water and is adsorbed by organic matter, so it could be expected to stay close to the surface of the mulch. Since it must be absorbed by weed roots to be effective, it could not provide good control when on the surface of the mulch. Metolachlor has a high solubility in water, but is bound tightly by organic matter. Under the low

rainfall conditions of this study it probably stayed close to the surface of the mulch, where it was subject to photodecomposition and volatilization. Since metolachlor is sensitive to both, the control provided by the combination on the bare plots should be attributable to the simazine. However, the control of yellow nutsedge in the bare plots was excellent, and very good in the mulched plots. The nutsedge control would have to be due to the metolachlor since simazine has little effect on nutsedge. It is apparent that under field conditions the metolachlor remains active longer than expected under hot, sunny, dry conditions. All of the flower species were tolerant of the simazine + metolachlor applications under the conditions of the test.

Napropamide under the mulch was the outstanding treatment in the study, providing almost total control of annual grasses, broadleaved weeds, and yellow nutsedge. It has a higher solubility in water than any other herbicide in the study other than metolachlor. There must have been enough soil moisture under the mulch to activate it more thoroughly than the other herbicides. The napropamide treatments on bare soil and on top of the mulch provided better than expected control. Napropamide is very sensitive to photodecomposition, with a predicted half-life of four days under the conditions of the study. In theory, it should have broken down before it had a chance to be activated, but like the metolachlor maintained more of its activity under hot, sunny, dry conditions than predicted. All of the flower species were tolerant of the napropamide applications under the conditions of the test.

Oxadiazon provided very good control when on bare soil and fair control when on top of the mulch. It provided no control when under the mulch. The oxadiazon was applied in the granular formulation and should have needed moisture to activate and disperse the chemical from the granules. It would be expected that this would occur more efficiently in the soil moisture under the mulch than on bare soil or on top of the mulch. But that obviously did not occur. Oxadiazon kills germinating weed seedlings on contact, like oxyfluorfen {2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene}. It is known that oxyfluorfen requires light for herbicidal activity. It appears that the same may be true for oxadiazon. Overall, the flowers were less tolerant of the oxadiazon on bare soil than of the other treatments. The little rain that did occur may have splashed some soil particles containing oxadiazon onto the foliage where it could have damaged some tissue.

It is not known why isoxaben provided better than expected control of annual grasses. It was most effective when on bare soil, and moderately effective when under the mulch. It is not sensitive to photodecomposition or volatilization, so it could remain active under the adverse conditions of the study. Isoxaben did not provide any control when on top of the mulch. It has a very low solubility in water and probably remained on the surface of the mulch where it could have no effect on weed seed germination. It did not control yellow nutsedge regardless of placement. Though the flower quality ratings for isoxaben alone on bare soil were generally lower than those of other treatments, when used in combination with oryzalin at the same rate, they were close to average. It can not be definitively determined whether or not isoxaben reduced flower plant quality.

Like isoxaben, oryzalin provided very good control of annual grasses when on bare soil, fair control when under the mulch, and no control when on top of the mulch. It has a low solubility in water and is adsorbed by organic matter, so it too would remain close to the surface of the mulch where it would be ineffective at controlling germinating weed seeds. It is supposed to be sensitive to photodecomposition, but provided very good control even when on the soil surface. As expected, it did not control yellow nutsedge, regardless of placement. All of the flower species were tolerant of the oryzalin applications under the conditions of the test.

The control of annual grasses provided by isoxaben plus oryzalin was similar to oryzalin alone on bare soil, but better than either alone under the mulch or on top. As expected they did not control yellow nutsedge. All of the flower species were tolerant of this combination.

In summary; simazine + metolachlor , napropamide, isoxaben, and oryzalin perform better when placed under a mulch than on top. Oxadiazon performed much better when on top of the mulch.

METOLACHLOR COMBINATIONS FOR WEED CONTROL IN WILDFLOWERS

J. F. Derr[1]

ABSTRACT

Metolachlor granules at 4.5 and 9.0 kg/ha and combinations of metolachlor with simazine, isoxaben, and oxadiazon were evaluated in 1990 in newly-transplanted lanceleaf coreopsis (Coreopsis lanceolata L.), ox-eye daisy (Chrysanthemum leucantheum L.), blanket flower (Gaillardia aristata Pursh), and purple coneflower (Echinacea purpurea Moench). Metolachlor applied alone at 4.5 kg/ha caused slight injury (approximately 10%) 2 weeks after treatment (WAT) to ox-eye daisy, blanket flower, and purple coneflower, but did not injure coreopsis. Combining simazine at 0.9 kg/ha with metolachlor at 3.6 kg/ha or combining isoxaben at 0.8 kg/ha with metolachlor at 4.5 kg/ha resulted in injury to all four species, with the greatest injury observed in ox-eye daisy (approximately 60% damage), and the least injury seen in coreopsis (approximately 15% damage). These 2 combination treatments reduced stand of ox-eye daisy, but not of the other 3 species 8 WAT. Combining metolachlor at 4.5 kg/ha with oxadiazon at 2.2 kg/ha appeared to slightly increase injury to ox-eye daisy, blanket flower and purple coneflower over that observed with metolachlor applied alone, but this combination did not reduce stand of any species. Metolachlor at 4.5 kg/ha applied alone or in combination with other herbicides controlled yellow nutsedge 90% or greater 7 WAT.

An additional study was established in 1991, using the same treatments listed above, plus combinations of metolachlor at 4.5 kg/ha with oryzalin or prodiamine at 2.2 kg/ha. Greater overall injury was observed across treatments than in the 1990 study, perhaps due to high temperatures at planting and need for frequent irrigation in 1991. Metolachlor at 4.5 kg/ha applied alone resulted in 8 to 28% injury 4 WAT, depending upon species, but did not reduce crop stand. Combining metolachlor at 3.6 kg/ha with simazine at 0.9 kg/ha reduced wildflower stand 6 WAT by 60 to 100%, depending upon species. Combining metolachlor at 4.5 kg/ha with isoxaben at 0.8 kg/ha reduced stand of purple coneflower, blanket flower and ox-eye daisy. Combining metolachlor with oxadiazon at 4.5 kg/ha reduced stand of purple coneflower, but did not affect stand of the 3 other species. Combining metolachlor at 4.5 kg/ha with oryzalin, prodiamine, or oxadiazon at 2.2 kg/ha did not reduce stand of any species. Combining metolachlor with oryzalin or prodiamine did not increase crop injury over that seen with metolachlor applied alone. At 5 WAT, metolachlor at 4.5 kg/ha applied alone or in combination gave 95% or greater yellow nutsedge control, but control decline to approximately 80 to 90% one month later.

[1]Assoc. Prof., Va. Polytech. Inst. and State Univ., Hampton Roads Ag. Exp. Sta., Virginia Beach, VA 23455

A COMPARISON OF TWO FORMULATIONS OF OXADIAZON ALONE AND VARYING RATES OF BUTRALIN PLUS OXADIAZON

Larry J. Kuhns[1]

ABSTRACT

Seedling geranium (Pelargonium X hortorum), Discovery Orange marigold (Tagetes erecta L. cv. Discovery Orange), White Madness petunia (Petunia X hybrida Hort. Vilm.-Andr. cv. White Madness), Pulcino Mix zinnia (Zinnia elegans Jacq. cv. Pulcino Mix), purple wintercreeper euonymus [Euonymus Fortunei (Turcz.)Hand.-Mazz.], English ivy (Hedera helix L.), vinca (Vinca minor L.), Meyer lilac (Syringa Meyeri C.K. Schneid.), and Burkwood viburnum (Viburnum X Burkwoodi Hort. Burkw. & Skipw.) were planted on May 20 to 21, 1991. On May 22-23 the following treatments were established: control, oxadiazon at 2.2 and 4.4 kg/ha; EXP03621B at 2.2 and 4.4 kg ai/ha; and oxadiazon at 2.2 kg/ha plus butralin at 2.2, 3.3, 4.4, or 6.6 kg/ha; each lightly covered with a coarsely ground wood chip mulch. Unmulched control and oxadiazon at 4.4 kg/ha plots were also included. The coarsely ground wood mulch was applied to a depth of 1.5 cm or less. Percent weed control was rated on July 4 and September 6, 1991. All flower plants were harvested and weighed August 14 to 16; woody plants were harvested and weighed Oct. 9 to 10. On July 4 both control plots were covered with weeds, but the mulched control appeared to have a higher density of weeds. It was obvious that the thin layer of mulch was not inhibiting weed growth, and may in fact have enhanced it. The oxadiazon at 4.4 kg/ha without mulch provided total weed control. All other herbicide treatments except the EXP03621B at 2.2 kg/ha provided close to 90% weed control, or better. The level of control provided by the combinations containing the three highest rates of butralin was slightly better than the other treatments. Applying a light layer of mulch obviously reduced the effectiveness of the oxadiazon. On September 6 the oxadiazon without mulch still provided close to total weed control. Weed control in the mulched plot treated with oxadiazon at 4.4 kg/ha was reduced 30% compared to the unmulched plot. There is no reason to believe that the weed control in the other mulched treatments was not similarly reduced. The level of control provided by the EXP03621B was not quite as high as for the oxadiazon at similar rates. Adding butralin to the oxadizon only slightly increased the control obtained. There was no difference in crop plant size between the controls with and without mulch. The geranium, marigold, petunia, zinnia, lilac, viburnum, and vinca were smaller in the oxadiazon treated plots without mulch than in those with mulch. There were no trends indicating any differences in crop tolerance of any of the species to any of the treatments with oxadiazon, EXP03621B, or butralin when covered with mulch.

INTRODUCTION

Oxadiazon [3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one] has a very low solubilty in water and a slow release rate from its carrier in granular formulations. Though it provides control of a broad spectrum of weeds, there are some that it does not control well. The objective of this study was to compare the control provided by two granular formulations of oxadiazon and oxadiazon in combination with varying rates of butralin . Nine species of ornamental plants were included in the test plots to determine their tolerance to the different treatments.

MATERIALS AND METHODS

The test site had an actively growing crop of Triticum aestivum L. (winter wheat) about 1 m tall. It was plowed, disced, and rototilled and the 2.5 by 5.5 m test plots were arranged in a

[1] Professor of Ornamental Horticulture, Department of Horticulture, The Pennsylvania State University, University Park, PA 16802

randomized complete block design with three replications. Buffer strips 30 cm wide surrounded each plot, and shallow trenches were dug with hoes between all plots to prevent runoff of herbicides into adjacent plots.

The following plants, with size at the time of planting, were planted on May 20-21, 1991: seedling geranium, 13-18 cm (Pelargonium X hortorum); Discovery Orange marigold, 13-18 cm (Tagetes erecta L. cv. Discovery Orange); White Madness petunia, 10-15 cm (Petunia X hybrida Hort. Vilm.-Andr. cv. White Madness); Pulcino Mix zinnia, 10-15 cm (Zinnia elegans Jacq. cv. Pulcino Mix); purple wintercreeper euonymus, 10-15 cm [Euonymus Fortunei (Turcz.)Hand.-Mazz.]; English ivy, 10-15 cm (Hedera helix L.); vinca, 10-15 cm (Vinca minor L.); Meyer lilac 15-20 cm (Syringa Meyeri C.K. Schneid.); and Burkwood viburnum ,15-20 cm (Viburnum X Burkwoodi Hort. Burkw. & Skipw.). Six plants of each of the woody species and five of each of the flowers were planted in each plot.

On May 22-23 the following treatments were established: control, oxadiazon 2G at 2.2 and 4.4 kg/ha; EXP03621B at 2.2 and 4.4 kg ai/ha; and oxadiazon at 2.2 kg/ha plus butralin 2.3G at 2.2, 3.3, 4.4, or 6.6 kg/ha; each lightly covered with a coarsely ground wood chip mulch. Unmulched control and oxadiazon at 4.4 kg/ha plots were also included. The amount of herbicide for each plot was preweighed and hand applied. The mulch was spread to depth of 1.5 cm or less.

The plots received about 2 cm of overhead irrigation following planting and prior to the herbicide application. At the time of application it was sunny and 28-30°C. On May 24, following establishment of all the treatments, 2.5 cm of overhead irrigation was applied to incorporate and activate the herbicides. The growing season was hot and exceptionally dry, and the plots were irrigated again on June 19 and August 8.

The percent weed control provided by each treatment was visually rated on July 4 and September 6, 1991. All plots were handweeded by July 9 to minimize the effects of weed competition on plant growth. Canada thistle [Cirsium arvense (L.) Scop.] was scattered throughout the plots. It was handpulled and not included in any weed control ratings because none of the herbicides in the study could be expected to control it, and it was not uniformly distributed. All flower plants were harvested and weighed August 14 to 16; woody plants were harvested and weighed Oct. 9 to 10. One month prior to harvesting the flower plants all mature or dead flowers were removed.

RESULTS AND DISCUSSION

The predominant weeds in the plots on July 4 were common purslane (Portulaca oleracea L.), hairy galinsoga (Galinsoga ciliata (Raf.)Blake), common groundsel (Senecio vulgaris L.), and wild buckwheat (Polygonum convolvulus L.). Also distributed throughout the area were common chickweed [Stellaria media (L.) Cyrillo], Pennsylvania smartweed (Polygonum pensylvanicum L.), tumble pigweed (Amaranthus albus L.), shepherd's purse [Capsella bursa-pastoris (L.) Medic.], and curly dock (Rumex crispus L.). Both control plots were covered with weeds, but the mulched control appeared to have a higher density of weeds. It was obvious that the thin layer of mulch was not inhibiting weed growth, and may in fact have enhanced it. The high population of annual grasses normally found growing in test plots at the research farm were almost totally absent. An examination of the use of the land for the two previous growing seasons eliminated the possibility of herbicide carryover from prior experiments. A possible explanation is that the actively growing winter wheat crop that was plowed under just prior to establishment of the plots could have had an allelopathic effect on the annual grasses.

On July 4 the oxadiazon at 4.4 kg/ha without mulch provided total weed control (Table 1). All other herbicide treatments except the EXP03621B at 2.2 kg/ha provided close to 90% weed control, or better. The level of control provided by the combinations containing the three highest rates of butralin was slightly better than the other treatments. The oxadiazon alone or the EXP03621 contained low amounts of all the weeds found in the control plots. The combinations with the three highest rates of butralin did not contain common groundsel.

Table 1. Weed control ratings on July 4, 1991, 43 days after treatment (DAT), and on September 6, 107 DAT. Numbers represent an average of three replications.

Herbicide	Rate (kg/ha)	Mulch[a]	% Weed Contol July 4	% Weed Contol Sept 6
Control		-	0	0
Control		+	0	0
Oxadiazon (2G)	2.2	+	86	60
Oxadiazon (2G)	4.4	+	90	68
Oxadiazon (2G)	4.4	-	100	97
EXP03621B	2.2	+	74	55
EXP03621B	4.4	+	88	45
Butralin (2.3G) + Oxadiazon (2G)	2.2 2.2	+	88	72
Butralin (2.3G) + Oxadiazon (2G)	3.3 2.2	+	97	63
Butralin (2.3G) + Oxadiazon (2G)	4.4 2.2	+	91	83
Butralin (2.3G) + Oxadiazon (2G)	6.7 2.2	+	95	68

[a] a coarsely ground wood chip mulch 1.5 cm or less deep.

Applying a light layer of mulch obviously reduced the effectiveness of the oxadiazon. This may have been because the mulch limited its dispersal. The buffer strips around the treated and mulched plots had weeds growing in them, indicating the herbicides were staying where they were applied, as opposed to the unmulched plots, in which the herbicides spread over the buffer zones. Perfectly uniform applications are hard to accomplish by hand, and the spread that occurred on the bare soil may have evened the distribution, whereas on mulched soils gaps in the coverage would persist. Adsorption of the herbicides by the mulch should not have been a factor because the mulch was a coarse, fresh wood that would not be as chemically active as a well composted material containing more humic exchange sites.

The predominant weeds in the plots on September 6 were common purslane and hairy galinsoga. They dominated the test area. Other weeds present at this time were common yellow woodsorrel (Oxalis stricta L.), common dandelion (Taraxacum officinale Weber), common chickweed, and Pennsylvania smartweed. The oxadiazon without mulch still provided close to total weed control 15 weeks after application. The control was better than expected because the herbicides were exposed to hot, sunny, dry conditions throughout the summer; conditions which promote photodecomposition and volatilization.

Weed control in the mulched plot treated with oxadiazon at 4.4 kg/ha was reduced 30% compared to the unmulched plot. There is no reason to believe that the weed control in the other mulched treatments was not similarly reduced. The predominant weeds in all of the treated plots were hairy galinsoga and common purslane, with common dandelion and common yellow woodsorrel distributed throughout the plots. The weed control was difficult to rate at this time because the plant density in the treated plots was low, but each weed plant was large; especially the galinsoga and purslane. The level of control provided by the EXP03621B was not quite as high as for the oxadiazon at similar rates. Adding butralin to the oxadizon only slightly increased the control obtained.

There was no difference in plant size between the controls with and without mulch (Table 2). Early in the season, before there was much weed growth, the plants in the plots without mulch had mud splashed onto their lower leaves during irrigation and were not as attractive as those in the mulched plots.

The geranium, marigold, petunia, zinnia, lilac, viburnum, and vinca were smaller in the oxadiazon treated plots without mulch than in those with mulch. Oxadiazon has a low solubility in water, is adsorbed onto soil particles, and kills weeds through contact activity. The soil splashed onto soft foliage carried enough herbicide with it to burn the foliage and result in reduced growth for the season. The euonymus and ivy are apparently resistant to oxadiazon activity because they grew equally well in the mulched and unmulched plots.

There were no trends indicating any differences in crop tolerance of any of the species to any of the treatments with oxadiazon, EXP03621B, or butralin with mulch.

Table 2. Plant weights (g) on August 14 to 16, 1991 (geranium, marigold, petunia, and zinnia) and October 9 to 10 (all others). Weights are an average of four plants per treatment. Means with the same letter within a column are not different at the .05 level.

Herbicide	Rate (kg/ha)	Mulch[a]	Geranium	Marigold	Petunia	Zinnia	Euonymus	Ivy	Vinca	Lilac	Viburnum
Control		-	123d	239d	54f	322b	10d	9e	9cd	6d	6d
Control		+	161cd	292d	80f	308b	8d	10e	6d	9cd	10c
Oxadiazon (2G)	2.2	+	173bc	384bc	146cde	382ab	26a	19ab	10cd	12bc	12bc
Oxadiazon (2G)	4.4	+	225a	406bc	143cde	462a	20bc	17abc	24ab	12bc	17a
Oxadiazon (2G)	4.4	-	151cd	307cd	51f	171c	22ab	18ab	10cd	7d	7d
EXP03621B	2.2	+	188ab	375c	114def	425ab	16c	12cde	19b	13ab	15ab
EXP03621B	4.4	+	171bc	395bc	165bcd	396ab	23ab	17abc	17bc	13ab	15ab
Butralin (2.3G) + Oxadiazon (2G)	2.2 2.2	+	199ab	423abc	244a	373ab	23ab	14bcd	21ab	11bc	14ab
Butralin (2.3G) + Oxadiazon (2G)	3.3 2.2	+	219a	458ab	232a	419ab	16c	16bc	18bc	14ab	12bc
Butralin (2.3G) + Oxadiazon (2G)	4.4 2.2	+	192ab	437abc	220ab	459a	24ab	17bc	23ab	16a	13bc
Butralin (2.3G) + Oxadiazon (2G)	6.7 2.2	+	163cd	491a	205abc	482a	18c	23a	28a	13ab	16ab

[a] A coarsely ground wood chip mulch 1.5 cm or less deep

ISOXABEN LONGEVITY FOR FIELD GROWN ORNAMENTALS

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

ABSTRACT

Isoxaben is a recently registered preemergence herbicide for turf and ornamentals. Several field and container studies conducted on Long Island in the past five years have found it to be safe on a large number of woody and herbaceous ornamentals. However there have been some exceptionally sensitive species identified which are injured or killed by exposure to soil treated with usage rates of isoxaben.

A field study was conducted to determine the magnitude of the potential problem of residual isoxaben activity in the soil interfering with the growth of sensitive or marginally tolerant species. Freshly disked Riverhead sandy loam with a pH 5.7 and 2.0 % O.M. was treated with isoxaben (0.14, 0.28, 0.55 and 1.1 kg/ha) on either September 24, 1989 or April 27, 1990. In late August 1990, healthy five week-old foxglove transplants (Digitalis purpurea 'Excelsior') and one year-old rooted cuttings of Azalea (Rhododendron sp. 'Coral Bells') were transplanted into each plot. The following spring, on May 15, 1991, the plants were evaluated for root and shoot vigor as well as fresh weight. The results indicate that the isoxaben-sensitive species foxglove, was significantly injured by either 0.55 or 1.1 kg/ha isoxaben applied at both timings. However the higher rate was more injurious when applied on April 1990 than on September 1989. The azalea cultivar, which had previously shown tolerance to isoxaben when grown in soilless container media, was injured at both timings by 1.1 kg/ha, but not by the lower rates.

Residual preemergence control of the winter annual weeds, horseweed {Conyza canadensis(L.)Cronq.} and Virginia pepperweed (Lepidium virginicum L.) was still very good at the higher isoxaben rates applied at either timing. However, common groundsel (Senecio vulgaris L.) was only well controlled by the 1.1 kg/ha rate applied in April 1990.

These results suggest that as isoxaben becomes more widely used in commercial nurseries and landscapes, good record keeping and careful observation of plant response is needed to access the long term safety to some ornamental species.

[1/]Weed Science Specialist, Cornell Cooperative Extension, Long Island Horticultural Research Laboratory, Riverhead, NY 11901.

[2/]Associate Professor, Dept. of Floriculture and Ornamental Horticulture, Cornell University, Ithaca, NY 14853

EFFECTS OF HERBICIDE RESIDUES ON THE ESTABLISHMENT OF OAT COVER CROPS IN NURSERY STOCK

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

ABSTRACT

The establishment of winter cover crops for erosion control in field grown nursery stock is a common practice in some regions. The benefits include reduced wind erosion, reduced water erosion, weed suppression, and a return of organic matter to the soil. Fall-seeded oats are commonly used in New York because they establish quickly and winter-kill, thus eliminating the need for herbicide applications to kill the cover crop. Preemergent herbicides, at the rates used in nursery crops, have the potential to carry over and inhibit the establishment of cover crops. These tests were conducted to compare registered and experimental herbicides for their safety to fall-seeded oats.

Preemergent herbicides were applied on April 25, 1986 and May 3, 1988 to established and newly planted nursery stock. The herbicides included: isoxaben at 0.6 and 1.1 kg/ha, simazine at 1.1 and 1.5 kg/ha, metolachlor at 3.3 and 6.7 kg/ha, pendimethalin at 2.2 and 4.5 kg/ha, napropamide at 2.2 and 4.5 kg/ha, oxadiazon 50WP at 2.2 and 4.5 kg/ha, and prodiamine at 1.1, 2.2, and 4.5 kg/ha. In each test, treatments were applied in a randomized complete block design with 4 replicates using a CO_2 backpack sprayer calibrated to deliver 280 L/ha. Oats were slit-seeded on or about September 1 of each year. Four to 6 weeks after seeding, oat root and shoot vigor were visually evaluated on a 0 to 5 scale where 0 = dead plants and 5 = the best growth.

Neither metolachlor, napropamide, nor simazine injured the oats at the rates tested. The lower rates of isoxaben and pendimethalin also did not injure the oats. However, the higher rates of these two herbicides and all rates of prodiamine and oxadiazon stunted the oats. Based on these data these herbicides were ranked from most injurious to safest in the following order: oxadiazon > prodiamine > isoxaben $\geq$ pendimethalin > napropamide = simazine = metolachlor. In a separate experiment, when perennial ryegrass was used as the fall-seeded cover crop, none of the above treatments reduced the stand density. In that test, oryzalin at 3.3 kg/ha was the only treatment to injure the cover crop. Using bok choi (*Brassica rapa chinensis*) as a bioassay, soil residues of isoxaben were detected from spring applications of 0.14 kg/ha.

These data show that when winter cover crops are used in nursery stock, the potential for residual herbicide injury depends on the herbicide selected, the rate applied, and the species of cover crop to be established. Where crop rotation is practiced, very careful attention must be paid to replant restrictions. In each case, a bioassay before planting is advisable.

---

[1]Assoc. Prof., Cornell Univ., Ithaca, NY, and Extension Weed Specialist, Long Island Hort Research Lab, Riverhead, NY, respectively.

CLOPYRALID FOR WEED CONTROL IN CONTAINER-GROWN AZALEA, JUNIPER, MUGO PINE, AND TAXUS

J. Ray Frank and C. Edward Beste[1]

ABSTRACT

Clopyralid was evaluated as a broadcast foliar application at 0.14, 0.28, and 0.56 kg/ha on container grown 'Hino Crimson' Azalea (Rhododendron x 'Hino Crimson'), 'Blue Pacific Juniper (Juniperus conferta Parl. 'Blue Pacific'), 'Mugo Pine' (Pinus mugo Turra.), and 'Wards Yew' (Taxus x media Rehd. 'Wardii').

The first application was made to newly planted plants using X-77, a non-ionic surfactant at 0.25% v/v, in a spray volume of 230 L/ha. A second application using the same rates and formulation was made the following year to the 'Blue Pacific Juniper' and the 'Wards Yew.'

Some control of common groundsel (Senecio vulgaris L.), horseweed (Conyza canadensis (L.) Conq.), Pennsylvania bittercress (Cardamine pensylvanica Muhl. ex Willd.) and yellow woodsorrel (Oxalis stricta L.) was obtained following two applications of Clopyralid at 0.28 and 0.56 kg/ha. One application of Clopyralid at any tested rate was ineffective in controlling prostrate spurge (Euphorbia humistrada Engelm. ex Gray), yellow woodsorrel, or Pennsylvania bittercress.

No phytotoxicity or growth reduction was observed with any of the woody nursery materials used in these experiments.

[1]Research Horticulturalist (Weed Science) and Associate Professor, respectively, USDA, ARS, Frederick, and University of Maryland, College Park, MD.

CONTROL OF MUGWORT IN ORNAMENTALS WITH CLOPYRALID

John F. Ahrens[1]

ABSTRACT

Mugwort (Artemesia vulgaris L.) is one of the most competitive and difficult-to-control weeds in ornamental plants. The effects of clopyralid on mugwort and selected ornamentals were investigated in an experiment in Merrimac sandy loam with 3% organic matter. In the first year (1989) clopyralid was applied in June or July at 0.14, 0.28 and 0.56 kg/ha in 281 L/ha over established ornamentals. The plants included yew (Taxus cuspidata), fraser fir (Abies fraseri), arborvitae (Thuja nigra 'Dark American'), eastern hemlock (Tsuga canadensis) and juniper (Juniperus horizontalis 'Plumosa Compacta'). Rhododendron (Rhododendron 'Roseum Elegans') was planted in April 1991.

In April of 1990 and 1991 rootstocks of mugwort were planted into the plots and clopyralid was reapplied in June or July and August or September. Periodic visual ratings were used to evaluate mugwort control and plant injury. Top growth of mugwort was cut and weighed in September 1991.

In October 1990, clopyralid at 0.56 kg/ha in June or July or at 0.14 or 0.28 kg/ha in June plus September or July plus September gave over 90% control of mugwort. In April 1991 control with 0.28 kg/ha applied in June plus September was complete. Regrowth occurred by June 1991 however, and despite applications in June and July, control in September was still not complete (99%).

Control of 1991-planted mugwort was not as effective as observed in 1990. June applications at 0.56 kg/ha gave better control (89%) than July applications (45%). Applications at 0.28 kg/ha in June plus July reduced top growth of mugwort 78%.

Clopyralid caused no observable injury to yew, arborvitae, juniper or rhododendron, and only slight injury to fraser fir and hemlock in the form of curled needles on new growth.

These results indicate that clopyralid can reduce infestations of mugwort selectively in certain ornamental evergreens but further information is needed on timing of applications and cultural management of the mugwort to achieve high levels of control.

---

[1] Plant Physiologist, The Connecticut Agricultural Experiment Station, Valley Laboratory, Windsor, CT 06095.

ALIEN PLANTS AT ORIENT BEACH STATE PARK, NEW YORK, AND A COMPARISON WITH FIVE COASTAL SITES

Richard Stalter[1] Dwight T. Kincaid[2] and Eric E. Lamont[3]

ABSTRACT

Native and introduced vascular plants at Orient Beach State Park (OBSP) reported by Latham (1934) were compared with those found in a study by Lamont and Stalter (1991). Eight percent of the plants found by Latham (1934) were non-native; forty-four percent of the plants collected by Lamont and Stalter (1991) were non-native. Most alien taxa at OBSP were observed in the eastern portion of the park where human impact is considerable. Nineteen percent of the vascular plants are non-native in the relatively pristine western portion of the park where human influence is minimal. In pairwise G-tests, the frequency of alien vascular plants at OBSP is highly significantly diferent ($p < .001$) from that at Little Beach Island, N.J; Assateague Island, VA; and Fisherman Island, VA; sites where human influence is minimal. The percentage of alien vascular plants at OBSP west (Long Beach) is significantly different from Cape May Point State Park, N.J., a site that is highly disturbed.

INTRODUCTION

Orient Beach State Park (OBSP), Suffolk Co., New York, is located on the north fork of Long Island just southwest of Orient Point (Lat. 41° 08'N, Long. 72° 16'W, U.S. Geol. Serv.[9] The park consists of a 6.4 km long, recurved spit varying in width from about 550 m near the park's center to less than 50 m near the western end. OBSP is bordered by Gardiner's Bay on the south and Little Bay, Long Beach Bay, and Orient Harbor on the north.

Orient Beach State Park was established in 1929 by the Long Island State Park and Recreation Commission. In 1934 Roy Latham published a flora of the new State park that included brief descriptions of plant communities and an annotated checklist consisting of 227 vascular plant species. Latham[5] described an area relatively undisturbed by human influence, with only 8% of the flora consisting of non-native species. Invasive alien plants such as *Phragmites australis* and *Taraxacum officinale* were not reported from the park.

During the 1950s and 1960s, park visitation increased and construction began on new picnic grounds, concession stands, bathhouses, playgrounds, and maintenance buildings. All development was restricted to the park's eastern half (Orient Beach), while the park's western half (Long Beach) remained natural and relatively undisturbed

[1] Department of Biological Sciences, St. John's University, Jamaica, N.Y. 11439

[2] Department of Biological Sciences, Lehman College, City University of New York, Bronx, N.Y. 10468

[3] New York Botanical Garden, Bronx, N.Y. 10458

by human influence. Roads were never constructed along Long Beach, and several areas were designated as bird sanctuaries. Public access to the park's west end was restricted and in some cases prohibited.

The objectives of the present study are: (1) to compare the native and introduced (i.e., alien) vascular plants present at Orient Beach State Park by Latham in 1934 with those found in a study by Lamont and Stalter (1991 in press); (2) to compare the native and alien taxa present at the eastern portion of the park (Orient Beach) with that of the western portion (Long Beach); (3) to compare the native and alien flora at Orient Beach State Park with the native and alien taxa found at five coastal sites on the east coast of the United States: Little Beach Island, N.J. (Stalter 1991 -- unpublished data); Cape May Point State Park, New Jersey (Sutton, Meyer and Stalter)[8]; Assateague Island, Virginia (Stalter and Lamont)[7]; Fisherman Island, Virginia (Boule)[1]; and Fort Sumter, South Carolina (Stalter and Lamont, in prep.). Orient Beach State Park is subjected to considerable human impact on its eastern half. Assateague Island, Virginia, is visited by thousands of visitors each year, and is most crowded during the annual July weekend "pony round up." Fisherman Island, dissected by U.S. Rt. 13, is 1.0 km south of the tip of the Delmarva Peninsula. Fisherman Island is the least disturbed and most inaccessible site. Fort Sumter, South Carolina, approximately 0.5 hectare in size, is the smallest and most heavily impacted site.

METHODS

Orient Beach State Park was sampled at least twice a month from April 1988 through October 1990 for a total of about 46 field days. Herbarium voucher specimens of each taxon were prepared and depsited at OBSP; some specimens are also kept on duplicate file at the New York Botanical Garden.

The species checklist of OBSP compiled by Lamont and Stalter [4] contains an inventory of 277 vascular plants that reproduce spontaneouslyl and persist for more than one year without cultivation, including native taxa, naturalized and adventive weeds, and escapes from cultivation. The checklist is divided into four categories: Pteridophytes, Conifers, Dicots, and Monocots (Table 1). Nomenclature follows that of Gleason and Cronquist[3] and Mitchell[6] and the concept of families follows that of Cronquist.[2] Table 2 presents a summary and comparison of the frequencies of native and alien vascular flora of OBSP with that found at five additional coastal sites.

RESULTS AND DISCUSSION

The current vascular flora of OBSP consists of 67 families, 183 genera, and 277 species of which 156 (56%) are native (Table 1). A comparison of numbers of species from OBSP collected by Latham[4] and the current authors is presented in Table 1.

The Orient Beach portion of OBSP is richer in species than the Long Beach portion. This is a direct result of the increased number of introduced, non-native species into the park's east end, due to increased visitor use. Forty-seven percent of the Orient Beach flora consists of non-native species, while 19% of the Long Beach flora consists of non-natives. The vegetation of the western half of Orient Beach State Park (Long Beach) remains relatively pristine and very similar to the vegetation as described there by Latham[4].

The vegetation of the eastern half of the park has undergone statistically significant changes in the frequencies of alien versus native taxa ($G = 86$, $p < .001$). Eighty-five native plant species reported by Latham[4] from OBSP are now apparently extirpated from the park. One hundred and four non-native species have been introduced to the park since 1934, of which 23 species are grasses (Poaceae). Most of the alien species are concentrated in the park's eastern half.

The percentage of alien plants at Long Beach, the undisturbed western poriton of OBSP, is similar to the percentage of alien plants found at Little Beach Island, N.J.; Assateague Island, VA, and Fisherman Island, VA. Human influence at these sites is minimal. Interestingly, the percentage of alien plants at each of the aforementioned sites decreases with decreasing human influence. Long Beach can only be approached by foot. Long Beach's isolation coupled with the threat of Lyme disease (from northern deer ticks), and mosquitoes (in season) keeps visitors at this site to a minimum. Fisherman Island, VA, is accessible only by special permit. In addition to natural dispursal, seeds of some alien species are brought to Fisherman Island on cars. Seeds of alien species might be washed from passing vehicles during rain storms, while other alien taxa might be transported to the site on the shoes and clothing of park personnel who infrequently visit the island. Assateague Island has the highest percentage (23.7%) of alien species of the four most pristine sites discussed in this paper. The greatest number of introduced species at Assateague Island occur at parking lots in the vicinity of beaches, a pony pen area, nature trail, lighthouse, and ranger headquarters.

The percentage of alien plants at Orient Beach State Park (east) is highly significantly different in log-likelihood G-tests ($p < .01$) from Cape May Point State Park, N.J. and Fort Sumter, South Carolina. All three of these sites are highly disturbed. Cape May Point State Park's alien taxa are concentrated in mowed fields, the parking lot and around the Visitor Centers. Fort Sumter, which was ravaged by Hurricane Hugo in September 1989, had the lowest percentage (27.9) of alien species of these three sites. Perhaps the alien species suffered disproportionately from salt water inundation during Hugo than native vegetation.

The eastern portion of Orient Beach State Park, Orient Beach, has the greatest percentage (47) of introduced species. Approximately thirty percent of Orient Beach has been set aside for visitor use, which accounts for the high percentage of introduced species. The loss of many native plant species and the addition of new species, especially grasses, reflects the ever-changing environment of OBSP. Human disturbance and natural forces, such as salt spray and periodic flooding during frequent northeasters and infrequent hurricanes, are the physical forces responsible for the dynamic environment and dynamic flora of the park.

Literature Cited

1. BOULE, M.E. 1979. The vegetation of Fisherman Island, Virginia. Castanea 44: 98-108.

2. CRONQUIST, A. 1981. An integrated system of classification of flowering plants. Columbia Univ. Press, New York, 1262 p.

3. GLEASON, H. A. AND A. CRONQUIST. 1963. Manual of vascular plants of northeastern United States and adjacent Canada. Willard Grant Press, Boston. 810 p.

4. LAMONT, E.E. AND R. STALTER, The vascular flora of Orient Beach State Park, Long Island, New York. Bull. Torrey Bot. Club. in press.

5. LATHAM, R. 1934. Flora of the state park, Orient, Long Island, N.Y. Bull. Torrey Bot. Club 34: 139-149.

6. MITCHELL, R. S. 1986. A checklist of New York State plants. N.Y.S. Mus. Bull. No. 458, Albany, N.Y.

7. STALTER, R. AND E.E. LAMONT. 1990. The vascular flora of Assateague Island, Virginia. Bull. Torrey Bot. Club 117: 48-56.

8. SUTTON, P. R. MEYER AND R. STALTER. 1990. The vascular plants of Cape May Point State Park, Cape May County, New Jersey. Bull. Torrey Bot. Clun 117: 294-300.

9. U.S. GEOLOGICAL SURVEY. 1956. Orient, New York Quadrangle (map).

Table 1. Comparison of the 1990 and 1934 census of the vascular flora of Orient Beach State Park, Long Island, New York.

	Pteridophytes	Conifers	Dicots	Monocots	TOTAL
	1990 (1934)	1990 (1934)	1990 (1934)	1990 (1934)	1990 (1934)
Families	2 (4)	2 (2)	53 (49)	10 (8)	67 (63)
Genera	3 (4)	2 (2)	133(116)	45 (36)	183 (158)
Species	3 (4)	3 (2)	203(165)	68 (56)	277 (227)
Native species	3 (4)	2 (2)	112(150)	39 (53)	156 (209)
Introduced species	0 (0)	1 (0)	91 (16)	29 (3)	121 (19)

Table 2. Comparison of native and alien vascular flora of Orient Beach State Park (OB) with that found at five coastal sites: Little Beach Island, N.J. (LB); Cape May Point State Park, N.J. (CM); Assateague Island, VA (AI); Fisherman Island, VA (FI); and Fort Sumter, SC (FS). Percentage of alien taxa are in parentheses.

	LOCALITY					
	OB	LB	CM	AI	FI	FS
Total species	277	79	377	443	139	68
Native species	156	63	247	338	111	49
Introduced species	121 (43.6)	16 (20.2)	130 (34.4)	105 (23.7)	28 (20.1)	19 (27.9)

INTERACTION OF PLANT RESIDUES AND REDUCED HERBICIDE RATES IN CORN UNDER TWO TILLAGE SYSTEMS

P. C. Bhowmik and B. M. O'Toole[1]

ABSTRACT

Experiments were conducted in field corn to determine the relationship between reduced rates of herbicides, tillage systems, and plant residues. Oats 'Ogle' were planted on September 4, 1990, at 213 and 426 kg ha^{-1}, to provide the residue levels. 'Agway 588S' corn was planted on May 15, 1991. Tank-mix combination of alachlor plus atrazine at 2.8 kg ha^{-1} (1X) and the reduced rates at 1.4 and 0.7 kg ha^{-1} (1/2 X and 1/4X), and pendimethalin at 1.7 kg ha^{-1} (1X) and the reduced rates at 0.84 and 0.42 kg ha^{-1} (1/2 and 1/4X) were applied preemergence in low and high oat residue areas in minimum-tillage system. A similar experiment was conducted in no-tillage system. Grass and broadleaf weeds per 400 cm^2 and corn were sampled three times in 1991 for weights or heights. Major weed species were large crabgrass [Digitaria sanguinalis (L.) Scop.], yellow foxtail [Setaria lutescens (Weigel) F.T. Hubb.], common lambsquarters (Chenopodium album L.), and horseweed (Erigeron canadensis L.).

Regardless of residue levels, the full rate (1X) of alachlor plus atrazine or pendimethalin at 1/2X or 1X rate controlled large crabgrass effectively 8 WAT in minimum-tillage system. However, at 14 WAT, only the full rate (1X) of pendimethalin controlled large crabgrass by 90%. All rates of alachlor plus atrazine combinations controlled yellow foxtail up to 8 WAT, while only the full rate controlled yellow foxtail 14 WAT. Only the 1X rate of pendimethalin controlled yellow foxtail by 94% up to 4 WAT. Both the full rate and 1/2X rate of alachlor plus atrazine controlled common lambsquarters up to 14 WAT. The full rate and 1/2 rate of both pendimethalin and the combination of alachlor plus atrazine controlled horseweed up to 14 WAT. Alachlor plus atrazine at the full rate resulted in highest corn silage yield (47,098 kg ha^{-1}) compared to the untreated ckeck (15,632 kg ha^{-1}).

All rates of alachlor and atrazine combination controlled (over 90%) large crabgrass 8 WAT in no-tillage system. Only the full rate of pendimethalin controlled large crabgrass 14 WAT. The 1/4X rate of pendimethalin controlled yellow foxtail by 90% 8 WAT. Only the full rate of alachlor plus atrazine combination controlled yellow foxtail effectively 14 WAT. While pendimethalin at the full rate controlled horseweed by 83% 8 WAT, alachlor and atrazine combination at 1/2X rate gave 93% control up to 14 WAT. Pendimethalin at the full rate gave only 60% control of common lambsquarters 8 WAT. The lowest rate (1/4X) of alachlor and atrazine combination controlled common lambsquarters effectively up to 14 WAT. Alachlor plus atrazine at the full rate resulted in highest corn silage yield (44,070 kg ha^{-1}).

In general, oat residue from fall-planted cover crops had little effect on the performance of reduced rates of herbicides used. This may have been due to the amount of residue produced from fall-planted oats.

---

[1]Associate Professor and Research Technician of Weed Science, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Integrating Chemical and Mechanical Weed Control In Corn

Jane Mt. Pleasant[1], Robert Burt and James Frisch

Increased concern over the environmental impact of pesticides has many farmers returning to cultivation in order to decrease herbicide use. Although cultivation is an effective weed control practice, as many as three or four passes may be required for acceptable control. For many field crop farmers the cost in time and labor for cultivation is too high. Combining mechanical and chemical weed control practices may significantly reduce herbicide use and the number of cultivations compared with that required if either method were used alone. A field experiment was conducted to compare integrated chemical and mechanical weed control practices with treatments relying wholly on chemical or mechanical weed control.

The experiment was established at the Robert Musgrave Research Farm in Aurora, NY in 1989 and continued for three years. Eight treatments were applied in a randomized complete block design with four replications. Plot size was 15' by 100' in 1989 and 1990 and 15' by 170' in 1991. Treatments were: 1) broadcast herbicide; 2) broadcast herbicide + cultivation; 3) row crop cultivation 2x; 4) rolling cultivation 2x; 5) rolling cultivation 1x + row crop cultivation 1x; 6) band herbicide + row crop cultivation 2x; 7) band herbicide + rolling cultivation 2x; and 8) band herbicide + rolling cultivation 1x + row crop cultivation 1x. The broadcast herbicide used atrazine (1 lb/A ai) and pendimethalin (1.5 lb/A ai). The band herbicides were applied to a ten-inch band over the corn row at the same rate in the band as the broadcast herbicide.

Corn yields were significantly different among treatments in 1989 but no differences were found in the other two years. Percent weed cover, however, differed by treatment in all three years. In 1989 the broadcast plus cultivation treatment had the highest corn yields (136 bu/A) and the rolling cultivation 1x + row crop cultivation 1x the lowest yield (108 bu/A). Yields ranged from 108 to 135 bu/A in 1990 and 110 to 120 bu/A in 1991 with no significant differences. Weed levels in the three treatments which utilized only cultivation were higher than the other treatments in 1989 and 1990. In 1991, only the rolling cultivation 2x treatment had significantly higher weed levels. Treatments which relied on combinations of herbicide applications and cultivations had low weed levels and acceptable corn yields in all three years.

---

[1]Assistant Professor, Research Support Specialist and Field Technician, Department of Soil, Crop and Atmospheric Sciences, Cornell University, Ithaca, N.Y. 14853

MANAGING COVER CROPS AND WEEDS FOR NO-TILL CORN

R. L. RITTER[1/]

ABSTRACT

Field studies were conducted in 1990 and 1991 to examine different cover crops and herbicide programs for use in no-till corn (Zea mays L.) production. Trials were conducted at the Poplar Hill Research Station located in Quantico, MD and at the University of Maryland Beltsville Field Station located in Beltsville, MD. In the Fall of 1989 and 1990, crimson clover (Trifolium incarnatum L.) and hairy vetch (Vicia villosa Roth) were planted at each location. The following Spring, corn was no-till planted into the established cover crops. Planting was generally performed around May 1, when the crimson clover was in bloom and averaging 30 cm in height, while the hairy vetch averaged 45 cm in height.

Herbicide programs consisted of nine different treatments. Glyphosate, paraquat and 2,4-D were applied alone at planting. These three knock-down herbicides were also compared in tank-mixes with metolachlor plus atrazine. Finally, these same three materials were applied alone at planting and followed by a postemergence application of DPX-V9360, made approximately 4 weeks after planting. A tenth treatment was the untreated control.

The use of a knock-down herbicide at planting was insufficient in providing season-long weed control. Although the desiccating cover crops provided a high degree of shading, to the soil surface, use of a preemergence or postemergence herbicide was necessary to provide adequate season-long weed control. Overall, the use of a knock-down herbicide followed by DPX-V9360 provided best season-long weed control at both locations in 1990 and 1991. Among the knock-down herbicides evaluated, 2,4-D provided best control of hairy vetch while control was variable with all three herbicides on crimson clover.

[1/] Assoc. Prof., Agric. Exp. Stn., Agron. Dept., Univ. of MD, College Park, MD 20742.

CORN VARIETAL TOLERANCE TO VIRAL DISEASE AS INFLUENCED BY PRIMISULFURON APPLICATIONS TO JOHNSONGRASS IN 1991

M.G. Schnappinger, R.L. Ritter, E.S. Hagood, C.B. Sperow, and J.F. Baniecki[1]

ABSTRACT

Maize Dwarf Mosaic Virus (MDMV) and Maize Chlorotic Dwarf Virus (MCDV) are insect transmitted viral diseases of johnsongrass [Sorghum halapense (L.) Pers.] and corn (Zea mays L.). Field observations have shown that selective postemergence control of johnsongrass with sulfonylurea herbicides can increase the incidence of these diseases in corn. Insects feed on johnsongrass which is the primary host of both MDMV and MCDV. When the johnsongrass is controlled, the contaminated insect vectors move to the secondary host, corn, and transmit the diseases during the normal feeding process. The resulting symptoms (discolored and stunted corn) can easily be misinterperated as herbicide injury since the the insect vectors are not very mobile and infection is usually limited to the herbicide treated area.

Many seed corn companies have varieties that are resistant to MDMV and MCDV, but field testing for tolerance has been limited to trials where corn is grown in the presence of actively growing johnsongrass. Thus, research initiated in 1990 was continued in Maryland, Virginia, and West Virginia in 1991 to determine if genetic tolerance to MDMV and MCDV would be adequate when infected johnsongrass was selectively controlled with postemergence applications of primisulfuron. A total of eighteen hybrids were tested in five replicated field trials during 1990 and eleven hybrids were included at four locations in 1991.

Average disease incidence and severity ranged from very low for a reportedly "virus resistant" hybrid to extremely high for a known susceptible hybrid. Four of the hybrids had excellent tolerance at all locations over both years, while several others displayed resistance that varied with location. Numerous hybrids were intermediate in tolerance which may therefore be adequate under moderate disease conditions. Use of virus tolerant hybrids can reduce the negative impact of MDMV and MCDV on corn following postemergence control of johnsongrass.

[1]*Senior Scientist, Agric. Div., Ciba-Geigy Corp., Centreville, MD 21617, Associate Professor, Agronomy Dept., Univ. of MD, College Park, MD 20742, Associate Professor, VPI&SU, Blacksburg, VA 24061, and Professors, WVU, Morgantown, WV 26505*

GIANT RAGWEED CONTROL IN SOYBEANS AND CORN

H. Menbere and R. L. Ritter 1/

ABSTRACT

Giant ragweed (Ambrosia trifida L.) is a summer annual weed that is increasing in occurrence throughout much of the Mid-Atlantic region. This weed is not only a strong competitor for light and nutrients, but makes harvesting difficult.

From 1987 to 1991, field trials were established to compare numerous chemical combinations and sequential treatments for giant ragweed control in corn (Zea mays L.) and soybeans [Glycine max (L.) Merr.]. Studies were conducted in Maryland on a site that was heavily infested with a natural population of giant ragweed. Tests were established as randomized complete block designs with three replications. Herbicides that were incorporated were disced in two times to a depth of 10-15 cm. All preplant incorporated (PPI) and preemergence (PRE) soybean applications plus postemergence corn applications were made with a CO2 pressurized back sprayer that delivered 200 L/ha at 150 kPa using SS-8003 flat-fan nozzles. Postemergence soybean applications utilized similar equipment delivering 250 L/ha at 200 kPa. Visual ratings were made throughout the growing season using a scale of 0 to 100 with 0 = no control, and 100 = complete control.

In corn, early postemergence (giant ragweed = 1-30 cm tall) and late postemergence (giant ragweed = 1-60 cm tall) applications were compared. Treatments proving excellent season-long control (>90%) for both timings incluld CGA-136872, dicamba, dicamba plus atrazine package-mix, bentazon plus atrazine package-mix, and 2,4-D.

In soybeans, imazaquin applied PPI provided best season-long control of giant ragweed among all soil applied combinations. Comparisons among postemergence applications indicated that fomesafen or lactofen provided best control.

1/ Agri. Res. Tech. and Assoc. Prof., Agric. Exp. Stn., Agron. Dept., Univ. of MD, College Park, Md 20742.

USING REDUCED RATES OF POSTEMERGENCE HERBICIDES IN SOYBEANS

J. W. Lewis and R. L. Ritter 1/

ABSTRACT

Greenhouse studies were conducted in 1990 and 1991 to evaluate several postemergence soybean [Glycine max (L.) Merr.] herbicides. Acifluorfen, bentazon, chlorimuron, imazethapyr, and an acifluorfen/bentazon 2/ package-mix were applied at 1X and 1/2X use rates. Applications were made in combination with the following adjuvants: nonionic surfactant, crop oil concentrate, or a surfactant/nitrogen package-mix 3/. Treatments were applied to weeds growing in four inch pots and arranged as a randomized complete block design with 3 replications. Velvetleaf (Abutilon theophrasti Medic.), common ragweed (Ambrosia artemisiifolia L.), and common cocklebur (Xanthium strumarium L.) were treated at 3 different growth stages as follows: velvetleaf - 3, 4, 5-lf stages; common ragweed - 4, 6, 8-lf stages; and common cocklebur - 3, 4, 5-lf stages). Visual control ratings were made at 1, 2, 3, and 4 weeks after treatment (WAT). After the fourth week, plants were cut at the soil surface, dried, and weights recorded.

Best control of common cocklebur was achieved at the 3-lf stage. Chlorimuron, imazethapyr, and the acifluorfen/bentazon package-mix all provided > 90% control at the lowest rates tested depending upon adjuvant. Best velvetleaf control was obtained with the acifluorfen/bentazon package-mix at a rate of 0.6 kg/ha when combined with 3.5 L/ha of the surfactant/nitrogen package-mix. Plants were in the 3-4-lf stage. Best control of common ragweed was achieved at the 4-6-lf stage with acifluorfen and the acifluorfen/bentazon package-mix at the lowest rates tested depending on adjuvant.

Field studies conducted in Maryland in 1991 examined the same herbicide and adjuvant combinations on common cocklebur and ivyleaf morningglory [Ipomoea hederacea (L.) Jacq.]. Field studies were performed as randomized complete block designs with 3 replications. Treatments were applied to 3 different growth stages; common cocklebur - 3, 4, 5-lf stages and ivyleaf morningglory - 2, 5, 8-lf stages. Visual control ratings were made at 1, 2, 4, and 8 WAT. Soybeans were taken to yield.

Best control of ivyleaf morningglory was obtained with chlorimuron at 0.009 kg/ha in combination with 2.3 L/ha of crop oil concentrate when plants were in the 2-lf stage. Best control of common cocklebur was obtained with imazethapyr at 0.04 kg/ha in combination with a nonionic surfactant when the plants were in the 3-lf stage.

1/. Grad. Asst. and Assoc. Prof., Agric. Exp. Stn., Agron. Dept., Univ. of MD., College Park, MD 20742.

2/. Storm is a mixture of 0.32 kg/L bentazon and 0.16 kg/L acifluorfen manufactured by BASF Corp., Parsippany, NJ 07054.

3/. Patrol is a mixture of 28% nitrogen solution(25% nitrogen) and nonionic surfactant (75%) manufactured by SETRE Chemical Co., Memphis, TN 38137.

PRE- AND POSTEMERGENCE CONTROL PROGRAMS FOR ANNUAL WEEDS IN SOYBEANS

Russell R. Hahn[1]

ABSTRACT

Field experiments were conducted in 1990 and 1991 to evaluate several pre- and postemergence herbicides for annual grass and broadleaf weed control in soybeans [Glycine max (L.) Merr.]. Preemergence applications of lactofen and V-53482 were evaluated for the control of velvetleaf (Abutilon theophrasti Medik.), common ragweed (Ambrosia artemisiifolia L.), and common lambsquarters (Chenopodium album L.). Postemergence applications of imazethapyr with six adjuvants were also evaluated for control of these annual broadleaf species. The experiments were conducted near Aurora and Etna, NY on silt loam soils with 4% organic matter. A randomized complete-block design with four replications was used in each experiment. Herbicides were applied in water to 10 by 25 ft plots using 80015 flat spray tips mounted on a compressed air bicycle sprayer calibrated to deliver 25 gpa of spray solution.

Preemergence applications of lactofen at rates of 0.2 to 0.4 lb ai/A caused no soybean injury either year while postemergence applications of 0.2 lb/A of lactofen caused 20 to 30% soybean injury. The preemergence application of 0.2 lb/A of lactofen provided excellent common ragweed and common lambsquarters control, however, applications of lactofen at 0.2, 0.3, and 0.4 lb/A provided only 40, 55, and 59% velvetleaf control respectively. Postemergence application of 0.2 lb/A lactofen provided 83% velvetleaf control but only 53% common lambsquarters control.

No soybean injury was observed 14 days after planting (DAP) at Aurora or Etna following preemergence applications of 0.063 or 0.094 lb ai/A of V-53482 because no measurable precipitation fell during that period. Injury ratings 28 DAP averaged 16% for all V-53482 treatments while standard treatments of 1 lb ai/A linuron or 0.5 lb ai/A metribuzin caused less than 5% soybean injury. A total of 2.56 and 1.54 in of rain fell at Aurora and Etna respectively during that 2-week period. Soybean recovery was rapid and no injury was observed 56 DAP. When applied alone, 0.063 lb/A of V-53482 provided 99 and 97% velvetleaf and common lambsquarters control respectively while 1 lb/A of linuron provided 89 and 99% velvetleaf and lambsquarters control. Common ragweed control was 60% with 0.063 lb/A of V-52483 and 86% with 0.094 lb/A of V-52483. Linuron at 1 lb/A controlled 79% of the common ragweed.

Postemergence applications of imazethapyr at 0.063 lb ai/A provided an average of 93% velvetleaf control while common lambsquarters control was only 58%. Postemergence applications of imazethapyr with 1% (v/v) BCH 815 15S gave 77% common lambsquarters control compared to an average of 55% control with the five other adjuvants. Although there were differences in common ragweed control among the six adjuvant combinations, none of them provided acceptable control.

---

[1]Assoc. Prof., Dept. of Soil, Crop and Atmospheric Sci., Cornell Univ., Ithaca, NY 14853

BRC 602: WEED CONTROL IN SOYBEANS

S. Dennis, S. W. Cosky and M. P. Whalen

ABSTRACT

Field experiments were conducted in 1990 and 1991 to evaluate the postemergence effectiveness of BRC 602 for controlling grass weeds in soybeans [Glycine max (L.) Merr.] in the northeast. BRC 602 was applied alone and in combinations with several broadleaf herbicides and evaluated for weed control. All studies were conducted utilizing randomized complete block designs and with three or four replications.

Applications rates of BRC 602 depended upon the targeted weed species. Generally, BRC 602 was applied at 6, 8 and 10 oz/A with crop oil concentrate or non-ionic surfactant.

Season long control (>90%) of important grass weed species, including giant foxtail (Setaria faberi Hermm.) and barnyardgrass [Echinochloa crusgalli (L.) Beauv.], have been observed from applications of BRC 602 alone.

Crop tolerance to BRC 602 is excellent. Visual crop injury ratings were recorded. There was no reported injury symptomatology from applications of BRC 602 alone.

These studies indicate that BRC 602 may be used successfully in weed control programs for the control of important grass weed species with excellent crop tolerance.

ICI Americas Inc., Agricultural Products, Wilmington, DE 19897.

BROADLEAF HERBICIDE EFFECTS ON POSTEMERGENCE GRASS CONTROL IN SOYBEANS

B. S. Manley, H. P. Wilson, and T. E. Hines[1]

ABSTRACT

Field studies were conducted in 1991 to evaluate BRC602, quizalofop and clethodim and tank-mixing broadleaf and grass herbicides for postemergence annual grass control in soybeans (Glycine max L. Merr.). All studies utilized a randomized complete block design with three replications, and were located at the Eastern Shore Agricultural Experiment Station in Painter, Va. Treatments were applied postemergence with a tractor-mounted plot sprayer delivering 235 l/ha at a pressure of 210 kpa. The grasses evaluated were giant foxtail (Setaria faberi Herrm.) and large crabgrass (Digitaria sanguinalis L. Scop.).

In one study treatments included three rates of BRC602 from 134 to 224 g/ha, quizalofop at 98 g/ha and mixtures of either of these herbicides with standard rates of fomesafen, chlorimuron, chlorimuron plus thifensulfuron, and fomesafen plus thifensulfuron. In a second study, treatments included BRC602 and quizalofop at the rates used in the first study and mixtures with bentazon, fomesafen, bentazon plus fomesafen, and fomesafen plus 2,4-DB. Treatments in a third study included clethodim at 105 g/ha, and mixtures of clethodim with bentazon, chlorimuron, lactofen, acifluorfen plus bentazon, imazethapyr, thifensulfuron, chlorimuron plus lactofen and imazethapyr plus lactofen. A non-ionic surfactant was added to treatments in the first study at 0.25% v/v and crop oil concentrate was added to treatments in the second and third studies at 1% v/v.

BRC602 controlled giant foxtail and large crabgrass equivalent to that of quizalofop in both of the first two studies. Giant foxtail control did not differ between treatments in the first two studies. In the third study, giant foxtail control from mixtures of clethodim with bentazon, chlorimuron and all imazethaphyr combinations was lower than control from other clethodim treatments. Large crabgrass control with all mixtures was lower than control from the respective grass herbicides alone in all three studies. It is concluded that annual grass species respond differently to postemergence grass herbicides applied in mixtures with herbicides for broadleaf weeds.

---

[1]Grad. Res. Asst., Prof., and Agri. Res. Sci. A., Eastern Shore Agric. Exp. Stn., Va. Polytech. Inst. and State Univ., Painter, VA 23420.

RESPONSE OF TWO SULFONYLUREA RESISTANT WEEDS TO DIFFERENT ALS/AHAS INHIBITING HERBICIDE FAMILIES

J. de Castro[1], T. Malefyt[2], and R.D. Ilnicki[3]

ABSTRACT

Duplicate whole plant experiments were conducted at the American Cyanamid Agricultural Research Center in Princeton, NJ to evaluate cross-resistance between five ALS/AHAS inhibiting herbicide families in biotypes suspected of being resistant to the sulfonyl urea, chlorsulfuron.

One biotype of common chickweed (Stellaria media) and one of kochia (Kochia scoparia) were collected from suspected chlorsulfuron resistant populations resultant from continuous use of this herbicide in monoculture cereal. These biotypes were compared to susceptible biotypes of common chickweed and kochia. The five herbicides representing different ALS/AHAS inhibiting herbicide families were: chlorsulfuron (sulfonylurea), imazethapyr (imidazolinone), CL 290,567 (triazolopyrimidine), AC 299,677 (sulfonylcarboxamide) and AC 311,629 (a novel family currently under development at American Cyanamid Company). All herbicides were applied postemergence (plants 3 to 4 cm tall) at rate ranges where each herbicide achieved control of the susceptible biotypes.

For each biotype, GR_{50} (herbicide rate achieving 50% growth reduction) were determined by taking fresh weights. A relative resistance to each herbicide was determined by calculating the ratio of the GR_{50} for susceptible and resistant biotypes for each species. Results are given in Table 1. Data demonstrate that all herbicides controlled susceptible biotypes of common chickweed and kochia. Resistant common chickweed was only controlled by chlorsulfuron (relative resistance 100X) and imazethapyr (4X), but not by any of the other herbicides. The resistant kochia biotype was only controlled by CL 290,567 (16X), and not by any of the other herbicides at rates more than 1000X those which achieved control of the susceptible biotypes.

Significant differences were seen in each biotypes' response to the herbicide family tested. Therefore, if herbicide resistance develops as a result of the continuous use of an ALS/AHAS inhibiting herbicide, the level of cross-resistance to other ALS/AHAS inhibiting herbicide families can vary greatly and should be tested for each species before any conclusions about cross-resistance can be made.

---

[1]Biologist, American Cyanamid Company, Princeton, NJ 08543 and Graduate Student Rutgers University, New Brunswick, NJ 08903
[2]Group Leader, American Cyanamid Company, Princeton, NJ 08543
[3]Res. Prof of Weed Sci., Crop Science Dept. Rutgers University, New Brunswick, NJ 08903

Table 1: Resistance level of chickweed and kochia to five ALS/AHAS inhibiting herbicide families. Relative resistance was determined by calculating the ratio of the GR_{50} (herbicide rate achieving 50% growth reduction) for susceptible and resistant biotypes for each species. Average of 2 experiments.

HERBICIDE (FAMILY)	CHICKWEED Suc (GR_{50})	CHICKWEED Res (GR_{50})	CHICKWEED **Rel-Res**	KOCHIA Suc (GR_{50})	KOCHIA Res (GR_{50})	KOCHIA **Rel-Res**
Pursuit (IM)	<1	4	**4X**	<1	+20000	**+20000X**
Glean (SU)	<1	100	**100X**	<1	+10000	**+10000X**
CL 290,567 (TP)	200	+2000	**+10X**	<125	2000	**15X**
AC 299,677 (SC)	165	+16000	**+100X**	675	+16000	**+20X**
AC 311,629 (NC)	<16	+10000	**+1000X**	<16	+10000	**+1000X**

IM = imidazolinone
TP = triazolopyrimidine
NC = new class of chemistry
SU = sulfonyurea
SC = sulfonylcarboxamide

< = GR_{50} is lower than lowest rate tested.
> = GR_{50} is greater than highest rate tested.

+ = relative resistance is at least the given value.

NICOSULFURON AND PRIMISULFURON INTERACTION WITH SOIL APPLIED INSECTICIDES

Steven J. Carlson and Kurt Seevers 1/

ABSTRACT

American Cyanamid Company has conducted interaction studies with nicosulfuron, primisulfuron and soil applied insecticides in field corn (Zea mays L.) over the last two years throughout corn production areas in the United States. All currently labeled soil applied insecticides were included in our studies.

Results of our studies indicate that nicosulfuron or primisulfuron in the absence of soil insecticides have the potential to cause visual injury. Primisulfuron tends to induce greater visual injury than nicosulfuron. All soil applied insecticides have the potential to induce interaction symptoms, however the interaction is infrequent and varied in intensity. The potential for interaction symptoms to occur is reduced when the insecticides are applied as a band compared to in-furrow applications. It appears that precipitation in conjunction with nicosulfuron or primisulfuron application increases the potential for interaction.

Our studies indicate that banded applications of the 20CR formulation of terbufos reduces the potential for interaction to levels of other soil applied insecticides, including phorate. However, in-furrow applications of the 15G formulation of terbufos tend to have an unacceptable potential for interaction with either nicosulfuron or primisulfuron. Based on these results, American Cyanamid Company is recommending banded applications of terbufos 20CR with nicosulfuron only, or phorate used with either nicosulfuron or primisulfuron.

1/ Technical Service Representative and Insecticide Specialist, respectively, American Cyanamid Company, Lawrenceville, NJ.

Control of Smooth Crabgrass with Applications of Preemergence Herbicides at Reduced Rates

G. W. Hamilton, Jr., P. J. Landschoot, T. L. Watschke, J. N. Clark, and B. F. Hoyland[1]

An experiment was conducted at University Park, PA to evaluate the control of smooth crabgrass (Digiteria ischaemum (Schreb.) Muhl.) from subsequent year, reduced rate applications of selected preemergence herbicides.

The experiment was conducted on a 7 year old stand of perennial ryegrass (Lolium perenne L.) maintained at 4.5 cm. In 1989, treatments were arranged in a randomized complete block design with three replications, and in 1990, treatments were arranged in a split block design with three replications. Treatments were applied at the label rate to the entire plot on April 27, 1989. On April 23, 1990, treatments were applied at label rates to half of the blocks and at one-half of the label rate to the other half of the blocks. Sprayable treatments were applied with a CO_2 powered boom sprayer, delivering 701 l/ha with 6504 nozzles. Granular treatments were combined with sand and applied with a shaker jar. Commercially acceptable control was considered to be 80% or greater.

All of the 1989 treatments provided acceptable contol, with the exception of benefin 60DF and benefin 2.5G. Of the full rate treatments in 1990, only DCPA 5G and benefin 2.5G did not provide acceptable cotrol. Those same treatments did not provide acceptable control at half rates, along with DCPA 6F, bensulide 4E, prodiamine 65WDG, pendimethalin 60WDG, benefin 65DF, dithiopyr 1EC, and Team.

It appears that acceptable control of smooth crabgrass can be achieved with reduced rates of some preemegence herbicides, following an application at full rates.

---

1 Supervisor, Assistant Professor of Turfgrass Science, Professor of Turfgrass Science, Research Technologist, and Research Technologist, Penn State University, University Park, PA 16802

TABLE 1: Control of smooth crabgrass with preemergence herbicides applied at reduced rates following a previous year's label rate application. Treatments were applied on April 27, 1989, and April 23, 1990.

		RATE (kg ai/ha)		1989 % CONTROL	1990 -% CONTROL-	
TREATMENT	FORMULATION	Full	Half	Full	Full	Half
1 DCPA	75 WP	11.77	5.88	93	98	88
2 DCPA	6 F	11.77	5.88	88	80	59
3 Bensulide	4 EC	14.01	7.01	98	86	56
4 Prodiamine	65 WDG	0.56	0.28	97	98	70
5 Pendimethalin	60 WDG	1.68	0.84	83	97	76
6 Benefin	60 DF	2.80	1.40	72	92	57
7 Dithiopyr	1 EC	0.43	0.21	97	86	70
8 Check		0.00	0.00	0	0	0
9 DCPA	5 G	11.77	5.88	88	59	29
10 Benefin	2.5 G	2.24	1.12	77	43	64
11 Team	2 G	2.24	1.12	85	91	43
12 Oxadiazon	2 G	2.24	1.12	98	98	93
13 Dithiopyr	0.25 G	0.56	0.28	98	99	100
14 Prodiamine	0.5 G	0.56	0.28	80	97	96
15 Check		0.00	0.00	0	0	0

PRE/POSTEMERGENCE AND POSTEMERGENCE CONTROL OF SMOOTH CRABGRASS

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

Two experiments were conducted to evaluate the control of smooth crabgrass (Digitaria ischaemum (Schreb.) Muhl.) with selected preemergence and postemergence herbicides and their combinations. The postemergence study was conducted on a blend of turf-type tall fescue, and the pre/postemegence study was conducted on a blend of perennial rygrass.

Treatments of both studies were arranged in a randomized complete block design with three replications. Treatments were applied with a 0.9 m, CO_2 powered boom sprayer, delivering 374 l/ha with two T-jet 6504 nozzles. The pre/postemergence treatments were applied on July 7 and the postemergence treatments on July 12. The crabgrass was in the 3 to 5 tiller stage in both studies at the time of application. Crabgrass control was rated on a scale of 0 to 100%, with 80% being considered acceptable control. Both studies were rated on August 27.

In the pre/postemergence study, prodiamine at 0.43 kg ai/ha combined with fenoxaprop-ethyl at 0.20 kg ai/ha provided the best control of crabgrass (93%). Prodiamine at 0.56 kg ai/ha combined with either fenoxaprop-ethyl at 0.13 kg ai/ha or MSMA at 2.24 kg ai/ha, and fenoxaprop-ethyl alone at 0.20 kg ai/ha also provided acceptable control.

In the postemergence study, quinclorac at 0.84 kg ai/ha and fenoxaprop-ethyl at 0.20 kg ai/ha provided the best postemergence control of crabgrass. (There were duplicate treatments of quinclorac at 0.84 kg ai/ha in anticipation that follow-up applications may have to be made.) Quinclorac applied at 0.56 kg ai/ha was insufficient to provide control from a single application. Previous research has indicated the need for two sequential applications at 0.56 kg ai/ha to provide equivalent to one application at 0.84 kg ai/ha.

---

1 Supervisor, Professor of Turfgrass Science, and Research Technologist, Penn State University, University Park, PA 16802

TABLE 1: Control of smooth crabgrass with selected pre/post chemical combinations. Treatments were applied on July 5, 1991 and rated August 27, 1991.

	TREATMENT	FORMULATION	RATE (kg ai/ha)	% CONTROL
1	Prodiamine	65 WDG	0.56	88
	Fenoxaprop-ethyl	1 EC	0.13	
2	Prodiamine	65 WDG	0.56	83
	MSMA	6 S	2.24	
3	Prodiamine	65 WDG	0.56	53
	Quinclorac *	75 DF	0.84	
4	Prodiamine	65 WDG	0.43	93
	Fenoxaprop-ethyl	1 EC	0.20	
5	Quinclorac	75 DF	0.84	53
6	Quinclorac	75 DF	0.84	32
	Benefin	60 DF	2.24	
7	Fenoxaprop-ethyl	1 EC	0.09	77
	Benefin	60 DF	2.24	
8	Fenoxaprop-ethyl	1 EC	0.09	72
	Benefin	60 DF	3.36	
9	Fenoxaprop-ethyl	1 EC	0.09	78
	Pendimethalin	60 WDG	1.68	
10	Benefin	60 DF	2.24	2
11	Fenoxaprop-ethyl	1 EC	0.20	80
12	HOE 360	28 EC	0.05	13
	Benefin	60 DF	2.24	
13	HOE 360	28 EC	0.05	38
	Pendimethalin	60 WDG	1.68	
14	Check		0.00	0

TABLE 2: Control of smooth crabgrass with selected postemergence herbicides. Treatments were applied July 12, 1991 and rated August 27, 1991.

	TREATMENT	FORMULATION	RATE (kg ai/ha)	% CONTROL
1	Dithiopyr	1 EC	0.43	63
	MSMA	6 S	1.12	
2	Dithiopyr	1 EC	0.43	37
	Fenoxaprop ethyl	1 EC	0.07	
3	Dithiopyr	1 EC	0.43	32
4	Dithiopyr	1 EC	0.56	30
5	Quinclorac	75 DF	0.84	90
6	Quinclorac	75 DF	0.56	47
7	Quinclorac	75 DF	0.84	82
8	Quinclorac	75 DF	0.84	88
9	MSMA	6 S	2.24	45
10	Fenoxaprop ethyl	1 EC	0.20	82
11	Check		0.00	0

* all quinclorac treatments had BAS 09002S surfactant added

1991 CGA-163935 Experimental Use Permit Trials

D. B. Vitolo, J. D. Abbott, J. Cantwell,
C. Moseley, and S. W. Pruss. 1/

ABSTRACT

CGA-163935 (proposed common name cimectacarb) is a growth regulator being developed for vegetative inhibition of warm- and cool-season turfgrass.

CIBA-GEIGY Corporation conducted an Experimental Use Permit (EUP) program in 1991 with CGA-163935 to evaluate plant growth regulator effects on eleven turfgrass species. The EUP program was conducted on golf courses, sod farms, and commercial and residential lawns. Rates of CGA-163935 tested ranged from 300 to 950 g ai/ha, with rates dependent on species treated and duration of activity desired. In the northeastern United States, EUP trials were conducted in New York, Pennsylvania, Connecticut, and Ohio. Cool-season turf species treated in these trials included bentgrass (Agrostis palustris Huds.), Kentucky Bluegrass (Poa pratensis L.), tall fescue (Festuca arundinacea Schreb.), perennial ryegrass (Lolium perenne L.) and fine fescue (Festuca spp.). Parameters measured in the EUP program included mowing reduction, clipping weights, color, and general turf quality, as well as tank-mix compatibility and methods of application.

The 1991 CGA-163935 EUP program confirmed the effectiveness of this compound in reducing the frequency of mowing and the amount of grass clippings produced over a wide range of turf species and situations. Applied to mixed spp. home lawns in Pennsylvania, cumulative growth was reduced by 50% and number of mowings by 20% when averaged across four sites. In Connecticut, CGA-163935 applied to bentgrass fairways reduced total clipping volumes from 48-60% over four week periods. Normal germination and establishment of bentgrass was observed when overseeded 2-5 days after applications of CGA-163935. Differential tolerance of annual bluegrass (Poa annua) vs. bentgrass to CGA-163935 indicates that this compound may be useful in a Poa reduction program. No incompatibilities with tank-mixes or application methods were noted.

1/ CIBA-GEIGY Corp., Northeast Research Station, R. D. 2, Box 92, Hudson, NY 12534

DIMENSION® TURF HERBICIDE - A TECHNICAL OVERVIEW

J. M. Higgins[1]

ABSTRACT

(Body of Abstract)

Dimension (dithiopyr) is the first member of the pyridine class of herbicides being developed by Monsanto. Dimension provides selective annual weed control at low use rates in established turfgrasses. Both preemergence and postemergence activity have been observed, which is quite unique among herbicides that control weeds through inhibition of cell division. Results from extensive environmental and toxological studies have shown Dimension to exhibit low potential for adverse effects on either humans, mammals, birds, insects or the environment. Laboratory studies have shown that Dimension does not cause gene mutations, tumors, birth defects, or interfere with normal reproduction. Dimension is a highly lipophilic herbicide with low water solubility (1.38 ppm), and a high affinity for soil particles. The average partition coefficient (KOC) is 1638 ml/g. Thus, once Dimension has been applied to turfgrass, it has low potential for groundwater contamination and/or surface runoff. Environmental fate and dislodgeable residue results show the average half-life to be 17 days after application with minimal vertical and lateral movement of Dimension in the soil. The primary means of degradation is photolysis with minimal breakdown due to microbial or hydrolysis.

[1]Dimension Technical Development Manager, Monsanto Co., 800 N. Lindbergh Blvd., St. Louis, MO 63167

® Registered Trademark of Monsanto Company

Prodiamine, a Preemergence Annual Grass and Small Seeded Broadleaf Herbicide for Turf.

D.G. Eastman, T.E. Bregger, D.W. Wells, D.H. Williamson and J.F. Yoder[1]

Prodiamine is the common name for N^3,N^3 ,-Di-n-propyl-2,4-dinitro-6-(trifluoromethyl)-m-phenylenediamine a dinitroaniline class herbicide. Prodiamine has low water solubility and atmospheric volatility with excellent soil persistence and herbicidal activity. The commercial product in turf, trade name Barricade®, is formulated as a 65% water dispersable granule packaged in water dissolvable bags. Barricade® is a broad spectrum product that gives full season control of annual grasses and many small seeded broadleaf weeds when applied and activated by rainfall or irrigation prior to the germination and emergence of the weed. Barricade® prevents germination and inhibits root growth in susceptible species.

Normal recommended rates for application are: 0.65 lb ai/A (1.0 lb product) in Northern U.S., 0.81 lb ai/A (1.25 lb product) in the Transition zone, and 0.98 lb ai/A (1.5 lb product) in the Southern U.S. Annual grass weeds controlled include goosegrass (Eleusine indica L.) ELEIN, annual bluegrass (Poa annua L.) POANN, smooth crabgrass (Digitaria ischaemum Schreb. ex. Schweig.) DIGIS, large crabgrass (Digitaria sanguinales L.) DIGSA and yellow foxtail (Setaria glauca L.) SETLU. Difficult to control weeds such as goosegrass respond best to sequential applications of Barricade®. Small seeded annual broadleaf weeds controlled include prostrate spurge (Euphorbia humistrata Engelm. ex. Gray) EPHHT, henbit (Lamium amplexicaule L.) LAMAM, common chickweed (Stellaria media L.) STEME. One of the strengths of Barricade® is consistent long term control over a wide geography, relative to many currently used commercial standards.

Barricade® is safe to turfgrass species when used as directed. The maximum recommended annual rate for turfgrasses ranges from 0.50 lb. ai/A (0.8 lb. product) to 1.5 lb. ai/A (2.30 lb. product) dependent upon the sensitivity of the turfgrass type, length of time turf is established and period of control desired. Unless otherwise directed in the use directions, Barricade® should only be applied to turf that is filled in and established.

Broadcast reseeding or overseeding can be done effectively if preplanning provides approximately 4-6 months waiting period for each 0.50 lb. ai/A (0.75 lb product) applied. This waiting interval can be shortened to 3-4 months if the turf surface is opened and seed is placed directly into the soil.

[1] Sandoz Crop Protection Corp., Des Plaines, IL 60018

Last update: 9/26/91 DGE

PERFORMANCE OF MON 35035 DRY GLYPHOSATE EFFERVESCENT TABLET

D. C. Riego[1]

ABSTRACT

MON 35035 is a dry effervescent glyphosate tablet. One tablet weighs 8.96 grams and contains 5.37 grams acid equivalent. When dissolved in water, the tablet forms the sodium salt of glyphosate. One tablet is designed to be dissolved in 710 ml of water. Each tablet dissolved in water in approximately two minutes without shaking. MON 35035 is a broad spectrum, non-selective, postemergent herbicide in dry, solid tablet form developed for homeowner use. It provided excellent postemergent control of many annual and perennial grass and broadleaf weeds. Control of tough-to-control species such as poison ivy (Rhus radicans) was also excellent. Weed control was equal to that provided by Roundup RTU (ready to use) formulations.

---

[1]Senior Product Development Associate, Monsanto Company, Industrial, Turf, and Ornamentals, Carmel, IN 46032

A MODIFIED SYSTEM FOR EXAMINING HERBICIDE EFFECTS ON ROOT DEVELOPMENT IN SOD

R.B. Taylorson[1]

ABSTRACT

A field experiment measuring the effect of several preemergence crabgrass herbicides on rooting strength of Kentucky bluegrass (Poa pratensis L.) sod was conducted in 1991. Rooting strength was estimated by lifting wire rings buried beneath cut sod plugs at the time of herbicide application. The experiment was an RCB design with six replications. Measurements were made at 3, 6, 9, & 12 weeks after application. At each date, 24 rings were lifted for each treatment. Two devices were used. Measurements at three and six weeks were by a spring type weighing scale. Later measurements were by a hydraulic jack powered device. Herbicides used were oxadiazon at 4.5 kg ai/ha, and two dinitroanilines; butralin at 6.7 kg ai/ha, and pendimethalin at 3.4 kg ai/ha. Only pendimethalin caused significant reduction in rooting.

---

[1]Adjunct Professor, Plant Sciences Dept., Univ. of Rhode Island, Kingston, RI 02881.

EFFECTS OF DITHIOPYR ON TURFGRASS QUALITY AND ROOT MORPHOLOGY

P. C. Bhowmik and B. M. O'Toole[1]

ABSTRACT

Field experiments were conducted on established Kentucky bluegrass (Poa pratensis L.), creeping bentgrass (Agrostis palustris Huds.), and perennial ryegrass (Lolium perenne L.) to evaluate the effects of annual application of dithiopyr (Mon-15151) on turfgrass quality and to determine the recovery of treated turfgrass from consecutive treatments over a period of two or three years. Dithiopyr at 0, 0.3, 0.6, 0.8, 1.1, 1.7, 2.2 kg ha^{-1} was applied preemergence to weeds. Treatments were applied annually to the same plots for three years on bentgrass putting green and for two years on Kentucky bluegrass and perennial ryegrass turf.

Treatments were applied to 1 by 3 m plots with a CO_2-backpack sprayer at a pressure of 152 kPa in 675 L ha^{-1}. Foliar injury to turfgrass was visually rated on a scale of 0 to 100%. Bentgrass quality and color were rated on a scale of 0 to 9. To determine stand density and root development, 10.2-cm-dia. plugs were removed randomly from each plot 4, 8, and 12 weeks after treatment in each year. Each treatment consisted of 6 plugs, having two plugs from each plot, replicated three times. Plugs were individually potted in 15.2-cm-dia. plastic pots containing coarse sand. Plugs were watered daily as needed to prevent drought stress and were mown to appropriate height once a week. After 6 weeks of growth in the greenhouse, roots were carefully washed, and root length, root dry weights, and shoot numbers were determined.

'Baron' Kentucky bluegrass quality nor the color was affected by any of the treatments. Kentucky bluegrass was tolerant to dithiopyr up to 1.7 kg ha^{-1}. Root regrowth, tiller and rhizome numbers were unaffected with this rate of dithiopyr. Recovery of Kentucky bluegrass from one annual spring application of dithiopyr for two consecutive years showed no adverse effects.

Perennial ryegrass was tolerant up to 1.7 kg ha^{-1} of dithiopyr. No injury was noted with any of the treatments after one or two years of annual application of dithiopyr. Root regrowth, tiller and rhizome numbers were unaffected by all treatments, and turfgrass quality was acceptable.

'Penncross' bentgrass was tolerant to dithiopyr up to 1.1 kg ha^{-1}. A slight injury (13 to 18%) was noted with dithiopyr treatments (1.7 to 2.2 kg ha^{-1}). None of the treatments affected bentgrass color or quality in all years. None of the treatments reduced root regrowth or stolon production. One annual spring application of dithiopyr (0.3 to 1.1 kg ha^{-1}) for three consecutive years caused no adverse effects on the recovery or overall quality of the bentgrass on the putting green.

[1]Associate Professor and Research Technician of Weed Science, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

DITHIOPYR RESIDUE EFFECTS ON TURFGRASS SEEDLING ESTABLISHMENT

J. C. Neal and J. F. Osmeloski[1]

ABSTRACT

Late summer or early fall is the recommended time to seed or over-seed cool-season turfgrasses. However, long-residual preemergent herbicides applied in the spring and summer for crabgrass (*Digitaria* spp.) and goosegrass (*Eleusine indica* (L.) Gaertn.) control have the potential to interfere with turfgrass seedling establishment. Dithiopyr (MON 151..) is a preemergent herbicide which has provided season-long crabgrass control from spring applications. This long residual activity could interfere with the success of fall seedings. Therefore, we conducted experiments to define safe treatment-to-seeding intervals for dithiopyr and the major cool-season turfgrasses.

Dithiopyr 1EC (MON15104) at 0.3, 0.4, 0.6, 0.8, and 1.1 kg/ha; dithiopyr 0.25% GR (MON15125) at 0.3, 0.6, and 0.8 kg/ha; pendimethalin 60WDG at 3.3 kg/ha; and oxadiazon 2% GR were applied on or about the first of June, July, and August of 1990 and 1991 to an established turf. In 1991, treatments were also applied on May 1. Experimental design was a randomized complete block with four replicates. In mid-August, the turf was killed with 2 kg/ha glyphosate. On September 1, Kentucky bluegrass (*Poa pratensis*), perennial ryegrass (*Lolium perenne*), Chewings fescue (*Festuca rubra* var *commutata*), and creeping bentgrass (*Agrostis palustris*) were slit-seeded across all herbicide treatments. Turfgrass injury and percent cover were visually evaluated.

In the 1990 experiment, dithiopyr 0.25% GR significantly reduced the percent coverage in all grass species at all rates and timing intervals except for 0.3 kg/ha applied in June to perennial ryegrass and chewings fescue. The EC formulation was less injurious. July and August applications were injurious to all species. June applications at 0.3 kg/ha were safe to all four species; however, higher rates reduced turf cover and the rate of establishment. In 1991, May applications at rates above 0.3 kg/ha reduced turf cover. Pendimethalin injured all four grasses when applied in August and slowed seedling establishment when applied in July. June applications injured bentgrass but were safe on the other species. May applications of pendimethalin appear to safe on all species. Oxadiazon at 3.3 kg/ha injured all species at all application times.

In general, under the conditions of these tests in up-state New York, dithiopyr 1EC at 0.3 to 0.4 kg/ha was comparable to pendimethalin at 3.3 kg/ha for over-seeded turf safety. The length of residual activity of dithiopyr 0.25% GR was comparable to oxadiazon 2% GR in these tests. These data suggest careful rate selection and proper attention to over-seeding intervals are essential when these residual herbicides are used in turf, particularly when used in early-postemergent or split application programs.

[1]Assoc. Prof. and Technician, respectively; Dept of Flor & Orn Hort, Cornell Univ., Ithaca NY

ASSESSING PLANT SPECIES DIVERSITY: AN IMPORTANT CHALLENGE IN FOREST VEGETATION MANAGEMENT

Susan L. Stout[1]
Stephen B. Horsley[2]
David S. deCalesta[3]

ABSTRACT

Biodiversity is the variety of animals and plants, the communities they form, and the ecological functions that they perform at genetic, stand, landscape, and regional scales. It encompasses species, age class, and structural diversities. Addresssing the issue of biodiversity is becoming increasingly important in the management of natural resources within ecosystems. On a broad scale, the health and welfare of ecosystems are reflected by the degree of diversity that exists. On a political scale, maintaining or enhancing biodiversity is becoming an important legal and biological driving force behind management of ecosystems. And on a practical scale, the degree of diversity existing within local environments has a direct bearing on management of weed species.

Species diversity is a component of biodiversity that focuses on the identities and abundances of species in an environment. Measures of species diversity include species richness (numbers of species), abundance (numbers of individuals, clones, etc.), and evenness or dominance. Indices of diversity have been developed that combine richness and evenness into single statistics. Most indices emphasize either richness or evenness more heavily, so care in selection of indices is important.

Assessments of diversity pose some practical problems: 1) developing measures that include different life forms, like clonal fern plants, or 2) including trees ranging in size from seedlings to mature individuals, or 3) developing a sampling procedure that detects rare species while accurately reflecting the relative abundance of dominant ones. Solving these problems will allow us to determine the effects of herbivory, such as deer browsing, silvicultural practices, and herbicides on species diversity. These research results can lead to guidelines for land managers concerned about diversity, and can facilitate meeting legal requirments for maintaining it.

---

[1] Project Leader, USDA Forest Service, Northeastern Forest Experiment Station, Warren, PA 16365.

[2] Plant Physiologist, USDA Forest Service, Northeastern Forest Experiment Station, Warren, PA 16365.

[3] Wildlife Biologist, USDA Forest Service, Northeastern Forest Experiment Station, Warren, PA 16345.

IMPACT OF DEER DENSITY ON SPECIES DIVERSITY OF ALLEGHENY HARDWOOD STANDS

David S. deCalesta[1]

ABSTRACT

Feeding damage by white-tailed deer (Odocoileus virginianus) on woody vegetation can have a significant impact on diversity of these plant forms and on diversity of other wildlife that are dependent upon habitats structured by these plants. Results of a recently-completed 10 year study of the impact of deer on hardwood regeneration indicate that there is a strong and significant linear relationship between deer density and diversity of plants and selected other wildlife species on the Allegheny Plateau in western Pennsylvania. Deer densities of 10, 20, 40, and 80 deer per square mile were artificially maintained within fenced enclosures at 4 sites in and around the Allegheny National Forest near Warren PA from 1980-1990. At each of the 4 replicate sites, clearcutting, shelterwooding, and no cutting were performed on 10%, 30%, and 60%, respectively, of exclosures containing each of the 4 deer densities. Within each silviculturally-treated area at each site, species richness and abundance of woody species, herbaceous species, songbirds and small mammals were calculated, and associated indices of diversity (Margalef and Berger-Parker) were computed. As deer density increased from 10 to 80 per square mile, number of woody species detected dropped from 10 to 5, herbaceous species dropped from 15 to 10, bird species dropped from 29 to 20, and small mammals dropped from 6 to 5. Abundances of woody and herbaceous vegetation and songbirds declined as deer density increased, but small mammal numbers were unchanged. The Margalef and Berger-Parker indices of diversity for woody and herbaceous vegetation, songbirds, and small mammals all declined as deer density increased. The impact by deer on diversity of plants and animals may mask or confound impacts of silvicultural practices, such as application of herbicides, on diversity of plant and animal life within forested landscapes. The range of deer densities provided by the study encompassed the range of densities expected across forested landscapes in the Northeast. As the impact of deer density on diversity of plant and animal life was progressively greater with increases in deer density, areas with deer densities $\geq$ 20 per square mile may exhibit increasing levels of confounding when impacts of herbicides and other silvicultural practices on biodiversity are investigated.

---

[1] Wildlife Biologist, USDA Forest Service, Northeastern Forest Experiment Station, Warren, PA 16365.

HERBICIDE EFFECTS IN A STUDY OF MANAGEMENT STRATEGIES IN ALLEGHENY HARDWOODS

Susan L. Stout[1]

Species diversity of regeneration was studied in twenty 4.9-acre plots that had received silvicultural treatments associated with five different management strategies in 1980 and 1985. The tested strategies were even-age, two-age, single-tree selection, economic selection, and group selection. For each strategy, the four plots received the array of treatments that would be found in a balanced forest managed under that strategy. For the even-age plots, for example, three plots were thinned, while one was harvested using a shelterwood sequence. The even-age harvest plot, one of the even-age thinning plots, and one of the two-age harvest plots received a backpack application of 1# ai/acre of glyphosate in 25 gallons of herbicide mix during the initial treatment sequence. Tallies of understory vegetation on each study area were made before and five and 10 years after the initial silvicultural treatment, on twenty 6-foot radius plots per study area. Calculation of the Brillouin index of species diversity showed that 20 plots per treatment was sufficient for reliable estimates of species diversity. At each tally, stem counts of all woody plants by species and height class were made. Tallies of herbaceous plants were made as % cover by 5 categories of species: Rubus spp., ferns, grasses and sedges, tall herbs, and club-mosses. Each of these categories contained several plant species. Over the ten years of the study, differences in height developed between treatments and plots, and these data can be used to show the importance of recognizing these differences in analysis of species diversity. Species diversity was expressed as species richness (number of species), by calculation of the Shannon, Berger-Parker, and Margalef indices, which incorporate both species richness and species abundance. All of these indices were calculated for all stems greater than 2" in height and for all stems greater than 1' in height. In addition, species diversity was expressed as the proportion of study plots dominated by each species.

There were no statistically significant differences in species diversity, as measured by species richness, or by any of the three indices, among the management strategies before or ten years after the initial treatments. None of the management strategies resulted in a statistically significant change in the diversity of the understory woody vegetation as measured by these indices, although there were increases in the Shannon Diversity Index for plots managed under the even-aged, group selection, single-tree selection, and economic selection strategies. While there were some shifts of species dominance associated with all treatments, these were most dramatic on the two-age and even-age management plots, largely due to the shifts in species dominance that occurred on plots that received the herbicide treatment.

---

[1] Project Leader, USDA Forest Service, Northeastern Forest Experiment Station, Warren, PA 16365.

SPECIES DIVERSITY OF ALLEGHENY HARDWOOD STANDS OVER TIME AFTER A SINGLE APPLICATION OF GLYPHOSATE

Stephen B. Horsley[1]

ABSTRACT

Species diversity was studied in five 20-acre Allegheny hardwood stands that received a glyphosate-shelterwood cut treatment to remove understory ferns (Dennstaedtia punctilobula, Thelypteris noveboracensis), grasses and sedges, striped maple (Acer pensylvanicum) and beech (Fagus grandifolia) and reestablish regeneration of desirable forest tree species. Ferns were the most important interfering species in four stands; beech, striped maple and fern were all important interfering species in the fifth stand. The study was designed as a split plot experiment. Ten acres of each stand was treated with 1# ai/acre of glyphosate in 25 gal of herbicide mix in August 1979. The remaining 10 acres were untreated. During the following winter the entire 20-acre stand received a shelterwood seed cut leaving 60% residual stocking. Both treated and untreated portions of each stand had similar total basal area and basal area in black cherry before and after the shelterwood cut. Deer density at all sites was in excess of 40/sq mi. Tallyies of vegetation at each site were made on 20 six ft radius plots per treatment at five times during the study: 0 (before herbicide treatment), 1, 2, 4 and 7 years after treatment. Calculation of the Brillouin index showed that 20 plots per treatment was sufficient for reliable estimation of species diversity. At each tally, stem counts of all woody plants by species and height class were made. Since the lighting conditions beneath the shelterwood overstory permitted little height growth for the duration of the study, species data were pooled over all height classes for calculation of species diversity indices. Tallies of herbaceous plants were made as % cover by 5 catagories of species, Rubus spp., ferns, grasses and sedges, tall herbs, and club-mosses. Each of these categories contained several plant species. Species diversity was expressed as species richness (number of species), and by calculation of the Berger-Parker and Margalef indices, which incorporate both species richness and species abundance.

On control plots, cover by fern and grass increased 9-27% and 1-2%, respectively as a result of the shelterwood cut. Numbers of striped maple and beech stems remained the same or decreased. None of the indices of species diversity changed significantly during the 7 year duration of the experiment for either woody or herbaceous plants. On plots treated with glyphosate, mean fern cover ranged from 13-62% before treatment. One year after treatment it ranged from 2-11% cover. By 4 years after treatment it had regrown to pretreatment levels. Grass and sedge were initially controlled by the herbicide, but soil disturbance during the shelterwood cutting resulted in significantly increased cover by grasses and sedges originating from seed stored in the forest floor seed bank. All indices of species diversity increased following application of glyphosate and shelterwood cutting for both woody and herbaceous species, although none of these increases were statistically significant. Glyphosate did not have a negative effect on species diversity in this study.

---

[1] Plant Physiologist, USDA Forest Service, Northeastern Forest Experiment Station, Warren, PA 16365.

APPLICATION CONSIDERATIONS FOR PENNDOT'S ROADSIDE VEGETATION MANAGEMENT PROGRAM

Arthur E. Gover, Larry J.Kuhns, and David A. Batey[1/]

ABSTRACT

The Pennsylvania Department of Transportation (PennDOT) maintains over 42,000 miles of roadway, much of it with only a 33 ft right-of-way. This leaves roadside managers with 6 to 8 ft on each side of the roadway to conduct what is arguably their most pressing task - brush control. In order to prevent off right-of-way damage and maintain a low profile in terms of foliar injury (brownout), PennDOT has based much of its brush control work on fosamine ammonium. High volume handgun or boom-mounted OC nozzles spraying on a percent solution basis have given way to computerized injection sprayers with fixed position spray heads. These sprayers have increased productivity by covering more acres with less solution and more acres in less time. The rate of injection changes with ground speed to provide accurate delivery of herbicide over a range of vehicle speeds. Several systems provide multiple spray swaths to allow the spray pattern to change in accordance with the target.

Spray volumes for brush control applications tend to range between 230 to 500 l/ha. Even at the low end of this range, spray solution drips off the leaves of treated brush, and often results in a concentrated application to the understory, and reduces the effective application rate to the brush. Reducing spray volume to enhance spray retention on the vertical canopy would alleviate understory injury, and should provide better brush control with the same rates, or allow for herbicide rate reductions while providing equal brush control. Research plots have been established with spray volumes of 85 l/ha with vehicle speeds of 2.7 m/sec. The same equipment at operational speeds of 4.4 m/sec would provide a spray volume of 50 l/ha. Further testing is required to ensure spray pattern integrity under operational conditions.

Another method to improve spray retention would be to use a viscous spray carrier such as an invert emulsion. This would offer the same advantages as very low aqueous spray volumes, plus the benefits of reduced drift, and pattern delineation on the target vegetation. This type of application has been adapted to current equipment, and though still in the development phase, offers promise as a method of effective, highly selective brush control.

[1/] Project Associate, Professor of Ornamental Horticulture, and Research Technologist, respectively, The Pennsylvania State University.

CUSTOMIZED ICI FIELD RESEARCH EQUIPMENT

S. W. Cosky and S. Dennis[1]

ABSTRACT

Market Development Representatives (MDR) for ICI Americas Inc. are responsible for conducting yearly field studies evaluating the effectiveness of crop protection chemicals. In many instances, the trialist is involved with evaluations of insecticides, fungicides and herbicides. The trialist conducts a number of these studies under his/her own direction. Commercially available farm equipment is often unsuitable for the tasks of establishing and maintaining these studies.

Corn and soybean establishment may be accomplished using standard agricultural farm integral planters, such as the John Deere 7100 Max-Emerge, but several modifications are made and incorporated to fulfill several research requirements. In the northeast, ICI MDR's utilize modifications made by Allen Machine Co. (ALMACO) to conduct both herbicide and insecticide trials, as well as herbicide/insecticide interaction trials. The use of modified Noble insecticide applicators allowing in-furrow, T-band and banded soil insecticide applications simplify this work greatly. The use of cone seeders and automatic plot measuring devices increase the accuracy and efficiency of plot establishment.

Soil fumigant application for horticultural crop research is often difficult to establish with great accuracy. A prototype unit built by Reddick Fumigants, Williamston, NC, allows accurate metering and broadcast shank injected applications of metham soil fumigant. The use of an electric DC powered pump for delivering fumigant material allows for stationary calibration. Injector knives may be removed and hardware added to cover fumigated areas with a plastic seal. The unit is operated with a 33 horsepower tractor, suitable for light mineral and muck soils.

The customization of field equipment for agricultural research most often results in reducing trial variation and increasing efficiency for the field researcher.

[1]ICI Americas Inc., Agricultural Products, Wilmington, DE 19897.