CHEMICAL CONTROL OF YELLOW NUTSEDGE IN CORN

R. R. Hahn[1/]

ABSTRACT

Preplant-incorporated and preemergence herbicide applications were evaluated for the control of yellow nutsedge (Cyperus esculentus L.) in corn at three locations in New York State during the 1977 growing season. The objective was to compare the efficacy of alachlor and metolachlor as preplant-incorporated and preemergence treatments with standard preplant-incorporated treatments of butylate plus R-25788 and EPTC plus R-25788. Soil types at the three locations were Barbour silt loam in Delaware County, Niagara and Collamer silt loams in Genesee County, and Vergens clay in St. Lawrence County. Organic matter levels were 3.7, 3.9, and 5.1% respectively. Alachlor was applied at 3.4 kg/ha and metolachlor was used at both 2.2 and 3.4 kg/ha. Preplant-incorporated applications of butylate plus R-25788 and EPTC plus R-25788 were made at the rate of 4.5 kg/ha. The acetanilide and thiocarbamate herbicides were applied alone and in combination with 1.1 kg/ha of atrazine. Herbicide treatments were applied to 3 by 7.6 m plots between May 18 and 26, 1977 and all preplant-incorporated treatments were mechanically mixed with the soil by double discing or harrowing.

Relatively dry soil conditions persisted at all three locations for 2 to 3 weeks following plot establishment. As a result, when yellow nutsedge control ratings were averaged over locations, preplant-incorporated applications of alachlor and metolachlor were more effective than preemergence applications. In addition, there was a positive response to increasing the rate of metolachlor from 2.2 to 3.4 kg/ha. When applied preplant-incorporated, 3.4 kg/ha of alachlor provided yellow nutsedge control similar to that obtained with 4.5 kg/ha of either butylate plus R-25788 or EPTC plus R-25788. Incorporation of 3.4 kg/ha of metolachlor not only provided better control than alachlor but also showed more activity than either thiocarbamate herbicide on this pest.

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HERBICIDES FOR VELVETLEAF CONTROL IN CORN

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ABSTRACT

Thirty-five herbicide treatments, including preplant incorporated, preemergence and postemergence treatments, were evaluated for control of velvetleaf in corn at Fabius, New York, in 1977. Due to the moderately dry weather following planting, the preplant incorporated treatments gave the best overall control. EPTC + antidote, alone or with atrazine, completely controlled velvetleaf. Preemergence treatments which included pendimethalin at 2 lb/A were also satisfactory. Early postemergence combinations of pendimethalin with atrazine or cyanazine and oil concentrate, or pendimethalin alone with oil concentrate, gave 90 to 100% control. Treatments of dicamba or 2,4-D made at the same time severely stunted but did not eliminate this weed. Late postemergence sprays applied when the velvetleaf was in the six leaf stage were generally less effective.

INTRODUCTION

Velvetleaf (*Abutilon theophrasti* Medic.) is becoming a serious problem in corn (*Zea mays* L.) in the Northeast. This experiment evaluates thirty-five herbicide treatments for its control.

MATERIALS AND METHODS

The experimental area was located at Fabius, New York, on a Halsey gravel loam, with a pH of 7.4, organic matter of 6.0%, and a cation exchange capacity of 7. The area had been seeded with velvetleaf in the Spring of 1976, resulting in a heavy infestation.

On May 17, 1977, preplant incorporated treatments were cross-disced into a dry soil and the corn planted the same day. The preemergence treatments were applied the following day. Approximately two weeks later, on June 2, 1977, the early postemergence applications were made. At this time, the corn was in the four true leaf and the velvetleaf in the two true leaf stage. Twenty days later, on June 22, 1977, when both the corn and the velvetleaf had six true leaves, the late postemergence treatments were applied. All treatments were applied with a CO_2 hand carried sprayer. The experimental design was a randomized, complete block with four replications.

Control of velvetleaf was evaluated on July 7, 1977 and August 10, 1977. The rating scale used was: 0 = no effect, 10 = complete kill.

RESULTS

The results of weed control are presented in Table 1.

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Table 1. Control of velvetleaf with various herbicides and combinations.

Trt. No.	Chemical & Formulation	Timing	Rate ai/A	Vele Control 7/07/77	Vele Control 8/10/77
1.	EPTC + antidote + atrazine	PPI	4.0+1.5	9.5	9.8
2.	EPTC + antidote + atrazine	PPI	6.0+1.5	9.5	10.0
3.	butylate + antidote + atrazine	PPI	4.0+1.5	9.0	9.5
4.	butylate + antidote + atrazine	PPI	6.0+1.5	9.3	9.5
5.	EPTC + antidote	PPI	4.0	9.3	8.8
6.	EPTC + antidote	PPI	6.0	9.5	10.0
7.	butylate + antidote	PPI	4.0	8.0	8.3
8.	butylate + antidote	PPI	6.0	8.3	8.5
9.	atrazine	PPI	1.5	6.3	7.3
10.	atrazine	PPI	2.0	8.0	8.7
11.	atrazine	Pre	1.5	0.3	0.3
12.	atrazine	Pre	2.0	0.8	0.3
13.	pendimethalin + atrazine	Pre	1.5+1.5	5.8	6.5
14.	pendimethalin + atrazine	Pre	2.0+2.0	8.3	8.0
15.	pendimethalin + atrazine	Pre	1.5+1.5		
	+ bentazon	+ Post	+0.5	8.0	8.5
16.	pendimethalin + atrazine	EPo	1.5+1.0		
	+ oil concentrate*		+1.7%	10.0	10.0
17.	pendimethalin + atrazine	LPo	1.5+1.0		
	+ oil concentrate*		+1.7%	7.5	8.0
18.	pendimethalin + oil concentrate*	EPo	1.5+1.7%	10.0	10.0
19.	pendimethalin + oil concentrate*	LPo	1.5+1.7%	5.0	6.5
20.	pendimethalin + cyanazine	EPo	1.5+2.0		
	+ oil concentrate*		+1.7%	10.0	10.0
21.	pendimethalin + cyanazine	LPo	1.5+2.0		
	+ oil concentrate*		+1.7%	7.3	9.0
22.	metolachlor + atrazine	Pre	2.0+1.6	2.3	0
23.	atrazine + simazine	Pre	1.5+1.5	1.5	1.0
24.	atrazine + dicamba	EPo	1.5+.25	9.3	9.3
25.	alachlor + dicamba	EPo	2.0+.25	5.5	5.0
26.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by Vel 4092 3E	EPo	.25	6.3	6.0
27.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by dicamba	EPo	.25	6.5	6.5
28.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by Vel 4092 + 2,4-D amine	EPo	.25+.50	6.0	6.5
29.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by dicamba + 2,4-D amine	EPo	.25+.50	7.3	7.0
30.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by bentazon	LPo	1.0	9.0	9.0
31.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by dicamba	LPo	.25	4.3	6.5
32.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by 2,4-D amine	EPo	.50	3.8	1.5
33.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by 2,4-D amine	LPo	.50	6.0	7.0
34.	(alachlor + cyanazine)	Pre	(1.0+1.0)		
	followed by bentazon	EPo	.75	9.0	8.5
35.	alachlor + cyanazine	Pre	1.0+1.0	0.3	0.5

* Booster Plus E

WEED CONTROL IN FIELD CORN WITH THIOCARBAMATE HERBICIDES WITH ANTIDOTES

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ABSTRACT

The objectives of this study were to determine whether there were differences in corn response and weed control to three thiocarbamate herbicides containing two antidotes, R-25788 and R-29148. Only in one year of the two-year study did butylate, EPTC, and vernolate at high rates without antidotes reduce stand and vigor of corn. Stand and vigor were also reduced by butylate + R-29148 at the highest rate but not by butylate + R-25788 or by the other herbicides containing either antidote.

There were no differences in the weed control produced by the three herbicides as a result of antidote additions with two exceptions. Butylate + R-29148 produced less control of lambsquarters than butylate alone or butylate + R-25788. Control of galinsoga was slightly less from EPTC alone than EPTC with antidotes.

INTRODUCTION

The use of antidotes with herbicides to reduce injury to sensitive crops is gaining interest with herbicide developers as well as with weed control researchers. The addition of N,N-diallyl-2,2-dichloroacetamide (R-25788) to thiocarbamate herbicides has proved successful in reducing injury to corn (*Zea mays*) and this antidote is now available in some commercially-prepared products having this chemistry.

Recently, a new antidote, R-29148 (chemistry not disclosed), has been made available and appears to have merit for use with thiocarbamate herbicides. It was the objective of this study to determine whether the new antidote is as effective as R-25788 in reducing injury to corn, and to determine what effect do antidotes have on weed control.

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MATERIALS AND METHODS

Experiments were established in 1976 and 1977 in field corn using S-ethyl diisobutylthiocarbamate (butylate), S-ethyl dipropylthiocarbamate (EPTC) and S-propyl dipropylthiocarbamate (vernolate) formulated with R-25788 and R-29148. In 1976, Midstates 869 corn was treated with butylate, EPTC, and vernolate, alone, at 4 and 8 lb/A; the same herbicides, formulated with R-25788 at 4, 6 and 8 lb/A; and the same herbicides formulated with R-29148 at 4, 6 and 8 lb/A. In 1977, the same variety and the same herbicides formulated with the same antidotes were used; however, all herbicide preparations were used at three rates, i.e., at 4, 6, and 8 lb/A.

All herbicides and all formulations were applied prior to planting and soil incorporated.

RESULTS AND DISCUSSION

In 1976, it was observed that butylate without antidotes slightly reduced stand and vigor of corn at the two rates used, i.e., 4 and 8 lb/A, whereas stand, and to a lesser extent, vigor of corn were slightly reduced by the higher rate of EPTC and vernolate without antidotes. Stand and vigor were slightly reduced by butylate containing the antidote, R-29148, at 8 lb/A but not by any rate of EPTC or vernolate containing antidotes.

There were no differences in the control of redroot pigweed (*Amaranthus retroflexus* L.), velvetleaf (*Abutilon theophrasti* Medic.) or fall panicum (*Panicum dichotomiflorum* Michx.) as a result of the antidote additions and all species were more than adequately controlled by all rates of the three herbicides. With lambsquarters (*Chenopodium album* L.), there were some differences, however. Control of this species was poorer with butylate than with EPTC or vernolate. Furthermore, control with butylate containing antidotes was poorer than with butylate alone, the formulations containing the antidotes about equal in the control they effected. Control of lambsquarters by EPTC and vernolate was comparable with slightly better control from vernolate. Control of this weed was decreased by the additions of antidotes, with slightly greater reductions from R-29148.

In 1977, the weed spectrum was different from the previous year. In the experimental area there were lambsquarters, galinsoga (*Galinsoga parviflora* Cav.), jimsonweed (*Datura stramonium* L.), common ragweed (*Ambrosia artemisiifolia* L.) and fall panicum. Redroot pigweed and velvetleaf were not present.

In 1977, no herbicide, with or without antidote, had any effect on stand or vigor of corn. The response of lambsquaters was similar to that observed the previous year. Butylate failed to control lambsquarters effectively; however, the control with EPTC and vernolate was very good and considerably better than in 1976. Control of lambsquarters was less with butylate + R-29148 than with butylate alone or with butylate + R-25788, the latter two formulations being about the same.

There were no differences in control of galinsoga, jimsonweed, common ragweed, or fall panicum between the various formulations of butylate.

Control of galinsoga was slightly less with EPTC alone than with EPTC plus antidotes, the formulations with antidotes effecting about equally. Control of the other weeds was equal for all preparations of EPTC.

Excellent control of galinsoga and fall panicum was obtained with vernolate, with and without antidotes, with no differences between formulations. On the other hand, there were some slight differences in control of jimsonweed and common ragweed between the formulations of vernolate at the lowest rate. Control of jimsonweed was less with vernolate + R-25788 than with the other formulations and common ragweed was controlled less by vernolate alone than with vernolate plus the antidotes.

EFFECTS OF TILLAGE PRACTICES ON WEED CONTROL IN CORN

H. P. Wilson, T. E. Hines and J. E. Dunton, Jr.[1/]

ABSTRACT

Corn (*Zea mays* L.) growth, yields, and weed control were compared for corn grown under four systems of cultural practices on sandy loam soils in 1977. In addition to the conventional system involving plowing, discing and planting, three minimum tillage systems were compared. In the first, rye (*Secale cereale* L.) was permitted to grow to a height of 30 inches before being killed by paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) or glyphosate [N-(phosphonomethyl)glycine] 10 days prior to planting. In the second, rye was planted late the previous fall and attained a height of only 4 to 6 inches before being killed with paraquat or glyphosate on April 11 when the tall rye was killed. In the third study, no cover crop was planted following soybean harvest. One week prior to planting this study, the soybean inter row area was subsoiled to a depth of 14 to 16 inches; corn was seeded into the subsoiled area. In this study paraquat or glyphosate was included with the preemergence herbicides to kill existing vegetation. Preemergence herbicides were applied within one day of planting. Early injury resulted from pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] and from atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine] + alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide] + 2,4-D [(2,4-dichlorophenoxy) acetic acid] but was rapidly outgrown. Corn growth varied with tillage practices and initially was best for conventionally planted and for subsoiled corn. As the season progressed, the corn planted in tall rye looked best under the droughty conditions experienced during 1977. Weed control also varied with tillage. All herbicides performed well in conventionally planted corn but control was less under all three minimum tillage plantings. In general, the better treatments for annual grasses contained cyanazine (2-[[4-chloro-6-(ethylamino)-s-triazin-2-yl] amino] -2-methylpropionitrile), metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide], pendimethalin, and simazine [2-chloro-4,6-bis(ethylamino)-s-triazine]. Alachlor was least effective against large crabgrass (*Digitaria sanguinalis* L. Scop.). Cyanazine was weak against redroot pigweed (*Amaranthus retroflexus* L.). Highest yields were from conventionally planted corn followed in order by minimum tillage in tall rye, subsoiled, and minimum tillage in short rye.

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An Examination of Pre vs. Postemergence Weed Control Under Dry Conditions

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ABSTRACT

Field experiments were established in 1977 at Aurora, New York to compare the relative activities of selected herbicides when applied preemergence at planting, delayed preemergence and early postemergence. Herbicides were applied a) the same day of planting, b) seven days after planting when the approximately 1/3 of corn was in early spike, and c) at the 4 to 5 leaf stage of corn and 1 to 2 leaf stage of weeds. Herbicides applied postemergence were applied alone or with a non-phytotoxic oil-surfactant mix (Booster Plus E).

Visual evaluations made approximately one month after treatment revealed that the activities of all preemergence treatments made at planting were considerably less than observed with identical treatments made in 1976 or previous years. For example alachlor plus atrazine in 1976 provided 94% control of annual grasses and broadleaves while in 1977 gave only 76% control. Similarly, in 1976 metalachlor plus atrazine gave 95% control and in 1977 only 72% kill. The major difference between 1976 and 1977 was precipitation following preemergence applications. More rainfall occurred sooner after treatment in 1976 than in 1977. The reduced precipitation in 1977 seemed to cause less chemical to be in solution and hence less available for activity. In addition, in 1977, rainfall for three weeks after treatment was considerably less than in 1976.

In 1977, applications made postemergence to corn and weeds tended to give greater weed control than preemergence treatments. This was not true in 1976. During the bicentennial year, applications made postemergence were no more effective than treatments made preemergence. The explanation for the differences between years would again seem to be rainfall. In 1976 sufficient rain after treatment allowed preemergence activity to be equal to the activity obtained when chemicals were applied directly to weeds. In 1977, the lack of rainfall caused low preemergence activity but had no influence on post activity because chemical penetration after post applications is more direct.

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CANNABIS SATIVA L. RESPONSE TO PARAQUAT

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ABSTRACT

Illicit fields of marihuana (Cannabis sativa L.) plants can be destroyed *in situ* by either mechanical or chemical procedures. Paraquat is frequently used internationally to treat fields of marihuana plants, the source of marihuana, hashish, and hash oil. The objectives of two greenhouse studies conducted at Beltsville during 1976 and 1977 were to investigate: (1) the effects of paraquat applications on the growth and cannabinoid content of marihuana, and (2) the interrelationships between herbicide treatments and time on the narcotic properties of marihuana. In the first study, Jamaican marihuana seeds were germinated in soil, and plants were grown 51 days prior to treatments with paraquat at 0, 0.07, 0.14 and 0.28 kg/ha ai in a volume of 94 L/ha. Plants were harvested 23 days after treatment and leaf tissues were analyzed for cannabidiol (CBD) and Δ^9-tetrahydrocannabinol (Δ^9THC). Concentrations of CBD and Δ^9THC in marihuana ranged from 2,186 to 246 ppm and 14,123 to 1,783 ppm, respectively, as paraquat rates increased from 0 to 0.28 kg/ha. Correlation coefficients for paraquat:cannabinoid relationships were -0.88 and -0.93 ($P < .01$) for CBD and Δ^9THC, respectively. Plants that received 0.28 kg/ha paraquat were killed, however, most of the leaves remained on the plants. Thus it was possible to harvest marihuana from these plants. Jamaican plants were established in the greenhouse for the second study following procedures used in the first investigation. When the plants were 49 days old, they were treated with paraquat as in the previous experiment. Marihuana was harvested 0, 1, 2, 4, 8, 24, 48, 96, 192, and 384 hours after treatment. No significant differences in Δ^9THC concentrations were observed among treatments or harvest dates. However, Δ^9THC concentrations tended to decrease with increased levels of paraquat and tended to increase with increased plant age.

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THE COMPLETE RESEARCH REPORT - AN ESSENTIAL STEP TO EPA REGISTRATION

JAMES D. RIGGLEMAN[1]

A presentation consisting of 20 cartoon slides and narration depicting the essential elements of a complete research report and the reason these elements are required by EPA and State Registration groups to make decisions about a registration request. The series was prepared based on the author's 10 years of experience in preparing and defending data packages for product registrations. The presentation essentially follows "Test Details" of Volume 32, Proceedings of the NEWSS and brings in examples from product labels and actual INCOMPLETE research reports. The entire theme is to get more complete reports and more registrations for more efficient agriculture.

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ESTABLISHMENT OF BIRDSFOOT TREFOIL BY NO-TILLAGE MEANS

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ABSTRACT

Study I: A pasture sod containing a mixture of weed and grass species was treated with paraquat or glyphosate prior to the planting of 'Empire' birdsfoot trefoil (12 kg/ha) on May 28, 1977 by either a John Deere Power-till[2] drill or a Midland Zip[2] seeder. The soil was a Howard gravelly loam with a 20 percent slope. The dominant grass species were orchardgrass, Kentucky bluegrass and timothy. Dominant broadleaved species were plantain sp., dandelion, cinquefoil, and some white cockle. Herbicides were applied (kg/ha) on May 11, 1977 (E) and May 26, 1977 (L) as follows: paraquat 0.5 E, 0.5 L, 0.25 E plus 0.25 L, 0.5 E plus 0.5 L, 1.0 E, 1.0 L; glyphosate 0.5 E, 1.0 E, 1.5 E; glyphosate 0.5 E and 1.0 E plus paraquat 0.25 L or 0.5 L. Birdsfoot trefoil established successfully in all treatments involving glyphosate or glyphosate plus paraquat. The highest rates resulted in most satisfactory stand and yields. Birdsfoot trefoil did not establish in control plots or plots treated with paraquat alone, in single or split treatments. Stands obtained with either drill were satisfactory.

Study II: Paraquat and glyphosate each at 0.5-, 1- and 2-kg/ha and dalapon at 2-, 5-, and 8-kg/ha were applied to well established sods of perennial ryegrass, timothy, bluegrass, tall fescue and orchardgrass in May of 1976 and 1977. Within two days after herbicide treatment, 'Viking' birdsfoot trefoil (10 kg/ha) was planted with a power-till drill. The site was a poorly drained Erie-Ellery channery silt loam (reworked) with a fragipan at 30 to 40 cm. Results were characterized by unusual effectiveness of paraquat in controlling the perennial grasses. In 1976, birdsfoot trefoil established successfully after all rates of paraquat except 1/2 kg/ha on fescue. Results were similar for 1977 except for orchardgrass at 1/2- and 1-kg/ha paraquat; birdsfoot trefoil did not establish successfully. Both years, 1- or 2-kg/ha glyphosate was required for consistant birdsfoot trefoil establishment. Fescue was more tolerant of glyphosate than the other species. An 8 kg/ha rate of dalapon was required for birdsfoot trefoil establishment but results were not as consistant as with the other two herbicides. Tall fescue was most resistant to dalapon and bluegrass the least in this study.

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[2]Mention of a trade name is for identification purposes and does not imply endorsement over products of a similar nature by the Agricultural Research Service or Cornell University.

HOE-29152 FOR CRABGRASS CONTROL IN NEW SEEDINGS OF ALFALFA

Robert A. Peters[1]

ABSTRACT

HOE-29152 at .3 and .6 kg/ha (ai) readily killed large crabgrass up to 30 cm height in new seedings of alfalfa. No phytoxicity was displayed by the alfalfa. Preplant incorporated and preemergence applications of HOE-29152 showed relatively little activity. EPTC, benefin and profluralin also gave good crabgrass control. As with the latter three materials, HOE-29152 needed to be used with a broadleaf herbicide. 2,4-DB gave excellent control of the lambsquarters in the plots but there were indications of antagonism with HOE-29152 when the materials were tank mixed. HOE-29152 promises to provide greater flexibility in controlling annual grasses in alfalfa seedings than is possible with existing materials. It would be especially useful in no-tillage seedings where preplant incorporated materials cannot be used.

INTRODUCTION

Currently registered herbicides for annual grass control in new seedings of alfalfa (Medicago sativa L.) are all preplant incorporated materials. The one exception is dinoseb which is of limited effectiveness on annual grasses. A postemergence grass herbicide for new alfalfa seedings would be very useful especially for grass control in no-tillage seedings where incorporated materials cannot be used.

MATERIALS AND METHODS

The experiments were done at the Agronomy Research Farm, University of Connecticut, Storrs. The soil type is a Paxton fine sandy loam with a 4% organic matter content. All treatments were applied in 150 l/ha of water carrier using a small plot sprayer. Both experiments were randomized complete block designs replicated three times. In Experiment A plot size was 1.5 x 6 m; in Experiment B it was 1.5 x 9 m. In the Experiment A area the dominant weeds were large crabgrass (Digitaria sanguinalis (L.) Scop.) and lambsquarters (Chenopodium album L.). Both species were also present in Experiment B but the density was very heavy.

A new experimental material with the code designation HOE-29152 ([methyl 2-(4-trichloromethylphenoxy)phenoxy]propanoate) was compared in Experiment A with several labeled herbicides. See Appendix for identity of the other herbicides. In Experiment B influence of stage of growth of the weeds upon the effectiveness of HOE-29152 was studied.

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Table 1 - Experimental Variables

	Experiment A	Experiment B
Fertilization	April 25, 1977 2200 kg/ha lime 165 kg/ha P_2O_5 and K_2O	June 27, 1977 1100 kg/ha 10-10-10
Seeding	May 20, 1977 Iroquois alfalfa - 13 kg/ha	June 27, 1977 Iroquois alfalfa - 13 kg/ha
Herbicide applications	Preplant inc. - May 25, 1977 Premerg. - May 27, 1977 Early post - June 16, 1977 Late post - June 28, 1977 Very late post -	 July 12, 1977 July 15, 1977 Aug. 2, 1977
Condition at spraying		
Early post	27° C max. temp. Clear.	24° C max. temp. Soil surface dry when spraying but 5 cm rain fell next night.
Late post	27° C max. temp. Clear.	28° C max. temp. Sky clear. No wind.
Very late post		27° C max. temp. Clear. Slight breeze.
Stage of growth		
Early post	Alfalfa 1-2 true leaves; crabgrass 3-4 leaves; lambsquarters 5 cm.	Alfalfa 1 true leaf; crabgrass 4 leaves starting to tiller.
Late post	Alfalfa 3 true leaves; crabgrass 3 leaves with 2-3 tillers; lambsquarters 5-10 cm.	Alfalfa 2 true leaves; crabgrass 5 cm with 2 tillers.
Very late post		Crabgrass 30 cm.

RESULTS AND DISCUSSION

Experiment A

Excellent control of crabgrass was obtained from any of the preplant incorporated treatments containing EPTC, profluralin and butralin as shown by Table 2. Benefin significantly reduced crabgrass yields except when combined with 2,4-DB or dinoseb. Methazole applied as a preemergence treatment was ineffective. The HOE-29152 compound was not active applied either preplant incorporated or preemergence. HOE-29152 was very active applied, however, as an early or late postemergence treatment. The .3 and .6 kg/ha rates significantly reduced crabgrass both early and late postemergence. The .15 kg/ha rate applied at the early postemergence stage was also effective. There was evidence that a tank mix of HOE-29152 and 2,4-DB was antagonistic in reference to crabgrass control. Significant control of crabgrass with the tank mix when applied at the late postemergence stage was obtained only with the higher rate (.6 kg/ha) of HOE-29152.

HOE-23408 at 1.1 kg/ha displayed less actively on crabgrass than any postemergence application of HOE-29152 applied alone.

Lambsquarters showed little response to HOE-29152. Most of the other chemicals used resulted in yields significantly lower than the control. The only treatments other than the HOE-29152 treatments which did not significantly reduce lambsquarters below the control were Benefin, methazole 0.8 kg/ha and dinoseb.

Alfalfa yields were not significantly affected by any of the treatments nor were the yields on the control plots significantly different from those plots with complete weed control. The lack of any impact of the weeds on alfalfa yields was related to the relatively thin stands of the weeds involved.

Experiment B

The alfalfa was subjected to very heavy competition from weed growth in Experiment B. The initial stand, especially of the crabgrass, was very dense and the 110 kg/ha of N applied in the fertilizer resulted in heavy weed growth. The injury ratings in Table 3 show that all the treatments were effective in controlling crabgrass except for the .15 kg/ha rate of HOE-29152 applied at the late postemergence stage when the crabgrass was starting to tiller. In this experiment there was no advantage in adding adjuvant 1 or 2. The activity of HOE-29152 on crabgrass was strikingly shown by the kill obtained at .3 and .6 kg/ha applied over a month after planting when the crabgrass was over 30 cm in height. Applications made at such a late date would not be practical on an alfalfa seeding since serious competition to the alfalfa would already have occurred. Also, the dead crabgrass collapsed onto the alfalfa stand creating a mulch effect.

Table 2 - Evaluation of HOE-29152 and Other Herbicides for Weed Control in a New Seeding of Alfalfa

Treatments	Rate kg/ha (ai)	Weed Control Ratings[1]			Dry Matter Yields kg/ha Aug. 3, 1977		
		Alf.	Crab.	Lambs.	Alf.	Crab.	Lambs.
EPTC 7E	3.3 ppi	0.0	7.3	4.0	1220	30	30
EPTC + 2,4-DB	3.3 ppi + 1.1 post	0.0	9.8	9.8	1365	7	50
EPTC + dinoseb	3.3 ppi + 1.1 post	0.0	9.0	8.0	1150	50	65
EPTC + methazole	3.3 ppi + 0.8 pre	0.8	7.8	3.8	1080	20	290
Benefin	1.4 ppi	0.5	6.8	2.5	1110	50	510
Benefin + 2,4-DB	1.4 ppi + 1.1 post	0.5	8.3	9.8	1345	275	0
Benefin + dinoseb	1.4 ppi + 1.1 post	0.0	6.8	7.8	1090	145	140
Benefin + methazole	1.4 ppi + 0.8 pre	0.0	8.0	7.8	1055	7	355
Profluralin	1.1 ppi	1.0	6.5	2.5	1340	20	285
Profluralin + 2,4-DB	1.1 ppi + 1.1 post	0.5	6.5	9.8	1010	115	0
Profluralin + dinoseb	1.1 ppi + 1.1 post	0.8	6.3	5.8	1235	115	190
Profluralin + methazole	1.1 ppi + 0.8 pre	1.0	6.5	5.3	1160	30	270
EPTC + methazole	1.1 ppi + 0.5 pre	0.0	9.0	7.0	965	30	220
EPTC + methazole	1.1 ppi + 1.4 pre	0.0	9.8	7.5	1320	7	225
Butralin	1.7 ppi	2.0	4.8	3.5	1120	80	420
Methazole	0.8 pre	1.8	2.8	2.8	1055	350	515
Methazole	1.1 pre	3.0	3.3	6.3	1185	270	370
Methazole	1.7 pre	3.0	2.5	5.8	1205	300	150
HOE-29152 + 2,4-DB	0.3 ppi + 1.1 early post	2.3	2.5	9.5	1220	390	0
HOE-29152 + 2,4-DB	0.6 ppi + 1.1 early post	2.5	1.8	10.0	1040	260	0
HOE-29152 + dinoseb	0.3 ppi + 1.1 early post	2.8	4.5	3.8	1015	175	645
HOE-29152 + dinoseb	0.6 ppi + 1.1 early post	1.5	4.3	4.8	1150	290	270
HOE-29152 + 2,4-DB	0.3 pre + 1.1 post	3.0	3.3	10.0	965	480	0
HOE-29152 + 2,4-DB	0.6 pre + 1.1 post	1.8	5.0	9.3	980	340	0
HOE-29152	0.15 early post	1.5	5.5	0.0	975	125	820
HOE-29152	0.3 early post	0.5	9.0	4.5	975	0	690
HOE-29152	0.6 early post	1.3	9.5	6.3	1150	0	625
HOE-29152 + adjuvant 1	0.3 early post + 0.5% v/v	2.3	8.8	1.3	965	15	640
HOE-29152 + adjuvant 2	0.3 early post + 0.5% v/v	0.8	9.8	2.5	960	0	820
HOE-29152 + adjuvant 1	0.3 late post + 0.5% v/v	0.8	9.0	2.0	995	20	400
HOE-29152 + adjuvant 1	0.6 late post + 0.5% v/v	0.0	9.8	2.8	920	100	550
HOE-29152 + adjuvant 2	0.3 late post + 0.5% v/v	1.5	7.5	2.3	915	65	545
HOE-29152	0.6 late post	0.5	10.0	1.8	725	0	995
HOE-29152 + 2,4-DB	0.3 early post 1.1 (tank mix)	1.8	6.0	9.0	1360	130	60
HOE-29152 + 2,4-DB	0.6 early post 1.1 (tank mix)	0.0	9.7	8.7	1045	0	250
HOE-29152 + 2,4-DB	0.3 late post 1.1 (tank mix)	3.8	1.3	9.8	935	420	15
HOE-29152 + 2,4-DB	0.6 late post 1.1 (tank mix)	0.0	8.8	10.0	1200	0	4
HOE-23408	1.1 early post	1.0	5.5	3.8	1040	180	470
Control		2.8	0.8	2.0	990	255	615
$LSD_{.05}$					N.S.	135	220

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

As in Experiment A, very little effect of HOE-29152 was observed on the lambsquarters. In fact, the lambsquarters grew even more vigorously after the crabgrass was killed. Only when 2,4-DB was combined with HOE-29152 so that both species were killed was the alfalfa free of competition. The stand ratings indicate a marked improvement in stand as of Oct. 21, 1977 over the control from all treatments, nevertheless, all plots except the HOE-29152 + 2,4-DB reflected the impact of weed competition.

HOE-29152 promises to be a valuable herbicide for postemergence control of crabgrass infesting new seedings of alfalfa. An additional herbicide must also be used, however, for annual broadleaf weed control. 2,4-DB in a tank mix will control most of the most common broadleaf weeds in alfalfa seedings but there is some indication that its use will reduce the activity of the HOE-29152.

Table 3 - Effectiveness of HOE-29152 on Crabgrass of Varying Size

	Herbicide Treatments	Rate kg/ha (ai)	Time of Application	Injury Ratings 1/ Sept. 2, 77 Alfalfa	Injury Ratings 1/ Sept. 2, 77 Crabgrass	Stand Density Ratings 2/ Oct. 21, 77 Alfalfa
1.	HOE-29152	0.15	Early Post	3.0	8.0	7.7
2.	HOE-29152	0.3	Early Post	2.7	10.0	7.7
3.	HOE-29152	0.6	Early Post	2.3	10.0	7.0
4.	HOE-29152	0.1	Late Post	3.7	4.3	5.3
5.	HOE-29152	0.3	Late Post	2.3	10.0	7.7
6.	HOE-29152	0.6	Late Post	2.3	10.0	8.3
7.	HOE-29152 + adjuvant 1	0.3 0.5% v/v	Late Post	2.3	10.0	7.3
8.	HOE-29152 + adjuvant 2	0.3 0.5% v/v	Late Post	2.3	10.0	9.0
9.	HOE-29152	0.3	Very Late Post	3.0	9.0	7.0
10.	HOE-29152	0.6	Very Late Post	2.7	10.0	7.3
11.	HOE-29152 + 2,4-DB	0.3 1.1	Very Late Post	2.3	10.0	10.0
12.	Control			7.7	0.0	2.3

1/ 0 = No effect; 10 = Complete kill
2/ 0 = No stand; 10 = Complete ground cover

APPENDIX

Common name	Chemical name
EPTC	S-ethyl dipropylthiocarbamate
benefin	N-butyl-N-ethyl-a,a,a-trifluoro-2,6-p-toluidine
profluralin	N-(cyclopropylmethyl)-a,a,a-trifluoro-2,6-dinitro-N-propyl-p-toluidine
2,4-DB	4-(2,4-dichlorophenoxy)butyric acid
dinoseb	2-sec-butyl-4,6-dinitrophenol
methazole	2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione
HOE-23408	methyl 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoate
butralin	4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzeamine

Quackgrass (*Agropyron repens* L. Beauv.) Control with HOE 29152

Bradley Majek and William B. Duke[1]

ABSTRACT

A field experiment was established at Etna, New York designed to determine the activity of HOE 29152 against established quackgrass. The experimental area consisted of a stand of quackgrass previously established in 1970 and maintained as a forage crop since that time. The field was plowed in early 1976 and allowed to regrow. Early in 1977 the field experiment was established on this stand of quackgrass. The experiment consisted of applications of HOE 29152 to quackgrass in the 4 to 5 leaf stage one week prior to plowing, after plowing incorporation by double discing, preemergence, and postemergence at the 4 leaf stage of the perennial weed. All treatments were replicated 4 times and the experimental design was a randomized complete block. All herbicide applications were made with a Mater Plot Sprayer using air as the propellent. Rainfall occurred 6 hours after applications of the postemergence treatments.

Throughout the entire experiment, only the postemergence applications were effective in reducing both foliar and rhizome growth. The reductions in quackgrass development were not as dramatic as had been observed in preliminary experiments in the greenhouse during the winter of 1977, however, this was explainable by virtue of the rainfall which occurred shortly after application of the postemergence treatments. In the plots treated with foliar applications of HOE 29152, several intact rhizome systems were exumed. These rhizomes were cut into single node pieces and planted into peat moss in the greenhouse to evaluate their potential for regrowth. One month after transplanting to the greenhouse, it was obvious that HOE 29152 translocated into certain areas of the rhizome system but not in others. The chemical did translocate from the mother plant to daughter plants that had surfaced at the time of application, however, it did not appear to translocate to the nodes of the mother rhizome from which the initial plant had surfaced. Because of this lower degree of translocation lateral shoots from rhizomes off of the mother rhizome were noticed to appear in the treated plots later in the season. This may not occur if the rainfall is absent for a 12 to 24 hour period following 24 hour treatment.

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WEED CONTROL IN SOYBEANS WITH PREPLANT INCORPORATED TRIFLURALIN, ORYZALIN, ETHALFLURALIN, AND PENDIMETHALIN IN COMBINATION WITH METRIBUZIN

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

ABSTRACT

Effective combination rates of four dinitroaniline herbicides with metribuzin were investigated. Trifluralin at 3/4 lb/A combined with 3/8 lb/A metribuzin was the most effective combination for fall panicum and velvetleaf control. Oryzalin at 1/2 lb/A combined with metribuzin at 1/4 lb/A were adequate to provide excellent broadleaf weed control and acceptable control of fall panicum; however, 3/4 lb/A oryzalin did not seem to improve fall panicum control. Ethalfluralin at 1/2 lb/A in combination with 3/8 lb/A metribuzin effected excellent broadleaf weed control and good control of fall panicum. Excellent control of fall panicum was obtained when the combination of rate of ethalfluralin was raised to 3/4 lb/A. The combinations of 3/4 lb/A pendimethalin with 3/8 lb/A metribuzin and 1 lb/A pendimethalin with 1/4 lb/A metribuzin provided excellent weed control. The higher rate of metribuzin seemed to be more effective on velvetleaf.

INTRODUCTION

The use of dinitroaniline herbicides in soybeans (*Glycine max* L.) is well established. Although they are effective on most grasses, they often do not adequately control many broadleaf weeds. The asymmetrical triazine, metribuzin [4-amino-6-tertbutyl-3-(methylthio) as triazin-5(4H)-one], is effective in controlling most broadleaf weeds, however, it is ineffective in controlling many grasses. When used in combination, the dinitroanilines and metribuzin have the potential to effect broad spectrum weed control at rates lower than those needed when each is applied alone.

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This experiment was designed to determine the most effective rates of four dinitroanilines used in combination with metribuzin. The well established dinitroaniline for use in soybeans, trifluralin (α,α,α -trifluoro-2, 6-dinitro-N, N-dipropyl-p-toluidine), was used as a chemical comparison for three more recent dinitroanilines, oryzalin (3, 5-dinitro-N^4, N^4-dipropylsulfanilamide); ethalfluralin [N-ethyl-N-(2 methyl-2-propenyl)-2, 6-dinitro-4-(trifluoromethyl)benzenamine]; and pendimethalin [N-(1-ethylpropyl)-3, 4-dimethyl-2, 6-dinitrobenzen= amine].

MATERIALS AND METHODS

This research was conducted in 1977 at the Adelphia Research Center, New Jersey Agricultural Experiment Station in a Freehold sandy loam. Prior to herbicide application, $7\frac{1}{2}$ by 19 ft, three row plots were established in a randomized complete block design with three replicates. Treatments were applied 40 gpa, June 15, using a backpack CO_2-propelled sprayer with water as a carrier and incorporated to a depth of 3 in within one hour after application. Plots were sown with Cutler 71 soybeans following incorporation.

The dominant weed species growing in the experimental area were: lambsquarter (*Chenopodium album* L.), redroot pigweed (*Amaranthus retroflexus* L.), velvetleaf (*Abutilon theophrasti* Medic.) and fall panicum (*Panicum dichlotomiflorium* Michx.). Plots were rated July 19 using a scale of 0 to 10, where 0 is no effect on weed or crop stand or vigor and 10 is complete kill.

RESULTS AND DISCUSSION

No significant soybean injury was observed with any of the treatments investigated.

Metribuzin alone provided excellent broadleaf weed control especially at rates higher than 1/4 lb/A (Table 1). Good control of fall panicum was obtained at 1/2 lb/A and excellent control at 3/4 lb/A. Trifluralin was ineffective in controlling velvetleaf. Velvetleaf control was greatly improved when trifluralin was combined with metribuzin. In combination, 3/4 lb/A trifluralin was needed to control fall panicum and 3/8 lb/A metribuzin improved broadleaf control.

Oryzalin alone did not adequately control fall panicum (Table 2). When combined with metribuzin, the 1/2 and 3/4 lb/A rates of oryzalin effected comparable control of fall panicum. Broadleaf weed control was slightly improved with the addition of 3/8 lb/A metribuzin.

Table 1. The effects of trifluralin and metribuzin applied preplant incorporated alone and in combination on weed stand in soybeans.

Herbicide	Rate lb ai/A	Lambs-quarter[1/]	Pigweed[1/]	Velvetleaf[1/]	Fall panicum[1/]
trifluralin	1/2	9.3	8.8	6.7	6.3
	3/4	9.8	9.6	6.0	9.0
	1	10.0	10.0	7.3	9.9
metribuzin	1/4	9.8	9.2	9.0	6.0
	3/8	10.0	10.0	9.8	7.3
	1/2	10.0	9.5	9.2	8.3
	3/4	10.0	10.0	9.9	9.8
trifluralin + metribuzin	1/2 + 1/4	10.0	10.0	9.8	8.5
	1/2 + 3/8	10.0	9.8	9.0	7.0
	3/4 + 1/4	10.0	10.0	8.8	9.2
	3/4 + 3/8	10.0	9.8	9.5	9.2

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

Table 2. The effects of oryzalin and metribuzin applied preplant incorporated alone and in combination on weed stand in soybeans.

Herbicide	Rate lb ai/A	Lambs-quarter[1/]	Pigweed[1/]	Velvetleaf[1/]	Fall panicum[1/]
oryzalin	1/2	9.7	9.3	8.0	7.3
	3/4	10.0	9.7	9.7	7.5
metribuzin	1/4	9.8	9.2	9.0	6.0
	3/8	10.0	10.0	9.8	7.3
	1/2	10.0	9.5	9.2	8.3
	3/4	10.0	10.0	9.9	9.8
oryzalin + metribuzin	1/2 + 1/4	10.0	9.8	9.7	8.0
	1/2 + 3/8	10.0	10.0	8.7	8.0
	3/4 + 1/4	9.7	9.3	9.3	8.7
	3/4 + 3/8	10.0	9.8	9.6	8.0

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

When applied alone, ethalfluralin did not control velvetleaf; however, when used in combination with 3/8 lb/A metribuzin, excellent control of all broadleaf weeds was obtained (Table 3). The 3/4 lb/A combination rate of ethalfluralin was more effective in the control of fall panicum.

Pendimethalin applied alone did not adequately control velvetleaf (Table 4). The combination of pendimethalin at 3/4 lb/A with 3/8 lb/A metribuzin and both combinations with 1 lb/A pendimethalin effected excellent broad spectrum weed control. The higher rate of metribuzin was slightly more effective on velvetleaf.

Based on these data, the control of broadleaf weeds, velvetleaf in particular, can be greatly improved with a combination of 3/8 lb/A metribuzin with lower than base rates of trifluralin, oryzalin, ethalfluralin, or pendimethalin. Fall panicum control was also improved when metribuzin was combined with oryzalin.

Table 3. The effects of ethalfluralin and metribuzin applied preplant incorporated alone and in combination on weed stand in soybeans.

Herbicide	Rate lb ai/A	Lambs-quarter[1/]	Pigweed[1/]	Velvetleaf[1/]	Fall panicum[1/]
ethalfluralin	1/2	10.0	10.0	7.5	9.3
	3/4	10.0	10.0	6.7	9.3
	1	10.0	10.0	6.7	10.0
metribuzin	1/4	9.8	9.2	9.0	6.0
	3/8	10.0	10.0	9.8	7.3
	1/2	10.0	9.5	9.2	8.3
	3/4	10.0	10.0	9.9	9.8
ethalfluralin + metribuzin	1/2 + 1/4	10.0	10.0	9.0	8.3
	1/2 + 3/8	9.8	9.8	9.7	9.0
	3/4 + 1/4	10.0	10.0	7.7	9.0
	3/4 + 3/8	10.0	10.0	9.7	10.0

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

Table 4. The effects of pendimethalin and metribuzin applied preplant incorporated alone and in combination on weed stand in soybeans.

Herbicide	Rate lb ai/A	Lambs-quarter[1/]	Pigweed[1/]	Velvetleaf[1/]	Fall panicum[1/]
pendimethalin	3/4	10.0	9.7	5.3	10.0
	1	10.0	9.7	7.2	9.0
metribuzin	1/4	9.8	9.2	9.0	6.0
	3/8	10.0	10.0	9.8	7.3
	1/2	10.0	9.5	9.2	8.3
	3/4	10.0	10.0	9.9	9.8
pendimethalin + metribuzin	1/2 + 1/4	10.0	9.7	7.7	10.0
	1/2 + 3/8	10.0	9.8	9.8	9.5
	3/4 + 1/4	10.0	9.8	9.5	9.5
	3/4 + 3/8	10.0	10.0	9.6	7.7

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

METOLACHLOR COMBINATIONS FOR ANNUAL GRASS AND BROADLEAF CONTROL IN SOYBEANS

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ABSTRACT

A total of 19 soybean studies were conducted in Maryland and Pennsylvania over the period from 1974-1977. Metolachlor and alachlor were applied alone or in combination with linuron, metribuzin, dinoseb and dinoseb + naptalam either preemergence or at cracking.

Metolachlor applied at 1.4-1.7 kg ai/ha or alachlor at 1.7-2.2 kg ai/ha provided good to excellent control of six annual grass species while broadleaf weed control was less than adequate at most locations. The inclusion of linuron at 0.6-0.8 kg ai/ha or metribuzin at 0.3-0.7 kg ai/ha in tank mixes with metolachlor or alachlor gave control of additional weeds such as common ragweed and common lambsquarters. Combinations of metolachlor at 1.4-1.7 kg ai/ha plus either dinoseb (3.3-5.0 kg ai/ha) or dinoseb + naptalam (2.2-3.3+1.1-1.7 kg ai/ha) applied preemergence or at cracking were effective on the grasses and weeds listed above while also controlling ivyleaf morningglory and jimsonweed. Treatments applied at cracking were the most effective for broadleaf weed control. Under dry conditions encountered in 1977, ppi and preemergence applications metolachlor and metribuzin (1.7+0.4 kg ai/ha) provided control of yellow nutsedge while the same treatments applied as a preemergence tank mix were less effective.

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EVALUATION OF HOE-29152: JOHNSONGRASS CONTROL, SOYBEAN VARIETY SUSCEPTIBILITY AND RAINFALL EFFECTS.

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ABSTRACT

HOE-29152 was evaluated in field and greenhouse experiments. Field results in an established johnsongrass stand indicated that HOE-29152 was least active as a preemergent treatment, had moderate activity when applied preplant incorporated and had the greatest activity when applied postemergent. Preemergent treatments of 4 lb/A gave less than 70% control at the end of the season. Incorporation of the herbicide gave 80% control at the end of the season at 3 lb/A but only 30% control at 1 lb/A. No soybean injury occurred with preemergent or preplant incorporated treatments. Postemergent control of johnsongrass with HOE-29152 at $1\frac{1}{2}$ to 5 lb/A was approximately 90% at the end of the season if sprayed when johnsongrass was 6 to 12 inches tall. At 1 to 4 inches or at 18 to 42 inches johnsongrass control significantly decreased. Application of HOE-29152 at 1 lb/A postemergent gave 60 to 80% control at the end of the season whereas 0.75 lb/A caused only temporary stunting of the johnsongrass. Slight soybean necrosis occurred in only one of two years at $1\frac{1}{2}$ lb/A. At 5 lb/A 50% of the soybean leaves became necrotic. Two weeks after application, however, no injury was noted. Yields were not reduced even at the highest rate used in these studies (5 lb/A). Rhizome control was rated the year following HOE-29152 application. No rhizomes were present in treatments which had at least 90% control ratings the previous year. Another field experiment indicated that four soybean varieties were not differentially susceptible to HOE-29152 at 3 lb/A applied at three different stages of growth. Greenhouse experiments indicated no differential susceptibility of 16 soybean varieties treated with 3 lb/A. HOE-29152 lost 80% of its effectiveness if simulated rainfall was applied 10 minutes after spraying soybeans at 3 lb/A and 20% if simulated rainfall was applied one day after spraying. HOE-29152 appears to be an effective chemical for postemergent control of johnsongrass in soybeans.

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EFFECTS OF CULTIVATION ON WEED CONTROL AND SOYBEAN YIELDS

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ABSTRACT

Research was conducted for three years to determine the influence of cultivation on weed control and yields of soybeans (Glycine max (L.) Merr.) grown on sandy loam soils. In 1974, plot size was 12 ft by 20 ft and contained 4 rows; two rows were cultivated 6 weeks after planting and the remaining two were not disturbed. In 1975 and 1976 plots were 6 rows wide and measured 18 ft by 20 ft to permit three cultivation treatments (0, 1 and 2 times). Preemergence herbicide treatments included alachlor (2-chloro-2', 6'diethyl-N-[methoxymethyl]acetanilide), linuron (3-[3,4-dichloropheny1]-1-methoxy-1-methylurea), and dinoseb (2-sec-butyl-4,6-dinitrophenol) and combinations of alachlor with both linuron and dinoseb. All treatments were replicated 4 times. The effects of cultivation varied with chemical and weed species but in general best weed control was obtained from combinations of alachlor with either linuron or dinoseb plus one or two cultivations. Soybean yields were increased by both the first and the second cultivations. The amount of yield increases were frequently more than might be anticipated on the basis of improved weed control alone.

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SOYBEAN RESPONSE TO POSTEMERGENCE HERBICIDES

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ABSTRACT

Postemergence herbicides provide soybean producers opportunities for additional weed control, provided that crop injury can be minimized. The purpose of this 1977 field experiment was to determine trends of soybean injury of selected foliar-applied herbicides.

Soybeans ('Celeste') were planted on 23 June in a sandy-loam soil at Georgetown, DE. The field was kept weed-free with alachlor (1.68 kg/ha) and linuron (0.56 kg/ha) applied preemergence, and two cultivations. Subsurface irrigation was used as needed.

Five postemergence compounds or combinations were broadcast to different plots at either the 3-trifoliate, 7-trifoliate, or mid-bloom stage. A logarithmic sprayer was used, with starting rates about three times the recommended rates. Treatments and starting rates were: 1) RH 6201 + diclofop (1.68 + 3.36 kg/ha), 2) RH 6201 + HOE 29152 (1.68 + 2.52 kg/ha), 3) bentazon (4.48 kg/ha), 4) 2,4-DB (0.56 kg/ha), and 5) chloroxuron (4.48 kg/ha).

Treatments 1 and 2, when applied at the 3-leaf stage, resulted in 60-80% stand reduction at the 100% application rate. Surviving plants remained badly stunted throughout the season. At the 50% application rate applied to the 3-leaf stage, leaf chlorosis and leaf abscission were typical. Brown flecks were evident on sprayed foliage as low as 13% of starting rates. Soybeans sprayed at the 7-leaf and mid-bloom stages suffered no stand reduction, and recovered more rapidly than those sprayed at the 3-leaf stage. Time of maturity was not affected.

Bentazon and chloroxuron (treatments 3 and 5) were best tolerated, regardless of application time. Though stand reduction did not occur, the 100% rate applied to the 3-leaf stage resulted in a 10-15% height and dry-weight reduction. Some leaf chlorosis and abscission occurred at all growth stages at both 100% and 75% application rates, and brown flecks were typical at the 25% rate. All plants recovered rapidly after herbicide application, and time of maturity was not affected.

Injury from 2,4-DB (treatment 4) applied at the 3-leaf stage increased with time. Severe stunting and delayed maturity occurred at the 100% application rate. At all growth stages, application was followed by epinasty of the contact area, followed by crinkling of subsequently emerging leaves. Soybeans at the 7-leaf, and especially the mid-bloom stage, recovered much more rapidly than those sprayed at the 3-leaf stage.

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RH-6201 - A NEW POSTEMERGENCE SOYBEAN HERBICIDE

John P. Hartnett [1]

ABSTRACT

In 1977, RH-6201 (sodium 5-[2-chloro-4-(trifluoromethyl)-phenoxy]-2-nitrobenzoate) was evaluated as a postemergence soybean herbicide at 0.25, 0.5, and 1.0 lb ai/A alone and at 0.125, 0.25, and 0.5 lb ai/A plus ¼% v/v of Triton AG-98 surfactant in 10 and 40 gal of spray/A. These treatments were applied 24 and 31 days after planting in two separate trials at Odessa, Delaware, when the soybeans (variety Williams) had one trifoliate leaf and three trifoliate leaves. Similar trials were also applied 23 and 37 days after planting at Felton, Delaware, when soybean (variety Essex) development was at the one and five trifoliate leaf stages. In all four tests, dinoseb at 0.38 lb ai/A and bentazon at 0.75 lb ai/A plus ¼% v/v of Triton AG-98 were applied in 10 and 40 gal of spray/A as standards for comparison.

The soybeans were planted in Odessa, Delaware, in 14 inch rows on May 25, 1977 and in Felton, Delaware, in 30 inch rows on May 31, 1977. Both sites were then treated with alachlor at 1.5 lb ai/A preemergence. The plot size at both locations was 5 by 30 ft and each trial utilized a randomized complete block design with three replications. Four plots in each replication received no postemergence herbicide and these served as the controls. The postemergence sprays were applied at 3 mph using compressed nitrogen gas and a 3-nozzle boom located 18 inches above the soybeans. The 10 gal/A sprays were applied with Spraying Systems Co. Teejet 8001LP nozzles at 15 psi, and the 40 gal/A sprays with Teejet 8004LP nozzles at the same pressure.

Common ivyleaf morningglory (Ipomoea hederacea) was uniformly present in both trials at Felton and Odessa, Delaware. Velvetleaf (Abutilon theophrasti) and common lambsquarter (Chenopodium album) were in both Odessa, Delaware trials. Common ragweed (Ambrosia artemisiifolia) and jimsonweed (Datura stramonium) were present only in the Odessa, Delaware trial applied 31 days after planting.

The weed control results showed that species such as ivyleaf morningglory, ragweed, and jimsonweed were very sensitive to RH-6201. Control of these weeds was not appreciably influenced by time of application, spray volume per acre, or the addition of surfactant. For example, 23 to 24 days after planting, ivyleaf morningglory varied in size from a pair of cotyledon leaves to six leaves and required 0.25 lb ai/A of RH-6201 for 90% control. Thirty-seven days after planting, the morningglory plants were 8 to 18 inches in diameter and required 0.5 lb ai/A of RH-6201 for 90% or better control.

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Velvetleaf and lambsquarters control was influenced by time of application, spray volume per acre, and the addition of surfactant. With these weeds, the application of RH-6201 at 0.125 to 0.25 lb ai/A 24 days after planting gave better control than the application of 0.5 to 1.0 lb ai/A 31 days after planting. When treatments were applied 24 days after planting, a spray volume of 40 gal/A gave better control than 10 gal/A, and 40 gal/A with surfactant gave even better control than 40 gal/A without surfactant.

POSTEMERGENCE APPLICATIONS OF A NEW HERBICIDE USED IN COMBINATION WITH ADJUVANTS IN SOYBEANS

Ratemo W. Michieka, Darlene M. Frye, Richard D. Ilnicki and Carol N. Somody[1/]

ABSTRACT

A new diphenylether herbicide, RH 6201, shows promise for both preemergence and postemergence use in soybeans. Postemergence applications to soybeans, when in the first trifoliate stage, produced fair control of velvetleaf and excellent control of ragweed with little control of fall panicum. Increases in control of all species were obtained by additions of nonphytotoxic oil to the herbicide control, increasing as the volume of oil was increased. Increases in control were not as pronounced with an addition of surfactant (Booster Plus E).

Control of pigweed and fall panicum was greater from postemergence applications of RH 6201 where alachlor was used preemergence than where it was not used. Further increases in control were obtained where a surfactant was added to RH 6201 (TRITON AG-98).

INTRODUCTION

The new experimental herbicide, sodium 5-[2-chloro-4-(trifluoromethyl)-phenoxy]-nitrobenzoate (RH 6201), a diphenylether, is being developed for postemergence weed control in soybeans (*Glycine max* L.) and peanut (*Arachis hypogaea*). From our experience with this herbicide in 1976, we observed that preemergence applications gave excellent control of lambsquarters (*Chenopodium album* L.) and very good control of redroot pigweed (*Amaranthus retroflexus* L.), velvetleaf (*Abutilon theophiasti* Medic.), and fall panicum (*Panicum dichotomiflorum* Michx.). Furthermore, control of these species was slightly less with "at cracking" applications and that control from postemergence applications, at the first trifoliate leaf stage of soybeans, was comparable to but slightly better than that produced by preemergence applications.

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It was the objective of this study to evaluate early postemergence applications of RH 6201 in soybeans on weed control and crop tolerance and to determine whether additions of two adjuvants would increase effectiveness and/or injure the crop.

MATERIALS AND METHODS

Cutler 71 soybeans were planted in 30-inch rows in Freehold sandy loam soil at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey, on June 20. Immediately after planting plots 3 rows wide (7 1/2 feet) by 19 feet long were established to receive postemergence applications of RH 6201. A set of plots was also established to receive preemergence applications of 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) at 1 1/2 lb/A to be followed by RH 6201 applied postemergence. This was planned in order to ascertain whether soybeans would be more sensitive to postemergence RH 6201 than where no preemergence herbicide was applied. All treatments were applied in triplicate in a complete randomized block design.

Approximately 20 days after planting RH 6201 was applied at rates of 1/4, 1/2, and 1 lb/A to the soybeans after the first trifoliate leaves were fully expanded. In addition to a set of treatments without adjuvant, one series each of RH 6201 at the same rates, was applied using 11E oil at 1/4, 1/2, and 1 GPA and Booster Plus E at 1.6% v/v. The nonphytotoxic herbicidal 11E oil is a paraffinic oil of medium viscosity (110 sec.) and Booster Plus E is a blend of 100 sec. nonphytotoxic oil plus a nonionic emulsifier. All applications were applied as sprays with water the carrier in 40 GPA.

The plots treated with alachlor preemergence also received RH 6201 at the two lower rates, one set without spray adjuvant and another set with Triton AG-98 at 1/2% v/v in the spray solution. The experimental area contained the following weeds: redroot pigweed, velvetleaf, and fall panicum. These were in the 2-leaf seedling stage approximately 1/2 to 1 inch tall at time of spraying.

On July 27, approximately two weeks after herbicide application, all plots were rated for weed control and crop tolerance using the scale 0 to 10 where 0 = no control or effect on stand and 10 = complete control or elimination of stand.

In a separate experiment RH 6201 was also investigated as a preemergence herbicide at rates of 1/2, 1, and 2 lb/A on the same variety of soybeans, but planted 10 days earlier on June 10 and treated on June 13. These plots were rated on the same day and comparisons between the two experiments will be made.

RESULTS AND DISCUSSION

In Table 1 are summarized weed control data for RH 6201 applied alone and in combination with two spray adjuvants. From this table it can be seen that with increasing rate of herbicide, without adjuvant, there was a commensurate increase in the control of redroot pigweed and fall panicum although the control of the latter species was poor. The effects on velvetleaf are not definitive. One interesting fact is apparent. As the volume of oil was increased there were increases in the control of all species but the increases were greater for velvetleaf and fall panicum. Still another observation worthy of note. Additions of Booster Plus E to RH 6201 improved the control of redroot pigweed only slightly, had no effect on fall panicum, and only increased the degree of control of velvetleaf at the highest rate of the herbicide.

In Table 2 are summarized weed control data from an adjoining experiment in which RH 6201 was applied preemergence. Comparing the data in this table with the data in Table 1, it can be seen that RH 6201 is equally effective on pigweed whether applied preemergence or postemergence and that control of fall panicum is better from preemergence applications than from postemergence applications.

In Table 3 weed control data from preemergence alachlor followed by postemergence RH 6201, with and without surfactant, are summarized. Control of redroot pigweed and fall panicum was better from this combination than from RH 6201 alone (Table 2); however, the control of velvetleaf was not as good. With the addition of surfactant to this combination, control of velvetleaf was enhanced but there was no increase in the control of the other two species.

Table 1. Weed control in soybeans with RH 6201 applied post-emergence alone and in combination with spray adjuvants.

Herbicide and Adjuvant	Rate, lb/A	Weed Control[1] Pigweed	Velvetleaf	Fall Panicum
RH 6201, 2LC	1/4	7.5	7.7	1.3
	1/2	9.2	8.8	1.8
	1	9.7	4.8	4.2
+ 11E oil 1/4 GPA	1/4	9.7	7.3	3.8
	1/2	9.7	9.3	6.0
	1	9.8	9.3	7.7
+ 11E oil 1/2 GPA	1/4	9.8	7.0	5.2
	1/2	10.0	9.7	7.0
	1	9.7	9.5	7.4
+ 11E oil 1 GPA	1/4	9.9	9.9	7.0
	1/2	10.0	9.9	7.9
	1	10.0	9.9	8.8
+ Booster Plus E 1.6% v/v	1/4	9.2	4.2	1.2
	1/2	9.1	5.8	2.8
	1	9.8	9.1	4.8

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

Table 2. Weed control in soybeans with RH 6201 applied preemergence.

Herbicide	Rate, lb/A	Weed Control[1]			
		Lambs-quarters	Pigweed	Velvet-leaf	Fall Panicum
RH 6201, 2LC	1/2	9.5	8.1	7.0	3.7
	1	9.7	9.5	9.3	7.7
	2	10.0	10.0	9.4	8.2

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

Table 3. Weed control in soybeans from preemergence alachlor and RH 6201 applied postemergence with and without a spray adjuvant.

Herbicide and Adjuvant	Rate, lb/A	Weed Control[1]		
		Pigweed	Velvetleaf	Fall Panicum
alachlor (pre) + RH 6201 (post)	1½ + 1/4	9.9	3.0	9.8
	1½ + 1/2	10.0	9.1	9.9
alachlor (pre) + RH 6201 (post) + Triton AG-98 1/2% v/v	1½ + 1/4	9.9	9.9	9.9
	1½ + 1/4	10.0	9.7	9.9

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

POSTEMERGENCE HERBICIDES FOR ANNUAL WEEDS IN SOYBEANS

J. V. Parochetti and T. C. Harris[1]

ABSTRACT

Field studies were conducted in 1976 and 1977 evaluating several herbicides for preemergence and postemergence weed control in soybeans. Experiments were located at the Wye Institute and were randomized complete block designs with 4 replications. Plot size was 10 by 20 feet. In 1976 dichlofop applied preemergence (0.75 and 1.5 lb/A) and postemergence (1.5 lb/A) failed to control giant green foxtail. Rainfall did not occur for 13 days following preemergence treatments. Postemergence treatments were applied when giant green foxtail was 2 to 3 inches in height. At cracking treatments of dichlofop + napthalam + dinoseb (0.75 + 3.0 + 1.5 lb/A) resulted in greater than 95% control of giant green foxtail. Control of common lambsquarter was < 70% except in treatments containing bentazon or chloroxuron. In another study in 1976, RH6201 was applied premergence and postemergence to soybeans at cracking, second trifoliate, and fifth trifoliate leaf stage. Postemergence RH6201 at 1 lb/A resulted in greater than 95% giant green foxtail control at all stages of application. RH6201 at 0.25, 0.5 and 1 lb/A affected best (85 to 90%) control of common lambsquarters when applied in the second trifoliate stage; all other application times resulted in no greater than 70% control. In 1977, dichlofop at 1 lb/A applied to giant green foxtail at 1 to 2 inches tall resulted in greater than 98% control. Combinations of dichlofop (0.5 lb/A) plus RH6201 (1 lb/A) effected excellent control of giant green foxtail and common lambsquarters. Postemergence RH6201 alone did not result in acceptable giant green foxtail control, although late season control of common lambsquarters was 90% or better. Postemergence HOE 29152 + RH6201 at 0.5 + 0.5 lb/A resulted in greater than 98% control of common lambsquarters and giant green foxtail.

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EFFECT ON NO-TILLAGE COVER CROPS BY PARAQUAT, DIQUAT OR GLYPHOSATE APPLIED IN WATER OR FERTILIZER SOLUTIONS [1]

J. V. Parochetti [2]

Abstract. In greenhouse studies water losses from orchardgrass was rapidly reduced in 7 days by about 84% of the untreated control following foliar applications of 0.50 lb/A paraquat, whereas water losses from lb/A glyphosate treated foliar was reduced about 56%. Water loss from paraquat treated orchardgrass remained lower than glyphosate treated orchardgrass throughout the 30 days of the experiment. Difference in water loss from rye plants treated with glyphosate or paraquat were similar to each other. In seven field studies conducted from 1972 through 1977, herbicides were evaluated when applied to foliage of orchardgrass, rye or barley in either water, aqueous nitrogen or a complete fertilizer solution. The complete fertilizer solution reduced foliar necrosis from paraquat and glyphosate when observed in 1 to 2 weeks following application when compared to water or aqueous nitrogen as the carrier. Aqueous nitrogen as a spray carrier plus a surfactant effected more rapid foliar necrosis than water. With both fertilizer spray solutions higher surfactant concentrations were needed to effect foliar necrosis comparable to water as a carrier. Diquat resulted in inferior foliar necrosis when compared to treatments of paraquat or glyphosate. The addition of a residual herbicide was often necessary to effect orchardgrass death particularly when applied with fertilizer solutions.

INTRODUCTION

The use of liquid fertilizer solutions as a spray carrier for some herbicides is now a commerically acceptable practice. Many questions, however, need to be answered regarding the use of paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) and glyphosate (N-(phosphonomethyl) glycine) mixtures in aqueous fertilizer solutions as they relate to no-tillage production. Surfactants had been shown to be necessary for better foliar necrosis with paraquat in fertilizer solutions (2). Early research (1,3,5) evaluating efficiency of foliar necrosis by paraquat on cover crops indicated that both aqueous nitrogen and a complete fertilizer solution needed a surfactant. Necrosis was also found to be much slower when paraquat was applied in fertilizer solutions rather than in water as the spray solution.

Furthermore, glyphosate effects foliar necrosis much more slowly than the rapid dessiciation caused by paraquat (4). The amount of water lost from slowly dieing cover crops treated with glyphosate could deplete the soil moisture and be detrimental to the following crop.

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[1] Scientific Article No.A-2387 and Contribution No. 5402 of the Maryland Agricultural Experiment Station, Department of Agronomy, College Park, Maryland.

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One of the purposes of the present report was to determine the relative loss of water from glyphosate and paraquat treated plants under greenhouse conditions. Another purpose of this research was to evaluate the efficiacy of diquat, paraquat or glyphosate alone or in combination with triazine herbicides on three grass cover crops under field conditions.

MATERIALS and METHODS

Greenhouse studies. These studies were conducted at the National Vegetable Research Station, Wellesbourne, England in the summer of 1975. Water loss from paraquat or glyphosate treated orchardgrass (*Dactylis glomerata* L.) or rye (*Secale cereale* L.) was recorded. Established orchardgrass was clipped and transplanted into 8 inch diam plastic pots two weeks before treatment. At treatment time the leaves were 4 inches in height and approximate dry matter weight of the foliage of orchardgrass was 68 g/pot. Rye seeds were planted in 3.5 inch diam plastic pots and thinned to 10 plants prior to treating. Rye was 4 inches in height at treatment time and the soil moisture was similar to the orchardgrass study.

Herbicides were applied in water at 55.8 gpa at 40 psi. The commerical formulation of glyphosate was used which contains a surfactant. A surfactant (0.125% v:v) was added to the paraquat treatment, since that formulation used in England contained no surfactant.

The water content of the pots 24 hours after thorough watering was about 45%. Pots weights at the beginning of the experiment were noted and the amount of water added each day to achieve this initial weight was recorded as the water lost in grams per day per pot. To reduce soil evaporation, styrofoam beads (about 1 mm diam) were added to a 1 cm depth on the top of each pot.

Studies were replicated 4 times.

Field studies. Seven field studies were conducted from 1972 through 1977. Unless noted otherwise, the following information is appliable to each study. With two exceptions all studies were conducted at the Forage Research Farm, Clarksville, MD on a Delanco clay loam; experiment 4 was located at the Plant Research Farm, Silver Spring, MD on a silt loam soil and experiment 5 was located at the Wye Institute, Queenstown, MD on a silt loam soil. Plot size was 5 by 20 feet. Experimental design was a randomized complete block with 3 or 4 replications. Herbicides were applied with an experimental sprayer at 30 gpa and 30 psi. The aqueous nitrogen[3] was a 30% solution made of equal parts of ammonium nitrate and urea. The complete (12% N, 8% P_2O_5 and 8% K_2O) fertilizer solution[3] was made by mixing fresh phosphoric acid with aqua ammonia and adding ammonium nitrate and urea plus KCl; the solution pH was 6.5.

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[3] Fertilizer solution provided each year by Willard Chemical Company, Frederick, Maryland.

Table 1. Experiment number, date of treatment, cover crop, age of cover crop, height of cover crop and reference to tables wherein treatment are presented.

Experiment Number	Date of Treatment	Cover Crop	Age of Cover Crop	Height of Cover Crop	Treatments Listed in Following
1	May 2, 1972	Orchardgrass	3 years	6 to 8 inches	Table 2
2	May 10, 1973	Orchardgrass	2 years	10 to 12 inches	Table 3
3	May 10, 1973	Orchardgrass	2 years	10 to 12 inches	Table 4
4	April 24, 1974	Rye	6 months	24 inches	Table 5
5	May 14, 1976	Barley	7 months	18 inches	Table 5
6	May 17, 1976	Orchardgrass	2 years	30 inches	Table 3
7	May 26, 1977	Orchardgrass	3 years	30 inches	Table 4

RESULTS and DISCUSSION

Greenhouse studies. Water loss from glyphosate and paraquat treated orchardgrass foliage was different (Figure 1). With paraquat treatment, water loss was rapidly reduced and continued to decline for the 30 days following treatment of the herbicides. Water loss was highest with glyphosate. Greatest reduction in water loss occurred from the highest rate (0.5 lb/A) of paraquat applied. Seven days after treatment the water loss from plants treated with 0.5 lb/A paraquat was 28g/day/pot (84% reduction of the control) for 0.5 lb/A paraquat; water loss was 54 g/day/pot (69% reduction of the control), and for 1 lb/A glyphosate water loss was 78 g/day/pot (56% reduction of the control) (Figure 1); the average water loss for the control for the entire 30 day period was 176 g/day/pot. The approximate differences in water loss were maintained throughout the 30 day study.

With rye there was no differences between water loss from paraquat or glyphosate treated foliage (Figure 1). Water loss declined rapidly in the first 7 days from approximately 32 g/pot to about 4 g/pot/day (88% reduction of the control) for both herbicides. The average water loss for the control pots for the 8 day experiment was 36 g/pot/day.

Since water losses were similar for paraquat and glyphosate treated annual grass cover crop, soil moisture depletion probably would not constitute a serious problem in no-tillage crop production. However, with orchardgrass, a perennial, water losses were much higher for glyphosate treated plants throughout the 30 days following treatment when compared to paraquat; thus glyphosate treated plants could contribute to a soil moisture deletion much more readily than paraquat-treated perennial grass cover crops.

1972 - Experiment I. The spray carrier consisted of aqueous nitrogen, complete fertilizer or water. Paraquat, used alone without surfactant, resulted in less than 55% foliar necrosis of orchardgrass when observed 3 days after treatment with all spray carriers (Table 2). With paraquat plus 0.125% (v:v) surfactant initial foliar necrosis of orchardgrass with a spray carrier of aqueous nitrogen was 90%, with water 83%, with complete fertilizer solution 60%. At the end of 2 months, orchardgrass in all treatments with only paraquat (plus

a surfactant) had regrown. Two commercial formulations for atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine], the water disperable liquid (WDL) containing 4 lb/gal and the 80% wettable powder (WP), were used. Initial orchardgrass necrosis with paraquat (plus a surfactant) and atrazine with spray carrier solutions were ranked: aqueous nitrogen (77% for WDL and 77% for WP)> water (73% for WDL and 67% for WP)> complete fertilizer solution (50% for WDL and 30% for WP). At the end of 2 months, orchardgrass foliar necrosis resulting from paraquat (plus a surfactant) and atrazine in various liquid carriers was ranked: water (100% for WDL and WP)> liquid nitrogen (97% for WDL and 93% for WP)> complete fertilizer (91% for WDL and 78% for WP); without a surfactant after 2 months, orchardgrass foliar necrosis was: liquid nitrogen (97% for WDL and 60% for WP) water, (90% for WDL and 83% for WP) and complete fertilizer (93% for WDL and 72% for WP).

1973 and 1976 - Experiments 2 and 6. In Experiment 2 initial necrosis 7 days after treatment resulting from paraquat plus surfactant was more rapid when water or aqueous nitrogen were the spray carriers than with a liquid fertilizer solution carrier (Table 3). There was little difference in these particular comparisons 19 days after treatment. Within the applications made with water, applications of paraquat were more phytotoxic with the addition of a surfactant when observed 31 days after treatment. Within the aqueous nitrogen applications paraquat plus 0.125% v:v surfactant or higher resulted in more rapid necrosis. Paraquat plus 0.25% v:v surfactant affected significantly greater necrosis for all dates observed when compared to paraquat applied with liquid nitrogen without surfactant. With complete fertilizer applications with paraquat, there was no significant difference between surfactant concentrations. The addition of atrazine was necessary to kill orchardgrass when observed at the end of the experiment.

In Experiment 6, generally the best foliar necrosis was attained when water was the spray solution (Table 3). With water as the spray carrier, neither surfactant rate nor addition of the residual herbicide had much effect, except in control of new growth of orchardgrass in July (data not shown). Then, atrazine provided adequate residual control compared to where paraquat was used alone.

The nitrogen solution as a spray carrier reduced the effectiveness of the herbicides, although high surfactant levels 0.125% v:v or higher reduced this effect significantly. With a fertilizer solution carrier similar results were obtained as with the nitrogen solution.

1973 and 1977 - Experiments 3 and 7. Paraquat caused the most rapid necrosis, but orchardgrass regrew with a single paraquat treatment (Table 4). Single glyphosate treatments at 2 lb/A with all three liquid carriers effected orchardgrass foliar necrosis slowly, taking about 3 weeks to achieve greater than 90% necrosis. The addition of atrazine to glyphosate neither enhanced or antagonized the foliar necrosis of orchardgrass. When observed 19 days after treatment orchardgrass necrosis was generally greater when a single treatment of glyphosate was applied with water as the carrier.

Experiment 7 was similar to Experiment 3 and data for foliar necrosis of orchardgrass was similar (Table 4). Lodging of orchardgrass treated with gly-

phosate was significantly lower than that treated with paraquat 20 days after treatments (data not shown).

1974 and 1976 - Experiments 4 and 5. Of the three foliar herbicides applied without residual herbicides (atrazine or simazine), glyphosate effected the slowest foliar necrosis of rye; diquat (6,7-dihydrodipyridol {1,2-α:2',1'-c} pyrazindediium ion) was generally less effective than paraquat (Table 5). When glyphosate was applied with aqueous nitrogen rye necrosis was much greater than when applied in water or a complete liquid fertilizer solution when observed 4 days after treatment. When observed 8 days after treatment, rye necrosis was the poorest from the treatment of diquat in either spray carrier. When glyphosate, paraquat, or diquat were applied with residual herbicides, rye necrosis was generally similar to treatments without residual herbicides.

In Experiment 5 when comparing barley necrosis resulting from glyphosate across spray solutions or results from diquat or paraquat, little differences were noted, although aqueous nitrogen treatments showed consistently better performance 5 days after treatment (Table 5). Diquat treatments resulted in the poorest barley necrosis 30 days after treatment.

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Table 2. Foliar necrosis of orchardgrass following treatment with paraquat alone or in combination with atrazine applied in water, aqueous nitrogen or complete fertilizer solution at the Forage Research Farm, Clarksville, Md in 1973 (Experiment 2) and 1976 (Experiment 6).

				1973 - Expt. 2				1976 - Expt. 6	
				Orchardgrass Necrosis				Orchardgrass Necrosis	
Treatment	Rate (lb/A)	Surfactant (% V:V)	Spray Solution	7 DAT[a] (%)	19 DAT (%)	31 DAT (%)	64 DAT (%)	8 DAT (%)	21 DAT (%)
Paraquat	0.5	none	water	68.3	78.3	73.3	8.3	81.3	88.8
Paraquat	0.5	none	water	68.3	86.0	98.0	98.0	98.0	95.0
+ Atrazine[b]	2.5								
Paraquat	0.5	0.0625[c]	water	53.3	80.0	99.3	98.0	81.3	01.3
Paraquat	0.5	0.0625	water	65.0	85.0	98.3	95.0	83.8	98.8
+ Atrazine	2.5								
Paraquat	0.5	0.125[d]	water	70.0	88.3	94.7	46.7	88.8	95.0
Paraquat	0.5	0.125	water	65.0	86.7	99.3	96.3	80.0	96.3
+ Atrazine	2.5								
Paraquat	0.5	0.25[e]	water	76.6	88.3	88.3	55.0	-	-
Paraquat	0.5	0.25	water	68.3	85.0	99.3	96.7	-	-
+ Atrazine	2.5								
Control	---	none	none	0	0	0	0	6.3	5.0
Paraquat	0.5	none	nitrogen[f]	40.0	73.3	65.0	3.3	40.0	53.8
Paraquat	0.5	none	nitrogen	40.0	78.3	87.7	64.7	50.0	70.0
+ Atrazine	2.5								
Paraquat	0.5	0.625	nitrogen	53.3	73.3	68.3	28.3	52.5	63.8
Paraquat	0.5	0.625	nitrogen	55.0	86.7	99.3	99.7	72.5	91.3
+ Atrazine	2.5								
Paraquat	0.5	0.125	nitrogen	70.0	85.0	71.7	20.0	72.5	78.8
Paraquat	0.5	0.125	nitrogen	60.0	85.0	99.7	95.0	85.0	96.3
+ Atrazine	2.5								
Paraquat	0.5	0.25	nitrogen	71.7	86.7	84.0	55.0	-	-
Paraquat	0.5	0.25	nitrogen	51.7	86.7	99.3	99.3	-	-
+ Atrazine	2.5								
Control	---	none	nitrogen	18.3	23.3	11.7	0	0	2.5
Paraquat	0.5	none	comp. fert.[g]	38.3	66.7	50.0	0	52.5	52.5
Paraquat	0.5	none	comp. fert.	51.7	83.3	95.0	91.7	51.3	71.3
+ Atrazine	2.5								
Paraquat	0.5	0.0625	comp. fert.	48.3	76.7	76.3	35.0	70.0	78.8
Paraquat	0.5	0.0625	comp. fert.	50.0	78.3	93.3	96.0	73.8	90.0
+ Atrazine	2.5								
Paraquat	0.5	0.125	comp. fert.	58.3	78.3	75.0	13.3	68.8	77.5
Paraquat	0.5	0.125	comp. fert.	45.0	81.7	93.0	86.7	63.8	86.3
+ Atrazine	2.5								
Paraquat	0.5	0.25	comp. fert.	36.7	70.0	70.0	18.3	-	-
Paraquat	0.5	0.25	comp. fert.	45.0	83.3	99.0	98.0	-	-
+ Atrazine	2.5								
Control	---	none	comp. fert.	15.0	16.7	3.3	1.7	-	-
			Bayes $LSD_{0.05}$	12.8	11.5	13.2	29.1	8.8	6.5

[a] DAT is days after treatment.
[b] The water dispersable atrazine 4 lb/gal was used.
[c] 0.0625% is 8 oz/100 gal water of Ortho X-77.
[d] 0.125% is 16 oz/100 gal water of Ortho X-77.
[e] 0.25% is 32 oz/100 gal water of Ortho X-77.
[f] Aqueous nitrogen (30%) solution is an equal mixture of ammonium nitrate and urea.
[g] Complete fertilizer (pH 6.5) is 12% N, 8% P_2O_5, and 8% K_2O made from phosphoric acid mixed with aqua ammonia, ammonium nitrate and urea plus KCl.

Table 3. Foliar necrosis of orchardgrass following treatment with paraquat alone or in combination with two formulations of atrazine applied in water, aqueous nitrogen or complete fertilizer solution at the Forage Research Farm, Clarksville, MD 1972.

			1972 - Expt. 1				
			Orchardgrass Necrosis				
Treatment	Rate (lb/A)	Spray Solution	3 DAT[a] (%)	8 DAT (%)	17 DAT (%)	30 DAT (%)	60 DAT (%)
Paraquat (no surfactant)	.5	water	20.0	30.0	30.0	16.7	0
Paraquat (no surfactant)	.5	water	23.3	63.3	80.0	90.0	83.3
+ Atrazine (80WP)[b]	2.5						
Paraquat (no surfactant)	.5	water	53.3	80.0	93.3	96.7	90.0
+ Atrazine (4WDL)[c]	2.5						
Paraquat (0.125% Ortho X-77)	.5	water	83.3	76.7	56.7	30.0	16.7
Paraquat (0.125% Ortho X-77)	.5	water	66.7	86.7	100	100	100
+ Atrazine (80WP)	2.5						
Paraquat (0.125%[d] Ortho X-77)	.5	water	73.3	90.0	100	100	100
+ Atrazine (4WDL)	2.5						
Paraquat (no surfactant)	.5	nitrogen[e]	53.3	63.3	43.3	16.7	0
Paraquat (no surfactant)	.5	nitrogen	36.7	63.3	73.3	73.3	60.0
+ Atrazine (80WP)	2.5						
Paraquat (no surfactant)	.5	nitrogen	66.7	83.3	96.7	96.7	96.7
+ Atrazine (4WDL)	2.5						
Paraquat (0.125% Ortho X-77)	.5	nitrogen	90.0	86.7	70.0	50.0	26.7
Paraquat (0.125% Ortho X-77)	.5	nitrogen	76.7	83.3	96.7	96.7	93.3
+ Atrazine (80WP)	2.5						
Paraquat (0.125% Ortho X-77)	.5	nitrogen	76.7	83.3	96.7	100	96.7
+ Atrazine (4WDL)	2.5						
Paraquat (no surfactant)	.5	comp. fert.[f]	30.0	33.3	23.3	10.0	6.7
Paraquat (no surfactant)	2.5	comp. fert.	13.3	20.0	56.7	63.3	66.7
+ Atrazine (80WP)	2.5						
Paraquat (no surfactant)	.5	comp. fert.	40.0	63.3	80.0	83.3	80.0
+ Atrazine (4WDL)	2.5						
Paraquat (0.125% Ortho X-77)	.5	comp. fert.	60.0	60.0	56.7	23.3	16.7
Paraquat (0.125% Ortho X-77)	.5	comp. fert.	26.7	46.7	70.0	70.0	70.0
+ Atrazine (80WP)							
Paraquat (0.125% Ortho X-77)	.5	comp. fert.	50.0	80.0	90.0	96.7	86.7
+ Atrazine (4WDL)	2.5						
		Bayes $LSD_{0.05}$	14.4	12.6	16.8	20.8	23.5

[a] DAT is days after treatment.
[b] 80WP is 80% wettable powder formulation.
[c] 4WDL is a water disposable liquid containing 4 lb/gal.
[d] 0.125% is 16 oz/100 gal water.
[e] Aqueous nitrogen (30% N) solution is an equal mixture of ammonium nitrate and urea.
[f] Complete fertilizer (pH 6.5) is 12% N, 8% P_2O_5, 8% K_2O made from phosphoric acid mixed with aqua ammonia, ammonium nitrate and urea plus KCl. No caly was used in this fertilizer solution.

Table 4. Foliar necrosis of orchardgrass following treatment with either paraquat or glyphosate alone or in combination with atrazine applied in water, aqueous nitrogen or complete fertilizer solution at the Forage Research Farm, Clarksville, MD in 1973 (Experiment 3) and in 1977 (Experiment 7).

			1973 Expt. 3				1977 Expt. 7	
			Orchardgrass				Orchardgrass	
			Necrosis				Necrosis	
Treatment	Rate (lb/A)	Spray Solution	6 DAT[a] (%)	8 DAT (%)	19 DAT (%)	64 DAT (%)	6 DAT (%)	20 DAT (%)
Glyphosate	1.0	water	5.0	78.3	99.7	100	7.5	58.8
Glyphosate	1.0	water	8.3	65.0	90.0	99.7	5.0	71.2
+ Atrazine[b]	2.5							
Glyphosate	2.0	water	8.3	81.7	100	100	-	-
Glyphosate	2.0	water	5.0	71.7	100	100	-	-
+ Atrazine	2.5							
Paraquat[c]	.5	water	71.7	85.0	95.0	36.7	90.0	94.5
Paraquat	.5	water	68.3	90.0	95.0	99.7	88.8	98.0
+ Atrazine	2.5							
Control	---	-	0	0	33.3	0	-	-
Glyphosate	1.0	nitrogen[d]	28.3	55.0	55.0	58.3	32.5	83.8
Glyphosate	1.0	nitrogen	21.7	60.0	46.7	98.0	31.2	93.8
+ Atrazine	2.5	nitrogen						
Glyphosate	2.0	nitrogen	23.3	55.0	78.3	93.3	-	-
Glyphosate	2.0	nitrogen	23.3	68.3	68.3	100	-	-
+ Atrazine	2.5							
Paraquat	.5	nitrogen	73.3	91.7	97.7	30.0	97.8	98.8
Paraquat	.5	nitrogen	63.3	88.3	98.0	97.6	95.0	99.8
+ Atrazine	2.5							
Control	---	-	25.0	33.3	3.3	0	10.0	3.8
Glyphosate	1.0	comp. fert.[e]	10.0	26.7	70.0	80.0	7.5	34.8
Glyphosate	1.0	comp. fert.	16.7	41.7	40.0	90.0	7.5	3 .2
+ Atrazine	2.5	comp. fert.						
Glyphosate	2.0	comp. fert.	10.0	46.7	93.3	98.0	-	-
Glyphosate	2.0	comp. fert.	10.0	46.7	81.7	99.7	-	-
+ Atrazine	2.5	comp. fert.						
Paraquat	.5	comp. fert.	55.0	78.3	73.3	25.0	57.5	84.8
Paraquat	.5	comp. fert.	46.7	71.7	76.7	86.7	58.8	81.2
+ Atrazine	2.5	comp. fert.						
Control	---	comp. fert.	21.7	16.7	23.3	16.7	6.2	0
		Bayes $LSD_{0.05}$	9.0	18.2	32.2	23	7.9	22.4

[a] DAT is days after treatment.
[b] The water dispersable liquid formulation of atrazine used at 4 lb/gal.
[c] The surfactant Ortho X-77 was used with all paraquat treatments at 0.25% (V:V) or 32 oz/100 gal spray solution.
[d] Aqueous nitrogen (30% N) solution is an equal mixture of ammonium nitrate and urea.
[e] Complete fertilizer (pH 6.5) is 12% N, 8% P_2O_5, and 8% K_2O made from phosphoric acid mixed with aqua ammonia, ammonium nitrate and urea plus KCl.

Table 5. Foliar necrosis of rye or barley following treatment with either paraquat, diquat, or glyphosate alone or in combination with atrazine, plus simazine applied in water, aqueous nitrogen or complete fertilizer solution at the Plant Research Farm, Silver Spring, MD in 1974 (Experiment 4) and at the Wye Institute, Queenstown, MD (Experiment 5).

			1974 - Expt. 4 Rye Necrosis		1976 - Expt. 5 Barley Necrosis	
Treatment	(lb/A)	Solution	4 DAT[a] (%)	8 DAT (%)	5 DAT (%)	30 DAT (%)
Control	----	water	15	5	80.0	76.7
Paraquat[b]	0.25	water	76.3	90		
Paraquat	0.25	water	68.8	76.3	60.0	85.0
+ atrazine[c]	1.25	water				
+ simazine[c]	1.25	water				
Diquat	.25	water	71.3	45	70.0	25.0
Diquat	.25	water	63.8	73.8	68.3	41.7
+ atrazine	1.25	water				
+ simazine	1.25	water				
Glyphosate	0.25	water	27.5	95.0	15.0	90.0
Glyphosate	0.25	water	12.5	93.8	3.33	85.0
+ ataazine	1.25	water				
+ simazine	1.25	water				
Control	----	liq. nit.[d]	25	40	81.7	95.0
Paraquat	0.25	liq. nit.	85	82.5	81.7	95.0
Paraquat	0.25	liq. nit.	81.3	97.5	85.0	100.0
+ atrazine	1.25	liq. nit.				
+ simazine	1.25	liq. nit.				
Diquat	0.25	liq. nit.	80	47.5	75.0	18.3
Diquat	0.25	liq. nit.	78.8	85	73.3	50.0
+ atrazine	1.25	liq. nit.				
+ simazine	1.25	liq. nit.				
Glyphosate	0.25	liq. nit.	86.3	95.0	48.3	70.0
Glyphosate	0.25	liq. nit.	78.8	100	30.0	80.0
+ atrazine	1.25	liq. nit.				
+ simazine	1.25					
Control	----	comp. fert.[e]	23.8	11.3	-	-
Paraquat	0.25	comp. fert.	80	85	81.7	80.0
Paraquat	0.25	comp. fert.	86.3	100	58.3	81.7
+ atrazine	1.25	comp. fert.				
+ simazine	1.25	comp. fert.				
Diquat	0.25	comp. fert.	78.8	52.5	66.7	16.7
Diquat	0.25	comp. fert.	77.5	92.5	45.0	60.0
+ atrazine	1.25	comp. fert.				
+ simazine	1.25	comp. fert.				
Glyphosate	0.25	comp. fert.	46.3	77.5	30.0	65.0
Glyphosate	0.25	comp. fert.	42.5	90.0	10.0	88.3
+ atrazine	1.25	comp. fert.				
+ simazine	1.25	comp. fert.				
		Bayes $LSD_{0.05}$	12.8	22.5	14.4	18.0

[a] DAT is days after treatment.
[b] The surfactant Ortho X-77 was used at 0.125% (V:V) or 16 oz/100 gal of spray solution.
[c] Atrazine and simazine formulations used were the commercial 80% wettable powders.
[d] Aqueous nitrogen (30%) solution is an equal mixture of ammonium nitrate and urea.
[e] Complete fertilizer (pH 6.5) is 12% N, 8% P_2O_5, and 8% K_2O made from phosphoric acid mixed with aqua ammonia, ammonium nitrate and urea plus KCl.

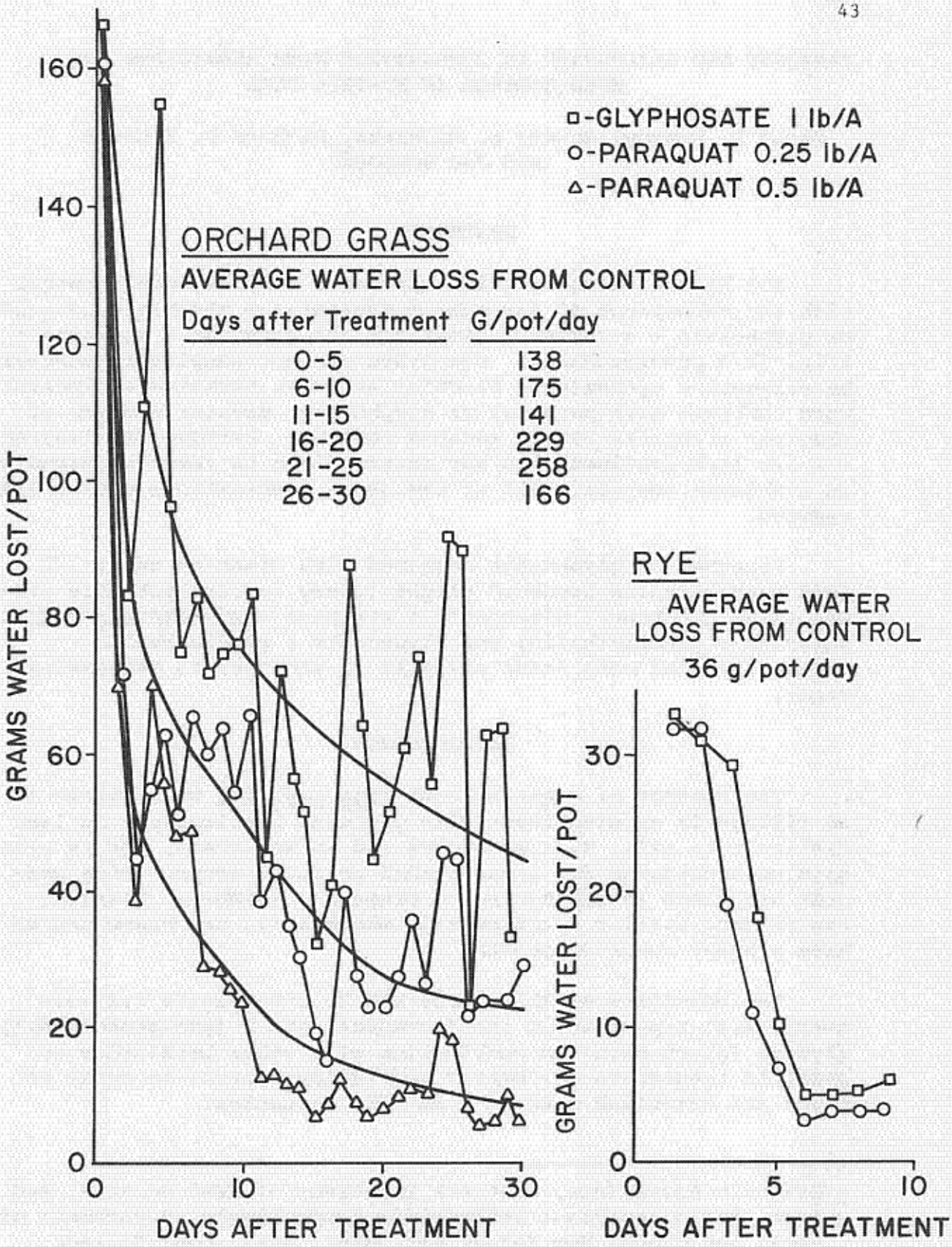

Figure 1. Water loss in gram per day per pot from paraquat or glyphosate treated established orchardgrass and recently emerged rye.

PARAQUAT AND GLYPHOSATE IN COMBINATION WITH HERBICIDES FOR WEED CONTROL IN NO-TILL CORN

Carol N. Somody, Ratemo W. Michieka, Richard D. Ilnicki and Jan Somody[1/]

ABSTRACT

All herbicide combinations produced complete weed control with the exceptions of paraquat + cyanazine + alachlor; paraquat or glyphosate + atrazine + simazine; and paraquat + simazine + 1 1/2 lb/A pendimethalin. Crabgrass was not completely controlled by paraquat + cyanazine + alachlor and when atrazine + simazine were combined with paraquat or glyphosate, greater numbers of vigorous crabgrass plants escaped control. Paraquat + simazine + 1 1/2 lb/A pendimethalin was intermediate to these combinations in crabgrass control. All of the above combinations controlled ragweed.

Paraquat or glyphosate combined with simazine and 1 1/2 lb/A pendimethalin produced slight injury to corn but this effect was later outgrown. Glyphosate + atrazine + simazine; paraquat + atrazine + pendimethalin; and glyphosate + pendimethalin + dicamba reduced corn stand slightly in addition to decreasing vigor.

INTRODUCTION

The concept of planting corn (*Zea mays* L.) with little or no tillage is gaining favor with growers, particularly on land difficult to till, such as slopes and in wet areas. It is also gaining acceptance for areas seeded to cover crops. Time and cost are saved in not having to prepare a seedbed. Planting can be done earlier, particularly where soils are heavy and/or have a heavy cover of growth.

The objective of this study was to investigate 1,1'-dimethyl-4,4'-bipyridinium ion (paraquat) and N-(phosphonomethyl) glycine (glyphosate) in combination with other herbicides as possible treatments for better vegetation control in order to plant and establish corn in a no-till situation.

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METHODS AND MATERIALS

All herbicides were applied to a standing rye (Secale cereale L.) cover crop on May 3 to plots designed for three 30-inch rows 24 feet long. Herbicide applications were made in 40 GPA with a CO_2-propelled sprayer equipped with a boom having 5 nozzles spaced 20 inches apart. Corn (var. Midstates 869) was planted May 10 on a Holmdel loam soil at the Soils and Crops Research Station, New Jersey Agricultural Experiment Station in Adelphia, New Jersey. Paraquat at 1/2 lb/A and glyphosate at 2 lb/A each were applied in combination with 2-chloro-4-(ethylamino) -6-isopropylamino)-s-triazine (atrazine) + 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor); 2- [[4-chloro-6-(ethylamino)s-triazin-2-yl] amino]-2-methyl= propionitrile (cyanazine) + alachlor; 2-chloro-4,6-bis (ethyl-amino)-s-triazine (simazine) + alachlor; atrazine + simazine; atrazine + N(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzen= amine (pendimethalin); simazine + pendimethalin; and pendi-methalin + 3,6-dichloro-o-anisic acid (dicamba). All combina-tions containing paraquat included surfactant X-77 1% v/v. All of the s-triazines were applied at 1 1/2 lb/A, alachlor at 2 1/2 lb/A, pendimethalin at 1 and 1 1/2 lb/A, and dicamba at 1/2 lb/A (Table 1).

Ragweed (Ambrosia artemisiifolia L.), crabgrass (Digitaria sanguinalis L.) and the corn were rated July 13 on a scale of 0 (no weed control or crop injury) to 10 (complete weed control or 100% reduction in crop stand or vigor).

RESULTS AND DISCUSSION

Paraquat with surfactant and glyphosate each applied alone gave complete control of ragweed. Paraquat produced only fair control of crabgrass and glyphosate effected poor control (Table 2). Crabgrass was vigorous with both herbicides. There was a very slight decrease in corn stand and vigor for both contact herbicides with paraquat producing slightly more than glyphosate.

Paraquat and glyphosate combined with atrazine + alachlor produced complete weed control with a very slight decrease in corn vigor. When simazine replaced atrazine in the mixture also containing paraquat, weed control was also excellent with less, but still a negligible, amount of corn stunting. When cyanazine

was used as the s-triazine component, a slight amount of crabgrass escaped control when combined with paraquat + alachlor, but the species was effectively controlled when used with glyphosate + alachlor. A slight reduction in vigor occurred when in combination with paraquat + alachlor and paraquat + simazine + alachlor (Table 1).

Combinations of paraquat or glyphosate with atrazine + simazine had no serious effect on crabgrass and some corn vigor reduction occurred. Combinations of one triazine + alachlor reduced crabgrass even more and vigor reduction of corn was less. The glyphosate treatment also reduced stand of corn slightly.

Paraquat or glyphosate combined with 1 lb/A pendimethalin + atrazine controlled all weeds completely, but the mixture with paraquat gave a slight decrease in corn stand and vigor. With the rate of pendimethalin increased to 1 1/2 lb/A, slight injury occurred to corn with both paraquat and glyphosate.

Pendimethalin at 1 lb/A combined with simazine and either paraquat or glyphosate also controlled all weeds but the mixture with glyphosate produced a slightly greater decrease in corn vigor. When 1 1/2 lb/A of pendimethalin was used, some crabgrass escaped and injury to corn vigor increased over the 1 lb/A rate, especially in combination with paraquat.

Paraquat or glyphosate combined with pendimethalin and dicamba controlled all weeds but also reduced corn vigor slightly, especially the glyphosate tank mix, which also injured the corn stand slightly.

Table 1. Combination of herbicides used with paraquat and glyphosate on a rye cover crop for no-till corn.[1/]

Herbicide combinations	lb/A
atrazine + alachlor	1 1/2 + 2 1/2
cyanazine + alachlor	1 1/2 + 2 1/2[b]
simazine + alachlor	1 1/2 + 2 1/2[b]
atrazine + simazine	1 1/2 + 1 1/2
atrazine + pendimethalin	1 1/2 + 1[b] 1 1/2 + 1[b]
simazine + pendimethalin	1 1/2 + 1[a] 1 1/2 + 1 1/2
pendimethalin + dicamba	1 + 1/2

1/All combinations were applied with paraquat at 1/2 lb/A and glyphosate at 2 lb/A.

a) The tank mix with paraquat did not affect corn vigor at all.

b) The tank mix with glyphosate did not affect corn vigor at all; all treatments other than a) and b) affected vigor to some extent.

Table 2. Weed control by those herbicide combinations which did not completely control crabgrass.

Herbicide Combination	Rate, lb/A	Crabgrass S	Crabgrass V
1. paraquat + X-77 1% v/v	1/2	6.5	2.5
2. glyphosate	2	3.8	2.5
3. paraquat* +	1/2	9.0	8.0
alachlor +	2 1/2		
cyanazine	1 1/2		
4. paraquat +	1/2	8.3	5.0
atrazine +	1 1/2		
simazine	1 1/2		
5. glyphosate +	2	7.3	5.0
atrazine +	1 1/2		
simazine	1 1/2		
6. paraquat +	1/2	8.5	7.5
pendimethalin +	1 1/2		
simazine	1 1/2		

*All treatments containing paraquat had the surfactant X-77 1% v/v.

METOLACHLOR COMBINATIONS FOR WEED CONTROL IN NO-TILLAGE CORN

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ABSTRACT

Research was conducted with no-tillage corn in Maryland and Pennsylvania over a period from 1974-1977 at 20 locations. With paraquat being used to control existing vegetation in all treatments, metolachlor was applied alone or in combination with either atrazine or simazine. Comparisons were also made with alachlor alone or tank mixed with atrazine.

Combinations of metolachlor and atrazine (1.7+1.3 kg ai/ha) were effective against annual grasses such as Setaria spp. and large crabgrass while higher rates (1.9+1.7 or 2.2+1.8 kg ai/ha) were required to control fall panicum. Tank mixes of metolachlor and simazine (1.7+1.3 kg ai/ha) provided very good to excellent control of all annual grass species including fall panicum. Broadleaf weed control was excellent with all atrazine or simazine combinations while either metolachlor or alachlor alone failed to be effective on common ragweed, Pennsylvania smartweed, ivyleaf morningglory or velvetleaf. Metolachlor combinations with atrazine provided adequate control of yellow nutsedge in several trials.

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QUACKGRASS CONTROL IN NO-TILLAGE CORN

N. L. Hartwig[1/]

ABSTRACT

Various herbicides known to have activity on quackgrass (Agropyron repens) were tested for quackgrass control in no-tillage field corn (Zea mays L., var. Pioneer 3780) planted on May 7.

The most consistent and best quackgrass control (98% +) was obtained with split applications of atrazine 2 lb/A in the fall (Oct. 3) followed by atrazine 1.3 lb/A + simazine 1.3 lb/A tank mixed with paraquat .3 lb/A, Booster E oil 1.3 qt/A or dalapon 2.4 lb/A applied in early spring (April 29). The highest corn yield, 172.9 bu/A, was obtained with the split atrazine (fall), atrazine + simazine (spring), treatment which included Booster E oil.

Single applications of higher rates of atrazine 3.9 lb/A + simazine 1.3 lb/A with Booster E oil 1.3 qt/A or paraquat .3 lb/A on April 29 also gave 98% quackgrass control with no significant reduction in corn yield.

Spring applications (March 30) of atrazine 2 lb/A followed by various combinations of atrazine, simazine, cyanazine, cyprazine, metolachlor, dalapon, paraquat and Booster E oil on April 29 gave 94 to 98% quackgrass control with a significant reduction in corn yield due to quackgrass competition. Fall applications (Oct. 3) of paraquat .25 lb/A followed by the same herbicide combination following spring atrazine treatments gave 85 to 97% quackgrass control with a significant reduction in corn yield.

Metribuzin 1.5 lb/A applied March 30 followed by atrazine 1.3 lb/A + cyanazine 2.6 lb/A on April 29 gave 98% quackgrass control but corn stand and yield was significantly reduced by metribuzin injury.

Fall and spring treatments of glyphosate at 1.33 and 2.0 lb ai/A were applied at about 2 week intervals starting Sept. 19 through Nov. 17 and on April 25 and May 7. Over 90% quackgrass control was obtained from late Sept. and early Oct. treatments at both rates of glyphosate. Control was 80 to 90% for late Oct. and 50 to 60% for Nov. treatments. Late April and early May treatments gave better than 90% quackgrass control again.

Buthidazole at 1 and 2 lb/A applied March 30 gave 82 and 98% quackgrass control respectively but corn stand and yield was significantly reduced due to herbicide injury.

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WEED AND SOD CONTROL FOR NO-TILLAGE CORN IN AN OLD ALFALFA STAND

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ABSTRACT

Pre-plant applications of several herbicide mixtures, consisting of the herbicides; atrazine, simazine, 2,4-D, dicamba, paraquat, dalapon, DNBP, cyanazine, glyphosate and alachlor, plus several surfactants, were applied to an old alfalfa field on April 30, 1976. The weed species present were; alfalfa (Medicago sativa L.), rough fleabane (Erigeron strigosus), dandelion (Taraxacum officinale), quackgrass (Agropyron repens), timothy (Phleum pratense) and orchardgrass (Dactylis glomerata). Corn (Zea mays L., var. Pioneer 3780) was planted on May 10, 1976, ten days after the application of herbicides.

The best weed control, as indicated by weed dry weights, was obtained with the tank mixtures of atrazine 1.5 lb/A + simazine 1.5 lb/A + 2,4-D 0.33 lb/A + dicamba 0.17 lb/A with either paraquat 0.25 lb/A, booster E oil 1 qt/A, diesel oil 2 gal/A, diesel oil 2 gal/A + dinoseb 1.25 lb/A or dalapon 2.5 lb/A. Also glyphosate at 1.5 or 2.0 lb/A with tank mixtures of atrazine 1.5 lb/A + alachlor 2.5 lb/A, simazine 1.5 lb/A + alachlor 2.5 lb/A, atrazine 1.5 lb/A + simazine 1.5 lb/A, and cyanazine 1.5 lb/A + alachlor 2.5 lb/A gave excellent weed control. Weed control appeared to be slightly inferior when cyanazine was substituted for simazine in the tank mixtures.

The highest corn yield was obtained from the atrazine + simazine + 2,4-D + dicamba tank mixture applied with booster E which yielded 212.1 bu/A. Other high yields observed included the use of paraquat or diesel oil + DNBP in place of booster E. These yields were both 189.3 bu/A, and they were the only yields not significantly different from the highest yield.

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GLYPHOSATE AND PARAQUAT IN COMBINATION WITH HERBICIDES FOR WEED CONTROL IN NO-TILL DOUBLE CROP SOYBEANS

Carol N. Somody, Ratemo W. Michieka, and R. D. Ilnicki[1/]

ABSTRACT

Paraquat alone did not control lambsquarters or fall panicum. Excellent overall weed control was obtained with paraquat + alachlor + metribuzin at both the 1 1/2 and 2 lb/A rates of alachlor. Excellent results were also obtained with paraquat + 3/4 lb/A pendimethalin + linuron; glyphosate + 1 lb/A oxadiazon; and glyphosate + 1/2 lb/A oxyfluorfen. Soybean vigor was reduced by oxyfluorfen in combination with glyphosate.

The only combinations containing glyphosate which were ineffective on fall panicum and wild mustard were pendimethalin + linuron. Diesel oil as a substitute for paraquat or glyphosate produced ineffective control of fall panicum for the combinations alachlor + linuron; alachlor + naptalam + dinoseb; and alachlor + metribuzin.

INTRODUCTION

Planting soybeans (Glycine max L.) in small grain stubble continues to attract the attention of weed science researchers as well as growers themselves. The effectiveness of 1,1'-dimethyl-4,4'-bipyridinium ion (paraquat) and N-(phosphonomethyl) glycine (glyphosate) as rapidly-acting foliage herbicides as well as the availability of proven soil-applied residual herbicides have made this possible. Furthermore, some new experimental soil applied herbicides appear to hold promise for this new cultural technique.

In 1976 Ilnicki et al. (Proc. NEWSS 30:23-24) reported that combinations of 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (alachlor) + 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron) and alachlor + 4-amino-6-tert-butyl-3-(methylthio)as-triazin-5(4H)one (metribuzin) in combination with paraquat or glyphosate were promising for weed control in double-

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crop soybeans. In 1977, Michieka et al. (Proc. NEWSS 31:61-69) observed that N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzen= amine (pendimethalin) or linuron in combination with glyphosate or paraquat effected good control of weeds and that there was no advantage in combining these two with either of the two contact herbicides.

It was the objective of this study to explore further the use of these herbicides in this relatively new cultural practice as well as to evaluate some new herbicides. Another objective was to determine if diesel fuel could substitute for glyphosate or paraquat as a knockdown agent.

METHODS AND MATERIALS

Soybeans (Glycine max L. cv. Williams) were planted June 22 into a standing barley stubble at the Soils and Crops Research Center, New Jersey Agr. Expt. Sta., Adelphia, N. J. Three 30-inch soybean rows occupied each 24-foot long plot on a Freehold sandy loam soil. On June 23, herbicide applications were made at 40 GPA with a 5-nozzle CO_2-propelled backpack sprayer. Paraquat at 1/2 lb/A (plus the surfactant X-77 1% v/v) and glyphosate at 2 lb/A were combined with pendimethalin; 2-tert.-butyl-4-(2,4-dichloro-5-isopropoxgphenyl)-$\Delta^2$1,3,4 oxadiazolin-5-one (oxadiazon); 2-chloro-1-(3-ethoxy-4-nitro= phenyl)-4-trifluoromethyl benzene (oxyfluorfen); alachlor + N-1 naphthylphthalamic acid (naptalam) + 2-sec-butyl-4,6-dinitrophenol (dinoseb); alachlor + linuron; alachlor + metribuzin; alachlor + oxyfluorfen, and pendimethalin + linuron (Table 1). Alachlor + naptalam + dinoseb, alachlor + linuron, and alachlor + metri- buzin were also applied with diesel oil containing Triton 363M 1% v/v at 2 GPA, in place of paraquat or glyphosate. A rating system with 0 = no crop injury or weed control and 10 = complete crop stand or vigor reduction or total weed kill was used on July 19 to consider effects on soybeans, lambsquarters (Chenopodium album L.), common ragweed (Ambrosia artemisiifolia L.), wild mustard (Brassica kaber (DC.), fall panicum (Panicum dichotomiflorum Michx.), and stinkgrass (Eragrostis cilianensis (All.) Lutati.).

RESULTS AND DISCUSSION

Combining glyphosate with pendimethalin produced improved lambsquarter control over that of paraquat + pendimethalin, but

control of fall panicum was only fair with both of these combinations. Fall panicum control was improved by combining either paraquat or glyphosate with 1 lb/A oxadiazon but soybean vigor was slightly reduced. Increasing the rate of oxadiazon to 1 1/2 lb/A produced no overall increase in control where paraquat was included, but the combination with glyphosate produced excellent weed control with very slight soybean injury.

Oxyfluorfen at 1/4 lb/A produced good weed control in combination with glyphosate, but with paraquat, soybean vigor was decreased significantly and weed control was poor. Doubling the rate of oxyfluorfen did not improve control where paraquat was used. Excellent weed control, however, was obtained with glyphosate but soybean vigor was decreased significantly.

Paraquat or glyphosate in combination with 1 1/2 or 2 lb/A alachlor and naptalam + dinoseb were poor on lambsquarter and the combination with paraquat reduced crop vigor significantly.

Paraquat in combination with 2 lb/A alachlor + linuron produced excellent weed control as a result of the increased rate of alachlor, but the latter did not affect the fair control produced by the corresponding glyphosate tank mix.

The 1 1/2 and 2 lb/A rate of alachlor in combination with metribuzin produced almost complete control with paraquat but with glyphosate in place of paraquat only fair weed control resulted regardless of the rate of alachlor.

Increasing the rate of pendimethalin did not improve weed control at all over the lower rate when used with paraquat and linuron. When glyphosate was substituted for paraquat, the fair weed control for the herbicides was not improved.

Alachlor + linuron + diesel oil was ineffective on lambsquarter and fall panicum. Alachlor + naptalam + dinoseb + diesel oil also produced very poor control of lambsquarter and wild mustard whenever control of stinkgrass decreased. Substituting naptalam + dinoseb with metribuzin produced a good increase in lambsquarter control and the poor control of fall panicum and wild mustard was not improved.

Table 1 - Single and combination herbicide treatments used with paraquat and glyphosate in no-tillage, double-crop soybeans.*

Herbicide	Rate (lb/A)
pendimethalin	1
oxadiazon	1 1 1/2
oxyfluorfen	1/4 1/2
alachlor + (naptalam + dinoseb)	1 1/2 (2 + 1) 2 + (2 + 1)**
alachlor + linuron	1 1/2 + 1/2 2 + 1/2
alachlor + metribuzin	1 1/2 + 3/8 2 + 3/8**
pendimethalin + linuron	3/4 + 1/2 1 + 1/2

*All single and combination herbicide treatments used with paraquat at 1/2 lb/A and glyphosate at 2 lb/A.

**These treatments also applied with diesel fuel oil at 2 GPA containing Triton 363M 1% v/v instead of glyphosate or paraquat.

DISSIPATION OF TRIAZINES IN CONVENTIONAL AND NO-TILLAGE CORN

J. V. Parochetti[1]

ABSTRACT

Field studies were conducted from 1973 through 1977 in silt loam soil at the Plant Research Farm, Silver Spring, MD to determine the dissipation of atrazine, simazine and cyanazine in conventional and no-tillage corn. Rye was used as a cover crop in no-tillage corn and was treated with paraquat. To determine triazine persistence, barley was sowed in the autumn in the experimental area following corn harvest; the land was disked twice and the barley planted. The following spring, individual plots were harvested. Plot size was 10 by 30 feet with 4 replications. Additional data taken were fall panicum control, corn injury ratings approximately one month after planting, and corn yields. Cyanazine was included only in 1973 and 1974 studies at 2, 4 and 8 lb/A. No reduction in barley yields were noted the following spring, indicating no cyanazine persistence. Atrazine and simazine were applied at 2, 4, 8 and 16 lb/A in all years except in 1973 and 1974 when the 16 lb/A rate was not included. There was no reduction in barley yields from the highest rates of atrazine in 1973 (8 lb/A) and 1975 (16 lb/A) in both conventional and no-tillage corn. Atrazine residuals did effect barley yields in both conventional and no-tillage corn in 1974 at 16 lb/A, but not at 8 lb/A. In 1976, atrazine dissipation was greater in no-tillage than conventional tillage; in the no-tillage system, barley yields were reduced only at the 16 lb/A or higher. In some years simazine was more persistent than atrazine. In 1973 simazine was the only herbicide (8 lb/A) to effect barley yields in both conventional and no-tillage corn. In 1974, simazine at rates of 8 and 16 lb/A, in both tillage systems, reduced barley yields. Simazine dissipated more rapidly under no-tillage than conventional tillage in 1975 and 1976 whereas in other years there were no differences. In 1975 barley yields were reduced in no-tillage only in 16 lb/A plots of simazine whereas in conventional tillage 8 lb/A or higher reduced barley yields. In 1976, barley yields were reduced in no-tillage at 8 lb/A or higher whereas in conventional tillage 4 lb/A or higher reduced barley yields.

Significant corn injury occurred with simazine at rates of 8 and 16 lb/A in no-tillage and at 16 lb/A in conventional corn in 1975 although corn yields were not reduced. Fall panicum control was best from applications of simazine and cyanazine when compared to the control atrazine treatments.

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THE EFFECT OF NITROGEN ON SOIL PH AND ATRAZINE METABOLISM

G. W. Burt and M. G. Schnappinger [1]

ABSTRACT

Enhanced triazine dissipation caused by pH effects of nitrogen fertilizers may be an important factor in reducing triazine effectiveness in the field. This problem may be amplified under no-tillage conditions because the upper surface, once acidified by nitrogen, is not mixed into the soil profile. Laboratory and field experiments were conducted to determine the effect of nitrogen on the pH of the soil surface. In the laboratory, vials (height = 7.0 cm; diameter = 3.5 cm) were filled with soil, sprayed with a commercially formulated liquid nitrogen solution and then placed in constant temperature chambers at 25 C. Vials were removed at predetermined times after spraying, sectioned into four depths (0-.5, .5-1, 1-2 and 2-4 cm) and the pH determined. The nitrogen solution was applied at a rate equivalent to 100 pounds of nitrogen per acre unless otherwise stated and contained 42.2% ammonium nitrate and 32.7% urea.

Application of 100 lb/A nitrogen solution affected the pH in most soils studied. The pH of a Lakeland sand and a Hagerstown loam (original pH = 6.8) increased during the first week after nitrogen application and then was reduced more than one pH unit below the controls at 20 days after application. At 95 days after nitrogen application the pH remained approximately one pH unit below control values. These changes in pH occurred equally throughout the 4 cm depth in the Lakeland sand but were more pronounced in the upper 2 cm in the Hagerstown loam. The pH of a Chillum loam soil (original pH = 5.0) increased in response to nitrogen application throughtout the first 30 days. At 95 days after nitrogen applicatiopn the pH was equal to the controls. Adjusting the pH of the three soils mentioned above with CaO or $FeSO_4$ to pH values from 4.5 to 7.4 did not greatly effect the pH response to nitrogen levels except at the lower pH values. Additional experiments have shown the effect of different nitrogen application rates on pH and the quantities of two different liming materials ($CaCO_3$ and Promesol) required to overcome the acidification of the soil by nitrogen fertilizer. Bioassay and radioactive experiments with atrazine and simazine are now in progress in order to determine the importance of the interaction between nitrogen fertilizer, soil pH and triazine inactivation.

Field results also indicated that liquid nitrogen application reduced the soil pH. This reduction in pH was significant at the 0 to 0.5 in depth but not at 0.5 to 3.0 in depth. Weed control ratings for Setaria sp. and Panicum dichotomiflorum indicated that there was a correlation between low pH in the soil surface and poor weed control with atrazine and simazine.

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WEED SEED RESPONSE TO ETHYLENE AND RELATED HYDROCARBONS

R. B. Taylorson [1/]

ABSTRACT

Seed germination of 10 grass and 33 broadleaved weed species was examined for response to ethylene. Only nine species were promoted, two were inhibited, and the remainder were not affected. Of the species promoted, purslane (*Portulaca oleracea* L.) lambsquarter (*Chenopodium album* L.), and several Amaranths including redroot pigweed (*Amaranthus retroflexus* L.) were affected most. Transformation of phytochrome to the active form (P_{fr}) gave interactions with the applied ethylene which ranged from nil to synergistic. In subsequent tests purslane, redroot pigweed, and giant foxtail (*Setaria faberi* Herrm.), a species not responsive to ethylene, were examined for germination response to 14 other low molecular weight hydrocarbon gases. Some promotive activity was found in the olefins propylene and propadiene on purslane and pigweed. Propion- and butyraldlehyde were slightly stimulatory to purslane only.

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FIELD EVALUATION OF SEVERAL POTENTIAL GERMINATION STIMULANTS

W. Hurtt and R. B. Taylorson[1/]

ABSTRACT

Studies were conducted on a clay loam soil at Frederick, MD in 1976 and 1977 to determine if weed seeds could be stimulated to germinate by incorporation of various chemicals into the soil. The chemicals applied and rates (ai) were: sodium azide at 4.48, 8.96, 17.90, and 35.84 kg/ha; ammonium nitrate at 33.60 and 67.20 kg/ha; and butylate at 0.22 and 0.45 kg/ha. Each test site was prepared with a tractor-mounted rotary tiller to a finished depth of 18 cm. Plots, 1.3 x 6.1 m, were arranged in a randomized complete block design with four to six replicates. Chemicals were incorporated by rotary tilling to a depth of 8 $\pm$ 1 cm following application in water at 235 L/ha with a bicycle sprayer. Each block contained two controls to obtain a better estimate of variations in the weed population. Numbers of emerged weed seedlings per 0.1-m^2 quadrats were recorded at various intervals.

The first application was in Sept. 1976 and weed counts made at 23 and 58 days after treatment. Few statistically significant differences were found between treatments at either date. On the second evaluation date, the plots treated with 0.22 kg/ha of butylate were the only ones containing more weeds than the control plots. The apparent enhancement of emergence was 14% for broadleaf weeds.

Treatments applied in April and May of 1977 were generally inconclusive. Few weeds emerged in any plots because of extreme drought conditions. There were suggestions of enhanced emergence of weeds from various treatments but no consistent trends were evident.

The June application received considerably more rainfall with resulting larger weed populations. Weed counts at 51 and 71 days after application showed large increases (48 to 90%) in grass populations in plots treated with the lowest rate of sodium azide and butylate.

The Sept. application, in contrast to the four previous experiments, experienced more normal rainfall and temperatures. Analysis of the broadleaf weed data over two rating dates showed several significant differences between treatments with indications of azide and butylate stimulation at the lowest application rates. Examination of the treatment times date interaction revealed that the plots treated with sodium azide at the lowest rate had significantly more broadleaf weeds than any other plots including both controls.

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TUBER DORMANCY AND RESPONSE OF YELLOW NUTSEDGE BIOTYPES TO PHOTOPERIOD AND ATRAZINE [1/]

C. P. Yip and R. D. Sweet [2/]

ABSTRACT

Several experiments were conducted in controlled environment to determine if tuber dormancy of yellow nutsedge (*Cyperus esculentus* L.) biotypes from Washington (WA), Illinois (IL), New York (NY), Georgia (GA), Arizona (AZ) and Florida (FL) was correlated with the temperature regimes of their natural habitat. Tubers were collected from plants grown in the greenhouse, and stored at 4° or 15°C for zero to five weeks. They were sprouted at an alternating temperature of 21° to 26°C. Tubers from WA, IL and NY required a longer period of 4°C treatment to break dormancy than those from GA, AZ and FL. In photoperiod experiments, seven biotypes were grown under 10, 12, 14 and 16-hour photoperiod for 3, 6 and 12 weeks. Tuberization of all biotypes was enhanced with decreasing day length. Except GA, growth of all biotypes was greatly reduced under 10-hour photoperiod. GA produced as much top growth under 10-hour photoperiod as 12, 14 or 16-hour photoperiod. Biotypes from southern latitudes (GA, AZ, FL, HI) produced more top growth than those from more northern latitudes (WA, CA, NY) under 12-hour photoperiod. Biotypes from WA, CA, AZ, GA and FL were more tolerant of atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-*s*-triazine] than those from NY, IL and OH. Differences in tuber size among biotypes did not influence their response to atrazine.

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Factors Affecting the Growth of Quackgrass (*Agropyron repens* L. Beauv.)

Bradley Majek and William B. Duke[1]

ABSTRACT

The majority of quackgrass (*Agropyron repens* L. Beauv.) rhizome buds remain dormant at all times in the field but not when placed in the greenhouse or growth chamber. Herbicide translocation studies conducted under these controlled conditions have been hampered by an increased tendency for the rhizome buds to break dormancy rather than acting like normal field grown plants. In the greenhouse lateral shoots are formed by up to 100% of the lateral rhizome buds after planting, after contact of the rhizome tip with the side of a plot or flat, or with the removal of a rhizome tip. Studies have indicated that the behavior of the lateral buds of the quackgrass rhizome are influenced by a variety of factors including nutient levels available in the growth medium. Varying levels of nitrogen, phosphorous, and potassium available to quackgrass grown under standard sand culture techniques resulted in altering the behavior of the apical tip and lateral buds of the quackgrass rhizomes. It appears that altering nutrient levels will enable one to change the dormancy characteristics of control grown plants to closely approximate those observed under field conditions.

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EPTC + R-25788 INJURY TO CORN: THE INFLUENCE OF SOIL MOVEMENT AND STAGE OF GROWTH

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

ABSTRACT

The separation of EPTC and R-25788 in the soil is a possible reason for the sporadic toxicity of this herbicide to corn. Previous studies have shown that EPTC and R-25788 separate when they move down through the soil profile because the protectant is more mobile than EPTC.

A study was conducted to determine the relative position of EPTC and R-25788 in soil columns (24 cm tall by 9.2 cm diam) immediately after leaching and 6 days thereafter. The soil (Galestown loamy sand) was treated by applying EPTC + R-25788 at 212 and 18 ppm, respectively, in the upper 2 cm of the columns and adding sufficient water (6.25 cm) to moisten the soil in the entire column but not enough to leach out. EPTC and R-25788 contents in 4 (6 cm) soil sections from each column were determined. The ratio of EPTC to R-25788 changed from the applied 12:1 (commerical formulation) to 1229:1 in the upper 6 cm of soil and 0.8:1 in the lower 6 cm of soil in columns analyzed immediately after treatment. In columns analyzed 6 days after treatment, the EPTC to R-25788 ratio in the upper 6 cm of soil was 23:1 and decreased gradually to 1.8:1 in the lower 6 cm of soil. It appears, therefore, that the EPTC to R-25788 ratio may be restored to normal upon drying of the soil. However, there is a period of time following leaching where the concentration of EPTC in the soil, close to the surface, is much greater than 12 times the concentration of R-25788.

Another study was conducted in the greenhouse to determine the susceptibility of corn to EPTC + R-25788 at different growth stages. Corn (Pioneer 3334A) was planted in pots (15 cm diam) at 2 week intervals for 8 weeks. EPTC (+ R-25788) was applied at 12.5 and 25 ppm in the soil to plants 0, 2, 4, 6 and 8 weeks old. Injury symptoms and plant height were recorded weekly. Plants treated at 0, 2 and 4 weeks showed injury from EPTC at 12.5 or 25 ppm. After 56 days, however, only those treated when 4 weeks old remained injured. When applied at 25 ppm, plants treated when 0, 2, or 4 weeks old showed significant height reductions. After 56 days, however, all plants recuperated (> 84% of control) except those treated when 4 weeks old (45% of control). It appears, therefore, that corn is most susceptible to EPTC + R-25788 when exposed at 4 weeks after planting.

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RESPONSES OF CORN, CRABGRASS AND LAMBSQUARTERS TO VARYING LEVELS OF N AND K IN NUTRICULTURE

P. J. Shea and R. A. Peters[1]

ABSTRACT

Growth chamber experiments were conducted to study the responses of corn, large crabgrass (Digitaria sanguinalis L. Scop.) and lambsquarters (Chenopodium album L.) to varying levels of N and K in modified Hoagland's solution. K concentrations were held at 6 mM for N treatments of 8×10^{-1} mM, 6 mM, 25 mM and 40 mM. N concentrations were held at 25 mM for K treatments of 5×10^{-2} mM, 1.5 mM, 6 mM and 10 mM. Corn was grown either alone or in association with crabgrass or lambsquarters. Both weeds were also grown alone. Plants were harvested after 4 weeks. Height, dry weight yields, tiller number and N and K content of the shoots and roots were determined.

Corn plants produced higher yields than weeds alone or in association. Weed yields were reduced more in association than corn yields. When grown alone, corn and crabgrass yields increased with N or K levels, with the greater response at the lower increments. Lambsquarters yields increased only with the lower increments of N or K. In association, corn and lambsquarters yields increased with N or K levels but crabgrass showed little change.

All plants removed less total nutrients in association than when grown alone. Percent N or K of corn remained the same or decreased in association while that of weeds remained the same or increased. Corn removed more N and K from solution than crabgrass or lambsquarters either alone or in association. Weeds growing alone removed similar amounts of K, but lambsquarters removed more N than crabgrass. Nutrient removal by corn was little affected by a change in associate weed species. Lambsquarters removed more N and K in association than crabgrass.

When grown alone, corn and crabgrass removed more N and K as either nutrient was increased. Lambsquarters removal of N did not increase beyond 25 mM N or 6 mM K nor was K removal increased beyond 25 mM N. In association, weed and corn removal of N increased with N concentration. Corn in association with lambsquarters removed more N with increasing K levels than when in association with crabgrass. N removal by crabgrass in association did not increase with K levels. N removal by lambsquarters did increase at the lower increment of K. K removal by corn in association increased with N or K levels. K removal by crabgrass in association increased with K concentration, but did not increase beyond 6 mM N. K removal by lambsquarters in association did not increase beyond 25 mM N or 6 mM K.

When grown alone maximum crabgrass tillering occurred at 6 mM K and 40 mM N but did not respond to N or K increments in association. All plants increased their root/shoot ratios when grown in association.

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ANNUAL WEEDY GRASS COMPETITION IN FIELD CORN[1/]

Jonas Vengris[2/]

ABSTRACT

Competition studies in field trials were conducted between field corn and annual weedy grasses. In 1974 large crabgrass (Digitaria sanguinalis (L) Scop.) and in 1975 and 1976 fall panicum (Panicum dichotomiflorum Michx.) was dominant weed. In all experiments these two weedy grasses represented over 90 percent of the total weed population. The yields of silage corn without weed competition were 36.9 kg/plot. When weeds competed for the whole season yields were 21.2 kg/plot. The longer weedy grasses were allowed to compete after corn emergence, the more corn yields were decreased. The period of weedy grass competition that field corn tolerated was 2 to 4 weeks. Competition for moisture was probably a prime factor. Weedy grass control was most critical during the first 2 to 4 weeks after corn emergence. Grassy weed control for longer periods did not increase corn yields significantly. Field corn had a very significant competitive effect on weeds present.

INTRODUCTION

Fall panicum (Panicum dichotomiflorum Michx.) and crabgrasses (Digitaria spp.) have become serious problems in most of the Northeastern United States. Fall panicum was considered scarce and almost insignificant some fifteen years ago, however, the advent of 2,4-D [(2,4-dichlorophenoxy) acetic acid] and atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine] for weed control in corn and other crops has changed this picture. Major infestations are seemingly correlated with intensive cropping and heavy atrazine or 2,4-D use since these herbicides frequently do not provide adequate control. The major infestations with these weeds are found in corn, alfalfa, birdsfoot trefoil, sweet corn, and soybeans. Under presently used high levels of fertility and apparent resistance to acceptable herbicides, these weed species develop into vigorous spredding or upright plants which undoubtedly reduce crop yields through competition for moisture, nutrients, and light. Data for crop losses from various weeds are limited. Quantitative information concerning losses in productivity caused by problem weeds is needed to determine the economic feasibility of proposed weed control practices.

The objective of our investigations was to obtain specific information concerning competition between these two annual weedy grasses and silage field corn (Zea mays L. Agway 390X)in relation to the time of weed emergence and length of competition.

1/ Paper No. 2187, Massachusetts Agr. Exp. Sta., Univ. of Massachusetts at Amherst. This research is supported from Exp.Sta. Hatch Project No.375.

2/ Prof. Dept. of Plant and Soil Sci., Univ. of Massachusetts, Amherst, MA. 01003.

MATERIALS AND METHODS

Field experiments in 1974, 1975, and 1976 were conducted at the South Deerfield experimental farm on fine sandy loam with good drainage. A randomized block design with four replicates was used. Each plot consisted of four corn rows planted 0.9 m apart, 9 m long.

The experimental areas were thoroughly and uniformly infested with fall panicum and crabgrass weeds. Each year the experimental area was overseeded with fall panicum seed to be certain of obtaining thick weed populations in addition to natural infestations. In rather low populations of weeds, weed densities may influence the competitive effect of the weeds significantly. In contrast, heavy populations such as occurred in our experimental areas seem to have a saturating competitive effect. Several-fold increases in population of weeds then influence their total effect very little (2). In 1974 crabgrass was dominant weed comprising 70% of the stand and in 1975 and 1976 fall panicum by far was dominant plant comprising 85% of the weed stand. In all experiments both these two weedy grasses together represented over 90 percent of the total weed population. The rest of the weed population consisted of yellow foxtail (Setaria lutescens (Weigel) Hubb.), witchgrass (Panicum capillare L.) and giant foxtail (Setaria faberi Herrm). All experimental areas were kept free of broadleaf weeds by hand weeding. In 1974 and 1976 a few scattered lambsquarters (Chenopodium album L.) and redroot pigweed (Amaranthus retroflexus L.) plants were killed with 2,4-D.

Seedbed was prepared by disking, liming and fertilizing with 1120 kg/ha of 10-10-10 fertilizer. Additionally each year approximately three weeks after corn emergence areas were topdressed with ammonium nitrate at 56 kg/ha nitrogen. Seedbed was prepared 1 to 3 days before corn planting and corn was planted in 1974, 1975 and 1976 on May 16, May 19, and June 6, respectively.

In the experiments treatments were included in which weeds were controlled for different periods at the beginning of the season after corn emergence. Thereafter, no control measures were applied. To study corn competitive effect on weeds in these treatments, corn was removed in duplicate plots to allow weeds to establish and grow in pure stands. Treatments were included in which weeds were allowed to grow undisturbed for different periods and until harvest of corn. At the end of the prescribed periods of weed competition, the weeds were removed with as little disturbance to the corn as possible and weed yields were determined. The weed-free condition was maintained until harvest by periodic hand-weeding.

Silage corn was harvested in September, approximately 15 weeks after emergence. Two middle rows served for yield determination. Weed yields were determined by weighing two 0.4m^2 area weeds in each plot. In Tables dry matter yields per 16.7m^2 plots are presented.

Monthly average air temperature and precipitation at Amherst, Massachusetts are presented in Table 1.

Table 1. Monthly average air temperatures and precipitation at Amherst, Massachusetts

	Temperature				Precipitation			
Month	1974 (C)	1975 (C)	1976 (C)	Normal (C)	1974 (mm)	1975 (mm)	1976 (mm)	Normal (mm)
May	13.1	16.9	14.2	14.3	132	53	114	96
June	18.9	19.3	22.2	19.3	86	119	56	103
July	21.8	23.1	21.5	22.0	94	268	56	97
August	20.7	21.1	21.1	20.9	101	156	158	98
September	16.6	15.2	16.3	16.6	183	219	70	110
October	7.8	12.3	9.4	11.0	49	124	109	78
Total					645	939	563	582

RESULTS AND DISCUSSION

The longer weedy annual grasses were allowed to compete after corn emergence, the more crop yields were decreased (Table 2). There was a drastic reduction in yield when weeds competed for the whole season. Although even after two weeks of competition crop yields were already slightly decreased, differences were not statistically significant. Six weeks of competition decreased corn yeilds in any year significantly. As the weeds competed with crop for longer and longer periods, the yield of the crop was reduced further. Competition for all season, i.e. approximately 15 weeks, decreased corn yields in 1974, 1975, and 1976 by 40%, 25%, and 62%, respectively.

Table 2. Air dry matter yields of silage corn and weeds as influenced by weed competition for indicated periods after which corn grew alone.

	1974		1975		1976		Averages	
	kg/16.7m^2		kg/16.7m^2		kg/16.7m^2		kg/16.7m^2	
Treatments	Corn	Weeds	Corn	Weeds	Corn	Weeds	Corn	Weeds
1. No competition	36.8a[a)]	0	37.0a	0	36.8a	0	36.9	0
2. Competition 2 weeks	35.5ab	1.0	36.6a	0.3	34.4ab	1.1	35.5	0.8
3. Competition 4 weeks	30.6d	4.3	35.1ab	0.8	25.6d	3.6	30.4	2.9
4. Competition 5 weeks	29.4d	4.6	-	-	21.7c	7.5	25.6	6.0
5. Competition 6 weeks	26.2e	6.8	29.1c	4.6	-	-	27.6	5.7
6. Competition 7 weeks	25.3e	7.4	-	-	16.8f	9.6	21.0	8.5
7. Competition 8 weeks	-	-	29.9c	6.7	16.0f	13.1	23.0	9.9
8. Competition all season	22.0f	8.6	27.6c	7.6	13.9g	14.9	21.2	10.4

a) Numbers within columns not followed by the same letter are significantly different at the 5% level as determined by the Duncan's multiple range test.

Under the conditions of our experiments, the fertility levels were high and mineral nutrients were evidently adequate for both the crop and weeds. Corn for the whole growing season was taller than the weedy grasses present and competition for light could not play any important role. In all probabity moisture was minimum and thus was the most important factor in these competition

trials. Actually the 1975 season (Table 1) was rather wet, competition for moisture rather weak, and corn yield decrease due to the competition was the lowest. It took more than four weeks of weed competition to decrease corn yields significantly. On the other hand the 1976 growing season was the driest and competition for moisture could have been stronger than for the other two years. Further, in 1976 corn was planted rather late and in June the emerged fall panicum produced vigorous, fast growing and competitive seedlings (3). In plots where weedy grasses competed all the growing season, the weeds growing together with corn that year produced even higher yields than the corn. If competition for soil moisture is the prime factor, the crop may suffer permanent damage from weed competition very early in the season. If competition is primarily for light, the crop may tolerate the weeds for a fairly long time and not suffer yield reducing suppression until the weeds exceed the crop plants in height and shade them.

Table 3. Air dry matter yields of corn and weeds as influenced by length of weed-free period after corn emergence.

Treatments	1974 kg/16.7m^2 Corn	1974 kg/16.7m^2 Weeds	1975 kg/16.7m^2 Corn	1975 kg/16.7m^2 Weeds	1976 kg/16.7m^2 Corn	1976 kg/16.7m^2 Weeds	Averages kg/16.7m^2 Corn	Averages kg/16.7m^2 Weeds
1. Weed-free 2 weeks	34.7abc[a)]	3.0	33.9b	5.4	30.4c	2.7	33.0	3.7
2. Weed-free 4 weeks	34.8abc	0.6	34.7ab	0.7	31.2c	0.2	33.6	0.5
3. Weed-free 5 weeks	36.9a	0.4	-	-	32.4abc	0.1	34.6	0.2
4. Weed-free 6 weeks	35.9ab	0.2	36.0ab	+[b)]	-	-	36.0	0.1
5. Weed-free 7 weeks	36.4ab	0.2	-	-	32.5abc	+[b)]	34.4	0.1
6. Weed-free 8 weeks	-	-	36.0ab	+[b)]	34.0ab	+[b)]	35.0	+
7. Weed-free all season	36.8a	0	37.0a	0	36.8a	0	36.9	0
8. Check, no control	22.0f	8.6	27.6c	7.6	13.9g	14.9	21.2	10.4

a) Numbers within columns not followed by the same letter are significantly different at the 5% level as determined by the Duncan's multiple range test.

b) + indicates yields less than 0.1 kg/16.7m^2 plots.

In any year weed control for longer than 4 weeks (Table 3) did not increase silage corn yields significantly. In 1974 even two week control was effective enough to obtain corn yields not significantly lower than from plots with weed control all season. This demonstrates that it is important to eradicate the first crop of weedy grass seedlings. In 1974 and 1975 when weed control was stopped as early as two weeks after corn emergence, weeds were not able to establish a vigorous competitive stand in advanced and taller corn.

Table 4. Corn yield decrease due to weed competition and weedy grass yield decrease due to corn competition.

Treatments	Corn yield decrease % 1974	1975	1976	Average	Weed yield decrease % 1974	1975	1976	Average
1. Competition all season	40	25	62	42	-	78	35	57
2. Weed-free 2 weeks	5	9	17	10	77	76	82	78
3. Weed-free 4 weeks	5	6	15	9	95	95	95	95
4. Weed-free 6 weeks	2	3	-	3	96	98	-	97

In treatments with different weed-free periods after corn emergence weeds that emerged subsequently grew either with or without competition from the corn. In the absence of competition from the crop, weeds made considerable growth before harvest time. In contrast the duplicate plots, where the field corn was not removed due to the competition from the crop, weed growth was suppressed. In check plots where weeds were allowed to compete all the growing season, corn yields were decreased due to weed competition 42 percent (Table 4). On the other hand weed yields of check plots due to the competition by corn were decreased 57 percent. This indicates that corn is a stronger competitor and decreased weed yields more than weeds decreased corn yields. After 2, 4 or 6 weeks weed-free corn, newly emerged weeds were suppressed even more. Corn yield decrease by later emerged weed seedlings was negligible. Dawson (2,3) speaks about two-stage weed control. During the first stage the farmer must provide control of weeds by some means (herbicide, tillage). During the second stage the crop controls weeds by competition, provided, of course, that the stand of the crop is complete and vigor is normal. Competition for light appears to be the major basis for competitive weed control during the second stage. In our case weeds emerging after a 4-weeks weed-free period on the average suppressed corn 9 percent, whereas on the other hand weeds were suppressed by corn 95 percent.

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REDROOT PIGWEED COMPETITION IN RED KIDNEY BEANS[1/]

Andrew Senesac and P. L. Minotti[2/]

ABSTRACT

A field experiment was designed to estimate when and for how long dry beans must be maintained weed free to avoid yield depressions. In some plots Redkloud beans were maintained weed free by weekly hand hoeing for specified time periods (two week intervals) while in other plots weeds were allowed to grow before being removed at two week intervals. Bean yields (biological yield and pod yield) were taken at harvest and biological yield at midseason (six weeks). Final harvest was at the mature green pod stage due to an August infestation of Sclerotinia white mold. Weed yield was taken at harvest and when removed from plots that were subsequently maintained weed free.

The natural stand of redroot pigweed (Amaranthus retroflexus L.) was dense and uniform comprising about 90-95% of the weed population. Beans kept weed free for the first four weeks or more showed little reduction in yield. Also weeds present for the first four weeks had little effect on bean yields providing they were not allowed to persist beyond that time. Weed growth and population was severely reduced when plots were kept clean for more than four weeks. The bean canopy was closing in at about five weeks in these plots.

Pigweed competing with beans for the entire season reduced pod weight by 77% while pigweed was reduced only 27% by full season bean competition. Six week data showed pigweed reducing bean dry weight 23% while pigweed was reduced 42% by beans demonstrating the greater relative dry weight production of pigweed later in the season. Pigweed competition for eight weeks or more also markedly reduced harvest index, the proportion of shoot dry matter comprised by the maturing pods.

Under these conditions where weed pressure was considerable, the data indicate that an ideal preemergence herbicide treatment should remain effective for about four weeks and that postemergence treatments should not be delayed beyond this time.

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Release of Phytotoxic Residues from Wild Mustard

(*Brassica kaber* (D.C.) L.C. Wheeler)

C. G. Erickson and W. B. Duke

ABSTRACT

Wild mustard (*Brassica kaber* (D.C.) L.C. Wheeler) is a very competitive weed in corn (*Zea mays* L.) and other crops in upstate New York. Preliminary greenhouse research has suggested that the competition may in part be due to the release of phytotoxic chemicals from decaying top and stem residues. Aqueous extracts of decomposing wild mustard were highly toxic to Japanese millet (*Echinochloa crusgalli* var *frumentacea* (Roxb.) W.F. Wight) in an agar system. The soil microbial effect on the decomposition extracts will be discussed.

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STABLE PLANT COMMUNITIES - THEIR DEVELOPMENT AND MAINTENANCE

Richard Stalter 1/

The following study is based upon ten years of field work and observations by the author. To appreciate the development of plant communities, a knowledge of the factors influencing plant succession must be understood. It has been well documented (41) that succession on disturbed sites may be influenced by the type of community surrounding the disturbed site, soil conditions including texture, shallowness of soil profile, topography, depth of the water table, competition for soil moisture, shading, macro and micro-climate, phytochemical considerations (allelopathy), faunal influence including insect activity, activity of small and large mammals, the previous use of the land including the type of crop grown on the land (42), and the type of management of the right-of-way (41). Each of these aforementioned factors will be discussed in the body of this paper with the exception of the previous use of the land since the last two topics have been discussed in detail in an earlier paper by the author (41). A list of desirable grasses, shrubs, and small trees is included (Table 1.). While most investigators include work on plant succession, many seem to be unaware of the effect of allelopathy on plant succession (38) and its importance in maintaining certain kinds of plant communities. Accordingly a considerable portion of this paper is devoted to allelopathy.

If a cleared forest area in the eastern United States is allowed to lie undisturbed, it is usually invaded by annuals during the first year, numerous perennials the second year, and eventually by woody plants (36). Any disturbance of natural vegetation, e.g., cultivation, fire, or lumbering will produce a sequence of communities.

In cleared forest areas, such as utility rights-of-way, the perennial herbs are soon superseded by the woody plants of the neighboring forest. In forests where the woody vegetation has only been partially destroyed, e.g., cut but not plowed or severely burned, the progress of succession is more rapid than in fallow fields or abandoned pastures in the same region. Certain arborescent and frutescent species capable of reproducing vegetatively by root and stump sprouts may attain dominance at an earlier date.

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There are significant studies of the vegetation of Connecticut (30); Massachusetts (11, 28); Martha's Vineyard (34); Long Island (6, 8); New Jersey (2, 45); and Maryland (27), and excellent accounts of the history of the vegetation of southern New England (5, 34). These accounts, gleaned primarily from old travel diaries, indicate that the colonists found forest conditions similar to those of today. The vegetation and plant communities of all the above-mentioned areas are covered in an excellent book Deciduous Forests of Eastern North America (3).

There are numerous investigations of secondary succession (3, 7, 35, 36, 37, 44).

A report on secondary succession and "old field" associations in southern Rhode Island and southeastern Massachusetts indicates that red cedar (*Juniperus virginiana* L.), sweet birch (*Betula lenta* L.), gray birch (*Betula populifolia* Marsh.), choke cherry (*Prunus virginiana* L.), and dogwood (*Cornus* spp.) are generally found on abandoned fields (28). These trees are replaced by oaks (*Quercus* spp.), and American ash (*Fraxinus americana* L.) tending toward the hemlock-hardwood climax community (28). Hemlock (*Tsuga canadensis* (L.) Carr) is the tree best fitted to dominate the climax forest of southern New England due to its longevity, shade tolerance, and ultimate size (5). However, hemlock's rather high moisture requirements and its susceptibility to fire and desiccating winds render it poorly adapted to xeric sites such as south-exposed ridges, and the sandy, level, wind-swept coastal regions.

The plant communities of the piedmont of North Carolina have been analyzed from the standpoint of secondary succession (35). Horseweed (*Erigeron canadensis* L.) is often dominant in a field abandoned for one year; aster (*Aster*) dominant the second year; and broom sedge (*Andropogon virginicus* L.) dominant in a field abandoned five years. Various shrubs are early invaders of abandoned North Carolina fields accompanied by pine (*Pinus*) which may assume dominance in a field by the fifteenth year. A field abandoned for 50 years is still dominated by pine; however, a well developed hardwood understory may be present. At 200 years an oak-hickory climax forest may develop on the site.

In the Piedmont Plateau of New Jersey, ragweed (*Ambrosia artemisiifolia* L.) and primrose (*Oenothera parviflora* L.) are immediate dominants on fields where crops have been grown the same year (2). Goldenrod (*Solidago nemoralis* Ait.) assumes dominance by the second year and is replaced by aster (*Aster ericoides* L.), which increases to dominance by the fifth year. Little blue stem (*Andropogon scoparius* Michx.) is dominant by the fifteenth year. Red cedar invades fields soon after abandonment and remains the dominant arborescent species for over 60 years. The two dominant shrubs of succession are dewberry (*Rubus flagellaris* Willd.) and poison ivy (*Rhus radicans* L.). At 100 years oaks (*Quercus*) and hickories (*Carya*) assume dominance and

are the climax arborescent species (2).

The successional trends displayed on the fallow land in southern New England (28) are somewhat comparable to those observed on the piedmont in New Jersey (2) or on the flood plain of the Raritan River, New Jersey (45).

However, there are several examples that negate the plant succession to climax concept. Stable treeless communities have been observed by millions of visitors driving along the Blue Ridge Parkway there each year. In Alabama and Mississippi a band of prairie can be found surrounded by coastal plain forest and deciduous forest (36). On Long Island a vast treeless area comprising 60,000 acres known as the Hempstead Plains once extended from Queens County to Hicksville and Farmingdale. Today the area has been reduced to approximately 600 acres in the vicinity of Mitchell Field, and represents the last remnant of natural prairie east of the Appalachians (MacManus 1972, personal communication). Wayne Seifort, a former graduate student in the Biology Department at C. W. Post University, has studied this area under the direction of Dr. R. Loveland (Seifort 1973, personal communication).

The importance of the above communities should not be neglected by ecologists, especially by those who deal with right-of-way management. These unique communities are proof that stable treeless communities can exist under varied climatic conditions and geographic areas, and their existence suggests that with proper management similar stable communities might be encouraged under power lines and rights-of-way.

Animals play an important role in affecting or altering succession in forests and abandoned fields. Insect larva, under certain conditions, may cause serious damage to tree and shrub seedlings since the larva consume the roots of the woody and herbaceous vegetation. The diffuse root systems of grasses appear to withstand insect predation better than arborescent or frutescent species (39). Mice and meadow voles may also feed upon the bark of many tree and shrub species. When the populations of small rodents are large, woody plant seedlings may be particularly susceptible to mouse girdling. Rabbits also feed upon the stems of woody plants and may do a great deal of damage in areas where the winters are unusually severe. More specifically, heavy snow-falls, prolonged snow cover, and high rabbit populations, may prove most damaging to woody species since grasses will be covered leaving only twigs as sustenance for rabbits. The preceeding conditions might be expected once every 10 to 15 years. However, the rabbits will only eat the vegetation that protrudes above the snow so that small protected seedlings will escape damage. Similarly, deer may also browse on woody plants at times when their populations are large and when winter conditions are as described above. I have examined areas in New Jersey near Morristown where starved deer have browsed shrubs adjacent to houses within three

miles of the center of town. In areas where deer are protected and their populations large, deer can be most effective in limiting shrub and tree seedling growth.

Soil conditions including texture, structure, profile development, topography, and soil moisture all affect the kinds of species and rates of succession in an area. Where soil moisture is limiting, grasses can usually out-compete woody species since the fibrous root systems of grasses facilitate rapid and effective moisture absorption (40). Moreover, grasses can endure greater soil moisture stress than most woody plants. In central New York State soil moisture and soil nutrient competition is the most important factor limiting woody vegetation on dry sites (40). In areas that marginally support forests, such as the eastern border of the prairies, moisture nutrient competition may be very severe.

Micro-climate (42) may also be an important factor limiting certain types of vegetation. On rights-of-way, low growing woody plants are exposed to daily extremes in temperature. Most people have observed this phenomenon where portions of the same shrub or tree may bloom or produce leaves a week earlier on one part of the plant than another. Usually the lower branches that are on or close to the ground where day temperatures are warmer may flower earlier than the higher branches. High day temperatures may stimulate precociousness in bud development. Many low growing plants on fields and rights-of-way that exhibit precocious vegetative development may be killed or damaged on clear still nights when frosts are likely to occur. Depressions or peculiarity in topography may result in pockets where cold air collects. These areas may experience frost weeks later in the spring than surrounding higher and/or more protected areas. If the tree seedlings and shrubs are out in leaf, a frost may retard their development, severely injure the plant, or kill it. Thus topography may play a role in enhancing perpetuation of herbaceous species.

The proximity to seed sources influences the type of species found in plant communities undergoing succession. If animals eat or destroy seeds, normal successional patterns will be altered. Invasion of woody species may occur by root sprouting on power line rights-of-way. Plants capable of root sprouting may rapidly invade an area since they are not dependent upon a substrate for moisture and nutrients.

Fire may also be important in retarding the invasion of woody species. Fire, if severe, may destroy shrubs and trees while not affecting grasses and certain herbaceous perennials. Species that are capable of perpetuating themselves vegetatively by root sprouts may be favored by periodic burning. Shading may also be an effective mechanism in eliminating the growth of sun-loving trees such as pine (Pinus), cedars (Juniperus), birches (Betula), and others. However, most open areas do not have sufficient

shade to eliminate the seedling growth of sun-loving plants. Moreover, it is usually the sun-loving herbaceous vegetation that is replaced by shrubs and trees. Finally, if a combination of heavy herbaceous cover is combined with excessive snowfalls, small seedlings can be buried and killed by the combination. On wet sites many seedlings can be buried and killed since the excessively humid anaerobic conditions are deleterious for buds and leaves (40).

Mechanisms that retard or destroy the development of woody vegetation are only active for small periods of time. Once a plant grows above the surrounding vegetation, the seedling will not be subjected to shading and/or burying. Moreover, larger plants with thicker bark may be less susceptible to fire and the ravages of faunal damage. Long leaf pine (Pinus palustris Mill.) is well adapted to periodic burning. A dominant plant of the southeastern coastal plain, long leaf pine may exist in a "rosette stage" for a period of 3 to 5 years and then grow from 1 to 3 feet a year for several years. During this period of rapid growth, the pine is most susceptible to fire. Once the plant reaches 7 to 10 feet in height, light to moderate burns do little damage.

Maintenance of stable plant communities may be obtained if rights-of-way owners and the people who manage them are cognizant of ecological principles (32,33). There are many publications that provide sound advice for right-of-way maintenance (22, 26, 31). While selective cutting of unwanted vegetation may be desirable in maintaining a right-of-way in an earlier stage of succession, selective cutting may be 3 to 6 times as costly as clear cutting (10). One might also consider the expertise or competence of workers hired to do selective cutting (41). Maintenance crews may not be able to distinguish undesirable tree seedlings and saplings from desirable low growing shrubs.

Herbicides have been widely used to control vegetation on rights-of-way. Herbicides are most effective if applied in the spring when the plants are in an active stage of growth. Root-suckers are killed more effectively by late summer basal spray (Egler 1973, personal communication). Maintenance crews should check local weather conditions before applying herbicide to vegetation. Sprays should not be applied during rainy weather or when rainfall is imminent. Heavy rain could wash the herbicide into streams or lakes where it might have an injurious affect on the stream organisms. Moreover, different trees and shrubs have different tolerances to herbicides (12, 13), and those species that are more resistant to herbicides should be treated more often.

Many rights-of-way managers and others fail to grasp basic ecosystem dynamics. Any area in its earliest stage of succession is extremely unstable (32,33). Accordingly, right-of-way maintenance should strive to produce the most stable

community possible that is compatible with power line maintenance. Egler's advice (14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25) has gone unheeded for years! A stable community may resist the invasion of trees and undesirable shrubs, will be aesthetically more attractive, and cost less to maintain than a right-of-way maintained by clear cutting or blanket application of herbicides (41).

Finally, right-of-way managers should use the expertise of scientists that are knowledgeable of ecology in dealing with right-of-way maintenance. It is advisable to choose a person who spends time in the field and who has published work on right-of-way maintenance and/or papers on plant succession.

Many investigators have noted that certain species might be favored on power line rights-of-way (41). Additional desirable shrubs may be encouraged by selective cutting or selective chemical treatment. Any species that is capable of retarding erosion in such places as steep slopes, bluffs, and stream banks should be encouraged. Several grasses - timothy (Phleum pratense L.), orchard grass (Dactylis glomerata L.), red fescue (Festuca rubra L.), foxtail grass (Alopecurus arundinacea L.), little blue stem, big blue stem (Andropogon gerardi Vitmin), and switch grass (Panicum virgatum L.) - might be encouraged where conditions are favorable for their growth and development (40). Of the above species, big blue stem and switch grass are probably of little value in the eastern United States since these two species grow in very restricted habitats. Grasses and shrubs should only be encouraged where conditions are optimum for their establishment and survival. If much time and money must be spent to maintain certain species and plant communities, the plants are not fit for that habitat, and should not be encouraged.

Special attention should be given to unique plant communities. The pine barrens of central and southern New Jersey, eastern Long Island, and Cape Cod, Massachusetts, usually produce trees that will not interfere with power lines. Since the pine barrens are highly flammable, it would be advisable to work with county and state officials to prepare roads which will serve as fire brakes under the power lines. This will assist power line maintenance crews and will serve as a fire barrier. The pine barrens should be periodically burned in the late fall when temperatures are cold and soil moisture high so as to remove debris and reduce the chances of more severe fires that usually occur in the spring. Natural meadows such as exist in central Long Island or near Montauk should be studied to provide information on the self-perpetuation of treeless areas.

High voltage power lines built to carry 460 kv-765 kv provide a new "challenge" to maintenance crews. Since most trees do not grow tall enough to interfere with these transmission lines, it would be advisable to allow natural forest vegetation including all tree species to revegetate the right-

of-way under these lines. Trails could be cut through the forest that would allow maintenance crews to work on the lines and would cause minimal disturbance to the plants and animals of the forest. The forest could be logged periodically for removal of tall trees that might interfere with the power lines to make logging a break-even venture.

While the term allelopathy was first coined by Molish in 1937, DeCandolle was one of the first scientists to notice the effect of one plant upon another (38). Fifty years after DeCandolle's suggestion, two scientists recognized that black walnut (Juglans nigra L.), inhibited the growth of vegetation growing under its branches (43). By 1911 it was noted that plant produced toxins might be important in affecting rates of plant succession (9). Rice states that "The salient point concerning allelopathy is that its effect depends upon a chemical compound being added to the environment by an allelopathic agent."[1] Allelopathy is distinct from competition (38).

There are many examples involving allelopathy: higher plants versus high plants; higher plants versus micro-organisms, micro-organisms versus higher plants, and micro-organisms versus micro-organisms (38).

Studies involving allelopathy in plant succession indicate that a spurge (Euphorbia supina Raf.) was able to inhibit the growth of several species that are common in the earliest stage of succession (e.g. horseweed (Erigeron canadensis L.) while wire grass (Aristida oligantha Michx.) was not affected. Moreover, species in later stages of succession are also adversely affected by the presence of certain species. Broom sedge is inhibiting to the growth of wire grass, little blue stem, and several other species (38). However, allelopathy is not restricted to herbaceous species. Black walnut (Juglans nigra L.), wormwood (Artemisia absinthium L.), tree-of-heaven (Ailanthus altissima (Mill.) Swingle), juniper (Juniperus L. spp.), pinyon pine (Pinus edulis Engelm.), American sycamore (Platanus occidentalis L.), and sugarberry (Celtis laevigata Willd.) inhibit the growth of several different plant species.

Of particular interest to aquatic biologists is the role of allelopathy in restricting species in aquatic habitats. Several distinct plant communities may be found in brackish and freshwater marshes within an elevation gradient of less than 0.5 feet (1). However, the investigators did not test the allelopathic effect of one species on another. Cattail (Typha latifolia L.) produced compounds that inhibited germination of its own

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[1] E. L. Rice, Allelopathy. New York: Academic Press 1974. p. 1

seedlings (29). The growth of tall reed (Phragmites Trin.), several other species in pure cultures, and various two species combinations in several types of natural substrates has been investigated. The results of this study show pronounced inhibition of certain species and pronounced stimulation on the part of others (38). Since tall reed may rapidly dominate open sunny areas with high water tables, waterfowl managers and others should conduct studies to (1) determine which species might inhibit the growth and invasion of aquatic habitats by tall reed, and (2) what allelopathic mechanism(s) are involved. I would be pleased to provide interested individuals with experimental procedures that might solve the tall reed (Phragmites Trin.) problem.

It has been demonstrated that a large number of plant parts contain inhibitors that may be autotoxic or inhibit germination and seedling development of other species. Researchers have found that leaves, stems, roots, flowers, fruits, and seeds contain inhibitors. Of the aforementioned plant parts, leaves are the most consistent source of inhibitors (38). These toxic substances are released during decay of plant material. Toxic plant substances may also enter the soil environment by root exudates, leachates of living and dead plant material, and by the production of volatile inhibitors. The classes of chemical compounds identified as inhibitors are listed in Table 2. and their mode of action summarized in Table 3. Moreover, various factors, e.g., light quality, intensity, duration (day-length), mineral deficiencies, water stress, temperature, age of plant organisms, affect the amount of inhibitors that are produced by plants.

Knowledge of allelopathy may be a great value to scientists who wish to maintain rights-of-way in early stages of succession. Certain species may be encouraged that are aesthetically attractive, require minimal maintenance, and retard and/or inhibit the growth of undesirable species.

Table 1. Desirable grasses, shrubs and small trees for power line rights-of-way. Letters following certain shrubs indicate habitat preference (H) hydric (wet), (M) mesic (optimum moisture), (X) xeric (dry).

GRASSES

Alopecurus arundinacea Foxtail grass
Andropogon gerardi Big blue stem
Andropogon scoparius Little blue stem
Andropogon virginicus Broom sedge
Dactylis glomerata Orchard grass
Festuca rubra Red fescue
Panicum virgatum Switch grass
Phleum pratense Timothy

SHRUBS AND SMALL TREES

Aesculus pavia Dwarf buckeye
Alnus rugosa Speckled alder (H)
Alnus serrulata Common alder (H)
Amelanchier spp. Shadbush (M)
Amorpha spp. False indigo
Andromeda glaucophylla Andromeda
Arctostaphylos uva-ursi Bearberry (X)
Aronia spp. Chokeberry (M)
Ascyrum spp. St. Peter's-wort
Asimina parviflora Dwarf paw-paw
Berberis vulgaris Barberry
Callicarpa americana Beauty-berry (M)
Calluna vulgaris Heather
Calycanthus floridus Carolina allspice (M)
Carpinus caroliniana Ironwood (M)
Castanea pumila Chinquapin
Ceanothus americanus New Jersey tea
Cephalanthus occidentalis Buttonbush (H)
Chamaedaphne calyculata var. angustifolia Leatherleaf (H)
Clethra alnifolia Sweet pepperbush (H)
Comptonia peregrina Sweet fern (X)
Corema conradii Broom-crowberry
Cornus amomum Red willow (M-H)
Cornus canadensis Bunch cherry
Cornus spp. Dogwood
Corylus americana American hazelnut (M)
Corylus cornuta Beaked hazelnut (M)
Crataegus spp. Hawthorn (M)
Cyrilla racemiflora Black ti-ti (H)
Daphne mezereum Mezereum
Dirca palustris Leatherwood
Eleagnus angustifolia Russian olive (X-M)
Empetrum nigrum Black crowberry
Epigaea repens Trailing arbutus (X-M)
Erica spp. Heath
Euonymus americanus Bursting heart (M)
Euonymus obovatus Running strawberry bush (M)
Gaultheria procumbens Wintergreen (X)
Gaylussacia baccata Huckleberry (X)
Gaylussacia frondosa Dangleberry (X)
Gaylussacia spp. Huckleberry (X)
Hamamelis virginiana Witch hazel (M)
Hypericum spp. St. John's-wort (H-X)
Ilex decidua Possum-haw (H-M)
Ilex glabra Inkberry
Ilex opaca Holly (M)
Ilex spp. Holly
Ilex verticillata Winterberry (M)
Ilex vomitoria Yaupon (X)
Itea virginica Virginia willow (H)
Kalmia angustifolia Bog laurel (H)
Kalmia latifolia Mountain laurel (X-M)
Leiophyllum buxifolium Sand myrtle
Leucothoe racemosa Fetterbush (M-H)
Ligustrum vulgare Privet (M)
Lindera benzoin Spice bush (H-M)
Litsea aestivalis Pond spice (H)
Lyonia ligustrina Maleberry (H-M)
Lyonia mariana Staggerbush (H-M)
Mitchella repens Partridge berry (M)
Myrica cerifera Wax-myrtle (X)
Myrica gale Sweet gale (H)
Myrica pensylvanica Bayberry (M-X)
Nemopanthus mucronata Mountain holly
Ostrya virginiana Hop hornbean (M)
Persea borbonia Red bay (M)
Physocarpus opulifolius Ninebark
Ptelea trifoliata Wafer ash
Pyrus americana Missey-moosey
Quercus ilicifolia Bear oak (X)
Quercus prinoides Dwarf chinquapin (X-M)
Rhamnus alnifolia Buckthorn
Rhododendron spp. Azalea (M-H)
Rhododendron viscosum Clammy azalea (H-M)
Ribes americanum Wild black currant (M)
Ribes spp. Currant (Gooseberry)
Rosa spp. Rose
Rubus flagellaris Dewberry (M)
Rubus hispidus Bristly dewberry (M)
Rubus occidentalis Black cap (M)
Rubus trivialis Southern dewberry (X-M)
Salix discolor Pussy willow (H-M)
Salix humilis Small pussy willow (H-M)
Sambucus canadensis Elderberry (H-M)
Shepherdia canadensis Soapberry
Sorbus spp. Mountain ash
Spiraea alba Meadowsweet (M)
Spiraea latifolia Meadowsweet (M)
Spiraea spp. Meadowsweet
Staphylea trifolia Bladdernut
Stewartia spp. Camellia (M)
Stillingia sylvatica Queen's root (X)
Symphoricarpos albus Snowberry (M)
Vaccinium spp. Blueberry
Vaccinium angustifolium Lowbush blueberry (M)
Vaccinium corymbosum Highbush blueberry (M-H)
Vaccinium vacillans Lowbush blueberry (M)
Viburnum acerifolium Mapleleaf viburnum (M)
Viburnum dentatum Arrow-wood (M)
Viburnum lentago Nannyberry (M)
Viburnum prunifolium Black haw (M)
Xanthoriza simplicissima Yellow-root (M)

Table 2. Chemical compounds identified as inhibitors.

1. Water soluable organic acids
2. Straight - chain alcohols
3. Aliphatic aldehydes
4. Ketones
5. Simple unsaturated lactones
6. Long-chain fatty acids
7. Anthraquinones, naphthoquinones and complex quinones
8. Steroids and terpenoids
9. Simple phenols, benzoic acid, and derivatives
10. Coumarins
11. Cinnamic acid and derivatives
12. Flavanoids
13. Tannins
14. Amino acids and polypeptides
15. Alkaloids
16. Cyanohydrins
17. Sulfides and mustard oil glycosides
18. Purines and nucleosides

Table 3. Mechanisms of action of inhibitors.

1. Inhibition of cell division and elongation
2. Inhibition of gibberellin or indoleacitic acid induced growth
3. Effect on mineral uptake
4. Retardation of photosynthesis
5. Inhibition or stimulation of respiration
6. Inhibition or stimulation of stomatal opening
7. Inhibition of protein synthesis and changes in lipid and organic acid metabolism
8. Inhibition of hemoglobin synthesis
9. Changes in permeability of membranes
10. Inhibition of specific enzymes: Pectolytic enzymes, cellulase, catalase, peroxidase, phophorylases, and others

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WEEDS OF THE WORLD. IId., THE WEEDS OF AFRICA NORTH OF THE SAHARA - A SUMMARY

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ABSTRACT

This is a summary of one section of a long-term project on the "Weeds of the World." In its original format this section comprises an alphabetical checklist of 577 species and varieties providing the Latin species and family names, life span and other biological data. Crop associations, distribution for certain regions, bibliographies and illustrations were also included.

INTRODUCTION

The present study is a summary of one section of a long-term project on "Weeds of the World" (19-25). The checklist of weeds of "Africa North of the Sahara" (26) has been prepared from the studies of a number of investigators noted below, and is the basis for the present summary. The recent work of Holm et al. (15) also should be consulted.

The relatively narrow zone of arable land lying along the entire Mediterranean coast of North Africa hardly exceeds 400 kilometers (250 miles) in width at any point. Yet within these areas and those of the Sudan, Egypt, Nile Valley and other extensively irrigated areas, a scattered and flourishing- yet diversified - agriculture exists. This arable zone extends from the northwest Africa coastal area of Morocco, through the Mediterranean coastal areas of Algeria, Tunisia, Libya, and Egypt. To the immediate south of this fertile land lie the vast wastes of the Libyan and Sahara deserts - covering some 2,000,000 square miles - nearly one-sixth of the African continent (30).

The weed records for Morocco (177,117 square miles) have been taken from the publications of Ducellier (30), and some records of poisonous plants have been included from the work of Nahon (see, 26). Algeria (896,592 square miles) has a coastline along the Mediterranean about 650 miles long. The weed records from Algeria have been taken principally from the publication of Perrot (31) where some 89 species in the vicinity of Batna are discussed. Tunisia has an area of 63,379 square miles.

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The weed records for Tunisia have been taken from the publication of Chabrolin (5) listing 29 weeds of wheat, and that of Delaporte (8) listing 19 species of thistles. A detailed study of the flowering parasite of cereals, Thesium humile (Santalaceae), has been prepared by Chabrolin (6).

Libya comprises an area of 675,000 square miles. The coastal area of Libya is larger in the division of Tripolitania and consists of several oases, large dune areas and the plateau spoken of as the Gebel. Tripoli receives 200 mm. of rainfall with decreasing rainfall southwards, and practically no rain falls south of latitude 31 degrees. The weed records of Libya are taken from the study of Stancic (32), and includes 90 species found in cereals.

Egypt occupies some 386,900 square miles with the most productive regions lying in the valley of the Nile and its delta, or Lower Egypt, north of Cairo. The Nile River flows through 960 miles in Egypt.

As the authors (Täckholm et al., 33) of the "Egyptian Flora" state in their preface - Egypt has what no other country possesses, a tomb flora. In this country every plant has a history. All the fruits, vegetables and flowers which were put in the tombs thousands of years ago to serve the dead as food or pleasure are still kept in fairly good condition and transmit to us an idea not only about the flora of ancient times but also about the cultural history of Egypt. One of the foremost students of this "archeological" flora was G. Schweinfurth (Keimer, 18). Other workers in this field include Keimer (17), Hartmann (14), Woenig (36) and Greiss (13). Täckholm (34) has published the lavishly illustrated book in Swedish, "Pharoah's Flowers;" while the more recent study of Kosinová (1974) lists other references on the archaeological flora. The treatise of Darby et al. (7) provides a detailed record of ancient foods.

Approximately 37 species of weeds were compiled from several earlier studies: a study of the weed flora of irrigation canals, a list of grasses and related plants by Garbouha (see, 12) and several smaller works. However, an additional 209 species have been added from the more recent studies of El Hadidi and Kosinová, Boulos (3) and Kosinová (29). The flora of Egypt as described by R. Muschler in 1912 included 1,503 vascular plants. Thus the total for Egypt now comprises some 246 species. The study of Kosinová (29) on the weed flora of cultivated land in Egypt is valuable for the description of weed communities and for an examination of synanthropophytes (plants associated with camps, nomadic groups, etc.). Other studies on Egyptian weeds should be consulted (16, 28, 35).

The Sudan is the largest of the areas here under consideration - occupying some 967,500 square miles. Actually the Sudan extends below the line of demarcation covered by this section - the Sahara Desert - into central and eastern Africa. However, since it and Egypt are closely associated in the Nile Valley it seems best to consider them together. The Sudd area is handled similarly - "Sudd" is from the Arabic for "block," referring to the vast marsh areas of the White Nile dominated by papyrus thickets, Vossia cuspidata, Echinochloa pyramidalis as well as other species.

Most of the weed records from the Sudan are from the Gezira area and for cotton fields in particular (Andrews, 1,2). The former report includes some records of water plants in the Gezira canals. Also included are some records from the Tozzi area of the Sudan (Bunting and Lea, 4).

DISCUSSION AND SUMMARY

The total number of species and varieties listed as weeds or ruderals in the present checklist totals 577. If this total should represent 10 per cent of the entire vascular flora, then the vascular flora for this vast region could comprise some 5,770 species and varieties.

A survey of the genera represented by five or more species (indicated by the number in parenthesis) includes the following:

Amaranthus (6) (Amaranthaceae)	Medicago (7) (Leguminosae)
Bromus (5) (Gramineae)	Phalaris (5) (Gramineae)
Centaurea (8) (Compositae)	Polygonum (7) (Polygonaceae)
Convolvulus (5) (Convolvulaceae)	Potamogeton (6) (Najadaceae)
Cyperus (10) (Cyperaceae)	Silene (5) (Caryophyllaceae)
Eragrostis (6) (Gramineae)	Sonchus (5) (Compositae)
Euphorbia (11) (Euphorbiaceae)	Vicia (8) (Leguminosae)
Lathyrus (8) (Leguminosae)	

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

Cruciferae (15)	Cyperaceae (2)
Compositae (23)	Leguminosae (17)
Amaranthaceae (5)	Umbelliferae (12)
Gramineae (26)	Labiatae (4)

As the center of ancient civilizations and primitive forms of agriculture (in earlier times) Egypt provides a unique study area for elucidating weed-crop interrelationships and the origins of some weeds. The annual regularity of cropping, from the very earliest days of man's agricultural efforts, was timed with regard to seasonal moisture for early growth - followed often by

drier periods during harvest. In Egypt, this was determined by the annual flooding of the Nile, with resultant silt deposition on the new planting areas. Thus, short favorable growth periods resulted in a selective process operating on certain annuals of the native flora. Eventually a distinctive weed flora arose associated with the particular crop and cropping practices (see, 19, p. 36). Kosinová (29, p. 284) provides a time-scale for the possible appearance of a large number of species - extending from the Neolithic period; from the 1st Dynasty (3200 B.C.) through the 21st Dynasty; and to the Coptic period.

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* Correct rendering of author here is: Laurent-Täckholm, V.

TROUBLES I'VE SEEN WITH SPRAYERS

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Failure to achieve desired weed control is blamed on many things. We've heard them all--too much moisture, too little moisture, herbicides applied too early, herbicides applied too late, soil composition or texture not right, too much water used, too little water used, wrong material for the species in question, and on and on. In certain situations some of the above reasons are valid.

But, how often is the delivery system considered and evaluated? Sprayers come in various designs for various jobs. Sprayer components wear and performance deteriorates. Is the sprayer right for the particular job and is it properly maintained, calibrated, and adjusted? Often times poor weed control can be traced to the sprayer or the manner in which it was used.

For more than a decade, sprayers have been a major part of my Extension program. During that time, many sprayer problems have been observed. I'd like to share the more important ones with you and suggest solutions.

Lets start at the beginning--determining the amount of chemical to put in the tank. Many operators don't know the application rate, the exact capacity of the sprayer tank or the acreage they are covering. When checking application rates, I've discovered differences of 30-40 percent range from what the operator thought he was applying. Often unsprayed areas such as headlands and drive strips are included, resulting in higher than desired rates on the treated areas. Data from operator's manuals or nozzle catalogs are not sufficiently accurate for field conditions; they provide a starting point but a calibration test should be made. A calibration test is simply a trial to determine application rate; applying a measured amount of liquid on a known area with the sprayer adjusted to selected conditions. Such a test will compensate for repeatable errors in pressure gages and tachometers, friction losses and tire slippage. A calibration check should be made whenever the application rate is changed or nozzles are replaced. Make at least one check each season. The operator must know the application rate (gallons per acre or gallons/1000 square feet) and the amount of water in the tank in order to know how much pesticide to put in the tank.

The next problem I've seen is far too many sprayers applying wettable powders without adequate agitation in the tank. This is especially evident in tanks larger than 150 gallons. Either jet or mechanical agitation is acceptable. Jet agitation should provide at least five gallons per minute for each 100 gallons of tank capacity. Agitation requirement from the pump can be reduced by using venturi or suction agitators that multiply the effect of the liquid flowing through the orifice by two and one-half to three times. Mechanical agitators are usually factory engineered and installed; normally they provide good agitation.

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Pumps must provide the pressure and flow necessary for the sprayer to function. As pumps wear, both volume and pressure may decrease below adequate working levels. The most common failure occurs with a roller pump-wettable powder-jet agitator combination. Roller pumps can be rebuilt by replacing the rollers but the wear on the pump housing cannot be corrected. It is usually feasible to rebuild a roller pump only once.

Often a roller pump is replaced by a centrifugal pump. This is an excellent choice since the centrifugal pump has a long life and produces a high volume flow to provide good jet agitation. However, the plumbing is different. A centrifugal pump's performance is severely affected by any restriction to the inlet; therefore, an in-line strainer in the pressure line should be used rather than a suction screen. Also, a pressure relief valve is not necessary with a centrifugal pump and usually a separate agitator line is not needed.

Another observation is poor performance from a centrifugal pump because it is not operated at rated speed. These pumps are sold with engineered drives to mount directly on either 540 or 1000-RPM PTO shafts. However, if the PTO shaft is operated at less than the rated speed, both volume and pressure will decrease. The impeller on most centrifugal sprayer pumps should rotate 2000-3000 revolutions per minute. In fact, if the pump is operated at 10 percent below rated speed, the volume will drop 10 percent <u>and</u> the maximum pressure will decrease 19 percent.

Nozzles, the last controllable part of the sprayer delivery system, are vital to accurate and uniform delivery of the pesticide to the target. Nozzles perform several functions including flow control, droplet formation, and droplet distribution.

Worn nozzles do not perform well in any of these functions, especially droplet formation and distribution. With flat-fan nozzles, droplets are formed by forcing a stream of liquid under pressure across a sharp-edged orifice. As the sharp edge wears, droplet formation deteriorates, resulting in wide variations of droplet size. More importantly, as the nozzle wears, the droplet discharge pattern changes causing poor coverage and uniformity. Worn nozzles should be replaced with tips made of a wear-resistant material such as stainless steel. Spray mixes containing wettable powers are especially abrasive and should not be used with fast wearing brass tips.

Often the wrong type of nozzles are used. Flat-fan, even flat-fan, and flooding fan tips are designed for herbicides. Most cone nozzles have characteristics better suited for insecticide and funicide application.

In some cases, failures with contact herbicides have been observed when applied with flooding fan nozzles. For optimum uniformity, flat-fan nozzles on a boom are recommended for broadcast application. Even flat-fan nozzles are best for band application.

Weed sprayers and nozzles are designed to operate at low pressure. Standard flat-fan nozzles should be operated at 20 to 40 psi; flooding and low-pressure flat-fan nozzles should be working at 10 to 20 psi. Higher

pressures produce more small droplets; the small, low density droplets stay suspended for a long time, causing drift to nontargets. Also, higher pressures increase both nozzle and pump wear.

In addition to equipment problems, a number of operational errors have been observed, including:

(a) Failure to clean the sprayer. Flush and drain at the end of each day. Use a cleaning agent when changing pesticide.

(b) Failure to drain and protect the sprayer, especially the pump, for winter storage. Some sprayers deteriorate more in storage than in use.

(c) Using a tractor without a speed indicator to pull sprayer. Must maintain constant speed to achieve uniform application.

(d) Spraying when wind exceeds five mph. Even moderate wind can blow spray droplet from target area and, more important, to nontarget areas.

(e) Improper sequence of mixing for various formulations and additives. Instructions should be more emphatic.

(f) Little understanding of interaction of adjuvants. More information is needed on the effects of one or more adjuvants in spray mix.

(g) Agitator not operating while filling tank or traveling to field. Wettable powders need constant agitation.

(h) Operator not familiar with equipment capabilities, limitations, and adjustments. Detailed training is necessary for good pesticide application.

The cures for most of the above problems are obvious. The question is how can the cures be implemented? Better, more explicit instructions? More intensive training? Stricter requirements on use of pesticides? Widespread use of custom spraying? Better equipment design?

All of us can contribute. I challenge each of you to join me, within your field and expertise, to exert whatever forces are necessary for the continued safe and efficient use of pesticides. This includes maintaining the sprayer as a safe, effective and efficient delivery system.

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APPLYING HERBICIDES WITH A WIPER

William V. Welker, Jr.[1/]

ABSTRACT

A herbicide applicator was developed to achieve selectivity by applying herbicides to weeds and avoiding the crop plant. This is possible where the weeds are taller than the crop. The wiper consists of a sponge 5 cm x 5 cm in cross section that is glued to the full length of an endless belt. The belt with the sponge attached passes around a pully system and through a reservoir that contains the herbicide solution. The excess liquid in the sponge is squeezed out of the sponge by a variable pressure wheel and returned to the reservoir. The wiper is mounted on two bicycle wheels and is propelled by a 1/2 horsepower air-cooled engine mounted on the frame of the wiper. A series of belts and pulleys are used to drive both the wiper belts and the wheels. The herbicide is deposited on the leaves of the weeds as the belt moves perpendicular to the forward movement of the wiper. Excellent control of tall weeds in cranberry bogs was achieved when using the wiper. No injury to the cranberry vines occurred with herbicides that cranberries will not tolerate when applied to their foliage.

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FLUORESCENT CHEMICALS AS TRACERS IN EFFECTIVE PLACEMENT OF PESTICIDES

Robert J. Argauer[1/]

ABSTRACT

An increasing number of researchers are using fluorescent chemicals to measure the distribution of pesticide spray and dust deposits, spray droplet size, amount of drift, and effectiveness of application equipment, and to follow the behavior of insects and higher animals. This paper will critically analyze the use of various fluorescent chemicals in monitoring the distribution of pesticides after application.

We have used fluorescent dyes as tracers together with direct pesticide analysis to determine the relative effectiveness of various adjuvants in increasing pesticide deposition on leaf surfaces. Those adjuvants that increase the viscosity of the solution in the spray tank also increase pesticide deposit on the plant by reducing runoff from the leaf surface. These effective viscosity modifiers include Keltose®, an alginate, Super Slurper or SGP® Adsorbent Polymer, a hydrolyzed starch-polyacrylonitrile graft copolymer, and Jaguar® A-20D, a guar gum.

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IMPORTANCE OF MECHANICAL PLACEMENT OF SOIL INCORPORATED HERBICIDES

J. C. Altemus and C. D. Christensen 1/

ABSTRACT

The dinitroaniline compounds are a unique class of herbicides. They are volatile in nature but much less so than the carbamate type herbicide. Both of these classes of compounds are herbicidally efficacious in their vapor state. However both herbicides need to be soil incorporated for different reasons. The dinitroaniline herbicide require mechanical placement in the soil zone because their vapor moves very little while the carbamate herbicide require immediate soil incorporation to lock in their vapor activity within the soil zone.

Proper soil incorporation is a prerequisite for effective season long weed control. The dinitroaniline herbicides require thorough mixing within the top two inches of soil. The proper incorporation tool should mix the dinitroaniline herbicide adequately within the surface zone to provide the desired control of annual grasses and broadleaf weeds.

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*p. 97 omitted

A Preliminary Report on the Use of the Fuerst Flexible Harrow for Incorporating Selected Herbicides

William B. Duke[1]

ABSTRACT

Different types of farm implements are used to incorporate selected preemergence herbicides. These implements may include a disc, a spring-tooth harrow, a roto-tiller or perhaps combinations of these. These tools for incorporation are primarily used for mixing either the thiocarbamate or dinitroaniline herbicides into the upper levels of the soil profile. Classically, the dinitroaniline-type materials have not required the same depth of incorporation required for thiocarbamates while thorough mixing is required for both classes. Experiments were established in 1977 to evaluate shallow versus deep incorporation of dinitroaniline, thiocarbamate, and acetanilide herbicides.

In one experiment, profluralin, benefin and EPTC were used and in another, butylate, alachlor and metalachlor. In each experiment, deep incorporation was accomplished by standard double discing in opposite directions immediately following chemical application. Shallow incorporation was done by discing the land once, applying the chemicals and then dragging a Fuerst Flexible Time Harrow over the treated area. The flexible harrow was pulled in one direction at high speeds to insure thorough mixing. It was estimated that depth of incorporation with this implement would have been approximately 3/4 to 1 1/2 in. Each experiment was set up in a split plot design with four replications with chemicals as main plots and incorporation method as the sub-plot. In experiment one, EPTC gave better overall weed control with deep incorporation but alfalfa exhibited greater safety following shallow mixing. Grass kill with benefin and profluralin with shallow incorporation was equal to that obtained when mixed deep. Broadleaf weed control with both dinitroanilines was better following deep incorporation. Alfalfa tolerance was improved with shallow herbicide incorporation.

In experiment two, alachlor, butylate and metalachlor gave greater nutsedge control following deep incorporation. Under the extreme dry conditions of 1977, shallow incorporation of alachlor and metalachlor improved activity over that obtained with preemergence treatments.

In summary, it appears that the flexible harrow should be more extensively examined as an implement for incorporating dinitroaniline herbicides. In addition, the observed improvement in alfalfa tolerance to these and other herbicides following a shallow versus deep incorporation lends support to the need for further research.

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GROWTH REGULATING ACTIVITY OF AN EXTRACT OF *CAMPTOTHECA ACUMINATA*

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ABSTRACT

A purified extract of *Camptotheca acuminata* was tested on several plant species in laboratory and greenhouse experiments. Applied to meristems or young internodes the extract consisting primarily of the camptothecin alkaloids inhibits plant growth. Inhibitor activity has been seen with Kentucky 31 tall fescue, tomato, tobacco, corn, and sunflower. In laboratory tests with Kentucky 31 fescue seedlings, the extract is effective at concentrations from 0.34 ppm to 34 ppm or higher causing inhibition, enhanced green color, and thicker, sturdier plants with no evidence of phytotoxicity or discoloration of leaves. Histological studies of inhibited axillary buds of Xanthi tobacco plants suggest the differentiating vascular system as a possible site of action for the extract.

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SCREENING OF A SECOND SERIES OF WEED SEEDS FOR GERMINATION RESPONSE TO NONANAL AND RELATED COMPOUNDS

G. R. Leather, R. C. French, and R. A. Long[1/]

ABSTRACT

Weed seeds were exposed to naturally-occurring organic volatiles that were previously found to stimulate fungal spore germination. Weed species tested were: green foxtail (*Setaria viridis*), quackgrass (*Agropyron repens*), large crabgrass (*Digitaria sanguinalis*), red sorrel (*Rumex acetosella*), buckhorn plantain (*Plantago lanceolata*), Canada thistle (*Cirsium arvense*), common purslane (*Portulaca oleracea*), common ragweed (*Ambrosia artemisiifolia*), bigroot morningglory (*Ipomoea purpurea*), and common lambsquarters (*Chenopodium album*).

The germination of red sorrel was stimulated by nonanenitrile and octyl thiocyanate. These chemicals also stimulated the dark germination of curly dock (*Rumex crispus*) during the first screening series. The effect of these compounds was an increase of up to 80% in the number of germinated seeds over those which received no treatment. Eight- and nine-carbon ketones and secondary alcohols were also stimulatory. Observations were made at three and ten days after treatment. No single compound promoted the germination of all species of weed seeds. However, nearly all species were inhibited at the germination or radicle growth phase by the highest concentration of chemical.

Structure-activity studies with nine-carbon compounds, indicated little activity with terminal oxygen functions, but marked activity when the hydroxyl or keto group was at the two position. This contrasts with the structure-activity pattern of stimulation observed in uredospores of the stem rust of wheat disease (*Puccinia graminis* var. *tritici*) wherein greatest activity resided in terminal oxygen functions, n-nonanal and 1-nonanol.

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INFUSION OF GROWTH REGULATORS AND OSMOCONDITIONING: METHODS TO ALLEVIATE STRESS DURING SEED GERMINATION AND SEEDLING EMERGENCE

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ABSTRACT

In general, growth regulators, as fusicoccin, cytokinin, GA, ethephon or their combinations infused into lettuce seeds via an organic solvent (e.g., acetone) or water proved highly effective in reducing the adverse effects of supraoptimal soil temperature regimes (e.g., 25-35° , 30-35° C), soil salinity (0.1 M NaCl) and drought (24% of dry wt. of 1 sandy loam: 1 peat moss soil mixture; 89% of dry wt of muck soil) as indicated by a reduction in the time taken for germination and the spread of germination.

Osmoconditioning of lettuce, celery, parsley, onion, soybean, pea and sweet corn seeds with 20-35% polyethylene glycol-6000 (PEG-6000) at 15-20° C for 4 to 14 days caused not only reduction in time of germination but also appeared to invigorate the seeds as shown by increased percentage germination. The effect of treatment was most apparent at low temperatures (8 to 10° C). Addition of 0.2% thiram in PEG solution proved essential for osmoconditioning of cereals and legumes. A combination of growth regulators (present during osmoconditioning or previously infused into seeds via acetone) and osmoconditioning proved highly effective in alleviating stress at both high and low temperatures in seeds of lettuce, celery and parsley.

The importance of these results in seed performance will be discussed.

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MODIFYING THE VEGETATIVE AND FLOWERING HABIT OF APPLE TREES WITH PLANT GROWTH REGULATORS

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ABSTRACT

Wide experience has been gained in the use of daminozide as a growth retardant on apple (Malus domestica Borkh) trees. Growth of terminal shoots and vigorous suckers can be curtailed by early season application. Ethephon at high concentrations will also act as a growth retardant. The combination of daminozide and ethephon at reduced rates is likewise effective in growth regulation and generally gives increased flowering. The two growth regulators P293 and PP528 can check vegetative growth of apple shoots for short periods of 2 to 4 weeks. During this interval resting axillary buds below the terminal may develop. The extent of growth of these lateral or axillary shoots and their flowering habit can be further modified by the application of daminozide and/or ethephon.

INTRODUCTION

The establishment of a modern high density apple planting requires a large investment. The new trees must develop a suitable framework and bearing surface quickly and then be brought into flowering and fruiting promptly to show a return on the investment. To accomplish this the precise regulation of vegetative growth and flower bud formation becomes increasingly important. Once flowering and fruiting are initiated the objective then is to maintain the planting at a consistent high annual production. Furthermore, the tree canopy must be maintained within the space allotted to it in the planting plan.

Unfortunately, there are many problems in the way of obtaining this goal. The original choice of tree spacing and the scion/rootstock combination have not always been well advised. Some mistakes are still being made. Then when an imbalance occurs as it frequently does growers tend to resort to dormant pruning as the traditional method of controlling tree size. But pruning delays bearing, and later when the trees become too tall or crowd adjacent trees pruning induces vigorous upright growth which may further complicate the problem rather than solve it.

Proper branch orientation and limb spreading (7), judicious use of nitrogen fertilizer to avoid unnecessary stimulation of vegetative growth, and shifting most of the pruning program to summer (6) are important aids in achieving the above objectives. In addition, plant growth regulators can be useful tools in the growers management program. Daminozide [butanedioic acid mono (2, 2-dimothylhydrazide)] is already being extensively used for control of vegetative growth in apples (1,3,4). Ethephon [(2-chloroethyl) phosphonic acid is also proving to be useful for this purpose (5) particularly in combination with daminozide (2,8).

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Greenhouse and field trials with several new growth regulators in recent years have revealed two candidate compounds that can be applied as foliar sprays on apple trees and reduce or stop terminal growth for short periods. These are P293 (2,3-dihydro-5-6-diphenyl-1,4-oxathiin) and PP528 [ethyl 5-(4-chlorophenyl)-2H-tetrazole-2-acetate]. During the period of reduced terminal growth lateral vegetative buds may become active, producing short side shoots. After degredation of the growth regulator terminal growth may be resumed either from the apical meristem or from a subtending lateral if the apical growing point was killed. This sequence could be of distinct benefit in developing side shoots or spurs for increased flowering and fruiting surface through the tree canopy and particularly to induce earlier and increased production in vigorous young trees. Another use of these temporary growth regulators might be to increase feathering or development of lateral branches on 1-year nursery trees.

Since these two growth regulators are relatively short lived and may not reduce total length growth of terminal shoots during the season as much as might be desired the possibility of combining these with daminozide and/or ethephon was attractive.

The experiments reported here were designed to evaluate these growth regulators alone and in combination on the growth and flowering of apple trees of different ages.

MATERIALS AND METHODS

Nursery trees of two varieties that had been budded on M9 rootstock in August 1975 received foliar sprays of growth regulators July 15, 1976. At that time the new shoots were from 50 to 60 cm in height which is an appropriate position for the development of lateral branches. A hand sprayer was used with leaf and stem surfaces covered to run-off. A treatment consisted of 4 replicated 6-tree plots.

The experiment with bearing age trees was conducted on 'Delicious'. These were 15-year-old trees propagated on M2 rootstock and were typical of the vigorous, crowded condition of many blocks of this cultivar. Bearing has been inconsistent, growth upright and vigorous and yelds below the potential for trees of this age. The first applications were made two weeks after bloom in 1976 using a pressure sprayer and hand gun with thorough coverage provided. Data on shoot length and lateral growth were obtained at the end of the season, and bloom density and fruit set data were obtained the following year.

A block of 40-year-old 'Cortland' trees on seedling rootstock has been used for the trials on controlling vegetative growth in the tops of heavily pruned trees. During the winter of 1975-76 the pruning consisted of cutting back into 3- and 4-year-old wood to lower the height of the trees for more efficient spraying, harvesting and subsequent pruning. Such pruning invariably stimulates vigorous shoot growth and sucker development throughout the upper canopy. When the new vegetative growth was from 10 to 12 cm long the treatments were applied with a hand gun and pressure sprayer. A platform on the top of the sprayer made it possible to direct the spray across the upper 20% of the tree canopy. The shoots in this area were covered thoroughly to point of run-off. Growth measurements were made at the end of the season and

blossom counts were made the following spring.

RESULTS AND DISCUSSION

In the experiments with nursery apple trees both P293 and PP528 increased the number of laterals (Table 1). The addition of daminozide with the PP528 did not significantly alter the number of laterals formed but it did modify their growth habit. The laterals were about 20% shorter than laterals on the trees receiving only PP528 and they formed a wider angle with the main leader and were thicker in diameter. Height of the tree was less in all treatments containing the daminozide. While this might be an undesirable feature in the acceptance of the nursery tree the quality of the laterals would appear to offset this disadvantage. The growth and development of the laterals on both the P293 and PP528 trees, including those with daminozide was good in the planting the following year (1977).

The daminozide and daminozide plus ethephon reduced shoot growth of the vigorous, bearing age 'Delicious' trees, and the combination of the two regulators significantly increased flowering the following year (Table 2). Neither of the treatments increased lateral formation on the current (1976) growth. All 3 treatments which included PP528 increased the number of laterals, reduced shoot growth and increased flowering. The combination treatment which included daminozide and ethephon with 50 ppm PP528 provided good growth control, increased flower bud formation and desirable, short spur-like lateral growths with no reduction in fruit set the current season. The higher rates of PP528, i.e., 100 and 200 ppm, caused some phytotoxicity and leaf abscission as well as reducing fruit set and yield. The higher rate of P293 provided some growth control, induced formation of a few laterals and increased flower bud formation without adversely affecting the current season's crop.

The growth of suckers in the tops of heavily pruned mature trees was reduced to 36% of the controls with the daminozide treatment. The combinations with ethephon and PP528 also provided similar growth control and increased flowering in the upper canopy the following spring (Table 3). By reducing the length and vigor of the sucker growth there was less shading of the fruiting areas throughout the tops of the trees during the summer and fall, and subsequent pruning in the tops is facilitated. The increased flowering and fruiting potential in the upper canopy aids in quickly reestablishing the fruiting surface in the top which will become a major factor helping to control excessive shoot and sucker growth.

The results of these trials illustrate the kinds of applications to which plant growth regulators may be of assistance in manipulating the growth and flowering habits of apple trees of various ages.

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Table 1. Effect of some growth regulators on development of two apple cultivars in the nursery.

Treatment (conc. ppm)	'Vista Bella' Height(cm)[a]	'Vista Bella' No. laterals	'Rome' Height(cm)	'Rome' No. laterals
P293 1000	126.1a[b]	1.2	113.0a	0.8
P293 2500	103.5b	1.4	96.0a	1.1
P293 1000+ daminozide 1000	99.0b	0.5	72.4b	0.4
P293 2500+ daminozide 1000	83.1c	1.6	65.3b	1.8
PP528 50	105.6b	2.9	104.4a	1.3
PP528 50+ daminozide 1000	83.2c	3.0	83.3b	1.8
Control	126.4a	1.1	128.5a	0.6

[a] Height and number of laterals or feather determined in October 1976.

[b] Means within columns followed by the same letter are not significantly different with the Duncan multiple range test 5% level

Table 2. Effect of some growth regulators on shoot growth and flowering of mature 'Delicious' apple trees. 1976-77

Treatment (June 10, 1976) Conc. ppm	Shoot length[a] (cm)	Number laterals/shoot	Flower buds (% of total)	Flower buds /cm limb circum.
Daminozide 1500	38.0	0	78	4.7
Daminozide 1500 + ethephon 250	29.2	0	85	7.0
PP528 100	23.2	2.6	80	5.8
PP528 200	12.5	3.1	65	4.5
P293 1000	47.1	0	70	5.7
P293 2000	42.9	0.7	69	5.8
PP528 50 + daminozide 1500 + ethephon 250	21.5	1.8	88	6.6
Control	53.9	0	56	4.7

[a] Growth measurements obtained in October at end of growing season; bud data obtained April, 1977.

Table 3. Control of sucker growth in the upper canopy of heavily pruned apple trees.

Treatment[a] 1976 (Conc., ppm)	Length growth suckers (cm)	Bloom intensity 1977 (% spurs flowering)
Daminozide 3000	33	36
Daminozide 2000 + ethephon 250	38	48
Daminozide 2000 + PP528 50 + ethephon 250	37	55
Control	91	20

[a] Treatments applied with hand gun and power sprayer May 29, 2 weeks after full bloom.

INFLUENCE OF TWO ETHYLENE-RELEASING COMPOUNDS ON ANTHOCYANIN FORMATION, SIZE, AND YIELD IN 'EARLY BLACK' CRANBERRIES [1/]

by

Robert M. Devlin and Irving E. Demoranville [2/]

ABSTRACT

The influence of CGA-15281 and R-27969 on anthocyanin production by cranberries (Vaccinium macrocarpon Ait. cv Early Black) was observed. Application of CGA-15281 10 days before harvest at a concentration of 2000 ppm and at a spray volume equivalent to 1.87 kl/ha increased anthocyanin development by 150%. Color development in cranberries was also enhanced in storage by CGA-15281. This was especially true for those berries treated with the lowest concentration (500 ppm) of CGA-15281. No difference in color development could be detected in cranberries treated with R-27969. Neither CGA-15281 or R-27969 caused any differences in yield or cranberry size.

INTRODUCTION

As the cranberry ripens anthocyanins are produced that impart to the fruit an attractive red color. In the cranberry industry it is realized that the development of this color is largely responsible for the popularity of the cranberry. Thus a premium is paid to the grower for cocktail and fresh fruit quality berries. However, to obtain dark, uniformly colored berries a grower must delay harvest until late in the growing season, a circumstance that presents

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1/ Paper No. 2175, Massachusetts Agricultural Experiment Station, University of Massachusetts at Amherst. This Research is supported from Experiment Station Project No. 331.

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some problems. Late harvest entails the cost and inconvenience of frost protection, shorter days, and inefficient use of labor. Thus a compound that increases anthocyanin production and allows early harvest would be economically valuable to the grower. In this study the experimental compounds CGA-15281 and R-27969 were tested for this purpose.

METHODS AND MATERIALS

A weed-free section of the State Bog at East Wareham containing a relatively consistent stand of cranberry vines (Vaccinium macrocarpon Ait. cv Early Black) was treated with CGA-15281 and R-27969 on August 24, 1976 at rates of 0, 500, 1000, and 2000 ppm to plots $6M^2$ in area. There were 4 replicates of each treatment with plots arranged in a randomized complete block design. Both CGA-15281 and R-27969 were applied 10 days before harvest at a spray volume equivalent to 1.87 kl/ha with a compressed air, 1 gal hand sprayer.

At harvest the plots were hand-scooped and the berries immediately weighed. Berry size was determined by the number of berries required to fill a standard 8-oz cranberry measuring cup. Subsamples were taken from each sample at harvest and again after 14 days in common storage (ambient shed temperatures ranged from 17 to 24° C). Immediately after sampling the berries were frozen to stop further color development. Pigment concentration was determined after all subsamples had been collected. Anthocyanin content of the berries was determined by the method of Servadio and Francis (8) with modifications described previously (2). The data were analyzed by analysis of variance.

Table 1. Effect of CGA-15281 on anthocyanin development, yield, and size of 'Early Black' cranberries. Anthocyanin is recorded in ug/g fresh fruit. Anthocyanin is abbreviated ancy.

CGA-15281 (ppm)	Ancy. at harvest	Ancy. after 14 days storage	Yield (kg/ha)	Cup count
0	26	45	13,363	111
500	30	88	13,238	109
1000	48	103	11,224	108
2000	65	110	14,551	111
LSD 5%	18	18	3,985	9
1%	25	25	5,586	12

RESULTS

Anthocyanin content of CGA-15281-treated berries was higher than in untreated berries (Table 1). Berries treated with 500 ppm did not differ significantly from the control. However, anthocyanin content was 84% higher in berries treated with 1000 ppm and 150% higher with 2000 ppm CGA-15281.

It is well known that the anthocyanin content of cranberries increases considerably when they are kept in common storage (7). In this study untreated berries showed a 73% increase in color after 14 days storage (Table 1). However, the production of anthocyanins in storage was much more pronounced in CGA-15281-treated berries. For example, berries treated with 500 ppm showed a 193% increase in pigment during 14 days common storage. Berries treated with higher amounts of CGA-15281 did not produce anthocyanins in storage as rapidly as those treated with 500 ppm. Thus, berries treated with 100 ppm showed a 114% increase and those treated with 2000 ppm a 69% increase (Table 1). Note that although berries treated with 500 ppm CGA-15281 did not differ in pigment content from the control at harvest, they were significantly different after 14 days in common storage (Table 1).

There was no significant difference in color between untreated berries and those treated with R-27969, both at harvest and after 14 days in common storage (Table 2).

No significant differences in yield or size of cranberries could be attributed to CGA-15281 or R-27969 (Table 1 and 2).

Table 2. Effect of R-27969 on anthocyanin development, yield, and size of 'Early Black' cranberries. Anthocyanin is recorded in ug/g fresh fruit. Anthocyanin is abbreviated ancy.

R-27969 (ppm)	Ancy. at harvest	Ancy. after 14 days storage	Yield (kg/ha)	Cup count
0	26	45	13,363	111
500	20	62	12,446	111
1000	38	62	13,058	107
2000	30	62	16,961	109
LSD, 5%	14	23	3,959	6
1%	19	32	5,548	8

DISCUSSION

Treatment of cranberries with malathion (0,0-dimethyldithiophosphate of diethyl mercaptosuccinate) or ethephon (2-chlorethylphosphonic acid) shortly before harvest enhances anthocyanin production (1,2,3,4,5,6,9). However, malathion is an insecticide and does not have federal clearance for use as a treatment to increase anthocyanin production in cranberries. Ethephon is cleared for this type of use but at the maximum amount allowable (1.12 kg/ha) the increase in anthocyanin is too small to be commercially acceptable.

The data presented in this study show that CGA-15281, applied shortly before harvest, will increase anthocyanin production in cranberries. Moreover, CGA-15281-treated berries color more rapidly in storage than do untreated berries. It is therefore possible, depending on cost and federal clearance, that the use of CGA-15281 could prove to be a commercially feasible way of improving color development in cranberries.

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FIELD EVALUATIONS OF SEVERAL NEW BIOSTIMULANTS ON SELECTED HORTICULTURAL CROPS

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ABSTRACT

Ergostim and Cytex are two new natural products which were developed as plant growth supplements. Ergostim is a formulation containing 5% of N-acetyl thiazolidin-4-carboxylic acid (derivative of L. cysteine) and 0.1% folic acid with adjuvant in buffered solution. Reports from Europe indicate Ergostim is very effective in stimulating seed germination, vegetative growth, fruit set and yield of many plant species which include apples, grapes, strawberries, potatoes, beans, melons, rice, wheat and corn. Cytex is a cytokinin-like plant growth regulator which is used to increase seedling vigor of celery, carrots, and radishes; increase yields of strawberries, citrus and tomatoes and maximize sugar content of sugar beets.

Field experiments were conducted during the 1977 season at the Agway Farm Research Center at Fabius, New York, to evaluate Ergostim and Cytex on corn, wheat, barley, strawberries, apples, potatoes, peppers and carrots. Results indicate that foliar applications of Ergostim increase early yields of potatoes and sweet corn and increase fruit set of apples. Foliar application of Cytex increased yield of strawberries, increased fruit set and fruit size in apples and increased seedling growth of cabbage, cucumbers and snapbeans. Combinations of Ergostim and Cytex were very effective in increasing fruit set, fruit size and yields of apples, strawberries, peppers and wheat.

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GREENHOUSE STUDIES OF CHEMICAL EFFECTS ON WILD OAT SEED SHEDDING AND GERMINATION

W. Hurtt and R. B. Taylorson[1/]

ABSTRACT

Studies to explore the possibility of affecting the premature shedding of wild oat seeds (*Avena fatua* L.) or their dormancy by the application of foliarly-applied chemicals have been continued. The screening technique has been refined somewhat from that previously described (Proc. NEWSS 31:151) but essentially consists of treating greenhouse or growth chamber plants at heading and collecting the seed yields over a 3-week harvest period. Nonshed seeds in the panicles were counted to determine the relative percentages of shed and nonshed seeds as the principal criteria of chemical effect.

Since most harvests contained seeds having a range of hull colors, a study was initiated to obtain baseline information on seed production and germination as a function of color of seeds planted. The three arbitrary color classifications were light, variegated and dark. Plants grown from light seeds produced only variegated and light seeds, but plants grown from dark seeds yielded seeds of all three color designations. Differences were found in ratios of shed to nonshed seeds as well as in germinability. In general, dark seeds were found to be more dormant than light seeds.

Other workers have shown that surfactants affect seed germination. To preclude the possibility of confounding an apparent chemical effect with an effect attributable to the surfactant in the carrier solution, we tested two nonionic surfactants at 0.5% v/v concentration at application rates of 350 and 700 L/ha. No definitive effects were found on seed germination. Both surfactants appeared to reduce seed shedding but the results were not substantiated when the experiment was repeated.

Since cytokinins have been shown to affect seed dormancy, several studies were conducted with a commercial source of mixed cytokinins derived from seaweed extract. Application rates were 1 mg/L in 350 and 700 L/ha of water. Total seed production was generally inhibited with values varying from 9 to 14%. The results from two experiments indicated that cytokinins increased shedding of dark seeds but the differences were not statistically significant. Germination of the nonshed seeds appeared to have been increased by the foliar application of cytokinins.

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WEED CONTROL IN FOUR VARIETIES OF SWEET CORN WITH ATRAZINE AND CYANAZINE IN COMBINATION WITH METOLACHLOR, ALACHLOR AND PENDIMETHALIN

Richard D. Ilnicki, Darlene M. Frye, Ratemo W. Michieka and Carol N. Somody[1/]

ABSTRACT

The use of the triazine herbicides, 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine (atrazine) and 2- [[4-chloro-6-(ethylamino) -s-triazine-2-yl] amino] -2-methylpropionitrile (cyanazine), and the acetanilide herbicide, 2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide (alachlor), in sweet corn (Zea mays saccharata L.) has become well established. Recently, a closely related herbicide to alachlor, an acetanilide, 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide (metolachlor) and a dinitroaniline herbicide, N-(1-ethylpropyl)-3, 4-dimethyl-2, 6-dinitrobenzenamine (pendimethalin) have been made available to weed researchers and these have shown some promise as herbicides in sweet corn. The objective of this study was to determine what effect these herbicides, applied alone or in combination, had on the response of four popular sweet corn varieties and on weed control.

Bellringer, Iochief, Seneca Chief, and Wonderful varieties were treated shortly after planting with the following herbicides: atrazine and cyanazine each applied alone, and in a number of combinations with metolachlor, alachlor, or pendimethalin.

Atrazine alone had no effect on any variety. Alachlor had a slight effect on Iochief and metholachlor slightly reduced vigor of Bellringer, Iochief, and Seneca Chief. Combinations of these two acetanilide herbicides with atrazine had no effect on any of the varieties and this undoubtedly was related to the slightly reduced rates of the herbicides used in the combinations. Pendimethalin alone reduced vigor of Iochief but this response was not observed in the combination with atrazine.

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Cyanazine reduced vigor, to a small degree, of Iochief, Seneca Chief, and Wonderful. Other treatments that affected responses to sweet corn included cyanazine plus metolachlor on Bellringer, cyanazine plus alachlor on Iochief, and cyanazine plus pendimethalin on Bellringer and Seneca Chief.

Generally, increases in weed control were noted from combination treatments than from the herbicides applied alone.

EVALUATION OF HERBICIDE-SURFACTANT COMBINATIONS ON SWEET CORN

by B. B. Messier and R. A. Ashley[1]

ABSTRACT

Twenty-six surfactants were evaluated in combination with atrazine (2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine) and metolachlor (2-chloro-N-(2-ethyl-6-methyl phenyl)-N-(2-methoxy-1-methylethyl)acetamide) in greenhouse experiments conducted at the University of Connecticut. Four inch plastic pots were filled with untreated, unamended Woodbridge fine sandy loam soil and seeded on June 6, 1977 with sweet corn (Zea Mays var rugosa cv. Seneca Chief) and tomato (Lycopersicon esculentum Mill. cv. Ace 55). A natural stand of large crabgrass (Digitaria sanguinalis (L.)Scop.) developed in the pots.

Pots were treated with metolachlor at 1.5 lb ai/A or atrazine at 1 lb ai/A alone and in combination with 26 surfactants. All surfactants were applied at a rate of 0.5% v/v or w/v. Treatments were applied with a mechanical cabinet sprayer calibrated to deliver 40 gal/A. Treatments were replicated three times.

Atrazine - surfactant treatments were applied June 14, 1977 when the sweet corn was in the 2-leaf stage, tomato in the cotyledon stage and crabgrass in the 1 to 2 leaf stage. Metolachlor - surfactant treatments were applied June 21, 1977 with sweet corn in the 6-leaf stage, tomato in the 2 leaf stage and crabgrass in the 3 to 4 leaf stage. Response of each species was rated one week after treatment using a 0 to 10 scale with 0 representing no effect and 10 representing complete kill.

Aerosol OT-100, OT-70PG, CPG and A-196 were selected from the greenhouse trial for field testing in combination with atrazine on the basis of improved crabgrass control. Aerosol A-102, 200 and 501 were selected for field testing in combination with atrazine and cyanazine [2-([4 chloro-6-(ethylamino)-s-triazen-2-yl]amino)-2-methyl propionitrile] because of the absence of crop injury in the greenhouse test.

Aerosol A102, A196, A268, OT-100, IB-45, 19, 22, TR-70, AY-B and C-61 were selected for field testing in combination with metolachlor because of increased activity on broadleaved plants as indicated by the response of tomato in the greenhouse trial. Aerosol A102, A103, A196, TR-70, and 501 were also selected for field testing in combination with alachlor [2-chloro-2',6'-diethyl-N-(metoxymethyl)acetamalide].

Seneca Chief sweet corn was seeded 6/23/77 to stand 8 inches apart in 3 ft. rows 10 feet long. Treatments were arranged in a randomized block design and were replicated 3 times. Soil was a Woodbridge fine sandy loam with a pH of 6.2 and 3% organic matter.

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Herbicide - surfactant treatments were applied 7/11/77 to sweet corn in the 5-6 leaf stage, crabgrass in the 2-3 leaf stage and redroot pigweed (Amaranthus retroflexus L.) in the 4 to 6 leaf stage. Atrazine and cyanazine were applied at 1 lb ai/A and metolachlor and alachlor at 1.5 lb ai/A. All herbicides were applied alone and in combination with the surfactants listed above. Surfactants were added at a rate of 0.5% v/v. Treatments were applied using a compressed air knapsack sprayer calibrated to deliver 40 gal/A. Treatments were rated July 18 using the 0 to 10 scale previously described.

Cyanazine + Aerosol 501 gave significantly better control of crabgrass and pigweed than cyanazine alone. On July 18, ratings of 10 and 6 were obtained for control of crabgrass and pigweed respectively with cyanazine + Aerosol 501 as compared to ratings of 4 and 2 with cyanazine alone. The use of Aerosol A102 or 200 in combination with cyanazine gave significantly increase pigweed control with each treatment receiving a rating of 7 on July 18.

Significant increases in crabgrass and pigweed control were observed in the July 18 rating where metolachlor + Aerosol AY-B was used. Ratings of 5 and 7 were recorded for crabgrass and pigweed control respectively as compared to ratings of 1 and 0 where metolachlor was used alone. A pigweed control rating of 4 was obtained with metolachlor + Aerosol 19 on July 18 which was also significantly better than metolachlor alone.

Alachlor + Aerosol A102 or A196 gave significantly increased pigweed control as compared to alachlor alone. On July 18 ratings of 6 and 5 were obtained for these treatments as compared to a rating of 2 for alachlor alone. There was no significant difference in crabgrass control.

None of the surfactants tested significantly increased pigweed or crabgrass control when used in combination with atrazine.

None of the herbicide - surfactant combinations tested in the field resulted in significant increases in crop injury. There were no significant differences in yield.

THE EFFECTS OF TWO ATRAZINE FORMULATIONS ON THE RESPONSE OF SEVERAL VARIETIES OF SWEET CORN

Ratemo W. Michieka, Carol N. Somody, Richard D. Ilnicki[1/]

ABSTRACT

Six sweet corn varieties, representing several maturity dates, were treated with two formulations of atrazine, the wettable powder and a flowable, both applied preemergence and postemergence. The early maturing Sundance variety was especially sensitive to both formulations of atrazine, applied either preemergence or postemergence with the flowable producing more injury from the postemergence application.

Bellringer and Gold Winner, early midseason varieties, were not injured by either formulation applied at any time.

There was only a slight effect on the midseason varieties Gold Cup and Wonderful. Gold Cup was only slightly affected by the highest rate of the flowable applied preemergence or postemergence and Wonderful only slightly affected by the higher rate of wettable applied preemergence.

The late maturing Sweet Sue was sensitive to both formulations regardless when applied; however, it was more sensitive to post application.

INTRODUCTION

There have been reports, although not well documented, that some sweet corn (*Zea mays saccharata*) varieties were particularly sensitive to liquid or flowable formulations of 2-chloro-4-(ethyl=amino)-6-(isopropylamino-*s*-triazine (atrazine). Whether this was generally true or whether unusual circumstances or conditions contributed to these responses was not known. From what evidence we could obtain, varieties were selected to investigate this problem. The objective of this study, therefore, was to study the response of six varieties of sweet corn, representing several maturities, to the standard wettable formulation and to a newer flowable liquid formulation of atrazine.

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MATERIALS AND METHODS

Six varieties of sweet corn were planted in Holmdel sandy loam soil on May 24 after complete seedbed preparation at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey. Each plot consisted of one row of each variety in 42-inch spacings in a randomized split plot design with 3 replications. Each variety was randomized within each plot. Immediately after planting, atrazine wettable powder at 1 1/2 and 2 lb/A and atrazine flowable at 1 1/2, 2, and 2 1/2 lb/A were applied preemergence in 40 GPA and the same rates were applied postemergence over the tops, June 14, when the corn was in the 4 to 5-leaf stage.

The varieties and maturity dates included the following: early maturity - Sundance; early-midseason - Bellringer and Gold Winner; midseason - Gold Cup and Wonderful; and late maturity - Sweet Sue.

The experimental area included the following weeds: common pigweed (*Amaranthus retroflexus* L.); ivyleaf morning glory (*Ipomoea hederacea* (L.) Jacq.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.), and fall panicum (*Panicum dichotomiflorum* Michx.).

All plots were rated on July 14, one month after the postemergence applications, using the scale of 0 to 10 where 0 = no control or no effect on the crop and 10 = complete control or complete elimination of stand.

RESULTS AND DISCUSSION

In Table 1 are summarized the responses of varieties to the two formulations of atrazine applied preemergence and postemergence. From this table it is immediately obvious that the Sundance variety was particularly sensitive to both atrazine formulations and there were no appreciable differences in the responses from the two formulations. Evident also is that this variety was sensitive to postemergence applications of atrazine and that the flowable formulation produced greater injury than the wettable powder formulation. It should be noted, also, that the stand in the check plots was reduced; however, the differences between the check and treated plots was of sufficient magnitude to justify that atrazine had some deleterious effect on this variety.

The early midseason varieties Bellringer and Gold Winner were not affected by either formulation applied preemergence or postemergence.

Of the midseason varieties, there was only a slight difference in response to the two formulations. Gold Cup was slightly reduced in stand by the highest rate of the flowable applied preemergence or postemergence. With regard to the variety Wonderful, stand was slightly reduced from the wettable formulation applied preemergence.

The late maturing variety, Sweet Sue, was sensitive to both formulations regardless when they were applied. The data are not consistent and there was some reduction in the check plots. Regardless of the variation, it may be said that this variety was more sensitive to postemergence applications of either formulation of atrazine than to preemergence applications.

Yield data are not included here but from preliminary observations of the field harvests, it is apparent that yields were reduced where stand reductions were 20% or greater.

In Table 2 are summarized weed control data. From these data it can be seen that there were no great differences in the degree of control of pigweed or ivyleaf morning glory; however, crabgrass and fall panicum control was slightly better from the flowable formulation than from the wettable powder and that preemergence applications were generally better than postemergence applications.

Table 1. The response of some sweet corn varieties to preemergence and postemergence applications of two atrazine formulations.

Herbicide and Formulation	Rate, lb/A	Varieties and Maturities[1]					
		Early	Early mid	Early mid	Midseason	Midseason	Late
		Sundance	Bellringer	Gold Winner	Gold Cup	Wonderful	Sweet Sue
Preemergence Applications (May 24)							
Atrazine 80W	1 1/2	5.7	0.0	0.0	0.7	0.3	2.3
	2	6.0	0.0	0.0	0.7	1.3	0.3
Atrazine 4L	1 1/2	5.3	0.0	0.0	0.7	0.3	1.3
	2	5.0	0.0	0.3	0.7	0.0	2.0
	2 1/2	5.3	0.0	0.0	1.0	0.0	2.3
Postemergence Applications (June 14)							
Atrazine 80W	1 1/2	4.7	0.0	0.3	0.7	0.0	3.3
	2	6.0	0.0	0.3	1.0	0.0	1.7
Atrazine 4L	1 1/2	5.3	0.0	0.3	0.7	0.3	1.0
	2	7.0	0.0	0.3	0.7	0.0	3.3
	2 1/2	6.0	0.0	0.0	1.7	0.0	3.3
Check	-	3.7	0.3	0.3	1.0	0.0	1.0

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

Table 2. Weed control in sweet corn from preemergence and postemergence applications of two atrazine formulations.

Herbicide and Formulation	Rate, lb/A	Weed Control[1]			
		Pigweed	Ivyleaf Morning glory	Crabgrass	Fall Panicum
Preemergence Applications (May 24)					
Atrazine 80W	1 1/2	10.0	9.3	3.7	5.0
	2	10.0	9.7	5.0	5.0
Atrazine 4L	1 1/2	10.0	9.0	5.0	4.7
	2	9.7	9.3	6.3	8.0
	2 1/2	10.0	10.0	8.3	7.7
Postemergence Applications (June 14)					
Atrazine 80W	1 1/2	10.0	9.7	0.3	3.7
	2	10.0	9.3	5.7	7.3
Atrazine 4L	1 1/2	10.0	9.7	4.0	4.3
	2	10.0	10.0	6.3	5.7
	2 1/2	10.0	9.7	8.0	6.0
Check	-	0.0	0.0	0.0	0.0

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

A COMPARISON BETWEEN ALACHLOR AND METOLACHLOR FOR CONTROL OF YELLOW NUTSEDGE[1]

D. T. Warholic and R. D. Sweet[2]

ABSTRACT

Alachlor and metolachlor were compared for yellow nutsedge control in nine experiments over a period of four years. The results of all tests are in agreement, although only three of these studies are detailed here. Metolachlor at 2.0, 3.0 and 4.0 lbs provided season-long control of yellow nutsedge, whereas equivalent rates of alachlor did not. At 2.0 and 3.0 lbs alachlor was more active on redroot pigweed and lambsquarters.

INTRODUCTION

Between 1974 and 1977 alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] and metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide] have been included in our field testing program for yellow nutsedge (Cyperus esculentus L.) control. A total of nine comparative studies have been concluded during this period. These studies have ranged from initial screening studies to side by side logarithmic comparisons, to detailed comparisons in a nutsedge-crop situation.

Observations from our screening studies (1,2) indicated that metolachlor had considerably more residual activity against yellow nutsedge than alachlor. Our more in depth work of the last two years have substantiated our initial observations. Only three of the nine experiments will be presented here, but they will illustrate the more important aspects of our findings.

MATERIALS AND METHODS

Logarithmic Comparisons - 1976

A two replicate non-crop experiment was initiated on April 19, 1976 when a majority of nutsedge tubers had sprouted but had not yet emerged. The soil type was a Palmyra Gravelly Loam with a pH of 7.4 and an O.M. content of 4.3%. Plot size was 6' x 60' and the experimented design was an RCB. Treatments were applied with a hand held, CO_2 pressurized, logarithmic, backpack sprayer delivering 55 gal of water per acre at 40 lbs p.s.i. through 8004 nozzles. Rate accuracy was assured by the use of a measured pacing rope and a metronome. Plots were rated on May 31, July 2 and on July 23.

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Single Rate Comparison of Alachlor and Metolachlor - 1977

Two identical non-crop tests were treated preplant incorporated (PPI) and surface on April 28 and May 24. Only the PPI part of the second test will be reported upon here although any part of either test would have illustrated the same points. Soil type and characteristics are the same as described for the logarithmic tests above. Application equipment was also identical with the exception that a single rate sprayer was used. An RCB design with three replicates was chosen with plot size being 6' x 20'. After the plots were sprayed, the front 8' of each was incorporated with a double disc to a depth of 3" driven back and forth in the same direction. Ratings were taken 60 and 69 days after application.

Sweet Corn - Nutsedge Yield Study - 1977

Nutsedge was in the five to six leaf stage when the field was finally fitted with a springtooth harrow. The soil type was a Howard Gravelly Loam with a pH of 6.5 and an O.M content of 4.0%. Plots were 6' x 15' with an RCB design and three replicates. Spraying equipment was a straight rate, small plot sprayer described previously. After certain plots had been sprayed, the total experimented area was reworked twice with a springtooth harrow. All plots were planted to Gold Cup sweet corn with a two-row John Deere plateless planter and the remaining plots treated. Visual ratings and yields were taken.

RESULTS

Logarithmic Comparisons - 1976

The preemergence results are presented in Figure 1. Incorporated results show the same trend. After seven weeks following application both alachlor and metolachlor were providing similar nutsedge control. At ten weeks, however, the longer lasting residual activity of metolachlor was apparent. Fourteen weeks after applications, metolachlor was providing between 70 to 95% control of nutsedge while 4 lbs of alachlor was giving less than 30%.

Single Rate Comparison of Alachlor and Metolachlor - 1977

The results are reported in Figure 2. Results were similar to those found in the previous test. Up to eight and one half weeks alachlor and metolachlor were undistinguishable from each other. At ten weeks, however, the greater residual activity of metolachlor was once again demonstrated.

Sweet Corn - Nutsedge Yield Study - 1977

Season long control of nutsedge was obtained by metolachlor but not alachlor, although yields were not reduced (Table 1.) A rating evaluating season long control was taken shortly before harvest. This rating clearly showed that metolachlor was providing better nutsedge control at all of the three rates tested. When compared at the two pound rate, alachlor appeared to be slightly more active on redroot pigweed (*Amaranthus retroflexus* L.) and common lambsquarters (*Chenopodium album* L.).

Table 1. Nutsedge control ratings and sweet corn yields from treatments of alachlor and metolachlor

Herbicide, Rate, Timing			Weed Control[a] 9/21/77 Nutsedge	Redroot Pigweed	Lambs-quarters	Average Plot Yield (lbs)	Average Ear Weight (lbs)
alachlor	2.0	Pre	6.0	9.0	7.0	18.1	0.6
"	3.0	"	5.0	9.0	7.0	15.3	0.7
"	4.0	"	7.0	9.0	9.0	18.8	0.7
metolachlor	2.0	Pre	8.0	6.0	6.0	17.2	0.7
"	3.0	"	8.0	8.0	7.0	16.7	0.7
"	4.0	"	8.0	9.0	9.0	16.6	0.7
butylate+	4.0	PPI	8.0	8.0	7.0	17.8	0.7
EPTC+25788	4.0	PPI	7.0	7.0	8.0	18.0	0.7
unweeded			4.0	5.0	6.0	10.9	0.5
hand weeded			8.0	9.0	9.0	18.7	0.7

[a]weed control ratings: 1 = no control; 7 = acceptable; 9 = perfect control

CONCLUSIONS

During a period of four years nine experiments were conducted which included alachlor and metolachlor at rates between 2 and 4 lbs applied both preplant incorporated and preemergence. Three of these studies were reported here. The results from the other six studies support the evidence presented here, this is, that rate for rate metolachlor gives somewhat longer lasting control of yellow nutsedge. Questions needing additional work are: (1) how much longer does metolachlor provide better control; (2) is this longer residual period reflected in increased crop yields; (3) does alachlor have an advantage over metolachlor in providing better broadleaf control in addition to redroot pigweed and lambsquarters; and (4) which material is better for the several important annual grass species such as fall panicum (*Panicum dichotomiflorum* Michx), barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], and large crabgrass [*Digitaria sanguinalis* (L.) Scop.], etc.

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Figure 1. Percent control of yellow nutsedge with alachlor and metolachlor at three rates and three intervals of time.

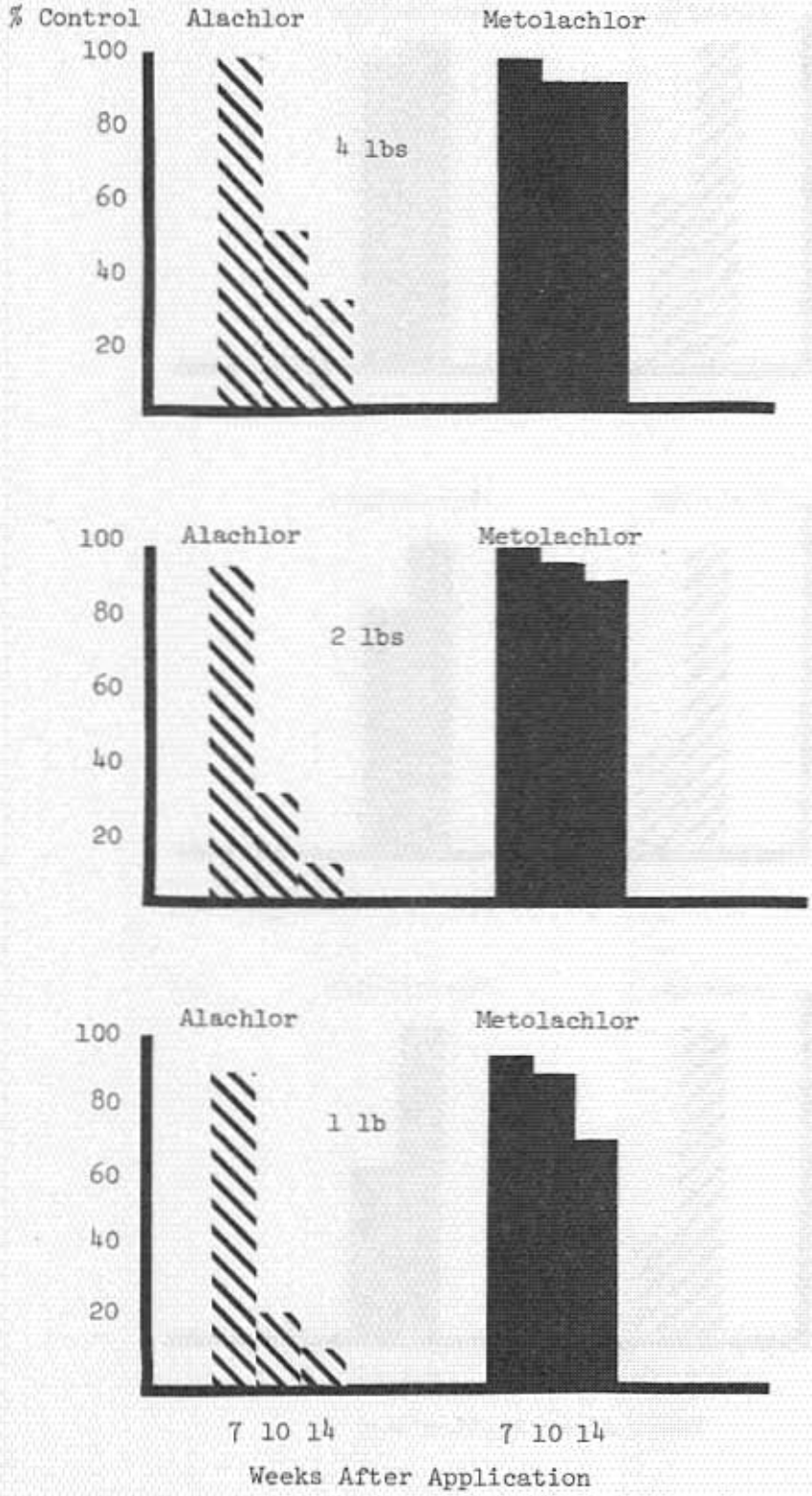
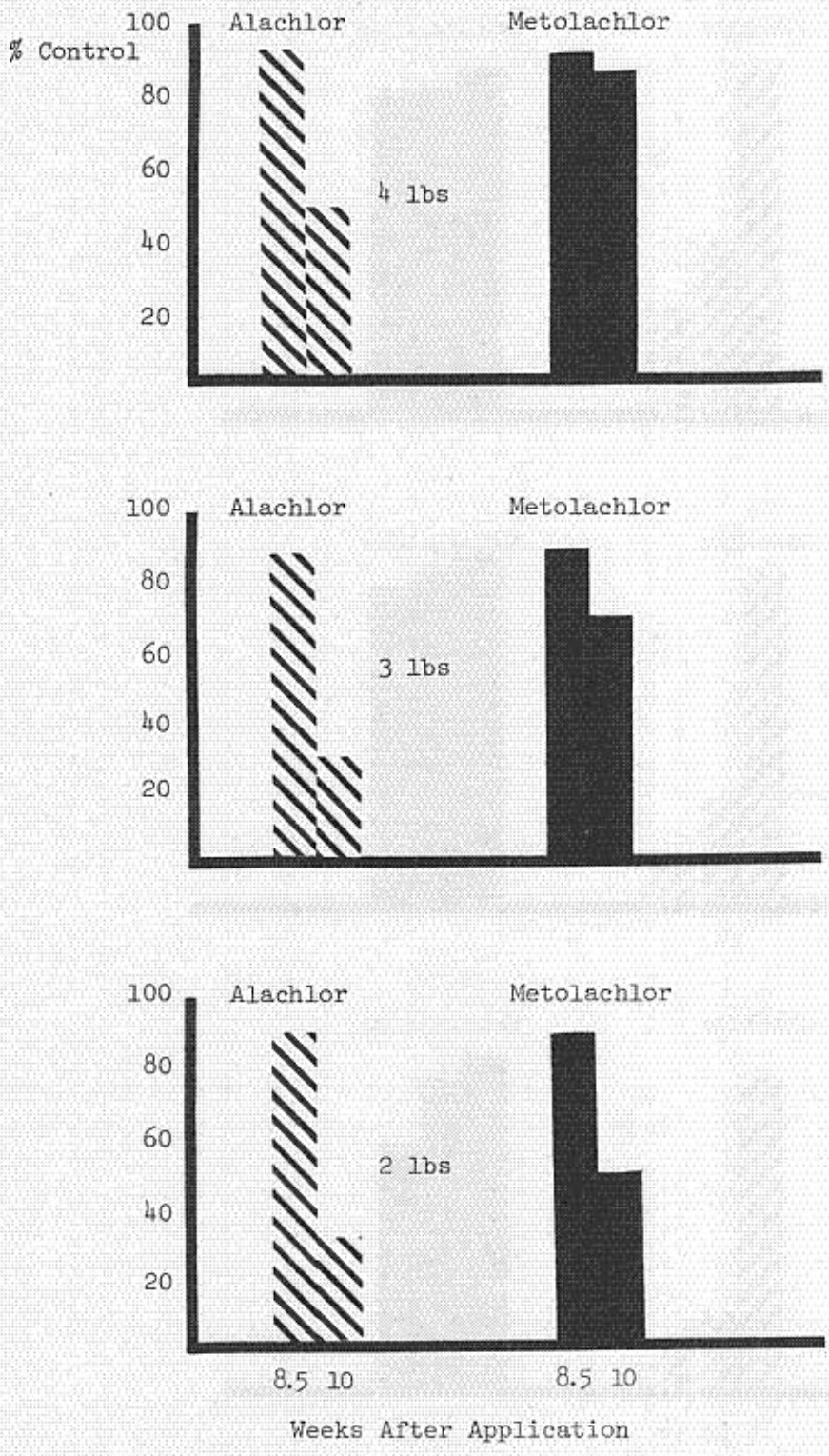


Figure 2. Percent control of yellow nutsedge with alachlor and metolachlor at three rates and two intervals of time.



THE RESPONSE OF SOME SWEET CORN VARIETIES TO THIOCARBAMATE HERBICIDES FORMULATED WITH AND WITHOUT ANTIDOTES

Carol N. Somody, Ratemo W. Michieka, Richard D. Ilnicki and Jan Somody[1/]

ABSTRACT

The EPTC rate-variety combinations which were most improved in both stand and vigor by the addition of R-25788 were Iochief, Seneca Chief, and Wonderful. Similar results were produced by EPTC + R-29148.

Vernolate plus antidote additions greatly improved stand and vigor of Bellringer and Iochief over that of vernolate alone.

Butylate at 8 lb/A significantly improved stand and vigor of Iochief by additions of R-25788. In general, butylate + R-25788 often decreased vigor of the corn varieties, as did butylate + R-29148.

EPTC with antidotes caused least amount of injury to Bellringer at all rates and Wonderful at 4 lb/A. Vernolate without antidotes did not injure Bellringer or Seneca Chief at higher rates. Butylate produced negligible injury to Bellringer and Wonderful at all rates and to Seneca Chief at the two higher rates without any antidotes.

INTRODUCTION

Preplant applications of thiocarbamate herbicide for weed control in corn have proved successful. Sometimes injury in the form of stunting and formative effects can result, particularly with high rates and when the weather is cold and wet. Antidotes, chemicals which prevent this injury, have a definite place in thiocarbamate weed control programs. Generally, sweet corn is more sensitive to thiocarbamates than field corn. It was the objective of this study to compare commercially-formulated thiocarbamate herbicides containing N,N-diallyl-2,2-dichloroacetamide (R-25788) with formulations containing no antidote and in formulations with a new antidote R-29148 on four popular sweet corn varieties grown in the Northeast.

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METHODS AND MATERIALS

Herbicides were applied May 24 to a well-prepared Holmdel sandy loam soil at the Soils and Crops Research Center, New Jersey Agricultural Station, Adelphia, N. J., to predesignated plot areas using a CO_2-propelled backpack sprayer. After the herbicides were applied, the area was incorporated with a tilrovator. Corn was planted in 42-inch rows, each of the four varieties is a single row, each plot being four rows wide and 24 feet long. Bellringer, Iochief, Seneca Chief, and Wonderful were the varieties studied. S-ethyl dipropylthiocarbamate (EPTC), S-propyl dipropylthiocarbamate (vernolate), and S-ethyl diisobutylthiocarbamate (butylate) were each applied at 4, 6, and 8 lb/A with and without the antidotes R-25788 and R-29148. The varieties were rated July 19 on a scale of 0 (100% stand or vigor) to 10 (complete stand reduction or loss of vigor).

RESULTS AND DISCUSSION

In Tables 1, 2, and 3 are summarized the responses of the varieties to the various formulations of EPTC, vernolate, and butylate, respectively.

Stand and vigor of Bellringer were not reduced by any of the EPTC rates or formulations. Vernolate at 8 lb/A without antidotes only affected the stand of Bellringer. There was also a 25% reduction in vigor at this rate. Both stand and vigor were not affected by vernolate + R-25788, but the formulation with R-29148 still decreased vigor by 10%. Butylate without antidotes did not injure Bellringer.

The stand of Iochief was reduced by 20% from both the 4 and 8 lb/A rates of EPTC. Formulations with antidotes effected no such response. Vigor reduction, which was significant at the 4 and 8 lb/A rates of EPTC without antidotes was less by at least 30% with the formulations containing R-25788 and R-29148.

Formulations of vernolate containing the antidotes had no effect on stand of Iochief whereas without reduced stand at both the 6 and 8 lb/A rate. However, the addition of the antidote did not completely overcome the large decrease in vigor at these rates.

The stand of Iochief was affected in a similar manner by butylate as with vernolate; however, all rates of butylate significantly decreased vigor. Only butylate + R-25788 at 8 lb/A and butylate + R-29148 at 4 lb/A improved vigor. Furthermore,

formulations containing both antidotes affected Iochief vigor.

EPTC + R-25788 produced only slight decreases in stand of Seneca Chief when compared to EPTC alone. Vigor of Seneca Chief was affected most of all the varieties by EPTC without antidotes, but this effect was not produced by formulations containing both antidotes.

Vernolate without antidotes did not injure the stand of Seneca Chief, but vigor decreased at the 4 and 8 lb/A rates. With the antidotes, this effect decreased significantly at the 8 lb/A but not the 4 lb/A rate.

Butylate also did not affect the stand of Seneca Chief but much vigor was reduced at 6 lb/A and the additions of the antidotes, although improving the response at 6 lb/A seemed to have no effect at the other rates.

EPTC with either antidote corrected the small decrease in the stand of Wonderful produced by 8 lb/A of EPTC. EPTC + antidotes also greatly affected the decrease in vigor produced by increasing rates of EPTC.

Vernolate did not affect the stand of Wonderful. Vernolate + R-25788 nullified vigor reduction produced by vernolate alone at all rates, but benefits were less with R-29148.

As with vernolate, butylate alone did not injure the stand of Wonderful, and even vigor was hardly affected. Thus, the antidotes were unnecessary.

Table 1. Effect of EPTC with and without antidotes in the response of several varieties of Sweet Corn.

Treatment	Rate, lb/A	Bell-ringer 1/ S	Bell-ringer 1/ V	Iochief 1/ S	Iochief 1/ V	Seneca Chief 1/ S	Seneca Chief 1/ V	Wonderful 1/ S	Wonderful 1/ V
EPTC	4	0.0	0.2	1.8	3.7	0.5	4.7	0.4	0.7
EPTAM 7E	6	0.0	0.7	0.3	1.0	0.7	5.2	0.5	2.5
	8	0.0	0.0	1.8	5.6	1.2	6.3	1.0	6.0
EPTC (R-25788)	4	0.0	0.4	0.0	0.7	0.0	1.2	0.2	0.7
ERADICANE	6	0.0	0.5	0.0	2.3	0.0	0.4	0.4	0.4
	8	0.0	0.4	0.0	2.2	0.0	0.5	0.0	0.7
EPTC (R-29148)	4	0.0	0.4	0.0	0.7	0.2	0.5	0.0	0.2
	6	0.0	0.7	0.0	0.9	1.9	1.7	0.2	1.3
	8	0.0	0.0	0.2	0.7	0.0	0.7	0.2	0.2

1/S = Stand and V = Vigor based on a scale of 0 to 10, where 0 = no effect and 10 = complete kill.

Table 2. Effects of vernolate with and without antidotes in the response of four varieties of sweet corn.

Treatment	Rate, lb/A	Bell-ringer 1/ S	Bell-ringer 1/ V	Iochief 1/ S	Iochief 1/ V	Seneca Chief 1/ S	Seneca Chief 1/ V	Wonderful 1/ S	Wonderful 1/ V
vernolate	4	0.0	0.7	0.2	1.0	0.0	1.9	0.0	1.0
VERNAM 7E	6	0.2	0.5	0.8	3.3	0.0	0.5	0.4	1.2
	8	1.0	2.5	1.2	3.4	0.5	4.3	0.7	2.3
vernolate	4	0.0	0.4	0.0	1.2	1.2	1.9	0.0	0.2
(R-25788)	6	0.0	0.5	0.4	2.0	0.0	0.9	0.0	0.2
SURPASS	8	0.0	0.0	0.0	1.4	0.3	0.9	0.0	0.0
vernolate	4	0.0	0.9	0.0	0.4	0.7	1.5	0.4	1.0
(R-29148)	6	0.0	0.4	0.7	2.5	0.0	0.7	0.0	0.4
	8	0.0	0.9	0.0	1.5	0.0	0.8	0.2	0.9

1/S = Stand and V = Vigor based on a scale of 0 to 10, where 0 = no effect and 10 = complete kill.

Table 3. Effects of butylate with and without antidotes in the response of four varieties of sweet corn.

Treatment	Rate, lb/A	Bell-ringer[1/] S	Bell-ringer[1/] V	Iochief[1/] S	Iochief[1/] V	Seneca Chief[1/] S	Seneca Chief[1/] V	Wonderful[1/] S	Wonderful[1/] V
butylate	4	0.0	0.4	0.0	1.9	0.0	0.5	0.0	0.4
SUTAN	6	0.0	0.7	0.8	1.2	0.0	3.0	0.0	0.4
	8	0.0	0.2	1.0	2.4	0.0	0.7	0.2	0.2
butylate	4	0.0	0.0	0.7	2.2	0.0	0.7	0.2	0.2
(R-25788)	6	0.0	0.4	1.0	3.7	0.0	1.8	0.7	1.7
SUTAN +	8	0.0	1.0	0.0	1.2	0.0	1.3	0.0	1.0
butylate	4	0.5	1.3	0.2	0.7	0.0	1.7	0.0	0.2
(R-29148)	6	0.0	0.5	0.4	1.9	0.0	1.2	0.0	1.0
	8	0.0	1.8	0.2	2.0	0.0	0.8	0.0	0.2

1/S = Stand and V = Vigor based on a scale of 0 to 10, where 0 = no effect and 10 = complete kill.

HERBICIDE CANDIDATES FOR WEED CONTROL IN ONIONS

G.W. Selleck and W.J. Sanok[1]

ABSTRACT

This experiment on onions (Allium cepa L.) was conducted on a sandy loam soil on Long Island to evaluate pre- and post-emergent herbicide application for the control of barnyard grass (Echinochloa crusgalli (L.) Beauv), pineapple weed (Matricaria matricaroides (Less) Porter), purslane (Portulaca oleracea L.), and crabgrass (Digitaria sanguinalis (L) Scop.). In this experiment, propachlor was used at 4.0, 6.0, and 8.0 lb/A per acre one week after seeding as a preemergence application. All other treatments were preceded by using DCPA at 6.0 lb/A preemergence. Nitrofen at 3.0 lb and in tank mix combination with HOE 23408 at 1.0 lb., HOE 29152 at 0.25, and 0.5 lb/A were applied at the three-leaf stage in onions. RH 2915 at 0.25 and 0.5 lb/A was applied at the two-leaf stage and oxadiazon at 0.5, 0.75, 1.0; methazole at 0.5, 0.75, and 1.0; and brominal at 0.31, and 0.38 lb/A were all applied post-emergence to onions at the three-leaf stage. Several of the treatments resulted in slight phytotoxicity to the onions, but none resulted in significant differences in yield.

All of the treatments resulted in good to excellent control of barnyard grass, pineapple weed, purslane, and crabgrass.

INTRODUCTION

Although onions are raised on a very limited acreage on Long Island, there is some interest in producing this crop using the direct-seeded method. Weeds continue to be one of the major problems in onion production. Presently registered herbicides have been effective in controlling most weeds but the changing weed spectrum and label restrictions continue to be a problem for growers.

MATERIALS AND METHODS

Three varieties of onions -- 614 Nutmeg, Hybrid 5551, and 622 Spartan Banner -- were direct seeded on April 11 using a Stan Hay seeder. These three varieties were planted one row each to a three-row bed at the Long Island Horticultural Research Laboratory on a Haven loam soil. All applications were made using a tractor-mounted sprayer delivering 40 gpa at 35 psi and replicated four times.

Applications of DCPA at 6.0 lb/A and propachlor at 4.0, 6.0, and 8.0 lb per acre were made on April 18. DCPA was applied to all plots (except for propachlor treatments) that were to be used in the later post-emergence treatments. Post-emergence application of RH 2915 at 0.25 and 0.5 lb/A were made on May 23 at the two-leaf stage. Nitrofen at 3.0 lb and in tank mix with HOE 23408 at 1.0, and HOE 29152 at 0.25, and 0.5 were made on June 6 when the onions were in the three-leaf stage. Oxadiazon at 0.5, 0.75, 1.0; methazole at

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0.5, 0.75, and 1.0; and brominal at 0.31, 0.38 were applied at the three-leaf stage. The second application of propachlor at 4.0, 6.0, and 8.0 lb/A was applied at the four-leaf stage. All of these treatments were repeated on June 27. Hand hoeing and weeding was done early in June before applications of the post-emergence materials were made.

Phytotoxicity ratings were made approximately one week to ten days after each application and are indicated in Table 1. The yield data is also given in Table 1 for each of the three varieties. Weed control ratings for those weeds present are indicated in Table 2. Ratings were made for pineapple weed on May 23, June 6, and June 17. Ratings for control of barnyard grass were made on June 17 and for purslane and crabgrass on July 20 and August 17.

RESULTS AND DISCUSSION

There was no phytotoxicity evident with the preemergence treatments of DCPA and propachlor. All of the treatments showed slight phytotoxicity when applied post emergence, including all three rates of propachlor. Symptoms were most evident after the second application of nitrofen and nitrofen combinations of HOE 23408 and 29152, and methazole. Obvious stunting and necrotic leaf banding occurred with the RH 2915, but there was no evidence of yield depression. This same leaf banding and growth suppression also occurred with brominal, but the difference in yield was not statistically significant.

All of the treatments provided acceptable control of the weeds present: barnyard grass, pineapple weed, purslane, and large crabgrass. Propachlor was more effective applied preemergence than where weeds were present. The three weedings permitted onions to develop normally on the untreated checks without which yields would have been severely depressed.

Work done by these authors and others (1,2,3,4) indicates that propachlor, methazole and oxadiazon have potential as good herbicide treatments in direct-seeded onions. It is hoped that results such as these will aid in registration of these materials to give us a better arsenal of chemicals to use in controlling weeds in onions.

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Table 1. Date of application, phytotoxicity and yield with herbicides in three onion trials.

Chemical	lbs AIA	Date of application 4/18	5/23	6/6	6/8	6/17	6/27	Phytotoxicity[1/] ratings 5/23	7/2	6/17	7/20	Yield lbs/plot Nutmeg	5551	S. Banner
nitrofen	3.0													
HOE 23408	1.0			x			x			0.0	1.3	30.6	37.8	26.4
nitrofen	3.0													
HOE 29152	0.25			x			x			1.0	1.3	32.6	41.6	29.8
nitrofen	3.0													
HOE 29152	0.5			x			x			0.67	2.2	31.8	36.7	27.8
oxadiazon	0.5			x			x			1.3	2.5	37.9	44.1	25.8
oxadiazon	0.75			x			x			1.5	1.5	26.8	37.6	26.6
oxadiazon	1.0			x			x			1.0	1.3	33.8	39.8	27.4
nitrofen	3.0			x			x			0.83	3.3	31.2	30.4	23.5
methazole	0.5				x		x			0.0	1.8	29.5	40.0	23.1
methazole	0.75				x		x			0.0	1.8	30.8	34.5	26.6
methazole	1.0				x		x			0.0	1.7	37.5	37.4	29.0
RH 2915	0.25		x				x		2.75		1.5	32.5	37.5	25.5
RH 2915	0.5		x				x		3.0		1.0	27.2	37.0	25.3
propachlor	4.0	x				x	x	0.0			2.0	35.6	43.6	26.1
propachlor	6.0	x				x	x	0.0			1.7	27.4	3 ℓ5	23.5
propachlor	8.0	x				x	x	0.0			2.0	34.0	38.0	24.4
brominal	0.31				x		x				2.3	31.6	35.2	21.1
brominal	0.38				x		x				1.0	26.0	29.1	21.8
Check											1.0	34.1	42.4	23.1

1/ 0 = no injury, 10 = complete kill

Table 2. Weed control ratings with herbicides in onions.

Chemical	lbs AIA	Weed control ratings[1/]							
		Barnyard grass	Pineapple weed			Purslane		Crabgrass	
		6/17	5/23	6/2	6/17	7/20	8/17	7/20	8/17
nitrofen	3.0	--	--	--	--	--	--	--	--
HOE 23408	1.0	--	--	--	8.5	--	9.5	8.5	9.3
nitrofen	3.0	--	--	--	--	--	--	--	--
HOE 29152	0.25	--	--	--	8.7	9.6	9.2	9.7	9.0
nitrofen	3.0	--	--	--	--	--	--	--	--
HOE 29152	0.5	--	--	--	8.8	9.5	9.0	9.5	9.0
oxadiazon	0.5	9.9	--	--	9.6	9.5	9.5	9.2	8.7
oxadiazon	0.75	--	--	--	--	9.7	9.4	9.5	8.8
oxadiazon	1.0	--	--	--	--	9.9	9.5	9.9	9.0
nitrofen	3.0	9.9	--	--	9.9	9.7	--	9.1	7.7
methazole	0.5	--	--	--	9.2	9.6	9.4	9.0	8.5
methazole	0.75	--	--	--	--	9.2	9.3	9.0	8.2
methazole	1.0	--	--	--	8.5	9.9	9.5	9.6	8.8
RH 2915	0.25	--	--	8.8	--	--	--	7.2	8.8
RH 2915	0.5	--	--	9.2	--	9.9	--	9.8	9.2
propachlor	4.0	9.4	9.9	--	--	8.8	9.2	8.2	7.8
propachlor	6.0	9.4	9.9	--	--	7.4	8.0	8.8	6.8
propachlor	8.0	9.4	9.9	--	--	9.4	9.2	8.8	8.0
brominal	0.31	9.0	--	--	9.0	9.3	8.5	9.2	4.8
Check		3.0[2/]	--	--	5.0[2/]	2.0[2/]	2.0[2/]	2.0[2/]	2.0[2/]

1/ 0 = no control, 10 = complete weed kill

2/ density per square foot

CHEMICAL WEEDING OF SEEDED ONIONS GROWN IN A MINERAL SOIL

Charles J. Noll[1]

ABSTRACT

During the last several years only DCPA at weed control rates did not injure onions when applied in a preemergence application. DCPA was applied in combination with and followed by other herbicides in postemergence treatments. The best treatment was DCPA preemergence followed by methazole, in a post or a series of postemergence treatments.

INTRODUCTION

Many Pennsylvania vegetable growers have limited acreages of onions grown in mineral soils. Weed control is a major problem especially for those growing onions from seed. Improved weeding practices could greatly reduce the cost of growing this crop.

In earlier experiments (2,3) onions were found to tolerate a number of herbicides if applied as a postemergence treatment, but only DCPA (dimethyl tetrachloroterephthalate) did not injure the onions if applied as a preemergence treatment. Similar results were reported by Beste (1). This weeding trial was designed to find the best herbicides to use on onions in a postemergence application following a preemergence treatment of DCPA.

MATERIALS AND METHODS

The weeding trial was conducted at the Rock Springs Farm located 10 miles west of University Park. The soil, a Murrill loam, was plowed in the fall of 1976 and the seedbed prepared April 18, 1977. The field was seeded the same day and the preemergence treatments applied the following day, April 19. Postemergence treatments were applied 43 days after seeding when onions had 2 true leaves, 53 days after seeding when onions had 3 true leaves or 83 days after seeding. Weeds present in order of importance were lambsquarters (*Chenopodium album* L.), pepperweed (*Lepidium virginicum* L.), galinsoga (*Galinsoga parviflora* Cav.), and a mixture of annual grasses largely foxtail (*Setaria glauca* (L.) Beauv.) and *Setaria viridis* (L.) Beauv.).

Single row plots were 27 feet long and 3 feet wide. Treatments covered the row for a width of 18 inches with cultivation controlling the weeds between the rows. Treatments were randomized in each of 8 blocks.

A rating scale of 0 to 10 was used to evaluate weed control, 0 being least desirable - no weed control, and 10 being most desirable - perfect weed control.

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RESULTS AND DISCUSSION

The results are presented in Table 1. All herbicides and herbicide combinations controlled lambsquarters. In the unweeded check weed competiton eliminated galinsoga. Pepperweed was not controlled by DCPA. Propachlor (2-chloro-N-isopropylacetanilide) and oxadiazon (2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-Δ^2-1,3,4 oxadiazolin 5-one controlled pepperweed when applied in a preemergence application but not when applied as a postemergence application. Bromoxynil (3,5-dibromo-4-hydroxybenzonitrile) and methazole, 2-(3,4-dichlorophenyl-4-methyl-1,2,4-oxadiozolidine-3,5-dione) gave best control in a postemergence application. The best overall weed control and onion yield was DCPA at 10 ai/A applied in a preemergence treatment followed by methazole at ½ ai/A applied 53 and 80 days after onions were seeded.

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Table 1. The effect of preemergence and postemergence herbicides on weeds and onions in 1977.

Treatment	lb. ai	Application Days from Planting	Average per plot: Lambs-quarters	Galinsoga	Pepper-weed	Grass	All Weeds	Yield of Bulbs: No.	Wt.
1 Unweeded check	--	PRE+1	1.8	10.0*	0.0	0.0	0.0	1.8	0.0
2 DCPA	10	PRE+1	9.4	8.1	2.4	7.1	6.3	17.0	1.9
3 DCPA+Propachlor	10+2	PRE+1	10.0	8.9	9.0	8.4	7.4	12.1	2.3
4 DCPA+Oxadiazon	10+½	PRE+1	10.0	9.5	10.0	8.0	8.1	9.6	1.6
5 DCPA	10	PRE+1	9.8	8.4	2.0	7.6	6.1	19.1	2.5
6 DCPA+Bromoxynil	10+1/5	PRE+1	9.5	8.6	6.9	7.1	7.1	23.4	3.9
7 DCPA&Propachlor	10&4	PRE+1&POST+63	9.8	8.5	0.4	7.3	6.1	18.3	2.5
8 DCPA&Oxadiazon	10&1	PRE+1&POST+63	9.6	8.6	2.0	8.4	7.3	25.4	3.9
9 DCPA&HOE 29152	10&½	PRE+1&POST+63	9.6	9.3	0.9	9.4	6.9	22.3	3.0
10 DCPA&Bromoxynil	10&2/5	PRE+1&POST+43+63	10.0	10.0	10.0	7.8	8.5	19.5	3.2
11 Bromoxynil	2/5	POST+43+63	9.3	10.0	9.9	0.9	2.4	2.9	0.2
12 DCPA&Methazole	10&½	PRE+1&POST+53+80	9.0	10.0	6.8	7.8	6.6	24.3	4.6
13 DCPA&Methazole	10&3/4	PRE+1&POST+53+80	10.0	10.0	8.3	8.5	8.1	23.3	3.8
14 DCPA&Methazole	10&½	PRE+1&POST+53+80	10.0	10.0	9.9	8.6	8.9	22.4	5.3
15 DCPA&HOE 29152+ Nitrofen	10&½+2	PRE+1&POST+63+80	9.4	9.0	2.0	8.0	6.6	16.9	2.6
Least Significant Difference 5%			1.1	1.1	1.9	1.8	1.1	1.7	1.4
Least Significant Difference 1%			1.4	1.4	2.4	2.3	1.4	2.3	1.7

*No galinsoga in heavy growth of lambsquarters.

DINITROANILINE TOXICITY TO GALINSOGA, RAGWEED, AND SEVERAL CROPS[1]

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

ABSTRACT

Seven dinitroanilines were investigated in 1976 and 1977 in a series of eight experiments for their effect on growth and yield in six crops and for their effectiveness in controlling five weed species. The dinitroanilines studied were butralin, dinitramine, fluchloralin, oryzalin, pendimethalin, profluralin and trifluralin. Kidney beans and potatoes were the most tolerant of all the crops; snap beans and English peas displayed intermediate tolerance; seeded cabbage and seeded tomatoes were least tolerant of the dinitroaniline herbicides.

None of the dinitroanilines injured red kidney beans or caused statistically significant yield reduction though oryzalin treated plots yielded 17% more beans than hand weeded plots. Katahdin potato yields were reduced by dinitramine at the recommended and high rates while pendimethalin at 1.0 and 1.5 lb DP, and trifluralin at 0.5 and 0.75 lb DPI, did not influence tuber yield.

Peas were stunted by all rates of oryzalin in 1976 and by the high rate of dinitramine, but yields were not reduced. For the third season there was stunting at the low and recommended rates of dinitramine in 1977, but yields were satisfactory. Snap beans were stunted by 1.5 and 2.0 lb of oryzalin and by 0.38 and 0.5 lb of dinitramine incorporated - recommended and high rates of both herbicides - but only the latter appeared to reduce yield.

Seeded cabbage yields were reduced on eel silt loam by treatments of oryzalin incorporated at 1.5 and 2.0 lb after the wet spring of 1976. Lower rates of oryzalin in 1977 with half the rainfall of the previous season did not interfere with yield. Seeded tomatoes were very vulnerable to all dinitroanilines evaluated.

While all the dinitroaniline herbicides controlled redroot pigweed (*Amaranthus retroflexus* L.) and common lambsquarter (*Chenopodium album* L.), the other weed species were resistant to many of the herbicides. Only oryzalin and pendimethalin were effective on galinsoga spp. [*Galinsoga ciliata* (Raf.) Blake and *Galinsoga parviflora* Cav.] and ladysthumb (*Polygonum persicaria* L.). Common ragweed (*Ambrosia artemisiifolia* L.) growth was severely inhibited by all rates of oryzalin 1.0, 1.5 and 2.0 lb and by the high rate, 0.5 lb, of dinitramine.

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INTRODUCTION

Dinitroaniline herbicides as a group are effective against annual grasses such as barnyardgrass [Enchinochloa crus-galli (L.) Beauv.] and large crabgrass [Digitaria sanguinalis (L.) Scop.] and against broadleaved weeds such as redroot pigweed and lambsquarter. Many other weeds such as some crucifers, common ragweed, and galinsoga spp. are resistant to many of these herbicides. Dinitroanilines can be used to control weeds in many vegetables, e.g., trifluralin is safe in snap beans (Phaseolus vulgaris var. humilis L.) and dry beans (Phaseolus vulgaris L.); on cabbage (Brassica oleracea var. capitata L.); pepper (Capsicum annum L.) and tomato (Lycopersicon esculentum L.) transplant; and in carrots (Daucus carota L.) and peas (Pisum sativum L.)

Dinitramine and profluralin can be used on beans and peas. Although some of these herbicides have been evaluated in a few vegetable crops against specific weeds (1,2,3) further comparisons are desirable on a wider range of crops and a number of problem weed species such as galinsoga and ragweed.

Our purpose was to compare seven dinitroaniline herbicides[3] in six crops against five weed species for: 1. efficacy on specific weeds and 2. phytotoxicity and effect on yield.

MATERIALS AND METHODS

Seven dinitroaniline herbicides were studied in 1976 at rates adjusted for soil type. The manufacturers' labelled recommendations were used in addition to a lower and a higher rate varying from 33 to 50% lower or higher than the labelled rate. In the three experiments conducted in 1977 both the number of products and the number of rates were reduced. In all, the following herbicides were evaluated: butralin, dinitramine, fluchloralin, oryzalin, pendimethalin, profluralin and trifluralin. All the herbicides were incorporated in 1976 except pendimethalin which was surface applied. In 1977, pendimethalin and oryzalin were applied preemergence and some treatments of incorporated oryzalin were also included. Crop tolerance was assessed by visual observations and yield measurements. Efficacy was evaluated by visual ratings of weed control and in some experiments by measuring weed biological yield.

Field plots were 6' by 15' in all crops except potatoes which were 6' by 20'. Herbicides were applied in 60 or 45 gal/A at 35 psi by hand held, CO_2 powered small plot sprayers equipped with 8004 Tee Jet nozzles. Treatments were replicated three times in 1976 and at least three times in 1977.

Incorporation was generally accomplished with a spring tooth followed by a meeker harrow adjusted to mix the herbicides 1 to 2" deep. However, a finger weeded was used for incorporation in potatoes and a double disk was utilized for the ragweed evaluation at Albion, New York.

For convenience, most of the other details pertaining to relevant dates and environmental conditions in the eight experiments conducted in 1976 and 1977 are listed in Table 1.

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[3] Chemistry given in Table 11.

RESULTS AND DISCUSSION

Almost all treatments were safe on Katahdin potatoes with the exception of the 0.5 lb rate of dinitramine (Table 2). This rate also caused early stunting and significantly reduced tuber yields. In addition, yields from the 0.38 lb treatment were significantly reduced. Oryzalin at 1.0 lb, but not at 1.5 lb, reduced tuber yields. There is no apparent explanation for the oryzalin results.

Lambsquarter and redroot pigweed were controlled satisfactorily by most dinitroanilines included in experiment 1, though oryzalin and pendimethalin were outstanding in this report.

Seeded Danish ballhead cabbage in experiment 2 was injured severely by several dinitroanilines with subsequent severe reductions in yields (Table 3). The high rates of dinitroaniline and oryzalin and all three rates of pendimethalin were the most toxic to cabbage. Heavy rainfall on the eel silt loam in early June 1976, may have accentuated this injury (Table 1). In 1977, again on silt, treatments were limited to oryzalin and trifluralin. Only oryzalin at 1.5 incorporated caused some reduction in yield (Table 4). All surface applied rates of oryzalin were safe. Moisture was only half the amount received in 1976.

In 1976 no safe treatment controlled galinsoga in seeded cabbage, although in 1977 oryzalin preemergence provided reasonable control. In addition, oryzalin and trifluralin were both effective on mouseear chickweed (Cerastium vulgatum L.)

In 1976 peas (cv. 'Perfected Freezer') were injured early by all rates of oryzalin and the high rate of dinitramine but yields were not reduced (Table 5). In 1977 dinitramine caused early stunting at all rates tested with no yield reduction (Table 6). For the last three seasons, yields of peas from dinitramine treatments have shown a trend toward slight reduction at the recommended rate or at the low rate, but no reduction at the high rate. The authors do not have an explanation; weed control has been effective at all rates of dinitramine.

In 1977 control of a heavy population of lambsquarter with a normal complement of redroot pigweed was good to excellent in most treatments. However, at 0.75 lb and 1.0 lb, oryzalin was slightly more effective when incorporated than it was surface applied.

In snap beans (cv. 'Spartan Arrow'), although the labelled and high rates of oryzalin and dinitramine caused stunting (Table 7) only dinitramine appeared to reduce yield (Table 8). California Light Red kidney beans were not injured by any treatment and yields were uniform with no significant differences when compared to hand weeded plots.

Only oryzalin at all rates incorporated and pendimethalin at the high rate controlled galinsoga spp. (Table 7), in agreement with results in the cabbage experiments.

Direct seeded tomatoes (cv. 'New Yorker') were injured moderately to severely by all the dinitroaniline herbicides (Table 9) and did not recover. Butralin and trifluralin, both incorporated, were least injurious, but even the low rates of these herbicides were only marginally safe to tomatoes.

Control of redroot pigweed was poor to fair while lambsquarter control was good to excellent although butralin was least effective. It was evident that none of the dinitroanilines evaluated were safe for direct seeded tomatoes.

In Albion, New York, seven herbicides were evaluated for control of common ragweed in a non-crop environment. Oryzalin incorporated at 1.5 and 2.0 lb appeared to suppress ragweed growth substantially. The weed seedlings were severely stunted; dry weights of these plants harvested six weeks after treatment were greatly reduced by all oryzalin rates (Table 10). Growth of the stunted ragweed plants was nil compared to ragweed growth in adjacent plots. A moderate infestation of ladysthumb was also controlled by all rates of oryzalin and by the recommended high rates of pendimethalin. This experiment was terminated 43 days after treatment. It was interesting that in the 1977 season, in three locations in New York State, oryzalin was evaluated for common ragweed control and it was inactive[4]. Early dry conditions may have been a factor.

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[4] 1977 personal communication with R.F. Becker

Table 1. Selected experimental details for eight dinitroaniline experiments described in this report.

Expt. No.	Crop	Soil Type	Starting Date Planting	Starting Date Treat.	Initial Moisture	Ratings Dates	Principal Weeds	Notes
1	Potatoes Katahdin	Howard gravelly loam	5/17/77	5/26/77	0.5" Rain 5/25/77 0.5" Irr. 5/31/77 0.4" Rain 6/7/77	6/23/77 7/7/77	Redroot Pigweed Lambsquarter	Hilled 6/28/77 Harv. 10/10/77
2	Cabbage Danish Ballhead	Eel silt loam	6/4/76	6/4/76	0.6" Rain 6/7/76 1.7" Rain 6/20-21/76	6/25/76 7/8/76	Galinsoga	Harv. 9/15/76
3	Cabbage Danish Ballhead	Eel silt loam	5/28/77	5/28/77	0.5" Irr. 6/1/77 0.4" Rain 6/7/77	7/2/77 7/13/77	Galinsoga Mouseear Chickweed	Harv. 9/28/77
4	Peas Selected Freezer	Howard gravelly loam	5/10/76	5/10/76	1.0" Rain 5/11/76	6/14/76 7/1/76	(weeds controlled with dinoseb)	Harv. 7/21/76
5	Peas Selected Freezer	Howard gravelly loam	5/4/77	5/4/77	0.7" Rain 5/5/77	5/26/77 7/11/77	Lambsquarter Redroot Pigweed	Harv. 7/18/77
6	Beans, Snap - Spartan Arrow Dry - CLRK	Eel silt loam	6/5/76	6/5/76	0.6" Rain 6/7/76	7/1/76 7/23/76	Galinsoga Redroot Pigweed	Harv.: Snap 8/10/76 Dry 9/28/76
7	Tomatoes New Yorker	Howard gravelly loam	5/24/76	5/24/76	0.5" Irr. 5/30/76 0.8" Rain 6/1-2/76	6/14/76 7/5/76	Redroot Pigweed Lambsquarter	Experiment discontinued 7/15/76
8	(Fallow Land)	Clarkson silty clay loam	--	5/14/76	Moisture adequate throughout experiment	6/11/76 6/28/76	Common Ragweed Ladysthumb	Ragweed harv. 6/28/76

Table 2. Effects of dinitroaniline herbicides on potatoes and weeds at Freeville, New York.

Herbicide, Rate, Timing[a] (lb/A ai)		Visual Rating by Species[b] Potato 6/23	Lambs-quarter 6/23	Redroot Pigweed 6/23	Total Potato Yield[c] lb/Plot 10/10
butralin	1.50 DPI	8.0	8.0	7.8	128.80
"	2.00 "	8.3	8.8	8.0	126.00
dinitramine	0.38 DPI	8.5	7.5	5.5	124.50
"	0.50 "	6.3	8.0	8.0	121.50
oryzalin	0.75 DP	9.0	8.8	6.8	127.50
"	1.00 "	9.0	8.8	8.5	117.50
"	1.50 "	9.0	9.0	8.8	126.25
pendimethalin	1.00 DP	8.8	9.0	8.5	127.00
"	1.50 "	8.3	9.0	9.0	128.25
profluralin	0.75 DPI	8.0	7.0	6.8	127.00
"	1.00 "	8.5	7.3	7.3	123.00
trifluralin	0.50 DPI	9.0	6.9	7.5	130.50
"	0.75 "	9.0	8.0	7.0	126.25
linuron	1.00 DP	8.5	9.0	9.0	132.25
untreated, not weeded		8.9	5.5	1.7	111.90
				Bayes LSD 5%	13.15

[a] DPI = delayed preemergence incorporated
DP = delayed preemergence

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

[c] means of 4 replications

Table 3. Effects of dinitroaniline herbicides on cabbage and weeds at Freeville, New York, 1976.

Herbicide, Rate, Timing (lb/A ai)		Visual Ratings[a] Cabbage 7/8	Galinsoga 7/8	Misc. Weeds[b] 7/8	Cabbage Yield (lb) For 20 Ft of Row[c] 9/15
butralin	1.50 PPI	7.0	2.5	---	56.83
"	2.00 "	7.0	3.3	---	60.13
"	3.00 "	6.0	2.0	---	56.54
dinitramine	0.25 PPI	7.3	3.0	---	52.36
"	0.38 "	5.3	7.0	---	56.67
"	0.50 "	5.3	---	MC 3.5	38.43
fluchloralin	1.00 PPI	8.0	3.0	---	63.73
"	1.50 "	7.7	1.5	---	62.77
"	2.00 "	5.7	3.0	---	51.70
oryzalin	1.00 PPI	6.7	6.0	---	67.70
"	1.50 "	4.7	8.0	---	50.01
"	2.00 "	4.0	7.3	---	31.39
pendimethalin	1.00 Pre	4.7	---	MC 4.5	48.33
"	1.50 "	2.0	5.5	---	7.63
"	2.00 "	2.3	6.7	---	2.93
profluralin	0.75 PPI	6.7	---	MC 3.0	51.33
"	1.00 "	6.7	4.3	---	64.31
"	1.50 "	7.3	4.3	---	66.15
trifluralin	0.50 PPI	7.3	---	Q 2.0	53.61
"	0.75 "	7.0	---	Q 2.0	63.87
"	1.00 "	7.0	---	MC 5.0	55.07
Not weeded		7.4	3.5	---	6.43
Hand weeded		8.1	---	---	67.67
				Bayes LSD 5%	23.43

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

[b] MC = marshcress; Q = quackgrass

[c] means of 3 replicates

Table 4. Effects of dinitroaniline herbicides on cabbage and weeds at Freeville, New York, 1977.

Herbicide, Rate, Timing (lb/A ai)			Visual Ratings[a] Cabbage 7/2	Galinsoga 7/2	Yellow Nutsedge Chickweed 7/13	Cabbage Yield (lb)[b] For 20 Ft of Row 9/23
oryzalin	0.75	PPI	7.3	5.7	9.0	106.0
"	1.00	"	8.3	5.3	9.0	99.3
"	1.50	"	7.3	7.7	9.0	75.0
"	0.75	Pre	7.7	7.3	7.7	108.0
"	1.00	"	7.3	7.3	8.0	93.0
"	1.50	"	8.0	7.7	8.0	97.0
trifluralin	0.75	PPI	8.0	2.0	8.0	116.3
trifluralin	0.75	"	8.0	7.7	8.7	117.3
napropamide	2.00	"				
hand weeded			8.7	2.3	2.0	109.0
					Bayes LSD 5%	36.7

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

[b] means of 4 replicates

Table 5. Effects of dinitroaniline herbicides on peas at Freeville, New York, 1976.

Herbicide, Rate, Timing (lb/A ai)			Visual Ratings[a] Peas 6/14	7/1	Pea Yield (lb) (20' Row) Vines 7/21	Mature Pods 7/21
butralin	1.00	PPI	8.7	9.0	12.0	3.43
"	1.50	"	7.7	9.0	12.1	3.04
"	2.00	"	7.7	8.7	11.8	3.26
dinitramine	0.25	PPI	7.7	8.7	11.1	2.65
"	0.38	"	7.0	8.7	12.9	3.30
"	0.50	"	5.7	8.0	14.7	3.51
fluchloralin	0.75	PPI	8.0	9.0	12.6	3.45
"	1.00	"	8.0	9.0	11.7	2.86
"	1.50	"	8.7	9.0	13.3	3.12
oryzalin	0.75	PPI	5.7	8.0	12.1	3.21
"	1.00	"	5.7	8.3	13.1	3.23
"	1.50	"	4.3	8.3	12.5	3.23
pendimethalin	0.75	Pre	8.7	9.0	12.6	3.39
"	1.00	"	8.0	8.3	11.7	3.51
"	1.50	"	8.7	9.0	15.1	4.53
profluralin	0.50	PPI	8.7	9.0	14.3	3.94
"	0.75	"	9.0	9.0	15.5	4.40
"	1.00	"	7.7	8.7	13.1	3.81
trifluralin	0.25	PPI	8.7	9.0	13.5	3.96
"	0.50	"	8.0	9.0	14.8	3.61
"	0.75	"	7.0	9.0	13.6	3.72
Hand weeded			8.7	8.7	12.5	3.83
Not weeded			8.5	6.3	7.7	1.94
					Bayes LSD 5%	1.01 (mature pods)

[a] 9 = no crop injury; 7 = commercially acceptable; 1 = complete crop kill

[b] means of 3 replicates

Table 6. Effects of dinitroaniline herbicides on peas and weeds at Freeville, New York, 1977.

Herbicide, Rate, Timing (lb/A ai)			Visual Rating By Species[a] Peas 5/26	Peas 7/11	Lambs-quarter 5/26	Pigweed 5/26	Pre Harvest Measurements Plants 20 Ft Row 7/18	Shelled Peas[b] (lb) /20 Ft Row 7/18	/Plant 7/18
dinitramine	0.25	PPI	6.3	8.0	8.3	9.0	74	3.15	.043
"	0.38	"	6.3	8.0	9.0	9.0	76	2.93	.039
"	0.50	"	6.0	8.0	9.0	8.5	65	3.18	.049
oryzalin	0.50	PPI	7.5	8.0	7.3	9.0	78	2.97	.038
"	0.75	"	7.0	8.0	9.0	9.0	77	3.02	.039
"	1.00	"	7.3	8.0	8.5	9.0	84	3.13	.037
"	0.75	Pre	9.0	8.0	6.3	8.0	96	3.36	.035
"	1.00	"	8.0	8.0	7.3	7.0	83	3.10	.037
trifluralin	0.50	PPI	8.8	8.0	8.8	7.0	96	3.24	.033
"	0.75	"	7.5	8.0	8.3	8.0	100	3.63	.036
oryzalin trifluralin	0.50 0.50	PPI PPI	5.0	8.0	8.3	9.0	74	2.77	.037
trifluralin oryzalin	0.75 0.75	PPI Pre	6.5	8.0	9.0	9.0	72	3.17	.044
Hand weeded			8.5	8.0	2.3	1.0	74	2.99	.026
Not weeded			8.3	8.5	2.0	1.5	71	1.92	.042

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

[b] means of 4 replicates

Table 7. Effects of dinitroanaline herbicides on snap beans, red kidney beans and weeds in Freeville, New York, 1976.

Herbicide, Rate, Timing (lb/A ai)			Visual Rating[a] Snap 7/1	Snap 7/23	Kidney 7/1	Kidney 7/23	Galinsoga 7/1	Galinsoga 7/23	NRPigweed 7/1	NRPigweed 7/23
butralin	1.50	PPI	8.5	8.8	8.5	8.5	3.7	3.3	7.8	7.8
"	2.00	"	8.5	8.0	7.8	8.5	4.1	5.0	8.8	8.5
"	3.00	"	8.0	8.0	8.5	9.0	3.7	3.0	9.0	8.8
dinitramine	0.25	PPI	9.0	8.3	8.8	8.8	4.3	4.3	8.5	8.3
"	0.38	"	7.0	6.8	8.3	8.5	4.7	6.0	9.0	8.5
"	0.50	"	6.3	6.8	7.5	8.0	7.0	7.3	9.0	8.8
fluchloralin	1.00	PPI	8.5	8.0	9.0	8.5	4.3	7.0	9.0	8.5
"	1.50	"	7.5	8.0	8.3	8.3	5.0	6.3	9.0	9.0
"	2.00	"	8.3	8.3	7.3	8.5	5.0	5.7	9.0	8.5
oryzalin	1.00	PPI	8.3	8.5	8.5	8.5	7.7	8.3	9.0	8.5
"	1.50	"	6.8	7.0	7.8	8.3	8.7	8.3	9.0	8.3
"	2.00	"	6.5	7.5	7.5	8.5	8.7	8.7	9.0	9.0
pendimethalin	1.00	Pre	8.8	7.5	8.5	8.5	6.3	7.0	9.0	8.5
"	1.50	"	8.8	7.5	8.3	8.8	7.3	5.7	9.0	8.8
"	2.00	"	8.5	7.5	8.3	8.5	8.7	8.0	9.0	9.0
profluralin	0.75	PPI	8.8	8.5	8.8	8.3	5.0	6.3	9.0	8.3
"	1.00	"	8.8	8.3	8.3	8.5	4.0	4.0	8.8	5.8
"	1.50	"	8.8	8.5	9.0	8.5	3.3	2.7	9.0	8.8
trifluralin	0.50	PPI	9.0	8.5	9.0	8.5	4.3	4.7	9.0	8.5
"	0.75	"	9.0	8.8	8.8	8.8	3.3	2.3	8.5	8.8
"	1.00	"	8.8	8.3	8.0	8.0	3.0	3.7	8.8	8.8
Untreated, hand weeded			9.0	9.0	8.8	9.0	-	-	-	-
Untreated, not weeded			8.8	8.3	8.5	8.7	4.3	5.8	5.0	4.3

[a] 9 = no crop injury or complete weed control; 7 = commercially acceptable;
1 = complete cropkill or no weed control

Table 8. Effects of dinitroaniline herbicides on yields of snap beans and red kidney beans in Freeville, New York, 1976.

Herbicide	Timing	Rate (lb/A ai)	Fresh Weight of Pods[a]/Plant (lb) Snap[b] 8/10	Red Kidney[b] 9/28
butralin	PPI	1.50	.090	.110
"	"	2.00	.090	.112
"	"	3.00	.081	.118
dinitramine	PPI	0.25	.070	.110
"	"	0.38	.079	.086
"	"	0.50	.084	.123
fluchloralin	PPI	1.00	.084	.131
"	"	1.50	.081	.122
"	"	2.00	.079	.139
oryzalin	PPI	1.00	.099	.132
"	"	1.50	.106	.134
"	"	2.00	.088	.150
pendime	Pre	1.00	.092	.085
"	"	1.50	.092	.107
"	"	2.00	.086	.135
profluralin	PPI	0.75	.079	.139
"	"	1.00	.090	.137
"	"	1.50	.092	.116
trifluralin	PPI	0.50	.092	.112
"	"	0.75	.075	.100
"	"	1.00	.088	.146
Hand weeded			.101	.118
Not weeded			.081	.095
		Bayes LSD 5%	.029	.046

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

[b] means of 4 replicates; 10 ft row harvested

Table 9. Effects of dinitroaniline herbicides on seeded tomatoes and weeds at Freeville, New York, 1976.

Herbicide	Rate (lb/A ai)	Timing	Visual Ratings[a,b] Tomato 6/14	Tomato 7/5	Pigweed 6/14	Pigweed 7/5	Lambsquarter 6/14	Lambsquarter 7/5
butralin	1.00	PPI	7.3	7.7	7.0	5.7	7.7	7.7
"	1.50	"	7.3	7.0	6.7	6.0	8.0	7.3
"	2.00	"	6.0	6.3	7.7	6.0	9.0	8.7
dinitramine	0.25	PPI	5.0	3.7	7.7	6.7	8.7	9.0
"	0.38	"	3.3	4.0	6.7	6.0	8.7	9.0
"	0.50	"	3.0	1.7	7.7	6.7	8.3	8.7
fluchloralin	0.75	PPI	4.7	3.0	7.0	6.7	8.7	8.0
"	1.00	"	5.3	4.7	8.0	7.7	8.3	8.3
"	1.50	"	3.3	2.0	7.3	6.0	8.7	9.0
oryzalin	0.75	PPI	5.0	2.7	8.7	7.0	8.7	8.3
"	1.00	"	4.7	4.3	7.3	7.0	9.0	9.0
"	1.50	"	4.3	4.0	8.7	8.0	8.7	9.0
pendimethalin	0.75	Pre	7.7	6.0	7.7	6.7	9.0	9.0
"	1.00	"	7.3	5.0	9.0	7.7	9.0	9.0
"	1.50	"	6.3	3.3	8.3	8.7	8.7	9.0
profluralin	0.50	PPI	7.0	6.3	6.0	6.7	9.0	9.0
"	0.75	"	6.7	6.7	7.3	7.0	8.7	8.7
"	1.00	"	6.7	5.0	7.7	7.0	6.3	8.7
trifluralin	0.25	PPI	7.7	7.0	7.0	6.3	7.3	8.0
"	0.50	"	6.7	6.7	8.0	6.7	8.0	8.3
"	0.75	"	5.3	5.7	8.0	7.3	8.3	8.3
Hand weeded			8.0	7.2	1.5	7.5	3.0	8.0
Not weeded			8.0	5.2	1.8	1.3	4.0	6.0

[a] 1 = no effect on weeds, complete kill of crop; 7 = commercially acceptable; 9 = complete weed kill, no effect on crop

[b] means of 3 replicates

Table 10. Effect of dinitroaniline herbicides on weeds in Albion, New York, 1976.

Herbicide, Rate, Timing (lb/A ai)			Visual Ratings[a] Common Ragweed 6/28	Visual Ratings[a] Ladys'-thumb 6/28	Measurements of Common Ragweed[b] No. Plants Per m^b 6/28	Dry Weight /Plant (gm)	Dry Weight Per m^b as % untreated
butralin	1.50	PPI	3.7	4.0	41	1.8	95
"	2.00	"	3.3	5.0	40	1.7	88
"	3.00	"	4.0	5.0	25	1.7	55
dinitramine	0.25	PPI	3.7	4.7	40	1.5	78
"	0.38	"	4.7	6.7	36	1.5	70
"	0.50	"	5.0	6.7	33	1.2	51
fluchloralin	1.00	PPI	4.7	6.0	36	1.2	84
"	1.50	"	5.0	7.0	37	1.8	86
"	2.00	"	4.3	6.7	35	1.8	77
oryzalin	1.00	PPI	6.0	7.0	14	0.2	4
"	1.50	"	7.0	8.0	19	0.2	5
"	2.00	"	7.0	7.7	7	0.2	2
pendimethalin	1.00	Pre	2.5	5.5	42	1.9	103
"	1.50	"	4.0	7.5	45	1.6	93
"	2.00	"	4.3	7.7	36	1.5	70
profluralin	0.75	PPI	2.7	3.7	58	1.7	127
"	1.00	"	3.3	4.7	50	1.7	110
"	1.50	"	4.0	6.3	40	1.6	83
trifluralin	0.50	PPI	3.0	2.0	38	1.7	83
"	0.75	"	3.5	4.0	36	1.9	88
"	1.00	"	2.5	4.5	47	1.7	103
untreated			1.7	3.0	43	1.8	100

[a] 1 = no effect on weeds; 7 = commercially acceptable weed control; 9 = complete weed kill

[b] all data represent averages of 3 replicates

Table 11. Chemicals included in these experiments.

Common Name	
butralin	4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzenamine
dinitramine	N^4,N^4-diethyl-α,α,α-trifluoro-3,5-dinitrotoluene-2,4-diamine
fluchloralin	N-(2-chloroethyl)-2,6-dinitro-N-propyl-4-(trifluoromethyl)aniline
oryzalin	3,5-dinitro-N^4,N^4-dipropylsulfanilamide
pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine
profluralin	N-(cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine
trifluralin	α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine
linuron	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea

METOLACHLOR TOLERANCE IN SNAPBEANS AND KIDNEY BEANS

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ABSTRACT

Field studies were performed in 1976 and 1977 at Fayette, New York to determine crop tolerance of Tendergreen snapbeans and California light red kidney beans to metolachlor and alachlor. Both herbicides were applied preplant incorporated and preemergence at 2.8 (use rate), 5.6 and 8.4 kg/ha. To assist with broadleaf weed control, 3.36 kg/ha of dinoseb was sprayed preemergence over all plots except the untreated check. Experimental design consisted of a randomized complete block with three replications. Each plot measured 3.66 by 6.1 meters (four rows wide). Kidney beans were evaluated three times in 1976 and twice in 1977, while snapbeans were evaluated twice during each year. The 1976 growing season was wet and cool, while in 1977 dry, warm weather prevailed.

In 1976, metolachlor was less injurious than was alachlor to both types of beans with the extent of injury being more severe in snapbeans. Furthermore, damage to snapbeans and kidney beans was more pronounced in plots treated preemergence than in those where the herbicides were incorporated prior to planting. Again, this effect was especially apparent with the more sensitive snapbeans. The maximum preplant incorporated rate of metolachlor and alachlor tolerated by snapbeans was 8.4 and 5.6 kg/ha, respectively. In plots treated preemergence, snapbeans tolerated from 2.8 to 5.6 kg/ha of metolachlor and only 2.8 kg/ha of alachlor. On the other hand, kidney beans tolerated up to 8.4 kg/ha of metolachlor and 5.6 kg/ha of alachlor, independent of method of application.

Similar results were obtained in 1977, although the dry weather minimized bean response to the herbicides. Snapbeans tolerated 8.4 kg/ha of metolachlor regardless of method of application and 8.4 kg/ha of alachlor only when applied preplant incorporated. Preemergence treatments of alachlor at this rate produced unacceptable stunting. Kidney beans were not seriously injured by any of the herbicide treatments in 1977.

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HERBICIDE TREATMENTS AND POTATO CULTIVAR INTERACTIONS FOR WEED CONTROL

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ABSTRACT

Six potato cultivars, Katahdin, Russet Burbank, Superior, Chippewa, Hudson and Norgold Russet, were planted in a weed-free area and evaluated for their competitive ability against weeds with the aid of cultivation and in conjunction with herbicidal treatments. Applications of EPTC at 6 lb/A, chlorbromuron 3 lb, linuron 1.5 lb, trifluralin 1 lb, metribuzin 1 lb and alachlor plus linuron (2 + 1 lb/A) were applied to the six cultivars on the same plots each year for six years. All treatments were applied at dragoff, with EPTC and trifluralin soil-incorporated. Barnyardgrass and ladysthumb developed on cultivated checks and trifluralin plots. All treatments provided good control of barnyardgrass. The alachlor + linuron combination was the most consistent performer during the six-year period, followed by metribuzin. Incorporated herbicides were more effective during a dry spring season, and EPTC was the best performer in three of six years. None of the treatments resulted in soil residues or depressed crop yields. It was not until the fourth year of the study that weed competition in cultivated checks reduced yields compared with the treatments. During the two years of the competition study, cultivars Katahdin and Hudson were most effective in suppressing weeds, and Superior least effective. The control of barnyardgrass without herbicides in Katahdin and Hudson approached that of Superior with the benefit of herbicidal treatments.

INTRODUCTION

Barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.) is the most serious weed pest in the 11,500 hectares of potatoes grown on Long Island. Frequently, and particularly under adverse weather conditions, commercial herbicides fail to provide weed control until harvest. Weeds become established at vine-fall, too late for control, making harvesting difficult. A decrease in harvesting efficiency has been estimated as high as 50%, with as much as 20% of the tuber crop lost over the chains in lumpy soil at harvest (1,2). Yip *et al.* (4) reported that cultivars Hudson and Green Mountain suppressed weeds more efficiently than Kathadin and Sebago. Katahdin and Superior are the most commonly grown cultivars on Long Island, and Hudson has been recently introduced because of its resistance to golden nematode. The present study is an attempt to assess the influence of herbicides on the weed population in potatoes and to evaluate potato cultivars on their ability to suppress weed growth.

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MATERIALS AND METHODS

Potato cultivars Katahdin, Russet Burbank, Superior, Chippewa, Hudson and Norgold Russet were planted each year in the same plots, 2 rows 34 in. apart x 30 ft. long. Six herbicidal treatments were applied in a split-plot design replicated six times on the same plots each year for six years. The treatments included EPTC (S-ethyl dipropylthiocarbamate) 6 lb/A ai, chlorbromuron (3-(4-bromo-3-chlorophenyl)-1-methoxy-1-methylurea) 3 lb/A, linuron (3-(,4-dichlorophenyl)-1 methoxyl-1-methylurea) 1.5 lb, trifluralin (aaa-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) 1 lb, metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one) 1 lb and alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide) plus linuron 2+ 1 lb/A. All treatments were applied preemergence at dragoff with a tractor-mounted sprayer delivering 40 pga spray at 35 psi. EPTC and trifluralin were soil incorporated with a finger weeder. The plots were established on a relatively weed-free area on Haven loam soil containing less than 2% O.M. Cultivation each year consisted of seed-bed preparation, drag-off and a single hilling. Untreated checks were usually cultivated twice during the growing season, but only once in 1977. Rainfall was augmented by one-inch of sprinkler irrigation as needed two or three times each season. Each of the herbicide treatments were assessed twice each season for the control of barnyardgrass and ladysthumb in comparison to untreated plots. During 1976 and 1977 each cultivar was assessed for its capacity to suppress weeds present in cultivated checks with and without herbicidal treatment.

RESULTS AND DISCUSSION

The population of barnyardgrass and ladysthumb developed particularly in untreated checks despite six years of cultivation at dragoff and two inter-row cultivations prior to the hilling operation. Of the six herbicidal treatments, ladysthumb became abundant after four years only in trifluralin plots. Some barnyardgrass was evident each year in all of the treatments, but was well controlled in comparison with untreated checks. The treatments had no detrimental affects on potatoes, nor was there any indication of harmful soil residues as a result of repeated applications. It was not until the fourth year that the weed population in the cultivated checks significantly depressed tuber yields in comparison to treated plots.

The alachlor-linuron combination was the most consistently effective treatment for barnyardgrass control during the six-year period, followed by metribuzin and EPTC (Table 1). EPTC was the best performer in the years 1972, 1973 and in 1977, but was surpassed by the alachlor-linuron combination during 1974-76.

The level of weed control in 1977 was somewhat lower with preemergence treatments than in previous years, due to unusually dry conditions in spring, but efficacy improved with incorporated herbicides EPTC and trifluralin Metribuzin efficacy was significantly reduced, and the alachlor-linuron combination dropped from first to second place. This relative effectiveness was also confirmed by yield responses as an average of all cultivars for each treatment (Table 2). In 1975, all tuber yields in the treatments were significantly higher than those of cultivated checks. Yield responses with linuron

and trifluralin were higher than with other treatments, despite less effective weed control. Weeds present in trifluralin plots were predominately ladysthumb, which appears to be less vigorous than barnyardgrass. In 1977, yields of all treatments except linuron and chlorbromuron were significantly higher than those of cultivated checks.

In the two years of variety assessment, cultivars Katahdin and Hudson were most effective in suppressing weeds, and Superior least effective. This is contrary to an earlier report in which cultivar Katahdin did not appear to be a vigorous competitor (4). Weed control with herbicides approached 90% in Katahdin and Hudson and 65% or less in Superior and Norgold (Table 3). The effectiveness of Chippewa and Russet Burbank appeared to be intermediate. During both years, weed control with the highly competitive cultivars Hudson and Katahdin without herbicides approached that of Superior and Norgold with the benefit of herbicidal treatments. Although yields of all varieties appeared to respond to herbicidal treatment in 1977, increases were significant only with cultivars Katahdin, Chippewa and Norgold.

This study confirms earlier work (4) that the early maturing cultivar Superior, popular for early fresh market potatoes on Long Island, does not effectively suppress weeds. However, the most common variety, Katahdin, appears to be well suited to the climate on Long Island and its competitive ability effectively supplements weed control provided by herbicides. The Hudson cultivar will be a desirable introduction for weed suppression, assuming other criteria are met.

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Table 1. Weed control[2/] with herbicides as a mean of 6 replicates in each of 6 potato cultivars.

Treatment	Lb/A	Year 1972	1973	1974	1975	1976	1977	72-77 Ave.
Alachlor + Linuron	(2 + 1)	6.8	7.0	8.0	8.7	8.4	8.0	7.8
Metribuzin	1	7.4	7.0	8.0	7.8	8.2	7.3	7.6
Chlorbromuron	3	6.3	6.3	7.0	7.8	7.4	7.8	7.1
Linuron	1.5	6.8	6.8	5.8	7.6	6.8	7.2	6.8
EPTC	6	7.8	7.0	6.1	6.8	6.3	8.2	7.0
Trifluralin	1	6.5	6.8	5.8	4.9	6.1	7.8	6.3
Cultivated check		2.5	2.0	0.	0.	1.2	3.3	1.5

2/ 0 = no control, 10 = complete control.

Table 2. Mean yields of 6 potato cultivars treated with herbicides.

Treatment	Yield cwt/A 1975	1977	Mean 1972 - 77
Alachlor + Linuron	370	296	309
Metribuzin	366	242	317
Chlorbromuron	357	274	301
Linuron	386	272	307
EPTC	350	306	316
Trifluralin	380	283	312
Cultivated check	299	249	292

Table 3. The effect of potato cultivars on weed control[2/] with and without herbicides.

Treatment[3/]	Rating (A) Cultivar						
	Kat.	Hud.	R.B.	Chip.	Nor.	Sup.	Mean
Av. of 6 herbicides[3/], 1976	8.9	8.5	8.6	7.0	6.5	4.1	7.3
Cultivated check[4/]	5.6	5.4	3.5	2.8	1.3	1.0	3.1
Av. of 6 herbicides[3/], 1977	8.9	9.1	7.7	7.8	6.5	6.5	7.7
Cultivated check[4/]	4.9	6.3	2.4	4.3	1.2	3.2	3.4

2/ 0 = No control, 10 = complete control.

3/ Mean of 6 treatments (EPTC 6 lb/A, ahlorbromuron 3, linuron 1.5, trifluralin 1, metribuzin 1, and alachlor + linuron 2 + 1 lb/A, 6 replicates each.

4/ Mean of 12 replicates.

AN EVALUATION OF SEVERAL HERBICIDES FOR WEED CONTROL IN KATAHDIN POTATOES

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

ABSTRACT

Metribuzin, trifluralin, ethalfluralin, oryzalin, linuron, and dinoseb were evaluated for weed control in white potatoes in 1977 at Aroostook Farm, Presque Isle, Maine. None of the herbicides applied alone or in combination caused any prolonged crop injury. With the exception of shallow incorporated ethalfluralin, preemergence applied ethalfluralin and the combination of ethalfluralin and oryzalin provided satisfactory broadleaved weed and quackgrass control. All herbicides and combinations gave excellent control of annual barnyard grass.

INTRODUCTION

Several herbicides, including metribuzin [4-amino-6-*tert*-butyl-3-(methlythio)-*as*-triazin-5(4*H*)-one], ethalfluralin [*N*-ethyl-*N*-(2-methyl-2-propenyl -2, 6-dinitro-4-(trifluoromethyl) benzenamine], trifluralin (α,α,α-trifluoro-2, 6-dinitro-*N*,*N*-dipropyl-*p*-toluidine), oryzalin (3,5-dinitro-N^4, N^4-dipropylsulfanilamide), linuron [3-(3,4-dichlorophenyl)-methoxy-1-methylurea], and dinoseb (2-*sec*-butyl-4, 6-dinitrophenol), were compared in various combinations for weed control in potatoes (*Solanum tuberosum L. 'Katahdin'*). These combinations were applied as preemergence treatments and layby treatments; and trifluralin was also used as a shallow incorporated herbicide at drag-off. The purpose of the study was to determine the efficacy of the herbicides used alone and in combination for control of mustard *(Brassica campestris L.)*, lambsquarters *(Chenopodium album L.)*, ladysthumb *(Polygonum persicaria L.)*, quackgrass *(Agropyron repens (L.) Beauv.)*, and barnyard grass *(Echinochloa crusgalli (L.) Beauv.)*.

MATERIALS AND METHODS

Preemergence treatments were applied to a Caribou gravelly silt loam soil under the conditions listed at the bottom of Table 1. All herbicides were applied in 303 liters of water using 40 psi pressure. A compressed air sprayer equipped with a two nozzle brush type boom was used to apply the various herbicides. Nozzles were Delavan raindrop type with No. 3374-3 tips. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with 6 replicates for each treatment. Weed control and crop injury ratings were made on two dates after treatment, as listed in Table 1 using the "Cornell" rating system of 1 to 9. During

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July, weed counts were made and species, as reported in Table 1, were identified in the "no treatment" plots.

RESULTS AND DISCUSSION

None of the herbicides applied alone or in combination in this study, as shown in Table 1, injured the potato crop. With the exceptions of trifluralin (shallow incorporated at drag-off), ethalfluralin alone, and the combination of ethalfluralin and oryzalin applied preemergence, all other herbicides and combinations gave very satisfactory broadleaved weed control and acceptable quackgrass control. The annual barnyard grass pressure in this study was not exceptionally heavy; however, all herbicides applied alone or combinations provided almost complete control of barnyard grass.

Table 1. Effect of various combinations of metribuzin, trifluralin, ethalfluralin, oryzalin, linuron, and dinoseb on weed control in Katahdin potatoes. Maine - 1977.

Treatments[a]		Crop injury and weed control ratings[b]							
		Crop injury		Broadleaved		Quackgrass		Annual grass	
Herbicide	kg/ha	7-8	8-16	7-8	8-16	7-8	8-16	7-8	8-16
No treatment		8.8	7.8	6.5	7.8	7.7	7.7	5.9	7.2
Dinoseb + Dalapon (PE)	5.04 + 0.56	7.8	8.0	8.5	9.0	8.0	8.2	8.8	9.0
Metribuzin (PE) + Trifluralin (LB)	0.56 0.56	8.2	7.7	8.8	8.7	7.8	8.0	8.5	9.0
Metribuzin (PE) + Trifluralin (LB)	0.56 + 0.84	8.2	8.7	9.0	9.0	7.6	7.8	8.6	9.0
Metribuzin (PE) + Trifluralin (LB)	0.56 + 1.12	8.2	8.3	9.0	9.0	8.2	8.0	8.8	8.7
Trifluralin (Shallow inc.) (at drag-off)	0.84	7.8	7.8	8.0	7.6	7.5	6.8	7.5	9.0
Trifluralin (Shallow inc.) (at drag-off)	1.12	8.0	7.7	7.7	7.3	8.0	6.5	8.7	9.0
Ethalfluralin E.C. (PE)	1.12	8.3	7.5	8.3	7.7	7.5	7.3	8.7	9.0
Ethalfluralin W.P. (PE)	1.12	8.3	7.8	7.5	7.8	7.2	7.2	8.8	8.8
Dinoseb + Ethalfluralin E.C. (PE)	3.36 + 1.12	8.3	8.3	9.0	8.8	7.2	7.7	9.0	9.0
Metribuzin + Ethalfluralin E.C. (PE)	0.56 + 1.12	8.0	7.8	9.0	9.0	8.0	7.8	8.8	9.0
Linuron + Ethalfluralin E.C. (PE)	1.12 + 1.12	7.8	7.7	9.0	8.8	7.5	7.7	9.0	8.8
Ethalfluralin + Oryzalin (PE)	0.56 + 0.56	7.8	7.7	8.8	8.2	7.7	7.8	8.7	9.0
Ethalfluralin + Oryzalin (PE)	1.12 + 1.12	7.3	7.3	7.3	7.5	7.0	6.7	8.2	8.7

Table 1 - continued

Treatments[a] Herbicide	kg/ha	Crop injury and weed control ratings[b] Crop injury 7-8	Crop injury 8-16	Broadleaved 7-8	Broadleaved 8-16	Quackgrass 7-8	Quackgrass 8-16	Annual grass 7-8	Annual grass 8-16
Metribuzin + Ethalfluralin + Oryzalin	0.56 + 0.56 + 0.56	8.2	8.2	9.0	9.0	8.0	8.2	8.8	8.7
Metribuzin + Oryzalin + Ethalfluralin (PE)	0.56 + 1.12 + 0.56	8.7	8.3	9.0	9.0	8.2	7.8	9.0	9.0
Metribuzin (PE)	0.56	7.8	8.5	8.8	9.0	8.0	8.2	8.7	9.0
Dinoseb (PE)	3.36	8.3	7.7	9.0	9.0	7.5	8.0	8.0	9.0
Linuron (PE)	1.12	8.7	8.7	9.0	9.0	7.5	8.0	9.0	9.0
Ethalfluralin (PE)	1.12	8.8	7.8	8.5	7.6	7.3	7.5	7.5	8.8

[a]Planted - May 31; killed - September 15, 1977.
Preemergence treatments applied - June 14. Weather - overcast. Temperature - 17.8C. Soil - very damp.
Layby treatments applied - July 20. Weather - overcast. Temperature - 20.0C. Soil - very dry.

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

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

Brassica campestris	1.4	*Echinochloa crusgalli*	1.5
Chenopodium album	0.6	*Agropyron repens*	0.6
Polygonum persicaria	0.9		

WEED CONTROL IN WHITE POTATOES WITH SOME PREPLANT INCORPORATED HERBICIDES FOLLOWED BY A DRAG-OFF CULTIVATION

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ABSTRACT

A number of herbicides, herbicide combinations, and sequential treatments were evaluated for weed control in white potatoes. Prior to emergence one half of each plot was given a drag-off cultivation.

EPTC alone was effective on grasses but not on some broadleaf species. Dragging off only improved control of lambsquarters but not of ragweed or smartweed. Pendimethalin alone was ineffective on the above-named broadleaf species but dragging off improved control except that of smartweed. Combining the two improved control of all weeds and dragging off did not further improve control.

Weed control by metribuzin was improved either by increasing the rate of application or by dragging off a lower ineffective rate. Combinations with pendimethalin improved control over the single herbicides with no improvement in control with dragging off. Metribuzin applied as a followup over incorporated pendimethalin was not as effective as when it was applied with pendimethalin together and dragging off only slightly improved their performance.

Preemergence cyanazine following incorporated EPTC was an outstanding treatment combination and there was no increase in control from dragging off.

INTRODUCTION

The use of preplant incorporated herbicides in potato (*Solanum tuberosum* L.) culture has become an accepted practice. This has been dictated by the nature of the herbicides available

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for use in and the type of weeds generally associated with the crop.

Notwithstanding that growers have safe and effective herbicides available, many of them traditionally use the drag-off operation prior to potato emergence as a weed control technique whether or not herbicides are used.

The objective of this study was to evaluate some new herbicides and herbicide combinations for weed control and crop tolerance by applying them prior to planting with incorporation and by applying some just before planting followed by preemergence applications of others. Another objective was to determine what effect a drag-off operation would have on the performance of these herbicide treatments.

MATERIALS AND METHODS

All prior-to-planting herbicide treatments were applied on April 18 to plot areas, 12' x 19', established to receive the herbicide treatments. A complete random block design with three replications was used. All treatments were applied in 40 GPA with water as the carrier. All plots were soil incorporated to a depth of 3 inches with a tractor-drawn tilrovator. After incorporation plots were relocated and planted to potatoes, variety Superior.

Sequential or followup treatments were made immediately after planting. In addition to the herbicide treatments, half of each plot (2 rows) was dragged off on May 2.

Herbicides and application procedures used in the study included the following: S-ethyl dipropylthiocarbamate (EPTC) applied prior to planting; EPTC applied prior to planting and followed by preemergence applications of 2 4-chloro-6-(ethyl=amine)-s-triazin-2-yl amino -2-methylpropionitrile (cyanazine), 2-(3,4-dichlorophenyl)-4-methyl-1,2,4-oxadiazolidine-3,5-dione (methazole), 4-amino-6-<u>tert.</u>-butyl-3-(methylthio-<u>as</u>-triazin-5(4H)-one (metribuzin), or combinations of methazole plus 2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide (alachlor); preplant applications of N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine (pendimethalin), combinations of pendimethalin and EPTC, and pendimethalin and metribuzin; preplant incorporated pendimethalin followed by preemergence metribuzin; combinations of alachoor and metribuzin applied prior to planting and incorporated; and preemergence combinations of alachlor plus

3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea (linuron) which served as the check treatment. Specific rates and combinations are presented in Tables 1 to 3.

Weed control ratings were made on July 14 approximately two months after the drag-off cultivation. Weeds in the experimental area included lambsquarters (Chenopodium album L.), common ragweed (Ambrosia artemisiifolia L.), Pennsylvania smartweed (Polygonum pensylvanicum L.) and barnyardgrass (Echinochloa crusgalli (L.)Beauv.).

RESULTS AND DISCUSSION

In Tables 1, 2 and 3 are summarized weed control results obtained from the various herbicides, herbicide combinations, application schedules, and the drag-off cultivation.

In Table 1 weed control data are summarized for EPTC, pendimethalin, and combination of these two herbicides. EPTC, alone, effected excellent control of barnyardgrass but not of lambsquarters, common ragweed, or Pennsylvania smartweed. The drag-off operation greatly improved control of lambsquarters but not of the other two species.

Pendimethalin was not effective on any of the weeds at the 3/4 lb rate and the control of weeds was not improved by a drag-off operation. Control of lambsquarter, common ragweed, and barnyardgrass was improved by the higher rate of the herbicide and the drag-off operation improved control even more. Pendimethalin had no effect on Pennsylvania smartweed.

Improved control of weeds was not obtained by combining EPTC and pendimethalin over that obtained from the components applied alone. Similarly, the drag-off cultivation did improve control of the various species and control was no better than that for the single herbicides.

Weed control data for pendimethalin and metribuzin are summarized in Table 2. Metribuzin at the lower or 1/2 lb rate was not effective on any of the weed species. Increasing the herbicide rate improved control considerably. The drag-off cultivation did not increase weed control very much and not to the extent it did at the lower rate.

The combination of pendimethalin and metribuzin was very effective when they were both applied at the same time. When

the herbicides were applied sequentially, i.e., metribuzin preemergence following preplant incorporated pendimethalin control was poorer for the broadleaf weeds and comparable to the control produced by the herbicides applied alone.

In Table 3 are summarized weed control data obtained from all other herbicide treatments included in the study. From these data it can be seen that the preemergence application of cyanazine over preplant incorporated EPTC was an outstanding treatment and that the drag-off operation did not improve control. As a matter of fact, a decrease in control of smartweed resulted as a result of dragging off.

Methazole over EPTC was very effective on all weeds except smartweed. Dragging off improved control of this species but had no effect on the other weeds.

Combinations of methazole plus alachlor applied preemergence following preplant incorporated EPTC was comparable to the control produced by methazole alone over EPTC. Smartweed was not controlled and was only slightly improved by dragging off.

The check or control treatment of alachlor plus linuron was effective on all species with the exception of smartweed. The drag-off cultivation had no effect on the degree of control of any of the species.

Table 1. Weed control in potatoes with EPTC and pendimethalin alone and in combination followed by a drag-off cultivation.

Herbicide	Rate lb/A	Weed Control[1]							
		Lambsquarters		Ragweed		Smartweed		Barnyardgrass	
		w/o[2]	w[3]	w/o	w	w/o	w	w/o	w
EPTC	3	3.3	10.0	6.7	4.7	0.0	4.0	10.0	10.0
pendimethalin	3/4	6.3	6.3	6.3	6.0	0.0	0.0	6.7	6.7
	1½	8.3	10.0	6.7	9.7	0.0	1.0	10.0	10.0
EPTC + pendimethalin	3 + 3/4	6.3	6.3	5.0	5.0	0.0	0.7	8.3	8.3
	3 + 1	7.7	9.3	6.0	9.3	0.0	1.7	9.7	10.0
	3 + 1½	7.0	10.0	5.7	9.7	0.7	3.7	10.0	10.0
alachlor + linuron (pre)	2¼ + 3/4	9.0	8.5	10.0	10.0	0.0	0.0	9.0	9.0
(check trmt)									

1. Based on scale 0 to 10, where 0 = no control and 10 = complete control.
2. Without drag-off cultivation.
3. With drag-off cultivation.

Table 2. Weed control in potatoes with pendimethalin and metribuzin applied alone and in combination prior to planting and incorporated and as sequential applications, with and without a drag-off cultivation.

		Weed Control[1]							
		Lambsquarters		Ragweed		Smartweed		Barnyard-grass	
Herbicide	Rate lb/A	w/o[2]	w[3]	w/o	w	w/o	w	w/o	W
pendimethalin (ppi)	3/4	6.3	6.3	6.3	6.0	0.0	0.0	6.7	6.7
	1½	8.3	10.0	6.7	9.7	0.0	1.0	10.0	10.0
metribuzin (ppi)	1/2	3.0	8.7	0.0	10.0	0.7	10.0	4.7	10.0
	1	10.0	10.0	10.0	10.0	9.7	10.0	9.7	10.0
pendimethalin + metribuzin (ppi)	3/4 + 1/2	9.7	9.7	9.3	9.7	4.3	6.3	9.7	9.7
pendimethalin (ppi) + metribuzin (pre)	3/4 + 1/2	7.3	7.3	3.3	4.7	1.7	4.7	10.0	10.0
alachlor + linuron (pre) (check trmt)	2¼ + 3/4	9.0	8.5	10.0	10.0	0.0	0.0	9.0	9.0

1. Based on scale 0 to 10, where 0 = no control and 10 = complete control.
2. Without drag-off cultivation.
3. With drag-off cultivation.

Table 3. Weed control in potatoes with EPTC, cyanazine, methazole, alachlor, and metribuzin applied in several combination schedules with and without a drag-off cultivation

Herbicide	Rate lb/A	Weed Control[1]							
		Lambsquarters		Ragweed		Smartweed		Barnyardgrass	
		w/o[2]	w[3]	w/o	w	w/o	w	w/o	w
EPTC (ppi)	3	3.3	10.0	6.7	4.7	0.0	4.0	10.0	10.0
EPTC (ppi) + cyanazine (pre)	3 + 1½	9.7	10.0	9.3	9.3	9.3	5.7	10.0	9.7
EPTC (ppi) + methazole (pre)	3 + 1	10.0	10.0	9.7	9.7	0.0	5.7	10.0	10.0
EPTC (ppi) + (methazole + alachlor) (pre)	3 + (1½ + 1½)	9.3	9.7	10.0	10.0	3.3	6.7	10.0	10.0
alachlor + metribuzin (ppi)	2 + 1/2	7.0	10.0	2.7	5.7	6.7	8.3	10.0	10.0
	2¼ + 1/2	8.3	10.0	6.7	9.3	4.3	9.7	8.7	10.0
alachlor + linuron (pre) (check trmt)	2¼ + 3/4	9.0	8.5	10.0	10.0	0.0	0.0	9.0	9.0

1. Based on scale 0 to 10, where 0 = no control and 10 = complete control.
2. Without drag-off cultivation.
3. With drag-off cultivation.

HERBICIDES FOR THE CONTROL OF ANNUAL WEEDS AND YELLOW NUTSEDGE IN POTATOES

G. W. Selleck and R. S. Greider[1/]

ABSTRACT

Standard potato herbicides, new herbicide candidates, and herbicide combinations were evaluated for the control of yellow nutsedge at one location, and for control of annual weeds in three groupings at another, in 1977. Katahdin potatoes were treated in quadruplicated plots 2 rows by 30 ft. Applications were made with a tractor-mounted sprayer delivering 40 gpa at 35 psi. A finger-weeder was used for incorporation on Riverhead sandy-loam. Untreated strips adjacent to treated plots supplemented randomized checks. Rainfall was augmented by sprinkler irrigation. Tillage consisted of field preparation, planting, dragoff, and a single hilling.

Annual weed plots were cultivated in mid-June. Approximately 30 treatments each were included in the yellow nutsedge trials and where only one herbicide was used in annual weed trials. Combination treatments for the control of annual weeds involved approximately 60 treatments.

RESULTS

Metolachlor at 2-3 lb/A gave best control of yellow nutsedge and barnyardgrass and held up longer than alachlor at 2-3 lb/A or H 26910 at 2-4 lb/A. A combination of metolachlor or alachlor with metribuzin (.5 lb/A), also controlled lambsquarters, purslane and ladysthumb.

Assessed early (6/6), treatments were inadequate for annual weed control because of dry soil and late weed germination. After precipitation, oryzalin (1-1.5 lb) and penoxalin (1-1.5 lb) maintained acceptable control of annual grasses, but was weak on ladysthumb as were Hoe compounds. Alachlor and metolachlor were about equal in performance with marginal activity on late-germinating crabgrass. Combination treatments were more effective for the control of ladysthumb and fall panicum. Some of the better combinations were metolachlor, alachlor, penoxalin and oryzalin each in combination with metribuzin (0.5-.75 lb) and metolachlor with linuron (.75-1 lb). Other effective combinations were linuron .75 lb, pre + Hoe 29152 .5 lb post, H 26910 2 lb + metribuzin .75 lb pre, metribuzin .5 lb pre + layby, alachlor 2 lb pre + metribuzin .5 lb, layby, alachlor 2 + linuron .75 pre + alachlor 2 lb layby, and methazole 1.5 pre + EPTC 4 lb/A layby.

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COMBINATIONS OF EPTC AND METRIBUZIN FOR WEED CONTROL IN POTATOES

By R. A. Ashley and D. J. Kahl[1]

ABSTRACT

Sixteen different times and rates of application of EPTC (S-ethyl dipropylthiocarbamate) and metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)one) alone and in combination were evaluated for weed control and crop injury in potatoes (Solanum tuberosum L). Preplant incorporated applications of EPTC or metribuzin or preemergence applications of metribuzin generally gave better weed control than layby applications of EPTC or postemergence applications of metribuzin. Combinations of EPTC and metribuzin did not significantly improve weed control as compared to the preplant incorporated or preemergence applications of the herbicides alone.

Significant yield reductions were recorded following postemergence applications of metribuzin alone. The yield reductions resulted from poor weed control.

INTRODUCTION

The labeling of metribuzin for pre and post emergence weed control in potatoes offers considerable flexibility in dealing with weed control problems when combined with standard materials. This paper explores the effectiveness of combinations of metribuzin with EPTC.

MATERIALS AND METHODS

Field experiments were conducted at the Agronomy Research Farm of the University of Connecticut, Storrs, Connecticut during the summer 1977. The soil used was a Woodbridge fine sandy loam with 3-4% organic matter and pH of 5.4.

Katahdin potatoes were planted on May 26, 1977 to stand 20 cm apart in 1m rows. Rows were 3m long. Treatments were arranged in a randomized block design and were replicated 3 times.

Herbicide applications were made with a 12 liter, compressed air, knapsack sprayer with an output of 375 L/ha. No tank mixes were applied. Combination treatments were applied as separate applications. Treatments were incorporated using a garden tractor mounted rototiller and incorporated to a depth of 2-3 inches.

EPTC was applied at 3.3 and 6.7 kg ai/ha. Metribuzin rates were 0.28 and 0.56 kg ai/ha. Applications were made ppi on May 26, 1977, pre on May 27, 1977, post on June 20, 1977 and layby on June 29, 1977. Layby applications were made to freshly cultivated soil and incorporated during the hilling process. All treatments were hilled on June 29, 1977.

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Measurable rainfall during the treatment period included: 2.2 cm on May 19, 1.8 cm on June 2, 4.1 cm between June 3 and June 19, 1.7 cm on June 19, 15 cm on June 21, 1.2 cm on June 27 and 2.5 cm on June 29.

The predominant weed species in the experimental area was large crabgrass (Digitaria sanguinalis (L.)Scop.). On June 22, 1977 untreated area supported populations of 2015 plants per square meter. Much smaller but uniform stands of common ragweed (Ambrosia artemisiifolia L.) and pennsylvania smartweed (Polygonum pensylvanicum L.) were also present. Stand counts for these species were 9 and 7 plants per square meter respectively.

Weed control and crop injury were rated on July 13 and October 11, 1977 using a 0 to 10 scale with 0 representing no effect and 10 representing complete kill.

Yield data were taken October 12-13, 1977.

RESULTS AND DISCUSSIONS

Preplant incorporated applications of EPTC were significantly more effective at controlling crabgrass and ragweed than were layby applications (Table 1). EPTC applied at 3.3 kg ai/ha showed a crabgrass control rating of 9 on July 13 as compared to a rating of only 4 for a comparable rate applied layby. Comparable ratings for ragweed control were 8 and 5 for EPTC 3.3 kg ai/ha ppi and layby respectively. By harvest these differences in early control had disappeared and there were no significant differences in weed control between ppi and layby applications of EPTC.

Preplant incorporated and preemergent applications of metribuzin gave significantly better control of crabgrass than postemergence applications. July 13 ratings of crabgrass control for applications of 0.56 kg ai/ha metribuzin were 9, 9 and 3 for ppi, pre and post emergent applications respectively. On October 13 ratings for these same treatments were 5, 6 and 3 respectively. Similar differences existed with control of ragweed and smartweed.

Poor weed control from layby applications of EPTC and postemergence applications of metribuzin likely resulted from the extremely wet weather at the time of application. About 6.3 cm of rain fell between June 19 and 30, reducing the effectiveness of weed control from cultivation and hilling operations preceding layby applications and washing postemergence applications off of plant foliage.

Combination treatments generally did not offer improved weed control over comparable times of applications of EPTC or metribuzin alone. Weed control ratings for EPTC + metribuzin 3.3 + 0.56 kg ai/ha ppi were not significantly different than metribuzin alone at 0.56 kg ai/ha ppi. On July 13 weed control ratings for the combination treatment were 7, 10, 10 from crabgrass, ragweed and smartweed respectively. Comparable ratings for metribuzin alone were 9, 9, 10.

Significant yield increases were recorded for combinations of EPTC + metribuzin at 3.3 + 0.28 kg ai/ha ppi + post and 3.3 or 6.7 +0.56 kg/ha layby + pre. Yields for these treatments were 2.6, 2.8 and 2.7 kg per plot respectively as compared to 2.1 kg for the hoed control. Significant yield reductions occurred in plots receiving 0.28 or 0.56 kg of metribuzin post. Yield from these plots were 1.1 and 1.2 kg respectively as compared to 1.2 kg for a weedy check and 2.1 kg for a hoed check.

Table 1. Effect of EPTC and metribuzin alone and in combination on weed control and crop injury in potatoes.

Treatment	Rate kg ai/ha	Time of Application	Crop Injury[1]	Weed Control[1] CG[2] 7/13	CG[2] 10/11	RW[3] 7/13	RW[3] 10/11	SW[4] 7/13	Yield kg/Plot[5]
EPTC	3.3	PPI	0	9	6	8	5	10	2.2
	6.7	PPI	1	9	7	9	6	8	1.8
	3.3	Layby	0	4	4	5	3	7	1.7
	6.7	Layby	0	5	7	4	8	7	1.7
Metribuzin	0.56	PPI	1	9	5	9	10	10	2.2
	0.56	PRE	0	9	6	10	9	10	1.9
	0.56	POST	0	3	3	2	5	10	1.1
	0.28	POST	0	1	1	3	7	5	1.2
EPTC +	3.3+0.56	PPI	0	9	6	10	0	10	2.0
Metri-	3.3+0.56	PPI+PRE	0	8	7	8	8	10	2.0
buzin	3.3+0.56	PPI+POST	0	9	7	7	6	9	1.8
	3.3+0.28	PPI+POST	0	9	8	8	5	10	2.6
Metribuzin	0.56+6.7	PPI+LAYBY	0	9	6	9	8	10	2.5
+ EPTC	0.56+6.7	PPI+LAYBY	1	9	7	10	9	10	1.9
	0.56+3.3	PRE+LAYBY	0	8	6	9	8	10	2.8
	0.56+6.7	PRE+LAYBY	0	8	5	9	9	10	2.7
Hoed Check	----	----	0	10	10	10	10	10	2.1
Weedy Check	----	----	0	0	0	0	0	0	1.2
LSD 5%			NS	0.8	3.4	1.7	NS	2.0	0.4

1. Ratings taken using a 0 + 0 10 scale with 0 = no effect and 10 = complete kill.
2. Large crabgrass (Digitaria sanguinalis L. Scop.)
3. Common ragweed (Ambrosia artemisiifolia L.)
4. Pennsylvania smartweed (Polygonum pensylvanicum L.)
5. Yields taken 10/12-13/77 represent the average of 3 replicates.

A COMPARISON OF R-12001, METRIBUZIN, AND DINOSEB COMBINATIONS FOR WEED CONTROL IN POTATOES

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

ABSTRACT

During 1977, R-12001, metribuzin, and dinoseb combinations were compared for broadleaved and grass weed control in white potatoes. R-12001 applied as pre-plant incorporated treatments caused obvious crop injury symptoms and was not always acceptable for weed control. R-12001 in combination with metribuzin or dinoseb provided satisfactory weed control. Metribuzin used alone as a preemergence treatment gave excellent control of broadleaved and grass type weeds without injury to the crop.

INTRODUCTION

Experimental herbicide, R-12001, (chemistry undisclosed) was evaluated alone and in combinations with metribuzin [4-amino-6-*tert*-butyl-3 (methylthio)-*as*-triazin-5(4*H*)-one] and dinoseb (2-*sec*-butyl-4, 6-dinitrophenol) for broad spectrum weed control in white potatoes (*Solanum tuberosum L. 'Katahdin'*). Shallow and regular incorporation of R-12001 was also evaluated to determine if shallow incorporation could control a higher percentage of annual barnyard grass [*Echinochloa crusgalli (L.) Beauv.*] than incorporation to soil depths of 8 to 10 centimeters.

MATERIALS AND METHODS

Preplant incorporated treatments of R-12001 were applied to a very dry Caribou gravelly silt loam and incorporated either shallow (5 cm) or regular (8-10 cm) with an Ariens Rocket rototiller. All herbicides were applied in 303 liters of water using 40 psi pressure. A compressed air sprayer equipped with a two-nozzle brush type boom was used to apply the various herbicides. Nozzles were Delavan raindrop type with No. 3374-3 tips. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with 6 replicates of each treatment. Weed control and crop injury ratings were made on two dates, as listed in Table 1, using the "Cornell" rating system of 1 to 9. During July, weed counts were made and species, as reported in Table 1, were identified in the "no treatment" plots.

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RESULTS AND DISCUSSION

Data presented in Table 1 indicate that all treatments of R-12001, metribuzin, and dinoseb at rates higher than 2.24 kg/ha caused some injury to potato plants which was still in evidence at the last rating in mid-August. Control of mustard (*Brassica campestris L.*) and lambsquarters (*Chenopodium album L.*) was satisfactory only when metribuzin or dinoseb was applied in combination with R-12001. Metribuzin alone as preemergence treatments gave very satisfactory control of broadleaved and grass weeds without causing crop injury. No consistent differences were apparent in favor of shallow incorporation of R-12001 for control of barnyardgrass [*Echinochloa crus-galli (L.) Beauv.*] as compared to regular preplant incorporation.

Table 1. Effect of R-12001 alone and in combination with metribuzin and dinoseb on weed control in Katahdin potatoes. Maine - 1977.

Treatments[a]		Crop injury and weed control ratings[b]							
		Crop injury		Broadleaved		Quackgrass		Annual grass	
Herbicide	kg/ha	6-29	8-16	6-29	8-16	6-29	8-16	6-29	8-16
Check - no treatment		9.0	7.8	6.0	6.3	6.0	6.5	8.0	6.0
Dinoseb (PE) + Dalapon (PE)	5.04 + 5.60	6.8	7.2	8.0	8.0	6.3	7.8	7.0	7.8
R-12001 (PPI) shallow inc.	2.24	7.3	7.0	5.5	7.1	6.0	6.0	7.2	7.8
R-12001 (PPI) regular inc.	2.24	7.3	7.6	6.5	7.1	5.0	5.8	6.5	7.2
R-12001 (PPI) regular inc.	4.48	6.1	6.8	6.4	6.3	6.0	6.3	7.0	7.2
R-12001 (PPI) regular inc.	4.48	5.3	6.8	5.5	5.6	7.0	6.8	7.6	8.1
R-12001 (PPI) shallow inc.	6.72	5.1	7.3	6.5	7.0	6.0	6.8	7.0	7.6
R-12001 (PPI) regular inc.	6.72	3.6	7.0	5.6	6.5	6.8	7.5	6.8	7.4
R-12001 (PPI) regular inc.	8.96	4.5	6.6	6.0	6.1	6.3	6.5	7.2	7.8
R-12001 (PPI) shallow inc. + Metribuzin (PE)	4.48 + 0.30	6.1	7.6	9.0	9.0	6.5	6.3	7.4	7.9
R-12001 (PPI) shallow inc. + Metribuzin (PE)	4.48 + 0.56	6.0	7.6	8.3	9.0	7.1	7.3	7.9	8.5
R-12001 (PPI) shallow inc. + Dinoseb (PE)	4.48 + 5.04	5.3	7.3	9.0	8.8	6.6	6.8	7.5	7.9

Table 1 - continued

Treatments[a] Herbicide	kg/ha	Crop injury and weed control ratings[b] Crop injury 6-29	Crop injury 8-16	Broadleaved 6-29	Broadleaved 8-16	Quackgrass 6-29	Quackgrass 8-16	Annual grass 6-29	Annual grass 8-16
R-12001 (PPI) shallow inc. +	4.48 +								
Dinoseb +	5.04+								
Dalapon (PE)	5.60	5.0	7.3	9.0	8.6	8.8	6.7	7.8	8.3
Metribuzin (PE)	0.56	8.3	7.7	8.5	8.7	6.7	6.7	8.1	8.6
Metribuzin (PE)	0.30	7.2	7.5	8.3	9.0	6.7	5.7	6.6	7.0
Metribuzin +	0.56 +								
Dalapon (PE)	5.60	7.0	7.2	8.8	8.8	6.7	6.7	7.3	7.9
R-12001 (PPI) shallow inc. +	4.48 +								
Metribuzin (PE) +	0.30 +								
Metribuzin (LB)	0.30	4.8	7.2	8.7	8.7	7.5	7.2	8.5	8.0

[a]Planted - May 31; killed - September 15, 1977.
PPI treatments applied - May 31. Weather - clear, sunny. Temperature - 24.0C. Soil - very dry.
Preemergence treatments applied - June 10. Partly overcast. Temperature - 17.8C. Soil - very moist.
Layby treatment applied - June 20. Weather - overcast. Temperature - 19.0C. Soil - dry.

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

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

Brassica campestris	2.4	*Galinsoga sp.*	0.3
Chenopodium album	1.2	*Echinochloa crusgalli*	0.8
Cirsium arvense	0.6	*Agropyron repens*	1.8

METRIBUZIN POST-EMERGENCE FOR CONTROL OF HEDGE BINDWEED AND BARNYARDGRASS IN POTATOES

G. W. Selleck and R. S. Greider

ABSTRACT

Metribuzin at .5, 1 and 2 lb/A a.i. and Glyphosate at 2 lb/A a.i. were applied post-emergence to Katahdin potatoes 6/8, and the metribuzin treatments and 2,4-D amine at 1 lb/A a.i. were applied 6/16. Applications were made with a CO_2 knapsack sprayer delivering 15 gpa at 35 psi on plots 2 rows x 25 ft replicated 4 times on Haven loam with 2% O.M. Tillage consisted of field preparation, planting, dragoff, hand cultivation (to simulate grower practice) and a single hilling. Pertinent application data are listed in Table 1.

Table 1. Application statistics.

Date	Stage (cm) bindweed	Stage (cm) potatoes	Temp. °F	R.H. (%)	Wind (mph)
6/8	2-33	15-20	65	40	8-12
6/16	23-81	25-30	80	70	0-3

Results: All rates of metribuzin applied early controlled hedge bindweed 95% or more on 8/31 and barnyardgrass 82% or more. Later applications were less effective. Glyphosate controlled the bindweed, but regrowth was unacceptable. Potato leaf chlorosis was visible with metribuzin (more severe with 2,4-D), and blossoming was delayed several days. Glyphosate killed most of the potatoes. With the exception of glyphosate, treatment yields were not significantly different.

Table 2. Hedge bindweed and barnyardgrass control[1/] with herbicides.

Treatment lb/A	Phyto. 6/24	Bindweed 7/8	Bindweed 8/31	Barnyardgrass 7/8	Barnyardgrass 8/31	Yield cwt/A
Metribuzin 0.5	1	7.4	9.7	9.3	8.2	216
Metribuzin 1	2	8.0	9.6	9.5	8.8	251
Metribuzin 2	3	8.8	9.9	9.7	9.1	254
Glyphosate 2	9	7.0	5.0	6.8	2.8	15
Check	0	1.7	2.0	0.4	6.4	179
Metribuzin 0.5	0	6.9	7.8	7.5	5.5	212
Metribuzin 1	0	7.6	8.5	8.0	8.0	266
Metribuzin 2	2	8.8	9.2	9.3	8.4	241
2, 4-D amine 1	3	9.6	7.0	0	6.8	226

1/ 0 = no control, 10 = complete control

WEED CONTROL IN WHITE POTATOES WITH PENDIMETHALIN AND METRIBUZIN APPLIED PRIOR TO AND AFTER DRAG-OFF

Carol N. Somody, Ratemo W. Michieka, Richard D. Ilnicki, and Jan Somody[1]

ABSTRACT

Pendimethalin applied prior to the drag-off did not adequately control Pennsylvania smartweed but effected fair to good control on lambsquarters, common ragweed, barnyardgrass and redroot pigweed. Post drag-off applications produced slightly better control of smartweed and poorer control of redroot pigweed and barnyardgrass. Metribuzin applied after drag-off produced excellent control of all weeds and combinations of metribuzin and pendimethalin did not improve control over that produced by metribuzin alone. The combination applied prior to drag-off was not as effective as that applied after drag-off. The combination nullified the slight decrease in vigor of potatoes produced by pendimethalin alone.

INTRODUCTION

The asymmetrical triazine, 4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5-(4H)-one (metribuzin), has proved to be an effective herbicide in white potatoes (*Solanum tuberosum* L.). Successful weed control has been obtained in soybeans (*Glycine max* L.) and corn (*Zea mays* L.) with the dinitroaniline herbicide, N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine (pendimethalin).

Metribuzin sometimes fails to give adequate weed control of grasses. Last year Michieka *et al*.(1), reported that metribuzin by itself applied prior to planting was effective on broadleaf weeds but poor on barnyardgrass (*Echinochloa crusgalli* L.). Because of this, it was deleted from the prior-to-drag-off treatments this year.

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It was the objective of this study to determine whether combinations of these herbicides could be used to advantage in potatoes and what effect the drag-off operation had on their performance.

MATERIALS AND METHODS

Research was conducted at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey. Potatoes (var. Superior) were planted April 18 and the herbicide treatments were applied May 2 prior to drag-off and immediately followed by after drag-off applications. A 6' x 19' split plot design with three replications was used on Sassafras loam soil.

Weed species in the experimental area were common lambsquarter (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), common ragweed (Ambrosia artemisiifolia L.), Pennsylvania smartweed (Polygonum pensylvanicum L.), and barnyardgrass. A scale of 0 to 10 (0 = no crop injury or weed control, 10 = total reduction in crop stand or vigor or complete weed control) was used to rate the experiment on July 6.

RESULTS AND DISCUSSION

Pendimethalin applied prior to drag-off gave poor control of smartweed and only fair control of lambsquarters and ragweed (see Table 1). The slight improvement in smartweed control produced by the after drag-off application was more than nullified by the decrease in pigweed and barnyardgrass control, both of which had been adequately controlled with prior to drag-off applications. Some increase in lambsquarter control at the higher rate of 1 lb/A applied after drag-off was noted.

Some slight injury to the potatoes with pendimethalin applied prior to drag-off showed a decrease at each rate in the after drag-off plots. Combining metribuzin with pendimethalin nullified the slight injury caused by pendimethalin alone at all rates either prior to or after drag-off.

Metribuzin, already noted to give poor barnyardgrass control when applied prior to planting, was excellent at all rates applied after drag-off for both weed control and crop tolerance. Thus, even though combinations of metribuzin and pendimethalin applied after drag-off provided excellent weed control and no crop injury, there was no improvement on what metribuzin accomplished alone.

When combinations of metribuzin and pendimethalin were applied prior to drag-off, control of all weeds was poorer than when both were applied together after the drag-off operation. Control was comparable to pendimethalin alone applied prior to drag-off.

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Table 1. The effects of pendimethalin and metribuzin applied prior to and after drag-off.

Herbicide	Rate lb/A	Potatoes[1]	Plant Responses[1] Lambs-quarter	Pigweed	Ragweed	Smartweed	Barnyard-grass
pendimethalin	3/4	1.7	6.0	9.7	6.3	0.0	8.3
(prior to)	1 1/2	0.7	4.7	9.3	6.7	1.7	8.0
pendimethalin	3/4	1.0	4.7	5.7	6.8	2.3	6.5
(after)	1	0.3	8.0	5.2	6.3	2.3	8.5
metribuzin (after)	1/2	0.0	9.0	9.7	8.7	7.7	8.5
	3/4	0.0	8.8	9.0	9.0	9.6	8.0
	1	0.0	9.7	10.0	9.0	9.3	8.0
pendimethalin +	3/4 + 1/2	0.0	7.0	8.6	8.0	3.7	7.0
metribuzin	3/4 + 3/4	0.3	6.3	8.6	7.3	4.7	8.0
(prior to)							
pendimethalin +	3/4 + 1/2	0.0	9.3	9.0	7.9	6.7	8.7
metribuzin	3/4 + 3/4	0.0	8.5	9.7	9.3	9.3	6.3
(after)							

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

GROWER USE OF PENDIMETHALIN HERBICIDE IN IRISH POTATOES

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ABSTRACT

In 1977 under EPA Experimental Use Permit No. 241-EUP-81, pendimethalin alone and in tank-mix combinations were used in Irish potatoes in Maine, Maryland, New Jersey, New York and Pennsylvania and ten other states.

Pendimethalin alone was applied preemergence for the control of several annual grass species and certain annual broadleaf weed species. Pendimethalin in tank-mix combination with metribuzin was applied preemergence and in tank-mix combination with EPTC was applied postplant incorporated to increase the weed control spectrum.

Under the diverse climatic and soil conditions, good to excellent weed control was obtained with pendimethalin and combination treatments. Data from final results will be discussed.

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THE EFFICACY OF PACKAGE MIXES VERSUS TANK MIXTURES OF ALACHLOR AND LINURON FOR WEED CONTROL IN KATAHDIN POTATOES

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

ABSTRACT

Comparisons of tank mixtures of alachlor plus linuron and alachlor plus metribuzin with package mixtures of the same herbicides applied at the same dosage levels were made to determine if there were any differences in efficacy to control weeds in potatoes. No significant differences in weed control or crop injury were indicated between tank and package mixtures.

INTRODUCTION

During 1977, comparisons of package and tank mixtures of alachlor [2-chloro-2′,6′-diethyl-*N*-(methoxymethyl)acetanilide] plus linuron [3-(3, 4-dichlorophenyl)-1-methoxy-1-methylurea] and alachlor plus metribuzin [4-amino-6-*tert*-butyl-3(methylthio)-*as*-triazin-5(4*H*)-one] were made to determine their efficacy for weed control in white potatoes *(Solanum tuberosum L. 'Katahdin')* grown at Presque Isle, Maine. Comparisons of three rates of alachlor for layby application in potatoes were also made to obtain crop injury and weed control data.

MATERIALS AND METHODS

All treatments were applied to a Caribou gravelly silt loam soil as per schedule in Table 1. All herbicides were applied in 303 liters of water using 40 psi pressure. A compressed air sprayer equipped with a two nozzle brush type boom was used to apply the herbicides. Nozzles were Delavan raindrop type with No. 3374-3 tips. Plot size was a single row, 6.1 meters long, arranged in a randomized block design with 6 replicates of each treatment. Weed control and crop injury ratings were made at two dates as listed in Table 1 using the "Cornell" visual rating system of 1 to 9. During July, weed counts were made by species in the "no treatment" plots, as reported in Table 1.

RESULTS AND DISCUSSION

Data presented in Table 1 indicate that tank mixtures of linuron plus alachlor were equally as effective for weed control in white potatoes as the package mixtures of alachlor and linuron. The highest rate of

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alachlor plus linuron as a tank mixture did produce moderately long-lasting crop injury symptoms, but weed control was not affected.

Comparisons of package mixtures of metribuzin and alachlor versus tank mixtures of metribuzin plus alachlor indicate, as shown in Table 1, that equal weed control was obtained from tank and package mixtures.

A comparison of three rates of alachlor for layby application indicated no improvement in control of barnyard grass [*Echinochloa crusgalli (L.) Beauv.*] as the rate was increased and probably because of the low grass pressure in this study.

Table 1. Comparisons of alachlor, linuron, and metribuzin combinations for weed control in Katahdin potatoes. Maine - 1977.

Treatments[a]		Crop injury and weed control ratings[b]							
		Crop injury		Broadleaved		Quackgrass		Annual grass	
Herbicide	kg/ha	7-11	8-19	7-11	8-19	7-11	8-19	7-11	8-19
Check - no treatment		8.8	8.5	6.7	6.5	6.0	7.7	4.8	7.2
Dinoseb + Dalapon	5.04 + 5.60	8.0	8.5	9.0	9.0	7.3	8.3	8.7	8.8
Alachlor + Linuron (PE)[c]	1.68 + 0.62	8.0	8.3	8.2	8.5	6.7	8.2	8.5	8.8
Alachlor + Linuron (PE)[c]	2.80 + 1.04	7.3	8.7	9.0	9.0	8.3	8.8	9.0	9.0
Alachlor + Linuron (PE)[c]	4.48 + 1.66	7.7	8.5	9.0	9.0	7.8	8.7	9.0	9.0
Alachlor + Linuron (PE)[d]	2.80 + 1.04	7.7	8.8	9.0	9.0	7.7	8.7	9.0	9.0
Alachlor + Linuron (PE)[d]	4.48 + 1.66	7.2	7.7	8.7	9.0	8.3	8.5	9.0	9.0
Alachlor + Metribuzin (PE)[c]	1.68 + 0.31	8.0	8.7	8.8	8.8	6.7	8.0	8.8	9.0
Alachlor + Metribuzin (PE)[c]	2.80 + 0.53	7.8	8.8	9.0	9.0	7.8	8.7	9.0	9.0
Alachlor + Metribuzin (PE)[c]	4.48 + 0.84	7.2	8.7	8.8	8.8	8.2	8.5	9.0	9.0
Alachlor + Metribuzin (PE)[d]	2.80 + 0.53	7.7	8.3	9.0	9.0	7.8	8.3	9.0	8.8
Alachlor + Metribuzin (PE)[d]	4.48 + 0.84	7.3	8.5	9.0	9.0	8.8	9.0	9.0	9.0
Metribuzin (PE)	0.56	8.3	8.7	9.0	9.0	7.5	8.5	8.8	9.0
Linuron (PE)	1.12	8.0	8.5	8.8	8.8	7.3	8.2	8.8	8.7
Metribuzin (PE) + Alachlor (LB)	0.56 + 1.68	8.3	8.2	9.0	9.0	7.7	8.7	9.0	9.0

Table 1 - continued

Treatments[a]		Crop injury and weed control ratings[b]							
		Crop injury		Broadleaved		Quackgrass		Annual grass	
Herbicide	kg/ha	7-11	8-19	7-11	8-19	7-11	8-19	7-11	8-19
Metribuzin (PE) + Alachlor (LB)	0.56 + 2.24	8.8	8.2	9.0	9.0	7.8	8.5	9.0	8.8
Metribuzin (PE) + Alachlor (LB)	0.56 3.36	8.8	8.3	9.0	9.0	8.0	8.7	9.0	9.0

[a]Planted - June 2; killed - September 15, 1977.
Preemergence treatments applied - June 16. Weather - clear. Temperature - 16.0C. Soil - slightly damp.
Layby treatments applied - July 20. Weather - overcast. Temperature - 19.4C. Soil - dry.

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

Package mix.

Tank mix.

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

Brassica campestris	0.5	*Echinochloa crusgalli*	0.3
Agropyron repens	0.7	*Polygonum persicaria*	0.6

YELLOW NUTSEDGE CONTROL IN ORCHARDS WITH TERBACIL

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ABSTRACT

Terbacil at 1.12 kg (ai)/ha effectively controlled yellow nutsedge (Cyperus esculentus L.) when applied as a supplemental foliar spray in combination with a 1% non-phytotoxic oil-water mixture during July to early August. The yellow nutsedge had developed in the herbicide treated area of a 'Rome Beauty' apple orchard. The yearly herbicide program included simazine or simazine-paraquat combination applied before apple bloom in April or May.

INTRODUCTION

Yellow nutsedge (Cyperus esculentus L.) infestations are an increasing problem in apple (Malus domesticus Borkh.) and peach (Prunus persica (L.) Batsch) orchards in the Cumberland-Shenandoah Valley of Pennsylvania, Maryland and the Virginias. The chief means of propagation are from the tubers and rhizomes. The important parts of the plant for increasing its infestation are centered around the basal bulb of the plant.[3, 4] Rhizomes originating from the basal bulb commonly differentiate into either tubers or new leafy shoots during the growing season. New rhizomes originating from the basal bulb may also differentiate directly into secondary basal bulbs. A parent plant can give rise to a complex system of secondary, tertiary and higher order vegetative shoots, each of which eventually produces rhizomes with tubers.[1]

Numerous soil applied herbicides have been evaluated for the control of yellow nutsedge. Influences upon the plant have varied from delayed sprouting to killing shoots after emergence.[2] Terbacil (3-tert-butyl-5 chloro-6 methyluracil) is a photosynthetic inhibitor readily absorbed through the root system and less so through the foliage of a plant. It is known to control yellow nutsedge at rates of 3.58 kg (ai)/ha to 8.96 kg (ai)/ha when applied to the soil surface before or during the early period of active growth of weeds.[5] The rates used generally are higher than those which may be recommended for use in apple and peach plantings.

MATERIALS AND METHODS

The objective of this study was to determine whether terbacil applied at acceptable rates as a foliar spray would control yellow nutsedge.

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A 'Rome Beauty' apple orchard planted in 1964 at 4.57 m by 6.7 m on Duffield silt loam had been band treated each year from 1966 to 1974 with simazine (2-chloro-4, 6-bis (ethylamino)-s-trizine) or paraquat (1, 1'-di methyl-4, 4'-bipryidinium ion)-simazine combination. The applications were made in April or May by the orchardist as a pre-apple bloom spray. Since 1974 terbacil has been used. The band width was 0.76 m on each side of the row. During the first 6 years of the orchard, scattered solid stands of yellow nutsedge developed in the 1.52 m by 4.57 m treated area between the trees in the row. The solid stands of yellow nutsedge ranged from 22 to 50 plants/ 0.093 m^2, an average of 36.2 plants/.093 m^2. The solid stands varied in size from 1.52 m by 4.57 m to 1.52 m by 32 m.

Twenty of twenty-five stands (plots) of yellow nutsedge were treated with a supplemental terbacil foliar spray. Terbacil applications of 1.12 kg (ai)/ha were made to fifteen plots and 2.24 kg (ai)/ha to five plots on August 10, 1970. All twenty plots received 1.12 kg/ha terbacil as a supplemental foliar spray on July 6, 1971. The rate of application was 448 L/ha. The terbacil was applied in a water-oil mixture containing 1.0% (v/v) non-phytotoxic oil with an unsulfonated residue content of 96% and a viscocity of 73 Saybolt seconds at 37.7°C. The plant height at the time of the August 10, 1970 application was 30 to 40 cm. The five non-terbacil treated plots were randomized throughout the terbacil treated plots.

Plant counts were made on October 6, 1972 and again on October 7, 1974. Visual observations were made in September 1977. No terbacil treatments were made from 1972 through 1974. During 1975, 1976 and 1977, the orchardist used terbacil at 1.12 kg/ha and 2.24 kg/ha as his regular herbicide treatment for the orchard including the plot areas.

RESULTS AND DISCUSSION

Within two weeks following the supplemental terbacil treatments, the yellow nutsedge plants showed definite signs of uptake. September observations of the August 10, 1970 treatments showed the top growth to be dead as well as most roots. Terbacil at 1.12 kg/ha appeared to be as effective as the 2.24 kg/ha rate; therefore, only the lower rate of terbacil was used for the 1971 application for all plots.

The effective control of yellow nutsedge from the supplemental terbacil treatments allowed plant counts to be made from larger areas. Instead of the .093 m^2 as used for the non-terbacil treated control plots, counts were made in terbacil treated plot areas which ranged from 4.16 m^2 to 29.12 m^2. A total area of 224.7 m^2 was involved in the plant counts from the twenty terbacil treated stands of yellow nutsedge.

The plant counts of yellow nutsedge were made fifteen months and 39

months following the July 6, 1971 supplemental terbacil treatment (Table 1).

Table 1. Yellow nutsedge plants remaining alive on October 6, 1972, 15 months following the second supplemental terbacil treatment (July 6, 1971) and on October 7, 1974, 39 months following treatment.

Treatment	Number Of Plots	Mean Number of Plants/.093 m^2 October 6, 1972	October 7, 1974
Supplemental Terbacil	20	0.95[a]	13.4[a]
Control	5	36.2	47.8

[a]Treated means are significantly different from control at 1% level.

The supplemental foliar terbacil treatment applied in early August over a paraquat-simazine seasonal pre-apple bloom herbicide program effectively controlled yellow nutsedge for a period of 15 months. Reinfestation was greatly retarded for a period of 39 months. Following a change in the seasonal herbicide program in 1975 to include terbacil, it is evident from visual observations in September 1977 that the orchardist has eliminated the yellow nutsedge problem from the sprayed band area in the orchard.

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GLYPHOSATE FOR WEED CONTROL IN APPLE ORCHARDS

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ABSTRACT

Glyphosate was applied each spring in replicated trials in three apple orchards for periods of 2, 3, and 4 years at rates of 1 to 3 lb/A (ae), alone or in combination with simazine. Sprays in volumes of 50 or 100 gal/A were banded 3 ft on either side of trees, hitting basal suckers and bark. Although treated suckers usually were killed, no injury to the trees was ever observed. A broad spectrum of annual and perennial weeds was killed by May applications of glyphosate. Weeds that were partially resistant included brambles (*Rubus* sp.), horsenettle (*Solanum carolinense* L.), and poison ivy (*Rhus radicans* L.). Delaying the glyphosate sprays until July one year essentially eradicated these species.

Drenching sprays of glyphosate at 2 or 4 lb/100 gal (ae) in June, July, or August on whole scaffold branches of apple trees, accelerated fruit drop on the treated branches but did not visibly affect the rest of the tree during that season. During the next season after spraying, these branches were severely injured or killed and strips of bark below them frequently were killed. Dwarfing of leaves sometimes occurred on adjacent higher branches on the same side of the tree. Untreated portions of trees bore heavy yields of fruit the following season.

Glyphosate proved to be a valuable herbicide for orchard use with little hazard to trees when kept off the foliage.

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METRIBUZIN UTILIZATION WITH TRANSPLANTED TOMATOES

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ABSTRACT

Experiments were conducted at two locations in northwest Ohio to determine the most efficient method of incorporating metribuzin (4-amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5(4H)-one) into weed control systems for transplanted tomatoes (*Lycopersicon esculentum* Mill.). The standard preplant herbicides, trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) or pebulate (S-propyl butylethyl thiocarbamate), did not provide an acceptable level of weed control at either site. Combinations of metribuzin with these two herbicides significantly improved the level of weed control, with postplanting applications of metribuzin more effective than preplant tank-mix treatments. Outstanding yellow nutsedge (*Cyperus esculentus* L.) control was achieved at the McClure, Ohio, site with two postplanting applications of metribuzin at 0.56 kg/ha applied 20 days apart. While some phytotoxicity was experienced with postplanting metribuzin treatments, the injury involved less than five percent of the foliage, did not delay crop development, influence yield, or adversely affect tomato fruit quality.

Efficacy and tomato tolerance to three formulations of metribuzin applied preplanting and postplanting were studied along with tank-mix treatments of the wetable powder (WP) metribuzin formulation with several other pesticides. The 4 Liquid (4L) formulation provided inferior initial broadleaf weed control compared to the WP formulation when applied preplanting. Efficacy of postplanting treatments were comparable for the three formulations; however, the 4L material produced more phytotoxicity than the WP treatment. Tank-mix treatments of metribuzin with azinphos-methyl (0,0-dimethyl S-(4-oxo-1,2,3-benzotriazin-3(4-H)ylmethyl)phosphorodithioate) produced more extensive signs of phytotoxicity than metribuzin applied alone and this treatment delayed crop maturity.

INTRODUCTION

Metribuzin has been recognized as a promising selective herbicide for use with transplanted tomatoes for several years and lable registration for use on this crop is anticipated. Metribuzin's forte is controlling a wide range of annual broadleaf weeds, and while some control of annual grasses may be obtained, it is often not at a commercially acceptable level. Because of this weakness, with grass species, it is natural to consider combining metribuzin with presently available tomato herbicides such as trifluralin or pebulate, which effectively control annual grasses. Since metribuzin can be applied both preplanting and postplanting, the question was raised as to how to use this herbicide most effectively when applied alone or combined with presently approved materials. In considering postplanting applications, it was anticipated that some growers may desire combining a fungicide and/or insecticide with metribuzin to minimize their pesticide spray costs. In 1977, two new formulations of metribuzin were under development, a 4L material and a 4-Flowable (4F) preparation.

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These experiments were undertaken in 1977 to further evaluate tomato response and efficacy of metribuzin when used alone or with standard herbicides or tank mixed with other pesticides. Also, it was desirable to determine if all three formulations of metribuzin were comparable in efficacy and crop response.

MATERIALS AND METHODS

A split-plot experiment designed to measure crop response to metribuzin alone and with standard herbicides was conducted at two locations, Napoleon and McClure, Ohio, in 1977. Main plots (treatments) were 3 by 6.1 m in size, with tomato varieties (C28 and C37) as sub-plots. Treatments were replicated four times on sandy loam soils having 2.2 to 2.5 percent organic matter. A second randomized complete block experiment at the Napoleon site was designed to study tomato response to three formulations of metribuzin as well as interactions of metribuzin tank-mix treatments with other pesticides. Single row plots of C37 tomatoes 1.5 m by 6.1 m were replicated four times. Chemicals used are listed in Table 1. Pertinent treatment, planting, and harvesting information are summarized in Table 2. All treatments were applied with a bicycle plot sprayer delivering 308 L/ha at 2.1 kg/cm^2, using compressed air as a propellant. Preplant incorporated treatments were rototilled 6 to 7.5 cm deep within two hours of application. Weed control was measured using a 0 to 10 rating system in which 0 represented no control and 10 complete control, and 8 was considered the minimum value to be commercially acceptable. Crop phytotoxicity was determined using a 1 to 5 rating system where 5 represented no visible injury and 1 represented crop kill. Dominant weed species in each experiment are listed in Table 2. No additional cultivation or hand weeding was employed with the exception of the "weeded control" plots. Tomato fruit quality characteristics: pH, color, titratable acidity, percent soluble solids, and ascorbic acid content were measured from 15 fruit samples of the C28 variety obtained from the Napoleon trial.

RESULTS AND DISCUSSION

The 1977 growing season was characterized by a dry spring (4.9 cm of precipitation in May) resulting in plant stress during the critical period of transplant establishment. Good growing conditions were experienced the rest of the summer.

Standard trifluralin and pebulate treatments at the Napoleon site did not provide satisfactory weed control, Table 3, and this may be a result of the somewhat dry soil conditions. The addition of 0.56 kg/ha of metribuzin as a tank-mix preplanting treatment with these herbicides, significantly improved broadleaf weed control but not to a level considered commercially satisfactory. Postplanting applications of metribuzin over trifluralin or pebulate provided excellent overall weed control throughout the season. A single application of metribuzin alone was judged inadequate; however, a preplant treatment followed by a postplanting application rated very high for weed control. Black nightshade was the most difficult weed to control at the Napoleon site with the

fewest escapes observed with metribuzin 0.56 kg/ha preplanting plus postplanting and pebulate preplanting plus metribuzin postplanting (data not shown). While phytotoxicity in the form of marginal leaf-tip burn was observed with postplanting metribuzin treatments, the injury affected less than 5 percent of the foliage, did not delay crop development or influence yield. Fruit quality determinations on the C28 variety indicated that herbicide treatments did not adversely affect pH, color, titratable acidity, percent soluble solids, or ascorbic acid content (data not shown).

The McClure site lacked annual grass weed pressure but provided a fairly uniform yellow nutsedge and cocklebur population. The dry soil conditions resulted in poor C37 transplant survival and this variety had to be replanted on May 26. Again, the standard herbicides, trifluralin and pebulate alone, were ineffective on broadleaf weeds - particularly cocklebur, and neither controlled yellow nutsedge adequately, Table 4. The dry soil conditions probably contributed to this rather poor performance.

Metribuzin preplanting at 0.56 kg/ha fell short of satisfactory broadleaf weed control while the same rate applied postplanting was judged initially more effective. Metribuzin combination treatments with trifluralin or pebulate were consistently more effective when applied postplanting rather than as tank-mix preplanting combinations. Nutsedge was effectively controlled with treatments involving a total of 1.12 kg/ha of metribuzin or with postplanting metribuzin applied over pebulate. The singular, outstanding nutsedge control occurred with two postplanting metribuzin treatments at 0.56 kg/ha applied 20 days apart. The C37 variety exhibited foliar leaf-tip burn from postplanting metribuzin treatments while the C28 variety appeared quite tolerant. This was due to the fact that C37 had to be replanted and was not as well established at the time of treatment. This phytotoxicity was not supported by a response in crop yield since the only significant yield reductions measured were a result of weed competition in the trifluralin and pebulate plots.

In evaluating performance of the three metribuzin formulations, preplanting treatments provided satisfactory initial weed control; however, there was an indication that the 4L material was inferior to the WP formulation in terms of broadleaf control, on June 9, Table 5. All formulations applied preplanting were incapable of providing acceptable control beyond June.

Postplanting applications of metribuzin over trifluralin applied preplanting provided a high level of weed control throughout the season. The 4L formulation was judged more phytotoxic than the WP formulation when evaluated on June 9; however, this injury did not persist (was not detected on July 28 - data not shown) or affect tomato yield.

Tank mix treatments of metribuzin WP with azinphos-methyl resulted in the greatest phytotoxicity observed, and in addition, plants receiving this treatment were distinctly later in ripening than other treatments in this test. This observation supports findings reported by Warholic et al. (2) who found that azinphos-methyl and endosulfan, when combined with metribuzin postplanting, reduced early fruit yield. None of the insecticide/fungicide combinations with metribuzin affected herbicide efficacy. No attempt was made to measure the influence of metribuzin on the efficacy of the insecticides since insect pressure was minimal in the test area.

Based on data from 1977 trials as well as from prior years (1) the most effective way to use metribuzin in tomato weed control programs is to combine it with standard preplant annual grass herbicides and to use it as a post-planting application rather than preplant tank-mix treatments. Soil incorporation probably dilutes metribuzin, reducing its activity; whereas, a postemergence application applied about three weeks after planting tends to coincide with many broadleaf weeds reaching the susceptible seedling stage. In addition, the later application tends to provide longer residual control helping to control late germinating weeds. If one elects to develop a control program utilizing only metribuzin, it is vital that a preplanting application be included in order to provide adequate annual grass control. Where yellow nutsedge is a problem, two postplanting applications of metribuzin at 0.56 kg/ha, about three weeks apart, should provide complete season long burn-down of nutsedge foliage. In light of the adverse crop response experienced with tank-mix treatments of azinphos-methyl with metribuzin, it would not appear advisable to consider mixing pesticides with metribuzin as a means of reducing spray application costs. Additional studies involving the 4L and WP metribuzin formulations need to be conducted to verify the apparent differences in efficacy and crop tolerance detected.

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Table 1. Chemical names or designations of herbicide studies.

Common name or designation		Chemical name
azinphos-methyl	(Guthion)	0,0-dimethyl S-(4-oxo-1,2,3-benzotriazin-3(4-H)yl) methyl) phosphorodithioate
carbaryl	(Sevin)	1-naphthyl N-methylcarbamate
endosulfan	(Thiodan)	hexchlorohexahydromethano-2,4,3-benzodioxathiepin-3-oxide
metribuzin	(Sencor/Lexone)	4 amino-6-*tert*-butyl-3-(methylthio)-*as*-triazin-5 (4H)-one
pebulate	(Tillam)	S-propyl butylethylthiocarbamate
trifluralin	(Treflan)	a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-*p*-toluidine
zinc-ion maneb complex	(M-45)	zinc ion and manganese ethylene bisdithiocarbamate

Table 2. Pertinent treatments, planting, harvesting dates, and weed species involved in three experiments conducted in 1977.

Experiment	Split-plot		Randomized Block
Location	Napoleon	McClure	Napoleon
preplant treatments	5/10	5/14	5/10
conditions	air temp 13°C soil temp 11°C	13°C 16°C	13°C 11°C
planted	C28, 37 on 5/11	C28, 37 on 5/18 C37 replanted 5/26	C37 on 5/12
postplanting treatments	Post 1, 6/3 21°C, 1-3 clusters	6/10, 23°C not well established	Post 6/3 Crop poor not vigorous
	Post 2, 6/24 27°C, full bloom	6/30, 24°C well established	
	Post 3, 7/15 32°C, fruit set	7/28, 29°C fruit set	
phyto, weed rating	6/13, 8/4	7/7, 9/8	6/9, 7/28, 8/19
harvest	8/11 hand harvest + 8/24 machine harvest	9/8 machine harvest	8/19 hand harvest
dominant weeds	black nightshade *Solanum nigrum*	cocklebur *Xanthium pensylvanicum*	
	lambsquarters *Chenopodium album*	lambsquarters	lambsquarters
	smartweed *Polygonum pensylvanicum*	smartweed	smartweed
	crabgrass *Digitaria sanguinalis*	yellow nutsedge *Cyperus esculentus*	crabgrass
	green foxtail *Setaria viridis*		green foxtail

Table 3. Response of weeds and transplanted tomatoes to metribuzin alone and in combination with two standard herbicides at Napoleon, Ohio, in 1977.

Treatments			Weed control rating 0 - 10				Crop response	
			B.L.W.		Grass		Phyto 1-5	Yield[a]
Herbicide	kg/ha	Appl.	6/13	8/4	6/13	8/4	6/13	m T/ha
Weeded control	--	--	8.5	10	9.7	10	5.0	55.5
Trifluralin	1.12	ppi	6.5	5.5	8.7	8.0	5.0	47.2
Trifluralin + metribuzin	1.12 + 0.56	ppi	7.1	7.2	8.5	8.8	5.0	56.9
Trifluralin + metribuzin	1.12 ppi + 0.28	post 1	8.6	6.6	9.5	9.2	4.7	56.0
Trifluralin + metribuzin	1.12 ppi + 0.56	post 1	9.1	8.4	9.2	9.4	4.0	59.6
Trifluralin + metribuzin	1.12 ppi + 0.28	post 1,2,3	8.4	8.5	9.5	9.2	4.5	58.5
Trifluralin + metribuzin	(1.12 + 0.56) ppi + 0.56	post 1	9.1	7.7	8.9	9.6	4.2	59.8
Metribuzin	0.56	ppi	7.4	6.4	7.9	4.5	5.0	54.2
Metribuzin	0.56 ppi + 0.56	post 1	9.4	8.7	9.9	10	4.5	53.5
Metribuzin	0.56	post 1	8.6	7.2	7.0	6.7	4.0	54.9
Metribuzin	0.56	post 1,2	8.6	7.6	8.7	8.6	4.0	51.9
Pebulate	6.7	ppi	6.5	3.0	7.7	6.2	5.0	44.8
Pebulate + metribuzin	6.7 + 0.56	ppi	7.7	8.0	8.9	7.5	5.0	54.3
Pebulate + metribuzin	6.7 ppi + 0.56	post 1	9.3	8.0	9.8	8.2	4.5	54.0
	LSD 5%		1.1	1.7	NSD	1.6	0.4	8.1
	LSD 1%		1.5	2.3		2.2	0.6	---

[a] Yield data is the mean of two varieties (C28 and C37) and the cumulative of two harvests; the first, a hand harvest on 8/4 and the second, a machine harvest on 8/24. While variety C28 outyielded C37, both varieties responded to treatments in a similar manner - i.e. variety by treatment interaction was not significant as measured by the F-test.

Table 4. Response of weeds and transplanted tomatoes to metribuzin alone and in combination with two standard herbicides at McClure, Ohio, in 1977.

Treatments			Weed control rating 1 - 10				Crop response	
			B.L.W.		Nutsedge		Phyto. 1 - 5 on C37	Yield[a] m T/ha
Herbicide	kg/ha	Appl.	7/7	9/8	6/21	7/7	(7/7)	(9/8)
Weeded control	--	--	10	10	10	10	5.0	60.9
Trifluralin	1.12	ppi	4.0	1.0	3.7	1.0	5.0	42.1
Trifluralin + metribuzin	1.12 ppi + 0.56	ppi	8.6	7.7	7.7	6.7	4.5	53.5
Trifluralin + metribuzin	1.12 ppi + 0.28	post 1	9.7	8.7	8.5	6.9	4.2	58.5
Trifluralin + metribuzin	1.12 ppi + 0.56	post 1	8.5	5.6	6.5	4.0	5.0	54.4
Trifluralin + metribuzin	1.12 ppi + 0.28	post 1,2,3	9.6	9.5	4.7	7.7	5.0	62.5
Trifluralin + metribuzin	1.12 + .56 ppi + .56	post 1	10	10	9.5	9.8	4.1	63.2
Metribuzin	0.56	ppi	7.9	6.6	8.0	8.1	5.0	59.4
Metribuzin	0.56 ppi + 0.56	post 1	9.6	9.7	9.5	9.5	3.6	61.6
Metribuzin	0.56	post 1	9.4	8.1	7.5	6.5	4.5	64.5
Metribuzin	0.56	post 1,2	10	9.7	8.6	10	3.7	63.6
Pebulate	6.7	ppi	5.5	2.7	6.0	6.7	5.0	47.0
Pebulate + metribuzin	6.7 + 0.56	ppi	9.0	8.0	7.0	7.0	4.8	58.5
Pebulate + metribuzin	6.7 ppi + 0.56	post 1	9.5	8.9	9.0	9.2	4.2	60.3
LSD 5%			1.1	1.7	2.4	2.9	0.5	12.3
1%			1.5	2.3	3.1	3.8	0.6	--

[a] No phytotoxicity symptoms were observed on the C28 variety (data not shown). The symptoms observed on C37 were judged temporary. While C28 and C37 produced significantly different yields, both varieties responded to treatments in a similar manner (i.e. the variety by treatment interaction was not significant by the F test).

Table 5. Efficacy and crop phytotoxicity of three metribuzin formulations and tank-mix treatments with other pesticides at Napoleon, Ohio, in 1977.

Treatments			Weed control rating 0 - 10				Crop Response	
			B.L.W.		Grass		Phyto rating	Yield
Pesticide(s)	Rate kg/ha	Appl.	6/9	8/19	6/9	8/19	6/9	m T/ha
Weeded control	--	--	10	9.5	10	9.5	5 a [a]	52
Unweeded control	--	--	0	1.0	7.0	4.0	5 a	35
Trifluralin	1.12	ppi	8.5	7.5	9.5	9.8	5 a	39
Metribuzin - WP	0.56	pp	9.4	3.7	9.7	3.5	5 a	37
Metr. - 4F	0.56	pp	8.6	6.0	9.2	5.8	4.8 ab	43
Metr. - 4L	0.56	pp	7.5	4.5	8.7	5.5	5 a	39
Trifluralin + metr. WP	1.12 ppi + 0.56	post	9.6	8.2	9.6	9.2	4.8 ab	37
Trifluralin + metr. 4F	1.12 ppi + 0.56	post	10	9.5	10	9.8	4.5 abc	39
Trifluralin + metr. 4L	1.12 ppi + 0.56	post	10	10	10	9.5	4.2 c	44
Trifluralin + metr. WP + azinphos methyl	1.12 ppi + (0.56 + 0.56)	post	10	9.0	10	9.8	4.1 c	35 (late)
Trifluralin + metr. WP + endosulfan	1.12 ppi + (0.56 + 1.12)	post	10	9.7	10	10	4.5 abc	44
Trifluralin + metr. WP + carbaryl	1.12 ppi + (0.56 + 1.12)	post	8.5	9.2	10	10	4.6 abc	43
Trifluralin + metr. WP + M-45	1.12 ppi + (0.56 + 2.68)	post	10	9.7	10	9.8	4.6 abc	41
Trifluralin + metr. WP + M-45 + carbaryl	1.12 ppi + (0.56 + 2.68 + 1.12)	post	10	9.7	10	9.8	4.4 bc	35
	LSD 5%		1.2	2.3	NSD	2.7		NSD
	1%		1.6	3.1		3.6		

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

THE EFFECT OF SPRAY TIME UPON STAND AND YIELD OF METRIBUZIN-TREATED TOMATO TRANSPLANTS

By E. H. Nelson and R. A. Ashley[1]

ABSTRACT

Tomato (Lycopersicon esculentum Mill. 'Heinz 1350') transplants were grown in a greenhouse at 16.5 C, watered as required, and supplied soluble fertilizer weekly. On the seventh day after field setting, transplants were treated with .56 kg ai/ha metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)one) at 6 am, 1 pm, or 7 pm. Control plots were not treated. All metribuzin-treated plants were injured more than controls, but evening-treated plants produced early and total yields comparable to those of controls. Percent N rose to the highest level and C:N ratio fell to the lowest level in treatments with most visible injury, stand reduction, and yield reduction.

INTRODUCTION

Research reports increasingly suggest that metribuzin injury to tomato transplants is at least partly related to environmental conditions before, at, and after the time of herbicide application. Environmental conditions over the course of a spring day could be expected to vary greatly. Tomato plant status, particularly carbohydrate level, changes over the course of a day in response to changes in the environment (1). In 1970 an experiment was conducted at the University of Connecticut Agronomy Research Farm, Storrs, Ct., to evaluate the responses of tomato transplants treated with metribuzin at different times of a single day. The transplants were treated early morning, midday, and early evening in hopes of encountering a broad range of environmental conditions typical of a Connecticut spring day.

MATERIALS AND METHODS

'Heinz 1350' tomatoes were seeded in the greenhouse April 2, transplanted to peat-vermiculite mix in 5.5 cm peat pots April 16, and field set May 18 when they averaged 21 cm and had six true leaves. The transplants were set in 3 m rows 1 m apart. Each 3 m row contained five transplants. The soil was a Woodbridge fine sandy loam with pH 6.2 and 3% organic matter content.

The design was a randomized complete block with four treatments and four replicates. The treatments were 1) control (no metribuzin), 2) 6 am metribuzin application, 3) 1 pm metribuzin application, and 4) 7 pm metribuzin application. Despite a favorable forecast for sunny conditions and increased midday temperatures, conditions varied little over the day (Table 1).

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Table 1. Conditions at the time of metribuzin application to tomato plants on May 25, 1976

Conditions	Time of metribuzin application		
	Morning (6 am)	Midday (1 pm)	Evening (7 pm)
Temperature (C)	11.7	12.8	13.3
RH (%)	64	62	54
Light (ft candles)	4400	2600	1000

Designated plots were treated with metribuzin .56 kg ai/ha on May 25, 7 days after field setting. Plots were weed free.

Crop injury ratings were taken six times from May 29 to July 30. Injury was measured as stand reduction or degree of tissue damage (0=no injury, 10= complete kill). Yield data, the number and weight of fruit, were taken from August 2 to September 27. Harvests through August 16 were reported as early yield since market prices from tomatoes remained high in Connecticut throughout that period. Untreated plots were hand weeded to minimize effects of weed competition on yield.

Tissue samples were taken from each treatment at planting, immediately before herbicide application, and at first data-taking. The samples consisted of the end leaflets of middle rank leaves taken from one-third of the plants in each treatment at planting, from one-third just prior to herbicide application, and from one-third at the time of first data collection. Leaf samples were oven dried and ground in a Wiley mill with 40 mesh screen. An elemental analysis for percents C, N, and H was performed by Baron Consulting Co., Milford, Ct., using a Perkin-Elmer elemental analyzer with thermal conductivity sensors with carbon dioxide and water traps. The combusted samples were converted to carbon dioxide, water, and nitrogen gas and element percentages recorded.

RESULTS AND DISCUSSION

Metribuzin at .56 kg ai/ha provided excellent weed control of the dominant broadleaf weed species--lambsquarters (*Chenopodium album* L.), redroot pigweed (*Amaranthus retroflexus* L.), and common ragweed (*Ambrosia artemisiifolia* L.)--over a 2-month period and good control for the remainder of the season. Initial control of large crabgrass (*Digitaria sanguinalis* L. Scop.) was excellent. However, this species reappeared after 7 weeks.

Among plots treated with metribuzin at different times of day, no significant differences in injury (rating range 5.9 to 8.6) were observed, but untreated controls sustained significantly less injury (rating 0.9) than treated plants (Table 2). Similarly, no differences existed in stand reduction among herbicide-treated plants (average 2.7 to 3.7 plants killed per plot), but untreated controls exhibited significantly less stand reduction (average 1.0 plant killed per plot) (Table 2).

Table 2. Effect of time of day of metribuzin application upon injury, stand reduction, early yield, and total yield of tomato plants

Time of herbicide application	Mean injury[1]	Stand reduction[2]	Early yield[3]	Total yield[4]
Control--no herbicide	0.9 a[5]	1.0	5.7 a	23.5
Evening	5.9 b	2.7 b	3.3 ab	13.9
Midday	7.6 b	3.7 b	1.2 b	6.7
Morning	8.6 b	3.2 b	0.5 b	5.7
	Significance at .01	Significance at .05	Significance at .05	Significance level=.10 LSD=15.0

[1] Rated 0 to 10 scale with 0=no effect to 10=complete kill.
[2] Average number of plants killed per plot of 5 plants.
[3] Kg tomatoes harvested per $3m^2$ through August 16 only.
[4] Kg tomatoes harvested per $3m^2$ over entire season
[5] Duncan's multiple range test: items followed by the same letter are not significantly different.

Despite differences in tissue injury and stand reduction, early yields of control plots (5.7 kg/$3m^2$) and evening-treated plots (3.3 kg/$3m^2$) were not different (Table 2 and Figure 1). Controls, however, produced a greater early yield than plants treated either in the morning (0.5 kg/$3m^2$) or at midday (1.2 kg/$3m^2$). Total yields showed a similar pattern. Control and evening-treated plants produced comparably (23.5 and 13.9 kg/$3m^2$, respectively), but controls produced a significantly larger yield than did midday-or morning-treated plants (6.7 and 5.7 kg/$3m^2$, respectively) (Table 2 and Figure 1).

Although treated plots sustained significantly more injury than did controls, the evening-treated plots, which exhibited least injury, were able to recover sufficiently to produce early and total yields comparable to those of controls.

A number of experiments have indicated that certain conditions predispose tomato transplants to metribuzin injury: low light before treatment, high light after treatment, high temperature after treatment, and/or low carbohydrate status in the plants (2)(3)(4)(5)(6).

According to these criteria, those plants exposed to most light before treatment and least light and lowest temperatures after treatment (i.e., evening-treated plants) should have performed best. They did.

Environmental conditions on the day of herbicide application varied less than anticipated (Table 1). Temperature varied only 1.6 C and relative humidity only 10%. The higher light intensities at 6 am (4400 ft candles) and 1 pm (2600 ft candles) than at 7 pm (1000 ft candles) and the duration of those intensities after herbicide application are much more striking.

Plants with accumulated photosynthates might be expected to tolerate herbicide treatment better than those with low photosynthate reserves. After a complete day of uninterrupted photosynthesizing, the evening-treated plants should have had a high level of photosynthate at treatment. Applied at evening, a photosynthetic inhibitor (e.g., metribuzin) dependent upon light for herbicidal action might be metabolized and detoxified for several hours before the initiation of light-induced herbicidal activity. Given an additional "rest"

(dark) period before photosynthesis and increased respiration, the evening-treated plants were apparently able to recover somewhat.

The ratio of carbon to nitrogen (C:N) used as an indicator of carbohydrate status fell to the lowest level in plants with most injury. Of treated plants, evening-treated plants with the highest C:N ratio at data-taking exhibited least injury (Figure 2).

Nitrogen is increasingly implicated as having a role in triazine (metribuzin) mode of action (7)(8). In this experiment, herbicide treatment was linked to a greater than normal average increase in percent N, an increase from 4.3% at treatment to 5.2% at data-taking in treated plants as compared to an increase from 4.1% to 4.5% in untreated plants (Figure 2). In treated plants, the least injury (evening-treated plants) was associated with the smallest increase in percent N and the lowest level of N at data-taking.

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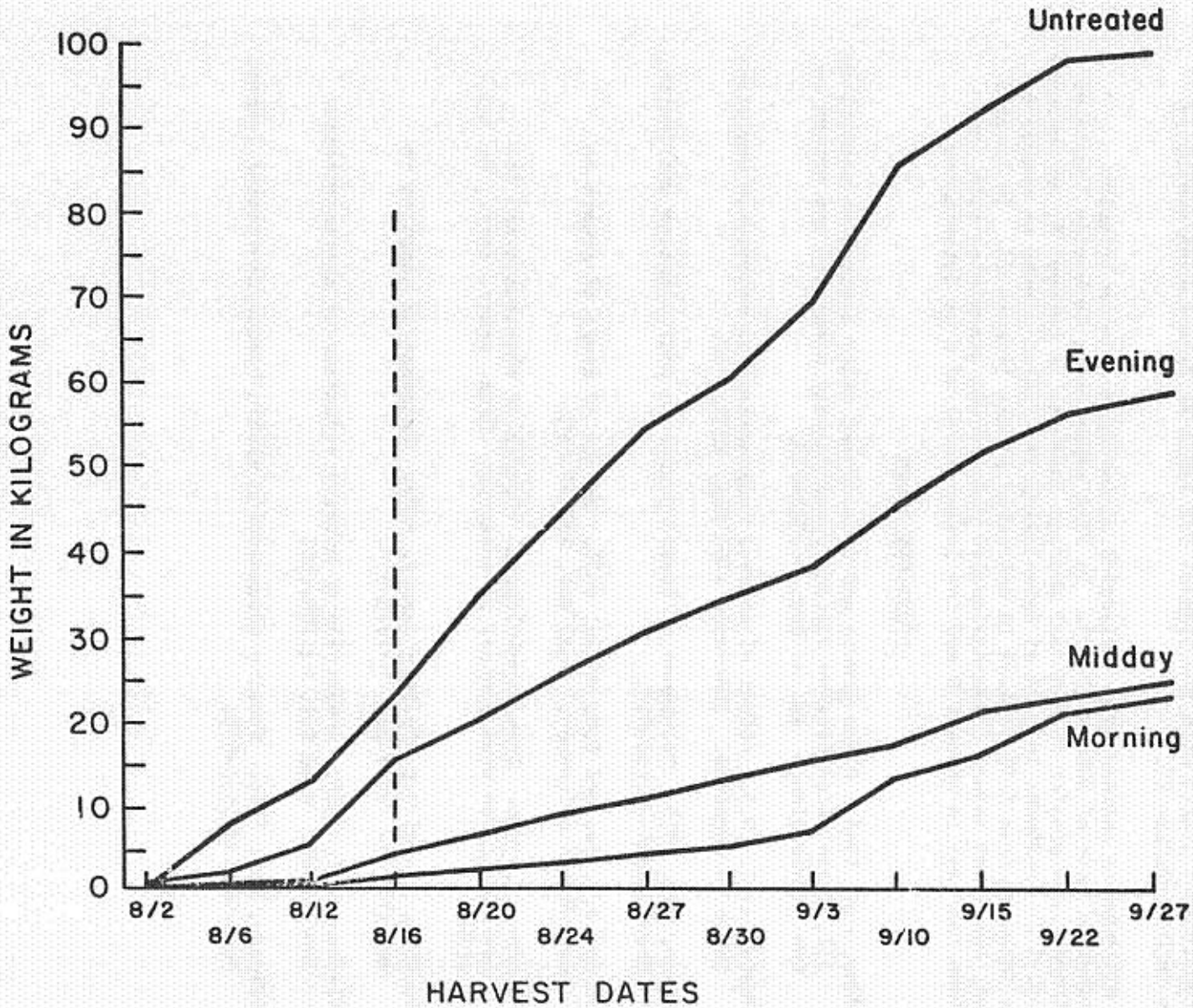

Figure 1. Early and total yields of tomato plants treated with metribuzin at one of three different times of day.

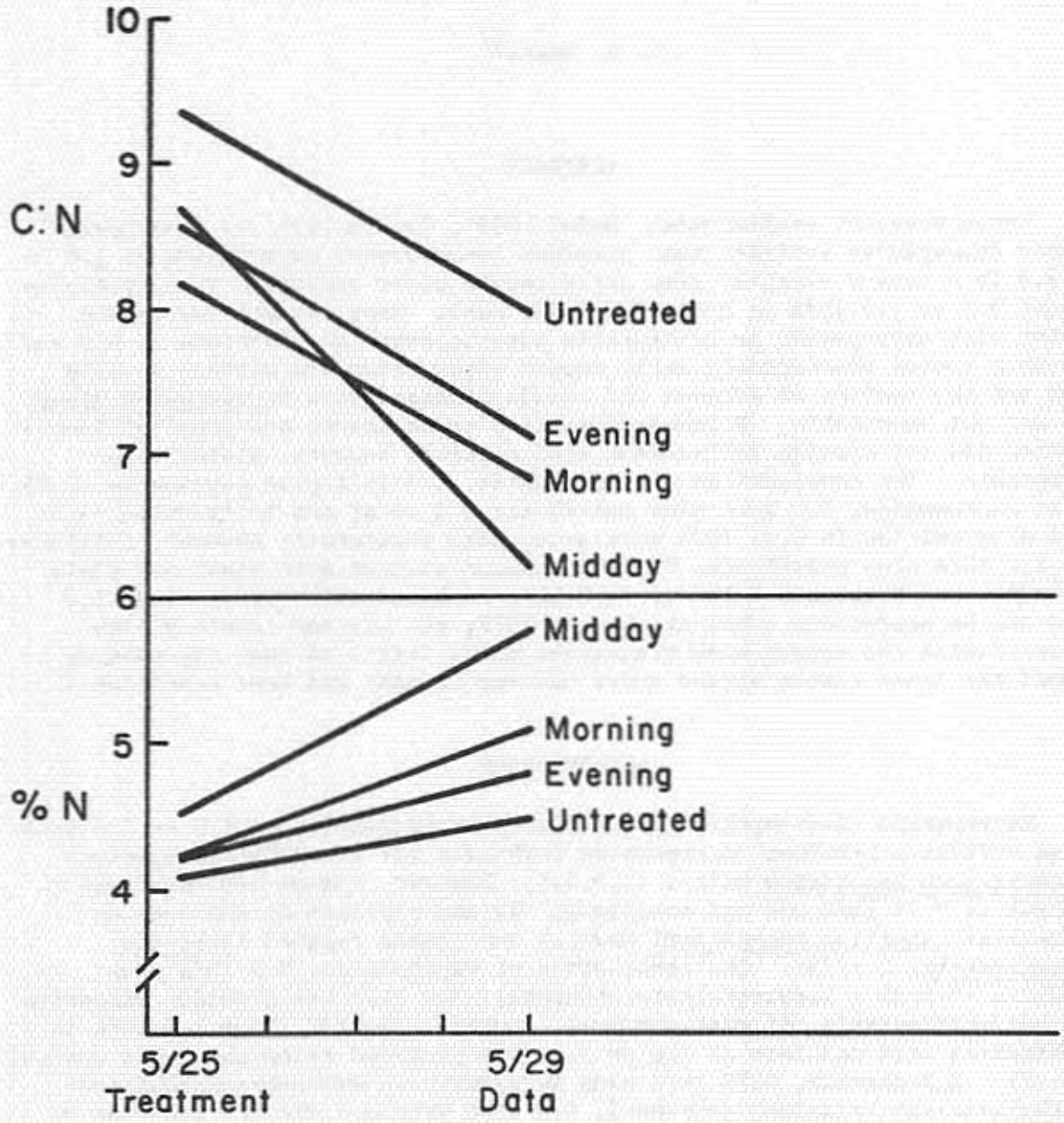

Figure 2. % N and C:N ratio in tomato leaf tissue of plants treated with metribuzin at one of three different times of day.

AN EVALUATION OF NAPROPAMIDE FOR TRANSPLANTED TOMATOES[1/]

C. E. Beste[2/]

ABSTRACT

Three years of studies with 'Heinz 1350', 'Heinz 1439' or 'Dorchester' tomato transplants indicate that preplant incorporated napropamide at 1.0 or 2.0 lb/A caused slightly less early tomato vigor reduction than trifluralin at 0.5 or 1.0 lb/A in a Norfolk loamy sand. Weed control and tomato yields with napropamide or trifluralin were acceptable. Pebulate at 4.0 and 6.0 lb/A caused unacceptable early tomato vigor reduction without a yield loss and the control of grasses and common lambsquarters (Chenopodium album L.) was not acceptable. Diphenamid applied preemergence and preplant incorporated did not provide full-season weed control; however, yields were acceptable. The combinations of napropamide, 1.0 lb/A plus metribuzin, 0.25 lb/A; napropamide, 2.0 lb/A plus metribuzin 0.5 lb/A; and trifluralin, 0.5 lb/A plus metribuzin 0.25 lb/A were acceptable treatments; however, trifluralin 1.0 lb/A plus metribuzin, 0.5 lb/A caused unacceptable vigor and yield reduction. Pebulate, 2.0 lb/A or 4.0 lb/A combined with napropamide, 1.0 lb/A was an acceptable combination. In 1977, the highest tomato yields occurred with the napropamide treatments which indicated that napropamide caused the least tomato stress under extreme drought and heat conditions.

INTRODUCTION

Napropamide [2-(α-naphthoxy-N,N-diethylpropionamide] at 1.0 to 2.0 lb/A is an effective preplant incorporated herbicide for transplanted tomatoes (Lycopersicon esculentum Mill.) (2,3,4,5); however, common lambsquarters control at 0.75 lb/A was not acceptable (1) and napropamide was weak on velvetleaf (Abutilon theophrasti Medic.) and common ragweed (Ambrosia artemisiifolia L.) (5). The combination of napropamide, 0.5 lb/A plus pebulate (S-propyl butylethylthiocarbamate), 3.0 lb/A has provided effective (1) and unacceptable (5) weed control. Napropamide at 0.75 or 1.0 lb/A in combination with pebulate at 3.0 or 5.0 lb/A provided acceptable weed control (3,4,5). Napropamide, 0.75 lb/A plus metribuzin [4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5 (4H)-one], 0.5 lb/A preplant incorporated was an acceptable treatment (4,5).

The objective of this study was to compare the weed control and transplanted tomato yields of napropamide and napropamide combinations with pebulate or metribuzin to the presently recommended herbicides trifluralin

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(α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), diphenamid (N,N-dimethyl-2,2-diphenylacetamide) and pebulate. Combinations of trifluralin plus metribuzin were compared with napropamide plus metribuzin.

MATERIALS AND METHODS

Herbicides were applied with a bicycle type sprayer utilizing CO_2 as the propellant and the spray volume was 34 gal/A at 36 psi. The spray boom had three 8003 nozzles spaced 20 inches apart for a swath width of 5 ft. A tractor-mounted rotatiller was used for incorporation to a 3 inch depth in a Norfolk loamy sand (0.6% organic matter). Field-grown tomato plants from Georgia were transplanted with an in-row spacing of 14 to 16 inches per plant and a row width of 64 inches. A mechanical transplanter was used and water was applied in the planter furrow. The experimental design was a randomized complete block with three replications. The rating scale was 0 for no effect on crop or weeds and 10 for complete kill. The herbicides napropamide, trifluralin, pebulate, diphenamid and metribuzin were evaluated. All studies were conducted at the Vegetable Research Farm, Salisbury, Maryland.

1974 - preplant incorporated herbicides were applied on May 6 and 'Heinz 1350' tomatoes were transplanted on May 7. The plot size was 64 inches by 18 ft with one row per plot. The plots were not cultivated. A tomato vigor rating was made on June 8 and a weed control rating was made on August 1 for common lambsquarters (*Chenopodium album* L.) and large crabgrass (*Digitaria sanguinalis* (L.)Scop.). Wholesome red and pink ripe fruit were harvested in a 10 ft row length in each plot on July 16, July 26, August 5 and August 15. The rainfall from May 6 to July 16 was 5.04 inches and from July 17 to August 15, additional rainfall of 5.03 inches occurred. From June 16 to July 31, the average daily maximum temperature was 84.3°F with 10 days of 90°F or above.

1976 - preplant incorporated herbicides were applied on May 13 and 'Heinz 1439' and 'Dorchester' were transplanted on May 13. However, the 'Dorchester' plants died and were replanted on May 21 without tilling the plots. The old plants were removed prior to replanting. The plot size was 64 inches by 16 ft with one row per plot. A preemergence (post-transplant) treatment was made on May 23 to the 'Dorchester' study. The plots were cultivated once with sidedress fertilizer on May 17. A tomato vigor rating was made on June 11 and a weed control rating was made on August 30 for common lambsquarters and the grasses, large crabgrass and goosegrass [*Eleusine indica* (L.)Gaertn.]. Ripe (red and pink) fruit of 'Heinz 1439' were harvested from the entire plot on July 20, July 29 and August 4. A single harvest of 10 ft of row in each plot of the 'Dorchester' study was made on August 6 and graded into ripe (red and pink), green and cull fruit. A total yield was calculated by combining green and ripe fruit yields and the percentage of ripe fruit in the total yield was calculated. The rainfall from May 13 to July 14 was 6.50 inches and an additional 2.15 inches occurred from July 15 to August 5. The average daily maximum temperature from June 16 to July 31 was 85.2°F with 5 days of 90°F or greater temperatures.

1977 - preplant incorporated herbicides were applied on May 12 and 'Heinz 1439' tomatoes were transplanted on May 12. The plot size was 64 inches by 16 ft with one row per plot. The plots were cultivated and side-dressed on June 3 and cultivated only on June 17. Tomato vigor was rated on June 2 and the weed control was rated on August 17 for large crabgrass, goosegrass, fall panicum (*Panicum dichotomiflorum* Michx.), and common purslane (*Portulaca oleracea* L.). Ripe (red and pink) fruit was harvested from the entire plot on July 13, July 21, July 28, August 3, and August 16. The combined rainfall and irrigation from May 12 to July 13 was 4.36 inches and from July 12 to August 16, the rainfall and irrigation was 4.61 inches. The average daily maximum temperature from June 16 to July 31 was 87.9°F with 20 days of 90°F or greater temperatures.

RESULTS AND DISCUSSION

Napropamide appeared to cause slightly less early vigor reduction of tomatoes compared to trifluralin (Table 1); however, neither trifluralin nor napropamide affected yields. Weed control with napropamide was only slightly better than trifluralin although trifluralin control of purslane was weak in 1977. The napropamide rate of 0.5 lb/A alone did not provide adequate weed control. Diphenamid did not provide acceptable weed control although yields were not reduced (Table 1). Unacceptable vigor reduction occurred with pebulate at 4.0 and 6.0 lb/A; however, early yields were not significantly reduced. Pebulate alone did not provide acceptable weed control and yields were lower. The combination of trifluralin plus metribuzin appeared to be more phytotoxic than napropamide plus metribuzin. In 1976, the 2x rate of trifluralin plus metribuzin (1.0 plus 0.5 lb/A) caused a significant reduction in total harvest yields compared to napropamide plus metribuzin (2.0 plus 0.50 lb/A). The combinations of napropamide, 1.0 or 2.0 lb/A plus metribuzin, 0.25 or 0.5 lb/A; and trifluralin, 0.5 lb/A plus metribuzin, 0.25 lb/A were acceptable treatments for transplant tomatoes. The combination of pebulate plus napropamide at 4.0 + 1.0 lb/A provided acceptable yields and weed control. However, pebulate plus napropamide at 4.0 + 2.0 lb/A and 6.0 + 1.5 lb/A appeared to reduce total yields in 1977. The combination of napropamide, 0.5 lb/A plus pebulate 2.0 lb/A provided better weed control than either herbicide alone, and this combination was an acceptable treatment.

The extremely hot and dry summer of 1977 with only 4.36 inches of water before the first harvest and 20 days of 90°F or greater temperatures caused severe stress on the tomatoes. The tomatoes treated with napropamide or napropamide plus metribuzin were the highest yielding treatments in 1977 which may indicate that the tomatoes were able to withstand the heat and drought stress better with napropamide than the other herbicides. Although these yield differences were not significant, the trend was evident and weed competition with some of the less effective treatments could be involved; however, the trend occurred for treatments with good weed control. The hand-weeded control plots usually have some root injury from hoeing which could have affected the yields under the drought stress in 1977.

Napropamide provided acceptable weed control with the 'Dorchester' canning-type tomato; however, the culls, which were primarily overripe soft

tomatoes, appeared to be greater than the other treatments (Table 2). This may have been due to the more vigorous vine growth usually associated with napropamide treatments which could have caused some early fruit formation with a concurrent reduction in ripe fruit yields. Weed control with diphenamid was weak which appeared to cause slight yield reductions. The combination of napropamide plus metribuzin appeared to cause slightly less vigor reduction than trifluralin plus metribuzin; however, both combinations provided acceptable weed control and yield. The combination of trifluralin; 0.5 lb/A plus metribuzin, 0.5 lb/A caused some early vigor reduction but produced the highest yield. This initial growth reduction may influence the yields in a once-over harvest by perhaps concentrating the fruit-set, and the opposite effect of early vegetative growth with extended fruit-set may have occurred with napropamide alone.

In summary, napropamide at 1.0 lb/A preplant incorporated provided acceptable weed control for transplant tomatoes and napropamide, 1.0 lb/A combinations with metribuzin at 0.25 lb/A or with pebulate at 4.0 lb/A provided acceptable weed control and yields. Napropamide may produce a slightly different yield response in a once-over harvest of a pear-shaped canning tomato.

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Table 1. An evaluation of napropamide, and several herbicide combinations, preplant incorporated, for weed control and yield with tomato transplants of 'Heinz 1350' in 1974 and 'Heinz 1439' in 1976 and 1977 in a Norfolk loamy sand with 0.6% organic matter at Salisbury, Maryland.

Treatment		Tomato Vigor Reduction[a/]			Weed Control[b/]						Yield (Tons/Acre)[c/]								
					Grasses			LQ		PL	1st Harvest			2nd Harvest			Total Harvest		
Herbicide	Lb/A	1974	1976	1977	1974	1976	1977	1974	1976	1977	1974	1976	1977	1974	1976	1977	1974	1976	1977
1.Control-weedy	---	0	0.3	0	0	0	0	0	0	0	0.64ab	0.03d	0.42ab	0.77c	2.09c	1.39a	1.72c	3.80c	9.21a-d
2.Handweeded	---	0	0	0	10	10	10	10	10	10	0.62ab	0.23a-d	0.66a	2.24bc	5.18ab	1.33a	7.75bc	10.73ab	10.58a-d
3.trifluralin (4E)	0.5	1.3	1.2	1.0	9.2	9.3	8.8	10	8.0	6.5	0.44b	0.26a-d	0.67a	2.92ab	5.98a	1.47a	9.39ab	12.61a	10.53a-d
4.trifluralin	1.0	---	0.7	1.5	---	10	10	---	9.7	9.7	---	0.36abc	0.37ab	---	4.78abc	0.78ab	---	10.84ab	8.03cd
5.napropamide (2E)	0.5	0	---	---	8.8	---	---	8.7	---	---	0.96ab	---	---	3.43ab	---	---	9.54ab	---	---
6.napropamide	1.0	0	1.7	0	10	10	10	10	10	10	0.52b	0.28a-d	0.48ab	2.97ab	3.01bc	1.10ab	8.46abc	9.83ab	14.54a
7.napropamide	2.0	---	---	0.1	---	---	10	---	---	10	---	---	0.45ab	---	---	1.34a	---	---	12.60abc
8.diphenamid (50W)	3.0[d/]	0.2	---	0.3	6.7	---	3.3	3.5	---	1.7	0.69b	---	0.09b	4.05a	---	0.81ab	10.76ab	---	11.78a-d
9.diphenamid	6.0[d/]	---	---	0.9	---	---	5.3	---	---	5.0	---	---	0.34ab	---	---	1.45a	---	---	8.98bcd
10.pebulate (6E)	2.0	1.2	---	---	3.7	---	---	5.7	---	---	1.18ab	---	---	3.17ab	---	---	8.09abc	---	---
11.pebulate	2.25	---	0.2	---	---	3.0	---	---	4.7	---	---	0.46ab	---	---	5.21ab	---	---	10.36ab	---
12.pebulate	3.0	0.7	---	---	3.8	---	---	2.0	---	---	1.30a	---	---	3.00ab	---	---	9.30ab	---	---
13.pebulate	4.0	---	---	1.9	---	---	2.7	---	---	5.8	---	---	0.59ab	---	---	0.78ab	---	---	7.88cd
14.pebulate	6.0	---	---	1.7	---	---	6.5	---	---	3.3	---	---	0.32ab	---	---	0.76ab	---	---	8.21cd
15.trifluralin + metribuzin	0.5+ 0.25	0.2	1.3	0.4	9.2	9.3	10	10	10	10	0.70ab	0.51a	0.27ab	2.68ab	5.52ab	1.10ab	8.04abc	13.32a	10.07a-d
16.trifluralin + metribuzin	1.0+ 0.5	---	2.7	2.8	---	10	10	---	10	9.5	---	0.15cd	0.15ab	---	3.40abc	0.38b	---	7.46bc	6.91d
17.napropamide + metribuzin	0.5+ 0.5	0.3	---	---	9.5	---	---	10	---	---	0.87ab	---	---	3.92a	---	---	12.19a	---	---
18.napropamide + metribuzin	1.0+ 0.25	---	---	0.3	---	---	10	---	---	10	---	---	0.36ab	---	---	1.04ab	---	---	14.20ab
19.napropamide + metribuzin	2.0+ 0.5	---	---	0.2	---	---	10	---	---	10	---	---	0.48ab	---	---	1.05ab	---	---	14.54a
20.napropamide + pebulate	0.5+ 2.0	0.8	1.2	---	9.7	9.0	---	9.7	10	---	0.84ab	0.15cd	---	3.73ab	6.00a	---	9.91ab	12.21ab	---
21.napropamide + pebulate	1.0+ 2.0	0.8	---	---	10	---	---	10	---	---	0.87ab	---	---	3.65ab	---	---	9.92ab	---	---
22.napropamide + pebulate	1.0+ 4.0	---	1.2	0.8	---	10	10	---	10	10	---	0.18bcd	0.57ab	---	4.80abc	1.10ab	---	10.39ab	11.81a-d
23.napropamide + pebulate	1.5+ 6.0	---	1.5	2.6	---	10	10	---	10	10	---	0.08cd	0.33ab	---	4.88abc	0.41b	---	9.68ab	6.48d
24.napropamide + pebulate	2.0+ 4.0	---	---	2.1	---	---	10	---	---	10	---	---	0.31ab	---	---	0.78ab	---	---	8.01cd

Mean separation within columns by Duncan's Multiple Range Test at the 0.05 level.

a/ Rated four weeks after transplanting. 0 = no vigor reduction, 10 = plants were killed. b/ Rated ten weeks after transplanting. 0 = no weed control, 10 = complete weed control. Weed populations: 1974 - 70% large crabgrass and 30% common lambsquarters (LQ). 1976 - grasses - 15 plants/sq. ft. composed of 50% large crabgrass and 50% goosegrass; (LQ) common lambsquarters - 20 plants/sq. ft. 1977 - grasses - 43 plants/sq. ft. composed of 80% goosegrass, 10% large crabgrass and 10% fall panicum; (PL) common purslane - 62 plants/sq. ft. c/ 1974 - 1st harvest July 16, 2nd on July 26, 3rd on August 5, and final on August 15. 1976 - 1st harvest July 20, 2nd on July 29, and final on August 4. 1977 - 1st harvest July 13, 2nd on July 21, 3rd on July 28, 4th on August 3, and final on August 16. Marketable fruit of reds and pinks were harvested. d/ Diphenamid applied preemergence (post-transplant) in 1977.

Table 2. The yield and weed control in 'Dorchester' tomato transplants with napropamide and several herbicides preplant incorporated in a Norfolk loamy sand (0.6% organic matter) at Salisbury, Maryland in 1976.

Herbicide	Lb/A	Tomato Vigor Reduction[a/]	Weed Control[b/] Grass	Weed Control[b/] Lambs-quarters	Yield (Ton/A)[c/] Ripe	Yield (Ton/A)[c/] Green	Yield (Ton/A)[c/] Total	Yield (Ton/A)[c/] Culls	Fruit Maturity % Ripe
1.Control-weedy	----	0	0	0	1.18c	0.94c	2.12c	0.33b	55ab
2.Handweeded	----	0	10	10	6.62ab	8.83a	15.45ab	1.14ab	42ab
3.trifluralin (4E)	0.5	0	9.8	9.2	5.79abc	6.33b	12.12ab	1.16ab	48ab
4.napropamide (2E)	1.0	0.3	10	10	4.85bc	9.06a	13.90ab	2.03a	34b
5.diphenamid (50W)	3.0[d/]	0	8.8	6.2	5.64abc	4.92b	10.55b	0.83ab	48ab
6.napropamide + metribuzin	1.0+ 0.25	0.2	10	10	8.20ab	8.21a	16.41ab	1.83a	49ab
7.trifluralin + metribuzin	0.5+ 0.25	0.7	9.5	10	7.29ab	8.10a	15.39ab	1.83a	47ab
8.trifluralin + metribuzin	0.5+ 0.5	1.0	10	10	10.51a	7.59ab	18.10a	1.23ab	58a

Mean separation within columns by Duncans Multiple Range Test at the 0.05 level.

a/ Rated four weeks after transplanting. 0 = no vigor reduction, 10 = plants were killed.

b/ Rated approximately ten weeks after transplanting. 0 = no weed control, 10 = complete weed control. Weed population: grasses - 15 plants/sq. ft. composed of 50% Crabgrass and 50% goosegrass; common lambsquarters - 20 plants/sq. ft.

c/ Harvested August 6, 1976. Total of ripe plus green only.

d/ Applied preemergence (post-transplant).

INTERACTION OF METRIBUZIN WITH TWO INSECTICIDES ON DIRECT SEEDED TOMATOES[1]

H. H. Hatfield, E. S. Mohammed and D. T. Warholic[2]

ABSTRACT

Metribuzin at 0.63 or 0.125 lbs/A was applied alone or combined with 1.0 lb of either endosulfan or azinphosmethyl as a postemergence spray on direct seeded tomatoes. Wherever metribuzin was applied, control of redroot pigweed (Amaranthus retroflexus L.) and lambsquarter (Chenopodium album L.) was excellent. Although not statistically different, three out of the four combinations were numerically lower in fruit number and weight as compared to metribuzin or either insecticide applied alone. There were no visible foliage symptoms.

INTRODUCTION

The safety and effectiveness of using very low, multiple rates of 1 to 2 oz of metribuzin [4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one] for broadleaf control in direct seeded and transplanted tomatoes (L. esculentum) has been confirmed (1,2,3). Work was begun in 1976 which explored the feasibility of combining metribuzin at these low rates with an insecticide (3). Results from that test indicated that both flower cluster number and early yield may have been reduced by metribuzin plus endosulfan[3]. Yields from a metribuzin - azinphosmethyl[4] combination also were somewhat reduced. This reduction occurred in spite of the fact that little or no phytotoxicity was observed with any treatments. Additional work with metribuzin insecticide combinations was conducted in 1977 to determine if these findings would be reproducible.

MATERIALS AND METHODS

Plots were seeded on 36" centers with two rows of New Yorker tomato. Plots were 6' x 15'. An RCB experimental design with three replications was used. All plots with the exception of the unweeded and hand weeded controls received a 1 oz application of metribuzin at the cotyledon stage of tomato to control early emerging redroot pigweed and lambsquarter. The combination treatments were applied four days later. All treatments were applied with a hand held, CO_2 pressurized, small plot sprayer delivering 55 gals/A at 40 p.s.i. with Tee Jet 8004 flat spray nozzles. Plots receiving an insecticide alone were kept weed free season long by hand weeding. Ten feet of each of the two rows were harvested on August 8. Harvest was premature due to a disease infestation and only green fruit were present.

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RESULTS AND DISCUSSION

Although total fruit weight varied among chemical treatments, no yield was statistically less than the yield from the hand weeded plots. However, fruit yields from three of the four insecticide combinations were numerically lower when compared to the herbicide or insecticide applied alone. In addition, azinphosmethyl combinations were not significantly different in fruit yield from the unweeded treatments. The feasibility of combining metribuzin with endosulfan is highly questionable since in 1976 there was a significant reduction in tomato yield. Furthermore, in 1977 the arithmetical yields were again reduced by this combination, but due to considerable plot variability there was not a statistically significant difference. These reductions occurred even though foliage symptoms were not evident, no tank-mix problems were encountered, and no synergistic or antagonistic influence on weeds detected. All treatments receiving two applications of metribuzin provided season long control of redroot pigweed and lambsquarter.

Table 1. Biological yield, total fruit weight, and average fruit number from postemergence metribuzin-insecticide combinations.

		Harvest Measurements 8/9/77		
Treatment[a]	lb/A	Biological Yield	Total Fruit Weight[b]	Average Fruit Number
1. metribuzin	0.063	36.0	6.58a	92
2. metribuzin	0.125	33.2	7.25a	92
3a. endosulfan(Thiodan)	1.000	34.7	9.83a	126
b. hand weeded				
4a. azinphosmethyl (Guthion)	1.000	32.9	8.83a	118
b. hand weeded				
5a. metribuzin	0.063	36.8	6.17a	78
b. endosulfan	1.000			
6a. metribuzin	0.125	38.2	9.00a	104
b. endosulfan	1.000			
7a. metribuzin	0.063	34.3	4.75ab	70
b. azinphosmethyl	1.000			
8a. metribuzin	0.125	35.6	5.42ab	67
b. azinphosmethyl	1.000			
9. hand weeded		35.8	6.25a	65
10. not weeded		5.6	1.83b	35
		Bayes LSD 5%	4.31	

[a] Treatments 1 through 8 received an earlier application of 1 oz of metribuzin at the cotyledon stage.

[b] Weight of green fruit from plants in 20' of row.

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WEED CONTROL IN TRANSPLANTED TOMATOES USING COMBINATIONS OF METRIBUZIN WITH DIPHENAMID OR TRIFLURALIN IN SEVERAL APPLICATION SCHEDULES

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ABSTRACT

Weed control and crop tolerance were studied in transplanted tomatoes using combinations of metribuzin with diphenamid and metribuzin with trifluralin. These herbicides were applied prior to planting and soil-incorporated. They were applied alone, in combination, and as sequential treatments with metribuzin being the followup herbicide. Metribuzin was also applied as a later postemergence treatment on previously-treated plots. Combinations of metribuzin and diphenamid produced slight but short-lived reductions in tomato vigor. Control of lambsquarters was better when these two herbicides were applied together than when these herbicides were applied separately. Ivyleaf morning glory was more difficult to control whether diphenamid and metribuzin were applied at the same time or when metribuzin followed diphenamid sequentially. Redroot pigweed, large crabgrass, fall panicum, and stinkgrass were controlled to the same extent by combinations or sequential applications of the two herbicides.

Generally, control of all species in the experiment was similar for combinations of trifluralin plus metribuzin whether applied together or as split applications.

Control of most species was improved further by a later postemergence application of metribuzin.

INTRODUCTION

The use of herbicides prior to transplanting with soil incorporation is an accepted practice in tomato (Lycopersicon esculentum Mill.) culture. Two herbicides, a,a,a-trifluoro-

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2,6-dinitro-N,N-dipropyl-p-toluidine (trifluralin) and N,N-dimethyl-2,2-diphenylacetamide (diphenamid) have been used in this manner for some time. Furthermore, diphenamid may also be applied to weed-free surfaces after transplanting and trifluralin can be used as a directed spray with soil-incorporation at the time of thinning seeded tomatoes. The relatively new asymmetric triazine herbicide, 4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one (metribuzin), has been approved for use in potato (Solanum tuberosum L.) and research data are available where this herbicide has been successfully used in tomato as pretransplant and post-transplant treatments.

It was the objective of this study to determine if metribuzin can be safely used in combination with trifluralin or diphenamid applied prior to transplanting and if it can be used after transplanting in areas previously treated with these combinations.

MATERIALS AND METHODS

This study was established at the Adelphia Research Center, New Jersey Agricultural Experiment Station, Adelphia, New Jersey on a Holmdel sandy loam soil. Beds 5' wide were prepared using a rotovator on May 11, 1977. Plots, the width of the bed x 19' long were established to receive herbicide treatments on the same day. Trifluralin, diphenamid, and metribuzin were applied alone at several rates and various combinations of metribuzin with trifluralin and metribuzin with diphenamid to predesignated triplicate plots in 40 GPA in a randomized complete block design. Immediately after application the plot areas were soil-incorporated to a depth of 3 inches with the rotovator maintaining the integrity of the plot beds. The following day Jetstar tomato plants were transplanted into the plots, 5 plants per plot. Approximately two weeks later on May 27, metribuzin was applied over the tops, to plots designated to receive the first post-transplant application (identified as "post" in the tables) and on June 17, three weeks later, metribuzin was again applied over the top to plots designated to receive the second post-transplant application (identified as "later post" in the tables). At time of setting, the transplants were 8 to 10 inches tall.

The experimental areas contained the following weeds: lambsquarters (Chenopodium album L.), redroot pigweed (Amaranthus retroflexus L.), ivyleaf morning glory (Ipomoea hederacea (L.) Jacq.), large crabgrass (Digitaria sanguinalis (L.) Scop), fall panicum (Panicum dichotomiflorum Michx.), and stinkgrass (Eragrostis cilianensis (All.) Lutati).

Throughout the study, periodic observations were made on transplant response and on weed control. A rating scale of 0 to 10 was used where 0 = no effect on stand and 10 = complete control or 100% elimination of stand. Detailed ratings were made on July 14 approximately one month after the last application of herbicide.

RESULTS AND DISCUSSION

In Tables 1 and 2 the responses of tomato to the various herbicide treatments and weed control are summarized. Furthermore, the various herbicides, combinations of herbicides and application schedules employed in this study are also presented.

In Table 1, the data are summarized for diphenamid and metribuzin. From this table, this can be seen that diphenamid applied alone had a slight effect on vigor of tomatoes. The same was true for metribuzin but not to the same extent. Regardless of the schedule, combinations of the two herbicides, also had an effect on the tomatoes, but not to the same degree that the individual herbicides had alone. These effects were later outgrown.

Several other interesting observations can be made from these data. There was no increase in control of lambsquarters from combinations of metribuzin and diphenamid over that produced by the herbicides applied alone. Furthermore, control was less when metrizubin was applied early postemergence following pre-transplant, incorporated diphenamid than when the two were applied together. The sequential application of metribuzin following diphenamid was improved when an additional application of metribuzin (later post) was made. Moreover, the difference between the two schedules, of diphenamid plus metribuzin versus the sequential or overlay application of metribuzin over diphenamid, was eliminated by the "later post" application of metribuzin. This "later post" application controlled young seedlings of lambsquarters that were present.

Another interesting point, ivyleaf morning glory was not adequately controlled either by diphenamid or metribuzin when applied singly. Control was not improved when the herbicides were combined and applied together or sequentially. There was no significant difference in control of this species between these two schedules. Control for these two schedules was improved, but not completely, by a later post application of metribuzin.

Control of redroot pigweed, large crabgrass, fall panicum, and stinkgrass were generally improved by combinations of the above herbicides, applied together or sequentially over the single herbicide application and control was not improved by a later post application of metribuzin.

In Table 2 summarized data for trifluralin and metribuzin are presented. From this table it is evident that there was a slight effect on vigor of tomatoes from trifluralin comparable to that produced by metribuzin. It should be indicated that this slight effect on vigor was later outgrown. From the schedules presented in the table, it should be noted that they were not completely like those for diphenamid and metribuzin. The sequential schedule with a later post application of metribuzin was not included in the study. However, some points are worthy of discussion.

Control of lambsquarters by the lowest rate of both trifluralin and metribuzin, each applied alone, was remarkedly good and that control was improved when these two herbicides, at the same rates, were applied together or sequentially.

Ivyleaf morning glory was not completely controlled by trifluralin at any rate and very poorly by metribuzin at all rates. Control was improved by these herbicides in combination regardless of how applied. Control was not improved by a later post application of metribuzin. This was comparable to what was observed for the similar schedule with diphenamid and metribuzin.

Control of large crabgrass, fall panicum, and stinkgrass was better from trifluralin alone than from metribuzin alone,which was expected. Combinations of the two herbicides, regardless of schedule, did not increase the degree of control over that produced by trifluralin alone. Furthermore, an additional application of metribuzin, as a "later post", did not improve control at all.

Redroot pigweed was effectively controlled by trifluralin and metribuzin and control was not improved by modifications in application schedules.

Table 1. The effects of diphenamid and metribuzin alone and in various combination schedules on transplanted tomatoes and on weed control.[1]

Herbicides and Application Schedules	Rate, lb/A	Tomato[2]	Weed Control[3]					
			Lambs-quarter	Pigweed	Ivyleaf Morning glory	Crabgrass	Fall Panicum	Stink-grass
diphenamid (ppi)	3	1.3	5.3	8.3	4.0	9.3	9.7	9.3
	4 1/2	1.7	7.7	6.0	3.7	10.0	9.3	9.7
	6	1.7	7.7	9.7	3.7	9.7	9.3	10.0
metribuzin (ppi)	1/4	1.0	8.7	10.0	5.7	9.3	5.3	4.3
	3/8	0.3	10.0	9.7	5.3	7.7	9.7	10.0
	1/2	1.0	10.0	10.0	5.0	8.7	9.0	9.0
diphenamid + metribuzin (ppi)	(3 + 1/4)	1.0	8.7	9.3	1.3	9.7	7.3	7.7
	(4½ + 1/4)	0.0	9.0	10.0	4.7	9.7	10.0	10.0
diphenamid (ppi) + metribuzin (post)	3 + 1/4	0.3	3.3	10.0	2.3	9.7	10.0	10.0
	4½ + 1/4	1.0	7.0	10.0	4.7	9.7	9.7	10.0
diphenamid + metribuzin (ppi) + metribuzin (post)	(3 + 1/4) + 1/4	1.0	10.0	10.0	8.3	10.0	9.7	10.0
	(4½ + 1/4) + 1/4	0.3	10.0	10.0	7.7	10.0	10.0	9.3
diphenamid (ppi) + metribuzin (post) + metribuzin (later post)	3 + 1/4 + 1/4	0.0	10.0	9.3	5.7	10.0	9.3	9.0
	4½ + 1/4 + 1/4	0.0	9.7	10.0	8.7	10.0	10.0	10.0

[1] Average of three replications.
[2] Vigor; based on 0 to 10 where 0 = no reduction in vigor of plants, 10 = vigor completely reduced.
[3] Based on scale 0 to 10, where 0 = no reduction in stand, 10 = stand reduced completely.

Table 2. The effects of trifluralin and metribuzin alone and in various combinations schedules on transplanted tomatoes and on weed control.[1]

Herbicide and Application Schedules	Rate, lb/a	Tomato[2]	Weed Control[3]					
			Lambs-quarters	Pigweed	Ivyleaf Morning glory	Crabgrass	Fall Panicum	Stink-grass
trifluralin (ppi)	1/2	0.7	9.3	9.7	8.3	10.0	9.3	9.7
	3/4	1.0	8.3	10.0	7.7	10.0	10.0	10.0
	1	0.7	10.0	10.0	7.3	10.0	10.0	10.0
metribuzin (ppi)	1/4	1.0	8.7	10.0	5.7	9.3	5.3	4.3
	3/8	0.3	10.0	9.7	5.3	7.7	9.7	10.0
	1/2	1.0	10.0	10.0	5.0	8.7	9.0	9.0
trifluralin + metribuzin (ppi)	(1/2 + 1/4)	0.7	10.0	10.0	9.3	9.7	9.7	9.3
	(3/4 + 1/4)	0.0	9.7	10.0	8.3	10.0	9.7	10.0
trifluralin (ppi) + metribuzin (post)	1/2 + 1/4	0.3	10.0	10.0	9.0	10.0	9.7	9.0
	3/4 + 1/4	1.0	10.0	10.0	8.3	10.0	9.7	10.0
trifluralin (ppi) + metribuzin (post) + metribuzin (later post)	1/2 + 1/4 + 1/4	0.7	10.0	10.0	7.0	10.0	10.0	10.0
	3/4 + 1/4 + 1/4	0.7	10.0	10.0	9.0	10.0	10.0	9.7

[1]Average of three replications.

[2]Vigor rating, based on 0 to 10 where 0 = no reduction in vigor of plants, 10 = vigor completely reduced.

[3]Based on scale 0 to 10, where 0 = no reduction in stand, 10 = stand reduced completely.

INFLUENCE OF TOMATO AND REDROOT PIGWEED DENSITIES ON SOIL ATMOSPHERE [1/]

E. S. Mohammed and R. D. Sweet [2/]

ABSTRACT

Although soil atmosphere has been given considerable attention, the influence of plant densities has not been investigated to any extent. The emphasis has been mainly on three gases viz CO_2, O_2 and C_2H_4 (ethylene). Researchers were essentially concerned with measurements of these gases in soil atmosphere. The principal finding was that CO_2 content was higher in cropped than in an uncropped land. Also C_2H_4 tended to accumulate in water-logged soils. In this study the soil atmosphere was approached in terms of the influence of a dense stand of particular species on CO_2, O_2 and C_2H_4. Also the soil atmosphere was considered among other factors such as water, light, nutrients, included in plant-plant competition. Heavy stands of either tomato (*Lycopersicon esculentum* Mill.) or redroot pigweed (*Amaranthus retroflexus* L.) were established either in the field or the greenhouse. Hypodermic syringes were used to draw soil atmosphere samples over a period of time from glass tubes inserted to a depth of 6 cm in the soil. The heavy stands of plants were compared with bare soil. Samples were analyzed by means of gas chromatography. The analysis showed that soil atmosphere from dense stand of plants had higher CO_2, similar O_2, and lower C_2H_4 than that of bare soil. The CO_2 and O_2 in the bare soil showed no change over time, while C_2H_4 showed an increase over time with both the bare and planted soil. However, the CO_2 level increased with time in the planted soil while O_2 content remained constant. These data do not indicate that soil atmosphere is a controlling factor in tomato-redroot competition.

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ANNUAL WEED CONTROL IN EGGPLANT

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ABSTRACT

A number of dinitroanilines, two acetanilides, and an amide were evaluated for weed control and crop response in eggplant. The dinitroanilines provided good initial weed control; however, none maintained acceptable long-season control of large crabgrass. Benefin and profluralin failed to maintain control of redroot pigweed while only benefin, fluchloralin, and pendimethalin maintained purslane control. The acetanilides did not adequately control purslane and only metolachlor at 2.8 kg/ha controlled large crabgrass over the growing season. These compounds were excellent for the control of redroot pigweed. Napropamide at 1.68 kg/ha produced excellent long-season broadleaf weed control and acceptable control of large crabgrass.

Slight stunting of growth was observed with the acetanilides, and serious crop injury resulted from late postemergence applications of metribuzin (examined only for crop response). No yield reductions were observed with the dinitroanilines; however, fruit weight decreased with benefin and profluralin. The acetanilides also effected yield reductions and decreased fruit weights. Crop safety was maintained with napropamide.

INTRODUCTION

Specialty crop production has become one of the fastest expanding segments of agriculture as the tastes of the American consumer have become more adventurous. One of the greatest problems facing the specialty crop grower is the lack of technical assistance such as chemical weed control. To date, no good herbicide is registered for use in eggplant (*Solanum melongena* L. var. *esculentum*) at the time of transplanting. Several dinitroanilines and napropamide [2(α-naphthoxy)-*N*,*N*-diethylpropionamide] have shown potential when used preplant incorporated before transplanting (1,2).

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This experiment was designed to test the efficacy in eggplant of some herbicides that have exhibited safety with members of the Solanaceae. The dinitroanilines investigated were: benefin [N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-(toluidine)]; ethalfluralin [N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluomethyl) benzenamine]; fluchloralin [N-(2-chloroethyl)-2,6-dinitro-N-propyl-4-(trifluoromethyl)aniline]; oryzalin (3,5-dinitro-N^4,N^4-dirpopylsulfanilamide);pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine]; profluralin [N-(cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine]; and trifluralin (α,α,α-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine). The two acetanilides, alachlor, [2-chloro-2^1,6^1-diethyl-N-(methoxymethyl) acetanilide] and metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N(methoxy-1-methylethyl) acetamide]; the amide, napropamide; and the asymetrical triazine, metribuzin [4-amino-6-tert-butyl-3-(methylthio) as triazin-5(4H)-one], were also investigated. All herbicides were formulated as emulsifiable concentrates except oryzalin and metribuzin which were wettable powders.

MATERIALS AND METHODS

This study was conducted at the Rutgers Research and Development Center near Bridgeton, New Jersey in 1977. Plots were established on an Aura loam soil with 1.5% organic matter and a pH of 6.1.

During seedbed preparation, 336 kg/ha of a 15-15-15 soluble fertilizer was incorporated into the soil. Single row, 1.5 by 6.1 m treatment plots were established in a randomized complete block design with four replicates. All herbicides were applied with water as the carrier using a hand-operated backpack CO_2-propelled experimental plot sprayer delivering 374.1 L/ha at 2.11 kg/cm^2. All the dinitroaniline herbicides and napropamide were applied June 15 and immediately incorporated to a depth of 7.6 cm. Eight week old, 25-cm high Harris Special Highbush eggplants were transplanted (9 plants per plot) into all experimental plots. The following day, the acetanilide herbicides were broadcast applied, post-transplant. Both days were humid, partly cloudy with an air temperature of 23.9°C and winds from the northwest at 9 to 12 km/hr. The soil surface was dry with ample moisture below. A late post-transplant, broadcast application of metribuzin was made July 13 under a sunny sky with an air temperature of 32.2°C and winds from the south-southwest at 4.8 km/hr. The cultivated check plots were handweeded July 15. Insect populations were controlled with regular applications of azinphosmethyl, methomyl,

and dimethoate.

Weed populations were determined July 22 by counting the weeds present in four $0.25m^2$ quadrats within the weedy check plots. The treatment plots were rated July 22 and again August 23 using a scale of 0 to 10 where 0 is no effect on weed or crop stand or vigor and 10 is complete kill.

Plots were irrigated with 1.27 cm of water June 18 and when needed thereafter to supplement natural rainfall.

RESULTS AND DISCUSSION

Weed pressure during the growing season was heavy, and several flushes of weed growth occurred. In general, weed control decreased during the growing season. The average density (plants/ $0.25m^2$) for the dominant weed species was: large crabgrass [*Digitaria sanguinalis* (L.) Scop.]123.8; redroot pigweed (*Amaranthus retroflexus* L.), 53.0; and purslane (*Portulaca oleracea* L.), 31.5.

Although the metribuzin treatments were applied too late to affect adequate weed control, serious crop injury was observed at both 0.14 and 0.28 kg/ha. Foliar necrosis, followed by leaf abscisson occurred on portions of the plant contacted by the spray, and subsequent recovery was slow.

Weed control with the dinitroanilines was greatly improved and crop safety maintained at the rates reported in Table 1 when compared to the 15% lower rates also tested. Eggplant vigor was not affected by the dinitroanilines; however, vigor decreased by the second month due to increased weed competition. Fluchloralin and trifluralin maintained good control of redroot pigweed over the entire growing season while commercially acceptable control (75% control) was provided by ethalfluralin, oryzalin, and pendimethalin. Although all the dinitroanilines initially controlled large crabgrass, long-season control did not persist. Only benefin, fluchloralin, and oryzalin maintained acceptable control of purslane beyond the first month.

Total broadleaf weed and grass control is best reflected in eggplant yields (Table 2). Significant increases in yield beyond that of the cultivated check were obtained from plots treated with ethalfluralin or profluralin, trifluralin, and fluchloralin (in order of significant yield increases). No yield reductions were observed with any of the dinitroanilines; however, fruit weight

Table 1. The effects of some dinitranilines on weed control and eggplant response.

Herbicide	Rate kg/ha	Eggplant[1/] Vigor		Weed Control (Stand)[1/] Pigweed		Crabgrass		Purslane	
		7/22	8/23	7/22	8/23	7/22	8/23	7/22	8/23
benefin	1.68	0.1	1.5	8.9	7.0	8.6	4.0	7.9	7.8
ethalfluralin	0.84	0.0	0.8	9.4	7.6	8.9	3.0	8.4	7.0
fluchloralin	1.68	0.0	0.1	9.8	9.0	9.9	7.1	9.2	7.6
oryzalin	0.84	0.0	1.1	8.8	7.6	8.4	3.8	9.1	7.5
pendimethalin	0.84	0.0	1.0	8.8	7.5	9.6	5.5	7.6	5.5
profluralin	1.12	0.0	1.1	8.8	6.6	9.3	6.1	7.8	6.0
trifluralin	0.84	0.0	0.3	9.7	8.5	9.7	5.8	7.9	5.5

[1/] Based on a scale of 0 to 10, where 0 means no effect and 10 means complete control.

Table 2. The effects of some dinitroanilines on eggplant yields.

Treatment	Rate kg/ha	1000's/ha[1/]	% cult. check	kg/fruit[2/]
benefin	1.68	4.3 d	93.5	0.37*
ethalfluralin	0.84	5.7 c	123.9	0.43
fluchloralin	1.68	7.8 a	169.6	0.40
oryzalin	0.84	4.9 d	106.5	0.41
pendimethalin	0.84	4.7 d	102.2	0.40
profluralin	1.12	5.8 c	126.1	0.39*
trifluralin	0.84	6.8 b	147.8	0.47
cultivated check		4.6 d	100.0	0.36*
weedy check		0.6 e	13.0	0.30*

[1/] Means followed by the same letter are not significantly different at the 5% level according to the New Duncan's Multiple Range Test.

[2/] Means followed by an asterisk are significantly lower than the commercially desired weight according to an LSD at the 5% level of 0.139.

was significantly lower than the commercially desirable weight of 0.45 kg for eggplants treated with benefin and profluralin.

A slight stunting of eggplant growth was observed with both rates of alachlor and metolachlor (Table 3). Again, weed pressure contributed to a decrease in vigor by the second month. Both compounds provided excellent long-season control of redroot pigweed and initial control of large crabgrass. Only metolachlor at the 2.8 kg/ha rate maintained good crabgrass control by the second month. Although both acetanilides were least effective in controlling purslane, alachlor (especially at the higher rate) provided better control than metolachlor. Napropamide, at 1.68 kg/ha in particular, maintained good long-season broadleaf weed control and commercially acceptable long-season grass control with complete safety.

Significant reductions in yield were observed in plots treated with alachlor and metolachlor (Table 4). Fruit weight was also significantly below the commercially desired weight for both rates of metolachlor and the 2.8 kg/ha rate of alachlor. Plots treated with napropamide at 1.12 kg/ha produced significantly greater yields than the cultivated check, and an additional significant yield increase was observed with the 1.68 kg/ha rate.

Based on these data, napropamide and several dinitroanilines (especially fluchloralin, trifluralin, and ethalfluralin) show promise for providing long-season weed control with crop safety in eggplant when applied preplant incorporated just before transplanting.

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Table 3. The effects of alachlor, metolachlor, and napropamide on weed control and eggplant response.

Herbicide	kg/ha	Eggplant[1/] Vigor		Weed Control (Stand)[1/] Pigweed		Crabgrass		Purslane	
		7/22	8/23	7/22	8/23	7/22	8/23	7/22	8/23
alachlor	2.24	0.4	1.0	9.5	9.1	9.3	2.7	7.1	6.3
	2.80	0.8	0.9	9.9	9.7	9.9	3.5	9.0	7.3
metolachlor	2.24	0.6	1.5	9.5	9.0	9.0	5.3	3.4	1.8
	2.80	1.0	1.8	9.9	9.8	9.1	8.4	5.9	4.5
napropamide	1.12	0.0	0.1	9.7	8.0	9.3	5.3	8.0	7.4
	1.68	0.0	0.0	10.0	9.6	9.8	7.6	9.6	8.9

[1/] Based on a scale of 0 to 10, where 0 means no effect and 10 means complete control.

Table 4. The effects of alachlor, metolachlor, and napropamide on eggplant yields.

Treatment	Rate kg/ha	1000's/ha[1/]	% cult. check	kg/fruit[2/]
alachlor	2.24	3.5 de	76.1	0.43
	2.80	4.4 cd	95.7	0.35*
metolachlor	2.24	3.6 e	78.3	0.30*
	2.80	2.7 f	58.7	0.37*
napropamide	1.12	6.0 b	130.4	0.40
	1.68	9.4 a	204.4	0.48
cultivated check		4.6 c	100.0	0.36*
weedy check		0.6 g	13.0	0.30*

[1/] Means followed by the same letter are not significantly different at the 5% level according to the New Duncan's Multiple Range Test.

[2/] Means followed by an asterisk are not significantly lower than the commercially desired weight according to an LSD at the 5% level of 0.139.

HERBICIDE CANDIDATES FOR WEED CONTROL IN CABBAGE

G.W. Selleck and W.J. Sanok[1/]

ABSTRACT

Two experiments were conducted in 1977 at the Long Island Horticultural Research Laboratory involving cabbage (Brassica oleracea L.). The first experiment involved pre-plant incorporated, preemergence, and post-emergence use of herbicides on the cabbage variety Danish Ballhead. The second experiment involved a stale seedbed treatment of weeds prior to planting the cabbage variety AC #5 and Snowball Imperial cauliflower.

In the first experiment dinitramine at 0.38 and 0.5, profluralin at 0.75 and 1.0, and trifluralin at 0.5 and 0.75 lb/A were applied pre-plant incorporated to cabbage seeding. Oryzalin at 1.0 and 1.5; butralin at 1.5 and 2.0; penoxylin at 1.0 and 1.5; alachlor at 1.0 and 1.25; bifenox at 1.0 and 1.5; oxadiazon at 0.5, 0.75, and 1.0; and nitrofen at 4.0 lb/A were all applied preemergence to the cabbage. Nitrofen at 3.0 lb/A in combinaton with HOE 23408 at 1.0, HOE 29152 at 0.5 and 0.25 lb/A were applied post emergence. Nitrofen at 3.0 plus HOE 29152 at 0.25 lb/A was applied both pre- and post emergence to the cabbage.

All of these treatments gave good to excellent control of crabgrass (Digitaria sanguinalis (L) Scop.) and purslane (Portulaca oleracea L.). All of these treatments gave some visible phytotoxic effects except nitrofen. Severe stunting, acompanied by a reduction in the number of mature heads at harvest occurred with penoxylin, dinitramine, alachlor, bifenox, and oxadiazon. Although the stand was reduced, the average head weight was not affected at harvest time.

In the second experiment, paraquat at 0.25, 0.50, and 1.0 and glyphosate at 1.5, 4.0, and 8.0 lb/A was applied post emergence to the weeds before seeding cabbage and cauliflower. Both chemicals at all rates were effective in controlling purslane and barnyard grass. Lambsquarters (Chenopodium album L.) was not adequately controlled with the 0.25 and 0.5 rate of paraquat, and ladysthumb (Polygonum persicaria L.) was not adequately controlled with the 1.5 lb/A rate of glyphosate. Neither of these treatments at these rates had any effect on the yield at harvest time.

INTRODUCTION

The increasing costs of labor and development of better field seeding techniques has increased the use of direct-seeded cabbage on Long Island. Weed competition during the early stages of growth remains a major problem. Presently registered herbicides have been effective in controlling most weeds in cabbage, but the continually changing weed spectrum has necessi-

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1/ Respectively, L.I. Horticultural Research Laboratory and Cooperative Extension, Suffolk County, New York.

tated the development of new herbicides. For these reasons, these trials were conducted to evaluate promising pre-plant incorporated, preemergence, and post-emergence herbicides for use on direct-seeded cabbage.

MATERIALS AND METHODS

In the first experiment Danish Ballhead cabbage was seeded using a Stan Hay seeder on July 12. Prior to seeding, dinitramine, trifluralin, and profluralin were applied and incorporated with a disk. The cabbage was planted in two-row plots with one seed dropped every three inches.

The chemicals were applied in 6 by 25' plots replicated four times, leaving a five-foot check area adjacent to each one of the chemical treatments in addition to the standard checks. Chemicals were applied using a tractor-mounted sprayer delivering 40 gpa at 35 psi. The pre-plant incorporated treatment applied July 11 and preemergence treatment applied July 12 were both on a very dry soil. The post-emergence treatment, applied July 27, was to a wet soil surface. Phytotoxicity and weed control ratings were taken on August 13.

In the second experiment paraquat and glyphosate, at three rates each, were applied July 9 to a stand of weeds consisting of purslane, barnyard grass, ladysthumb, and lambsquarters. The plots were six feet wide by 25 feet long and replicated four times. The weeds were between one and ten inches tall. Application was made with a tractor-mounted sprayer delivering 40 gpa at 35 psi. Cabbage variety AC #5 and cauliflower variety Snowball Imperial were seeded on July 13. Nitrofen at 4.0 lb/A was applied preemergence one day after seeding. Each plot was two rows wide by 25 feet long, with a five-foot check adjacent to each treatment. Phytotoxicity ratings and weed control were made on August 10.

RESULTS AND DISCUSSION

There was phytotoxicity in all of the treatments in the first experiment except for nitrofen at 4.0 lb/A. Severe stunting, accompanied by a reduction in plant stand, occurred with treatments penoxalin at 1.0 and 1.5, dinitramine at 0.38 and 0.5, alachlor at 1.0 and 1.25, bifenox at 1.0 and 1.5, oxadiazon at 0.5, 0.75, and 1.0 lb/A. At harvest the average weight in pounds per head was taken, and there are no significant differences based on treatment. As indicated in Table 1, all treatments at rates given gave good to excellent control of the crabgrass and purslane present.

In the second experiment, both paraquat and glyphosate were vere effective in the control of purslane and barnyard grass when applied pre-plant to the cabbage and cauliflower. Ladysthumb was adequately controlled by paraquat but the low rate of glyphosate, 1.5 lb/A, did not give adequate control. The 1.0 lb/A rate of paraquat gave control of lambsquarters but the lower rates, 0.25 and 0.5 lb/A, did not. The yield data indicates that there was no effect of chemical treatments on the cabbage or cauliflower.

Each of the materials used in both experiments show a great deal of potential for weed control in direct-seeded cabbage. However, the reduction in stand by using penoxalin, dinitramine, alachlor, bifenox, or oxadiazon indicates that the germinating cabbage has very little tolerance for these treatments.

Table 1. Phytotoxicity and weed control with herbicides in cabbage.

Chemical	lbs AIA	Time of applic.	Phyto.[1/] ratings	Avg. # heads	Avg. wgt. (lbs)	Weed Control Ratings[1/] Crabgrass	Purslane
oryzalin	1.0	pre	2.5	28	4.2	9.5	8.0
oryzalin	1.5	pre	3.0	24	4.6	9.4	9.9
butralin	1.5	ppi	1.8	29	4.8	9.2	9.9
butralin	2.0	ppi	3.2	25	4.6	9.0	9.6
penoxylin	1.0	pre	6.2	23	4.0	9.2	8.6
penoxylin	1.5	pre	5.5	19	4.6	9.7	9.5
dinitramine	0.38	ppi	3.4	18	5.6	9.0	7.8
dinitramine	0.5	ppi	3.5	20	4.7	9.0	9.4
trifluralin	0.5	ppi	0.0	30	4.0	8.8	8.4
trifluralin	0.75	ppi	3.2	28	4.4	8.5	7.8
alachlor	1.0	pre	4.3	20	4.3	9.7	9.7
alachlor	1.25	pre	4.0	24	5.2	9.5	9.9
bifenox	1.0	pre	7.4	19	4.9	9.2	9.9
bifenox	1.5	pre	8.0	24	3.0	9.2	9.9
oxadiazon	0.5	pre	7.0	19	5.1	9.6	9.4
oxadiazon	0.75	pre	8.0	16	4.0	8.8	9.3
oxadiazon	1.0	pre	8.0	16	4.3	9.4	9.8
nitrofen	4.0	pre	0.0	29	5.4	8.8	9.9
nitrofen	3.0						
HOE 23408	1.0	post	3.2	30	4.1	7.9	9.4
nitrofen	3.0						
HOE 29152	0.5	post	3.0	30	4.6	8.6	9.4
nitrofen	3.0						
HOE 29152	0.25	post	2.0	30	4.7	8.8	9.9
nitrofen	3.0						
HOE 29152	0.25	2/	2.5	28	4.2	9.4	9.9
profluralin	0.75	ppi	2.0	30	4.6	8.4	8.3
profluralin	1.0	ppi	1.2	26	4.8	8.9	8.2
Check			1.0	27	4.6	2.0[3/]	1.0[3/]
						15.0[4/]	12.0[4/]

1/ 0 = no injury or control, 10 = complete kill

2/ pre and post application

3/ density per square foot

4/ percent cover

Table 2. Weed control and yield with stale seedbed herbicide use in cabbage and cauliflower.

Chemical	lbs AIA	Weed Control Ratings[1/]				Yield lbs/plot
		Purslane	Barnyard Grass	Ladysthumb	Lambsquarter	
paraquat	0.25	9.0	7.0	7.0	6.0	37.2
	0.50	10.0	8.0	8.0	6.0	35.2
	1.0	10.0	8.0	9.0	10.0	37.8
glyphosate	1.5	10.0	8.0	5.0	7.0	32.5
	4.0	10.0	10.0	9.0	--	33.8
	8.0	10.0	10.0	9.0	--	35.1
Check		5.0[2/]	1.0[2/]	1.0[2/]	1.0[2/]	37.8

1/ 0 = no control, 10 = complete control

2/ density per square foot

CHEMICAL WEEDING OF CUCUMBER GROWN IN A STALE SEEDBED

Charles J. Noll[1]

ABSTRACT

Two short-lived contact herbicides, glyphosate and paraquat, were field tested alone and in combination with more persistant herbicides for their effect on weeds and cucumbers grown in a stale seedbed. Twenty-three days after seedbed preparation the cucumbers were seeded and the herbicides applied. The contact herbicides controlled the weeds that had emerged, but did not control the weeds that emerged after the application. The best of the persistant herbicides controlled these weeds. There was no significant difference in yield of fruit.

INTRODUCTION

A stale seedbed is a seedbed prepared for planting but not seeded to the crop plant until many weeds have emerged. The delay in seeding can be from a week to a month. Following seeding but prior to crop emergence, the weeds that have emerged are killed with a contact herbicide. This system has been successfully used for warm season crops such as cucumber.

Research by Noll (1,2) during the last two years has found that two of the best contact herbicides are glyphosate and paraquat. They kill the emerged weeds and do not injure the cucumber emerging after the treatment. Weeds that emerge after the contact herbicides are applied are not killed. The purpose of the research was to evaluate the herbicide that would kill the late germinating weeds.

MATERIAL AND METHODS

This study was conducted at the Rock Springs Farm located 10 miles west of University Park. The soil, a Hagerstown silt loam, was plowed in the fall of 1976 and the seedbed prepared May 23, 1977. After a 23-day delay on June 15, the cucumbers(variety, greenpak) were seeded and the herbicides applied. All herbicide combinations were tank mixed except paraquat (1,1'-dimethyl-4,4'-bipyridinium) and dinoseb (2-sec-butyl-4,6-dinitrophenol). Weeds present in order of importance were lambsquarters (Chenopodium album L.), pigweed (Amaranthus retroflexus L.) and (Amaranthus blitoides s. Wats.), purslane (Portulaca aleracea L.) and a mixture of annual grasses

Single row plots were 38 feet long and 5 feet wide. Treatments covered the row for a width of 3 feet with cultivation controlling the weeds.between the rows. Treatments were randomized in each of 6 blocks.

A rating of 0 to 10 was used to evaluate crop vigor and weed control; 0 being least desirable and 10 being most desirable.

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RESULTS AND DISCUSSION

The results are presented in Table 1. Glyphosate N-(phosphonomethyl glycine) and paraquat controlled the most important weed, lambsquarters, but did not control pigweed, purslane, and the grasses. The addition of naptalam, N-1-naphthylphthalamic acid, and chloramben, 3-amino-2,5-dichlorobenzoic acid and ethalfluralin, N-ethyl-N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluromethyl) benzenamine resulted in good pigweed control. The best herbicide used for purslane control was chloramben and the best herbicides for grass control were chloramben and ethalfluralin.

A single harvest was taken August 9 with the number and weight of fruit recorded. There was no significant difference in yield.

The best treatment for weeding of cucumbers was the combination of glyphosate or paraquat with chloramben.'

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Table 1. The Effect of Herbicides Alone and in Combination on Weeds and Cucumber Grown in Stale Seedbeds.

Treatment	lb ai	Application days from Soil Prep.	Average per Plot: Stand Plants	Vigor 0 - 10	Weeds 0 - 10: Lambs-quarters	Pig-weed	Purs-lane	Grass	All Weeds	Yield-Fruit No.	Wt.(lb)
1 Nothing		---	26	7.2	1.5	1.2	0.8	2.0	1.5	50	29.9
2 Glyphosate	2	+23 (June 15)	33	6.8	9.7	4.3	1.3	4.0	5.2	111	52.4
3 Glyphosate+Naptalam	2+4	+23	23	6.5	9.3	9.2	8.7	6.8	8.3	64	30.0
4 Glyphosate+Chlor-amben	2+2	+23	28	6.7	9.8	10.0	10.0	8.5	9.3	98	61.8
5 Glyphosate+DCPA	2+6	+23	23	5.3	10.0	7.7	8.3	6.2	8.0	46	30.8
6 Glyphosate+Dinoseb	2+2	+23	22	6.7	9.8	4.8	6.8	5.3	6.8	61	30.3
7 Glyphosate+Ethal-fluralin	2+2/3	+23	23	5.8	10.0	9.0	7.8	8.0	8.5	76	33.2
8 Glyphosate+Ethal-fluralin	2+1	+23	18	5.5	10.0	9.3	8.3	9.3	8.5	54	25.6
9 Glyphosate+ HOE 29152	2+½	+23	29	6.7	9.5	6.0	2.3	9.0	5.7	77	36.8
10 Glyphosate+ HOE 29152	2+1	+23	24	6.5	8.7	5.5	3.0	9.5	5.2	59	25.4
11 Paraquat	2	+23	34	7.3	9.5	3.7	3.2	2.8	5.0	76	29.5
12 Paraquat+Naptalam	2+4	+23	29	7.0	10.0	9.0	6.8	6.5	7.7	87	37.5
13 Paraquat+Chlor-amben	2+2	+23	17	6.0	10.0	10.0	10.0	9.8	10.0	59	29.8
14 Paraquat+DCPA	2+6	+23	21	5.8	10.0	7.0	8.0	6.5	8.0	44	22.4
15 Paraquat+Dinoseb	2+2	+23	29	7.2	9.8	3.8	5.8	4.5	6.7	81	38.9
16 Paraquat+Ethal-fluralin	2+2/3	+23	25	6.7	10.0	9.2	7.0	8.0	8.5	77	31.8
17 Paraquat+Ethal-fluralin	2+1	+23	32	7.2	10.0	9.7	9.3	8.2	9.0	91	47.7
18 Paraquat+ HOE 29152	2+½	+23	36	8.3	9.0	5.8	3.5	9.5	6.2	99	46.3
19 Paraquat+ HOE 29152	2+1	+23	25	7.3	9.7	6.2	4.0	9.0	6.7	67	33.7
Least Significant Difference 5%			NSD	NSD	1.4	1.7	2.2	1.9	1.5	NSD	NSD
Least Significant Difference 1%			NSD	NSD	1.7	2.0	2.7	2.4	1.8	NSD	NSD

GROWER USE OF PENDIMETHALIN HERBICIDE IN EDIBLE BEANS

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ABSTRACT

In 1977 under EPA Experimental Use Permit No. 241-EUP-82, pendimethalin alone and pendimethalin combinations were used preplant incorporated (PPI) in edible beans by growers in Delaware, Maryland, New York and Pennsylvania and thirteen other states.

Pendimethalin was used alone PPI for the control of several annual grass species and certain annual broadleaf weed species. Also, PPI tank-mix combination treatments of PROWL plus Eptam 7E was used to control additional weeds not susceptible to pendimethalin. Sequential treatments of pendimethalin applied preplant incorporated followed by a preemergence application of chloramben or dinoseb did increase the weed control spectrum where ragweed and wild mustard were problems.

Under the diverse climatic and soil conditions, good to excellent weed control was obtained with pendimethalin and combination treatments. Data from final results will be discussed.

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CONTROL OF HORSEWEED, NUTSEDGE, AND OTHER WEEDS IN CARROTS

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ABSTRACT

Three field experiments with carrots (Daucus carota L.) were conducted during 1977 in northwest Ohio. Horseweed (Conzya canadensis (L.) Cronq.) was effectively controlled with metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5 (4H)-one) without significant crop injury. Nutsedge (Cyperus esculentus L.) growth was suppressed by metribuzin at rates of 1.12 and 1.68 kg/ha, and while carrot foliage sustained chlorosis and marginal leaf-tip burn, recovery was rapid and yields appeared normal although weed-free controls were not available for comparison. Seventeen herbicide treatments evaluated for annual weed control revealed diclofop (methyl 2-(4-(2,4-dichlorophenoxy) phenoxy propanoate) combined with linuron (3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea) provided the most effective level of weed control. Two applications of metribuzin at 0.28 kg/ha, 18 days apart, resulted in carrot leaf-tip burn similar to that observed from two applications of linuron at 1.12 kg/ha. Single applications of metribuzin at 0.56 and 1.12 kg/ha resulted in moderate and severe tip burn respectively. However, crop development was not delayed and new leaf growth appeared normal indicating rapid crop recovery. Metribuzin failed to control black nightshade (Solanum nigrum L.) at all rates studied.

INTRODUCTION

Horseweed appears to be of increasing concern in the intensive carrot production area in northwest Ohio. Grower experience reveals horseweed tolerant to trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), linuron and stoddard solvent. Yellow nutsedge continues to be a problem weed, and while infestations are more patchy than most annual weeds, it seriously affects carrot production by plugging up cultivating equipment, interfering with harvesting operations as well as reducing yield. A preliminary study conducted in 1976 indicated that metribuzin could selectively control horseweed in carrots (1).

The objectives of 1977 trials were to define the metribuzin rate necessary to control horseweed and measure carrot seedling tolerance to postemergence treatments; to determine yellow nutsedge response to metribuzin in carrot culture; and to determine efficacy of a number of newer herbicides with potential for use in carrots.

MATERIALS AND METHODS

Three experiments were conducted in 1977. Experiment 1 involved a site with a heavy horseweed infestation (27 plants/m of row); Experiment 2, a site with yellow nutsedge as the dominant weed; and Experiment 3, a trial to evaluate performance of several herbicides for annual weed control. Experiments 1 and 2 were located in a commercial carrot field having a sandy loam soil type with

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3.2 percent organic matter and a pH of 6.1 while Experiment 3 was located on a similar soil type with 2.5 percent organic matter. All three experiments utilized two row plots, 1.5 m by 6.1 m in size, in randomized complete block design with four replicates. Critical dates of treatment applications are outlined in Table 1. All treatments were applied with a bicycle plot sprayer delivering 308 L/ha at 2.1 cm^2 using compressed air as a propellant. Preplant treatments were incorporated with a rotary powered tiller to a depth of 7 cm within two hours of application. Dominant weed species in Experiment 3 were: lambsquarters (Chenopodium album L.), smartweed (Polygonum pensylvanicum L.), black nightshade, common ragweed (Ambrosia artemisiifolia L.), crabgrass (Digitaria sanguinalis L.), and giant foxtail (Setaria faberii Herrm.). Weed control was assessed using a 0 to 10 rating system where 10 represents complete control, 0 represents no control, and 8 is the minimum level for commercial acceptance. Crop phytotoxicity was rated on a 1 to 5 scale where 5 represented no visible injury and 1 represented crop kill. On June 27, the hand weeding time to remove weed escapes was recorded for Experiment 3. This weeding time, expressed as a percent reduction in weeding time from the "unweeded control plot" represents a second measure of herbicide efficacy. Carrot yields for Experiments 1 and 2 were obtained by harvesting 10 feet of row from each plot. Yield data was not obtained from Experiment 3 because heavy rainfall during September resulted in severe root rot in most plots.

RESULTS AND DISCUSSION

Experiments 1 and 2 were located in a commercial carrot field which had already received 0.56 kg/ha of linuron. An additional linuron application of 1.12 kg/ha ten days later did not offer appreciable control of horseweed. Likewise, metribuzin at 0.14 kg/ha did not control 2.5 cm tall horseweed seedlings (in rosette stage 2.5 to 5 cm diameter with 9 to 12 leaves), Table 2. The 0.28 kg/ha rate of metribuzin provided borderline control while the 0.58 kg/ha rate was judged very satisfactory. Crop injury was limited to leaf-tip burn at the high rate. Because horseweed control was not satisfactory at the lower two rates of metribuzin, these plots were retreated on June 13, with the 0.14 kg plots receiving 0.56 kg/ha and the 0.28 kg plots receiving a repeat dose. All these treatments resulted in a high level of horseweed control which persisted until harvest, although there were fewer horseweed escapes in plots receiving two applications of metribuzin than where only one was used. Yield data reveal the strong competitive effects of horseweed, which reduced carrot yields by 50 percent in "control" plots compared to metribuzin treated plots.

Metribuzin was applied at rates of 0.26, 0.58, 0.86, 1.12, and 1.68 kg/ha to 10 to 15 cm tall yellow nutsedge plants with carrot tops about the same size. Only the 1.12 and 1.68 kg/ha rates were capable of suppressing nutsedge growth (Table 3) with the highest rate providing commercially acceptable control. Carrot foliage sustained moderate leaf-tip burn, but new growth appeared normal and recovery was rapid. It should be noted that this test involved a single application of metribuzin. We have evidence that two applications of metribuzin at 0.58 kg/ha, two weeks apart, will provide better burndown of nutsedge foliage than a single application at two or three times this rate.

Experiment 3, to assess annual weed control, revealed that two applications of linuron, 18 days apart, provided excellent control of broadleaf weeds, but annual grasses continue to present a problem (Table 4). The addition of trifluralin as a preplant treatment or diclofop as a postemergence tank mix treatment with linuron provided the necessary grass control to produce broad-spectrum weed control. Two applications of metribuzin at 0.14 to 0.28 kg/ha were not enough to adequately control smartweed. Carrot seedlings, 5 cm tall, tolerated these metribuzin treatments with only a trace of crop injury. Higher rates of metribuzin applied to 12 to 15 cm tall carrots resulted in moderate and severe phytotoxicity at 0.56 and 1.12 kg/ha respectively. The phytotoxicity observed appeared restricted to tip burning of terminal leaf tissue and did not appear to delay new leaf growth or crop development. Metribuzin failed to control black nightshade at all rates tested. RH 6201 (chemistry not available) did not provide satisfactory weed control. Dinitramine (N^4,N^4-diethyl-a,a,a-trifluoro-3,5-dinitrotoluene-2,4-diamine) and butralin (4-(1,1-dimethylethyl-N-(1-methylpropyl)-2,6,dinitrobenzenamine) provided satisfactory grass control but were very weak on broadleaf weeds. The addition of linuron as a postemergence overlay to dinitramine improved the weed control performance significantly.

Noll (2) reported that carrots would tolerate preplant treatments of metribuzin at 0.56 kg/ha but did not investigate postemergence applications. These experiments demonstrate that metribuzin can effectively control horseweed and suppress nutsedge growth in carrots with crop injury limited to leaf-tip burn. The fact that black nightshade is not controlled by metribuzin indicates that this herbicide will need to be used in conjunction with linuron and not be considered as an alternative. Carrot tolerance to tank mix treatments and sequential treatments of linuron and metribuzin need to be investigated.

LITERATURE CITED

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Table 1. Critical dates of various activities involved with the three carrot trials conducted in 1977.

Activity	Experiment 1	Experiment 2	Experiment 3
preplant treatments	---	---	4/13
seeding (variety Danvers 126)	4/1	4/1	4/13
postemergence treatment 1	5/27 carrots 10 cm	5/31 carrots 15 cm	5/26 carrots 5 cm
postemergence treatment 2	6/13 carrots 20 cm	---	6/14 carrots 15 cm
weed control rating	6/9, 7/7	6/9, 7/7	6/7, 6/23
hand weeding time	---	---	6/27
harvest	8/17	8/17	---

Table 2. Horseweed control in carrots with metribuzin, Experiment 1.

Treatment			Weed control rating 0-10		Crop Response	
Herbicide	Rate kg/ha	Appl. date	6/9	7/7	Early phyto. rating 1-5 6/9	Yield metric T/ha
"Control" (linuron)	0.56	5/17	0.0	0.0	5.0	18.8
Linuron	0.56 + 1.12	5/17,5/27	3.2	2.0	4.2	27.1
Metribuzin	0.14 + 0.56	5/27,6/13	3.2	9.0	5.0	34.9
Metribuzin	0.28 + 0.28	5/27,6/13	7.0	10.0	4.8	37.4
Metribuzin	0.56	5/27	8.5	9.8	4.2	38.5
LSD 5%			1.9	0.8	0.6	9.4
1%			2.7	0.9	---	13.2

Table 3. Nutsedge control in carrots with metribuzin, Experiment 2.

"Control"	---	---	0.0	0.0	5.0	38.5
Metribuzin	1.12	5/31	4.7	7.3	4.3	46.4
Metribuzin	1.68	5/31	7.3	8.5	4.0	40.9
LSD 5%			1.7	1.9	0.5	5.4
1%			2.5	2.7	0.8	---

Table 4. Response of annual weeds and carrots to 17 herbicide treatments at Napoleon, Ohio, in 1977.

Treatments			Weed control rating				% Red. in weeding time	Crop phyto. (1-5)	
			B.L.W.		Grass				
Herbicide	Rate kg/ha	Appl.	6/7	6/23	6/7	6/23	6/27	6/7	6/23
Weeded control	--	--	10	10	10	10	--	5.0	5.0
Unweeded control	--	--	0	0	0	0	--	5.0	5.0
Linuron	1.12	post 1,2 [a]	8.1	9.0	2.0	5.0	84	5.0	4.7
Linuron + diclofop	1.12 post 1,2 + 0.56 post 1		7.9	8.9	8.0	7.5	80	4.8	4.9
Linuron + diclofop	1.12 post 1,2 + 1.1 post 1		8.5	9.2	8.0	9.2	87	4.5	4.9
Linuron + diclofop	1.12 post 1,2 + 2.2 post 1		8.0	9.6	8.7	10.0	87	3.9	4.6
Trifluralin + linuron	1.12 ppi + 0.82 post 1		9.0	8.7	10.0	10.0	86	4.8	5.0
Trifluralin + metribuzin	1.12 ppi + 0.14 post 1,2		7.8	7.7	10.0	10.0	81	5.0	5.0
Trifluralin + metribuzin	1.12 ppi + 0.28 post 1,2		7.9	7.8	10.0	10.0	75	5.0	4.6
Trifluralin + metribuzin	1.12 ppi + 0.56 post 2		3.7	7.7	8.0	9.7	66	5.0	4.0
Trifluralin + metribuzin	1.12 ppi + 1.12 post 2		4.7	9.2	10.0	10.0	89	5.0	3.2
Trifluralin + metribuzin	1.12 ppi + 0.28 post 1 + 0.56 post 2		7.5	8.5	7.0	6.0	74	5.0	3.9
Trifluralin + RH 6201	0.56 ppi + 0.56 post 1		8.1	5.5	7.5	7.5	42	3.5	5.0
Trifluralin + RH 6201	0.56 ppi + 1.12 post 1		8.0	6.7	9.2	10.0	48	2.9	5.0
Dinitramine	0.56	ppi	6.2	5.1	9.9	10.0	54	5.0	5.0
Dinitramine	1.12	ppi	8.2	6.1	10.0	10.0	79	5.0	5.0
Dinitramine + linuron	0.56 ppi + 1.1 post 1		8.6	7.6	10.0	10.0	85	4.8	5.0
Butralin	1.68	ppi	6.2	5.2	9.8	10.0	50	5.0	5.0
Butralin	3.36	ppi	8.0	7.5	10.0	9.7	68	5.0	5.0
	LSD 5%		1.4	1.0	2.3	1.8	21	0.4	0.2
	1%		1.9	1.3	3.0	2.4	28	0.5	0.3

[a] Post 1 - application was made on 5/26 to carrots 5 cm tall, 3-leaf stage
Post 2 - application was made on 6/13 to carrots 12-15 cm tall

WEED CONTROL IN SOUTHERN GREENS

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ABSTRACT

Several dinitroanilines, two acetanilides and a diphenylether were evaluated and compared to registered compounds for weed control and crop response in southern greens. Pendimethalin and profluralin were more effective on redroot pigweed than trifluralin with comparable crop response. Collards were most sensitive to the dinitroanilines, and oryzalin reduced the stand of all four greens. Mustard greens were sensitive to the acetanilides while collards flourished. Nitrofen and DPCA effected excellent weed control and also increased yields. Both were superior to the remaining chemical checks.

INTRODUCTION

Southern greens, turnip greens (*Brassica rapa* L.); mustard greens (*B. juncea* Coss. var. *crispifolia*); and collards and kale (both *B. oleracea* L. var. *virdis*), are becoming important specialty crops as these regional favorites gain broader popularity. Since they are generally direct-seeded, weed competition during early stages of growth is a major problem in their culture and the presence of weeds at maturity decreases market quality. Herbicides presently registered for use in these greens have been fairly effective in controlling the common weeds; however, a continually changing weed spectrum necessitates the development of herbicides with different selectivities.

This experiment was designed to test the efficacy in southern greens of some herbicides that have exhibited safety with the Brassicaceae and to compare their performance with presently registered compounds. The dinitroanilines investigated were: fluchloralin [*N*-(2-chloroethyl)-2,6-dinitro-*N*-propyl-4-(trifluoro-methyl)aniline] ; isopropalin (2,6-dinitro-*N*,*N*-dipropylcumidine); oryzalin (3,5-dinitro-N^4, N^4-dipropylsulf=anilamide); pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-

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dinitrobenzenamine] ; profluralin [N-(cyclopropylmethyl)-α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine] ; and trifluralin (α,α,α,-trifluoro-2,6-dinitro-N-N-dipropyl-p-toluidine) which was used as a chemical check. The two acetanilides, alachlor [2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide] and metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(methoxy-1-methylethyl)acetamide], and the diphenylether, nitrofen (2,4-dichlorophenyl-p-nitrophenyl ether), were also investigated. DPCA (dimethyl tetrachloroterephthalate), chlorpropham (isopropyl-m-chlorocarbanilate), CDAA (N,N-diallyl-2-chloroacetamide), and CDEC (2-chloroallyl diethyldithiocarbamate) alone and in combination with chlorpropham or CDAA were used as chemical checks. All herbicides were formulated as emulsifiable concentrates except oryzalin and DPCA which were wettable powders.

MATERIALS AND METHODS

Plots were established at the Rutgers Research and Development Center near Bridgeton, New Jersey in 1977 on a Sassafras sandy loam with 1.5% organic matter and a pH of 6.8.

During seedbed preparation, 33.6 kg/ha of a 0-10-40 soluble fertilizer and 56 kg/ha nitrogen were incorporated into the soil. Following bed preparation, two sets of 1.5 by 4.6 m treatment plots were established, each in a randomized complete block design with four replicates. All herbicides were applied August 3 with water as the carrier using a backpack CO_2-propelled plot sprayer delivering 374.1 L/ha at 2.11 kg/cm^2. The day of herbicide application was calm, cloudy, and a humid 29.4C. The soil surface was dry with ample moisture below. The dinitroanilines were incorporated to a depth of 7.6 cm immediately following application. A single row each of Purple Top turnip greens and Giant Curled mustard greens was sown into one set of plots while a single row each of Vates collards and Siberian Curled kale was sown into the other set. Seeds were sown 0.64 cm deep at a rate of 3.4 kg/ha. The preemergence treatments were applied following seeding. The cultivated checks were handweeded August 25. Weekly applications of methomyl and *Bacillus thuringiensis* were used to control insect populations, and the greens were sidedressed with one 33.6 kg/ha application of nitrogen. Plots were irrigated with 1.27 cm of water August 4 and when necessary thereafter to supplement natural rainfall.

Weed populations were determined September 7 by counting the weeds present in eight 0.25 cm^2 quadrats within the weedy check plots. Treatment plots were rated using a scale of 0 to 10 where 0 is no effect on weed or crop stand or vigor and 10 is complete kill. Weed control data from both sets of plots were combined.

RESULTS AND DISCUSSION

Weed pressure was heavy, and grasses dominated the weed spectrum. The average density (plants/0.25 m^2) for the dominant weed species was: large crabgrass [*Digitaria sanguinalis* (L.) Scop.] 98.1; stinkgrass [*Eragrostis cilianensis* (All.) Lutati] 38.5; redroot pigweed (*Amaranthus retroflexus* L.) 27.7; purslane (*Portulaca oleracea* L.) 26.1; and goosegrass [*Eleusine indica* (L.) Gaertn.] 23.2. Goosegrass control was similar to large crabgrass.

The dinitroanilines provided good to excellent weed control with a slight improvement at the higher rate (Table 1). Trifluralin was the least effective on redroot pigweed. Although oryzalin effected broad spectrum weed control, it caused serious crop injury (Table 2). Collards were most sensitive as stand reduction was also observed with isopropalin at 1.12 kg/ha. Significant yield reductions in all four greens compared to the cultivated check were evident with oryzalin at 1.68 kg/ha (Table 3). Yield reductions in turnip greens occurred with fluchloralin at 1.68 kg/ha and in collards with isopropalin at 1.12 kg/ha. The latter was probably more a result of weed competition than phytotoxicity. When compared to trifluralin, pendimethalin and profluralin effected comparable, or even better, weed control and crop yields for all four greens. Indeed, they were more effective on redroot pigweed.

Although the acetanilides were ineffective on purslane, they provided excellent control of the other weeds (Table 4). Excellent weed control was obtained with nitrofen and DPCA. CDEC and chlorpropham alone or in combination, and CDEC in combination with CDAA were ineffective in controlling large crabgrass while only chlorpropham was ineffective on stinkgrass. Chlorpropham did not control redroot pigweed, and CDAA did not control the broadleaf weed species.

The acetanilides at the higher rate delayed growth of the greens (Table 5). Mustard greens were most sensitive and collards the least. Nitrofen and DPCA had no effect on crop vigor.

Table 1. The effects of some dinitroanilines on late summer weed control (stand) based on a scale of 0 to 10, where 0 = no effect and 10 = complete control.

Herbicide	Rate, kg/ha	Pigweed	Purslane	Crabgrass	Stink-grass
fluchloralin	1.12	9.8	9.5	9.6	8.7
	1.68	9.9	9.9	9.9	9.6
isopropalin	0.84	8.9	8.5	8.0	7.2
	1.12	9.6	9.4	9.1	9.6
oryzalin	1.12	9.2	9.9	9.2	9.9
	1.68	9.8	9.9	9.3	9.9
pendimethalin	0.56	9.5	8.9	9.1	9.9
	0.84	9.8	9.5	9.6	9.9
profluralin	0.84	9.2	9.7	9.4	9.8
	1.12	9.9	9.9	9.8	9.9
trifluralin	0.56	7.0	9.8	8.9	10.0
	0.84	7.7	9.8	9.7	9.9

Table 2. Responses of southern green stand and vigor to some dinitroanilines based on a scale of 0 to 10, where 0 = no effect and 10 = complete kill.

		Turnip Greens		Mustard Greens		Collards		Kale	
Herbicide	Rate, kg/ha	S	V	S	V	S	V	S	V
fluchloralin	1.12	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
	1.68	0.5	0.9	0.0	0.3	0.7	0.6	0.1	0.0
isopropalin	0.84	0.0	0.0	0.0	0.1	0.3	1.0	0.0	0.2
	1.12	0.0	0.0	0.0	0.0	2.2	0.3	0.0	0.0
oryzalin	1.12	0.6	0.7	2.1	1.2	3.9	3.3	0.6	0.5
	1.68	3.5	2.9	1.6	3.2	6.2	5.2	1.8	1.9
pendimethalin	0.56	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.2
	0.84	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.0
profluralin	0.84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1.12	0.0	0.0	0.0	0.0	0.4	0.3	0.0	0.0
trifluralin	0.56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3. The effects of some dinitroanilines on the yields (metric tons/ha) of southern greens.

Treatment	Rate, kg/ha	Turnip[1] Greens	Mustard[1] Greens	Collards[1]	Kale[1]
fluchloralin	1.12	29.6 cde	28.2 a-d	20.8 bc	25.8 cd
	1.68	22.4 f	25.5 cd	21.1 bc	28.2 abc
isopropalin	0.84	29.6 cde	30.5 a	11.0 d	26.4 cd
	1.12	32.0 abc	29.3 ab	20.8 bc	26.2 cd
oryzalin	1.12	26.2 e	18.8 e	17.7 c	24.2 d
	1.68	14.8 g	20.6 e	10.8 d	17.3 ef
pendimethalin	0.56	31.1 abc	25.8 bcd	24.2 ab	28.0 abc
	0.84	30.5 a-d	29.6 a	25.8 a	29.1 ab
profluralin	0.84	32.9 abc	30.9 a	24.0 ab	29.6 a
	1.12	30.2 bcd	28.5 a-d	25.8 a	27.8 bcd
trifluralin	0.56	33.6 ab	30.9 a	26.2 a	29.6 a
	0.84	33 8 a	28.9 abc	25.8 a	28.7 abc
Cultivated check		28.0 de	24.6 d	19.7 c	19.9 e
Weedy check		22.6 f	13.2 f	6.5 e	16.6 f

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

Table 4. The effects of some preemergence herbicides on late summer weed control (stand) based on a scale of 0 to 10, where 0 = no effect and 10 = complete control.

Herbicide	Rate, kg/ha	Pigweed	Purslane	Crabgrass	Stink-grass
alachlor	2.24	9.6	7.7	9.7	9.9
	2.80	9.5	8.4	9.9	10.0
metolachlor	2.24	9.9	6.3	9.9	9.9
	2.80	9.9	7.7	9.9	10.0
nitrofen	5.04	10.0	10.0	9.9	9.9
	6.72	10.0	10.0	9.9	10.0
DCPA	6.72	9.3	9.9	9.9	9.9
CDEC	4.48	8.8	8.0	5.3	9.6
chlorpropham	1.12	6.0	9.0	1.9	6.1
CDAA	8.96	5.4	4.8	8.3	9.8
CDEC + chlorpropham	2.24+ 0.56	6.9	8.2	3.0	9.3
CDEC + CDAA	3.36+ 3.36	8.0	7.6	6.7	9.9

Vigor and yield reductions with the remaining compounds can be attributed to weed competition rather than phytotoxicity. Significant yield reduction in mustard greens was observed with alachlor at 2.8 kg/ha and metolachlor at both rates. Collard yields with alachlor at 2.24 kg/ha, however, were significantly higher than the cultivated check. Yields of mustard greens, collards, and kale were significantly increased with nitrofen. Weed control and crop yields were comparable for nitrofen and DPCA and both herbicides were more effective than the remaining chemical checks.

Based on these data, pendimethalin, profluralin and nitrofen look promising for use in all four southern greens while alachlor and metholachlor show promise for use in collards, kale, and turnip greens.

Table 5. Responses of southern green stand and vigor to some preemergence herbicides based on a scale of 0 to 10, where 0 = no effect and 10 = complete kill.

Herbicide	Rate, kg/ha	Turnip Greens S	Turnip Greens V	Mustard Greens S	Mustard Greens V	Collards S	Collards V	Kale S	Kale V
alachlor	2.24	0.0	0.2	0.0	0.7	0.0	0.1	0.0	0.3
	2.80	0.2	0.6	0.2	1.4	0.0	0.0	0.9	0.7
metolachlor	2.24	0.1	0.2	0.0	2.0	0.0	0.1	0.0	0.2
	2.80	0.0	0.3	0.7	1.9	0.0	0.7	0.2	1.5
nitrofen	5.04	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0
	6.72	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0
DCPA	6.72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CDEC	4.48	0.0	0.0	0.0	0.2	0.0	0.5	0.0	0.5
chlorpropham	1.12	0.0	0.4	0.0	0.7	0.0	1.1	0.4	1.5
CDAA	8.96	0.0	0.3	0.0	0.5	0.0	0.7	0.0	1.1
CDEC + chlorpropham	2.24+ 0.56	0.0	0.3	0.0	0.6	0.0	0.4	0.2	1.0
CDEC + CDAA	3.36+ 3.36	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3

Table 6. The effects of some preemergence herbicides on the yields (metric tons/ha) of southern greens.

Treatment	Rate, kg/ha	Turnip[1] Greens	Mustard[1] Greens	Collards[1]	Kale[1]
alachlor	2.24	29.1 b	24.9 cd	25.3 abc	26.7 bc
	2.80	26.9 b	17.9 f	22.2 cd	21.3 fg
metolachlor	2.24	27.8 b	20.2 ef	16.8 e	24.6 cde
	2.80	27.6 b	19.9 ef	26.9 ab	21.7 efg
nitrofen	5.04	28.7 b	29.6 a	28.7 a	29.6 ab
	6.72	28.0 b	28.2 abc	28.7 a	30.9 a
DPCA	6.72	35.2 a	25.1 bcd	24.6 bc	29.8 ab
CDEC	4.48	32.7 a	28.5 abc	17.9 e	24.4 c-g
chlorpropham	1.12	27.6 b	21.1 de	8.1 gh	15.9 h
CDAA	8.96	25.8 bc	23.5 de	14.1 f	22.0 d-g
CDEC + chlorpropham	2.24+ 0.56	27.3 b	24.0 d	11.4 fg	20.8 g
CDEC + CDAA	3.36+ 3.36	28.5 b	28.7 ab	16.8 e	24.9 cd
Cultivated check		28.0 b	24.6 cd	19.7 de	19.9 g
Weedy check		22.6 c	13.2 g	6.5 h	16.6 h

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

THE RELATION OF THE PHYTOTOXICITY OF GLYPHOSATE TO ITS INJURY-FREE USE IN VINEYARDS

Part I. Glyphosate Studies as a Basis for Injury-Free Use.

N. J. Shaulis[1/], D. E. Crowe[1/], and R. A. Rogers[2/].

ABSTRACT

A formulation of the isopropylamine salt of glyphosate [N-(phosphonomethyl) glycine] was applied to grape vines in New York vineyards to observe vine response. With annual applications of 24 lbs. a.e. per acre (3 applications x 8 lbs. a.e.) of glyphosate to the same vines from 1973-1976 there has been maintenance of vine growth and yield with no injury. With 4 or 8 lbs. a.e. glyphosate per acre there has been a 25 percent increase in vine size, compared with the vine size in 1973 or with the vines receiving zero glyphosate. Applications of glyphosate to field bindweed (Convolvulus arvensis L.) in the bloom stage at rates of 2, 4, and 8 lbs. a.e. per acre resulted in at least 90 percent control through the current season. Applications of 4 lbs. a.e. per acre of glyphosate in 1974 afforded viticulturally acceptable control of field bindweed in 1974-1976. The identification of the vine's entry sites to glyphosate, the description of the spray zone and the leaf-free zone as well as the rate and timing of glyphosate to control field bindweed afford a basis for the use of glyphosate which can be injury-free and also effective.

INTRODUCTION

In New York vineyards, the problem of control of perennial weeds such as field bindweed (Convolvulus arvensis L.) is severe and extensive. That problem has not been met by the vineyard herbicides diuron, simazine, or paraquat. The control (1, 2, 3, 4, 5) of such perennial weeds by surface application of glyphosate led to an examination of the phytotoxicity of glyphosate to grapevines with the goal of developing an injury-free use of glyphosate to control perennial weeds in New York vineyards. That examination started in 1972 and is continuing. This reports some of the progress.

1/ New York State Agricultural Experiment Station (Cornell University), Geneva and Fredonia, New York.

2/ Monsanto Company, St. Louis, Missouri.

MATERIALS AND METHODS

The work was done near Fredonia, N.Y., much of it at the Vineyard Laboratory, of the New York Agricultural Experiment Station, located there. Unless otherwise stated, the variety was 'Concord'.

Two plantings of young grapevines were made for topical applications of glyphosate. Topical applications were made to: specific areas of leaves, specific segments of internodes, buds, canes, arms, trunks, trunks cut to expose phloem and xylem tissue, and roots as described below. One of the plantings was of about 200 vines each in a 13-liter container of either gravelly loam or of builders sand. After two years growth of the vines, some soil or sand was removed to expose non-suberized roots, for all vines. For half the vines the roots were covered by a one cm. deep layer of the rooting medium and then glyphosate treatments applied to the soil (or sand) surface of most of the vines.

The non-topical applications, where weed control was of concern, were made using a vineyard herbicide sprayer with a 100-gallon tank using the following specifications:

Table 1. Application Specifications for Glyphosate Application to New York Vineyards

	In-row band	Between rows
gpa	50	50
psi	35 to 40	35 to 40
nozzles	2, 8003	2, 8003
Spray ht. above vineyard floor	15	
Min. ht. of shoot base or leaf	22" to 24"	
Band width	30	60" to 78"
Wind mph	< 5	< 5

Time of application not later than end of grape bloom (90% of calyptra fallen).

Where vine injury was sought, the above sprayer, using a single-nozzle gun was used to obtain the directed application desired.

Measurements were:

Vine size	by	weight of cane prunings
Grape maturity	by	refractometer measure of total soluble solids
Grape yield	by	weight of crop per vine

Evaluations were:

Phytotoxicity symptoms	by	visual estimation of severity and extent of the symptoms
Weed control	by	visual extimation of: weed density as percent ground cover; height of the tallest 10% of the weeds

RESULTS AND DISCUSSION

Symptoms on Grapevines of Toxicity by Translocated Glyphosate

Table 2. The Symptons* of Injury by Glyphosate Translocated in Grapevines

The Tissue	The Symptom
Leaf:	
**surface	rugosity, with interveinal tissue depressed
petiolar sinus	widened to as much as 240°
**lobes	terminal lobe remains prominent; lateral lobes are irregular to absent
size	stunting
margin	irregular, frequently appearing torn
symmetry	reduced
color	interveinally chlorotic, as yellow green
location of affected leaves:	
from current season's application	apical to the point of application and usually persisting to the shoot apex
from previous season's application	primarily on leaves of non-lateral shoots with malformation increasing toward apex. On lateral shoots, malformation is less pronounced and then more severe on basal leaves

The Tissue	The Symptom
Bud	
rest breaking	very infrequent in weed control efforts
Shoot	
maturity	reduced to few or no internodes with periderm
size	stunting, over a wide range of severity
lateral shoot development	in extreme cases there is a profusion of stunted lateral shoots

* These symptoms were encountered with applications of glyphosate intended to cause injury. All such symptoms are available with application techniques described in this paper.

** These are more characteristic of glyphosate injury.

According to our experiments there is no single symptom on grapevines which is uniquely caused by glyphosate. Rather, there are some symptoms of injury, such as leaf rugosity and leaf lobing, which are unlikely to be caused by other agents; and with those more characteristic symptoms are the others such as stunting of leaves or shoots or reduced maturity of shoots which can be caused by glyphyosate as well as many other agents such as excessive cropping.

The diagnosis of injury by glyphosate requires the presence of the more characteristic symptoms along with some or most of the other symptoms.

Sites of Entry of Glyphosate for Translocated Injury to Grapevines

On the basis of the grapevine experiments with topical applications and with band treatment with glyphosate, we indicate the sites of entry and the sites of non-entry of glyphosate, based on the presence of symptoms as in Table 2.

The sites of entry are:

1. At least partially matured leaves (as more than ¼ of final size).

2. At least partially matured green internodes of shoots (as internodes at leaves as in #1 above).

3. At least partially mature buds on shoots.

The sites of non-entry are:

1. Very immature shoots and leaves (as the pale green very small leaves at the tip of the shoot near time of grape bloom). Such tissues will be killed by glyphosate.

2. Roots.

3. Canes (in the year subsequent to their being green shoots) from which shoots have been removed from the leaf-free zone prior to glyphosate application.

4. Trunks.

Table 3 shows that the sensitivity of 'Concord' grapevines to bloom-time applications of glyphosate is very high (1 lb. glyphosate in 50 gal. per acre is about 2500 ppm). The prevention of glyphosate injury to grapevines does not reside in selection of a less phytotoxic rate, but rather in the elimination of any contact of glyphosate with an entry point.

Table 3. The Response of Concord Vines in Autumn 1973 and Flower Cluster in 1974 from Whole-Vine Sprays of Glyphosate at Mid-Bloom Per Shoot in 1973. Geneva, N.Y. Exp. of W. J. Kender.

		PPM Glyphosate					
Vine Response	Season of Scoring	0	1	10	100	1,000	10,000
Foliation %	Fall 1973	80	95	80	40	7	2
Ripe nodes/cane		10	6	8	4	0	0
Rest broken		0	0	0	Severe		
Fl. cl/shoot	Spring 1974	2.3	2.0*	2.1	1.3*	Dead	Dead

* = small cl.

The Spray Zone Within the Leaf-Free Zone for Injury-Free Applications

Specifications

The spray zone is 15" above the vineyard floor. We have not experimented with various heights. The 15" height is 9" to 13" above the ridge. Such a zone is necessary for glyphosate application to weed foliage; and is adequate even with hemp dogbane plants 42" high at time of treatment. The zone of

about 9" above the spray zone should be free of shoot internodes and leaves.

The leaf-free zone includes the spray zone and is 9 or more inches higher than the spray zone. It should not contain any entry sites at the time of application, and if it does, they can be removed prior to application.

Avoidance of Entry Sites in the Leaf-Free Zone

This avoidance includes prevention of entry sites developing in the leaf-free zone by such viticultural techniques as having a training system and/or a cane length in which shoots originate at or above 36". It also includes elimination of entry sites, such as suckers; shoots on renewal trunks; and the positioning along the bottom vine of shoots which invade the leaf-free zone.

In addition to both the vine manipulation to avoid the presence of entry sites in and near the spray zone, and the suggested techniques of application, there is the matter of timing of application.

First is the choice of years of application because the difficulty of getting zero injury is probably greater for: (a) young vines with 5 to 12 shoots on one trunk; and (b) for vines of any age in a year when many suckers should be retained because of trunk injuries from cold or from fungi, than it is for a mature vine with several arms or cordons and many shoots. This requires a viticultural judgement that is not difficult, if the options are defined.

The choice of earliness of application depends on the requirements of the weed problem and of the vine problem. Glyphosate applications for control of perennial grasses can be earlier than for control of bindweed, and for hemp dogbane it is even later; but not later than the end of grape bloom as 90% of the calyptra fallen.

Weed control; using techniques applied in Table 1 and the concept of spray zone within leaf-free zone, was extraordinarily good.

Bloom time applications of 4 lbs. a.e./A of glyphosate in 1974 afforded viticulturally acceptable control of bindweed in 1974, 1975 and 1976. At the end of 1975 control was approximately 75%. Applications of glyphosate at rates of 2, 4 and 8 lbs. a.e. per acre resulted in at least 90% control in the current season.

The vine response to glyphosate applications will result from either damage to the vine or to the elimination of the weed competition. The major thesis of this paper has been that glyphosate application can be damage free, even injury free. The size of the response by grapevines treated with glyphosate, as we have described, thus depends on the amount of weed competition.

The best estimate we have is from a Concord vineyard of Mr. Stewart Dudley where annual applications of glyphosate at rates of 1, 2, 4, 8 and 24 lbs. a.e. /acre have been made in 1973-1976. With 24 lbs. a.e. glyphosate/acre there has been maintenance of vine growth and yield and no injury. With 4 or 8 lbs. of glyphosate per acre there has been a 25% increase in vine size, compared with the vine size in 1973 or with the vines receiving zero glyphosate.

CONCLUSION

The successful use of glyphosate in vineyards depends on its being used in an injury-free manner and at a time and rate which control the weeds.

The identification of the vine's entry sites, the description of the spray zone and the leaf-free zone as well as the rate and timing of glyphosate to control *Convolvulus arvensis* afford a basis for the use of glyphosate which can be injury-free and also effective.

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THE RELATION OF THE PHYTOTOXICITY OF GLYPHOSATE TO ITS INJURY-FREE USE IN VINEYARDS

Part II. Injury-free use in New York Vineyards.

R. A. Rogers[1/], T. J. Zabadal[2/], D. E. Crowe[3/] and T. D. Jordan[2/].

ABSTRACT

The isopropylamine salt of Glyphosate [N-(phosphonomethyl) glycine] was applied to vines in approximately 111 large scale trials for evaluation of perennial weed control and injury-free use in New York vineyards. Effective commercial control was obtained for the predominant perennial weed problems in New York vineyards. Phenological observations on timing of bloom, verasion, and fruit maturity indicated no differences among treatments or between treatments and check areas. Harvest information on percent soluble solids and weight per cluster indicated no differences among treatments or between treatments and check areas. It was demonstrated that glyphosate could be applied effectively and safely on a large scale basis to vineyards in New York.

INTRODUCTION

Over the past two decades the use of soil sterilant herbicides has resulted in selective control of annual weed species and certain perennials in New York vineyards. This control has resulted in a selective pressure for increased population densities of certain perennials. Consequently field bindweed (*Convolvulus arvensis* L.), hedgebindweed (*Convolvulus sepium* L), milkweed (*Asclepias syriacia* L.), hemp dogbane (*Apocynum cannabinum* L.), and quackgrass (*Agropyron repens* L. *Beauv.*) constitute the major weed problems not solved by current herbicides.

Other studies with glyphosate (1, 2, 3, 4, 5, 6) have shown commercial control of these and other perennial weed species. Although these studies show weed control, they do not demonstrate injury-free use in vineyards on a commercial scale.

1/ Monsanto Company, St. Louis, Missouri.

2/ Cooperative Grape Extension Specialist, New York.

3/ New York State Agricultural Experiment Station (Cornell University), Fredonia, New York.

The objective of this research project was to investigate not only weed control but injury-free use through large scale commercial applications of glyphosate in New York vineyards.

MATERIALS AND METHODS

A formulation of the isopropylamine salt of glyphosate was evaluated in 111 large scale trials for control of perennial weeds in New York vineyards in 1975 and 1976. These trials ranging from 1 to 5 acres were distributed throughout the major grape production areas of New York. These applications of glyphosate encompassed a wide range of soil and climatic conditions.

Listed below are the commercial grape varieties* (genus vitis) included for evaluation:

Native American Hybrids	French American Hybrids
Concord	Aurore (S. 5279)
Catawba	Cascade (S. 13053)
Delaware	Chancellor (S. 7053)
Niagara	Rougeon (S. 5898)
Ives	Chelois (S. 10878)
Dutchess	De Chaunac (S. 9549)
	Colobel (S. 8357)
	Leon Millot (Kuhlmann 194-2)
	Marechal Foch (Kuhlmann 188-2)
	Baco noir (Bacco No. 1)
	Vignoles (Ravat 51)
	Landot (Landot 4511)

*These varieties represent at least 96% of commercial grape production in New York State.

Treatments:

Roundup was applied as a sequential treatment following residual herbicide (s).

Before applying glyphosate all the suckers and shoots up to a height of 24 inches above ground level were removed.

Each plot location consisted of three treatments, each covering up to one acre of vineyard. Treatment areas within a given plot did not differ greatly in vine size, previous cropping history, susceptibility to frost injury, pruning severity or weed infestation.

Treatments Were:

1. Check Treatment - residual herbicide (diuron or simazine) followed, in some instances, by application (s) of paraquat.

2. Standard Glyphosate Treatments - residual herbicide followed by Roundup at rates of 1½ to 3.75 lb. a.e./A. Rates depended upon weeds to be controlled and the degree of infestation.

3. Glyphosate Safety Treatment - residual herbicide followed by three applications of 8 lb. a.e./A (24 lbs. a.e./A). Applications began the second week of May and were completed before the end of grape bloom. No contact herbicides were used in any glyphosate plot.

Application Notes:

All applications were made by commercial grape growers using a wide variety of commercial vineyard equipment.

Details of application techniques are as follows: GPA-30 to 60; sprayer pressure - 30 to 45 psi; spray height above vineyard floor - 15"; minimum height of shoot base or leaf - 24"; wind less then or equal to 5 mph; and ground speed 3 mph. In-row applications were 30 - 36" in width and between-row applications (when applied) were 60 - 78".

Evaluation Methods:

1. Weed Control - trials were scored on the basis of percent control 90 - 110 days and 350 - 365 days after treatment.

2. Injury-Free Use -

   a. Data was recorded for phenological events during the growing season for each treatment. These include bloom, veraison, and fruit maturity.

   b. Visual observations of vine injury were recorded throughout the project.

   c. Harvest data were collected on approximately 75% of the trials on cluster size, soluble solids, acidity, and overall crop size.

RESULTS AND DISCUSSION

Weed Control:

Results in Table 1 indicate effective commercial control of the predominent perennial weed problems in vineyards in New York. Glyphosate effectiveness on these species was dramatically greater than the standard weed control practices, which are currently being used. Use of residual herbicides in conjunction with glyphosate will provide broad spectum weed control of both annuals and perennials.

Table 1. Weed Control Results Obtained on Six Perennial Weed Species with Glyphosate.

Species	Glyphosate Rate (lb a.e./Acre)	No. of Trials	90-110 DAT	350 - 365 DAT
Field bindweed	2	45	85-90%	75-80%
Hedge bindweed	3	14	80-90%	45-55%
Milkweed	2	16	85-90%	85-90%
Hemp dogbane	5	8	70-80%	80-85%
Quackgrass	1.5	30	95%+	95%+
Virginia creeper	3	12	85-95%	80-90%
Brambles	3	7	65-70%	85%

Injury-Free Use:

Phenological observations on timing of bloom, verasion, and fruit maturity indicated no differences among treatments.

In only two of the 111 trials was there any significant leaf and shoot injury resulting from glyphosate applications. Recommended procedures were not strictly adhered to in these instances and this resulted in movement of glyphosate out of the spray zone. It should be emphasized that this level of injury-free use was possible only because of the precautions taken to remove sites-of-entry [see Shaulis, et. al. (6)] from the spray zone.

Table 2 illustrates glyphosate resulted in no significant effect on cluster weights and percent soluble solids. Negative responses, when present, were less than a three percent deviation from check samples. It is concluded that applications of glyphosate did not have any deletrious effect on any production parameters measured.

Table 2. The effect of Glyphosate on cluster weights and percent soluble solids of grape samples expressed as the average deviation from check samples in 1975 and 1976.

Year	Rate Lbs. a.e./ a.c./Year	% Soluble Solids	Grams per Cluster
1975	0	14.53*(35)**	101.88*(35)
	2	-0.07 (20)	+6.26 (19)
	4	+0.31 (28)	1.83 (21)
	8	-0.02 (3)	9.66 (3)
	24 (8+8+8 lbs.)	+0.26 (26)	2.31 (17)
1976	0	14.12*(38)	106.89*(38)
	2	+0.02 (13)	+5.40 (16)
	4	-0.02 (23)	-1.60 (25)
	8	+0.77 (3)	-2.70 (4)
	24 (8+8+8 lbs.)	-0.42 (11)	+3.88 (12)

*Represents the average value per year for percent soluble solids and weight per cluster in check areas. In each case data are deviation from check within variety and then such deviations between varieties are averaged.
**Numbers in parenthesis represents the number of trials.

CONCLUSION

It has been demonstrated through repeated large scale applications in 1975 and 1976 that glyphosate can be applied both safely and effectively to grape vines in New York.

Applications should be made according to the spray zone (15" above vineyard floor) within leaf-free zone (24" above vineyard floor) concept developed by Shaulis et. al. [Part I, (6)].

ACKNOWLEDGEMENTS

The technical assistance by Mrs. Sheldon Hubbard is much appreciated. This report was possible only by the extensive cooperation received from fieldmen, processors, and grape growers in New York.

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EVALUATING INTERNAL DISCOLORATION OF POTATOES USING A REFLECTION COLOR AND GLOSS METER.

by R. A. Ashley[1]

ABSTRACT

The severity of internal discoloration of potato tubers was determined using a Photovolt Model 670 reflection color and gloss meter. Use of a green glass filter gave the best resolution of differences over a range of potato samples showing from no to severe internal discoloration. The use of a red glass filter held some promise for high resolution among samples showing slight discoloration.

INTRODUCTION

The evaluation of internal discoloration of potato tubers has been approached with a variety of rating systems. Sieczka (2) rated tuber samples as simply showing internal discoloration or not. This system has very good reproducibility and can be used effectively by researchers with limited experience but does not assess the severity of injury. Murphy and Goven (1) rated internal discoloration as being slight moderate or severe. This system adequately assesses the magnitude of the injury but relies heavily on the experience of the user for standards and reproducibility.

During 1976 experiments were conducted at the University of Connecticut to evaluate the use of a reflection color and gloss meter for determining the severity of internal discoloration in potatoes.

MATERIALS AND METHODS

Potato tuber samples which had previously been visually evaluated for internal discoloration were obtained from H. J. Murphy, University of Maine, Orono. Samples were provided representing slight, moderate and severe discoloration. Tuber samples from Connecticut field plots showing no internal discoloration were also used.

Potato tubers were thoroughly washed and allowed to dry. Six slices approximately 3 mm thich were taken from the stem end of the tubers using a chip cutter. The cut surface of the potato tuber was then used to determine the degree of discoloration present.

Discoloration was determined using a Photovolt Model 670 reflection color and gloss meter with moveable search unit. A green glass filter was placed in the search unit and the search unit placed on a plain white card. The reflectance reading from a white card was adjusted to 100%. The search unit was then placed on the cut surface of the potato, moved in a circular pattern to scan the entire cut surface and the minimum reflectance reading recorded. The procedure was then repeated using a blue and a red glass filter. Ten samples of tubers

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showing no internal discoloration, slight discoloration, moderate discoloration or severe discoloration were measured. The percentage reflectance from each tuber was measured with each glass filter.

RESULTS AND DISCUSSION

Highly significant differences were obtained from reflection color readings of cut surfaces of potato tubers previously separated by visual ratings into groups showing no, slight, moderate or severe internal discoloration (Table 1.). Using a green filter on the search unit reflection readings of 66, 63, 57 and 49 were obtained from samples adjudged to show no, slight, moderate and severe internal discoloration respectively. A significant correlation between decreasing reflection color readings and increasing internal discoloration was obtained ($r = -.86$). The greatest variations in readings occurred where no internal discoloration was detected by visual ratings.

Use of blue or red filters did not give significant resolution between all levels of visually rated injury. With the blue filter significant differences were not recorded between slight and moderate rated tubers, while with a red filter differences between moderate and severe injury were not detectable. Resolution between no injury and slight injury appeared greatest when using the red filter and this procedure may have merit where detection of minor discoloration is the primary concern.

Table 1. Evaluation of internal discoloration of potato tubers using a Reflection color and Gloss meter.

Visual Rating	Percent Reflection		
Internal Discoloration	Green	Blue	Red
None	66	57	81
Slight	63	52	73
Moderate	57	48	64
Severe	49	40	64
LSD 1%	2.7	7.9	4.6

ACKNOWLEDGMENT

The author wishes to thank Mr. Hugh J. Murphy, University of Maine, Orono, for his cooperation and assistance in this work.

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UBI 252, A CANDIDATE FOR VINE KILLING IN POTATOES

G. W. Selleck[1/]

ABSTRACT

UBI-252 in combination with surfactant UBI 1126 has shown promise as a vine desiccant in tests during 1975-77, on several cultivars of potatoes. During 1977, UBI-252 at .5 and 1 lb/A in combination with surfactants UBI-1126 and UBI-1201 were applied to cultivars Superior, Chippewa, and Hudson. Other defoliants used were diquat at .25, .5, 1. and 1.5 lb/A, paraquat 0.5 lb, endothal 1 lb, ametryn 1.6 lb, dinoseb at 1 and 2 lb, endothal + paraquat (.5 + .25 lb) and endothal + diquat (.5 + .25 lb/A. Second applications of UBI-252 at .5 lb, diquat at .25 lb and dinoseb at 1 lb/A were applied five days after the first with a tractor-mounted sprayer delivering 100 gpa at 375 psi.

Table 1. Conditions at time of treatment.

Variety	Appl. date	R.H. %	Wind mph	Temp.°F.	Soil
Superior	8/10	75	10-15 SW	80	dry
Superior	8/16	80	5-10 SW	75	moist
Chippewa	8/26	30	3-5 SW	70	moist
Chippewa	9/1	70	3-5 SW	85	moist
Hudson	9/2	40	5-7 SW	85	moist
Hudson	9/8	30	3-5 NE	70	dry

UBI-252 at 1 lb/A, diquat 1 and 1.5 lb, endothall 1 lb, paraquat .5 lb and endothall + paraquat (.5 + .25 lb/A) provided the most rapid leaf-kill 5 DAT[2] in two of three varieties. These treatments except endothall also provided the most rapid stem kill 5 DAT. 'Superior' vines were easier to kill despite application one month earlier than on Chippewa or Hudson. Treatments which killed 99% or more of the leaves and 90% or more of stems of three potato cultivars 14 DAT are listed in Table 2.

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Table 2. Treatment in lb/A to provide 99% leaf and 90% stem kill of potatoes 14 days after treatment.

Chippewa	Superior	Hudson
diquat .25 + .25, 1, 1.5 paraquat .5, ametryn 1.6 endothall 1 endothall .5 + paraquat .25 endothall .5 + diquat .25 UBI-252 1 + .5 dinoseb 2, or 1 + 1	UBI-252(.5) +UBI-1126 (.25) + UBI-1201 (2) & other combinations diquat 1. 1.5 paraquat .5, ametryn 1.6, endothall 1 ametryn .8 + dinoseb 1	UBI-252 as for Superior diquat 1, paraquat .5 endothall .5 + paraquat .25 ametryn .8 + dinoseb 1

2/Days after treatment

BUTHIDAZOLE USES FOR INDUSTRIAL VEGETATION CONTROL

John G. Connell 1/

ABSTRACT

Buthidazole has been evaluated as a total vegetation control herbicide for five years in many parts of the country. Since May 1976 testing has been done under an Experimental Use Permit recently extended through the 1978 season. Label submission has also been completed. Results from small plot and commercial applications indicate that buthidazole is effective preemergence to weeds as well as postemergence. In Virgin areas, 6 to 12 pounds active ingredient per acre will give excellent control of annual and perennial weeds. Once control is established, annual retreatment can be done with 1.5 to 3 pounds active ingredient per acre for three months' control. Early spring retreatment applications require three to six pounds active ingredient per acre for seasonal control.

Buthidazole is a heterocyclic nitrogen derivative acting mostly by photosynthetic inhibition. It reaches the site of activity by both leaf and root absorption. Buthidazole is formulated as a 75% wettable powder. Some small plot testing has also been done with a 5% granular formulation. A liquid formulation is anticipated for spot treatment of brush.

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TEBUTHIURON FOR CONTROL OF MULTIFLORA ROSE

L. B. Lynn, W. E. Rogers and M. L. Jones 1/

ABSTRACT

Tebuthiuron provided effective control of multiflora rose in hedgerow plantings and as escaped plants in a pasturefield. Rates of 2 lb/A and above formulated as 20% pellets provided 100% control 12 to 16 months after either fall or spring application. Tebuthiuron 20%P caused 30% stand reduction in orchardgrass seeded 10 months after boradcast application at 2 lb/A. A longer waiting period may be required before reestablishing pasture grasses. A single large tebuthiuron pellet (6 LBAP) containing 5 grams active ingredient provided control of individual multiflora rose plants when placed at the drip line.

INTRODUCTION

Tebuthiuron, N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea, is a herbicide marketed by Elanco Products Company for total vegetation control on railroad ballast and industrial sites. A previous report to this society (2) indicated its efficacy in controlling a wide variety of herbaceous and woody plant species. Other reports have described the physical-chemical characteristics of tebuthiuron and its usefulness as an herbicide for control of rangeland brush (4,5). EPA has recently granted a temporary tolerance to permit its continued development as an herbicide for range and pastureland.

Multiflora rose (Rosa multiflora) has become a widespread and troublesome weed species in pastures in the northeast and midwestern states. In the 1930's the U.S. Soil Conservation Service promoted its establishment for erosion control and as living livestock barriers (1,3). Unfortunately multiflora rose has spread rapidly from the planted areas. It has become such a troublesome weed that many states have passed legislation for its control.

The purpose of these studies was to determine the efficacy of tebuthiuron for control of multiflora rose. Time of application, rate of application and pasture reestablishment were evaluated.

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MATERIALS AND METHODS

Tebuthiuron was evaluated as 20 percent, 1/16 inch extruded clay pellets (20%P) and as 3/4 inch compressed clay pellets. Each compressed pellet contains 5 grams active tebuthiuron which is sufficient to provide 6 pounds of active ingredient per 80 square feet. The compressed pellets are referred to as 6 LBAP (pound per acre pellets).

Four experiments were conducted in Ohio at a site where multiflora rose was growing in hedgerows, and as scattered plants in an adjacent pasture. The hedgerows were planted to multiflora rose and the plants in the pasture were escapes. In two experiments control was evaluated in the hedgerow planting. One was treated in the fall of 1975 and the other in the spring of 1976. Plots were nonreplicated, 10 feet wide by 100 feet long. The 20%P formulation was applied using a hand cranked cyclone spreader. At the same site two experiments were initiated for control of escaped multiflora rose plants. In one experiment both pellet formulations were applied to individual plants in the spring of 1976. Each treatment was replicated on three plants. The 6 LBAP formulation was applied as a single pellet at the drip line of each plant. The 20%P formulation was uniformly distributed by hand under each plant out to the drip line. In the second experiment only the 20%P formulation was evaluated. Treatments were broadcast applied in the fall of 1975 to 1/4 acre, nonreplicated plots using the hand cranked cyclone spreader. Orchardgrass (Dactylis glomerata) was seeded in these plots 12 months after treatment application.

In the spring of 1975 tebuthiuron was applied to a heavy thicket of multiflora rose in one acre nonreplicated plots in Maryland. Only the 20%P formulation was evaluated at this site. Application was with the hand cranked cyclone spreader.

RESULTS AND DISCUSSION

Tebuthiuron at rates of 2 lb/A and above provided control of multiflora rose. There was little difference in control whether application occurred in the fall or spring (Table 1). Fall application provided slightly earlier control during the following growing season, but the eventual result was the same, i.e. excellent control of multiflora rose. Control of individual rose bushes was obtained with the 6 LBAP as shown in Table 2. Control was much slower than with the 20% extruded pellets. The smaller, 20% pellets were evenly distributed under each rose bush, while only one of the larger 6 LBAP was placed at the drip line of each plant. Since tebuthiuron is taken up through the root system, better distribution of the smaller pellets and slower breakdown of the larger pellet probably accounts for the difference in time required for control. Although slower acting, the 6 LBAP has the desirable attribute of causing less damage to established ground cover.

Broadcast fall applications of tebuthiuron 20%P provided complete control of escaped multiflora rose plants at the lowest rate evaluated, 2 lb/A (Table 3). This rate resulted in 40% kill of ground cover consisting principally of broomsedge (Andropogon virginicus), goldenrod (Solidago spp.) and white clover (Trifolium repens). A 70% stand of orchardgrass was obtained in the 2 lb/A plot when seeded 10 months after treatment application. It may be necessary to provide a longer waiting period before reseeding. This does not appear to be a serious disadvantage. Despite the fact that the experimental site was on a fairly steep grade, the higher rate of tebuthiuron provided 90+% kill of ground cover with no soil erosion problem to date. Higher rates of tebuthiuron with 90+% kill of ground cover have had no soil erosion problem to date. Research is continuing to determine optimum time for reseeding treated pastures.

Results of tebuthiuron application to a heavy thicket of multiflora rose in Maryland agreed well with that obtained in Ohio. This experiment was terminated after 6 months because the site was cleared by the cooperator.

Multiflora rose was controlled by the lowest rate of tebuthiuron (2 lb/A) evaluated in these experiments. The only advantage in using higher rates was more rapid kill, probably due to increased numbers of pellets per unit area.

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Table 1. Percent control of multiflora rose in hedgerows at the Ohio location.

		Percent Control At Indicated Time After Application					
		Fall Applied - October 1975			Spring Applied - April 1976		
Treatment	Rate (lb/A)	6 mo 4/76	9 mo 7/76	12 mo 10/76	3 mo 7/76	6 mo 10/76	16 mo 8/77
Tebuthiuron 20%P	2	75	100	100	75	92	100
	4	53	95	98	83	93	100
	6	75	98	100	98	97	100

Table 2. Percent control of individual multiflora rose plants at the Ohio location.

		Percent Control At Indicated Months After Spring Application		
Treatment	Rate (lb/A)	3 mo	6 mo	16 mo
Tebuthiuron 20%P	6	99	99	100
Tebuthiuron 6 LBAP[1/]	6	63	80	100

1/ The 6 LBAP formulation is a large compressed clay pellet containing 5 grams active tebuthiuron per pellet or 6 lb/A placed on 8x10 foot centers.

Table 3. Percent control of multiflora rose, kill of ground cover and establishment of orchardgrass following broadcast application in the Ohio pasture

Treatment	Rate (lb/A)	Activity 10 months after Fall Application: Percent Control of Multiflora Rose	Activity 10 months after Fall Application: Percent Kill of Ground Cover 1/	Percent 2/ Orchardgrass Stand 12 Months After Application
Tebuthiuron 20%P	2	100	40	70
	4	100	90	50
	6	100	95	15

1/ Ground cover consisted principally of broomsedge, goldenrod and white clover.

2/ Percent stand compared to an assumed 100 percent stand in the control. Plots were rotary mowed and orchardgrass drill seeded 10 months after tebuthiuron application.

Table 4. Percent control of multiflora rose in a heavy thicket in Maryland.

Treatment	Rate (lb/A)	Percent Control At Indicated Months After Spring Application: 4 months	6 months 1/
Tebuthiuron 20%P	3	40	80
	6	100	100

1/ This experiment was terminated after 6 months because the cooperator cleared the land.

CLAMOR FOR ECONOMY MAY CAUSE WASTE IN RIGHT OF WAY MANAGEMENT

John B. Middleton 1/

Forty years have passed since the isolation and utilization of 24-D as a means of killing or injuring woody vegetation. Rightfully so, 24-D and the synthetic herbicides which have evolved have been referred to as the best money saver in power utility right of way maintenance. During these past years many, many new formulations and approaches were tried, tested, expanded in use or discarded. Techniques of application started out with hopes of a magic cure-all and slowly settled to reality. Much of the present state of the art can be attributed to chemical companies, applicator contractors, power utility foresters and other supervision as well as colleges and universities.

The first research with herbicides with which I am familiar was at Penn State University under the guidance of Dr. William C. Bramble who is currently retired from Purdue University. This research was measuring the effectiveness of ammate (ammonium sulfamate) in killing standing canes and cut stumps of selected species by placing the powder or crystals in frills, cups cut into the wood and sprinkling on the cut stump. This initial study with which I am familiar was followed by more sophisticated and comprehensive works.

Dr. Bramble still returns to continue the largest, oldest and most comprehensive study in the U. S. A. on the use of herbicides in relation to wildlife food and cover. Dr. Bramble and his consulting associate, Dr. William R. Byrnes, Purdue University, started this research on a Pennsylvania Electric Company right of way near Penn State University in 1951. The exceptional futuristic thinking of Dr. Bramble on this research is constantly brought to light through the pertinence and value of every aspect of the study today. No major changes have been made and none are anticipated.

The first power utility application that I recall was on the West Penn Power company. This was the original blanket spray with everything covered. A lot of the effects were dramatic and flagrant off and on the right of way. Mr. Fred Ashbaugh who headed up this program was in charge. Fred was a pioneer in the use of herbicides and made many significant contributions to chemical management of rights of way. Fred is now deceased but the efforts in herbicides that he put forth is a worthwhile memoriam to his life. The first ugly work that I saw was a noteworthy start. Fred would now be a leader in aesthetics and concern for the environment if my guess is right.

My first experience as a power utility forester with herbicides was in 1952. I was working in the Youngstown division of Ohio Edison Company. We had Penn Line Service apply blanket coverage to a 138 KV right of way between Youngstown and the Ohio River. It was ugly. The relief of finding a tool to combat brush at that time was an event for celebration. The blanket spray did an excellent short-term job and was fast and inexpensive. I believe it cost $28.00 an acre. Personnel to mechanically cut brush was nearly non-existant. What a boom -- What a tool.

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From the beginning of the 1950's there was much activity and clamor in the herbicide fields. Utility people were constantly contacted and offered assistance by chemical manufacturers, chemical applicators as well as college and university people. I remember much valuable help from Amchem, DOW, Du-Pont, Hercules, Monsanto and other chemical companies. These chemical companies employed intelligent and energetic representatives. They were always offering help. They recognized a market and wanted to sell. Today we rarely see any of them. Their market is established. Applicator companies most active and working on Pennsylvania Electric Company property were Asplundh, Davey, Penn Line Service and others. These applicator contractors are still busy on a limited scale but it is far short of the many visits, demonstrations, field trips and meetings that they worked on before territories of activity become established. These applicator contractors had outstanding personnel available to assist utility people. They made their contribution to the advancement of the usage of herbicides.

Herbicides started out with 24-D only on the market. Then, 245-T followed. These materials had varying effectiveness. Peoples sensitivity for the environment began to show up. Low volatile esters came on the market. These materials established the herbicides in power utility management. Amine materials were formulated. The lack of volatility was a great help. Combinations of 24-D and 245-T were formulated. Many a heated argument was started but never ended on the advantages and disadvantages of these simple formulations. Ammate was successfully used by many utilities. More sophisticated chemicals were formulated, field tested and then either dropped or their use expanded. Some of these materials which are still available and used are formulations with propionic acid, benzoic acid, picolinic acid, etc. Every new chemical and nearly every new effort brought about advancement in the art.

Techniques of application were originated, developed and tried. Many of the techniques of application are available to the right of way manager today. These techniques are blanket spray, waterborne stem-foliage, oil and water, basal cane, selective basal, dormant selective basal, stump treatment and helicopter application.

The power utility personnel in charge of right of way management today has an excellent selection of tools to properly handle any problem. The greatest need of the manager is to understand the many variables that are a part of the problem and how to properly use the excellent bag of tools that are available.

The greatest strides and accomplishments have been made by knowledged people who work with nature and vegetation. Native lower growing species can be manipulated in practically every situation to produce a well appearing, functional and economic right of way.

Successful right of way management must be analyzed over the long run. Thinking in terms of less than twenty (20) years is misleading and will bring about false economies.

It is the challenge and responsibility of every forester, arborist, engineer, manager in charge of to develop through the use of knowledge, chemical materials, techniques of application and tool the best possible right of way system for the power utility.

The clamor for economy must not overshadow the long range results of judicious right of way management.

RIGHT OF WAY MANAGEMENT INVOLVES PLANTS AND PEOPLE

Charles J. Olenik 1/

Within the past few years there seems to have been more and more negative information being handed out by all segments of the news media in regard to the use of herbicides and pesticides. Although this information is probably true as it relates to the specific accounts, it not only has an adverse effect on the material or chemical in the headlines, but also seems to give the public the idea that all herbicides are a threat to their well being or the environment.

Unfortunately this attitude has shown up with increasing occurrence when property owners are initially contacted to obtain permission to chemically treat the undesirable tree species growing on a right of way that crosses their property. On certain rights of way, landowner refusal to allow the use of herbicides on their property has necessitated that a cutting operation be used instead of a herbicide treatment. Cutting of course, is more costly and time consuming and does not achieve the desired results because of the resprouting of each cut stump and rapid growth of the sprouts into the conductors.

The utility company can, by legal means and right of way agreements, solve this problem and go ahead with their chemical program and in some cases this may be the only outlet available to keep a section of right of way free of brush and trees that can cause outages. However, the legal process is often times slow and leaves a lot to be desired as far as public relations with the landowners and the utility company are concerned.

There are several things a right of way manager can do in order to change the mind of a landowner that in most cases has the wrong information about herbicides that are presently used on rights of way to control the growth of undesirable tree species:

1. If a chemical technique other than a selective basal application is planned for use on a right of way then make a change and substitute the selective basal method. Most landowners object least to this type of application.

2. Explain that herbicides with proper application can be used safely without any undesirable effects to wildlife or the environment and if necessary back up the statements with documentation and studies done by chemical companies, utility companies, as well as government agencies, and universities.

3. If necessary take the landowner on the right of way and show him exactly what the spray crews are doing on the right of way as far as application of chemical, stems treated, stems not treated, and the volume of material applied.

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4. In some cases landowner refusal to agree to a chemical treatment isn't really the dislike of herbicides but stems from the fact that the owner feels he was cheated by the utility or a construction crew when a power line was built. This may or may not be the case, but to the property owner this is a good way to get back at the utility company.

   In this situation, if the right of way manager can get to the root of the problem the situation can be resolved and the chemical program can go ahead.

In years to come there is the possibility of further restrictions placed on the use of herbicides if there is a cry from the public to do so. We as right of way managers can help delay or prevent further restriction of herbicide use by educating those people who have the wrong information or wrong ideas about chemical application on our rights of way. Right of way management not only involves plants, but involves people too.

GLYPHOSATE FOR WEED CONTROL IN SHADE TREE NURSERIES

Chiko Haramaki[1]

ABSTRACT

Plantings of honeylocust, pin oak. red maple, red oak, and sugar maple were sprayed with glyphosate, simazine, and mixtures of glyphosate and simazine. Effective kill of annual and perennial weeds was obtained with post emergent applications of glyphosate at 2 and 4 lb ai/A and residual weed control obtained by adding 2 lb ai/A of simazine to the glyphosate. There was little or no difference in the growth of the trees sprayed with glyphosate and/or simazine and those not treated.

INTRODUCTION

Many small nurseries as well as some large ones are troubled by rampant weed growth which compete with the trees for space, light, nutrients, fertilizer and water. The unsightly weeds are present because of several reasons including that many of the most desirable times to apply herbicides coincide with the busy planting or digging seasons, lack of planning, lack of labor and the lack of knowledge. Glyphosate (N-(phosphonomethyl)glycine) has shown considerable promise as a postemergence herbicide in ornamental plantings (1,2,3, 4,5,6,7,8,9,10,11). Woody plants vary in their tolerance to glyphosate (2,3,6, 7,8,9,11). Glyphosate has been used to kill brambles if applied at the proper time of the year (10). It has also been shown to kill basal sprouts of several shade trees at 3 to 6 lb ai/A without injuring the rest of the tree (5). New growth soon covered some woody plant species which had their tips injured by glyphosate negating the initial damage (8).

Effective control of existing annual and perennial weeds has been demonstrated by several researchers (2,6,9,11). Where glyphosate alone had been used, there was good kill of the existing weeds which was soon infested by newly germinating weeds (1). The use of glyphosate plus a preemergent herbicide such as simazine (2-chloro-4,6-bis(ethylamino)-s-triazine) gave good control of existing weeds and subsequent germinating weeds (3,11).

The objectives of the experiments were to determine the effect of spraying glyphosate on the lower portion of the trunk of young shade trees, and on weed control of existing annual and perennial weeds and newly germinating weeds.

METHODS AND MATERIALS

The experiment was conducted in the nursery at the State Correctional Institution at Rockview, Bellefonte, Pennsylvania. The shade trees which ranged from one-half inch diameter to approximately two inches were growing in a Murrill silt loam. The shade trees used were honeylocust (Gleditsia triacanthos L.), pin oak (Quercus palustris Muenchh.), red maple (Acer rubrum L.), red oak (Quercus rubra DuRoi), and sugar maple (Acer saccharum Marsh.) There were 3 to 4 trees

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per plot. The five areas of the nursery used had not been cultivated or mowed and was covered with annual and perennial grasses and broadleaved weeds.

Table 1. Effect of Post Emergence Applications of Glyphosate Sprays on Weed Prevalence in Honeylocust Plantings, 1977.

	Quackgrass*		Grasses*		Broadleaves*		Overall*			Weed Height**	
Rate	7 wk	14 wk	7 wk	14 wk	7 wk	14 wk	0	7 wk	14 wk	7 wk	14 wk
0	0	0	1.3	1.0	5.3	6.7	4.3	6.7	7.6	1-3	1-3
1#/A	0	0	0.3	2.7	2.3	3.7	5.0	2.7	6.3	½-2	½-3
2#/A	0	0	0	1.0	1.2	3.0	4.3	1.2	4.0	0-2	½-1
4#/A	0	0	0	0.3	0.5	1.7	5.7	0.5	2.0	0-2	½
0+2#/A	0.7	1.0	1.3	2.0	3.3	4.3	5.3	4.7	6.3	1-3	½-3
1+2#/A	0.3	0	0.3	2.7	2.0	1.7	5.3	2.3	4.3	0-2	½-2
2+2#/A	0	0	0.2	1.0	2.3	2.0	4.3	2.3	3.0	½-2	½-2
4+2#/A	0	0	0	1.0	0	0.7	5.3	0	1.7	½	½

*0 = no weeds, 10 = 100% weed coverage.

**Height in feet.

Table 2. Effect of PostEmergence Application of Glyphosate Sprays on Honeylocust, 1977.

	Trunk Diameter*		Leaf**		Twig**		Bark**	
Rate	6-16	9-26	6-16	9-26	6-16	9-26	6-16	9-26
0	1.76	1.80	0	0	0.94	0.72	0	0
1#/A	1.54	1.58	0	0	1.33	1.02	0.33	0
2#/A	1.25	1.31	0.10	0	0.80	0.92	0.33	0
4#/A	1.39	1.50	0.17	0	1.25	1.19	0.78	0
0+2#/A	1.48	1.44	0.33	0	1.16	0.77	0.11	0
1+2#/A	1.50	1.63	0.11	0	1.00	0.89	0	0
2+2#/A	1.33	1.41	0.11	0	0.72	0.99	0.50	0
4+2#/A	1.38	1.38	0	0	1.00	1.11	0.78	0

*Trunk diameter in inches, two feet above soil line.

**0 = no injury, 5 = dead.

Table 3. Effect of Post Emergence Applications of Glyphosate Sprays on Weed Prevalence in Pin Oak Plantings, 1977.

Rate	Quackgrass*		& Grasses*		Broadleaves*		Overall*			Weed Height**	
	7 wk	14 wk	7 wk	14 wk	7 wk	14 wk	0	7 wk	14 wk	7 wk	14 wk
0	0.7	0	0.7	0.3	2.6	2.3	2.7	3.6	2.7	1-3	½-3
1#/A	0.3	0	0.7	0.7	0.7	1.0	1.3	1.3	2.0	1-2	1-2
2#/A	0.3	0	0.3	0.3	1.0	1.3	1.7	1.7	1.7	½-4	½-2
4#/A	0.3	0.3	0.7	1.0	1.0	1.7	3.3	1.7	2.7	1-4	½-3
0+2#/A	0.7	0.3	0.7	1.7	1.7	3.0	3.0	2.3	4.7	1-5	1-3
1+2#/A	0.8	0	0.8	1.7	1.2	1.7	3.0	2.0	3.3	1-4	1-3
2+2#/A	0	0	0	0	1.0	1.0	1.3	1.5	1.0	1-3	½-3
4+2#/A	0	0	0	0	0	0.3	1.7	0.7	0.3	1-2	½-2

*0 - no weeds, 10 - 100% weed coverage.

**Height in feet.

Table 4. Effect of Post Emergence Applications of Glyphosate Sprays on Pin Oak, 1977.

Rate	Trunk Diameter*		Leaf**		Twig**		Bark**	
	6-16	9-26	6-16	9-26	6-16	9-26	6-16	9-26
0	1.68	1.81	0	0	1.94	1.69	0	0
1#/A	1.45	1.46	0	0	2.10	1.60	0	0
2#/A	1.77	1.86	0	0	1.67	1.42	0.11	0
4#/A	1.32	1.33	0.30	0	2.00	1.76	0	0
0+2#/A	1.42	1.46	0.80	0	2.19	1.67	0	0
1+2#/A	1.61	1.68	0.80	0	2.36	1.84	0	0
2+2#/A	1.42	1.40	0	0	2.33	1.92	0	0
4+2#/A	1.62	1.68	0	0	2.66	2.61	0	0

*Trunk diameter in inches, two feet above soil line.

**0 - no injury, 5 - dead.

On June 17, 1977 the pin oak, red maple, red oak, and sugar maple plots were sprayed. At the start of the herbicide application, the air temperature was 81°F, the soil surface was 80°F, the soil 2 inches below the surface was 68°F, the soil was dry, the sky was hazy and there was no wind. At the conclusion of spraying the air temperature was 72°F, the soil surface was 78°F, and the soil 2 inches below the surface was 66°F and the sky was cloudy. The spraying was stopped because of a possibility of showers and there was a heavy thunder shower approximately an hour after the spraying was stopped. The honeylocust plots were sprayed on June 20, 1977 and the sky was clear and sunny and the soil was dry. The spray was applied with a controlled pressure CO_2

sprays with the boom held approximately two feet above the ground and at the rate of 140 gallons per acre. In each species block the basal portion of the trunk and the weeds were sprayed with glyphosate at 1, 2, and 4 lb ai/A and with a glyphosate and simazine mixture at the rates of 0 plus 2, 1 plus 2, 2 plus 2, and 4 plus 2 lb ai/A. There was a control plot in each replication and each treatment was replicated three times for each tree species. The plot size was 4 by 10 feet.

Table 5. Effect of Post Emergence Applications of Glyphosate Sprays on Weed Prevalence in Red Maple Plantings, 1977.

	Quackgrass*		Grasses*		Broadleaves*		Overall*			Weed Height**	
Rate	7 wk	14 wk	7 wk	14 wk	7 wk	14 wk	0	7 wk	14 wk	7 wk	14 wk
0	4.3	4.3	5.0	7.0	1.7	1.6	5.3	6.7	8.6	1-2	½-2
1#/A	3.0	4.3	4.0	7.0	1.3	0.6	4.0	5.3	7.6	1-2	½-2
2#/A	0.3	1.6	2.0	4.3	1.0	0.3	4.0	3.0	4.6	½-2	½-1
4#/A	2.0	4.0	3.0	6.3	0.7	0	4.7	3.7	6.3	½-2	1-1½
0+2#/A	3.7	5.3	3.7	5.7	1.0	0.7	4.0	4.7	6.3	1-3	½-1½
1+2#/A	2.0	4.6	2.3	5.7	1.3	1.0	4.0	3.3	6.3	2	½-2
2+2#/A	1.7	2.3	1.7	2.3	2.0	2.0	4.7	3.7	4.3	1-3	½-3
4+2#/A	0.5	1.3	0.5	2.0	0.2	0.3	3.7	0.7	2.3	½	½-1

*0 = no weeds, 10 = 100% weed coverage.

**Height in feet.

Table 6. Effect of Post Emergence Applications of Glyphosate Sprays on Red Maple, 1977

	Trunk Diameter*		Leaf**		Twig**		Bark**	
Rate	6-16	9-26	6-16	9-26	6-16	9-26	6-16	9-26
0	0.66	1.03	0.83	0.10	0.50	0	0	0
1#/A	0.78	0.83	0.87	0.46	0.23	0	0.17	0
2#/A	0.87	0.97	1.08	0.33	0.25	0	0.13	0
4#/A	0.84	0.89	1.07	0.25	0.25	0.25	0	0
0+2#/A	0.93	1.05	1.16	0.78	0.35	0	0	0
1+2#/A	0.94	1.12	0.83	0.56	0.33	0	0.33	0
2+2#/A	0.88	1.01	1.20	0.35	0.47	0	0.32	0
4+2#/A	0.86	0.98	0.85	0.95	0.20	0	0.67	0

*Trunk diameter in inches, two feet above soil line.

**0 = no injury, 5 = dead.

RESULTS AND DISCUSSION

On August 3, 1977 and September 26, 1977 the plots were examined. The predominant weeds in decreasing order of frequency which were present in the control plots were quackgrass (Agropyron repens Beauv.), smooth crabgrass (Digitaria ischaemum Muhl.), Canada goldenrod (Solidago canadensis L.), annual fleabane (Erigeron annuus Pers.), common ragweed (Ambrosia artemisiifolia L.) yellow woodsorrel (Oxalis stricta L.), hairy galinsoga (Galinsoga ciliata Blake) and rough cinquefoil (Potentilla norvegica L.).

Seven weeks after the herbicides were applied good control of quackgrass was observed in plots treated with glyphosate at 2 and 4 lb ai/A and mixtures of glyphosate and simazine at 2 plus 2 lb ai/A and 4 plus 2 lb ai/A. Reasonably good weed control was observed in plots treated with glyphosate at 2 and 4 lb ai/A and in those plots treated with a mixture of glyphosate and simazine at 2 plus 2 and 4 plus 2 lb ai/A. Many grass and broadleaf weed seedlings started to grow in the treated plots by the seventh week.

Fourteen weeks after herbicide application fair weed control was observed in the plots treated with 4 lb ai/A glyphosate and a glyphosate and simazine mixture at 4 plus 2 lb ai/A. Smooth crabgrass had started to heavily infest the plots which had been treated with the higher rates of glyphosate.

The shade trees were examined prior to the application of herbicides. The diameter of the tree trunks were measured and the leaves, twigs and bark were checked for injury. The trees were reexamined on September 26, 1977 which was approximately 14 weeks after herbicide application. A rating scale of 0 to 5 was used in which 0 was no injury, 1 was 2 percent injury, 2 was 5 percent injury, 3 was 25 percent injury, 4 was 50 percent injury and 5 was 100 percent injury or dead.

The honeylocust trees increased slightly in trunk diameter over the summer. The leaves exhibited little or no injury prior to and after treatment. There were a number of dead twigs prior to herbicide treatment and there was little or no change in the amount. There was little or no bark injury prior to the spraying and after 14 weeks the bark on the treated honeylocust trees appeared about the same as the untreated.

The trunk diameter of the pin oak trees made little or no growth over the summer regardless of treatment. The leaves exhibited little or no damage before or after treatment. There were a number of dead twigs on the trees and the amount was about the same 14 weeks later. The trees less than 1½ inches in diameter had smooth olive green bark while those larger had brown bark on the lower portion of the trunk. There was no visible differences between the treated trees and the control.

The diameter of red maple trunks increased slightly during the summer months regardless of the treatment. The leaves at many of the shoot tips were cupped and the internodes at the end of these stems were much shorter than a normal shoot. The cupped leaves and short internodes were found on trees in all treatments and controls. The twigs showed no injury in all plots other than the short internodes at the stem tips. There was no injury on the bark before or after herbicide application on any of the trees.

The trunk diameter of the red oak trees increased slightly in most of the trees. The red oak leaves showed no injury before or after herbicide application. Some of the twigs showed slight injury before spraying but by the end of summer no injury was present. No injury was observed on the red oak bark before or after herbicide application.

The trunks of sugar maple trees grew slightly over the summer in all treatments and controls. The leaves prior to the herbicide application had little or no injury but 14 weeks later almost all of the trees almost all of the trees had cupped leaves at the ends of the stems regardless if the trees had been sprayed with herbicides or not. Little or no injury was observed on the twigs before or after treatments. The sugar maple bark displayed no injury before or after herbicide application.

Effective kill of annual and perennial weeds can be obtained with applications of glyphosate at 2 and 4 lb ai/A and residual weed control can be had by adding 2 lb ai/A of simazine to the mixture. There was little or no difference in the growth of the trees sprayed with glyphosate and/or simazine and those not treated.

Table 7. Effect of Post Emergence Application of Glyphosate Sprays on Weed Prevalence in Red Oak Plantings, 1977.

	Quackgrass*		Grasses		Broadleaves		Overall			Weed Height**	
Rate	7 wk	14 wk	7 wk	14 wk	7 wk	14 wk	0	7 wk	14 wk	7 wk	14 wk
0	1.7	1.3	1.7	1.7	2.3	2.7	3.0	4.0	4.7	1-2	1-3
1#/A	1.7	0.7	1.7	1.0	2.0	3.7	3.0	3.7	4.7	1-2	½-2
2#/A	2.0	0.7	1.3	1.0	1.3	1.3	1.3	2.3	2.3	1-2	½-1
4#/A	0.7	0.3	1.0	0.3	0.3	1.0	3.3	1.7	1.3	1	1
0+2#/A	1.7	2.3	2.0	2.3	1.7	1.3	3.0	3.7	3.7	1-2	½-2
1+2#/A	1.0	2.0	1.3	2.3	1.7	1.0	3.3	3.0	3.3	1-2	1-2
2+2#/A	1.7	1.3	2.0	1.3	1.3	1.7	4.3	3.3	3.0	1-2	½-3
4+2#/A	1.7	1.7	2.0	1.7	2.0	1.7	5.3	4.0	3.3	1-2	½-2

*0 - no weeds, 10 - 100% weed coverage.

**Height in feet.

ACKNOWLEDGMENTS

The author wishes to thank Mr. Jeffery Wiest, Nursery Supervisor, State Correctional Institution at Rockview, Bellefonte, Pennsylvania; Monsanto Company and CIBA-Geigy Corporation for the use of trees and nursery, financial assistance and chemicals.

Table 8. Effect of Post Emergence Applications of Glyphosate Sprays on Red Oak, 1977.

Rate	Trunk Diameter*		Leaf**		Twig**		Bark**	
	6-16	9-26	6-16	9-26	6-16	9-26	6-16	9-26
0	1.25	1.47	0	0	0.81	0	0	0
1#/A	1.51	1.58	0	0	0.30	0	0	0
2#/A	1.21	1.32	0	0	0.44	0	0	0
4#/A	1.27	1.54	0	0	0.58	0.25	0	0
0+2#/A	1.42	1.57	0	0	0.89	0.11	0	0
1+2#/A	1.26	1.43	0.53	0	0.94	0	0	0
2+2#/A	1.33	1.45	0	0	0.92	0	0	0
4+2#/A	1.34	1.32	0	0	0.42	0	0	0

*Trunk diameter in inches, two feet above soil line.

**0 - no injury; 5 - dead.

Table 9. Effect of Post Emergence Applications of Glyphosate Sprays on Weed Prevalence in Sugar Maple Plantings, 1977.

Rate	Quackgrass*		Grasses		Broadleaves		Overall			Weed Height**	
	7 wk	14 wk	7 wk	14 wk	7 wk	14 wk	0	7 wk	14 wk	7 wk	14 wk
0	3.3	3.7	5.0	6.7	4.0	3.0	3.0	9.0	9.7	2-4	1-3
1#/A	3.6	2.7	5.3	7.3	2.3	2.0	2.3	7.7	9.3	1-3	1-2
2#/A	1.0	1.3	4.3	6.3	1.3	1.7	2.3	5.7	6.0	1-2	1-1½
4#/A	1.0	0.7	4.0	6.3	1.0	1.3	3.0	5.0	7.7	½-1	1-1½
0+2#/A	4.3	5.6	5.0	6.3	1.7	0.7	4.7	6.7	9.0	1-3	1-3
1+2#/A	4.0	5.3	4.7	6.7	0.7	1.3	4.3	5.3	6.0	1-3	1-3
2+2#/A	1.3	1.3	2.3	4.7	1.0	1.0	5.0	3.0	6.0	½-1	1-3
4+2#/A	0	0	0.3	2.7	0	1.3	4.0	0.3	4.0	½-1	½-1

*0 - no weeds, 10 - 100% weed coverage.

**Height in feet.

Table 10. Effect of Post Emergence Applications of Glyphosate Sprays on Sugar Maple, 1977.

Rate	Trunk Diameter*		Leaf**		Twig**		Bark**	
	6-16	9-26	6-16	9-26	6-16	9-26	6-16	9-26
0	0.95	1.10	0	2.43	0.11	0	0.08	0
1#/A	1.14	1.17	0.15	2.23	0.08	0	0	0
2#/A	0.92	1.02	0.08	2.03	0.09	0	0	0
4#/A	0.82	0.90	0.07	2.55	0.08	0	0	0
0+2#/A	0.99	1.12	0.08	2.16	0.16	0	0.08	0
1+2#/A	0.99	1.08	0.27	2.06	0.07	0	0	0
2+2#/A	0.88	1.08	0.13	1.60	0	0	0	0
4+2#/A	0.93	1.01	0.15	1.95	0	0	0.08	0

*Trunk diameter in inches, two feet above soilline.

**0 - no injury, 5 - dead.

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GLYPHOSATE AND PARAQUAT ON THE BARK OF SHADE TREES

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ABSTRACT

In order to evaluate further their safety on deciduous ornamental trees, glyphosate and paraquat were applied at the base of deciduous shade trees in a commercial nursery in West Suffield, Connecticut, during 1977. The trees were 1 year old whips planted in April, 1977, and treated after planting with simazine at 2 lb/A (ai) plus oryzalin at 2 lb/A (ai). The cultivars in this test were Greenspire linden, Marshall ash, red maple, sugar maple, Crimson King maple, red oak, pin oak, Sunburst locust, and Imperial locust. Sprays of paraquat or glyphosate in 50 gal/A were banded 18 in on either side of the trees and directed to spray the lower 15 to 18 in of bark. Basal suckers were removed before treatment to prevent foliar uptake. Three trees of each cultivar in each of four replicates received the sprays on June 22, 1977, and again on August 18, 1977. Paraquat was applied at .75, 1.5, and 3 lb/A (cation) with X-77 surfactant included at 0.25 % (v/v). Glyphosate was applied at 1.5, 3 and 6 lb/A (ae).

Injury from paraquat was related to dosage. Two months after the initial treatment the only injury detected was on the bark of 5 of the 12 lindens treated with paraquat at 3 lb/A. A month following the second application, bark injury on linden was slight with paraquat at 1.5 lb/A and severe at 3 lb/A. Two applications of paraquat at 1.5 or 3 lb/A also injured the bark of red maple, and two applications of paraquat at 3 lb/A injured Marshall ash. Two applications of paraquat at .75 lb/A, or glyphosate at 1.5 to 6 lb/A caused no detectable injury to the treated bark or to the crowns of any cultivar.

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FACTORS AFFECTING HEDGE BINDWEED CONTROL WITH GLYPHOSATE

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ABSTRACT

Roundup applied at 3.36 and 4.48 Kg/Ha. on a moist waterway and a dry abandoned potato field gave satisfactory control of hedge bindweed for 12 months. July applications provided 70-80% control for the moist area and was more prevalent. A surfactant, Mon 0011, at 1% by volume was applied with the two rates in another series of plots; in water containing 300 ppm of calicum and magnesium. Control was enhanced at 3.36 Kg/Ha., but not at 4.48 Kg/Ha. With Roundup at 2.24 Kg/Ha. and 4.48 Kg/Ha. in water containing 30-80 ppm no difference was observed.

Late summer or fall applications of Roundup are more reliable for control of hedge bindweed. Applications at 4.48 Kg/Ha. in July maintained 85-90% control for one year while a September treatment controlled 95%. An additional treatment was required at the end of 12 months to maintain the above control.

Treatments were applied in June to tilled and untilled soil. Roundup at 4.48 Kg/Ha. on tilled soil took three treatments to maintain 95% control and one less on untilled plots. Two additional applications were needed the following year to maintain 99% control. The directed treatments had no effect on lilac bushes, Japanese dogwood, holly, red maple, beech, white pine, white spruce, balsam fir, Eastern white cedar, red juniper, red and silver birch, black cherry, Eastern flowering dogwood, honey locust, blueberry, rhododendron, bayberry, forsythia, mountain laurel, or yews unless the foliage was unintentionally treated. If accidentally sprayed the leaves of deciduous trees or shrubs were defoliated. Coniferous plants developed slight chlorosis, but the needles did not drop.

Roundup at 4.48 Kg/Ha. applied in the fall of 1976 was followed by a natural succession of goldenrod (*Solidago* sp.), many-flowered aster (*Aster ericoides* L.), and common ragweed (*Ambrosia artemisifolia* L.) the following spring maintaining a 95% control of hedge bindweed through 1977. Observations at another location points to biological control by the agus tortoise beetle (*Metriona biclor* F.). Insect eggs were prevalent on the bindweed leaves in May. Upon hatching in June and July the beetle disseminated the leaves to the extent no treatment was required. This perdator along with dense stands of goldenrod, common ragweed, and many-flowered aster maintain control at 95% through 1977.

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GLYPHOSATE AND PARAQUAT FOR THE ESTABLISHMENT OF WOODY NURSERY STOCK

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ABSTRACT

Two series of experiments were conducted in an attempt to provide adequate preplant and postplant weed control for use in establishing woody nursery stock under field conditions. One set of experiments included the preplant application of glyphosate or paraquat prior to the planting of 16 species of bare-root lining-out stock into a field of established, actively-growing turf. Woody plants in these tests were: *Taxus*, *Ilex*, *Azalea*, *Juniperus*, *Pachysandra*, *Hedera*, *Ligustrum*, *Forsythia*, *Cornus*, *Acer*, *Quercus*, *Malus*, *Pinus*, and *Tsuga*.

Glyphosate was applied at 4.48, 8.96, and 13.44 kg ai/ha. Paraquat was applied at 1.12, 2.24 and 4.48 kg ai/ha. Each treatment was replicated four times using a tractor-mounted boom sprayer. The plots were 6.1 meters wide and 24.4 meters long. Both glyphosate and paraquat appeared to be satisfactory as preplant applications. Additional applications for full-season weed control will be needed.

A second series of experiments was designed to compare the effect of postplant directed sprays in controlling weeds in newly-planted nursery stock. Six species of lining-out stock including *Taxus media* hicksi - Hicks yew, *Taxus cuspidata* compacta - dwarf Japanese yew, *Ilex crenata* convexa - boxleaf Japanese holly, *Ilex crenata helleri* - Heller's Japanese holly, *Azalea species* v. Hershey red - Kurume azalea, and *Juniperus horizontalis* plumosa - Andorra juniper were used in these tests.

Treatments included alachlor as emulsifiable concentrate or granular formulations at 3.4, 4.5, and 6.7 kg ai/ha. Alachlor E.C. at 3.4 and 4.5 kg ai/ha was also used in combination with simazine at 2.2 kg ai/ha. The alachlor-simazine combination was used alone or followed by glyphosate treatments at 2.2, 4.5, or 5.6 kg ai/ha or paraquat at 0.56, 1.1, 2.2 kg ai/ha. Glyphosate or paraquat were also applied at the same rates alone 1 or 2 times during the first season.

During the second season 1, 2 or 3 applications of glyphosate or paraquat were made using directed sprays at each rate. Alachlor and simazine were effective in early-season weed control. Two or three treatments of glyphosate or paraquat were needed to control weeds throughout the growing season.

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GLYPHOSATE AS A MANAGEMENT TOOL FOR INCREASING FOREST PRODUCTIVITY

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ABSTRACT

A formulation of the isopropylamine salt of glyphosate [N-(phosphonomethyl) glycine] applied in water has been tested for control of perennial weeds to increase production of forests in Maine. Treatments have been used in three management situations: (I) Suppression of brambles (Rubus species) which aggressively invade commercial clearcuttings in spruce (Picea A. Dietr species)- fir (Abies balsamea (L.) Mill.) forests. (II) Aerial spray for suppression of undesirable woody broadleafed species; and (III) Site preparation for establishment of coniferous and hardwood planting stock. The first situation used backpack mistblower to apply a volume of 280 L/ha to undisturbed 0.005 ha circular plots to simulate commercial aerial application. Aerial sprays were helicopter applications of 37.4 L/ha to treatment areas of 1 to 1.5 ha. Preplant treatments were small hand or backpack hydraulic sprayers. Desired benefits are released and improved growth or establishment and early growth of desirable wood producing species.

During the three year period following strip- and patch-clearcutting, Rubus commonly established stands of 85 to 120 live stems per square meter with heights sometimes exceeding 2 m. Glyphosate provides excellent initial control and has been effective silviculturally through the two seasons of this study (Table 1). Where foot traffic possibly injured Rubus stems, levels of control were markedly decreased. Openings resulting from treatments are sometimes invaded by red sorrel (Rumex acetosella L.).

Aerial sprays applied in August 1977 are in early stages of evaluation. Glyphosate at 4.6 L/ha, thus far, shows moderate suppression and 9.35 L/ha good initial control of undesirables.

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Best control was achieved on poplars (Populus L. species), willows (Salix L. species), pin cherry (Prunus pensylvanica L. f.), maples (Acer L.), beech (Fagus grandifolia Ehrh.), and birches (betula L.). The higher rate has resulted in slight injury to spruce and pine (Pinus strobus L.) where it appeared there had been direct spray contact.

Band applications of 2.34, 4.68, and 9.35 L/ha have been effective for site preparation for planting of several tree species. Increased residual effectiveness has been achieved by combining applications with simazine (6.7 Kg/ha). Glyphosate applications are effective whether applied in August of the year prior to planting or shortly before planting in late spring or early summer.

Table 1. Glyphosate Applied to Established Stands of Rubus Species Following Cutting of Spruce-Fir Forests in Northern Maine.

Study Site	Date of Application	Rate of Application L/ha	Rubus Sp. Dry Matter Oven Dry (g/m^2) Before Trtmt	8/77	Average Weed Control Rating 12/7/77	Spruce-Fir Injury 13/7/77
I	19,20/8/75	9.35	508	134	7.5*	0
I	20/8/75	4.68	369	311	4.0*	0
II	21/8/75	9.35	873	135	6.5*	0
II	21/8/75	4.68	641	186	3.0*	0
II	24/8/76	7.01	-	-	9.0	0
V	24/8/76	2.34	-	-	8.0	0
V	24/8/76	4.68	-	-	8.5	0
V	24/8/76	7.01	-	-	9.0	0
V	24/8/76	9.35	-	-	9.0	0.1

*Ratings reflect inappropriate dilution of glyphosate and water as mentioned in situation one of text.

1977 PREEMERGENCE WEED CONTROL IN GLADIOLUS CORMELS

Arthur Bing[1/]

ABSTRACT

Postplant preemergence treatments of alachlor or napropamide on three varieties of gladiolus cormels were not as effective against weeds as diuron 0.5 lb/A plus DCPA 12 lb/A. Alachlor at 8 lb/A markedly reduced corm yield.

INTRODUCTION

Gladiolus, (Gladiolus grandiflorus) a major cut flower crop, are produced from larger corms. These flowering corms are produced new each year on top of old corms, directly from small cormels, or from smaller corms that are produced from cormels. Weeds are a costly problem in the production of cut flowers and in corm production.

Weed competition is more severe in the slower starting, lower growing plants from cormels. Since cormels are only planted 1-2 in deep compared to 4-5 in for larger corms they are more sensitive to herbicide injury.

Alachlor (2-chloro-2',6'-diethyl-N (methoxy methyl) acetanilide) and napropamide (2-(3-naphthoxy-N-N diethyl propionamide) have given some control of quackgrass (Agropyron repens L. Beauv) and yellow nutsedge (Cyperus esculentus L.) in gladiolus plantings (1). A further study of the tolerance of gladiolus to these two herbicides is necessary to determine their labeling potential. This study is a comparison of several rates of these two herbicides with the standard treatment of diuron (3-(3,4 dichlorophenyl)--1,1-dimethylurea) ½ lb/A plus DCPA (dimethyl tetrachloraterephthalate) 12 lb/A, an experimental compound MV 687 and hand weeded and unweeded plots.

MATERIALS AND METHODS

At Farmingdale N. Y., three rows of gladiolus cormels, a row each of varieties Pink Romance, T 704, and T 590, were planted 3 ft apart with guard rows the same distance on each side. A guard row and variety Pink Romance were planted in mid-April with the rows of T 704 and T 590 on May 13 and another guard row planted May 16. The cormels were planted in a furrow 6 in wide and 2 in deep in lots of 1000 (determined by weight) each in an 8 ft length of row with a 2 ft space between each lot. Each row contained 40 lots. After spreading the cormels in the flatbottomed furrow, they were ridged with an excess of soil. A day before treatment the ridges were raked almost level and left a weed free surface.

On May 16 preemergence herbicide treatments were made on randomized plots 150 sq ft in size including 10 ft across 5 rows of gladiolus a distance

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of 15 ft. The alachlor 15G, napropamide 10G, handweeded and untreated plots were replicated 4 times and the MV 687 8E and diuron 80W plus DCPA 75WP were replicated twice. All sprays were applied with a CO_2 powered small boom sprayer. Granules were applied with a hand shaker. The weather was clear and the air temperature 65-70°F. Very early the next morning MV 687 was incorporated with a rake.

RESULTS AND DISCUSSION

Weed ratings were made on July 20. The rating system was 1 = full of weeds to 10 = no weeds with a rating of 7 or more showing acceptable control. Evaluation was made of total weeds, grassy weeds, non grassy weeds and the specific weeds dominant in the area: common purslane (Portulaca oleracea L.), common groundsel (Senecio vulgaris L.), redroot pigweed (Amaranthus retroflexus L.), crabgrass (Digitaris sp. Heist.), and yellow foxtail (Setaria glauca L. Beauv.). The weed control data are summarized in Table 1. The ratings from individual plots showed that no treatment gave excellent control (a rating of 10) in all replicates. Only alachlor at 8 lb was comparable to the diuron plus DCPA for control of all weeds. The other treatments were less effective. All plots were handweeded shortly after ratings were completed and periodically during the season to reduce weed competition until harvest.

Corms were dug in mid to late September with each lot placed in an individual tray. The corms were cured in a warm building, cleaned, graded and weighed at the end of October. The effects of the treatments on the average yields of all replicates for each variety are shown in Table 2. A marked reduction was evident in stand and growth with alachlor at 8 lb/A and cormel yield of all three varieties were reduced. MV 687 also reduced yield as rates increased from 2 to 6 lb. Napropamide showed no adverse effect. In the untreated plots, the variety Pink Romance was less responsive to weed competition because it was planted earlier with earlier growth than T 704 and 590. There was considerable variability in the yields within treatments so that results indicate trends only. Although handweeding gave the best yields, it is not economically feasible.

ACKNOWLEDGMENT

Appreciation is extended to the ornamental horticulture students at the State University of New York at Farmingdale for planting and harvesting the gladiolus.

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Table 1. The effect of postplant preemergence herbicide applications on weed growth in gladiolus cormels planted late April and early May, treated May 16 and observed July 20.

Treatment		Weed control ratings[a]							
Common name	Rate lb ai/A	General	Grass	Non grass	Crabgrass	Foxtail grass	Common purslane	Red root	Groundsel
MV 687 8E	2(2)	4	6	7	7	9	8	8	8
	4(2)	7	8	7	8	9	8	8	8
	6(2)	6	8	7	8	10	8	7	8
Alachlor 15G	2	5	7	7	7	9	7	8	8
	4	7	8	8	8	10	10	9	8
	8	8	9	8	9	10	9	9	8
Napropamide 10G	2(3)	4	6	5	7	9	6	7	7
	4	5	7	6	8	9	8	7	7
	8	5	8	6	8	9	7	7	6
Diuron + DCPA 80W + 75W	½+12(2)	8	10	8	9	10	10	9	9
Handweeded		10	10	10	10	10	10	10	10
Untreated		2	4	4	4	5	7	6	6

(a) Rating system of 1 = no control, 10 = no weeds, 7 and above = acceptable control. Average of 4 replicates unless noted after the rate by ( ) to show number of replicates other than 4.

Table 2. The effect of postplant preemergence herbicide treatments on the corm yield of three varieties of gladiolus cormels planted late April early May, treated May 16 and harvested in late September.

Treatment		Yield of corms in grams[a]		
Common name	Rate lb ai/A	T 704	T 590	Pink Romance
MV 687 8E	2(2)	338	895	968
	4(2)	185	684	682
	6(2)	99	487	628
Alachlor 15G	2	426	825	965
	4	277	834	787
	8	190	413	494
Napropamide 10G	2(3)	323	796	791
	4	297	554	705
	8	504	770	791
Diuron WP+DCPA WP	½+12(2)	552	1088	943
Handweeded		669	1083	819
Untreated		125	357	825

(a) Yields are averages of 4 replicates unless indicated otherwise by ( ) after the rate.

PREEMERGENCE AND POSTEMERGENCE HERBICIDES FOR NURSERY PLANTINGS

John F. Ahrens 1/

ABSTRACT

In two separate field experiments over a 4-year period, herbicides were applied over newly planted nursery stock and repeated the following spring on a sandy loam soil. The herbicides were applied as sprays in 50 gal/A or as granules, after weeding or on established weed growth. Weed evaluations were followed by removal of escaped weeds and cultivation. Oats were seeded each fall to evaluate effects on a cover crop. Plant injury and growth were evaluated by visual ratings, by weighing clippings after the first season, and by weighing whole plants after the second season. To evaluate herbicidal effects on plant propagation, cuttings were taken in one trial and rooted in the greenhouse. Millet bioassays in the greenhouse of soil cores from plots of oryzalin and oxadiazon were used to evaluate persistence and penetration after two applications.

Oryzalin WP at 2 or 4 lb/A (ai) and oxadiazon WP or granules at 3 or 4 lb/A (ai) controlled 90 percent or more of all weeds during each season and seriously reduced oat cover crops in the fall without injury to juniper (Juniperus horizontalis plumosa compacta), yew (Taxus cuspidata), forsythia (Forsythia intermedia 'Lynwood Gold'), or white pine (Pinus strobus L.). Best residual control of weeds a year after application was obtained with oryzalin. Simazine at 1.5 lb/A (ai) plus oryzalin controlled common dandelion (Taraxacum officinale Weber) and fall pancium (Panicum dichotomiflorum Michx) better than oryzalin alone, but injured forsythia. One year following application at 4 lb/A per year for 2 years, phytotoxic residues of oxadiazon were found only in the upper 3 in of soil, whereas small residues of oryzalin were also found at the 3 to 6 in depth.

Alachlor ec at 4 to 8 lb/A plus simazine WP at 1.5 lb/A controlled most annual weeds for 2 to 4 months, and injured forsythia and white pine, but not yew or juniper. Granular formulations of alachlor plus simazine gave longer residual weed control with injury only to forsythia.

Asulam at 3 lb/A (ai) plus oxadiazon at 2 lb/A gave postemergence control of crabgrasses (Digitaria sp.), carpetweed (Mollugo verticillata L.), horseweed (Erigeron canadensis L.), and annual fleabane /Erigeron annus (L.) Pers)/ and provided residual preemergence control equal to oxadiazon alone at equivalent rates. Asulam alone controlled seedling annual grasses, but not carpetweed and did not provide long residual control.

In many cases, early injury to nursery plants from herbicides was counterbalanced by the promotive effects of weed control on plant vigor. Plant weights in plots with high levels of weed control usually were much greater than plant weights in untreated plots cultivated and weeded three to four times each season. None of the herbicides tested significantly affected the rooting of cuttings taken in the winter from yews and junipers that were treated in May or June of the two previous years.

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POSTPLANT WEED CONTROL IN SELECTED EVERGREEN LINER BEDS

Chiko Haramaki[1]

ABSTRACT

Newly planted liners of red bearberry, convexleaf Japanese holly, drooping leucothoe, blue rug juniper and savin juniper were sprayed with alachlor, diphenamid, metribuzin, napropamide, and simazine. Satisfactory weed control was obtained with alachlor at 2 lb ai/A or higher, diphenamid at 8 lb ai/A, metribuzin at ½ lb ai/A or higher, napropamide at 2 lb ai/A and up, and simazine at 1 lb ae/A and higher. Red bearberry, convexleaf Japanese holly and drooping leucothoe exhibited injury when sprayed with metribuzin and simazine. Drooping leucothoe had some injury in plots treated with alachlor, diphenamid and napropamide. Blue rug juniper and savin juniper showed little or no injury to any of the herbicides at the concentrations used.

INTRODUCTION

Effective weed control in new plantings of narrow and broadleaved evergreen liners can be achieved. Work in the past has shown that many species and varieties of deciduous and evergreen liners to be tolerant to a number of herbicides while achieving satisfactory weed control (1,2,3,4,5). More recent herbicides should be evaluated on some species and varieties which are not usually used as test plants for tolerance as well as for weed control.

The objective was to find herbicides which could be sprayed on newly planted broad and narrowleaved evergreen liners in clean cultivated soil with little or no damage to the liners and have acceptable weed control.

METHODS AND MATERIALS

The experiment was conducted at the Agricultural Research Center at Rock Springs, Pennsylvania. The soil, which was a Hagerstown silt loam, was disced and rototilled prior to planting on June 23, 1977. The evergreen liners were red bearberry (*Arctostaphylos uva-ursi* Spreng.), convexleaf Japanese holly (*Ilex crenata convexa* Thunb.), drooping leucothoe (*Leucothoe fontanesiana* Sleum.) Blue Rug juniper (*Juniperus horizontalis wiltoni* Moench.), and Savin juniper (*Juniperus sabina* L.). There were four plants of each variety in each plot. The planting day was sunny and the temperature was approximately 80 F. The top one inch of soil was dry and moist below. One inch of water was sprinkler irrigated immediately after planting.

On June 30, 1977 the herbicides were sprayed on the liners and soil with a CO_2 pressure controlled boom sprayer. The herbicides applied were alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide), diphenamid (N,N,-dimethyl-2,2-dipheylacetamide), metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4H)one), napropamide (2-(α-naphthoxy)-N,N-diethylpropionamide), and simazine

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Table 1. Effect of Postplant Application of Herbicide Sprays on Weed Growth, Fifteen Weeks After Application, 1977.

Chamical	Rate	Grasses*	Broadleaves	All Weeds
Alachlor	0	3.7	3.7	7.3
	2#/A	0	3.0	3.0
	4#/A	0	1.7	1.7
	8#/A	0	0.7	0.7
Diphenamid	0	2.7	3.7	6.3
	2#/A	1.3	4.7	6.0
	4#/A	2.3	4	6.3
	8#/A	0	2.3	2.3
Metribuzin	0	4.7	3.7	8.3
	½#/A	0.3	1.7	2.0
	1#/A	0.3	0.7	1.0
	2#/A	0	1.3	1.3
Napropamide	0	4.0	4.3	8.3
	2#/A	0.3	1.3	2.0
	4#/A	0.7	3.0	3.7
	8#/A	0	0.3	0.3
Simazine	0	3.0	3.3	6.3
	1#/A	0.3	0.3	1.0
	2#/A	0	0.3	0.3

*0 = No weeds, 10 = 100% weed coverage.

(2-chloro-4,6-bis(ethylamino)-s-triazine). The post plant herbicides were applied at the following concentrations: alachlor 2,4 and 8 lb ai/A, diphenamid 2, 4 and 8 lb ai/A, metribuzin ½, 1 and 2 lb ai/A, napropamide 2, 4 and 8 lb ai/A, and simazine 1, 2 and 4 lb ai/A. All plots were 90 square feet. Control plots were included for every herbicide and all treatments and controls were replicated three times. At the beginning of the spraying, the air temperature was 74°F, the soil surface temperature was 88°F, and the soil temperature two inches below the surface was 70°F. At the finish, the air temperature was 84°F, soil surface temperature was 92°F and the soil two inches below the surface was 80°F. The weather was clear and sunny with winds between 0-5 miles per hour. The soil was at field capacity.

Table 2. Effect of Postplant Applications of Herbicide Sprays on Evergreen Liners Fifteen Weeks After Application, 1977.

Chamical	Rate	Bear-* berry	Japanese Holly	Drooping Leucothoe	Bluerug Juniper	Savin Juniper
Alachlor	0	1.58	0.66	2.25	0.08	0.08
	2#/A	1.25	0.66	2.41	0	0.17
	4#/A	2.08	0.75	2.08	0	0.08
	8#/A	2.58	1.33	3.25	0	0.25
Diphenamid	0	1.33	0.42	2.25	0	0
	2#/A	0.50	0.25	3.08	0	0
	4#/A	1.83	0.33	1.41	0	0.17
	8#/A	2.66	1.66	3.00	0	0.42
Metribuzin	0	1.41	1.58	2.17	0	0
	½#/A	3.00	2.66	2.92	0.08	0.25
	1#/A	3.50	3.41	3.08	0.17	0.33
	2#/A	3.75	4.25	3.41	0.33	0.50
Napropamide	0	2.33	0.17	2.08	0	0.58
	2#/A	2.08	1.41	3.00	0	0
	4#/A	1.83	0.42	2.75	0	0.33
	8#/A	2.08	1.08	3.16	0	0.33
Simazine	0	1.41	1.33	1.83	0.08	0.08
	1#/A	2.17	2.83	2.41	0	0.83
	2#/A	3.66	3.42	2.41	0.17	0.75
	4#/A	2.42	3.58	1.92	0	1.00

*0 = no injury, 5 - dead.

RESULTS AND DISCUSSION

On October 12, 1977 the plots were examined. The predominant weeds in the control plots in decreasing order of frequency were redroot pigweed (*Amaranthus retroflexus* L.), fall panicum (*Panicum dichotomiflorum* Michx.), tumble pigweed (*Amaranthus albus* L.), yellow foxtail (*Setaria glauca* Beauv.), common lambsquarter (*Chenopodium album* L.), dandelion (*Taraxacum officinale*, Weber), common purslane (*Portulaca oleracea* L.), and Canada thistle (*Cirsium arvense*, Scop.).

Alachlor did an excellent job in controlling the grasses at rates of 2 lb ai/A and higher and acceptable control of the broadleaved weeds was obtained at rates of 4 and 8 lb ai/A. Diphenamid controlled all grasses and had some control of the broadleaved weeds at the 8 lb ai/A rate. Metribuzin treated plots showed excellent grass control and reasonably good broadleaved weed control at all rates including ½ lb ai/A. Napropamide gave good grass control and reasonably good broadleaved weed control at 2 lb ai/A and higher. Simazine showed excellent control of both grasses and broadleaved weeds at rates of 1 lb ai/A and higher.

Red bearberry plants had a slight amount of injury and discoloration regardless whether they were sprayed with herbicides or not. Metribuzin treated red bearberry had moderate to severe damage especially foliage and tip of shoot damage. Convexleaf Japanese holly had little or no damage when treated with alachlor, diphenamid, and napropamide. Moderate to severe leaf and shoot tip damage was found in the metribuzin and simazine treated plots. Chlorosis was common on these plants. Drooping leucothoe had slight to moderately severe injury in all plots regardless of treatment. Blue rug juniper showed little or no injury in all treatments and concentrations. Savin juniper was also tolerant to the herbicides and concentrations used.

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1977 PREEMERGENCE WEED CONTROL ON NURSERY LINERS

Arthur Bing[1/]

ABSTRACT

A wide variety of nursery liners showed very good tolerance to postplant preemergence applications up to 16 lb/A ai of granular formulations of alachlor, napropamide, or oxadiazon. In these experiments weed control was only fair at most rates.

INTRODUCTION

In previous research znd field trials (1) (2) alachlor (2-chloro-2', 6'-diethyl-N-(methoxymethyl) acetanilide), napropamide (2-(a-naphthoxy)-N-N--diethylpropionamid), and oxadiazon (2-tert-butyl-4-(2,4-dichloro-5--isopropolyphenyl)- Δ^2-1,3,4-oxadiazolin-5-one) have been safe on a wide variety of nursery plants and combined with 1 lb/A of simazine have given very satisfactory weed control. This experiment is an evaluation of these herbicides at rates of 2,4,8 and 16 lb/A for weed control and crop tolerance. This information will be helpful in securing registration and labelling to permit these herbicides to be legally used by nurserymen. These experiments are a continuation of a long term project at Riverhead and Farmingdale to develop the most efficient postplant preemergence weed control treatments for young nursery liners.

MATERIALS AND METHODS

The nursery liners shown in Table 1 were planted at Farmingdale on April 27 to 29 and at Riverhead on May 3 to 4, 1977. They were planted one cultivar per row and 2 ft between plants in 410 ft rows that were 3 ft apart. All plants were cultivated once, emerged weeds were removed before treatments were applied. During the growing season, overhead irrigation was applied as needed. There was adequate rainfall during the treatment period

Granular applications were made with a simple hand shaker on May 12 at Farmingdale and May 14 to 15 at Riverhead. At Riverhead, the soil was moist but with a rough surface from cultivation at the time of application and barnyard grass (Echinochloa crusgalli L. Beauv.) may have been ready to emerge. In both fields the plant stand looked good at the time of treatment.

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Each 360 sq ft plot consisted of a band 6 ft wide across 15 rows of nursery liners which were 3 ft apart and included 3 plants of each cultivar. Each treatment was replicated 4 times except the oxadiazon at 16 lb which was only replicated twice because of a shortage of material. Formulations used were alachlor 15G, napropamide 10G and oxadiazon 2G.

RESULTS AND DISCUSSION

Weed control was evaluated in late June after which all weeds were hand pulled in July and several times during the growing season. Weed control results are shown in Table 2 for the Farmingdale planting and Table 3 for the Riverhead planting. The rating system is 1 for full of weeds to 10 for no weeds with a rating of 7 or more indicating acceptable control. The figures in Table 1 and 2 are the averages of 4 replicates except where indicated. For a broader spectrum of weed control simazine at 1 lb/A should be added to alachlor, napropamide or oxadiazon. Napropamide was not very effective alone as seen by the poor ratings in Table 2 for Farmingdale but at Riverhead where barnyard grass was prevalent it was more effective. Higher rates of alachlor and oxadiazon gave better control at both locations. The predominant weeds were crabgrass (*Digitaria sp.* Heist.), red root pigweed (*Amaranthus retroflexus* L.), galinsoga (*Galinsoga sp.* R. & P.), common groundsel (*Senecio vulgaris* L.), common purslane (*Portulaca oleracea* L.), and barnyard grass (*Echinocloa crusgalli* L. Beauv.).

The growth of each individual plant was rated on October 12-13 using a system of 1 for a dead or missing plant to 10 for optimum growth. A rating of 8 to 10 indicates a good healthy plant. The averages of 4 replicates of 3 plants each are shown in Table 4 for Farmingdale and Table 5 for Riverhead. A few cultivars did not survive well enough to be considered of experimental value so were not included in the Tables. Injury from a herbicide would be shown in a table by a lower rating. None of the test plants showed a consistent reduction in growth with increased dosage of herbicide which indicates good crop tolerance for all rates of the materials used in this experiment.

ACKNOWLEDGEMENTS

Some plant materials were furnished by the N. Y. State Forest Tree Nursery, Woodbourne Cultural Nursery, Half Hollow Nursery and North Fork Nursery. Students in the ornamental horticulture program at the State University at Farmingdale grew some of the plant material and planted the liners at Farmingdale.

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Table 1. Liners planted at Farmingdale (F) and Riverhead (R)

Location	Common Name	Scientific Name
F	Azalea, Hinodigeri	*Rhododendron obtussum hinodegiri* Planch.
FR	Crabapple, Torringo	*Malus sieboldi* Rehd.
FR	Dogwood, Flowering	*Cornus florida* L.
FR	Dogwood, redstemmed	*Cornus stolinifera* Michx.
R	European cranberry bush	*Viburnum opulus* L.
FR	Goldenbells	*Forsythia intermedia* Zabel
F	Hemlock, Canadian	*Tsuga, canadensis* Carr.
F	Holly, Green Island	*Ilex crenata, Green Island* Thunb.
FR	Ivy English	*Hedera helix* L.
FR	Juniper, Hetz	*Juniperus chinensis hetzii glauca* L.
FR	Maple, Amur	*Acer ginnala* Maxim.
FR	Oak, red	*Quercus borealis* Michx.
FR	Pine, Japanese black	*Pinus thunbergii* Parl.
R	Pine, white	*Pinus strobus* L.
R	Purple winter creeper	*Euonymus fortunei radicans* Rehd.
FR	Privet, California	*Ligustrum ovalifolium* Hassk.
FR	Yew, Hicks	*Taxus cuspidata* Rehd.

Table 2. The effect of postplant preemergence herbicide applications on weed control in nursery liners planted at Farmingdale, N. Y. April 27 to 29, treated May 12 and observed in late June.

Treatment		Weed control ratings[a]							
Common name	Rate ai/A	General	Grass	Non grass	Crab grass	Red root	Galinsoga	Groundsel	Puralane
Napropamide	2	4	7	5	7	7	8	6	8
	4	4	7	5	7	6	7	8	7
	8	3	9	3	9	5	7	7	8
	16	4	9	6	9	6	6	9	9
Alachlor	2	3	7	4	7	6	6	7	8
	4	4	7	5	7	7	6	8	8
	8	6	9	7	7	8	9	8	9
	16	9	10	9	10	9	9	9	9
Oxadiazon	2	3	5	4	5	8	10	10	9
	4	5	8	6	8	10	7	9	10
	8	6	10	6	9	10	8	10	9
	16(2)	9	10	9	10	10	9	10	10
Untreated		2	5	4	5	6	5	9	8
Handweeded		10	10	10	10	10	10	10	10

(a) Rating system of 1 = no control, 10= no weeds, 7 and above = acceptable control. Average of 4 replicates unless noted after the rate by ( ) to show number of replicates other than 4.

Table 3. The effect of postplant preemergence herbicide applications on weed control in nursery liners planted at Riverhead, N.Y. May 3 to 4, treated May 14 to 15 and observed in late June.

Treatment		Weed control ratings[a]					
Common Name	Rate lb ai/A	General	Grass	Non grass	Barnyard grass	crabgrass	Puralane
Napropamide	2	4	4	9	4	10	10
10G	4	5	5	0	6	9	9
	8	8	8	9	8	9	9
	16	8	9	9	9	10	9
Alachlor	2	5	5	9	6	9	10
15G	4	6	6	9	6	9	9
	8	6	6	9	6	9	9
	16	10	10	10	10	10	10
Oxadiazon	2	5	5	10	5	9	10
2G	4	5	5	10	5	10	10
	8	6	6	10	6	10	10
	16(2)	8	8	10	8	9	10
Untreated		3	4	8	5	8	9
Handweeded		10	10	10	10	10	10

(a) Rating system of 1 = no control, 10 = no weeds, 7 and above = acceptable control. Average of 4 replicates unless noted after the rate by ( ) to show number of replicates other than 4.

Table 4. The effect of postplant preemergence herbicide applications on the growth of nursery liners planted April 27 to 29, treated May 12 and observed Oct. 12, 1977 at Farmingdale, N.Y.

Treatment		Growth ratings[a]											
Common name	Rate lb ai/A	Red oak	Amur maple	Hetz juniper	Hicks yew	Boxleafed holly	Hemlock	Red stemmed dogwood	Torringo crab	Azalea	English ivy	Forsythia	Privet
Napropamide 10G	2	9	7	6	10	10	10	8	6	8	4	10	10
	4	7	5	8	10	10	10	5	7	9	7	10	10
	8	8	6	8[3]	10	10	9	5	8	5	7	10	10
	16	9	7	5	10	10	10	8	8	7	7	10	10
Alachlor 15G	2	8	6	6	10	10	10	10	6	6	6	10	10
	4	8	4	6	10	10	10	6	8	8	9	10	10
	8	9	7	7	10	10	10	9	9	7	7	10	10
	16	9	6	6	10	10	9	8	9	6	8	10	10
Oxadiazon 2G	2	7	5	6	10	10	10	6	3	2	5	10	10
	4	9	6	7	10	10	10	8	8	5	4	10	10
	8	9	7	7	10	10	9	6	6	6	5	10	10
	16[2]	5	3	7	10	10	9	1	9	9	7	10	10
Untreated		6	6	4	10	8	10	6	6	4	5	9	10
Handweeded		8	8	6	10	10	9	9	4	6	6	10	10

[a]Rating system of 1 for a dead or missing plant to 10 for an excellent plant. Figures are averages of 4 replicates of 3 plants except where shown to the right of rates eg. 16[2] refers to 2 replicates.

Table 5. The effect of postplant preemergence herbicide applications on the growth of nursery liners planted May 3 to 4, treated May 14 to 15 and observed Oct. 12, 1977 at Riverhead, N. Y.

Treatment		Growth ratings[a]										
Common name	Rate lb ai/A	Privet	Red stemmed dogwood	Forsythia	Flowering dogwood	Torringo crab	Red oak	Euonymous	Amur maple	English ivy	Hicks yew	Viburnum
Napropamide 10G	2	9	8	10	5	9	6	9	7	10	10	6
	4	9	8	10	6	9	8	9	7	10	10	6
	8	10	8	10[3]	6[3]	10	8	8[3]	7	9	10	7
	16	10	8	10	6	9	7	7	9	10	10	5
Alachlor 15G	2	9	9	10	6	9	8	10	7	10	10	4
	4	10	6	9	5	9	7	9	7	10	10	7
	8	10	7	10	5	9	9	8	8	10	10	5
	16	9	5	10	6	10	9	9	7	10	10	7
Oxadiazon 2G	2	9	5	10	7	10	9	9	7	10	10	7
	4	10	8	9	5	9	8	9	8	9	10	7
	8	10	7	10	4	9	5	10	9	9	10	4
	16[2]	10	4	10	4	10	9	10	5	10	10	6
Untreated		10	6	9	5	7	6	9	6	10	9	6
Handweeded	(3)	10	9	10	6	9	8	9	9	10	10	6

[a]Rating system of 1 for a dead or missing plant to 10 for an excellent plant. Figures are averages of 4 replicates of 3 plants except where shown to the right of rates eg. Oxadiazon 16[2] refers to 2 replicates.

CONTROL OF ESTABLISHED WEEDS IN CONTAINER-GROWN NURSERY STOCK

John F. Ahrens 1/

ABSTRACT

Several experiments were conducted from 1973 to 1977 to control established weeds in container-grown nursery stock during the dormant season. Herbicides were applied as granules, as broadcast sprays in volumes of 50 gal/A, or as directed sprays in volumes of 200 to 400 gal/A.

Asulam was tested at dosages of 4 to 8 lb/A (ai), and glyphosate was tested at dosages of 0.3 to 1.0 lb/A (ae) over a number of dormant container-grown species. Weed control sometimes was poor with broadcast sprays of these herbicides in broadleafed evergreen plants where the plant canopy was full and weeds were small. Better weed control was obtained in leafless deciduous plants and in low growing plants such as juniper, where weed growth overtopped the plants. Asulam at 3 to 4 lb/A controlled creeping woodsorrel (Oxalis corniculata L.), blackgrass (Alopecurus myosuroides), Pennsylvania bittercress (Cardamine pennsylvania Muhl.), horseweed (Erigeron canadensis L.), oldfield toadflax (Linaria canadensis L. Dumont), and certain mosses, but not legumes or weeds among the Caryophylaceae. Glyphosate at 0.3 to 0.6 lb/A controlled all of the above weeds except certain legumes. Dormant container plants tolerant of both herbicides included junipers (Juniperus sp.), winterberry (Ilex verticillata), Canadian hemlock (Tsuga canadensis), deciduous azaleas, American holly and several Rhododendron cultivars. Evergreen azaleas generally were susceptible to injury from both herbicides, however. Dormant Spirea with a few attached leaves and Mt. Laurel (Kalmia latifolia) were both injured by glyphosate, but not asulam.

Nitrofen wettable powder at 8 lb/A (ai) controlled creeping woodsorrel without injury to Canadian hemlocks, Rhododendron 'Roseum eleagans' or Azalea 'Blauw's Pink'. Nitrofen gave fair control of bittercress but no control of horseweed or chickweeds (Stellaria sp.).

Chloroxuron wettable powder at 3.5 to 4 lb/A (ai) controlled bittercress, chickweeds and mosses, without injury to hemlocks, rhododendrons, azaleas, Mt. Laurel, or Japanese andromeda (Pieris japonica). Chloroxuron did not control horseweed, creeping woodsorrel, or blackgrass.

Wettable powders of oxadiazon, pronamide, and methazole also controlled one or more prevalent weed species in containers with safety in hemlocks and rhododendrons. In most cases, when a narrow weed spectrum was controlled, however, resistant weeds flourished and provided severe competition.

Granular dichlobenil at 4 or 6 lb/A (ai) controlled the broadcast spectrum of weeds, with legumes being the most resistant. The lower rate provided 90 to 95 percent control of established weeds with no serious injury to hemlocks and several rhododendron and azalea cultivars. Since concurrent studies showed the potential hazard of dichlobenil vapors to plants in enclosed plastic structures, it was found practical to make applications in early spring just before or after removal of the plastic. Irrigation soon after application was used to activate the herbicide and minimize volatile losses.

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EFFECT OF SURFACTANTS ON GERMINATION OF HAIRY CRABGRASS AND ANNUAL BLUEGRASS

W. H. Mitchell, A. E. McHugh and G. J. Hendricks 1/

ABSTRACT

The effect of surfactants on germination of hairy crabgrass (Digitaria sanguinalis Scop.) and annual bluegrass (Poa annua L.) was studied under growth chamber and greenhouse conditions. Both germinable and non-germinable hairy crabgrass seeds were used since a mixed population could be expected under field conditions. To achieve germination of the latter, endosperms were pierced with a sterilized sewing needle. All seeds were surface sterilized with a 10% chlorox solution (v/v) prior to initiation of tests. Petri dishes, lined with filter paper or containing finely screened silt loam soil, were used in growth chamber tests. Fifty hairy crabgrass seeds were placed in each dish. Surfactants used included Triton GR-5M (anionic), Priminox R-15 (cationic) and the following non-ionic materials: Triton X-100, AR-150, Surf-Side and Aqua-Gro. Surfactant treatments, ranging in concentration from 0.1 to 1.0% (v/v) using water as a solvent, were applied in sufficient amounts to thoroughly moisten the filter paper or soil. Adequate moisture levels were maintained either by repeated applications of surfactant treatments or distilled water. Final germination counts were made at the end of a 21-day test period. Greenhouse tests were conducted in 15cm plastic pots using silt loam soil as a growth medium.

Soil for the greenhouse test, involving annual bluegrass, was collected from an area heavily infested with the weed. All vegetation was removed from the soil surface prior to extraction of soil cores by use of a standard golf cup-cutter. Cores were placed in plastic pots, with soil mixed to a depth of 1.0cm and treated with a 1% (v/v) solution of Triton X-100. The appearance of annual bluegrass seedlings was recorded over a period of 41 days. All tests involved three replications in a completely randomized design.

The pattern of germination of hairy crabgrass, comparing treated and untreated seed, showed that treatment caused a reduction in germination with no apparent induction of a lag period (Fig. 1). Non-ionic and anionic surfactants were more effective than cationic types when used on soil growth media. Surfactant activity appeared to involve seed sorption resulting in possible reduction in oxygen diffusion. In this respect they were effective against both dormant and non-dormant seeds. Activity of surfactants was related to rate of application and moisture and temperature of growth media. It is suggested that by proper timing of application these factors combine to interrupt the normal growth cycle of hairy crabgrass leading to gradual reduction in the weed population.

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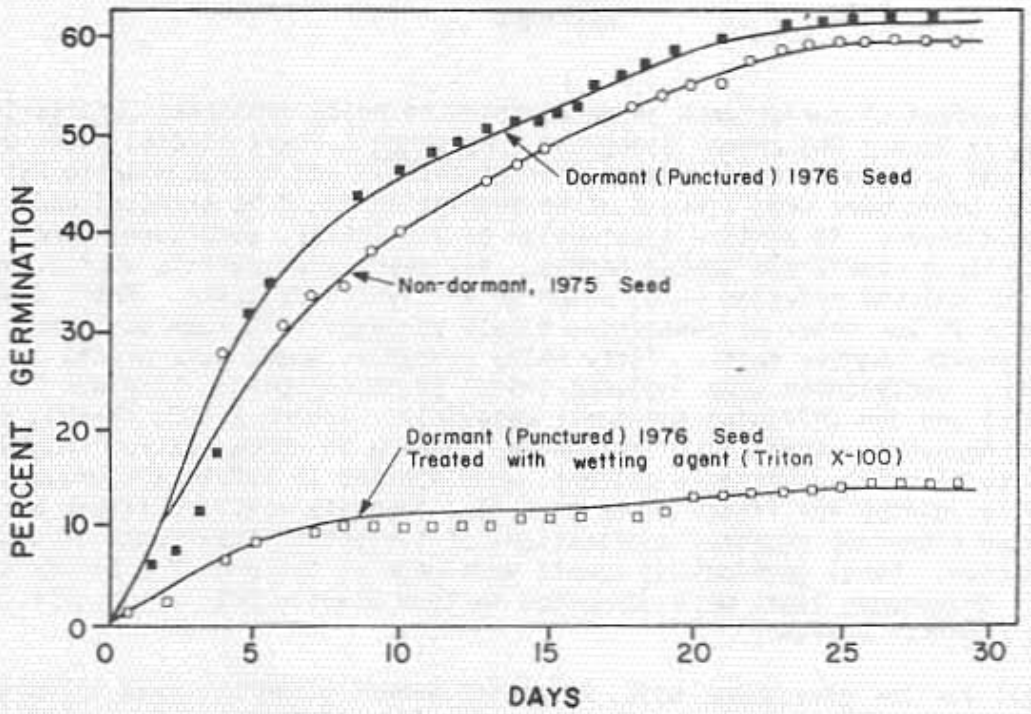

Fig. 1. Germination pattern of hairy crabgrass seed

Triton X-100 caused a very significant reduction in the germination of annual bluegrass seeds. Triton GR-5M and Surf-Side were less effective but still caused approximately a 50% reduction in relation to the control.

CONTROL OF CRABGRASS IN KENTUCKY BLUEGRASS AND RED FESCUE TURF USING PREEMERGENCE HERBICIDES.

T. L. Watschke and J. M. Duich[1/]

ABSTRACT. Six herbicides and one herbicide plus insecticide combination were applied April 22, 1977, to Kentucky bluegrass and creeping red fescue turfs to assess the preemergence control of smooth crabgrass. The materials used were DCPA (75W and 5G), pendimethalin (4EC and 10G), butralin (2.3G), prosulfalin (50W), bensulide (3.6G), benefin (2.5G), and a combination of benefin plus chlorpyrifos. Using 90% as an acceptable level of control, all DCPA formulations, the 2.24 and 3.36 kg/ha rates of pendimethalin 10G, the 75-A492 formulation of butralin, prosulfalin on bluegrass, and bensulide provided acceptable levels of control. All rates of the emulsified formulation of pendimethalin failed to provide acceptable control, and the high rate (2.8 kg/ha) caused some injury to the fescue. Injury to red fescue was also observed for all DCPA formulations with the wettable powder causing slightly more injury. The granular pendimethalin and butralin caused injury to red fescue that was similar to that caused by granular DCPA. Benefin provided consistent crabgrass control in both grasses (80%), but when combined with chlorpyrifos, the control dropped to 70 and 63% for bluegrass and fescue respectively.

INTRODUCTION

Although several products are commercially available for preemergence crabgrass [*Digitaria ischaemum* (Schreb.)Schreb. ex Muhl.] control in turf experimental herbicides must be continually screened for their potential. The ultimate goal is to have the safest, easiest to use, economically justifiable material with consistently excellent efficacy. Different formulations of materials already commercially available for use on other crops may have importance in turf management and should be tested. Also, with labor costs increasing, the necessity to apply pesticides in combinations has become reality, and the compatability of certain materials needs documentation.

The purpose of this study was to compare the preemergence crabgrass control and turf phytotoxicity of two experimental herbicides and a different formulation of an herbicide with commercial label (not for turf), with three commercially available materials. Also the combination

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of an herbicide and insecticide was included. Several of these herbicides have been previously evaluated at Penn State (4, 5, 6) and in other locations (1, 2).

MATERIALS AND METHODS

This research was conducted at The Joseph Valentine Turfgrass Research Center, The Pennsylvania State University. An eleven-year-old stand of Kentucky bluegrass (Poa pratensis L.) and a stand of creeping red fescue (Festuca rubra) the same age were treated on April 22, 1977, with six herbicides and one herbicide plus insecticide combination. The turf was maintained at a 3.2 cm cutting height and received 760 kg/ha of a 16-8-8 fertilizer on June 21. Rainfall was insufficient during May (driest in 90 years) to stimulate germination, therefore irrigation (twice, with approximate 2.5 cm applied each time) was necessary. Moderate germination was observed in late May, but frost on June 8 injured some crabgrass that had germinated or was germinating. Due to these climatological difficulties, the crabgrass cover was variable across the plots from 35 to 80 percent. The experiment was designed with two replications of each treatment on each grass with an untreated control plot adjacent to each treatment. This design facilitated rating and eliminated the potential problems caused by the variable crabgrass stand across the site.

Sprayed materials were applied to 0.9 by 7.3 m plots with a hand held boom sprayer, calibrated to deliver 76L/ha. Granular formulations were applied to 1.2 by 1.8 m plots with a shaker bottle.

The materials used were DCPA (dimethyl tetrachloroterephthalate) 5G (16/30 and 24/48 mesh), butralin [4-(1,1-dimethylethyl)-N-(1-methylpropyl)-2,6-dinitrobenzamine] 2.3G, prosulfalin (N-[4-(dipropylamino)3,5-dinitrophenyl]sulfonyl]S,S-dimethylsulfilimine) 50W, bensulide (0,0-diisopropylphosphordithioate S-ester with N-(2-mercaptoethyl) benzenesulfonamide) 3.6G, benefin (N-butyl-N-ethyl-α,α,α-trifluoro-2,6-dinitro-p-toluidine) 2.5G, benefin plus chlorpyrifos (0,0-diethyl-0-(3,5,6 trichloro-2-pyridyl)phosphorothioate and pendimethalin N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine. Application rates and control ratings appear in Table 1. Crabgrass control and injury were rated on August 18.

RESULTS AND DISCUSSION

Chemicals which gave acceptable control (at least 90%) of crabgrass included all the commercially available materials except benefin (Table 1). Benefin gave good control (80%) on both turf species, but has perennially given less control than the others (4, 5, 6). DCPA thinned creeping red fescue, with the wettable powder formulation causing slightly more injury than the granular.

Butralin has provided consistently excellent crabgrass control in both bluegrass and fescue (4, 5, 6), and continued to do so in 1977, however the further development and ultimate release of this promising compound does not appear likely. The manufacturer has indicated that further testing will be discontinued.

Pentimethalin, which has commercial label for use in agronomic crops showed excellent effacicy from the granular formulation (better than 95% for the 2.24 and 3.36 kg/ha rates). The emulsified formulation did not provide good control on either turf at the rates used. Higher rates of the liquid formulation are probably unwarranted due to injury of red fescue. Further experimentation with the granular formulation, with perhaps a less concentrated granule to insure adequate distribution, should be conducted.

Prosulfalin provided good to excellent crabgrass control on both turf species. As in the past (4, 5, 6), this compound showed excellent safety on creeping red fescue.

The combination of benefin plus chlorpyrifos did not provide acceptable crabgrass control (70 and 63% on bluegrass and red fescue, respectively). This combination gave less control than for benefin alone. There is evidence that phosphate insecticides are antidotal toward tribluralin herbicides (3) and the results of our study support this contention. It appears that when benefin is combined with chlorpyrifos the benefin rate should be higher than was used in this study.

Table 1. Evaluations of preemergence herbicides applied to Kentucky bluegrass and creeping red fescue for the control of smooth crabgrass. Herbicides were applied April 22, 1977.

Treatment	Formulation	kg/ha	% Crabgrass Control		% Injury*	
			KBG	CRF	KBG	CRF
DCPA	75W	11.20	97	97	0	13
DCPA	5G (16/30	11.20	99	94	0	8
DCPA	5G (24/48)	11.20	95	95	0	8
Pendimethalin	4EC	1.68	53	58	0	0
Pendimethalin	4EC	2.24	68	58	0	5
Pendimethalin	4EC	2.80	73	70	0	10
Pendimethalin	10G	1.68	90	88	0	3
Pendimethalin	10G	2.24	94	95	0	5
Pendimethalin	10G	3.36	97	98	0	10
Butralin	2.3G (75-A424)	4.48	88	73	0	5
Butralin	2.0G (75-A492)	4.48	97	97	0	13
Butralin	2.0G (75-A447)	4.48	85	88	0	8
Prosulfalin	50W	2.80	93	85	0	0
Bensulide	3.6G	16.80	98	98	0	3
Benefin	2.5G	2.24	83	80	0	5
Benefin + Chlorpyrifos		2.12 + 2.18	70	63	0	5

*Injury refers to discoloration and/or thinning.

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CONTROL OF CRABGRASS WITH PRE- AND POSTEMERGENCE HERBICIDES IN TURFGRASS[1]

B. B. Hesseltine and J. A. Jagschitz[2]

ABSTRACT

Experiments were conducted on established turfgrass to evaluate herbicides for pre- and postemergence control of smooth crabgrass [*Digitaria ischaemum* (Schreb.) Muhl.]. Effectiveness of herbicides was based on percent crabgrass control and degree of injury to turfgrass. In the preemergence test, effective crabgrass control (90-100%) was provided by benefin, butralin, DCPA, oxadiazon, prosulfalin, siduron, and HOE-22870. Good control (80-89%) was obtained with fluchloralin and H-26905. Poor preemergent control (less than 70%) and/or excessive turfgrass injury were obtained using napropamide, perfluidone, CGA-24705, HOE-29512, M-4212, and SN-533. Materials giving effective postemergence control of crabgrass included DSMA, MSMA, HOE-22870 and HOE-29512. Poor control and/or objectionable turfgrass injury resulted through use of butylate or RO-3-7042.

INTRODUCTION

Crabgrass is a troublesome weed in turfgrass, but effective control can be obtained with preemergent herbicides (1,7). Previous research has shown varying effectiveness with different formulations of the same preemergent herbicide. Examples of this are: phytotoxicity of DCPA to red fescue (*Festuca rubra* L.) in spray formulations compared to granular formulations (3), less control with sprays versus granular formulations (4), and varying control with different granular formulations of siduron (1,3). Experimental preemergent herbicides are being introduced to supplement the standard choices for crabgrass control.

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In 1976 and 1977 tests were conducted to evaluate control and toxicity characteristics of several standard and experimental preemergent herbicides at various rates and in different formulations.

Where preemergent herbicides are not used, the alternative of postemergence control remains. However, standard materials available often cause objectionable turfgrass injury and may require two or more applications for effective control (2,5). Consequently, efforts are underway to develop more effective postemergence herbicides. HOE-22870 is an experimental material which has shown promise in previous tests (2,5,6).

It has been suggested that crabgrass may become more difficult to control as it matures. With this in mind, two postemergence tests were conducted in 1977 to test herbicide effectiveness at different stages of crabgrass maturity. Both studies were designed to test herbicides at different rates and numbers of applications.

MATERIALS AND METHODS

All tests were undertaken at the Rhode Island Agricultural Experiment Station. The preemergent crabgrass tests were conducted on separate areas in 1976 and 1977 on mature red fescue (*Festuca rubra* L.) turf containing some Kentucky bluegrass (*Poa pratensis* L.). Turf maintenance consisted of mowing at a one-inch height and irrigation was used to insure crabgrass germination and prevent drought.

In 1976 all treatments were applied on April 26 and in 1977 on April 25 through 27. Granular herbicides were applied by hand, and the sprays in 86 gallons of water per acre with a CO_2 pressurized sprayer. Plot size was 4 x 5 feet with each treatment replicated three times. Visual estimates of turfgrass injury were made periodically using a 0-10 evaluation scale with 0 indicating no injury and 10 brown or dead turf. On August 31 of both years, a final determination of crabgrass control was made by comparison of crabgrass cover in each plot with that of the untreated check plots.

Two postemergence crabgrass control studies were conducted in 1977. The first test with 1 or 2 applications was carried out on a mature stand of Kentucky bluegrass with herbicide applications beginning June 23. At that time crabgrass plants were in the 3-6 leaf stage. Plot size was 3 x 6 feet with each treatment replicated three times. The second test with 1, 2 or 3 applications was conducted on a mature stand of red fescue with some Kentucky bluegrass present. Treatments were initiated July 28 when crabgrass plants were in the 4-5 tiller stage. Plots were 4 x 4 feet with each replicated four times. In both tests turfgrass injury ratings were made periodically. Percent control readings were taken on August 12 in the young crabgrass test and September 14 in the mature crabgrass test. Percent crabgrass control was determined by comparing the percent crabgrass in each plot to that in the untreated check plots.

RESULTS AND DISCUSSION

Preemergent Crabgrass Control

The effects of preemergent crabgrass control herbicides are shown in Table 1. At certain rates and formulations benefin, butralin, DCPA, oxadiazon, prosulfalin, siduron and HOE-22870 provided excellent crabgrass control without causing objectionable (2.0 or greater) turfgrass injury. Benefin formulations of fine-sized particles provided slightly better control than did the coarse granules. However, in both years the 3 lb. rate of fine-sized particles caused objectionable injury. Bensulide and DCPA provided excellent control at 7.5 lb/A, a rate lower than normally recommended. DCPA spray applications caused greater injury to red fescue than did the granular forms with no apparent difference in crabgrass control. Oxadiazon 5% and 10% formulations were not as effective as the 2% active ingredient material. This may be due to insufficient numbers of particles to cover the plot. Siduron sprays provided excellent results as did some of the granular formulations. There were, however, several granular materials which gave poor control. Similar results have been observed in previous studies (1,3). HOE-22870 in granular form caused less injury than sprays, while providing equivalent control.

Good control (80-89%) was obtained with fluchloralin and H-26905 at the 2 lb. rate. H-26905 at the 3 lb. rate provided excellent control, however, turfgrass injury in 1976 was objectionable. Poor control of crabgrass (less than 70%) and/or objectionable turfgrass injury resulted with use of napropamide, perfluidone, CGA-24705, HOE-29512, M-4212, and SN-533.

Postemergence Crabgrass Control

Results of postemergence herbicides in Kentucky bluegrass and red fescue turf are shown in Tables 2 and 3, respectively. Two 3 lb. applications of DSMA and two 1.5 lb. applications of MSMA provided excellent results. At higher application rates, or with three treatments, turfgrass injury increased particularly to red fescue. HOE-22870 was effective on young crabgrass, providing excellent control with two applications at the 4 lb. rate. Excellent control of mature crabgrass with HOE-22870, however, required two 8 lb. applications. HOE-29512 showed promising results with one application at the .125 lb. rate; however, higher rates caused objectionable injury to Kentucky bluegrass and red fescue. Poor crabgrass control and/or objectionable turfgrass injury resulted through use of butylate or RO-3-7042.

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Table 1. Crabgrass control and turfgrass injury from preemergence herbicide treatments applied to separate tests in 1976 and 1977.

Herbicide	Granular or spray	Rate lb ai/A	Maximum turfgrass injury[a]		Percent crabgrass control	
			1976	1977	1976	1977
Benefin	G (fine)	2	1.1	0.4	88	97
Benefin	G (fine)	3	2.2	2.0	96	99
Benefin	G (coarse)	2	0.4	1.1	68	90
Benefin	G (coarse)	3	0.5	1.5	85	95
Bensulide	G (3.6%)	10	1.2	0.7	98	99
Bensulide	G (3.6%)	7.5	-	0.8	--	98
Bensulide	S	10	0.5	1.4	99	99
Bensulide	S	7.5	-	0.3	--	98
Butralin	G (A34)	4	1.6 b	1.4	96	99
Butralin	G (A34)	6	2.9 b	-	96	--
Butralin	G (A34)	8	2.8 b	-	99	--
Butralin	G (A492)	4	-	1.8	--	98
Butralin	G (A447)	4	0.0	0.8	95	94
Butralin	G (A424)	4	0.0	1.6	89	98
DCPA	S (wp)	7.5	-	2.7 b	--	99
DCPA	S (wp)	10	2.0 b	2.5 b	100	100
DCPA	G (5%)	7.5	-	0.9	--	92
DCPA	G (5%)	10	1.2	0.9	92	98
DCPA	G (6.9%)	10	1.4 b	-	99	--
DCPA	S (flow)	10	1.8 b	-	99	--
Fluchloralin	S	2	0.8	-	81	--
Napropamide	S (wp)	4	3.1	-	95	--
Oxadiazon	G (2%)	2	0.7	0.6	95	82
Oxadiazon	G (2%)	3	0.5	-	97	--
Oxadiazon	G (2%)	4	0.5	1.3	99	98
Oxadiazon	G (2%)	8	-	2.8	--	99
Oxadiazon	G (5%)	2	-	0.1	--	42
Oxadiazon	G (5%)	4	-	1.4	--	81
Oxadiazon	G (5%)	8	-	1.9	--	97
Oxadiazon	G (10%)	2	-	0.7	--	25
Oxadiazon	G (10%)	4	-	0.7	--	73
Oxadiazon	G (10%)	8	-	1.8	--	95
Perfluidone	S (wp)	4	1.3	-	18	--
Prosulfalin	S (wp)	1.5	0.2	0.7	90	96
Prosulfalin	S (wp)	2	0.6	1.3	96	99
Prosulfalin	S (wp)	2.5	1.4	1.7	98	98
Prosulfalin	S (wp)	3	1.5	1.6	95	98

Crabgrass cover in untreated plots averaged 74%.

[a]Scale 0 to 10 (10=brown) from May through September.

[b]Reduction in fescue with increase in bluegrass.

Table 1, continued. Crabgrass control and turfgrass injury from preemergence herbicide treatments applied to separate tests in 1976 and 1977.

Herbicide	Granular or spray	Rate lb ai/A	Maximum turfgrass injury[a] 1976	Maximum turfgrass injury[a] 1977	Percent crabgrass control 1976	Percent crabgrass control 1977
Siduron	S (wp)	10	-	0.4	--	96
Siduron	S (wp)	12	0.2	-	94	--
Siduron	G (2.3%)	12	0.0	-	21	--
Siduron	G (2.65%)	10	-	0.2	--	97
Siduron	G (3.1%)	10	-	0.4	--	94
Siduron	G (3.1%)	12	0.0	-	93	--
Siduron	G (3.57%)	10	-	0.4	--	92
Siduron	G (3.59%)	10	-	1.0	--	84
Siduron	G (3.71%)	10	-	0.0	--	96
Siduron	G (3.71%)	12	0.0	-	95	--
Siduron	G (4.57%)	10	-	0.4	--	64
Siduron	G (4.57%)	12	0.0	-	71	--
Siduron	G (4.6%)	10	-	0.7	--	90
Siduron	G (4.7% 1977)	10	-	0.7	--	79
Siduron	G (4.7% 1976)	10	-	0.5	--	50
Siduron	G (4.7% 1976)	12	0.1	-	91	--
Siduron	G (5.75%)	10	-	0.5	--	83
Siduron	G (5.75%)	12	0.0	-	91	--
Siduron	G (7.66% 1976)	10	-	0.8	--	67
Siduron	G (7.66% 1976)	12	0.5	-	70	--
Siduron	G (7.66% 1977)	10	-	0.6	--	38
CGA-24705	G (5%)	3	2.5	-	25	--
CGA-24705	G (5%)	6	3.7	-	31	--
CGA-24705	S	3	3.3	-	16	--
CGA-24705	S	6	4.1	-	24	--
H-26905	S	2	0.9	1.0	89	87
H-26905	S	4	3.3 b	1.3	98	97
HOE-22870	S	4	1.0	-	63	--
HOE-22870	S	6	-	1.7	--	63
HOE-22870	S	8	1.8	2.0	96	72
HOE-22870	S	12	2.2	-	98	--
HOE-22870	G (2.5%)	4	0.7	-	83	--
HOE-22870	G (2.5%)	8	0.5	-	98	--
HOE-22870	G (2.5%)	12	0.6	-	99	--
HOE-29512	S	.5	-	2.1	--	19
HOE-29512	S	1	-	3.3	--	52
HOE-29512	S	2	-	2.5	--	92
M-4212	S	2	3.2	-	41	--
M-4212	S	4	3.8 b	-	90	--
SN-533	S	1.5	-	3.5	--	6
SN-533	S	3	-	4.2	--	12

Crabgrass cover in untreated plots averaged 74%.

[a]Scale 0 to 10 (10=brown) from May through September.

[b]Reduction in fescue with increase in bluegrass.

Table 2. Crabgrass control and turfgrass injury from post-emergence herbicides applied in 1977 to Kentucky bluegrass.

Herbicide	Rate in lbs ai/A 6/23	6/30	7/13	Maximum turfgrass injury[a]	Percent crabgrass control 8/12
DSMA	3	3	-	1.0	98
DSMA	4	4	-	1.0	96
DSMA	5	5	-	1.9	96
MSMA	1.5	1.5	-	1.2	97
MSMA	2	2	-	1.0	98
Butylate	3	3	-	2.7	14
Butylate	6	6	-	5.2	12
HOE-22870	4	4	-	0.9	95
HOE-22870	8	-	-	1.0	85
HOE-22870	8	8	-	1.0	99
HOE-29512	.125	-	-	1.2	87
HOE-29512	.125	.125	-	2.2	96
HOE-29512	.25	-	-	3.0	92
HOE-29512	.25	.25	-	4.5	98
HOE-29512	.5	-	-	4.2	94
RO-3-7042	.45	-	.45	3.0	1
RO-3-7042	.89	-	.89	7.3	66
RO-3-7042	1.34	-	1.34	7.9	89

Crabgrass cover in untreated plots averaged 82%.

[a]Scale 0-10 (10=brown) from July through September.

Table 3. Crabgrass control and turfgrass injury from post-emergence herbicides applied in 1977 to red fescue.

Herbicide	Rate in lbs ai/A 7/28	8/4	8/11	Maximum turfgrass injury[a]	Percent crabgrass control 9/14
DSMA	3	3	-	1.2	98
DSMA	3	3	3	1.4	100
DSMA	4	4	-	1.9	98
DSMA	4	4	4	2.0	100
DSMA[b]	3	3	-	1.2	98
MSMA	1.5	1.5	-	1.1	98
MSMA	1.5	1.5	1.5	1.6	100
MSMA	2	2	-	2.0	99
MSMA	2	2	2	2.1	100
HOE-22870	4	4	-	1.1	78
HOE-22870	8	-	-	0.8	75
HOE-22870	8	8	-	1.0	99
HOE-29512	.0625	.0625	-	1.3	81
HOE-29512	.125	-	-	1.4	97
HOE-29512	.125	.125	-	2.1	99
RO-3-7042	.45	-	.45	2.4	52
RO-3-7042	.89	-	.89	4.5	96

Crabgrass cover in untreated plots averaged 87%.

[a]Scale 0-10 (10=brown) from July through September.

[b]Granular formulation, others sprays.

STUDIES ON VERONICA SPECIES IN TURFGRASS

A. Bing[1] and R. W. O'Knefski[2]

ABSTRACT

Controlling speedwell which is most commonly called by its scientific name Veronica is complicated by different growth habits and response to herbicides of the several species that have become serious turfgrass weeds. This report is on the postemergence applications of several herbicides on V. filiformis (perennial), V. serpyllifolia (perennial) and V. arvensis (winter annual).

Endothal sprayed in the spring at 1 lb/A observed one month later or one year later controlled V. filiformis 70-95%, a repeat application 90-95% with no injury to turf. The control of V. arvensis was 50-90% with one to two treatments. There was no control of V. serpyllifolia.

DCPA sprayed at 10-12 lb/A with one treatment controlled V. filiformis 70-95% in one month and 95-100% as observed one year later. There was no control of V. serpyllifolia and in plots where filiformis and serphyllifolia were both growing the V. serpyllifolia was replacing the V. filiformis. There was excellent control of V. arvensis by DCPA but some new seedlings came up the next season. There was serious injury to bentgrass. However this was gradually replaced by bluegrass producing a much more desirable turf.

One application of bentazon sprayed at 1 lb/A gave 55-75% control of V. filiformis, 25% of V. serpyllifolia and 50% control of V. arvensis. Two or three treatments raised the control to 80-85%, 60% and 80-95% observed one month after treatment. One year later control was considerably less. There was no turf injury.

A mixture of 2,4-D, silvex and dicamba thinned out V. filiformis 50-60% after one month but it recovered after one year. V. serpyllifolia and V. arvensis were controlled about 95% but there was plenty of regrowth one year later.

The use of a wax bar impregnated with 2,4-D was more effective on V. serpyllifolia than on V. filiformis.

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USE OF HERBICIDES FOR RENOVATION OF TURF

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ABSTRACT

Killing persistent perennial grasses by herbicides has advantages over cultivation in preparing to reseed turf areas in some situations. With such species as bermudagrass, eradication is often the objective. In two experiments, two or three treatments of glyphosate at 3.4 kg/ha repeated 1 or 2 months apart killed all bermudagrass plants when evaluated a year after treatment. Single treatments at 3.4 kg/ha applied in June, July, or September, left an average of 4 to 18% bermudagrass. Two or three repeated treatments at 1.7 kg/ha left an average of less than 1% bermudagrass. The 0.84 kg/ha rate applied in three repeated treatments left an average of 3% bermudagrass. When 4.5 or 9 kg/ha rates were applied in September 1976, less than 1% survived in 1977. Dalapon, in repeated treatments at 11.2 kg/ha in June and September or July and September left 7 and 2% bermudagrass, respectively. Paraquat at 2.2 kg/ha repeated in June, July, and September, left an average of 56% bermudagrass. Siduron, at 44.8 kg/ha repeated three times, was ineffective in reducing bermudagrass stand. Results of similar treatments on zoysia were somewhat similar to those on bermudagrass and will be reported in detail. When four cultivars of creeping bentgrass were sprayed with glyphosate at 1.7 kg/ha and vertically moved immediately after spraying, the average stand left was 5%. This was significantly higher than the 1% left when vertically mowed 3 days after spraying or on plots not vertically mowed. In a renovation study comparing seedbed practices that can be done by the homeowner, glyphosate was applied to existing turf 14 and 1 day(s) before seven seedbed preparation treatments and seeding were done. Where grass was not controlled by herbicides, only the rotary-tilled plots had satisfactory stands of seeded grasses. Our data indicate that raking turf enough to allow grass seed to contact mineral soil, after treatment with glyphosate, is adequate for good stand establishment, providing there is daily watering to keep the seed moist for about 10 to 14 days. All seedbed treatments were statistically equal in 2 of the 3 years of our experimentation.

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TURFGRASS RENOVATION WITH CACODYLIC ACID, GLYPHOSATE AND PARAQUAT

John A. Jagschitz[1/]

ABSTRACT

Several field tests were conducted from 1974 to 1977 to evaluate cacodylic acid, glyphosate and paraquat for killing unwanted grasses and broadleaf weeds prior to turfgrass renovation. The influence of gallonage, mowing and retreatment was investigated along with the effects of the herbicides on turfgrass seedings. There was some variability in the results of the several tests. In some trials the chemicals were equally effective but seldom was vegetative kill 100%. Cacodylic acid (10 to 20 lb/A) was usually less effective in grass killing, especially Kentucky bluegrass, than paraquat (1 to 2.5 lb/A) or glyphosate (2 to 4 lb/A). Using a higher rate (30 to 40 lb) or repeat treatment (20-20 lb) resulted in improved kill. Glyphosate provided the most consistant and best grass kill. The grasses killed were bentgrass, crabgrass, Kentucky bluegrass, perennial ryegrass, red fescue and tall fescue. The 1 lb rate of paraquat was not as effective as the 2 lb rate for dandelion control. Glyphosate provided the most consistant kill of dandelions. In some trials white clover was very difficult to control. Paraquat in general provided the least clover kill. Varying the water volume from 86 to 258 gallons per acre with a sprayer or to 348 gallons with a hose proportioner did not alter the effectiveness of the herbicides. Mowing a Kentucky bluegrass-tall fescue area maintained at a 4-inch height to a 2-inch height before treatment did not influence grass kill. Mowing a 2-inch bentgrass-fescue-bluegrass area to 3/4 inch before treatment or to 1/2 inch one or two days after treatment did not influence grass or clover kill. Mowing at 1/2 inch before treatment resulted in glyphosate (2 lb) providing less white clover control and cacodylic acid (20 lb) less grass control. Retreatment provided effective control. Use of paraquat (2 lb) one week prior to renovation seeding with Kentucky bluegrass and red fescue resulted in a 13% stand reduction one month after treatment. No reduction was noted from treatment two weeks before seeding; but when retreated the day before seeding, there was a 24% reduction. Paraquat (2 lb) treatment one hour after seeding resulted in a 91% stand reduction. Cacodylic acid (20 lb) and glyphosate (4 lb) had little effect on the seeded grass stands.

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GROWTH RETARDATION OF TALL FESCUE IN A TRELLISED APPLE ORCHARD

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ABSTRACT

Mefluidide was applied on two occasions in 1976 to tall fescue growing between the rows of a trellised apple orchard. The effects of the mefluidide on color, height, and weight of the tall fescue were measured periodically throughout the season. All rates, 0.14, 0.28, and 0.56 kg/ha reduced color ratings, but did not decrease stand density. By the last color rating date (September 24), all treated turf had higher color ratings than the control. On the second application date (approximately four weeks later), the 0.14 kg/ha treatment received 0.56 kg/ha, the 0.28 kg/ha received 0.28 kg/ha, and the 0.56 kg/ha received 0.14 kg/ha. All treated grass had a significantly lower height than the control on all measurement dates except the last (September 24). Routine mowing management in the orchard was once per week. In the section treated with mefluidide there were only two mowings during the 11 week experiment, which would indicate a savings of nine mowings. Clipping weights that were taken during the mowing indicated that, on both occasions, all treated turf produced significantly less vegetation than the control. There were however, no differences in the weights across the mefluidide treatments.

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EFFECT OF GROWTH RETARDANTS ON COOL SEASON LAWN GRASSES[1/]

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ABSTRACT

Growth retardants alone and in combination with broadleaf herbicides, fungicides and surfactants and trim-mowing practices were evaluated on four, cool season, close-cut lawn grasses. Most favorable results with vegetative and seedhead suppression were obtained with mefluidide, MH alone and a combination of MH with CF or ethephon. All materials caused some degree of injury or discoloration. Growth retardants were effective when used with broadleaf herbicides (2,4-D, dicamba, mecoprop and silvex), fungicides (benomyl, chlorothalonil and quintozene) and surfactants (AL 1448, Pace and X-77). Fungicides reduced leaf spot on colonial bentgrass and appeared to reduce overall injury to Kentucky bluegrass from growth retardants. Trim mowing one week following treatment did not reduce effectiveness of growth retardants.

INTRODUCTION

Recent studies have shown that grass top growth and seedheads can be suppressed by the use of chemical retardants although they also produce some grass injury or discoloration (1,2,3,4,5). To further evaluate retardants several tests were initiated in 1976 and 1977 on close cut turfgrass. The growth response of Kentucky bluegrass, red fescue, colonial bentgrass and perennial ryegrass was investigated along with further tests on the use of fungicides to reduce grass injury (2,3). The effects of trim mowing after chemical use and the addition of surfactants and broadleaf weed killers with retardants were also investigated.

MATERIALS AND METHODS

Four grass species maintained at a mowing height of 1.5 to 2 inches in separate lawn areas were chemically treated in May, 1976. The species were: 'Exeter' colonial bentgrass (*Agrostis tenuis* Sibth.), 'Jamestown' red fescue (*Festuca rubra* L.), 'Manhattan' perennial ryegrass (*Lolium perenne* L.) and a mixture of 'Baron', 'Merion' and 'Sydsport' Kentucky bluegrass (*Poa pratensis* L.). In May, 1977, treatments were applied only to the bluegrass area. The chemicals (see Appendix), rates, dates of application and the mowing schedules

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are shown in Tables 1 to 9. Treatments were applied to plots measuring 4 by 4 feet and replicated three times. Granular (g) materials were applied by hand and other materials were applied as sprays at 50 gallons per acre with the exception of the dribble bar application of CME-10951 at 534 gpa. Chemical mixtures were applied as one spray with the exception of ethephon plus MH or mefluidide which were applied separately. Butylate was watered in at the rate of 5445 gpa in the 1976 bluegrass test and at 1361 gpa in the other tests. No rain occurred earlier than 1.3 days following any spray treatment and the maximum duration without rain following the granular treatments was 2.5 days. Where fungicides were used, they were applied as sprays at 218 gpa. Growth response was determined by grass height measurements, visual estimates of grass injury or color and by estimates of number of seedheads and/or measurement of seedhead heights.

RESULTS AND DISCUSSION

The results from the tests initiated in 1976 and 1977 are presented in Tables 1 to 9. Most chemical retardants produced good seedhead and top growth suppression but caused grass injury or discoloration. Most favorable results were obtained with mefluidide, MH alone and a combination of MH with CF or ethephon; however, the potential for injury to close cut turf appears greater with mefluidide. Spray applications of mefluidide were more effective than dry formulations. Results were less favorable with butylate, CGA-24705, CME-10951, ethephon, RO-3-7042, S-108, S-734 and SN-49537. The spray and dribble bar application of CME-10951 provided similar results.

Grass tolerance: Results from the four cool season grasses treated with chemical retardants (Tables 1,3,5,6) show that bluegrass was more tolerant than bentgrass, fescue and ryegrass to MH, MH plus CF, MH plus ethephon and RO-3-7042; fescue was more tolerant than bentgrass, bluegrass and ryegrass to S-108 and S-734; and tolerance among species was similar to mefluidide.

Green color: Observations were made on grass treated in the test of Table 9 using a visual rating from 0 to 10 with 10 indicating dark green turf. Treatments showed various shades of green on Kentucky bluegrass prior to mowing 6 weeks after treatment. Dark green treatments were: ethephon, ethephon plus MH, low rates of MH, MH plus surfactants, 2,4-D amine, 2,4-D plus mecoprop and the checks. Treatments rated as moderate light green (rating 6 to 7) before mowing were: CME-10951 P at high rate, mefluidide alone at the higher rates, mefluidide at .375 lb with surfactants or broadleaf herbicides. The only treatment rated as slight to moderate light green was mefluidide at .125 lb plus surfactants. All other treatments were rated slightly less dark green than the check prior to mowing. After mowing (7 weeks after application of chemicals) check plots and the plots having tall grass were rated as moderate light green. Mefluidide treatments were rated dark green to slight light green with most other treatments being slight light green. Twelve weeks after chemical applications, all treatments were color rated about equal.

Seedheads: Kentucky bluegrass seedheads became apparent 1 week following treatments in 1976 (applied May 10) and about 3 weeks in 1977 (applied May 3). Treatments made 1 week before seedheads became visible (Tables 1,2) indicate that mefluidide was the most effective chemical for seedhead suppression while

with earlier treatments (Tables 8,9) suppression was also obtained with MH, MH plus CF, MH plus ethephon and RO-3-7042. Seedhead suppression was less favorable with butylate, CME-10951 and ethephon. Treatments were shown to often suppress but not completely eliminate seedheads. In these cases appearance of the plots was affected as seedheads turned brown (Tables 1,2) and "injury" ratings were greater. For example, in the MH (3 lb/A) treatment, up to 37% of the plot was covered by seedheads after mowing and continued to detract from appearance for up to 9 weeks. This would tend to emphasize the importance of timely applications of growth retardants.

Surfactants and herbicides: The use of AL-1448, Pace and X-77 at concentrations of .1 and .5% had little effect on the results obtained from MH at the 2 lb rate and mefluidide at the .125 and .375 lb rates (Table 9). Combining the broadleaf herbicides 2,4-D, dicamba, mecoprop and silvex with the growth retardants MH and mefluidide provided no problem in sprayer application (CO_2 bottle sprayer) and did not change their growth regulating properties (Table 9).

Retreatment: Application of growth retardants 6 weeks following the first treatment (Table 8) resulted in only a slight reduction in grass height at 12 weeks. The grass in general was not growing vigorously. No increase in injury occurred with the 2 lb rate of MH, CME-10951 and MH plus CF while there was an increase in injury with mefluidide and the 3 lb rate of MH.

Trim mowing: Mowing Kentucky bluegrass 1 week following chemical treatment did not alter the results with the various retardants (Table 8). Although the trimmed grass was shorter in height this was due to a 5-week rather than a 6-week interval between mowings. It was felt, however, that trimming resulted in a more uniform turf and with slow-acting retardants could result in shorter grass and a better appearance (less "scalping") when mowing is resumed. Injury was increasingly greater as the time interval between mowing increased from 4 to 6 weeks or as the grass grew taller from 5 to 7 inches (Table 2). Untreated red fescue when mowed after an interval of 5 or 6 weeks had similar injury (Table 4). This can be attributed to the grass height being uniformly low (3.6 inches) at 5 or 6 weeks. Injury due to chemicals was not influenced by the mowing time intervals except when associated with bluegrass heights reaching 4.3 inches. Possibly "scalping" took place when mowing was resumed at the 2-inch height. Grass heights should serve as a guide as to when mowing should be resumed to improve appearance. Results in Tables 2 and 4 and those of previous tests (2,3) show that most chemical retardants can restrict grass growth in May-June for about 5 weeks to a height under 4 inches without "scalping" problems. The red fescue growth data in Table 7 show that retardants did not reduce growth during a 3-week period following the 5 weeks after treatment mowing. Grass having less growth than the checks had injury which could account for the reduced height. General observations of grass growth in this and previous tests indicated little chemical growth retardation of Kentucky bluegrass after 5 or 6 weeks.

Fungicides: The use of quintozene plus benomyl on Kentucky bluegrass did not alter regulating properties of the retardants (Table 1). They did, however, provide a reduction in grass injury during the initial 6-week period not apparently related to disease incidence. Similar results have been observed in other tests where disease incidence was low (2,3). The use of the fungicide chlorothalonil on the red fescue area where disease incidence was low did not consistently affect the retardants (Tables 3,7). Where chlorothalonil was used on colonial bentgrass the grass was slightly taller in most instances and not

injured as much (Table 5). Grass injury was related to disease incidence. Data not presented in this paper was recorded by pathologists on the incidence of red leaf spot (Helminthosporium erythrospilum) 4 weeks after treatment. Grass treated with growth retardants had red leaf spot lesions on 20 to 40% of the blades. The use of chlorothalonil reduced leaf spot to 3% or less which was similar to grass not treated with retardants.

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Table 1. Kentucky bluegrass response to chemicals applied May 10, 1976, and mowed at a 2-inch height 1 week later (trim) and regularly at a 2-inch height after 5 weeks.

	Chemical	lb/A	Fungi-cide	Grass Height (in) 5 wk	Seedhead Height (in) 5 wk	Seedhead Stand (0-10)[a] 5 wk	% Cover after mow 6 wk	Kentucky bluegrass injury (0-10)[a] 0-3 wk	4-5 wk	6 wk	7-9 wk	16 wk
17	MH	2		3.5	5.4	8	17	.3	.4	1.5[b]	1.7	0.0
2	MH + CF	2 + 1		3.3	4.8	6	21	.2	1.5	1.3[b]	1.9	.3
10	MH + CF	2 + 1	Q + B[c]	3.1	4.3	8	34	0.0	0.0	.5	2.0[b]	0.0
1	MH	3		2.9	3.2	8	37	.7	1.7	2.0[b]	2.6[b]	0.0
9	MH	3	Q + B	2.5	3.3	9	34	0.0	.3	.8	3.1[b]	.3
18	MH	4		2.5	2.7	8	38	.9	1.9	2.4[b]	3.5[b]	0.0
35	Ethephon	2		4.7	7.1	7	1	0.0	0.0	.7	2.3	2.4
5	MH + Ethephon	2 + 2		3.1	4.6	6	13	.9	1.1	1.3[b]	2.1	.7
13	MH + Ethephon	2 + 2	Q + B	3.3	4.5	8	17	0.0	0.0	.6	1.9	1.1
19	Mefluidide	.125		3.0	3.0	4	27	1.8	2.3	2.4[b]	3.1	0.0
3	Mefluidide	.25		2.4	2.4	1	17	2.1	3.1	3.0	3.0	1.0
11	Mefluidide	.25	Q + B	2.3	2.3	1	21	1.0	1.1	2.0	3.2	.7
20	Mefluidide g	.125		5.5	9.7	9	3	0.0	0.0	1.2	2.5	.5
4	Mefluidide g	.25		5.8	10.0	10	6	0.0	0.0	1.6	2.8	1.0
12	Mefluidide g	.25	Q + B	6.0	9.4	9	6	0.0	0.0	.7	2.2	.8
7	Mefluidide g	.5		4.3	7.7	8	20	0.0	.5	2.2[b]	3.1	1.1
15	Mefluidide g	.5	Q + B	4.6	7.9	8	23	0.0	0.0	1.0[b]	1.9	.4
25	Butylate + 4S	3		4.5	7.0	9	13	0.0	.5	2.2	2.9	.3
26	Butylate + 4S	6		3.8	5.2	9	21	.2	1.1	2.7[b]	3.7[b]	.7
21	CGA-24705	8		3.4	5.9	8	26	.8	1.0	2.5[b]	3.0[b]	.5
22	RO-3-7042	.4S		5.5	7.6	8	2	0.0	0.0	1.1	1.8	.6
23	RO-3-7042	.9		3.8	4.8	6	9	.8	1.1	1.0	1.8	0.0
24	RO-3-7042	1.8		2.5	2.7	5	32	1.9	2.9	3.0[b]	3.7[b]	0.0
27	SN-49537	.25		5.3	9.2	9	2	0.0	0.0	2.0	3.8	1.1
28	SN-49537	.5		4.6	9.0	9	4	0.0	.6	3.2	5.2	3.6
29	SN-49537	1		5.0	9.2	8	2	0.0	.4	2.7	4.7	2.1
30	S-108 g	.5		4.1	6.5	8	24	0.0	.8	2.2[b]	2.4	0.0
6	S-108 g	1		3.0	3.5	9	40	.2	1.4	3.1[b]	4.1[b]	.3
14	S-108 g	1	Q + B	2.8	3.2	9	43	0.0	.2	1.8[b]	3.6[b]	.4
31	S-108 g	2		2.4	2.5	8	51	1.1	3.8	5.6[b]	5.8[b]	1.3
32	S-734 g	.5		3.0	3.9	9	42	.2	1.7	3.8[b]	4.1[b]	1.4
33	S-734 g	.75		2.9	3.4	9	43	1.1	2.9	4.0[b]	4.6[b]	1.2
34	S-734 g	1		2.6	2.8	8	48	.9	3.3	5.0[b]	5.8[b]	3.1
8	Check			6.3	10.0	9	2	0.0	0.0	1.7	2.2	0.0
16	Check		Q + B	6.8	9.8	9	2	0.0	0.0	1.0	2.1	.9
36-40	check			6.2	9.7	9	2	0.0	0.0	1.4	2.3	.4

[a]0 = no injury, 10 = brown; 0 = no seedheads, 10 = normal stand (421/sq ft).

[b]More than half the injury is due to brown seedheads.

[c]Quintozene and Benomyl applied May 17 at 3/8 and 1/4 lb ai/1000 sq ft, respectively.

Table 2. Kentucky bluegrass response to chemicals applied May 10, 1976, and mowed at a 2-inch height 1 week later with mowing resumed 4, 5 and 6 weeks after chemical treatment.

	Chemical	lb/A	Grass Height (inches)	Seedhead Height (inches)	Seedhead Stand (0-10)[a]	% Cover (after mow)	Kentucky Bluegrass Injury (0-10)[a] (weeks after chemicals) 0-3	4	5	6	7	9	16
Mowing Resumed at 4 weeks			(4 wk)	(4 wk)	(4 wk)	(4 wk)							
1	MH	3	2.7	3.4	7	35	.5	1.4	1.7	2.3[b]	3.3	3.0[b]	0.0
2	MH + CF	2 + 1	3.0	4.0	8	28	.5	.7	1.2	1.6[b]	2.5	2.1	0.0
5	MH + Ethephon	2 + 2	3.1	5.2	7	14	.5	1.0	1.0	1.3[b]	2.5	2.7	1.0
3	Mefluidide	.25	2.2	2.2	1	18	2.6	2.5	2.6	2.3[b]	3.0	2.6	.3
4	Mefluidide g	.25	4.6	6.8	9	19	0.0	0.0	.9	1.5[b]	1.7	1.9	.3
7	Mefluidide g	.5	3.3	5.1	8	30	0.0	.4	1.1	2.1[b]	2.5	3.4[b]	.7
6	S-108 g	1	2.8	3.3	9	52	.2	1.2	2.3	3.8[b]	4.1	4.1[b]	.3
8	Check		5.2	7.2	10	6	0.0	0.0	.9	1.3	1.6	2.2	0.0
Mowing Resumed at 5 weeks			(5 wk)	(5 wk)	(5 wk)	(6 wk)							
1	MH	3	2.9	3.2	8	37	.7	.7	1.7	2.0[b]	2.6	2.5[b]	0.0
2	MH + CF	2 + 1	3.3	4.8	6	21	.2	.6	1.5	1.3[b]	1.4	1.9	.3
5	MH + Ethephon	2 + 2	3.1	4.6	6	13	.9	1.0	1.1	1.3[b]	2.0	2.1	.7
3	Mefluidide	.25	2.4	2.4	1	17	2.1	2.8	3.1	3.0	3.0	2.9	1.0
4	Mefluidide g	.25	5.8	10.0	10	6	0.0	0.0	0.0	1.6	2.1	2.8	1.0
7	Mefluidide g	.5	4.3	7.7	8	20	0.0	.4	.5	2.2[b]	2.8	3.1	1.1
6	S-108 g	1	3.0	3.5	9	40	.2	.9	1.4	3.1[b]	4.1	3.8[b]	.3
8	Check		6.3	10.0	9	2	0.0	0.0	0.0	1.7	1.6	2.2	0.0
Mowing Resumed at 6 weeks			(6 wk)	(6 wk)	(6 wk)	(7 wk)							
1	MH	3	3.4	3.8	9	35	.9	1.4	2.1	2.4	3.5[b]	2.9[b]	0.0
2	MH + CF	2 + 1	4.3	5.0	6	19	0.0	.6	.6	.9	2.2[b]	2.8	0.0
5	MH + Ethephon	2 + 2	3.9	5.7	8	14	0.0	0.0	.5	.8	1.9[b]	3.7	1.0
3	Mefluidide	.25	3.6	3.6	5	31	2.5	2.8	2.7	2.4	3.4[b]	2.5	0.0
4	Mefluidide g	.25	6.0	9.7	9	8	0.0	0.0	0.0	0.0	1.8	2.8	.5
7	Mefluidide g	.5	5.2	8.2	8	21	0.0	.3	.5	.5	3.0[b]	3.2	1.2
6	S-108 g	1	3.2	3.6	9	43	.3	1.2	2.3	3.6[b]	4.5[b]	3.6[b]	.8
8	Check		7.0	11.5	10	2	0.0	0.0	0.0	0.0	2.1	2.7	.3

[a]0=no injury, 10=brown; 0=no seed heads, 10=normal stand (421/sq ft)

[b]More than half the injury is due to brown seed heads.

Table 3. Red fescue response to a fungicide and to chemicals applied May 13, 1976, and mowed at a 1.5-inch height 1 week later (trim) and at a 2-inch height regularly after 5 weeks and regularly at 1.5-inch height after 9 weeks.

	Chemical	lb/A	Fungicide	Grass height (inches) 5 weeks	Seedhead stand (0-10)[a] 5 weeks	Fescue Injury (0-10)[a] 0-3 weeks	4-5 weeks	6 weeks	8 weeks	10 weeks	16 weeks
1	MH	2		2.8	1	2.2	3.2	1.1	1.6	.7	.7
3	MH + CP	2 + 1		2.5	0	3.0	3.9	1.7	1.6	0.0	0.0
23	MH + CP	2 + 1	C[b]	2.5	0	2.6	3.3	1.2	2.0	2.0	0.0
30	Ethephon	2		2.4	4	.2	0.0	.1	1.6	2.5	2.4
4	MH + Ethephon	2 + 2		2.3	1	2.8	3.7	1.6	1.3	0.0	.3
24	MH + Ethephon	2 + 2	C	2.2	1	2.7	3.5	1.2	.8	0.0	.3
2	MH	3		2.2	1	3.3	4.6	2.4	2.2	.7	.7
22	MH	3	C	2.5	1	3.1	3.6	1.9	1.9	1.7	0.0
5	Mefluidide	.125		3.0	1	2.8	3.0	1.2	1.5	.6	.9
6	Mefluidide	.25		2.8	1	3.7	3.7	.7	1.1	.6	0.0
25	Mefluidide	.25	C.	3.2	0	3.3	3.1	1.0	1.9	1.2	.4
7	Mefluidide g	.25		3.9	9	.2	.2	.4	1.7	0.0	.7
8	Mefluidide g	.5		3.6	9	0.0	.6	.5	1.6	1.1	0.0
26	Mefluidide g	.5	C	3.3	8	.3	.5	.5	1.5	.8	.3
101	Mefluidide g	1		3.2	9	.9	2.4	1.2	1.7	1.2	0.0
103	Mefluidide g + S-734 g	.25 + .5		3.2	9	0.0	2.0	2.3	3.4	0.0	0.0
15	CGA-24705	6		2.7	6	1.3	2.7	2.9	2.2	0.0	0.0
16	RO-3-7042	.9		2.4	1	4.0	4.3	1.7	1.0	0.0	0.0
17	RO-3-7042	1.8		1.8	0	4.5	5.8	3.9	2.7	0.0	1.7
18	SN-49537	1		3.2	8	0.0	2.6	2.6	3.3	3.0	1.9
21	Butylate + 4s	4.5		2.9	6	.5	2.5	2.8	2.2	.6	0.0
9	S-108 g	.5		3.7	9	0.0	.7	.5	1.6	.6	.3
10	S-108 g	1		3.2	7	.3	1.7	1.9	1.4	0.0	1.0
27	S-108 g	1	C	3.0	6	.9	2.8	3.1	3.2	2.5	.5
11	S-108 g	2		2.7	4	1.5	3.6	3.4	3.3	0.0	.3
12	S-734 g	.5		3.1	6	.2	1.5	2.4	3.1	.6	.3
13	S-734 g	.75		2.7	6	.4	2.1	2.5	3.3	2.0	0.0
28	S-734 g	.75	C	3.4	8	.1	1.8	2.9	3.5	2.7	1.4
14	S-734 g	1		2.7	5	1.0	3.3	3.6	3.8	3.3	.9
102	S-734 g	1.5		2.9	9	0.0	3.2	3.3	3.6	2.7	0.0
19	Check			3.8	9	0.0	.3	.4	1.2	0.0	.6
20	Check			3.6	9	0.0	.3	.4	1.1	0.0	.7
29	Check		C	3.9	9	.2	0.0	1.1	1.2	.6	0.0

[a]0=no injury, 10=brown; 0=no seedheads, 10=normal stand (18/sq ft about 6.5 inch height)

[b]Chlorothalonil flowable applied May 24, June 4 and June 22, 1976, at .1875 lb ai/1000 sq ft.

Table 4. Red fescue response to chemicals applied May 13, 1976, and mowed at a 1.5-inch height 1 week later with mowing resumed 5 or 6 weeks after chemical treatment.

Chemical	lb/A	Grass height (inches)	Seedhead Stand (0-10)[a]	Fescue Injury (0-10)[a] (weeks after chemical) 0-3	4-5	6	7	8	10	16
Mowing resumed at 5 weeks		(5 wk)	(5 wk)							
2 MH	3	2.2	1	3.3	4.6	2.4	--	2.2	.7	.7
3 MH + CP	2 + 1	2.5	0	3.0	3.9	1.7	--	1.6	.0	.0
6 Mefluidide	.25	2.8	1	3.7	3.7	.7	--	1.1	.6	.0
10 S-108 g	1	3.2	7	.3	1.7	1.9	--	1.4	.0	1.0
13 S-734 g	.75	2.7	6	.4	2.1	2.5	--	3.3	2.0	.0
20 Check	--	3.6	9	.0	.3	.4	--	1.1	.0	.7
Mowing resumed at 6 weeks		(6 wk)	(6 wk)							
31 MH	3	3.1	0	3.0	4.0	1.9	1.3	1.8	.0	.8
32 MH + CP	2 + 1	3.4	0	2.8	3.2	1.2	.8	1.8	.8	.3
33 Mefluidide	.25	3.3	1	3.8	3.8	.7	.8	1.3	.0	.0
34 S-108 g	1	3.0	5	.5	1.9	1.8	1.6	2.2	.0	.0
35 S-734 g	.75	2.9	5	.2	1.8	2.7	3.3	2.5	2.3	.0
36 Check	--	3.6	9	.0	.4	.0	.5	1.1	.8	.5

[a]0 = no injury, 10 = brown; 0 = no seedheads, 10 = normal stand (18/sq ft average height was 6.5 inches at 5 weeks and 8 inch at 6 weeks).

Table 5. Colonial bentgrass response to a fungicide and to chemicals applied May 13, 1976, and mowed at a 1.5-inch height 1 week later (trim) and at a 2-inch height after 6 weeks and at a 1.5-inch height after 9 weeks.

	Chemical	lb/A	Fungicide	Grass height (inches) 6 weeks	Seedhead Stand (0-10)[a] 6 weeks	Grass Injury (0-10)[a] 0-3 weeks	4-6 weeks	7 weeks	8 weeks	10 weeks
1	MH	2		2.8	0	.6	2.0	1.3	2.0	1.8
3	MH + CF	2 + 1		2.9	1	1.7	3.3	1.7	2.1	1.8
23	MH + CF	2 + 1	c[b]	3.2	0	1.5	2.2	.7	.8	1.2
4	MH + Ethephon	2 + 2		2.4	0	0.0	2.3	1.2	1.4	1.6
24	MH + Ethephon	2 + 2	c	2.7	1	.3	1.1	.3	.4	1.2
2	MH	3		2.9	0	1.0	3.8	2.6	2.4	1.6
22	MH	3	c	2.7	1	1.1	2.5	.6	.9	.8
5	Mefluidide	.125		3.0	1	1.8	2.9	1.9	2.3	3.0
6	Mefluidide	.25		2.9	0	2.7	3.1	1.9	2.4	1.8
25	Mefluidide	.25	c	3.3	0	1.5	2.3	.7	1.1	1.1
7	Mefluidide g	.25		3.5	7	.3	.6	1.2	2.0	3.8
8	Mefluidide g	.5		3.1	5	.6	1.7	1.2	2.2	3.3
26	Mefluidide g	.5	c	3.5	4	1.0	.5	.2	.9	2.2
21	Butylate + 4S	4.5		2.7	4	0.0	2.9	3.2	3.1	1.5
15	CGA-24705	6		3.4	8	.3	.6	1.0	1.5	3.1
16	RO-3-7042	.9		3.0	5	1.1	1.8	1.4	2.1	2.5
17	RO-3-7042	1.8		2.3	2	2.1	4.3	3.3	3.0	1.0
18	SN-49537	1		2.9	4	0.0	3.4	3.3	3.5	3.8
9	S-108 g	.5		3.0	5	.3	2.3	1.8	2.4	1.7
10	S-108 g	1		2.5	1	.6	4.2	3.6	3.2	1.6
27	S-108 g	1	c	2.6	2	0.0	2.7	2.1	1.7	1.0
11	S-108 g	2		2.0	1	2.3	4.9	5.4	5.1	3.4
12	S-734 g	.5		2.4	3	.7	3.7	3.5	3.7	2.5
13	S-734 g	.75		2.3	2	.2	4.3	4.3	4.1	3.7
28	S-734 g	.75	c	2.2	1	0.0	3.3	3.2	3.9	3.6
14	S-734 g	1		2.2	1	.3	4.2	4.6	4.6	3.8
19	Check			3.8	10	0.0	.3	1.1	1.9	3.8
20	Check			3.9	8	0.0	.1	1.1	2.3	2.8
29	Check		c	4.4	9	0.0	0.0	0.0	.4	2.1

[a]0 = no injury, 10 = brown; 0 = no seedheads, 10 = normal stand.

[b]Chlorothalonil flowable applied on May 24, June 4 and June 22, 1976, at .1875 lb ai/1000 sq ft.

Table 6. Perennial ryegrass response to chemicals applied May 13, 1976, and mowed at a 1.5-inch height 1 week later (trim), at a 2-inch height regularly after 6 weeks and at a 1.5-inch height regularly after 9 weeks.

	Chemical	lb/A	Grass Height (inches) 6 weeks	Seedheads per 16 sq ft 6 weeks	Ryegrass Injury (0-10)[a] 0-3 weeks	4-6 weeks	7 weeks	8 weeks	10 weeks
1	MH	2	3.3	1	.2	1.7	1.1	2.4	2.5
3	MH + CF	2 + 1	2.7	0	1.2	3.6	3.1	3.3	2.8
4	MH + Ethephon	2 + 2	2.8	0	0.0	1.7	1.4	2.5	2.8
2	MH	3	2.8	1	.2	2.3	1.1	2.0	2.0
5	Mefluidide	.125	3.1	3	.2	.7	1.0	2.1	3.7
6	Mefluidide	.25	3.2	1	.8	1.6	1.3	2.3	3.0
7	Mefluidide g	.25	3.1	9	0.0	.8	1.5	3.0	4.0
8	Mefluidide g	.5	3.2	7	0.0	.8	1.5	3.1	3.7
15	CGA-24705	6	2.1	2	1.3	4.3	2.7	2.7	.9
16	RO-3-7042	.9	3.0	6	0.0	.4	1.1	2.5	3.8
17	RO-3-7042	1.8	3.1	3	.3	1.5	.8	2.2	3.2
18	SN-49537	1	2.3	4	3.3	5.6	5.1	5.6	4.0
9	S-108 g	.5	3.1	3	.4	1.4	.7	1.4	1.7
10	S-108 g	1	2.3	2	0.0	3.3	1.9	2.1	1.5
11	S-108 g	2	2.0	1	.2	4.7	3.2	2.4	.9
12	S-734 g	.5	2.1	1	.3	3.8	3.5	3.2	.9
13	S-734 g	.75	1.8	0	.2	5.1	3.9	4.0	.8
14	S-734 g	1	1.9	1	0.0	5.7	5.1	4.1	1.0
19	Check		3.3	5	0.0	.2	1.2	2.9	4.1
20	Check		3.8	17	0.0	.3	.8	2.6	3.8

[a]0 = no injury, 10 = brown

Table 7. The response of red fescue which was unmowed following the five weeks after chemical mowing at 2 inches from chemicals applied May 13, 1976.

	Chemical	lb/A	Fungicide	Grass Height (inches) (time after the 5-week after chemical mowing at 2") 1 week	2 weeks	3 weeks	Fescue Injury (0-10)[a] 1 week	2 weeks	3 weeks
1	MH	2		3.4	4.1	4.1	1.1	.6	.4
3	MH + CF	2 + 1		3.4	4.0	4.5	1.7	1.0	.6
23	MH + CF	2 + 1	C[b]	3.5	4.2	4.7	1.2	.6	.8
30	Ethephon	2		2.6	3.2	3.3	.1	.4	1.0
4	MH + Ethephon	2 + 2		2.9	3.1	3.4	1.6	1.3	.9
24	MH + Ethephon	2 + 2	C	3.0	3.4	3.9	1.2	.3	.1
2	MH	3		3.1	3.7	4.2	2.4	.9	.9
22	MH	3	C	3.7	4.0	4.6	1.9	1.2	.8
5	Mefluidide	.125		3.2	3.5	3.8	1.2	.6	.5
6	Mefluidide	.25		3.5	4.3	4.5	.7	0.0	.5
25	Mefluidide	.25	C	3.5	4.4	4.8	1.0	.2	1.0
7	Mefluidide g	.25		3.1	3.8	3.8	.4	.4	.7
8	Mefluidide g	.5		3.0	3.7	3.8	.5	.6	.4
26	Mefluidide g	.5	C	3.3	4.0	4.3	.5	.8	.6
101	Mefluidide g	1		2.6	3.4	3.4	1.2	.6	1.2
103	Mefluidide g + S-734 g	.25 + .5		2.4	3.2	3.2	2.3	2.2	2.3
15	CGA-24705	6		3.0	3.5	3.7	2.9	1.6	1.1
16	RO-3-7042	.9		3.2	3.9	4.3	1.7	.7	.7
17	RO-3-7042	1.8		2.8	3.3	3.7	3.9	2.9	2.1
18	SN-49537	1		2.4	3.0	3.0	2.6	2.9	2.7
21	Butylate + 4s	4.5		2.5	3.3	3.4	2.8	2.8	1.6
9	S-108 g	.5		3.1	3.5	3.9	.5	.8	.7
10	S-108 g	1		2.9	3.5	3.6	1.9	1.7	.7
27	S-108 g	1	C	3.0	3.5	3.8	3.1	2.5	2.9
11	S-108 g	2		2.6	3.0	3.2	3.4	2.9	3.0
12	S-734 g	.5		2.6	3.0	3.0	2.4	2.7	2.7
13	S-734 g	.75		2.1	2.5	2.6	2.5	2.8	2.9
28	S-734 g	.75	C	2.2	2.6	2.9	2.9	3.4	3.5
14	S-734 g	1		2.3	2.2	2.5	3.6	3.9	3.8
102	S-734 g	1.5		2.3	2.4	2.7	3.3	2.9	3.6
19	Check			2.8	3.4	3.8	.4	.3	.6
20	Check			2.7	3.5	3.5	.4	.7	.4
29	Check		C	3.3	4.1	4.3	1.1	.4	.3

[a]0 = no injury, 10 = brown.

[b]Chlorothalonil flowable applied May 24, June 4 and June 22, 1976, at .1875 lb ai/1000 sq ft.

Table 8. Response of Kentucky bluegrass to chemicals applied May 3, 1977, and to trim mowing (2 inch) 1 week later followed by regular mowing after 6 weeks and to trim mowing 1 and 6 weeks later with retreatment at 6 weeks and regular mowing after 12 weeks.

Chemical	lb/A	Grass height (in) 6 wks	12 wks	Seedhead Height (in) 6 wks	Stand (0-10)[a] 6 wks	Kentucky bluegrass injury (0-10)[a] 0-3 wks	4-6 wks	7 wks	8-9 wks	10-12 wks
CME 10951 (spray)	8.4									
No trim		3.3	-	4.8	3.2	1.0	1.2	1.0	2.1	1.6
Trim 1 week		2.9	-	5.0	5.0	1.0	.7	1.1	1.9	1.8
Trim+retreat 6 wks		3.0	3.5	4.2	3.3	.4	.5	1.4	2.1	1.7
MH	2									
No trim		3.3	-	5.5	.1	.7	.7	.8	1.2	1.3
Trim 1 week		3.1	-	5.6	.1	.4	.5	.6	.9	1.1
Trim+retreat 6 wks		3.1	3.7	3.1	.1	.5	.3	.6	1.0	1.4
MH	3									
No trim		3.1	-	.0	.0	.8	1.5	1.9	1.8	1.5
Trim 1 week		2.7	-	.0	.0	.6	1.3	1.7	1.6	1.4
Trim+retreat 6 wks		3.0	3.7	.0	.0	.6	1.2	1.8	2.3	2.4
MH + CF	2+1									
No trim		3.7		.0	.0	1.3	.7	1.2	1.4	1.3
Trim 1 week		3.3		.0	.0	.8	.6	.8	1.2	1.3
Trim+retreat 6 wks		3.6	4.5	.0	.0	.4	.3	.6	1.0	1.4
Mefluidide	.25									
No trim		3.3	-	3.8	.2	1.4	2.2	2.2	1.3	1.2
Trim 1 week		3.1	-	3.9	.1	1.8	3.4	2.7	1.8	1.1
Trim+retreat 6 wks		3.1	3.7	.0	.0	1.3	2.5	2.9	3.5	2.7
Mefluidide	.375									
No trim		3.1	-	.0	.0	1.6	2.8	2.1	1.3	1.1
Trim 1 week		2.9	-	.0	.0	1.5	2.7	2.4	1.4	1.2
Trim+retreat 6 wks		3.5	4.0	.0	.0	1.3	2.4	2.9	3.3	2.6
Check										
No trim		5.7	-	8.5	8.3	.7	.1	1.9	1.3	1.3
Trim 1 week		4.4	-	7.7	8.0	.4	.2	1.1	.9	1.1
Trim+retreat 6 wks.		5.2	4.0	8.3	9.2	.3	.0	.9	.6	.9

[a]0 = no injury, 10 = brown; 0 = no seedheads, 10 = normal stand (66/sq/ft).

Table 9. Kentucky bluegrass response to chemicals applied May 3, 1977, and mowed at 2-inch height one week later (trim) and regularly at 2-inch after 6 weeks.

Chemical	lb/A	Grass Height (in.) 6 weeks	Seedhead Height (in.) 6 weeks	Seedhead Stand (0-10)[a] 6 weeks	Kentucky bluegrass injury (0-10)[a] 0-3 weeks	4-6 weeks	7 weeks	8-9 weeks	10-12 weeks
1. Butylate	6	3.1	5.1	7.6	.4	1.2	1.7	2.4	1.8
2. CME 10951 (spray)	8.4	2.9	5.0	5.0	1.0	.7	1.1	1.9	1.8
3. CME 10951 (dribble)	8.4	2.9	5.7	6.3	.9	.7	1.1	2.0	1.8
4. CME 10951 (spray)	11.2	2.9	4.2	2.3	.8	1.2	1.2	1.7	1.4
5. CME 10951 (dribble)	11.2	2.7	4.5	4.8	.9	1.0	.8	1.8	1.4
6. Ethephon	1	4.0	7.2	7.3	.5	.2	.8	1.0	1.2
7. Ethephon + MH	1+2	3.1	6.0	0.1	.4	.7	.8	.9	1.1
8. Ethephon + Mefluidide	1+.25	3.1	5.7	0.2	1.9	2.9	2.2	1.3	1.1
9. MH	2	3.1	5.6	0.1	.4	.5	.6	.9	1.1
10. MH	3	2.7	0.0	0	.6	1.3	1.7	1.6	1.4
11. MH	4	2.5	0.0	0	.9	2.6	2.6	2.0	1.7
12. MH + CF	2+1	3.3	0.0	0	.8	.6	.8	1.2	1.3
13. MH + CF	3+1	2.9	0.0	0	1.1	1.3	1.6	1.5	1.4
14. Mefluidide	.125	3.1	5.7	0.2	1.5	2.3	2.2	1.8	1.3
15. Mefluidide	.25	3.1	3.9	0.1	1.8	3.4	2.7	1.8	1.1
16. Mefluidide	.375	2.9	0.0	0	1.5	2.7	2.4	1.4	1.2
17. RO-3-7042	.9	3.5	5.0	0.3	.7	1.6	1.6	1.6	1.3
18. MH + Pace	2+.1%	3.3	3.9	0.1	.6	.4	.8	1.3	1.4
19. MH + Pace	2+.5%	3.3	3.9	0.2	.5	.8	1.0	1.0	1.3
20. MH + AL 1448	2+.1%	3.5	0.0	0	.5	.6	.6	1.1	1.1
21. MH + AL 1448	2+.5%	3.1	4.5	0.1	.4	.5	.6	.8	1.0
22. MH + X-77	2+.1%	3.3	6.0	0.1	.7	.7	.8	1.2	1.2
23. MH + X-77	2+.5%	3.1	3.5	0.1	.3	.5	.7	.9	1.1
24. Mefluidide + Pace	.125+.1%	3.1	4.5	0.1	1.0	2.3	1.8	1.4	1.2
25. Mefluidide + Pace	.125+.5%	3.3	6.0	0.1	1.4	2.4	1.8	1.2	1.1
26. Mefluidide + AL 1448	.125+.1%	3.5	0.0	0	1.6	2.3	2.2	1.3	1.3
27. Mefluidide + AL 1448	.125+.5%	3.1	3.1	0.1	1.2	2.6	2.1	1.3	1.0
28. Mefluidide + X-77	.125+.1%	3.1	6.4	0.3	.9	1.9	1.7	1.4	1.1
29. Mefluidide + X-77	.125+.5%	3.1	5.3	0.2	.9	2.1	1.6	1.1	1.1
30. Mefluidide + Pace	.375+.1%	3.1	0.0	0	1.9	3.2	2.3	1.9	1.3
31. Mefluidide + Pace	.375+.5%	3.1	0.0	0	2.9	3.5	2.3	1.4	1.0
32. Mefluidide + AL 1448	.375+.1%	3.1	0.0	0	2.3	3.4	2.2	1.4	1.2
33. Mefluidide + AL 1448	.375+.5%	3.1	0.0	0	2.8	3.5	2.2	1.5	1.3
34. Mefluidide + X-77	.375+.1%	3.1	3.9	0.1	1.3	2.4	2.3	1.2	1.1
35. Mefluidide + X-77	.375+.5%	2.9	0.0	0	1.6	2.7	2.4	1.5	1.1
43. Mefluidide + 2,4-D (ester)	.375+1	3.1	6.0	0.1	2.1	3.1	2.5	1.4	1.2
44. Mefluidide + 2,4-D (amine)	.375+1	3.1	4.5	0.2	1.2	2.2	1.8	1.6	1.2
45. Mefluidide + 2,4-D + Mecoprop	.375+1+1	3.1	5.5	0.1	2.2	3.1	2.2	1.8	1.4
46. Mefluidide + 2,4-D + Dicamba	.375+1+.25	3.3	5.3	0.3	2.1	2.0	2.3	1.6	1.2
47. Mefluidide + 2,4-D + Silvex	.375+1+.5	3.5	5.0	0.1	2.3	2.9	2.1	1.9	1.5
48. Mefluidide + 2,4-D + Silvex + Dicamba	.375+1+.5+.125	3.3	6.0	0.1	2.4	2.6	2.2	1.7	1.3
49. Mefluidide + 2,4-D + Mecoprop + Dicamba	.375+1+.5+.125	3.3	3.8	0.1	2.6	2.7	2.0	1.5	1.4
50. MH + 2,4-D (ester)	2+1	3.3	0.0	0	1.2	.8	1.2	1.7	1.5
51. MH + 2,4-D (amine)	2+1	3.3	5.0	0.2	1.1	.5	.7	.8	1.1
52. MH + 2,4-D + Mecoprop	2+1+1	3.3	4.8	0.1	1.2	.4	.7	.8	1.1
53. MH + 2,4-D + Dicamba	2+1+.25	3.1	5.5	0.1	1.5	.6	.7	1.0	1.2
54. MH + 2,4-D + Silvex	2+1+.5	3.1	0.0	0	1.4	.5	1.0	1.4	1.3
55. MH + 2,4-D + Silvex + Dicamba	2+1+.5+.125	3.7	5.7	0.3	1.4	.5	.9	1.2	1.3
56. MH + 2,4-D + Mecoprop + Dicamba	2+1+.5+.125	3.3	4.8	0.2	1.1	.4	.8	.9	1.1
57. 2,4-D (ester)	1	4.0	7.7	7.3	1.0	.2	1.2	1.0	1.2
58. 2,4-D (amine)	1	4.2	7.0	7.7	.7	.3	1.2	1.1	1.2
59. 2,4-D + Mecoprop	1+1	3.7	7.2	8.0	.9	.3	1.0	1.0	1.2
60. 2,4-D + Dicamba	1+.25	3.5	6.4	7.2	1.2	.4	.9	1.0	1.2
61. 2,4-D + Silvex	1+.5	4.2	7.7	7.3	1.3	.2	1.2	1.1	1.2
62. 2,4-D + Silvex + Dicamba	1+.5+.125	4.0	7.2	7.3	1.6	.5	1.3	1.2	1.1
63. 2,4-D + Mecoprop + Dicamba	1+.5+.125	3.3	6.1	4.7	1.6	.4	.8	.8	1.1
64-70. Check		4.4	7.7	8.0	.4	.2	.1	.0	1.1

[a]0 = no injury, 10 = brown; 0 = no seedheads, 10 = normal stand (66/sq/ft).

APPENDIX

Material	Supplier	Material	Supplier
2,4-D + silvex + dicamba, 2,4-D, ethephon and Pace	Amchem Products, Inc.	CGA-24705	CIBA-GEIGY Corp.
2,4-D + mecoprop	Rhodia, Inc.	CME-10951 P	CELAMERCK GMBH & CO. KG
2,4-D + mecoprop + dicamba	Mallinckrodt, Inc.	dicamba	Velsicol Chemical Corp.
2,4-D + silvex, X-77	Chevron Chemical Co.	mefluidide	3M Co.
AL 1448	ICI United States, Inc.	MH, S-108 and S-734	UNIROYAL Chemical
butylate	Stauffer Chemical Co.	RO-3-7042	HLR Sciences, Inc.
CF	U.S. Borax	SN-49537	NOR-AM Agr. Products, Inc.

COMBINATIONS OF GROWTH RETARDANTS AND BROADLEAF HERBICIDES FOR ROADSIDE TURFGRASS[1/]

J. D. Stich, R. C. Wakefield, and J. A. Jagschitz[2/]

ABSTRACT

Roadside turfgrass was treated with growth retardants and broadleaf herbicides alone and in combinations to evaluate chemical compatibility and growth control effectiveness. Evaluation was based on evidence of turf injury, vegetative and seedhead suppression of turfgrass and broadleaf weed control.

All spray mixtures were compatible. Mixtures of mefluidide with 2,4-D, mecoprop, silvex or dicamba alone or in various herbicide combinations were satisfactory and judged to be equally effective.

INTRODUCTION

Growth retardant chemicals have been employed as a means of controlling both seedhead and vegetative growth of turfgrass with various degrees of success, since the early 1950's. Recent studies (1,6) have found that growth retardants are particularly effective for roadside turf, thereby reducing the labor and mowing cost of these areas. Mowing is the most troublesome roadside maintenance operation faced by highway agencies in the northeast section of the country, according to Hottenstein (3).

Broadleaf herbicides have also been employed effectively for many years (4,5). Foote and Himmelman suggested the incorporation of a broad spectrum herbicide with a growth retardant to avoid a ragged appearance of roadside turf due to the growth of broadleaf weeds (2). Eliminating the broadleaf weeds, of course would also have the beneficial effect of drastically reducing the competition for the available nutrients, moisture and light required for good plant growth.

The objectives of this study were twofold: first, to further examine the effects of growth retardants on top growth and appearance of highway turf under field conditions; and secondly, to assess the effects and compatability of growth retardants in combination with several broadleaf herbicides.

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[2/] Graduate Research Assistant, Professor, and Associate Professor, respectively, Department of Plant and Soil Science, Agricultural Experiment Station, Kingston, Rhode Island 02881.

MATERIALS AND METHODS

This experiment was conducted on the highway median on U.S. Route 1, Wakefield, R.I. The site consisted primarily of red fescue (Festuca rubra L.) infested with a variety of broadleaf weeds, predominately hawkweed (Hieracium vulgatum L.), dandelion (Taraxacum officinale Weber), broadleaf plantain (Plantago major L.), red clover (Trifolium pratense L.) and white clover (Trifolium repens L.). On May 4, 1977, the treatments were applied in water, using a 1.8 m boom bicycle sprayer, delivering 76.5 liters per hectare. The chemicals used, along with rates of active ingredient per hectare (kg ai/ha), are listed in Table 1. Chemical formulations are presented in the Appendix.

The experiment consisted of fifteen treatments applied to 1.8 m by 7.6 m plots and randomized in three complete blocks. On May 6, 197 , the entire test area was trim-clipped at 7.6 cm. Seedhead counts and yield samples were taken on each plot and were recorded approximately seven weeks after treatment. Seedhead numbers were taken by counting seedheads in a randomly thrown quadrat (.46 x .46 m). Weed and injury ratings were also recorded periodically. Weed control was defined on a visual rating of percent weeds in each plot. Likewise, injury was also based on visual ratings from zero (0) to a most desirable ten (10), indicating no turf injury.

All data were statistically analyzed using Duncan's multiple range test.

RESULTS AND DISCUSSION

Compatibility tests of mefluidide with broadleaf herbicides showed that no precipitation or turbidity occurred that would interfere with spray applications.

The effects of growth retardants and broadleaf herbicide combinations on roadside turf are summarized in Table 1. Included, also, are responses of roadside turf to applications of growth retardants and herbicides alone. Results indicate that only the experimental compound CME-10951P caused some discoloration. All other chemicals applied alone or in combinations had no adverse effects on appearance of the turf. All herbicide treatments including MH + CF and CME-10951P significantly reduced weeds. Grass and weed yields showed that most treatments significantly reduced clipping weights. Exceptions were the treatment receiving MH alone, which contained an abundance of weeds and the 2,4-D plus mecoprop treatment with, and without dicamba, which contained more grass. Seedhead counts showed that all treatments significantly reduced seedheads with the exception of those receiving only herbicides. Maleic hydrazide (MH) by itself and with CF, also did not significantly reduce seedheads. MH is normally effective in seedhead control (1), but for some unexplained reason, was ineffective in grass seedhead suppression in this test.

Test results provided evidence that growth retardants in combination with broadleaf herbicides can effectively control vegetative and seedhead growth

Table 1. Effects of growth retardant and broadleaf herbicide combinations on injury, clipping yields, weeds and seedheads of roadside turf treated May 4, 1977.

Treatment	Kg/ha A.I.	Turf Injury[a]	Clipping yields (grams)	Percent weeds	Seedheads/ .21 m^2
1. Control	--	10	75 a[b]	44 a	154 ab
2. Mefluidide	0.42	10	20 ef	15 bc	67 cd
3. Mefluidide+2,4-D(ester)	0.42+1.12	10	21 ef	0 c	50 d
4. Mefluidide+2,4-D(amine)	0.42+1.12	10	24 ef	2 c	54 cd
5. Mefluidide+2,4-D(A)+Mecoprop	0.42+1.12+1.12	10	19 ef	5 c	65 cd
6. Mefluidide+2;4-D(A)+Dicamba	0.42+1.12+0.28	10	35 ce	1 c	61 cd
7. Mefluidide+2,4-D(E)+Silvex	0.42+1.12+0.56	10	13 f	0 c	56 cd
8. Mefluidide+2,4-D(E)+Dicamba+Silvex	0.42+1.12+0.14+0.56	10	19 ef	0 c	40 d
9. Mefluidide+2,4-D(A)+Dicamba+Mecoprop	0.42+1.12+0.14+0.56	10	20 ef	1 c	67 cd
10. 2,4-D(A)	1.12	10	46 bd	0 c	93 ad
11. 2,4-D(A)+Mecoprop	1.12+1.12	10	56 ac	4 c	140 ac
12. 2,4-D(A)+Dicamba+Mecoprop	1.12+0.14+0.56	10	54 ac	0 c	100 ad
13. MH	5.60	10	65 ac	24 b	102 ad
14. MH+CF	3.36+1.12	9	36 ce	0 c	79 bd
15. CME-10951P	10.00	7	29 df	2 c	56 cd

[a]0 = dead, 10 = dark green

[b]Means within columns followed by different letters are not significantly different at the 5% level according to Duncan's multiple range test.

of roadside turf and eliminate weeds resulting in fewer cuttings while also enhancing the appearance of the roadside turf. Treatment combinations of mefluidide, with 2,4-D (ester or amine), mecoprop, silvex or dicamba alone or in various herbicide combinations appeared to be equally effective in this test.

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APPENDIX

Common Name	Chemical Name
Mefluidide	N[2,4-dimethyl-5[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide
2,4-D	(2,4-dichlorophenoxy)acetic acid
mecoprop	2-[(4-chloro-o-tolyl)oxy]propionic acid
dicamba	3,6-dichloro-o-anisic acid
silvex	2-(2,4,5-trichlorophenoxy)propionic acid
MH	1,2-dihydro-3,6-pyridazinedione
Chloroflurenol (CF)	Methyl 2-chloro-9-hydroxyfluorene-9-carboxylate--8.8%. Methyl-9-hydroxyfluorene-9-carboxylate--2.1%. Methyl 2,7-dichloro-9-hydroxyfluorene-9-carboxylate--1.6%.)
CME 10951P	A product of CELAMERK GmbH & Co. KG. (experimental)

TOLERANCE OF EARLY BLACK' CRANBERRY TO FURLOE-124 AND METRIBUZIN

by

R.M. Devlin[2/] I.E. Demoranville,[2/] and S.S. Kostusiak[3/]

ABSTRACT

Metribuzin (4-amino-6-tert-butyl-3-[methylthio] -as-triazin-5[4H]-one) and Furloe-124 (isopropyl m-chlorocarbanilate + para-chlorophenyl N-methylcarbamate) were tested for their effect on cranberry (Vaccinium macrocarpon cv 'Early Black') vine growth, yield, berry size, and color. Temporary chlorosis of vine leaves occurred as a result of 4.5 and 6.75 kg/ha metribuzin applications. There was no vine damage due to Furloe-124. Metribuzin at 4.5 and 6.75 kg/ha also caused considerable decreases in yield. Smaller berries resulted from the highest (6.75 kg/ha) application of metribuzin. Berry size and yield decreased when 67.5 kg/ha Furloe-124 was applied. Pigment content was not influenced by either metribuzin or Furloe-124.

INTRODUCTION

Wild bean (Apios tuberosa Moench.) and saw brier (Smilax glauca Walt.) are particularly destructive weeds in the cranberry bogs of southeastern Massachusetts. We estimate that at least 20% of the cranberry acreage of this region is infested

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with wild bean and saw brier and where heavy infestation occurs (5% of the acreage) commercial culture of cranberries is impossible.

In our 1976 weed test program we found that wild bean could be controlled on cranberry bogs with pre-emergence applications of either 4.5 kg/ha metribuzin or 45.0 kg/ha Furloe-124. In addition, we found that saw brier could be controlled with a pre-emergence application of 67.5 kg/ha Furloe-124.

In the present study the influence of metribuzin and Furloe-124 on cranberry vine growth, yield, berry size, and color was determined.

METHODS AND MATERIALS

A section of bog relatively free of weeds and possessing a consistent stand of vines was chosen for treatment. Metribuzin was applied April 12, 1977 at 0, 2.25, 4.5, and 6.75 kg/ha. Furloe-124 was applied at 0, 22.5, 45.0, and 67.5 kg/ha. There were 4 replicates and plots ($6.4m^2$) were randomized within replicates. On September 8, the plots were hand-harvested and the berries were immediately weighed and size determined by the number of berries required to fill a standard 250 cc cranberry measuring cup. Subsamples were taken from each sample at harvest and immediately frozen to stop further color development. Pigment concentration was determined after all of the subsamples had been frozen for at least 30 days. Color was analyzed by the method of Fuleki and Francis (2) with slight modifications (1).

RESULTS

Vines treated with 4.5 and 6.75 kg/ha metribuzin were about 50% chlorotic 90 days after application. However, evidence of chlorosis had almost completely disappeared by harvest time, 156 days after application. Vines treated with Furloe-124 showed no evidence of damage at any of the rates applied.

In those plots treated with 2.25 kg/ha metribuzin no significant differences from the control were found in yield, size, and pigment content (Table 1). Increasing the application of metribuzin to 4.5 kg/ha significantly lowered yield but not size or pigment content. At the highest application of metribuzin (6.75 kg/ha) berries were much smaller and yield was dramatically down (Table 1). However, a significant difference in

pigment content could not be found.

Table 1. Effect of pre-emergence application of metribuzin on yield, color, and size of 'Early Black' cranberry.

Metribuzin (kg/ha)	Yield (g)	Cup Count	Pigment mg/100g Fruit
0.00	5394	94	14
2.25	4600	98	12
4.50	2686	95	15
6.75	737	110	18
LSD 1%	1650	12.4	11.6
5%	1177	8.8	8.2

In Furloe-124 treatments significant differences could only be found in those plots receiving 67.5 kg/ha. At that rate there was a 45% decrease in yield and a considerable drop in size (Table 2). Pigment content was not influenced by Furloe-124.

Table 2. Effect of pre-emergence application of Furloe-124 on yield, color, and size of 'Early Black' cranberry.

Furloe-124 (kg/ha)	Yield (g)	Cup Count	Pigment mg/100 Fruit
0.0	5394	94	14
22.5	6017	100	17
45.0	3990	101	18
67.5	2970	117	12
LSD 1%	1998	11.9	11.1
5%	1425	8.5	7.9

DISCUSSION

Metribuzin and Furloe-124 are excellent herbicides for the control of wild bean and saw brier on cranberry bogs. However, at the rates shown to be effective some loss of yield and berry size occurs. When the alternative to no control of these weeds is to plow under the vines and rebuild the bog then both or either metribuzin or Furloe-124 are acceptable herbicides to the grower.

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MORPHOLOGICAL CHARACTERISTICS OF YELLOW NUTSEDGE ECOTYPES[1]

C. P. Yip and R. D. Sweet[2]

ABSTRACT

Yellow nutsedge (Cyperus esculentus L.) ecotypes collected from several states in the U.S. were grown in the field and greenhouse to determine if there was a relationship between their growth characteristics and natural habitats. Based on the spiklet length, the ecotypes were categorized into two major varieties, namely var. esculentus with short (<1.5 cm) spiklets and var. leptostachyus with long (>1.5 cm) spiklets. Var. esculentus includes ecotypes collected from Illinois, Ohio, New York (excluding Long Island, New York), while those from Washington, Oregon, California, Hawaii, New Mexico, Arizona, Oklahoma, Maryland, Virginia, Georgia, Florida and Long Island, New York, fall into the var. leptostachyus. Except for Florida and Arizona, var. leptostachyus produced fewer shoots than var. esculentus. Tubers of var. leptostachyus were relatively larger, fewer and had less roots than those of var. esculentus, except for Arizona which had the smallest tubers. Additional information will be presented on shoot to root and shoot to tuber relationship, and on rhizome size and distribution.

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WEED CONTROL UNDER CLEAR PLASTIC MULCH FOR SEEDED CANTALOUPE

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ABSTRACT

Five years of studies on weed control for seeded cantaloupe (Cucumis melo L., var. reticulatus, 'Gold Star') with clear plastic mulch in a Norfolk loamy sand have shown that butralin, preplant incorporated (PPI), at 1.5 lb/A provided acceptable control of common purslane (Portulaca oleracea L.), goosegrass [Eleusine indica (L.)Gaertn.], carpetweed (Mollugo verticillata L.) and german millet (Setaria italica (L.)Beauv.) with acceptable crop safety and yield. Butralin did not control ragweed (Ambrosia artemisiifolia L.). Dinoseb, applied preemergence (Pre) at 1.0 and 3.0 lb/A was an acceptable treatment for cantaloupe; however, grass control was weak. Cantaloupe stunting occurred with 4.5 and 6.0 lb/A dinoseb. The combination of butralin, PPI, and dinoseb, Pre, provided outstanding weed control and yields. Bensulide and the combination of bensulide plus naptalam, PPI, did not provide acceptable weed control; however, yields were usually not reduced. DCPA at 6.0 lb/A, PPI, caused unacceptable vigor reduction and purslane control was weak. DCPA appeared to cause a delay in fruit maturity; however, total yields were acceptable. Chloramben methyl ester, Pre, provided excellent crop safety but purslane control was weak; however, yields were acceptable. Trifluralin at 0.25, 0.5, and 1.0 lb/A, PPI, caused unacceptable stunting of the cantaloupe and yields were reduced although weed control was acceptable. The rapid development of the cantaloupe vine canopy provides significant weed suppression and this competition may be sufficient to prevent yield reductions with only partially effective weed control. Therefore, herbicide treatments should not reduce early cantaloupe seedling vigor. Herbicides can provide weed control under clear plastic mulch equivalent to the fumigant treatment of Vorlex(R) at 20 gal/A. Grasses and common purslane are the most difficult weeds to control under clear plastic in the Delmarva area.

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THE EFFECTS OF MULTIPLE APPLICATIONS OF GLYPHOSATE UPON WATERLILIES

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ABSTRACT

Fragrant waterlily (Nyphaea odorata Ait.) treated in mid-summer with glyphosate at rates of 3 or 6 lb ai/A exhibited severe injury symptoms one month after treatment. The water surface was clear of waterlily leaves two months after treatment. No regrowth occurred the following spring in the treated areas. Examination of the rhizomes at that time revealed that they were badly decayed. Later that spring a large number of waterlily seeds in the bottom sediment germinated and a very dense stand of seedlings developed in the plots. Two years after treatment, infestation of fragrant waterlily was as severe as the initial stand.

A second study was established in an area that had received no previous treatment. Glyphosate was applied at rates of 2 and 4 lb ai/A to the foliage of fragrant waterlily in early summer. The control of the waterlilies was excellent by late summer. The following season, when the seedlings had covered the water surface, glyphosate was reapplied at the same rates to the same plots. The control was excellent at the end of that summer. The following year no regrowth occurred and no further seed germination occurred in these plots and they have remained free of waterlilies for the past three summers.

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ATRAZINE RESIDUES IN THE CHESAPEAKE BAY

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During 1977, atrazine residues were monitored in major streams entering the Chesapeake Bay and in the upper and lower Bay. Residue levels in water are generally below 1 ppb. Sediment samples collected randomly from the Bay contained no detectable levels of atrazine.

Extensive studies with both atrazine and simazine confirm that there is little or no effect on emerged or submerged higher aquatic plants at levels below 1000 ppb, or on algae at levels below 100 ppb of either herbicide in water. It appears unlikely that atrazine will have detrimental effects in the aquatic environment.

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