COMMON COCKLEBUR RESPONSE TO CHLORIMURON AND IMAZAQUIN

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

Field and greenhouse studies investigated the susceptibility of several populations of common cocklebur (Xanthium strumarium L.) to chlorimuron (Classic) and imazaquin (Scepter). Common cocklebur populations from Davis Wharf, VA and Nanticoke, MD had various histories of Scepter applications, and were not controlled by Scepter. Seeds were collected from all populations in the fall of 1993 for greenhouse studies.

In field studies conducted in 1993 and 1994, 3,000 or 4,000 ft^2 areas with high densities of common cocklebur at two sites in Davis Wharf were treated POST with 0.063 and 0.125 lb/ai/A Scepter plus 0.25% v/v non-ionic surfactant. Common cocklebur densities in 1993 in treated plots at the time of application were 146 and 192 plants/m^2 at sites one and two, respectively. Densities of actively growing common cocklebur at 43 DAT at both sites were 65 and 39 plants/m^2 in plots treated with 0.063 and 0.125 lb/A Scepter, respectively. In 1994 at site one, there were no actively growing plants 16 DAT where Scepter was applied and 143 plants m^2 in the untreated control. By 40 DAT, densities of actively growing common cocklebur were 116 plants/m^2 in the untreated control and 12 and 6 plants/m^2 from 0.063 and 0.125 lb/A Scepter, respectively. Approximately half of the plants in treated plots 40 DAT had recovered from Scepter applications and the other half germinated after Scepter applications. By 66 DAT at site one, there were 31 and 10 plants/m^2 from 0.063 and 0.125 lb/A Scepter, respectively. At site two in 1994, there were 15 and 10 plants/m^2 25 DAT from 0.063 and 0.125 lb/A Scepter, respectively, and 58 plants/m^2 in the untreated control. All plants in the treated plots at site two had germinated after Scepter applications. By 47 DAT at site two, densities were 24 and 14 plants/m^2 from 0.063 and 0.125 lb/A Scepter. In additional field studies in Davis Wharf, it was found that control of both common cocklebur populations was higher than 75% from Scepter, imazethapyr (Pursuit), bentazon (Basagran), Classic, and pyrithiobac (Staple).

Greenhouse studies investigated the response of three populations from Davis Wharf and one population from Nanticoke to postemergence applications of 0.063 and 0.5 or 1.0 lb/A Scepter and to 0.008 and 0.064 lb ai/A Classic. Control of all populations in the greenhouse was generally 80% or higher. Common cocklebur populations from Davis Wharf and Nanticoke are not resistant to Scepter or Classic.

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[1]Grad. Res. Asst., Prof., and Agric. Res. Spec. Sr., East. Shore Agric. Res. and Ext. Center, Virginia Polytech. Inst. and State Univ., Painter, VA, 23420.

EFFECT OF TWELVE ANNUAL APPLICATIONS OF DIURON, SIMAZINE, AND TERBACIL ON A SOIL MICROBE COMMUNITY IN WEST VIRGINIA

T. J. Tworkoski and W. V. Welker[1]

ABSTRACT

Diuron, simazine, and terbacil were applied annually at rates of 4 lb/A to separate plots near Kearneysville, WV from 1981 through 1995. Untreated controls and spring and fall cultivation treatments were included. Components of the soil microbial community were measured in 1993 and 1994. The number of colony forming units (CFU) of bacteria and actinomycete per g soil was greatest in cultivated plots (7.1×10^6) and least in terbacil-treated plots (1.6×10^5). The number of gram-negative bacteria and fungi were least in terbacil-treated plots (3.3×10^5 and 2.2×10^4 CFU/g, respectively) but were not significantly different from other treatments. Colony forming units in all soil components from simazine and diuron-treated plots were between those from control and terbacil-treated plots. Low CFU from terbacil-treated plots may be partly due to reduced vegetation (less than 5% vegetative cover in Fall) compared to control (more than 80% cover) and the consequent reduction of soil organic matter (32% less than control).

INTRODUCTION

Simazine (6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine), diuron (N'-(3,4-dichlorophenyl)-N,N-dimethylurea), and terbacil (5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H,3H)-pyrimidinedione) are used as preemergence herbicides to control weeds near fruit trees. These herbicides have been available for over thirty years and in some instances have been applied repeatedly within an orchard. They do not leach readily from the soil, and do not accumulate in large quantities. But several annual applications can contribute to soil residues (3, 9, 10). Diuron and simazine are biologically degraded and serve as a resource for some soil microbe populations (2, 10). In some instances, herbicides have stimulated certain soil microflora components while inhibiting others (4, 6). Effects of long-term applications of herbicides are further complicated by soil herbicide-sorption kinetics that differ between recent and aged residues (11). In this experiment, three components of the soil microflora community were measured following twelve annual applications of diuron, simazine, and terbacil.

MATERIALS AND METHODS

Field. Plots (5 X 50 ft) were selected in a randomized complete block design in a 2-acre field near Kearneysville, WV. Beginning

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[1]Plant Physiol. and Weed Sci., USDA-ARS Appalachian Fruit Research Station, Kearneysville, WV 25430

in the Spring of 1981, simazine (Princep, 80% WP), diuron (Karmex, 80% dispersible granule), and terbacil (Sinbar, 80% WP) were applied to separate plots at rates of 4 lb ai/acre. Herbicides were applied over the top with a 4-nozzle boom equipped with Delavan LF-F tips on 20-in spacing, in a carrier volume of 58.7 gal/A. Herbicides were applied between the first weeks of May and June each year. In addition to herbicide treatments, control plots were maintained. Ailanthus altissima were dominant on control plots and were sheared annually to a 1 ft height each winter in order to slow ecological succession. A cultivation treatment was applied to separate plots, with cultivation to a depth of 20 cm in May and October each year. Average weekly soil temperatures were recorded and soil physical and chemical properties were determined. Vegetation was estimated visually in June and September as the percent ground area covered.

Field microflora components. Soil was sampled three times during 1993 and 1994: 1 week before herbicide treatment, 1 week after herbicide treatment, and 6 weeks after herbicide treatment. A 2.54-cm diameter soil probe was used to remove 5 subsamples per plot to a 20 cm depth. Preliminary work demonstrated only a small microbial presence at depths below 20 cm. The 5 subsamples per plot were pooled and each sample was quantitatively evaluated for total bacteria and actinomycetes, gram-negative bacteria, and fungi.

Soil from each plot was mixed, stones were removed, and 10 g was placed in 90 mL phosphate buffer (50mM, pH 7.0) for 60 min and shook on an orbital shaker (1,000 rpm). Serial dilutions with buffer were made with concentrations from 10^{-1} to 10^{-6}.

Bacteria and actinomycetes. Dilute nutrient agar was prepared by mixing 0.8 g Bacto Nutrient Broth with 18.0 g Bacto Agar in 1 L water and sterilized at 121 C and 15 psi for 20 min. Cycloheximide was added to the agar following sterilization to yield a 100 ug mL^{-1} concentration. One-hundred uL of two dilutions (10^{-3} and 10^{-4}) were spiral plated [Spiral Systems, Bethesda, MD] on two petri dishes per dilution. Plates were incubated at 25 C and total number of actinomycete and bacterial colony forming units (CFU) were counted [Model 500A CFU counter, Spiral Systems] after 5 days.

Gram-negative bacteria. Dilute nutrient agar was prepared as described above and crystal violet was added after sterilization to a final 2 ug mL^{-1} concentration (5). One-hundred uL of two dilutions (10^{-3} and 10^{-4}) were spiral plated on two petri dishes and CFUs were counted as described above.

Fungi. Potato dextrose agar (19.5 g in 500 mL H_2O) was sterilized and streptomycin and rose bengal were added to final concentrations of 300 and 2 ug mL^{-1}, respectively (7). One-hundred uL of the 10^{-2} and 10^{-3} dilutions were spread on two plates per dilution. Plates were then evaluated following 5 days

incubation for fungal CFUs.

Experimental Design. The field experimental design was completely random with 5 treatments and 4 replications. Analysis was completed by GLM (SAS).

RESULTS AND DISCUSSION

Weed management had little effect on soil fungi and no effect on gram-negative bacteria in the soil (Table 1). Diuron treated plots had more fungi than terbacil treated plots. Total bacteria and actinomycete were affected by weed management. Cultivated plots had twice and four-fold more bacteria CFUs than simazine and terbacil plots, respectively. Cultivated plots had greater organic matter content that terbacil treated plots (1.7 vs. 1.3%, respectively). Aeration resulting from the cultivations may also have stimulated bacteria and actinomycete growth. Bacteria and actinomycete CFUs did not differ between control and any herbicide treated plot. These herbicides, therefore, did not cause large toxic or stimulatory effects on the microbial community. Skipper and Volk (1972)also found a weak relationship between microbial population numbers and the capacity to biodegrade atrazine [2-chloro-4-(ethylamino) s-triazine]. However, qualitative changes may have occurred within the microbial community. In this experiment, individual bacteria species were not measured.

Differences in CFUs were associated with time of measurement (Table 1). Fungi CFUs declined while total bacteria CFUs increased after May. Seasonal patterns of increasing temperatures to a range from 27 to 32 C probably contributed to these trends (1). Gram-negative bacteria decreased between May and June and then increased between June and August. These differences do not correlate with herbicide application. No statistical interaction was found between weed management treatment and time of measurement. An interaction was expected if a component of the soil microbial community was stimulated or inhibited by a herbicide.

In this experiment, the only notable difference among soil microbe components due to herbicide treatment was reduced CFUs in soil from terbacil treated plots (Table 1). These plots had less than 5% vegetation coverage in contrast to all other plots that had at least 50% coverage. This lack of vegetation contributed to decreased soil organic matter (a microbial energy source) and to soil compaction that reduced aeration. It is likely that these alterations in the soil environment contributed to the reduced CFUs. In addition, we performed experiments that demonstrated that herbicide-degradation capacity of soil microbes was not different between control plots and plots which had been treated with herbicides (data not shown).

This experiment was conducted under conditions (soil, climate, and longevity of application) that are likely for peach orchards

in the Shenandoah Valley and Cumberland Plateau region of the eastern U.S. Microbial diversity was not quantitated, but clearly the total number of microbes was not reduced by diuron and simazine. There was no evidence for selection for herbicide-degrading microbes following repeated herbicide application. The results indicate that long-term use of diuron, simazine, and terbacil under the conditions in this experiment does not dramatically alter the soil microbial community.

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Table 1. Effects of past weed management practices on selected components of soil microflora.

Main effects[a]	Fungi	Microflora Components Gram-negative bacteria	Total bacteria and actinomycetes
	(cfu x 10^5/g soil d.w.)[b]		
Weed Management			
Control	0.40ab[c]	5.99a	38.58abc
Cultivated	0.36ab	7.08a	70.97a
Diuron	0.43a	4.98a	58.24ab
Simazine	0.31ab	5.45a	35.65bc
Terbacil	0.22b	3.27a	15.98c
Time Measured			
May	0.52a	6.91a	28.06b
June	0.25b	3.31b	39.00ab
Aug	0.26b	5.85ab	64.59a

[a] No interaction occurred between weed management practice and time of measurement. May, June, and August measurements were 1 week before, 1 week after, and 6 weeks after weed management, respectively.

[b] cfu is colony forming units estimated by dilution plating.

[c] Within a column and main effect, means followed by the same letter do not differ at the 0.05 level according to Duncan's Multiple Range Test.

ISOXABEN SPRAY COMBINATIONS AND GRANULAR HERBICIDES FOR CONTAINER-GROWN WOODY ORNAMENTALS

Todd L. Mervosh and John F. Ahrens[1]

ABSTRACT

A study begun in 1994 to evaluate sprayable herbicides containing isoxaben for preemergence weed control in container-grown ornamentals was expanded in 1995 to include granular herbicides in addition to Ornamental Herbicide II (OH2) [oxyfluorfen (2 lb/A) plus pendimethalin (1 lb/A)]. The additional granular treatments consisted of Rout [oxyfluorfen (2 lb/A) plus oryzalin (1 lb/A)], Snapshot 2.5TG [isoxaben (0.75 lb/A) plus trifluralin (3 lb/A)], and Ronstar 2G [oxadiazon (4 lb/A)] plus Devrinol 5G [napropamide (4 lb/A)]. Sprayable treatments contained isoxaben alone (1.5 lb/A) and in combinations (0.75 and 1.5 lb/A) with napropamide (4 and 8 lb/A), oryzalin (2 and 4 lb/A), pendimethalin (3 and 6 lb/A), and prodiamine (2 and 4 lb/A).

Plots consisted of three plants each of rhododendron (*Rhododendron catawbiense* Michx. 'Nova Zembla'), spirea (*Spiraea x bumalda* Burvenich 'Dolchica'), and wintergreen euonymus [*Euonymus fortunei* (Turcz.) Hand.-Mazz. 'Emerald Gaiety'] in 2-gallon containers plus six containers holding only soil mix. Common groundsel (*Senecio vulgaris* L.) seed was sown lightly over all plantless containers prior to the first treatment. Herbicides were applied on July 20 to weed-free containers and, after weeds had been pulled, on October 13. Sprays were applied at 30 gal/A with a backpack sprayer via a 2-nozzle boom, and granules were applied with a calibrated auger-feed drop spreader. The study area was irrigated by sprinklers for 20 min following herbicide application. Plant injury was evaluated 1, 4, and 11 weeks after the first application. At 5 and 12 weeks after treatment, weed control ratings and counts of individual weeds by species were recorded as they were removed from the containers.

After the first application in 1995, the only significant plant injury was observed on rhododendron from isoxaben (1.5 lb/A) plus pendimethalin (6 lb/A). Rhododendron was also injured more by this treatment than any other in 1994, especially after the second and third applications. Common groundsel, willowherb (*Epilobium* sp.), and horseweed [*Conyza canadensis* (L.) Cronq.] were the most prevalent weed species in the containers. For 5 weeks after application, Rout and isoxaben combined with either prodiamine, pendimethalin, or oryzalin provided excellent suppression of weed emergence. By 12 weeks after application, control of weeds, particularly horseweed, was generally quite poor. The best treatment was the high rate combination of isoxaben plus prodiamine, which prevented more than 90% of weed growth. Of the granular herbicides, Rout provided the highest degree of residual weed control. The study will continue to be evaluated into the spring of 1996.

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[1] Assistant Agricultural Scientist and Emeritus Weed Scientist, The Connecticut Agricultural Experiment Station, Valley Laboratory, Windsor, CT 06095.

PREEMERGENCE AND POSTEMERGENCE WEED MANAGEMENT IN 38 AND 76 CM CORN

C. Benjamin Coffman[1]

ABSTRACT

A field investigation was established in 1994 to evaluate the influence of preemergence and postemergence herbicide treatments in no-tillage corn sown in 38 and 76 cm rows. This study was located in Washington County, Maryland, on a Duffield silt loam (fine-loamy, mixed, mesic Ultic Hapludalf). The field was fertilized with swine manure and commercial fertilizer according to soil test results. Dekalb (DK588) seed was sown on 24 May to achieve plant densities of 118,000 and 59,000 /ha in 38 and 76 cm rows, respectively. Row spacing/density treatments were in plots 18 by 73 m with three replicates. Herbicide treatments were subplots 6 by 24 m with nine replicates. Spring weed cover required the application of glyphosate at 2.2 kg/ha over the entire research area on 25 May. Comparison was made between PRE application of atrazine and pendimethalin at 1.7 and 1.1 kg/ha and POST application of nicosulfuron and dicamba at 0.046 and 0.28 kg/ha. PRE applications were made 25 May whereas POST applications were made 24 June when weeds were 0.3 to 1.0 m tall and corn plants were 0.3 to 0.6 m tall. Dominant weeds on 24 June were common lambsquarters (Chenopodium album L.) and hemp dogbane (Apocynum cannabinum L.).

Weed cover estimates, silage, and grain yields were obtained in the fall. Mean silage yields from the 38 cm spacing for PRE, POST, and untreated controls (UTC) were 31.8, 35.3, and 29.8 Mg dry weight/ha, respectively. Silage yields from the 76 cm rows were 22.0, 21.7, and 19.8 Mg dry weight/ha for the PRE, POST, and UTC treatments, respectively. In the 38 cm spacing grain yields for PRE, POST, and UTC treatments were 8470, 8780, and 5590 kg/ha (15.5% moisture), respectively. Grain yields in the 76 cm rows were 7270, 7150, and 3350 kg/ha (15.5% moisture) for the PRE, POST, and UTC treatments, respectively. Comparisons within herbicide treatments between row spacing/density treatments revealed higher silage and grain yields from the 38 cm corn than from the 76 cm corn, reflecting both the greater density of crop plants and a lower weed cover (WC). In the 38 cm corn, weed cover (WC) was 8, 4, and 91 percent for PRE, POST, and UTC treatments, respectively. However, in the 76 cm corn, weed cover was 46, 31, and 100 percent for PRE, POST, and UTC treatments, respectively. In 38 cm corn there were higher yields of silage and grain in POST treatments than in PRE treatments. There were no differences in silage or grain yields between PRE and POST treatments in 76 cm corn. POST herbicide treatments needed 50% less herbicide than PRE treatments and had lower weed cover and higher crop production.

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[1]Agronomist, USDA-ARS, Beltsville, MD, 20705

CONSTRUCTING A DEGREE-DAY BASED METHOD FOR PREDICTING SMOOTH CRABGRASS EMERGENCE

M.A. Fidanza, P.H. Dernoeden, and M. Zhang[1]

ABSTRACT

A limited amount of information exists regarding the microclimatic conditions necessary for smooth crabgrass [Digitaria ischaemum (Schreb. ex Schweig) Schreb. ex Muhl.] emergence. Efficient control of smooth crabgrass could be achieved by targeting and timing management strategies that correspond to smooth crabgrass emergence. Therefore, the objectives of this research were to develop a method for predicting initial smooth crabgrass emergence and for describing smooth crabgrass emergence throughout the season. Preliminary results from 1992 and 1993 appeared previously in the Northeastern Weed Science Society Abstracts.

The study sites consisted of a mature stand of 'Fylking' Kentucky bluegrass (Poa pratensis L.) in 1992, and 'Sydsport' and 'Merion' Kentucky bluegrass in 1993. In 1994, the field study was conducted on an unknown blend of perennial ryegrasses (Lolium perenne L.). All field sites had a previous record of heavy smooth crabgrass infestation. Experimental plots were arranged in a randomized complete block design with four replications, and measured 1.5 by 3.0 m. Plots were mowed bi-weekly with a rotary mower.

In 1993 and 1994, smooth crabgrass emergence was assessed weekly by counting and removing newly germinated seedlings from three, 625 cm^2 fixed grids per plot. A different method for evaluating smooth crabgrass emergence was used during 1992. Air and soil temperatures were monitored, measured, and recorded with a computer-driven datalogger (CR10 Measurement and Control Module, Campbell Scientific, Logan, Utah). Micro-environmental information was collected from 1 April through 31 August. Air temperatures were measured 15 cm above the soil surface. Soil temperatures were measured beneath turfgrass stands from both mowing heights at three depths: 1) 0.0 cm where sensors were placed adjacent to plant crowns; 2) 2.5 ± 0.5 cm soil depth; and 3) 5.0 ± 0.5 cm soil depth. Air and soil temperatures were recorded and data collected at five minute intervals and averaged each hour. The information was stored in the datalogger until transferred to a laptop computer for additional processing and statistical analysis.

A greater number of smooth crabgrass seedlings were visually observed in turf mowed to a height of 3.7 cm versus 6.4 cm, however, the differences were not significant between mowing heights on most rating dates in 1993 and 1994. From 1992 to 1994, crabgrass was first observed at the study sites between 26 April to 4 May, and two major emergence periods were observed between 17 May to 29 July. During the seven day period prior to first emergence, minimum and mean soil temperatures at the 2.5 cm depth ranged from 10.4 to 12.5°C, and 13.9 to 17.5°C; respectively. During the major crabgrass emergence periods, minimum and mean soil temperatures at the 2.5 cm depth ranged from 19.5 to 21.1°C, and 22.8 to 24.9°C, respectively.

Degree-day units calculated from air temperature and soil temperatures at all depths were considered, however, soil temperatures measured at the 2.5 cm depth were used to calculate degree-days (DD). Data from all three years were used to determine a base temperature of 12°C for use in calculating degree-day units. A degree-day range of 42 to 78 was associated with the first appearance of smooth crabgrass. The major emergence period was related to a degree-day range of 140 to 230 DD. Degree-day units were used to construct a regression model ($r^2 = 0.96$) that described cumulative percent smooth crabgrass emergence.

[1]Grad. Res. Asst., Prof. and Grad. Res. Asst.; respectively. Dept. of Agronomy, Univ. of Maryland, College Park, MD 20742.

COMPUTERIZED WEED ID PROGRAM FOR THE NORTHEASTERN UNITED STATES

N. L. Hartwig[1]

ABSTRACT

The first step in taking care of a weed problem is to identify the weed. This is not an easy task and unless one has had a course in plant or weed identification, its difficult to put a name on the plant you want to identify. Any weed control program hinges on you having made a correct identification of the weed problem. If you're asking an expert for advice or reading the label on the herbicide container, the correct choice is based on you having correctly identified the weed problem. Due to the increased use of computers in our daily lives, it seems the time is right to put a key to common weeds in the Northeastern U.S.A. on the computer and let it help you in the identification of weeds.

The main objective was to put a key to common weeds in Northeastern U.S.A. on a computer to help even those who have no taxonomic background identify an unknown weed. In the process of using the key, a person should become more familiar with key characteristics of common weeds so reliance on the computer key becomes less necessary with experience.

This weed ID program is being used to supplement the teaching of weed identification in a weed identification and control course at Penn State. In addition to students, anyone in extension or a position of advising growers and homeowners on weed problems in the Northeastern and Midwestern states should find this computerized key invaluable. Also anyone who wants to teach themselves weed identification will find this key very useful.

Since the preferred personal computer among students at Penn State and the extension service in Pennsylvania is a Macintosh, this program has been written for the Macintosh using the software program Hypercard. As with any key, only those weeds which are part of the key can be keyed out. This computer based key includes yellow nutsedge, wild garlic, wild onion, 21 grasses and 156 dicots. The key is based on 10 key characteristics for grasses and 12 key characteristics for dicots for most of the weeds contained in "The Weeds of the North Central States" common to the eastern Midwest and Northeast. The program has search capabilities to identify the weeds having the characteristics the user specifies with final identification made possible by a combination of digitized pictures of the weed with zooms and associated descriptive text. The program also comes with a videodisk with over 1000 color images of the 180 weeds or as a complete package on CD Rom.

[1] Prof. of Weed Sci., Dept. of Agronomy, Pennsylvania State University, University Park, PA. 16802

PBPA and BAS-145138 as Safeners Against the Herbicidal Activity of Norflurazon in Corn [1]

Robert M. Devlin[2], S. J. Karczmarczyk, I. I. Zbiec, and Z. K. Koszanski[3]

ABSTRACT

Both PBPA and BAS-145138 gave partial protection to corn against the herbicidal activity of norflurazon. Since the major herbicidal action of norflurazon is the blocking of carotenoid synthesis, we can speculate that the safening effect of PBPA and BAS-145138 in norflurazon-treated corn is either due to their interference with this blocking action or to their acceleration of the metabolism of norflurazon in the plant.

INTRODUCTION

Devlin and Zbiec (5) demonstrated that PBPA (p-bromophenoxyacetic acid) could partially protect against the bleaching effect of clomazone {2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidione} on corn. The safener BAS-145138 [1-dichloroacetyl-hexahydro-3,3,8-trimethylpyrrolo-(1,2-)-pyrimidin-6-(2H)-one] has been shown to protect corn against chloroacetamide and thiocarbamate herbicides (7,8,9). In addition, Devlin and Zbiec (3,6) showed that BAS-145138 could partially protect corn against several sulfonyulurea and imidazolinone herbicides.

In the present paper the effect of PBPA and BAS-145138 as safeners against the herbicidal activity of norflurazon [4-chloro-5-(methylamino)-2-(3-trifluoromethyl)phenyl)-3(2H)-pyridazinone] on corn (Zea mays L.) was studied. Since the mode of action of clomazone (blocking carotenoid synthesis) is similar to that of norflurazon and since PBPA was shown to partially protect corn from clomazone activity (5), it was assumed that some protection from norfluazon activity could also be obtained with PBPA. The safening effect of BAS-145138 was compared to that of PBPA.

MATERIALS AND METHODS

Seeds were soaked for 6 h in 1 mM solutions of PBPA or BAS-145138. The treated seeds were sown in 8-cm styrofoam pots (15 seeds per pot) containing moist vermiculite that had previously been treated with 100 ml of 2, 5, and 10 uM solutions of norflurazon. This was equivalent to rates of 0.12, 0.30, and 0.60 kg/ha. The bottoms of the pots were punctured several times to allow good drainage and the seeds were covered with moist vermiculite to a depth of

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2/ Prof., Cranberry Experiment Station, University of Mass. East Wareham, MA 02538.

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

about one cm. Petri dish halves were used as holders for the pots to catch drainage and as an indirect method of providing water and nutrients. The plants were grown in a growth chamber under constant conditions of light (152 uE m^{-2} s^{-1}, 16 h light, 8 h dark) and temperature (22 1°C). After shoot emergence, 30 ml of 1/2 strength Hoagland solution were applied daily to each pot via the petri dish holders. After 13 days the first, second, and third leaf were removed for pigment extraction. The leaves were analyzed for chlorophyll and carotenoid content according to the methods of Devlin and Zbiec (4). The amount of chlorophyll present, in ug of chlorophyll per g of leaf tissue extracted, was calculated according to the equations of Arnon et al. (1). The amount of carotenoid pigment present, in ug of carotenoids per g of leaf tissue extracted, was calculated according to the equation of Schnarrenberger and Mohr (11). All experiments were replicated four times and all data were subjected to analysis of variance.

RESULTS

As expected, corn treated with norflurazon showed a significant drop in chlorophyll content. If corn was additionally treated with PBPA a partial safening was observed. For example, there was a 31% drop in total chlorophyll content in the first leaf of corn treated with 2 uM norflurazon and a drop of 81% in the first leaf of corn treated with 5 uM norflurazon. The addition of 1 mM PBPA dropped the aforementioned reductions to 25 and 31%, respectively (Table 1). Separate analyses of the effect of norflurazon and PBPA on chlorophylls a and b paralleled that of total chlorophyll (Table 1).

Table 1. The safening effect of PBPA on the inhibitory influence of norflurazon on pigment synthesis in corn. Chlorophyll and carotenoid extracts were made from the first leaf. TChl = total chlorophyll and Car = carotenoid.

Nor (uM)	PBPA (mM)	Chl a (ug/g)	Chl b (ug/g)	TChl (ug/g)	Car (ug/g)
0	0	1452	231	1683	711
2	0	901	156	1056	442
2	1	1088	175	1263	522
5	0	257	56	313	142
5	1	984	176	1160	480
10	0	22	20	41	21
10	1	580	112	693	285
LSD	5%	111	19	126	51
	1%	150	26	172	69

Carotenoid content of the first leaf of corn was significantly reduced by norflurazon and this effect was considerably lessened by the application of PBPA. For example, 5 uM norflurazon alone caused an 80% drop in carotenoid content, but in the presence of 1 mM PBPA only a 33% drop was observed (Table 1).

Less, but significant, PBPA safening of corn from the herbicidal activity of norflurazon was observed when the second and third leaves were extracted for pigment content. Norflurazon at 2 and 5 uM caused reductions in total chlorophyll of 78 and 94%, respectively. In the presence of 1 mM PBPA those reductions were 62 and 68% (Table 2). Carotenoid pigments were also protected by PBPA, but only to a small extent (Table 2).

Table 2. The safening effect of PBPA on the inhibitory influence of norflurazon on pigment synthesis in corn. Chlorophyll and carotenoid extracts were made from the second and third leaves. TChl = total chlorophyll and Car = carotenoid.

Nor (uM)	PBPA (mM)	Chl a (ug/g)	Chl b (ug/g)	TChl (ug/g)	Car (ug/g)
0	0	1545	238	1784	781
2	0	327	62	389	165
2	1	591	94	685	300
5	0	78	23	100	46
5	1	493	84	577	242
10	0	6	5	11	11
10	1	242	50	292	126
LSD 5%		84	14	95	38
1%		114	19	130	51

The first leaf of corn treated with 2 uM norflurazon was completely protected against chlorophyll and carotenoid loss by 1 mM BAS-145138 (Table 3). Only partial protection was given by the safener in corn treated with 5 uM norflurazon, The same pattern of bleaching by norflurazon and safening by BAS-145138 was followed when chlorophyll's a and b were analyzed separately (Table 3).

Similar to safening studies with PBPA the second and third leaves of corn treated with norflurazon received less protection from BAS-145138 than the first leaf (Table 4). For example, complete protection from pigment loss was observed in the first leaf of corn treated with 2 uM norflurazon and 1 mM BAS-145138 (Table 3). However, the second and third leaves of corn treated in the same manner showed reductions of total chlorophyll and carotenoid content of 33 and 31%, respectively (Table 4).

Table 3. The safening effect of BAS-145138 (BAS) on the inhibitory influence of norflurazon on pigment synthesis in corn. Chlorophyll and carotenoid extracts were made from the first leaf. TChl = total chlorophyll and Car = carotenoid.

Nor (uM)	BAS (mM)	Chl a (ug/g)	Chl b (ug/g)	TChl (ug/g)	Car (ug/g)
0	0	1250	206	1456	636
2	0	675	113	788	348
2	1	1181	194	1375	588
5	0	451	84	535	240
5	1	728	126	854	382
10	0	78	18	96	56
10	1	650	127	778	332
LSD 5%		93	14	105	46
1%		126	19	142	62

Table 4. The safening effect of BAS-145138 (BAS) on the inhibitory influence of norflurazon on pigment synthesis in corn. Chlorophyll and carotenoid extracts were made from the second and third leaves. TChl = total chlorophyll and Car = carotenoid.

Nor (uM)	BAS (mM)	Chl a (ug/g)	Chl b (ug/g)	TChl (ug/g)	Car (ug/g)
0	0	1225	181	1406	596
2	0	449	83	533	228
2	1	818	132	949	412
5	0	242	52	295	128
5	1	622	113	735	327
10	0	24	63	88	29
10	1	419	78	498	212
LSD 5%		105	55	131	50
1%		143	74	178	68

DISCUSSION

This study demonstrated that both PBPA and BAS-145138 partially protect corn from the herbicidal activity of norflurazon. Norflurazon blocks carotenoid synthesis by inhibiting the activity of the enzyme phytoene desaturase (10). In the absence of carotenoids, chlorophyll is photooxidized causing the plant to bleach and eventually die (2). Since the major herbicidal action of norflurazon is the blocking of carotenoid synthesis, we can speculate that the safening effect of PBPA and BAS-145138 in norflurazon-treated plants is either due to their interference with this blocking action or to their acceleration of the metabolism of norflurazon in corn.

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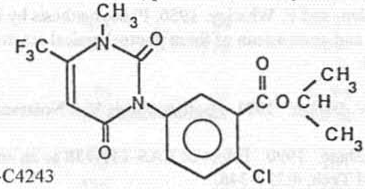
Influence of UCC-C4243 on Plant Growth and Enzyme Activity [1]

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

ABSTRACT

The grasses barley and corn were less sensitive to UCC-C4243 than the broadleaf plants pea and radish. Barley was more sensitive than corn to the herbicide. Of the two broadleaf plants tested, radish was much more sensitive to UCC-C4243 than pea. In barley the activity of all four enzymes tested was increased by UCC-C4243, increasing with the rate of herbicide applied.. In contrast to barley, in pea UCC-C4243 caused decreases in activity of acid and alkaline phosphatases and nitrate reductase. However, peroxidase activity was considerably increased.



Chemical structure of UCC-C4243

INTRODUCTION

The substituted uracil UCC-C4243 [2-chloro-5-(3,6-dihydro-3-methyl-2,6-dioxo-4-(trifluoromethyl)-(2H)-pyrimidinyl)benzoic acid, 1-methylethyl ester] is under development by Uniroyal Chemical as a broad spectrum preemergence and postemergence herbicide for use in wheat, sugarcane, corn, sorghum, field peas, and lentils (3,4,5,6,7,9). Similar to acifluorfen {5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoic acid and methyl ester}, UCC-C4243 is a strong inhibitor of protoporphyrinogen oxidase, the final common enzyme of the heme and chlorophyll synthesis pathways (1,2,8). Consequently, susceptible plants treated with UCC-C4243 show rapid chlorosis and desiccation (3).

In the present paper the effect of UCC-C4243 on the growth of barley (Hordeum sativum L.), corn (Zea mays L.), radish (Raphanus sativus L.), and pea (Pisum sativum L.) was studied. Also the influence of UCC-C4243 on the activity of several enzymes in barley and pea was determined.

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2/ Prof., Cranberry Experiment Station, University of Mass. East Wareham, MA 02538.

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

METHODS AND MATERIALS

Growth studies: Seeds were soaked for 6 h in different concentrations of UCC-C4243. The imbibed seeds were sown in 8-cm styrofoam pots (15 seeds per pot) containing moist vermiculite and then covered with about one cm of additional moist vermiculite. The plants were grown in a growth chamber under contant conditions of light (126 uE $m^{-2}s^{-1}$, 16 h light and 8 h dark) and temperature (22±1°C). The bottoms of the pots were punctured several times to allow good drainage. Petri dish halves were used as holders for the pots to catch drainage and as an indirect method of providing water and nutrients. After shoot emergence 30 ml of 1/2 strength Hoagland solution was applied daily to each pot. After 12 days (barley, corn, and pea) and 21 days (radish) the seedlings were removed from the pots. The ten largest seedlings (determined by shoot length) from each pot were selected and their shoot length, fresh weight, and dry weight determined.

Enzyme studies: The assays for nitrate reductase, peroxidase, acid phosphatase and alkaline phosphatase were done according to the methods of Zbiec et al. (10). All growth and enzyme experiments were replicated four times and all data subjected to analysis of variance.

RESULTS AND DISCUSSION

The grasses barley and corn were less sensitive to UCC-C4243 than the broadleaf plants pea and radish. Barley treated with 0.5 uM UCC-C4243 showed a 17% reduction in shoot length and an 11% reduction in fresh weight, but no reduction in dry weight (Table 1). Corn was less sensitive than barley to the herbicide. For example, barley treated with 3 uM UCC-C4243 had reductions in shoot length, fresh weight, and dry weight of 72, 67, and 53%, respectively (Table 1). However, at the same herbicide rate corn showed reductions in shoot length, fresh weight, and dry weight of 34, 33, and 21%, respectively (Table 1).

Table 1. Effect of UCC-C4243 on the growth of barley and corn.

	Barley Shoot			Corn Shoot		
C-4243 (uM)	Length (mm)	Fr. Wgt (mg/pl)	Dry Wgt (mg/pl)	Length (mm)	Fr. Wgt (mg/pl)	Dry Wgt (mg/pl)
0.0	184	158	16.0	154	497	43.8
0.1	183	159	16.0	-	-	-
0.5	153	141	16.0	-	-	-
1.0	111	111	13.5	140	414	36.8
2.0	74	69	9.5	119	369	35.8
3.0	51	52	7.5	101	333	34.8
4.0	-	-	-	97	316	33.5
5.0	-	-	-	84	269	29.3
LSD 5%	11.1	12.3	1.8	8.2	36.2	3.6
1%	15.2	16.9	2.4	11.2	49.6	4.9

Of the two broadleaf plants tested, radish was much more sensitive to UCC-C4243 than pea. For example, radish treated with 0.5 uM UCC-C4243 showed reductions in shoot length, fresh weight, and dry weight of 45, 73, and 72%, respectevely. When twice as much of the herbicide was applied to pea the reductions observed for shoot length, fresh weight, and dry weight were 9, 7, and 4%, respectively (Table 2).

Table 2. Effect of UCC-C4243 on the growth of pea and radish.

	Pea Shoot				Radish Shoot		
C-4243 (uM)	Length (mm)	Fr. Wgt (mg/pl)	Dry Wgt (mg/pl)	C-4243 (uM)	Length (mm)	Fr. Wgt (mg/pl)	Dry Wgt (mg/pl)
0	178	781	71.0	0.0	75	1012	109
1	162	724	68.0	0.1	65	781	80
2	118	524	50.0	0.2	58	562	63
4	69	314	30.3	0.3	57	531	57
6	52	257	22.5	0.4	49	446	46
8	34	226	19.5	0.5	41	275	31
10	23	149	14.5	0.6	22	122	14
LSD 5%	6.4	42.7	4.8	LSD 5%	6.6	74.0	9.1
1%	8.7	58.2	6.6	1%	9.0	100.7	12.4

In barley the activity of all four enzymes tested was enhanced by UCC-C4243, increasing as the rate of herbicide was increased from 0.1 to 1 uM (Table 3). This was especially true with nitrate reductase and peroxidase where very large increases in activity were observed at the higher rates of UCC-C4243 tested (Table 3).

Table 3. Effect of UCC-C4243 on enzyme activity in 10 day old barley seedling. Phosphatase and Unit are abbreviated "Phos" and "U", respectively. A phosphatase unit is defined as the amount of enzyme contained in 100 g of fresh tissue which liberates 1 mM p-nitrophenol at 40° C. A unit of peroxidase activity is the increase in OD of the reaction mixture per one min per 100 g fresh tissue.

C-4243 (uM)	Acid Phos (U)	Alkaline Phos (U)	Nitrate Reductase (uM NO_2/g/h)	Peroxidase (U)
0.0	28.5	0.689	25.4	60.5
0.1	33.7	0.730	29.1	67.1
0.5	36.0	0.770	37.3	118.0
1.0	38.6	0.928	68.2	125.0
LSD 5%	2.28	0.062	7.8	6.0
1%	3.20	0.087	11.0	8.4

In pea the presence of UCC-C4243 caused decreases in activity for acid and alkaline phosphatases and nitrate reductase (Table 4). However, Peroxidase activity was considerably increased by the herbicide. For example, pea treated with 8 uM UCC-C4243 showed a 188% increase in peroxidase activity (Table 4).

Table 4. Effect of UCC-C4243 on enzyme activity in 12 day old pea plants. Otherwise see Table 3.

C-4243 (uM)	Acid Phos (U)	Alkaline Phos (U)	Nitrate Reductase (uM NO_2/g/h)	Peroxidase (U)
0	41.4	1.58	47.9	26.9
1	38.8	1.27	40.3	23.4
2	34.2	1.10	33.3	28.2
4	32.8	1.07	25.4	45.8
6	29.4	0.93	18.9	71.9
8	26.1	0.76	13.4	77.4
LSD 5%	2.5	0.17	3.23	9.6
1%	3.5	0.23	4.43	13.2

Wright et al. (8) demonstrated that UCC-C4243 requires light for herbicidal activity. In the presence of light UCC-C4243 blocks porphyrin biosynthesis by inhibiting protoporphyrin oxidase, the final common enzyme of the heme and chlorophyll synthesis pathways (1,7,8). Consequently, the major symptoms of UCC-C4243 phytotoxicity are chlorosis and the development of necrotic tissue.

In the present study the above mentioned symptoms (chlorosis and necrosis) did develop in treated plants, but in a much slower manner than is usually exhibited. This was probably due to the method of herbicide application, i.e., by soaking seeds in solution of UCC-C4243. What this study did show was that, in general, broadleaf plants are more sensitive to UCC-C4243 than grasses and that radish is highly sensitive to the herbicide. This suggests that UCC-C4243 could be a useful herbicide for the control of weeds in the mustard family.

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The Effect of Nutrients on Weed Seed Germination and Weed Density

Guangyong Zou and Richard A. Ashley[1]

Abstract

Using soil fertility management to regulate weed germination and infestation development has received significant attention. However, its potential for widespread applicability in the field is limited by the lack of understanding of the nutrients effect on weed germination. This study was initiated to determine if nutrients have an effect on weed seed germination under growth chamber conditions and the relationship between soil nutrient levels and weed density under field conditions.

The design of the growth chamber experiment was a RCBD with 8 treatments (N-P-K, mM: 0-0-0, 1-1-6, 5-1-6, 10-1-6, 15-1-6, 10-5-6, 10-1-1, and 10-1-12. All treatments contain 5 mM Ca and 2 mM Mg) and 6 replications for crabgrass (*Digitaria sangulinalis* (L.) Scop.), fall panicum (*Panicum dichotomiflorum* Michx.), foxtail (*Setaria lutescens* (Weigel) Hubb.), wild mustard (*Brassica kaber* (DC.) Wheeler.), and pigweed (*Amaranthus retroflexus* L.). The experiment was repeated 3 times and treated as blocks in data analysis. One hundred seeds of each species were imbibed in 10-cm diameter petri dishes lined with one Whatman No. 1 filter paper with 5 ml of nutrient solution. Petri dishes were wrapped by a layer of clear plastic. Weed germination (%) was observed at 15 days after the experiment was initiated. Growth chamber conditions were maintained at 15/25° C for 8/16 hr dark/light. The field experiment was conducted at the Department of Plant Science Field Research Facility of the University of Connecticut, Storrs. A 90 m × 30 m filed was selected to investigate lambsquarters (*Chenopodium album* L.) densities and soil nutrient levels by a nested sampling scheme. The field was plowed and fitted on August 1, 1995. Total of 123 soil samples were taken to a depth of 15 cm in the following 2 days. Weed counts were made in a 0.25m^2 quadrat for each of 123 sampling points on August 23, 1995. No crop was planted during the season. Path analysis was introduced to evaluate the effect of 5 macronutrients and pH on lambsquarters density.

In the growth chamber study, crabgrass and pigweed showed the greatest germination percentage, while the wild mustard germination percentage was greater than foxtail and fall panicum. Overall NPK effect was significantly positive compared to non-NPK. Various NPK rates have same effects on crabgrass and foxtail germination, while the germination of fall panicum, wild mustard, and pigweed depends on nutrients concentration, especially N (Fig. 1). The most promotive N concentration was above 10 mM for all these three species. The only species that responded to K concentration was wild mustard and 12 mM K decreased the germination.

Under the field condition, the path diagram (Fig. 2) indicated that lambsquarters density was mainly related to Mg (β=1.10), P (β=0.58), NO_3^- (β=0.19), and Ca (β=-1.42). Other variables influence the density through indirect effects. The results confirmed that manipulation of weed infestation by fertility management is possible. Because the relationship between weed and soil systems is so complicated that further study is needed to illuminate the clear picture of soil nutrients and weed population development.

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[1] Graduate Assistant and Professor, respectively, Departmant of Plant Science, University of Connecticut, Storrs, CT 06269-4067.

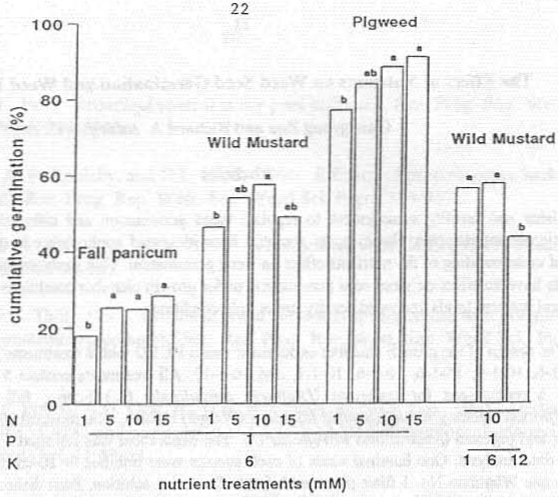

Figure 1 The effect of various NPK nutrients solution on fall panicum, wild mustard, and pigweed seeds germination (%). Bars have same letter are not significantly different, according to LSD at the 5% level.

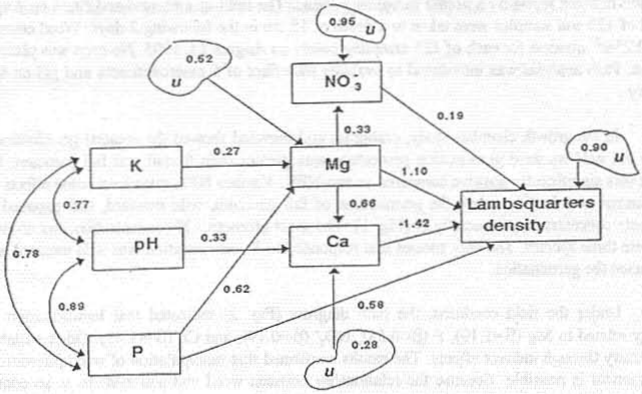

Figure 2 Path diagram of common lambsquarters density as affected by soil nutrients and pH. One-headed arrows indicate potential direct effects of independent variables, whereas two-headed arrows indicate that independent variables might correlated with one another for reasons that are not currently analyzed. Values along the lines denote the strength of the relationships. All path coefficients are significant at the 5% level.

CONTROLLING CIRCLING ROOTS IN CONTAINER GROWN ORNAMENTALS WITH ROOT INHIBITING HERBICIDES

Larry J. Kuhns, Tracey Harpster, and Clyde Elmore[1]

ABSTRACT

SpinOut[2] is a commercially available product containing copper hydroxide that is designed to prevent the development of circling roots in container grown ornamentals. The objective of this study was to determine the effect of two root-inhibiting herbicides, oryzalin and trifluralin, on the development of circling roots in container grown ornamentals when painted onto the inside surface of the containers.

The treatments presented in Table 1 were painted on the inside surfaces of 4-in plastic pots or painted on 6 in marker stakes. Rooted cuttings of wintercreeper euonymus (Euonymus fortunei Hand.-Mezz) were planted in a 1 peat:1 perlite:1 soil mix Feb. 8-10, 1995. Painted stakes were inserted vertically at three positions against the wall of the container to intercept circling roots. There were 16 containers of each treatment. Eight were rated for circling roots then harvested May 17 to 22 and eight were rated and harvested July 6 to7, 1995. Root circling was rated on a scale of 1 to 5, with 1 indicating no circling roots and 5 indicating many circling roots. Following harvest stem growth was measured and the dry weights of the roots, stems, and leaves were determined.

None of the treatments including the stakes prevented the development of circling roots (Table 1). In most situations, circling roots stopped at oryzalin treated stakes, but in some, roots grew between the stakes and the wall of the container. Also, it was hard to rate these treatments because root circling was already initiated by the time the roots contacted the stakes.

Trifluralin in Vapor Gard[3] reduced the amount of circling roots, but not to acceptable levels. Trifluralin in latex paint was ineffective at 0.5%, slightly reduced the development of circling roots at 2 %, and at 4 % reduced circling rooting to the same extent as the SpinOut. The trifluralin was in an emulsifiable concentrate formulation and may have mixed better with the paint if it had been oil-based.

Surflan at 0.5% in Vapor Gard reduced the development of circling roots to the same extent as the SpinOut. All other rates of Surflan, in both carriers, almost totally eliminated circling roots.

There were no significant differences in root weight or total plant weight among any of the treatments at either date of evaluation.

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[1] Prof. of Ornamental Horticulture and Research Associate, Dept. of Horticulture, The Pennsylvania State University, University Park, PA 16802; and Professor of Weed Science, University of California, Davis, CA

[2] SpinOut contains 7.1% copper hydroxide in a latex paint base, Griffin Corp.,Valdosta, GA 31601

[3] Vapor Gard is an anti-transpirant containing 96% di-1-p-Menthene, Miller Chemical and Fertilizer Corporation, Hanover, PA 17331

Table 1. The average circling root rating, root weight, and total weight of wintercreeper euonymus planted as rooted cuttings on February 6-8, 1995; and rated and weighed July 6-7, 1995. Root circling was rated on a scale of 1-5, with 1=no circling roots and 5=many circling roots. Treatments were painted on the inside of 4 in. containers into which rooted cuttings of the euonymus were planted; or were painted on 6 in stakes and stuck into the medium, against the wall of the container, at three evenly spaced positions. The average of 8 plants per treatment is presented.

		Weight (g)	
Treatment	Root circling	Roots	Total
Untreated control	4.8 a	1.7	13.6
SpinOut	2.1 d	1.8	12.9
Oryzalin (0.5%) in Latex paint	1.1 e	1.5	15.2
Oryzalin (2.0%) in Latex paint	1.0 e	1.3	13.0
Oryzalin (4.0%) in Latex paint	1.0 e	1.5	14.4
Oryzalin (0.5%) in Vapor Gard	2.1 d	1.2	13.9
Oryzalin (2.0%) in Vapor Gard	1.1 e	1.1	12.9
Oryzalin (4.0%) in Vapor Gard	1.0 e	1.2	13.9
Trifluralin (0.5%) in Latex paint	4.9 a	1.6	14.7
Trifluralin (2.0%) in Latex paint	3.8 c	1.5	13.8
Trifluralin (4.0%) in Latex paint	2.0 d	1.0	13.9
Trifluralin (0.5%) in Vapor Gard	4.0 bc	1.3	7.9
Trifluralin (2.0%) in Vapor Gard	4.5 abc	2.6	14.8
Trifluralin (4.0%) in Vapor Gard	4.1 bc	2.3	11.4
Spinout on stakes	4.6 ab	1.7	13.6
Oryzalin (0.5%) on stakes (paint)	4.4 abc	2.1	15.6
Oryzalin (2.0%) on stakes (paint)	4.7 ab	1.5	14.4
Oryzalin (4.0%) on stakes (paint)	4.8 a	1.9	16.0
Oryzalin (2.0%) on stakes (V. Gard)	4.6 ab	1.4	16.1
Latex paint on stakes	4.8 a	1.7	14.4

WEEDS OF THE NORTHEAST - PROGRESS REPORT

R. H. Uva, J. C. Neal and J. M. DiTomaso[1]

ABSTRACT

The use of a weed identification manual is the first step in determining the most appropriate weed management strategy in any cropping system. Such manuals are essential tools for growers, consultants, Cooperative Extension agents, IPM scouts, turf and landscape managers, weed science students, and dealers and sales support personnel, who must tailor weed management strategies for specific weed problems.

Several weed identification manuals are available for regions of the country other than the Northeast, unfortunately they do not cover many of the important species in our geographic area. The 2 weed identification manuals produced for the Northeastern US are both limited in scope, illustrated with low quality line drawings, and contain cursory descriptions written with inconsistent terminology.

The primary objective of this project was to develop an updated, practical guide to the identification of common and economically important weeds of vegetable, orchard, and agronomic crops, as well as nurseries, gardens, and turf found in the Northeastern United States. We are pleased to report that *Weeds of the Northeast* has been completed and was sent to the publisher, Cornell University Press, in August of 1995. The book covers nearly 300 weedy species, 175 with full-length descriptions and the remaining number as similar species. For example: hairy galinsoga (*Galinsoga ciliata*) received a full-length description while small flower galinsoga (*G. parviflora*) is covered on the same page as a "similar species". Included in the book are nearly 800 color photos of weeds at several growth stages and 200 line drawings of key characteristics. Permission to use line drawings from existing publications was graciously provided by Ciba Crop Protection Co. and The Scotts Company. Original art work was produced by the senior author and Ms. Bente Starke King, formerly illustrator for the Bailey Hortorium at Cornell University.

The text is organized in the following manner:

I. **Introduction and Table of Contents**
II. **Character Identification Index:** a listing of weed species with easy to recognize characteristics, e.g. spiny to touch, basal rosette, milky sap, etc.
III. **Identification Key** (based on vegetative charachteristics)
IV. **Plant Descriptions**: Each including, correct names and synonymy, general description (life cycle and growth habit), reproductive characteristics (including structures and phenology), vegetative characteristics (of seedlings and mature specimens), post-senescence characteristics, habitats, distribution, similar species (including distinguishing characteristics), line drawings, and/or color pictures (various stages of growth and key characteristics).
V. **Glossary of Terminology** (with illustrations)
VI. **Index**

At the time of writing this abstract, the production schedule should make the book available by August of 1996, in time for Fall classes. The estimated retail price will be about $30 for a soft bound edition. Members of sponsoring organizations, such as the Northeastern Weed Science Soeciety, will be eligible for a pre-print order discount of about 20%.

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[1]Graduate Research Asst. and Assoc. Prof., Dep. Flor. & Orn. Hort., Cornell Univ., Ithaca, NY, and Asst. Prof., Dep. Vegetable Crops, U.C., Davis, CA

DURATION OF ANNUAL GRASS CONTROL WITH CHLOROACETAMIDE HERBICIDES

M. G. Schnappinger, D. B. Vitolo, C. M. Moseley, T. A. Bauer, S. W. Pruss[1]

ABSTRACT

Control of annual grasses during the middle and latter part of the growing season often affects the choice of herbicides used by growers. Utilization of plantback studies where annual grass species are seeded at various intervals after herbicide application demonstrate the ability of these herbicides to provide residual control.

Replicated field studies were conducted during 1994 and 1995 in Indiana, Maryland, Ohio, Pennsylvania, and New York where Japanese millet (*Echinochloa crus-galli* var. frumentacea) and giant foxtail (*Setaria faberi* Herrm.) were seeded at weekly or bi-weekly intervals after application of several chloroacetamide herbicides currently used in corn (*Zea mays* L.) and/or soybean (*Glycine max* L.). Comparisons were made between labeled rates of metolachlor, acetochlor, alachlor, and dimethenamid.

At all locations in 1994 and 1995, metolachlor was the most effective herbicide especially when the indicator species were planted at six weeks after herbicide application.

TABLE 1. Control of Japanese millet and giant foxtail planted six weeks after labeled rates of several chloracetamide herbicides were applied- 1994 & 1995.

	Location and Year							
	MD-94	OH-94	NY-94	PA-94	IN-95	MD-95	NY-95	MD-95
	% CONTROL							
HERBICIDE	ECHCF						SETFA	
METOLACHLOR (DUAL II 7.8E)	100	98	96	78	100	83	95	71
ACETOCHLOR (HARNESS+ 7EC)	33	/	/	45	62	21	10	25
ACETOCHLOR (SURPASS 6.4EC)	45	48	81	52	78	18	10	16
DIMETHENAMID (FRONTIER 7.5EC)	63	70	70	50	83	42	32	25
ALACHLOR (LASSO 4MT)	37	40	14	45	/	/	0	/

[1] Senior Scientist, Senior Research Specialist, Technical Service Manager, Senior Research Representative, and Regional Manager, respectively, Ciba Crop Protection, Washington, PA 15301

DISTRIBUTION, DISPERSAL AND ABUNDANCE OF HAY-SCENTED FERN SPORES IN MIXED HARDWOOD STANDS

Larry H. McCormick and Kathy A. Penrod[1]

ABSTRACT

A study was conducted in 1992 to assess the abundance and distribution of viable hay-scented (*Dennstaedtia punctilobula* (Michx.) Moore) fern spores in the forest floor of central Pennsylvania hardwood stands before and after seasonal spore dispersal. Intact soil samples were collected at various distances and directions from established fern communities and placed in a greenhouse to effect spore germination. Spore abundance was estimated by counting the number of gametophytes which developed. Results indicate that a large viable sporebank exists in many central Pennsylvania hardwood forests. Viable spores were present in over 97% of pre- and post-dispersal samples with estimates of upward to 160,000 viable spores per square meter. Viable spores occurred at all distances within the 50 m from source zone sampled. The number of viable spores generally decreased with distance from the source with the highest abundance occurring within 10 m of the source. There was evidence of directional effects on spore abundance at some sampling locations, however, the effect was variable between sites. These data indicate the potential exists for the establishment of hay-scented ferns from a viable sporebank in central Pennsylvania hardwood stands.

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[1] Professor and Graduate Student, respectively, School of Forest Resources, The Pennsylvania State University, University Park, PA 16802.

BEDDING PLANT TOLERANCE TO THREE FORMULATIONS OF PENDIMETHALIN

A.F. Senesac and M. Macksel[1]

ABSTRACT

A field study was conducted to evaluate the safety of three formulations of pendimethalin on five annual bedding plant species. Three formulations: emulsifiable concentrate (3.3EC) water dispersible granule (60 WDG) and dry granule (2G) were applied immediately post plant (IPP) to freshly tilled soil, at 2.0 and 4.0 lb ai/A. The 4.0 lb/a rate of each formulation was also applied IPP over a 1.0 inch layer of chipped bark mulch. To evaluate the potential safening effect of a delayed application, the 4.0 lb/a rate of each formulation was also applied to freshly tilled soil 14 days after transplanting (DPP). Napropamide (5G) was applied IPP at 4.0 lb ai/A as a standard for comparison.

Three transplants of each species, (Begonia x semperflorens-cultorum hort. 'Green Leaf Scarlet'), (Impatiens walleriana Hook. 'Accent Orange'), (Vinca rosea L. 'Cooler Grape'), (Petunia x hybrida hort. Vilm.-Andr. 'Grandiflora White'), (Salvia splendens Sell ex Roem. & Schult. 'Fuego') were planted in raised beds in Riverhead sandy loam. The study was arranged in a Randomized Complete Block design and the treatments were replicated four times.

The results of visual evaluations of plant vigor as well as a destructive harvest of the above ground shoots indicate that begonia, impatiens, vinca and salvia were significantly injured by all formulations and rates of pendimethalin applied IPP to bare ground. A safening effect was observed on these four species when the granular, but not the sprayable, formulations were applied IPP to mulched soil. Waiting 14 days before application safened the three pendimethalin formulations for begonia and impatiens, but only the granule was safened for salvia and vinca at this timing. Postplant applications of the pendimethalin 2G were safe on petunia at all timings and rates. Waiting 14 days safened all three formulations for this species. Napropamide did not significantly injure any of the five species.

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[1]Weed Science Specialist and Research Technician, Cornell University, Long Island Horticultural Research Laboratory, Riverhead, NY

THE EFFICACY OF POST APPLIED HERBICIDES COMPARING DIFFERENT ADJUVANTS

J.A. Saik[1], L.M. Walker[2], D.M. Goodale[3]

ABSTRACT

Herbicide efficacy for postemergence weed control soybeans (Glycine max [L.] Merr.), will increase where adjuvants are used. Five surfactant families were used in three different studies including fertilizer blends, crop oil concentrates, organo silicones, nonionic surfactants, and methylated seed oil derivatives. The soybean response and weed control were evaluated by visual observation (percent control).

Imazamox (Raptor) at 4oz/acre, acifluorfen at 8oz/acre, and adjuvants were applied to ivyleaf morningglory (Ipomea hederacea [L.] Jacq.), and giant foxtail (Setaria faberi Herrm.). The combinations were applied at the third trifoliate leaf stage on the soybeans. Ivyleaf morningglory was 6-8 inches in height (4-6 leaves), and giant foxtail was 10 inches tall. They were applied at Lawernceville, New Jersey and evaluated at 22 days after treatment (DAT), the soybean response was evaluated at 8 DAT. The treatments were LI-700[i] at 0.25% v/v, sunit II[ii] at 1.5pt/acre, biosurf[iii] at 0.25% v/v, induce[iv] at 0.25% v/v, activator 90[v] 0.25% v/v, spreader 80[vi] at 0.25% v/v, nu-film[vii] at 5.3 oz/acre, freeway[viii] at 4.0 pt/100 gal., herbimax[ix] at 1.0 qt/acre, trooper[x] at 1.0 qt/acre, 2.5 pt/acre, and cayuse[xi] at 0.5%v/v. All treatments except for the fertilizer blends were applied with 28-0-0 UAN at 1.0 qt/acre.

Imazethapyr was applied at 4oz/acre with adjuvants and 28-0-0 UAN at 1.0 qt/acre, except for the fertilizer blends. These treatments were applied at Mount Joy, Pennsylvania to common lambsquarters(Chenopodium album L.) at 1-3 inches in height, and hemp dogbane at 12-26 inches in height, and evaluated at 63 DAT. The soybean application was at the third trifoliate leaf and the response was evaluated at 16 DAT. The treatments were LI-700 at 2.0 pt /100 gal., sunit II at 1.5 pt/acre, biosurf at 0.25% v/v, induce at 0.25% v/v, activator 90 at 0.25%v/v, silwet[xii] at 2.0 pt/100gal., freeway at 4.0 pt/100 gal., herbimax at 1.0 qt/acre, peptoil[xiii] at 1.0 qt/acre, cayuse at 2.5 pt/acre, and trooper at 2.5 pt/acre.

Imazamox efficacy increased on ivyleaf morningglory above 90% control with the use of sunit II (methylated seed oil derivative), and herbimax (crop oil concentrate). Imazamox also increased the efficacy on giant foxtail above 97% control when used with of sunit II. Trooper at 2.5 pt/acre (fertilizer blend) had 98% control when compared to trooper at 2.0 pt/acre at 96% control. Herbimax was the least phytotoxic with only 6% soybean injury followed by activator

[1] Undergraduate Agronomy Student, The State University of New York, College of Agriculture and Technology at Cobleskill, Cobleskill, New York 12043.
[2] Product Development Manager, AG-CHEM INC. Salisbury, Maryland 21802.
[3] Professor of Agronomy, The State University of New York, College of Agriculture and Technology at Cobleskill, Cobleskill, New York 12043.

90 (nonionic surfactant) at 7% and sunit II showing 10% injury. Imazamox combined with sunit II gave the greatest weed control over activator 90 and herbimax. Imazathapyr efficacy increased on common lambsquarters above 90% with all treatments except cayuse (fertilizer blend), and peptoil (crop oil concentrate). Imazethaypyr also increased the efficacy on hemp dogbane (Apocynum cannabinium L.) to 70% control with the use of spreader 80 (nonionic surfactant), freeway (organo silicone), and all the other treatments were under 60% control. Soybeans showed the greatest phytotoxicity to cayuse at 25%, whereas sunit II only caused 5% injury to the soybeans. These data show that cayuse is not the ideal adjuvant for the use of imazethaypyr.

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[i] Loveland Industries, INC. P.O. Box 1289 Greeley, CO 80632
[ii] Agsco, INC. P.O. Box 458 Grand Forks, ND 58206
[iii] Loveland Industries, INC. P.O. Box 1289 Greeley, CO 80632
[iv] Helena Chemical Company 5100 Poplar, Suite 3200 Memphis, TN 38137
[v] Loveland Industries, INC. P.O. Box 1289 Greeley, CO 80632
[vi] Custom Chemicides P.O. Box 11216 Fresno, CA 93772
[vii] Miller Chemical & Fertilizer Corporation Box 333 Hanover, PA 17331
[viii] Loveland Industries, INC. P.O. Box 1289 Greeley, CO 80632
[ix] Loveland Industries, INC. P.O. Box 1289 Greeley, CO 80632
[x] AG-CHEM INC. 312 w. Main St. P.O. Box 2178 Salisbury, MD 21802
[xi] Wilber-Ellis P.O. Box 16458 Fresno, CA 93755
[xii] Helena Chemical Company 5100 Poplar, Suite 3200 Memphis, TN 38137
[xiii] Drexel Chemical Company P.O. Box 9306 Memphis, TN 38109

EARLY AND MID POST CRABGRASS CONTROL WITH REDUCED RATE TANK MIXES.

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

ABSTRACT

Postemergent control of crabgrass in creeping bentgrass turf is a challenge requiring careful attention to plant growth stage and herbicide rate selection. Crabgrass must be identified at the 1 to 3 leaf stage to be controlled with the low rates of fenoxaprop (Acclaim) required for acceptable safety on creeping bentgrass. However, repeated applications at 10 to 14 days are necessary to achieve acceptable control. With each application, turf injury is possible. This test was conducted to evaluate tank mixes of low doses of Acclaim and dithiopyr (Dimension) alone and in combination for efficacy on 1-3 leaf and 1-3 tiller smooth crabgrass (*Digitaria ischaemum* Schreb. *ex* Muhl.) and safety on $^1/_2$ inch cut creeping bentgrass turf. Treatments were dithiopyr at 0.09 to 0.38 lb ai/A and fenoxaprop at 0.032 to 0.09 lb ai/A applied separately and combinations. Tests were conducted in two locations: Riverhead and Ithaca, NY each on established turfgrass areas mowed weekly at 2 $^1/_2$ inches. Riverhead tests were conducted on established perennial ryegrass that was irrigated weekly. The Ithaca site was irrigated 2 days prior to treatment and again 1 day after treatment, otherwise the Ithaca site was under severe to moderate drought stress throughout the season.

Early postemergent treatments of Acclaim at 0.12 lb ai/A provided acceptable crabgrass control at the 3-week ratings but control decreased in later ratings (<60% by 4 weeks and < 20% by September). The labeled rate of Acclaim for early post crabgrass control in bentgrass, 0.032 lb ai/A applied at 14 day intervals was ineffective in both early post studies. Dimension alone provided ≤50% control. Tank mixing Acclaim at 0.06 lb ai/A with 0.38 lb ai/A Dimension provided >80% control initially but control from this treatment also decreased to unacceptable levels by 4 weeks.

Crabgrass control was better with mid-post (1 to 3 tiller) applications than the earlier timing. By September Acclaim at 0.12 lb ai/A provided > 80% control in the Riverhead test and >90% in the Ithaca test. Acclaim at 0.09 lb ai/A controlled crabgrass 85% in Ithaca but < 70% in Riverhead. Dimension alone did not control tillered crabgrass. For Tank mix treatments, crabgrass control increased as the rate of either herbicide increased. In Riverhead, the only combinations providing >80% control were Acclaim at 0.09 lb ai/A with 0.18 or 0.38 lb ai /A. In Ithaca, these treatments, as well as Acclaim at 0.06 + Dimension at 0.38, provided >90% control. Also in Ithaca, the following combinations provided between 80% and 90% control: 0.09 + 0.09, 0.06 + 0.09, 0.06 + 0.18, and 0.032 + 0.38 lb ai/A Acclaim + Dimension, respectively.

The only treatment with acceptable crabgrass control in any test and to provide acceptable creeping bentgrass safety was 0.032 lb ai/A Acclaim + 0.38 lb ai/A Dimension. Unfortunately, in 1995 this treatment provided acceptable control in only one of four tests. Higher rates of Acclaim, required for more consistent control, resulted in unacceptable bentgrass injury.

These data suggest, that in a year such as 1995, when crabgrass pressure is high and environmental conditions are not condusive to postemergent control, reduced rates of Acclaim and Dimension may be ineffective. This underscores the importance of well timed preemergent herbicide programs in bentgrass turf where known populations of crabgrass exist.

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[1] Research Technician and Weed Science Specialist Cornell University Long Island Horticultural Research Laboratory, Riverhead, NY

[2] Assoc. Prof., Dept of Floriculture and Ornamental Horticulture Cornell University, Ithaca, NY

WEED CONTROL IN SOYBEANS WITH SULFENTRAZONE

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

ABSTRACT

Sulfentrazone is new herbicide for control of certain broadleaf weeds in soybean (Glycine max L. Merr.). To investigate the activity of sulfentrazone on several annual broadleaf weeds indigenous to eastern Virginia, research was conducted from 1989 through 1995 except in 1990. Studies were conducted near Painter, Va., on a State sandy loam (Typic Hapludults) with a pH of 5.9 to 6.2 and organic matter content of 1%. Following conventional seed-bed preparation, soybean was planted in 30-in rows. Herbicides were applied PPI and PRE at 25 gpa using a tractor-mounted plot sprayer equipped with flat fan spray tips. Treatments included sulfentrazone alone and in combinations with other herbicides. Treatments were not the same throughout the study but were often changed in response to previous results. Weed species were generally similar throughout the yr and included common lambsquarters (Chenopodium album L.), common ragweed (Ambrosia artemisiifolia L.), common cocklebur (Xanthium strumarium L.) jimsonweed (Datura stramonium L.) and smooth pigweed (Amaranthus hybridus L.). Moisture was adequate in all yr to establish a uniform stand of soybean and weeds. Visual estimates of percent crop injury and weed control were made and in several years soybean was harvested to permit yield determinations. In 3 yr, wheat (Tritium sativa L.) was planted no-till following soybean harvest to bioassay for injury to this rotational crop. Wheat injury ratings and seed injury yields were collected. Sulfentrazone controlled most broadleaf species early but control of certain species diminished as the season progressed. Common lambsquarters and smooth pigweed control was 95% and above all season by sulfentrazone. Common ragweed and jimsonweed control was initially above 80% but diminished to 50% or below by Aug. or Sept. Sulfentrazone gave 50 to 75% common cocklebur control and control of morningglory spp. was often 75 to 80% late in the season. Occasional observations of yellow nutsedge (Cyperus esculentus L.) indicate that sulfentrazone should be effective against this species. Sulfentrazone frequently injured soybean early and occasionally caused shorter plants late in the season, especially from PRE applications. Soybean yield seemed to reflect good weed control. Wheat planted after soybean harvest was injured initially but recovered within 7 to 14 d and produced high yields. Sulfentrazone should be an effective component of soybean weed control programs.

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[1]Grad. Res. Asst., Prof., and Agric. Res. Spec. Sr., East. Shore Agric. Res. and Ext. Center, Virginia Polytech. Inst. and State Univ., Painter, VA, 23420.

Absortion and Translocation of Sulfonylureas Combinations by Johnsongrass and Hemp Dogbane

Pablo A. Kálnay, S. Glenn, and William H. Phillips, II[1]

ABSTRACT

Activity and translocation of nicosulfuron and primisulfuron combinations with 2,4-D or dicamba in johnsongrass [*Sorghum halepense* (L.)Pers.] and hemp dogbane (*Apocynum cannabinum L.*) were studied in the greenhouse. Experiments were designed as randomized complete blocks with 3 replications and all the experiments were replicated. Applications of herbicides were made when johnsongrass was 15 inches tall and hemp dogbane was 12 inches tall. Johnsongrass treatments consisted of 1/2X and 1X labelled rates of nicosulfuron and primisulfuron applied alone and in combination with 2,4-D or dicamba at 1/2, 1, and 2X labelled rate. The 1X rate of nicosulfuron, primisulfuron, 2,4-D and dicamba was 0.031, 0.036, 0.5, and 0.25 lb/A, respectively. Visual ratings of control and regrowth were obtained 56 days after treatment (DAT). Dicamba had no effect on the activity of nicosulfuron or primisulfuron on johnsongrass. Applications of 2X 2,4-D with 1X nicosulfuron or primisulfuron reduced johnsongrass control (79 and 76%, respectively) when compared to 1X nicosulfuron or primisulfuron applied alone (95 and 98%, respectively). Lower rates of 2,4-D had no effect on johnsongrass control when tank mixed with nicosulfuron or primisulfuron compared to either sulfonylurea herbicide applied alone. This indicated that 1.0 lb/A 2,4-D can antagonize johnsongrass control with nicosulfuron and primisulfuron, but dicamba and lower rates of 2,4-D had no effect. Translocation of nicosulfuron in johnsongrass was studied by applying 3 µl of ^{14}C-nicosulfuron to the uppermost fully expanded leaf following treatment with unlabelled nicosulfuron alone or in combination with 1X rates of 2,4-D or dicamba. The plants were harvested 1 and 7 DAT and separated into plant parts, then freeze-dried and combusted in a biological oxidizer. Translocation of ^{14}C was similar for all treatments, suggesting that 2,4-D and dicamba had no effect on nicosulfuron translocation in johnsongrass. Hemp dogbane control with tank mixtures of nicosulfuron with the 1/2X rate of dicamba is greater thn that achieved with either herbicide applied alone. A study was initiated to compare the absorption and translocation of nicosulfuron and dicamba in hemp dogbane following tank mixture treatments compared to either herbicide applied alone. The uppermost fully developed leaf of hemp dogbane was treated with 3 µl of either ^{14}C-nicosulfuron or ^{14}C-Dicamba following applications of unlabelled nicosulfuron, dicamba, or nicosulfuron plus dicamba tank mixtures to the entire plant. The plants were harvested 1 and 6 DAT, separated into plant parts, freeze-dried, and combusted. There was no difference in ^{14}C absorption among treatments following applications of ^{14}C-nicosulfuron or ^{14}C-Dicamba.Total translocation of^{14} C-nicosulfuron was higher 6 DAT for the nicosulfuron plus dicamba combination compared to nicosulfuron applied alone.Increased translocation of nicosulfuron to the upper leaves (85%) and to the crown and roots (130%) was detected compared to nicosulfuron applied alone. 6 DAT of ^{14}C-Dicamba translocation also increased when nicosulfuron and dicamba were combined, compared to dicamba applied alone. This was due to a 43% increase in movement of ^{14}C-Dicamba to the upper leaves of hemp dogbane. These data indicate that the 1/2 X rates of 2,4-D or dicamba used in combination with nicosulfuron for broadleaf weed control was not detrimental to the activity of nicosulfuron on johnsongrass. Increased control of hemp dogbane following applications of nicosulfuron plus dicamba tank mixtures compared to either herbicide applied alone was correlated with increased translocation of nicosulfuron and dicamba with the tank mixtures.

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[1]Grad. Res. Asst., Assoc. Prof., and Grad. Res. Asst., Dept. of Agronomy, University of Maryland, College park, MD 20742.

THE EFFICACY OF IMAZAMOX FOR WEED CONTROL IN SOYBEANS

J.A. Saik[1], L.M. Walker[2], and D.M. Goodale[3]

ABSTRACT

Imazamox is a new herbicide, tradename Raptor®, developed by American Cyanamid Company for postemergence control of grass and broadleaf weeds in soybeans (*Glycine max* [L.] Merr.). When applied postemergence at 4oz or 5oz/acre rate, imazamox exhibits excellent control on giant foxtail (*Setaria faberi* Herrm.) and common lambsquarters (*Chenopodium album* L.) [figure #1 & #2, respectivep].

Tank mix partners were used to increase the efficacy of imazamox on common ragweed (*Ambrosia artemisiifolia* L.), ivyleaf morningglory (*Ipomea hederacea* [L.] Jacq.), and tall morningglory (*Ipomoea purpurea* [L.] Roth.).

Imazamox was evaluated in replicated field trials in Worcester, Maryland; Lawrenceville, New Jersey; and Mount Joy, Pennsylvania. Imazamox applied to giant foxtail at 6-9" tall, and common lambsquarters at 1-3" tall, evaluated at 49 days after treatment (DAT) and 63 DAT respectively, showed excellent control with and without tank mix partners. When applied to common ragweed , ivyleaf , and tall morningglory at 4-9" tall and evaluated at 49 DAT achieved 95% or greater control at the 4oz/acre rate with a tank mix partner. The tank mix partners that help achieve these results were imazethapyr at (2oz/acre), chlorimuron + thifensulfuron-methyl at (1/16oz/acre & 1/8oz/acre), chlorimuron at (1/8oz/acre), thifensulfuron at (1/16oz/acre & 1/8oz/acre), fomesafen at (12oz/acre), acifluorfen at (16oz/acre) and flexstar at (16oz/acre). Along with the tank mix partners, LI 700 adjuvant was used at 0.25% v/v + 28-0-0 at 1qt/acre. These combinations were applied to soybeans at the third trifoliate leaf stage.

Soybeans expressed excellent tolerance to imazamox when applied alone. Imazamox applied with chlorimuron, thifensulfuron, lactofen, and acifluorfen provided a 5% or greater soybean response.

Imazamox also provided excellent control of giant foxtail and common lambsquarters in late planted soybean. To compliment these results, imazamox has greater crop rotational flexibility than other imidazolinone herbicides. This makes imazamox an excellent herbicide for late planted soybeans where crop rotation is an important factor.

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[1] Undergraduate Agronomy Student, The University of New York, College of Agriculture and Technology at Cobleskill, Cobleskill, New York 12043.
[2] Product Development Manager, AG-CHEM INC. Salisbury Maryland 21802.
[3] Professor of Agronomy, The State University of New York, College of Agriculture and Technology at Cobleskill, Cobleskill, New York 12043.

®Raptor is a registered trademark of American Cyanamid Co.

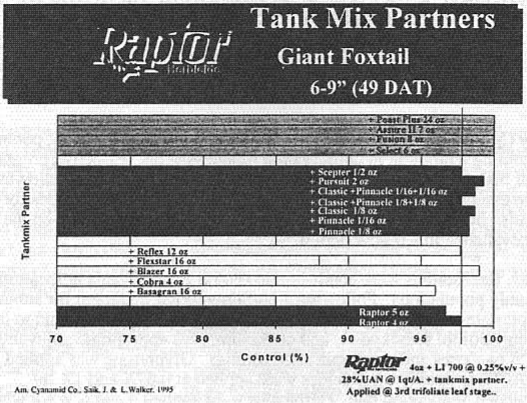

Figure 1.

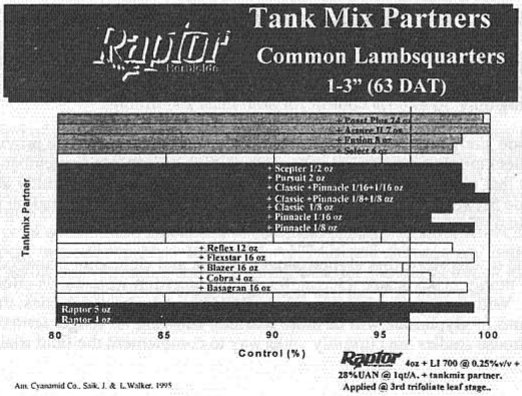

Figure 2.

EFFECT OF GLYPHOSATE AND SEVERAL ACCase INHIBITOR HERBICIDES ON WIRESTEM MUHLY CONTROL

D. D. Lingenfelter and W. S. Curran[1]

ABSTRACT

Wirestem muhly (Muhlenbergia frondosa (Poir.) Fernald) is a warm season, perennial grass species that is becoming a problem in conservation tillage systems. Effective programs currently do not exist for managing wirestem muhly in reduced-tillage corn. The following research was designed to evaluate glyphosate and several ACCase inhibitor herbicides for wirestem muhly control in soybeans. In addition, the effect of glyphosate application timing on the control of wirestem muhly was evaluated in a fallow period.

In 1994 and 1995, field studies were conducted in central Pennsylvania at locations with established wirestem muhly populations. Following a burndown/PRE treatment for annual weed control, transgenic (glyphosate-tolerant) soybeans (Glycine max) were planted in mid to late May. Glyphosate, fluazifop, quizalofop, sethoxydim, and clethodim, plus appropriate adjuvants, were applied postemergence at two rates and two application timings. Glyphosate was applied at 0.5 and 1.0 lb ai/A and the ACCase inhibitor herbicides were applied at 0.67X and 1X the manufacturer's recommended application rate. Herbicides were applied 4 and 6 WAP when wirestem muhly was 10 to 12" and 18 to 20" tall, respectively. In the fallow period study, glyphosate, plus 0.25% (v/v) nonionic surfactant, was applied at 0.5 and 1.0 lb ai/A at two to three week intervals from mid May through mid October (or first killing frost). A randomized complete block design with four replications was used for all studies. Herbicides were applied with a CO_2-backpack sprayer that delivered 10 gpa.

End of season results from the soybean study show that both rates of glyphosate provided less than 80% control of wirestem muhly with the early application timing and greater than 95% control from the later application. Fluazifop and clethodim gave similar control (70 to 80%) over both rates and application timings. Sethoxydim and quizalofop were less effective at controlling wirestem muhly, providing only 50 to 65% control for both rates and timings.

In the fallow period study, the end of season ratings revealed that glyphosate provided 90 to 100% control of wirestem muhly from applications made in mid June to late September. Preliminary results show that glyphosate provided 65 to 85% control of wirestem muhly the year following treatments made between mid June and mid August. Earlier or later application timings always provided less than 65% control.

In summary, these results show that glyphosate, fluazifop, and clethodim provided season long control of wirestem muhly in soybeans. Quizalofop and sethoxydim were not as effective at wirestem muhly control. With the introduction of glyphosate-tolerant soybean varieties, timely postemergence applications of glyphosate will be more feasible, allowing for longer term control of wirestem muhly. Greenhouse studies are currently underway to complement the field trials.

[1] Ext. Asst. and Asst. Prof. of Weed Science, Dept. of Agronomy, The Pennsylvania State University, University Park, PA 16802

THE EFFECTIVENESS OF SEVERAL HERBICIDES FOR THE CONTROL OF EASTERN BLACK NIGHTSHADE

E. L. Werner, J. O. Yocum, and W. S. Curran[1]

ABSTRACT

Eastern black nightshade (Solanum ptycanthum Dun.), an annual weed belonging to the solanaceae family, is a native to the United States and is common throughout North America east of the Rocky Mountains. In Pennsylvania, eastern black nightshade is an increasing weed problem in soybeans (Glycine max). Yield reduction can be attributed to this weed, however the main impact is on soybean harvest. One nightshade plant can produce up to 1000 berries and in excess of 50,000 seeds. Foliage and the juice from berries can foul combine harvesters. The juice from the berries can also reduce crop quality and serve as centers for storage mold initiation. Season-long control of eastern black nightshade is difficult since emergence is sporadic and few effective soybean herbicides exist.

There are several new herbicides reported to have activity on eastern black nightshade; but little or no data on their performance are available. Herbicides used in Pennsylvania soybean fields such as alachlor and metolachlor preemergence and imazethapyr, acifluorfen, and lactofen postemergence can be effective in managing eastern black nightshade. However, increased herbicide and application costs, lack of timely weed scouting, and the increased use of several sulfonylurea herbicides have increased the eastern black nightshade problem. The objective of this research is to evaluate both new and labeled materials to determine their effectiveness.

Field and greenhouse studies examined several herbicides for control of eastern black nightshade. Field studies were conducted in Berks and Landcaster counties located in southeastern Pennsylvania. Pioneer 9392 soybeans were planted with a drill in the spring of 1995. Applications were made using a CO_2 backpack sprayer in field plots measuring 10 by 25 feet, treatments were replicated three times. Postemergence treatments were applied when eastern black nightshade was 1 to 2 inches tall. Crop phytotoxicity, visual weed control ratings, crop yield, and eastern black nightshade biomass and berry production were measured.

End of season control ratings indicate that the preemergence herbicides provided good to excellent control. The chloroacetamide herbicides including alachlor, metolachlor, dimethenamid, and FOE5043 provided 89 to 98% control. Sulfenthrazone controlled 100% of the eastern black nightshade throughout the season. Imazethapyr applied preemergence gave 93% control, while postemergence applications provided 95 to 100% control. Postemergence treatments offered a wide range of results from no control to complete control. Control with CGA248757 and flumichlorac ranged from 45 to 100%. CGA277476 and cloransulam-methyl were the least effective herbicides. Lactofen and acifluorfen were the most effective of the diphenylethers providing 82 to 100% control, while fomesafen was the least effective.

[1] Res. Tech., Senior Res. Assoc. of Weed Science and Asst. Prof. of Weed Science, respectively, Dept. of Agron., The Pennsylvania State University, University Park, PA 16802.

THE PERFORMANCE OF SCORPION* III POSTEMERGENCE IN CORN

A.E. Haack, V.B. Langston, D.M. Simpson, and B.R. Sheppard[1]

ABSTRACT

Flumetsulam is a broad spectrum broadleaf herbicide registered as a formulation blend in combination with metolachlor, or clopyralid for preplant or preemergence applications in field corn (Zea mays L.). Flumetsulam has demonstrated excellent efficacy on several key broadleaf weeds and good crop tolerance in field corn when applied postemergence. Scorpion III, which received registration in 1995, is a postemergence premix product consisting of 9.3 percent flumetsulam, 25 percent clopyralid, and 50 percent 2,4-D formulated as a water dispersible granule. This product, designated as experimental number NAF-73, was developed through extensive research conducted by DowElanco. The combination was chosen because of complementary broadleaf weed spectrum and alternative modes of action of the active ingredients.

Scorpion III provided consistent control of several key broadleaf weeds in field corn when applied postemergence at 236 g/ha with a non-ionic surfactant to weeds up to 8 inches tall. No adverse crop response was observed when applied to corn up to 8 inches tall. Scorpion III will provide growers with an effective postemergence option for weed control in corn. Unique advantages of this product include water soluble packaging, low volatility, soil residual activity, an atrazine alternative, and a weed resistance management tool.

* Trademark of DowElanco

[1]Herbicide Field Development Scientist, Herbicide Field Development Scientist, Herbicide Field Development Scientist, and Product Development Manager, DowElanco, Indianapolis, IN 46286

CLORANSULAM-METHYL PERFORMANCE IN POSTEMERGENCE APPLICATIONS IN SOYBEANS IN THE EASTERN U.S.

V. B. Langston, A. E. Haack and R. A. Dorich[1]

ABSTRACT

Cloransulam-methyl, the active ingredient in FirstRate herbicide, has been tested in field trials from 1990 to 1995 in soybeans. Performance observed during 1990 to 1994 has been reported. Results in 1995 in soybeans with cloransulam-methyl applied postemergence show performance on common cocklebur (Xanthium strumarium), velvetleaf (Abutilon theophrasti), common ragweed (Ambrosia artemisiifolia), giant ragweed (Ambrosia trifida), and annual morningglory species (Ipomoea sp.) similar to previous results. Control of broadleaves with cloransulam-methyl was good to excellent and equal to or greater than control with imazethapyr, chlorimuron, or chlorimuron + thifensulfuron. Excellent crop safety was observed with cloransulam-methyl (and other triazolopyrimidine sulfonanalide chemistry) when either soil-applied or postemergence on sulfonylurea (STS) soybeans or non-STS. STS selectivity with other triazolopyrimidine sulfonanalide molecules have been tested. All molecules tested which have the identical triazolopyrimidine ring structure as cloransulam-methyl are selective to STS.

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[1]Field Development Specialist, DowElanco, Raleigh, NC; Field Development Specialist, DowElanco, Camp Hill, PA; Product Development Manager, DowElanco, Indianapolis, IN

CLORANSULAM-METHYL PERFORMANCE IN SOIL APPLICATIONS IN SOYBEANS IN THE EASTERN U.S.

A.E. Haack, V.B. Langston, and R.A. Dorich[1]

ABSTRACT

Cloransulam-methyl, the active ingredient in FirstRate* herbicide, has been tested in field trials between 1990 and 1995 in soybeans (Glycine max). Performance observed between 1990 and 1994 has been reported. Results in 1995 in soybeans with cloransulam-methyl applied in combination with metolachlor, pendamethalin, or trifluralin in soybeans are reported. Cloransulam-methyl performance on common cocklebur (Xanthium strumarium), velvetleaf (Abutilon theophrasti), common ragweed (Ambrosia artemisiifolia), giant ragweed (Ambrosia trifida), annual morningglory species (Ipomoea sp.), common lambsquarters (Chenopodium album), and pigweed species (Amaranthus sp.) were similar to previous results. The level of control with cloransulam-methyl and other products tested decreased as application time before planting increased. Applications of cloransulam-methyl within two weeks of planting provided acceptable control of broadleaves equal to or greater than control with imazethapyr, imazaquin, or chlorimuron + metribuzin.

* Trademark of DowElanco

[1]Herbicide Field Development Scientist, Herbicide Field Development Scientist, and Product Development Manager, DowElanco, Indianapolis, IN 46286

FIRST YEAR EXPERIENCES WITH CHLORANSULAM-METHYL IN SOYBEANS

R. L. Ritter and H. Menbere*

ABSTRACT

Chloransulam-methyl (proposed tradename - Firstrate) is a new sulfonamide herbicide being developed by DowElanco. It was evaluated in 1995 for preemergence and postemergence use in soybeans [Glycine max. (L.) Merr.] for broadleaf weed control. Preemergence rates tested in 1995 were 0.032 and 0.048 lb ai/A, while the postemergence rate evaluated was 0.016 lb ai/A.

Chloransulam-methyl provided good preemergence control of common lambsquarters (Chenopodium album L.), common ragweed (Ambrosia artemisiifolia L.), and common cocklebur (Xanthium pensylvanicum Wallr.). Good postemergence activity was found on burcucumber (Sicyos angulatus L.), common cocklebur, common ragweed, giant ragweed (Ambrosia trifida L.), and spurred anoda [Anoda cristata (L.) Schlecht.]. While chloransulam-methyl provided good preemergence control of common lambsquarters, it did not have any postemergence activity on this weed.

*Assoc. Prof. and Agric. Res. Tech., Agric. Exp. Stn., Agron. Dept., Univ. of MD, College Park, MD 20742.

WEED MANAGEMENT SYSTEMS IN SOYBEANS WITH CHLORANSULAM-METHYL

J. Isgrigg III, J. W. Wilcut, and A. C. York[1]

ABSTRACT

Field experiments conducted in North Carolina evaluated chloransulam-methyl, chlorimuron, and a bentazon plus acifluorfen mixture applied alone POST, and following various PPI herbicides, for weed control, soybean (Glycine max L.) injury and yield. Options evaluated were trifluralin PPI at 952g ai/ha alone or in mixture with: flumetsulam at 70g ai/ha, chlorimuron plus metribuzin at 334g ai/ha, or imazaquin at 138g ai/ha. Postemergence options were: none, chloransulam-methyl at 17g ai/ha, bentazon plus acifluorfen at 560 plus 250g ai/ha, or chlorimuron at 13g ai/ha. Weed species evaluated were morningglory (Ipomoea spp.), prickly sida (Sida spinosa L.), common lambsquarters (Chenopodium album L.), common ragweed (Ambrosia artemisiifolia L.), and yellow nutsedge (Cyperus esculentus L.). Crop injury parameters evaluated included stunting, discoloration, and canopy closure.

The data presented is averaged across both locations. Chloransulam-methyl and chlorimuron POST, in any system, controlled Ipomoea species at least 95%. Systems that utilized only PPI herbicides did not adequately control Ipomoea species. Systems that included imazaquin, flumetsulam, or chlorimuron plus metribuzin followed by chlorimuron or chloransulam-methyl POST controlled yellow nutsedge at least 88%. Bentazon plus acifluorfen and PPI herbicides controlled yellow nutsedge 74 to 86%. All POST herbicides alone controlled yellow nutsedge at least 80%. Common lambsquarters control was 100% for all PPI plus POST systems except trifluralin followed by chlorimuron or chloransulam-methyl POST, which controlled common lambsquarters 75 and 88%, respectively. Chloransulam-methyl or bentazon on plus acifluorfen POST following any PPI treatment controlled prickly sida at least 88%, while trifluralin PPI followed by chlorimuron POST controlled 27%. Control was excellent when residual broadleaf herbicides were used followed by chlorimuron POST.

At 58 days after planting, Chloransulam-methyl POST showed 0% stunting, 9% discoloration, and 91% canopy closure. Chlorimuron POST resulted in 5% stunting, 19% discoloration, and 88% canopy closure while the bentazon plus acifluorfen POST had 4% stunting, 9% discoloration, and 89% canopy closure.

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[1] Grad. Res. Asst., Assoc. Prof., Prof., Crop Science Dept., North Carolina State University, Raleigh, NC 27695-7620

CGA-277476 FOR POSTEMERGENCE WEED CONTROL IN SOYBEANS

D. B. Vitolo, M. G. Schnappinger, T. A. Bauer, and S. W. Pruss[1]

ABSTRACT

CGA-277476 is a new sulfonylurea herbicide being developed by Ciba Crop Protection for postemergence broadleaf weed control in soybeans (*Glycine max* L.). CGA-277476 provides broadspectrum broadleaf weed control coupled with short residual activity, which allows normal northeastern crop rotations without concern for carryover injury.

Replicated field trials were conducted in New York, Maryland, Pennsylvania, Indiana, Michigan, and Ohio in 1994 and 1995 to evaluate the broadleaf weed control provided by CGA-277476 and several commercial standards (Table 1). CGA-277476 applied postemergence at 66 to 79 g ai/ha provided control of important weeds such as velvetleaf (*Abutilon theophrasti* Med.), common ragweed (*Ambrosia artimisiifolia* L.), common cocklebur (*Xanthium strumarium* L.), pigweeds (*Amaranthus* spp.), and morningglories (*Ipomoea* spp.), and supression of common lambsquarters (*Chenopodium album* L.).

The tank-mix combination of CGA-277476 plus CGA-248757, a second new postemergence herbicide under development by Ciba, applied at rates of 66 to 79 plus 4 g ai/ha, respectively, increased control of several weeds over the control provided by CGA-277476 alone. Control compared favorably with that provided by imazethapyr plus flumiclorac (70 plus 30 g ai/ha) (Table 2).

Rotational studies were conducted with CGA-2477476 at exaggerated rates in 1993-1995 to determine the potential for carryover to rotational crops, including alfalfa (*Medicago sativa* L.), sunflowers (*Helianthus annuus* L.), sugar beets (*Beta vulgaris* L.), sorghum (*Sorghum bicolor* L. Moench.), and tobacco (*Nicotiana tobaccum* L.). Little or no carryover injury with CGA-277476 was observed at rates up to 200 g ai/ha.

[1] Senior Research Specialist, Senior Scientist, Senior Research Representative, and Regional Manager, respectively, Ciba Crop Protection, Washington, PA 15301.

TABLE 1. Effect of Postemergence Herbicides on Broadleaf Weed Control, 1994.

Herbicide, rate (g ai/ha)	% Control, Weed (# Trials)			
	(3) ABUTH	(2) AMBEL	(2) CHEAL	(1) DATST
CGA-277476 79g	96	95	80	93
Imazethapyr 70g	94	77	70	100
Chlorimuron 13g	83	88	53	100

Evaluated 48 to 74 days after application. Metolachlor applied preemergence in all trials.

TABLE 2. Effect of Postemergence CGA-277476 plus CGA-248757 on Broadleaf Weed Control, 1994.

Herbicide, Rate (g ai/ha)	% Control, Weed (# Trials)				
	(3) ABUTH	(2) IPOHE	(2) XANST	(1) DATST	(3) CHEAL
CGA-277476 66g	87	92	94	72	72
CGA-277476 79g	89	89	95	80	77
CGA-277476 66g + CGA-248757 4g	96	93	94	80	81
CGA-277476 79g + CGA-248757 4g	98	91	94	100	80
Imazethapyr 70g + Flumiclorac 30g	88	91	95	100	68

Evaluated 11 to 68 days after application.

EVALUATION OF BRUSH CONTROL PROVIDED BY DICAMBA WITH LOW VOLUME APPLICATIONS

Jon M. Johnson, Chad W. Spackman, Arthur E. Gover, and Larry J. Kuhns[1/]

ABSTRACT

As part of a research project funded by the Pennsylvania Department of Transportation, a study evaluating brush control provided by the diglycol amine salt of dicamba alone and in combination with other herbicides was established within a recently clear cut area near State College, PA on September 8, 1994. Dicamba was applied alone at rates of 1.0, 1.25, 1.5, and 2.0 lb/a; in combination with triclopyr, imazapyr, and glyphosate; and compared to glyphosate plus imazapyr and fosamine ammonium plus imazapyr (Table 1). The plots were 20 by 100 ft, arranged in a randomized complete block with two replications. A CO_2-powered backpack sprayer equipped with a handgun and a Spraying Systems #5500 Adjustable ConeJet with a Y-2 tip operating at 20 psi was used to approximate an application volume of 15 gal/a. All spray treatments included a surfactant[2/] and a drift control agent[3/] at 0.125 and 0.5 percent v/v, respectively. Each plot contained several tree species in the 3 to 10 ft height range. The predominant species were red maple (*Acer rubrum* L.), black cherry (*Prunus serotina* Ehrh.), quaking aspen (*Populus tremuloides* Michx.), mockernut hickory (*Carya tomentosa* L.), white oak (*Quercus alba* L.), red oak (*Quercus rubra* L.), and green ash (*Fraxinus pennsylvanica* Marsh.). Visual ratings of foliar necrosis were taken September 22, 14 days after treatment (DAT). Visual ratings of percent canopy reduction were taken August 24, 1995 (350 DAT). Canopy reduction results are reported in Table 1.

The treatments causing the most foliar necrosis 14 DAT were 1.5 lb/a dicamba plus 0.38 lb/a imazapyr; both dicamba plus glyphosate treatments; and the glyphosate plus imazapyr. The treatments providing the best canopy reduction 350 DAT were the glyphosate plus imazapyr at 97 percent; 1.5 lb/a dicamba plus 0.38 lb/a imazapyr at 97 percent; and 2 lb/a dicamba plus 0.25 lb/a imazapyr at 89 percent. Fosamine plus imazapyr provided an average of only 79 percent canopy reduction, due primarily to poor control of quaking aspen. Dicamba plus glyphosate provided an average of 82 percent canopy reduction, including total control of cherry but poor control of ash. Dicamba alone did not provide satisfactory results at any rate.

The two dicamba plus imazapyr combinations evaluated in this trial provided control similar to glyphosate plus imazapyr, but used higher rates of imazapyr. Due to the soil activity of imazapyr, combinations with dicamba using lower rates of imazapyr need to be evaluated if this combination is to be regularly used on rights-of-way.

1/ Project Assistant, Research Technologist, Project Associate, and Professor of Ornamental Horticulture, respectively, The Pennsylvania State University, University Park, PA 16802

2/ Qwik-Wet, Exacto Chemical Co., Richmond, IL.

3/ Formula 358, Exacto Chemical Co., Richmond, IL.

TABLE 1: Visual ratings of canopy reduction of various brush species taken August 24, 1995. Treatments were applied September 8, 1994. Each rating value is the mean of two replications and the number in parentheses indicates the total treated stems for both replications. A '- -' indicates the species was not present in the treatment area.

		Canopy Reduction Ratings							
Herbicide	Application Rate (lb ai/a)	Maple (%)	Cherry (%)	Populus (%)	Hickory (%)	Oak (%)	Ash (%)	Other (%)	Average Total (%)
dicamba	2.00	86(9)	39 (17)	40 (5)	- -	40(2)	52 (16)	- -	53 (49)
dicamba	1.50	30(4)	13 (9)	49 (29)	8 (2)	76(10)	72 (11)	5(1)	36 (66)
dicamba	1.25	63(16)	44 (8)	39 (21)	5 (2)	63(17)	55 (13)	10(1)	41 (78)
dicamba	1.00	49(9)	33 (8)	46 (6)	25 (2)	72(9)	44 (20)	5(1)	42 (55)
dicamba triclopyr	2.00 0.75	83(7)	57 (17)	50 (19)	38 (5)	100(4)	89 (12)	- -	68 (64)
dicamba imazapyr	2.00 0.25	100(10)	89 (12)	71 (19)	60 (2)	98 (3)	97 (31)	100(1)	89 (78)
dicamba imazapyr	1.50 0.38	100(6)	94 (16)	94 (12)	100 (1)	100(1)	97 (24)	- -	97 (60)
dicamba glyphosate	2.00 1.50	57(10)	88 (11)	72 (9)	90 (2)	83 (3)	70 (21)	- -	75 (56)
dicamba glyphosate	1.50 1.50	82 (5)	100 (8)	85 (39)	- -	78 (2)	66 (16)	- -	82 (70)
fosamine imazapyr	3.00 0.15	100(10)	71 (19)	47 (20)	- -	- -	100(33)	- -	79 (82)
glyphosate imazapyr	3.00 0.15	100(8)	100 (7)	100(37)	98 (2)	87 (4)	98 (20)	- -	97 (78)
untreated	- - -	23(16)	6 (22)	7 (24)	6 (4)	5(10)	15 (33)	- -	11(109)
Significance Level (p)		0.003	0.0008	0.0003	0.0009	0.001	0.0005	- -	0.0001
LSD (p=0.05)		34	37	25	18	30	25	- -	12

EVALUATION OF WILDFLOWER ESTABLISHMENT IN TALL FESCUE SUPPRESSED WITH HERBICIDES

Chad W. Spackman, Jon M. Johnson, and Larry J. Kuhns[1/]

ABSTRACT

Wildflower stands in Pennsylvania have rarely performed well when established and left to grow for more than one year. As part of a cooperative project between the Pennsylvania State University and the Pennsylvania Department of Transportation, a study was initiated to establish annual wildflowers in tall fescue (*Festuca arundinacea* Schreb.) which was suppressed with non-selective, postemergence herbicides. The objective was to establish an annual wildflower planting in the spring which could be mowed in the fall, leaving a stand of tall fescue groundcover. Treatments included 0.75 and 1.5 lb ai/ac glufosinate-ammonium, 4 gal/ac Scythe[2/], 0.75 lb ai/ac glyphosate, 0.75 lb ai/ac diquat, and an untreated check. The treatments of glyphosate and diquat contained a surfactant[3/] at 0.125% v/v and all treatments contained a drift control agent at 0.25% v/v[4/]. Treatments were applied to 6 by 15 ft plots at Penn State's Landscape Management Research Center on April 18, 1995, using a CO_2-powered hand held sprayer equipped with Spraying Systems XR 8004 VS spray tips, delivering 40 GPA at 30 psi. On April 25, 1995, 7 days after treatment (DAT), the untreated check was mowed to 1.25 in, the entire study area was grooved two times to a depth of 0.25 in with a soil slicer, and all plots were seeded with wildflowers at 12 lbs/ac using a shaker jar. The annual wildflower mix contained cosmos (*Cosmos bipinnatus*), corn poppy (*Papaver rhoeas*), cornflower (*Centaurea cyanus*), tall plains coreopsis (*Coreopsis tinctoria*), sweet alyssum (*Dianthus barbatus*), and rocket larkspur (*Delphinium ajacis*). The wildflowers were mowed in October leaving a complete understory of tall fescue. Visual ground cover ratings of tall fescue were taken April 19, 1 DAT; July 12, 85 DAT; and September 18, 153 DAT; and green cover ratings of tall fescue were made April 25, 7 DAT; and May 19, 31 DAT. Visual ratings of groundcover and average canopy heights of the wildflowers were taken July 12 and September 18, 1995. Results of the tall fescue ratings are reported in Table 1a and wildflower ratings in Table 1b.

All plots initially contained 100 percent tall fescue cover with little or no weed pressure. There was little change in the grass cover or weed pressure at the end of the study in September. The green cover rating taken 7 DAT showed no or little discoloration in the untreated check or glyphosate plots. The most discoloration was provided by glufosinate-ammonium at 1.5 lb ai/ac with only 25 percent green cover remaining within the plot. The green cover rating 31 DAT showed all of the treated plots were recovering, except glyphosate which had 53 percent cover. The rating of wildflower cover on July 12 showed wildflowers germinating in all plots, with glyphosate-treated plots having 80 percent cover and the mowed check having 27 percent cover. The cover of wildflowers rated September 18 shows the glyphosate-treated plots with 63 percent cover and the mowed check with 25 percent. It is believed the decline in cover of wildflowers from July to September was due to a severe drought experienced during July, August, and September. A germination test of the wildflower seed mix was conducted indoors in April and all species germinated. The only wildflowers which germinated within the plots were cosmos, cornflower, and tall plains coreopsis.

The only treatment to provide an acceptable stand of wildflowers within the tall fescue, was glyphosate at 0.75 lb ai/ac. A possible disadvantage to this treatment however, would be that an over application could permanently destroy the established turf. This method of wildflower establishment could be very beneficial in reducing weed invasion into areas planted with wildflowers, while reducing turf reseeding costs.

1/ Research Technologist, Project Assistant, and Professor of Ornamental Horticulture, respectively, The Pennsylvania State University, University Park, PA.

2/ Scythe, 57% pelargonic acid, Mycogen Corp., San Diego, CA.

3/ QwikWet 357, Exacto Chemical Co., Richmond, IL.

4/ Formula 358, Exacto Chemical Co., Richmond, IL.

TABLE 1a: Visual ground cover ratings of tall fescue taken April 19, July 12, and September 18, 1995, and visual green cover ratings of tall fescue taken April 25 and May 19, 1995. Herbicide treatments were applied on April 18, 1995. Each value is the mean of three replications.

Herbicide[1/]	Application Rate	Ground Cover			Green Cover	
		Apr 19	Jul 12	Sep 18	Apr 25	May 19
	(ai/ac)	(----------%	----------)		(-------%	-------)
glufosinate-ammonium	0.75 lbs	100	96	100	42	94
glufosinate-ammonium	1.5 lbs	100	94	100	25	80
Scythe[2/]	4 gal	100	95	100	42	94
glyphosate[3/]	0.75 lbs	100	95	100	96	53
diquat[3/]	0.75 lbs	100	93	100	37	93
mowed check	- -	100	97	100	99	97
Significance Level (p)		- -	0.7	0.5	0.0001	0.0001
LSD (p=0.05)		- -	n.s.	n.s.	15	7

TABLE 1b: Visual ground cover ratings and average canopy heights of wildflowers taken July 12 and September 18, 1995. Herbicide treatments were applied on April 18, 1995, and the wildflowers were seeded at 12 lbs/ac on April 25, 1995. Each value is the mean of three replications.

Herbicide[1/]	Application Rate	Ground Cover		Avg. Height	
		Jul 12	Sep 18	Jul 12	Sep 18
	(ai/ac)	(--------%	----------)	(-------- in	---------)
glufosinate-ammonium	0.75 lbs	30	11	9	13
glufosinate-ammonium	1.5 lbs	30	15	9	12
Scythe[2/]	4 gal	33	16	9	11
glyphosate[3/]	0.75 lbs	80	63	18	22
diquat[3/]	0.75 lbs	53	46	10	16
mowed check	- -	27	25	8	15
Significance Level (p)		0.005	0.001	0.0002	0.01
LSD (p=0.05)		25	21	3	5

1/ All treatments contained Formula 358 (Exacto Chemical Co.) @ 0.25% (v/v).
2/ Application rate was 4 gal product/ac. Scythe, 57% pelargonic acid, Mycogen Corp.
3/ Contained QwikWet 357 (Exacto Chemical Co.) @ 0.125% (v/v).

PIN CHERRY EFFECTS ON ALLEGHENY HARDWOOD STAND DEVELOPMENT I. SHORT-TERM IMPACTS

Stephen B. Horsley and Todd E. Ristau[1]

ABSTRACT

Herbivory by white-tailed deer (*Odocoileus virginianus virginianus* (Boddaert)) is an important factor affecting commercial forest regeneration in Pennsylvania. The role of deer in the regeneration process is dependent upon their density. For example, a recent study at our laboratory showed that at deer densities <20 animals/mi^2, clearcut stands were dominated by pin cherry (*Prunus pensylvanica* L.) 10 years after cutting; at deer densities >20 animals/mi^2, clearcuts were dominated by black cherry (*Prunus serotina* Ehrh.). Both species were present as seedlings early in the life of all stands. At high deer density, pin cherry were eaten by deer; at low deer density, large numbers of pin cherry were not consumed and rapidly grew taller than other species. High densities of pin cherry resulted in failure of associated species to survive; at low pin cherry density other species survived and grew. In the current work, we have determined the threshold pin cherry densities above which regeneration of associated species falls below accepted stocking criteria by age 15. We collected data on milacre (3, 5, 10 years) and 0.025 acre (15 years) plots at 8 sites maintained at 10 or 20 deer/mi^2 after clearcutting. In addition to pin cherry, the data set contained large numbers of black cherry (shade intolerant) and birch (*Betula lenta* L., *Betula alleghaniensis* Brit.) (intermediate shade tolerance) and smaller amounts of other northern hardwood species. In our analyses we predicted the effect of pin cherry at age 3 on numbers of desirable (mostly black cherry) or commercial (mostly black cherry and birch) stems that were >0.5 in dbh at age 15. Stocking requirements for Allegheny hardwoods are based on 6 ft radius regeneration plots and require that 70% of them have at least 2 stems >0.5 in dbh to be satisfactorily stocked at this age.

Pin cherry stems <3 ft tall at age 3 were of little value in predicting the number of desirable or commercial stems later in the life of the stand; stems >5 ft tall had the highest predictive value (R^2=0.496). If stem origin (seedling or stump sprout) was not considered, we found that when there were >18 pin cherry on a 6 ft radius sample plot at age 3, stocking of that plot fell below 2 desirable stems >0.5 in dbh at age 15. The comparable number for commercial species was >100 pin cherry. Evaluation of the effect of pin cherry on seedling vs stump sprout origin stems showed that survival of stump sprout origin stems of either desirable or commercial species was unaffected by pin cherry density. These stems typically grew rapidly after clearcutting so that pin cherry did not gain a height advantage over them. Predictions of the effect of pin cherry on survival of desirable and commercial stems of seedling origin showed that when there were >3 pin cherry on a 6 ft radius sample plot at age 3, stocking of that plot fell below 2 desirable stems >0.5 in dbh at age 15. The comparable number for commercial stems of seedling origin was >50 pin cherry. Difference in the ability of desirable and commercial stems of seedling origin to withstand pin cherry interference seems to reside in the fact that the birches have greater shade tolerance than black cherry.

Treatments to remove pin cherry interference seem warranted when the predicted proportion of plots stocked with desirable stems at age 15 falls below 70%. Selection of the >3 or >18 pin cherry threshold for individual plot stocking depends on whether seedling origin stems are present or desired.

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

PIN CHERRY EFFECTS ON ALLEGHENY HARDWOOD STAND DEVELOPMENT II. LONG-TERM IMPACTS

Todd E. Ristau and Stephen B. Horsley[1]

ABSTRACT

The density of pin cherry (*Prunus pensylvanica* L.) early in the life of a stand can have important effects on species composition, growth, and yield later in the life of the stand. It becomes the dominant species in Allegheny hardwood stands for 25 to 40 years after clearcutting when deer density is < 20 animals/mi^2. When pin cherry stems exceed threshold densities early in the life of the stand (e.g., age 3) they reduce survival of seedling-origin stems of associated species. For example, we determined that when the number of pin cherry > 5 feet tall on a 6-foot-radius regeneration plot is > 3 at age 3, the number of desirable stems of seedling origin (mostly black cherry (*Prunus serotina* Ehrh.)) on the plot will fall below the required stocking criteria (two stems > 0.5 inch dbh) at age 15. The comparable threshold for commercial stems (mostly black cherry and birch (*Betula lenta* L., *Betula alleghaniensis* Brit.) is > 50 pin cherry. Stems of stump-sprout origin are little affected by pin cherry density because they grow rapidly after clearcutting so that pin cherry does not gain a height advantage over them.

The goal of the current work was to determine the effect of high versus low density of pin cherry early in the life of Allegheny hardwood stands on yield when the stands approach maturity. To test this hypothesis, we used data from a study established in 1936 on the Kane Experimental Forest in Elk County, Pennsylvania. The original study had four blocks, each containing 18 treatment plots; 6 of these plots received no treatment. Each plot was 0.1 acre in size; at each tally, 100-percent inventories by species and 1-inch diameter class were made. We used the six untreated plots from each of two original blocks: one block developed under high pin cherry density (1,630 to 3,600 stems/acre, average: 2,268 stems/acre at age 13) and one developed under low density (50 to 500 stems/acre, average: 183 stems/acre at age 13). Both blocks were clearcut in 1923. Documented deer density was < 20 animals/mi^2, so deer impact on regeneration was low. An evaluation in 1932 showed that both blocks contained many stems of seedling origin; there were more stems of stump-sprout origin in the high than the low pin cherry block. We calculated board-foot volume on both blocks using data collected in 1993, 70 years after clearcutting, to evaluate the influence of pin cherry density on yield.

The low pin cherry block averaged 11,037 board feet compared with 6,900 board feet on the high pin cherry block 70 years after clearcutting ($P = 0.050$). Merchantable mean stand diameter also was higher on the low (13.2 inches) than the high (11.6 inches) block ($P = 0.044$). In 1993, most of the surviving stems were of stump-sprout origin on the high pin cherry block, whereas there was a mixture of seedling and stump-sprout origin stems on the low block. The most important effect of pin cherry seems to have been the elimination of seedling-origin stems on the high pin cherry block early in the life of the stand. The lack of seedling-origin stems resulted in the reliance of stump-sprout origin stems to fully use stand growing space. Better stem distribution and consequent utilization of growing space in the low pin cherry block, where a mixture of seedling and stump-sprout origin stems were present, resulted in higher ultimate yield. These results support the finding that pin cherry should be treated early in the life of the stand when their numbers exceed threshold densities for survival of seedling-origin stems.

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

BURIED SEED VIABILITY AND GERMINATION REQUIREMENTS FOR MILE-A-MINUTE (*POLYGONUM PERFOLIATUM* L.)

C. Fagan Johnson and Larry H. McCormick[1]

ABSTRACT

Mile-a-minute, Polygonum perfoliatum L., is an introduced noxious weed from eastern Asia that is rapidly colonizing non-crop areas in Pennsylvania and surrounding states. Mile-a-minute is an aggressive annual vine capable of overtopping and dominating plant communities (<3m in height) growing along roadsides, edges of woods, forest clearcuts, utility rights-of-ways and stream banks. Since very little is known about the reproductive biology of mile-a-minute, seed germination trials and a buried seed study were conducted. The germination trials tested the effects of acid scarification, length of cold, wet treatment (2°C, 3-18 wks), and germination temperature (5, 10, 15, and 20°C) on seed germination. In the buried seed study, seeds were buried at four depths (1, 3, 6, and 10 cm) in a conifer plantation and in a grassy, open field with seed retrievals at 6, 12, and 17 months. Preliminary results of the germination trials suggest that: mile-a-minute seeds have a positive response to scarification; require a cold, wet treatment for germination (2°C, a minimum of 6 wks for scarified seeds, and a minimum of 9 wks for unscarified seed); show a maximum of at least 98% germination (9-18 wks scarified, and 15-18 wks unscarified) over a wide range of temperatures (5-20°C); optimum temperature for germination is 10-15°C. Preliminary results of the seed burial study suggest that: a majority of seeds remain sound and viable after 17 months in the soil (63-100%); forest cover types retain more sound seed over time (96-100%) than do open field cover types (63-92%); seeds are more likely to remain sound and viable the deeper they are buried (1-10 cm); seeds are only able to germinate in the spring season (6 and 17 months replicates), and germination percent increases as burial time increases.

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[1] Graduate Student and Professor, respectively, School of Forest Resources, The Pennsylvania State University, University Park, PA 16802.

EVALUATION OF SPRING-APPLIED HERBICIDE TREATMENTS FOR THE CONTROL OF SAKHALIN KNOTWEED

A.E. Gover, S.D.Guiser, C.W. Spackman, J.M.Johnson, and L.J. Kuhns[1/]

ABSTRACT

Sakhalin knotweed (*Polygonum sachalinense* F.Schmidt ex Maxim) and Japanese knotweed (*Polygonum cuspidatum* Sieb & Zucc.) are becoming an increasing problem along Pennsylvania's roadways. These very similar species are characterized by few-branched stems with hollow internodes, growing in dense colonies to heights of 10 ft. As part of an ongoing research project funded by the Pennsylvania Department of Transportation, a trial was established to screen a variety of herbicide combinations with limited soil residual activity. The study area was located near Doylestown, PA, on the shoulder of SR 611, in a Sakhalin knotweed patch approaching 0.5 acres. Treatments were applied May 10, 1994, to 6 by 40 ft plots with a CO_2-powered, hand held sprayer delivering 20 gal/ac at 29 psi, using Spraying Systems 8002 flat fan spray tips. The experimental design was a randomized complete block with three replications. Treatments (Table 1) included an untreated check, and combinations of clopyralid, dicamba, glyphosate, imazapyr, metsulfuron methyl, and triclopyr. All herbicide treatments contained a surfactant at 0.12 percent v/v[2/]. At the time of application, the knotweed ranged in size from 4 to 6.5 ft. Percent defoliation was rated June 10, and percent control of the treated stems was rated August 3 and October 11. The number of resprouts within each plot were counted August 3, and percent ground cover from resprouts was rated October 11, and May 26, 1995. Results are reported in Table 1.

All herbicide treatments provided greater than 90 percent defoliation at the June 10 rating, except for clopyralid plus imazapyr, clopyralid plus metsulfuron methyl, and imazapyr plus metsulfuron methyl. August 3 control ratings were lower for some treatments than the June 10 defoliation ratings because many of the treated stems resprouted from lower leaf axils. Five treatments were rated at greater than 90 percent control: dicamba plus clopyralid, dicamba plus imazapyr, glyphosate plus metsulfuron methyl, glyphosate plus imazapyr, and clopyralid plus metsulfuron methyl. Of these five, only glyphosate plus imazapyr had significantly more resprouts than the untreated check. On October 11, the best rated treatment was dicamba plus clopyralid, which provided complete control of treated stems and 4 percent ground cover from resprouts. Other treatments that provided at least 90 percent control of treated stems and 10 percent or less ground cover from resprouts included glyphosate plus imazapyr, glyphosate plus metsulfuron methyl, clopyralid plus imazapyr, clopyralid plus metsulfuron methyl, and imazapyr plus metsulfuron methyl. The untreated check plots contained 4 percent groundcover from resprouts. Resprouts ranged in height from 1 to 4 ft at this rating period. On the final rating of resprout cover, taken May 26, 1995, the only treatment not significantly different from the untreated check was triclopyr plus imazapyr, at 80 percent cover. The best rated treatment was dicamba plus clopyralid, at 8 percent. Treatments that were not significantly different from the best treatment ranged up to 25 percent resprout cover, and included glyphosate plus imazapyr, glyphosate plus metsulfuron methyl, dicamba plus imazapyr, glyphosate plus clopyralid, and clopyralid plus imazapyr.

The positive results provided by dicamba plus clopyralid and glyphosate plus clopyralid are very encouraging, as both combinations would have minimal soil residual activity, and would allow the seeding of desirable vegetation soon after treatment. Future research will focus on trying to maintain or improve efficacy of these treatments, while trying to reduce cost by increasing clopyralid rates within the mix, and possibly reducing dicamba and glyphosate rates.

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

[2/] Quik-Wet, Exacto Chemical Company, Richmond, IL.

TABLE 1: Summary of treated-stem control and resprout growth of Sakhalin knotweed treated May 10, 1994. A visual rating of percent defoliation was taken June 10, 1994. Visual ratings of percent control of the treated stems were taken August 3 and October 11, 1994. Number of resprouts were counted in each plot August 3, 1994, and percent cover of the resprouts was visually rated October 11, 1994, and May 26, 1995. Each value is the mean of three replications.

		Jun 10, 1994	Aug 3, 1994		Oct 11, 1994		May 26, 1995
Treatment	Application Rate	Defoliation	Control	Resprouts	Control	Resprout Cover	Resprout Cover
	(lb ai/ac)	(%)	(%)	(#/240 ft^2)	(%)	(%)	(%)
glyphosate	4	90	63	20	82	38	40
glyphosate + imazapyr	4 0.12	94	97	24	100	10	17
glyphosate + metsulfuron	4 0.038	96	99	10	98	5	18
glyphosate + clopyralid	4 0.19	95	81	16	95	13	23
triclopyr + metsulfuron	2.2 0.038	96	77	15	90	75	70
triclopyr + imazapyr	2.2 0.12	92	79	22	93	58	80
dicamba + imazapyr	3 0.12	99	100	10	100	20	21
triclopyr + clopyralid	2.2 0.19	94	63	19	93	47	72
dicamba + clopyralid	3 0.19	99	100	6	100	4	8
clopyralid + imazapyr	0.19 0.12	40	88	16	95	5	25
clopyralid + metsulfuron	0.19 0.038	43	94	12	98	5	43
imazapyr + metsulfuron	0.12 0.038	37	85	12	93	9	58
untreated check	- -	0	0	9	0	4	100
Significance Level (p)		0.0001	0.0001	0.0045	0.0001	0.0001	0.0001
LSD (p=0.05)		13	31	8	6	28	24

GROWTH SUPPRESSION OF KENTUCKY BLUEGRASS AND PERENNIAL RYEGRASS

T. L. Watschke and J. A. Borger, C. R. Shearer[1]

ABSTRACT

Two studies with identical treatments were conducted in 1995 (one on Kentucky bluegrass, Poa pratensis L., and one on perennial ryegrass, Lolium perenne L.). The objective of the study was to compare the growth suppression of each species throughout the growing season when treated with sequential applications of trinexapac-ethyl (three formulations) and paclobutrazol. The turf was mowed at 2 1/2 inches and received 0.5 lbs N/1000 ft^2 from urea one day prior to the first application. Growth regulator applications were made on May 3, June 13, August 23, and September 26. Sprayed treatments were made using a CO_2 powered hand-held boom sprayer with 6504 nozzles at 30 psi calibrated to deliver 40 gpa. Granular materials were applied using a shaker jar. Treatments not formulated on fertilizer received equivalent nitrogen fertilizer from Coron except the trinexapac-ethyl on corn cob and a nonfertilized check was also included. Turfgrass color and fresh foliar yield were assessed weekly throughout the season.

No significant color loss was noted on Kentucky bluegrass until the May 23 rating rate. On that date all trinexapac-ethyl treated turf had better color than untreated turf or that treated with paclobutrazol. On May 29 no significant clipping weight differences were found from any treatment, but by May 19, all turf treated with trinexapac-ethyl had significantly less clippings than untreated turf or that treated with paclobutrazol. The Kentucky bluegrass treated turf was not different in color from untreated turf again until June 12. On June 12, turf treated with trinexapac-ethyl had better color than the untreated turf while turf treated with paclobutrazol had significantly poorer color than untreated turf. Clipping weights on May 30 and June 5 were lower for turf treated with trinexapac-ethyl, but by June 12 turf treated with trinexapac-ethyl formulated as a 0.3 G (corn cob with and without fertilizer) did not have less clippings than untreated turf while turf treated with the 0.4G formulations had lower clipping weights. Also on June 12, turf treated with paclobutrazol had significantly lower clippings weights than untreated turf for the first time during the year. The second application of treatment was made on June 13. From June 26 until September 4 turf treated with paclobutrazol had significant poorer color than nontreated turf. During this same time period non of the turf treated with trinexapec-ethyl had poorer color ratings than untreated turf. Turf treated with paclobutrazol had significantly lower clippings weights than untreated turf from June 20 until August 22. The third application of PGR's for the year occurred on August 23 and by September 4, paclobutrazol treated turf again had significant lower clipping weights than the untreated turf. Turf sprayed with trinexapac-ethyl had significantly lower clipping weights than untreated turf until July 25 while granular applications did not significantly suppress that long (some lasted until July 10, others July 17). After the third application, paclobutrazol had significantly less clipping weight than untreated turf for the balance of the year. Also, on most dates color was significantly poorer than the untreated turf. Turf treated with trinexapac-ethyl followed a trend similar in growth reduction as paclobutrazol, but without loss of quality due to reduced color.

Responses of perennial ryegrass to applied growth regulators were similar to Kentucky bluegrass with the following exceptions; color loss from paclobutrazol was not as severe or long lasting, but growth suppression was not as great, disease (red thread) was more persistent on turf treated with growth regulators, but fertilizer addition reduced persistence trinexapac-ethyl treated turf had reduced color on only one day during the season.

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[1] Professor and Research Assistants, respectively, Department of Agronomy, Penn State University, University Park, PA, 16802

SEEDHEAD SUPPRESSION OF TALL FESCUE AND ANNUAL BLUEGRASS

T. L. Watschke and J. A. Borger, C. R. Shearer, and C. Heyl[1]

ABSTRACT

Two studies were conducted in 1995 with the objective of evaluating growth regulators for their efficacy for seedhead suppression. One of the studies was conducted as an evaluation of materials for their capability to suppress seedheads on low maintenance tall fescue (Festuca arundinacea L.) (roadside-type turf). The treatments in this study were applied on May 1, 1995 using a CO_2 powered hand-held boom sprayer with 6504 nozzles at 30 psi calibrated to deliver 40 gpa. No seedheads were visible on the tall fescue at the time of application. The turf was not mowed throughout the course of the study and no fertilizer or irrigation were provided. Seedhead suppression was rated on June 19, 1995, (seven weeks after treatment). A commercial acceptance level for seedhead suppression was considered to be 75%. Mefluidide alone at 8.8 ozs. product/A, EH1094 at 5.4 and 6.5 ozs. product/A and mefluidide at 8.8 ozs. product/A plus a combination of imazaquin and imazethapyr (Event) at 2.2 ozs. product/A provided acceptable seedhead suppression. The advantage of the mefluidide plus Event would be the potential weed control that might be realized from the Event.

The other study was conducted to assess mefluidide, the wetting agents Surfside 199 and 37, mefluidide plus Ferromec, and mefluidide plus 37 for seedhead suppression of annual bluegrass (Poa annua) on a golf course putting green. The wetting agents were also assessed for seedhead suppression when a sequential treatment was made at a 10 day interval.

The study was initiated on April 20, 1995, on a golf green at the six hole Nittany Course on the campus of Penn State University. Matierials were applied using a CO_2 powered hand-held boom sprayer with 8004 nozzles at 30 psi calibrated to deliver 80 gpa. Sequential treatments of selected wetting agents were made on May 1, 1995. After 24 hours, the green was irrigated with approximately 0.5 inches of water. Injury (discoloration) was rated on April 27 and May 26. On April 27, mefluidide alone at 4.4 ozs. product/A and mefluidide at the same rate but combined with 37 at 218 ozs. product/A caused unacceptable discoloration. Mefluidide at 4.4 ozs product/A plus Ferromec at 218 ozs product/A and all wetting agent applications did not cause unacceptable injury. By the May 26 rating, the mefluidide and mefluidide plus 37 treated turf had enhanced quality (primarily darker green color) while all other turf in the study was not different from the untreated check. Seedhead suppression was rated on May 8 and May 26. On May 8, mefluidide, mefluidide plus Ferromec, and mefluidide plus 37 had 95, 95, and 90% seedhead suppression respectively. Seedhead suppression resulting from applications of wetting agents or combinations thereof varied from 33 to 77% with the combination of 199 and 37 at 218 and 131 ozs product/A respectively providing the most seedhead suppression. However, by May 26 no seedhead suppression was found for any wetting agent, combination thereof, or sequential application while mefluidide, mefluidide plus Ferromec, and mefluidide plus 37 all maintained a high level of seedhead suppression

[1] Professor and Research Assistants, respectively, Department of Agronomy, Penn State University, University Park, PA, 16802

TURF RENOVATION WITH GROWTH REGULATORS AND OVERSEEDING

T. L. Watschke and J. A. Borger[1]

ABSTRACT

A study was conducted on a mixed cool season home lawn-type turf that did not contain any perennial ryegrass (Lolium perenne L.). The turf was maintained by rotary mowing at 2.5 inches weekly and on September 13, 1994 it was verticut in two directions and broadcast overseeded with a perennial ryegrass blend at a rate of 4 lbs/1000 ft^2. On September 15, 1994, three rates of trinexapac-ethyl (0.5, 0.75, and 1.0 oz/1000 ft^2) were applied and glufosinate was applied at 2 lbs ai/A. Treatments were in a randomized complete block design with three replications. Applications were made using a CO_2 powered hand-held boom sprayer with 6504 nozzles at 30 psi calibrated to deliver 40 gpa. Two inch plugs were taken from each plot on December 20, 1994 and planted in a greenhouse where plant counts were made on January 18, 1995. On September 8, 1995 usual ratings were made to assess conversion of the plots to perennial ryegrass.

Plant counts made on January 18, 1995 were converted to percentage of plants present in each plug. Applications of trinexapac-ethyl at all three rates allowed for perennial ryegrass to become established ranging from 55 to 68%. Application of glufosinate resulted in a 96% perennial ryegrass stand. Usual estimates made on September 8, 1995, showed a range of perennial ryegrass establishment into trinexapac-ethyl treated turf from 52 to 68% (almost exactly that found for the actual plant counts taken in the greenhouse the previous January). For glufosinate treated turf it was estimated that perennial ryegrass comprised 95% of the turf (the same as was found for plant counts in January).

It appears that perennial ryegrass can be successfully introduced (amounting to greater than 50% of the turf) by suppressing the existing stand with trinexepac-ethyl after overseeding. Clearly, applying glufosinate allows for a more complete conversion, but causes significant and unsightly discoloration of the turf in the process. Application of trinexapac-ethyl did not cause discoloration at the rates used in this study.

[1] Professor and Research Assistants, respectively, Department of Agronomy, Penn State University, University Park, PA, 16802

LOW VOLUME TURF APPLICATIONS WITH THE THINVERT® SYSTEM SECOND YEAR EVALUATIONS

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

ABSTRACT

The application of insecticides, herbicides, and turf growth regulators to fine turf areas can be accomplished effectively with mechanized application equipment. Low volume sprays would permit the use of backpack sprayers or light weight, maneuverable sprayers if spray drift could be controlled and efficacy of the treatments maintained. Application of these turf sprays with the small uniform droplets produced by the combination of a thin invert emulsion (Thinvert) and a new nozzle design offer the potential for improving the efficacy of turf pesticides, reducing spray drift, and increasing productivity. Two trials were conducted in 1994 to compare efficacy of plant growth regulators and herbicides applied by conventional flat fan nozzles at normal spray volume, low volume sprays applied with the Thinvert #73031 nozzle using water as a diluent, and with the #73031 nozzle and a thin invert as the spray carrier. During the 1995 growing season, trials were conducted to determine the efficacy of trinexapac-ethyl applied as a plant growth regulator to control the height growth and suppress seedhead production of several cool season turf grasses when applied in THINVERT at a spray volume of four gal/A.

A broadleaf weed control trial using triclopyr[3] at .5 lb/A and triclopyr + clopyralid[3] at .5 + .25 lb/A was applied comparing application with conventional flat fan nozzles at 20 gal/A, a Thinvert #73031 nozzle with water as a diluent at four gal/A, and a #73031 nozzle using a thin invert as a diluent at four gal/A. Applications were made to a mixed bluegrass (Poa pratensis L.), red fescue (Festuca rubra L.), and tall fescue (Festuca arundinacea Schreb.), turf at Bucks County Airport on 10/2/94. Major weed populations present included: dandelion (Taraxacum officinali Weber), buckhorn plantain (Plantago lanceolata L.), hawkweed (Hieracium pratense Tausch), common blue violet (Viola papilionacea Pursh.), cinquefoil (Potentilla simplex L.), white clover (Trifolium repens L.), and yarrow (Achillea millefolium L.). Evaluation 25 DAT showed that conventional flat fan nozzles at 20 gal/A gave an average of 38% weed control, while application with the Thinvert nozzle at four gal/A gave 49% weed control across all treatments. Evaluation of these plots one year after application, on 10/27/95, showed that conventional nozzles at 20 gal/A gave average broadleaf weed control of 52%, Thinvert nozzles using water at four gal/A gave 67% control, and Thinvert nozzles using Thinvert as a carrier at four gal/A gave 78% broadleaf weed control. Treatments using triclopyr + clopyralid averaged 85% broadleaf weed control one year after treatment, while treatments using triclopyr alone averaged 46% control.

Applications of trinexapac-ethyl[2] were made to bluegrass and tall fescue lawns in Bucks and Montgomery Counties, PA on 5/1/95. A Birchmaier backpack sprayer with a #73031 Thinvert nozzle, was used to apply the plant growth regulator at one lb/A in Thinvert at a volume of four gal/A. Evaluation 30 DAT showed that trinexapac-ethyl gave 75% height reduction of bluegrass and tall fescue turf with no apparent injury or discoloration. Treated bluegrass was slightly greener in color than untreated turf.

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1. Waldrum Specialties, Inc., Doylestown, PA
2. Ciba-Geigy Corporation, Greensboro, NC
3. DowElanco, Indianapolis, IN

CONTROL OF POA ANNUA IN BENTGRASS PUTTING GREENS

J. Cutler Robinson Jr. and Jeffrey F. Derr[1]

Abstract

Annual bluegrass (Poa annua L.) tends to invade bentgrass (Agrostis palustris L.) golf putting greens wherever they are grown. Its ability to thrive at low mowing heights with frequent irrigation makes a golf putting green an excellent site for Poa annua establishment. Once established, Poa annua detracts from the aesthetic and playing characteristics of a golf green. The nature of this weed to exist as both perennial and annual biotypes as well as its proficiency at producing seed make its control a challenge for golf course superintendents. Currently no product provides effective, safe, and complete control of existing Poa annua in bentgrass golf greens.

A practice putting green at Elizabeth Manor Golf and Country Club in Portsmouth, Virginia was selected to receive treatments of plant growth regulators as well as herbicides. The facility receives over 50,000 rounds of golf per year and the practice green is particularly highly trafficked. The ensuing data from the treatments provides "real world" results.

Treatments were applied to four foot by eight foot plots, replicated four times in a randomized complete block, and compared to an untreated control. The growth regulators applied were: a 1 lb/gallon emulsifiable concentrate formulation of Primo applied at 0.09, 0.19, and 0.28 lbs ai/A, and a 50% wettable formulation of paclobutrazol applied at 0.25 lb ai/A. These treatments were applied on 4/19, 5/3, 5/19, 6/7 and 6/20/94. The results showed that Poa annua populations were not changed statistically nor was putting quality improved to a significant level with any plant growth regulator treatment.

Herbicide treatments applied were ethofumesate applied alone at 0.5 and 0.75 lb ai/A on 10/23, 12/2/94, and 1/23/95. Two other treatments utilized combinations of dithiopyr and ethofumesate. Dithiopyr was applied at 0.5 lb ai/A on 10/12/94 and 1/23/95. Ethofumesate was applied to these plots at 0.5 or 0.75 lb/A on 10/12, 12/2/94, and 1/23/95. The treatments applied on 10/12/94 and 1/23/95 were applied as a tank mix. The use of ethofumesate plus dithiopyr was an effective and fairly safe control for Poa annua in bentgrass. While the reduction in Poa annua populations was not momentous through the rating period of October 1994 through April 1995, when compared to the increase in Poa annua in the untreated plots, the treatment effects were significant. Plots treated with the highest rate of ethofumesate plus dithiopyr exhibited a temporary and slight reduction in bentgrass quality and color through the winter months. Poa annua populations in these plots decreased by 10% while populations in untreated plots through the same period increased by over 50%.

[1]Superintendent, Bayville Golf Club, Va. Beach, VA 23455 and Assoc. Prof., Hampton Roads Ag. Exp. Sta., Va. Beach, VA 23455.

BROADLEAF WEED CONTROL IN BLUEGRASS

M.A. Czarnota and S.W. Bingham[1]

ABSTRACT

Confront (triclopyr/chlorpyralid) and Gallery (isoxaben) herbicides were compared to phenoxy herbicides for broadleaf weed control in Kentucky bluegrass (Poa pratensis L. "Plush'). In 1995, two identical tests were established at VPI&SU Turfgrass Research Center. These test areas were aerified, vertically mowed and fertilized at the rate of 1 lb N/1000 ft^2. Turfgrass was maintained at 1.5 inches and irrigated as needed. Tests were initiated on May 8 and contained three replications. Control (0 to 100 scale) of mouseear chickweed (Cerastium vulgatum L.), broadleaf plantain (Plantago major L.), buckhorn plantain (Plantago lanceolata L.), dandelion (Taraxacum officinale Wiggers), white clover (Trifolium repens L.) and crabgrass (Digitaria sanguinalis (L.) Scop.) were determined. Kentucky bluegrass was evaluated for injury, quality and percent cover.

In test one, there was no significant injury with any of the treatments. By 8 weeks after treatment (WAT) phenoxy herbicides were providing adequate control of white clover and plantains, and only a few of the phenoxy herbicides provided adequate dandelion control. Confront, at 8 WAT, provided poor control of dandelions and both plantains while providing good control of white clover. Gallery used alone provide poor control of all weed species. Confront and Gallery combinations, however, provided good to excellent (> 80%) control of all broadleaf weeds. Moreover, Gallery/phenoxy combinations provided good to excellent control of both plantain species and white clover at 8 WAT.

In test two, there was no significant injury with any of the treatments. Plantains were not rated in this test. The phenoxy herbicides provided varying control of the broadleaf weeds tested. At 8 WAT, Confront provided good to excellent control of dandelion and white clover while providing poor control of mouseear chickweed. Gallery alone provided poor control of all weeds. Confront and Gallery combinations provided good to excellent control of all broadleaf weeds rated by 8 WAT. Moreover, Gallery/phenoxy combinations provided similar results at 8 WAT.

In both tests, turfgrass quality reflected weed control ability of the herbicides. Quality was higher in treatments that provided good long term weed control, while in treatments that provide short term or poor weed control, quality remained at or below acceptable.

In both of the tests, it was discovered that the Gallery/Confront combinations provided some crabgrass control. This data was consistent with 1994 data, in that the Gallery/Confront combinations provided excellent crabgrass control (> 90%). At present, it is not understood why the combinations provide crabgrass control.

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[1]Grad. Res. Asst. and Prof. respectively, Dept. of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

EFFECT OF TIMING AND APPLICATION RATE OF ISOXABEN FOR BROADLEAF WEED CONTROL

R.S. Chandran, J.F. Derr and S.W. Bingham[1]

ABSTRACT

Broadleaf weed control is an important component of turfgrass management. Limited information exists on the residual activity of isoxaben for weed control in turf. A study was established in 1994 at Blacksburg as a randomized complete block design with four replications in 'Plush' Kentucky bluegrass (Poa pratensis L.) . Prior to preemergence treatments, the plots were dethatched and fertilized with nitrogen at 0.54 kg/100 m^2. A postemergence application of 2,4-D amine plus triclopyr amine was applied over the whole study area to control existing broadleaf weeds. Turf was mowed at a height of 3 cm and irrigated when needed. A 75% dry flowable formulation of isoxaben applied at 0.56, 0.83 and 1.12 kg ai/ha was compared to a granular formulation of oxadiazon applied at 3.36 kg ai/ha. Application timings consisted of spring treatment, fall treatment, and spring followed by fall treatment. Spring preemergence treatments were applied on May 18, 1994. Fall treatments were applied on October 6, 1994. All treated and check plots were seeded in rows with white sweet clover, dandelion, and buckhorn plantain. Data collection included weed counts of seeded as well as naturally existing broadleaf weeds. Percent cover of a mixture of large crabgrass (Digitaria sanguinalis L.) and smooth crabgrass (Digitaria ischaemum Schreb. ex Schweig.) was also monitored during early summer.

Following spring treatments in 1994, complete control of dandelion (Taraxacum officinale L.) and white sweet clover (Melilotus alba Medic.) was seen at approximately 6 weeks after treatment (WAT) with all 3 rates of isoxaben. Isoxaben provided >90% control of buckhorn plantain (Plantago lanceolata L.) and 85% control of dandelion at 15 WAT. Oxadiazon provided no control of buckhorn plantain, but controlled dandelion 61% at 15 WAT. Weed counts taken 8 months after fall (1994) treatment indicated that isoxaben provided at least 95% control of buckhorn plantain. Dandelion control at this time ranged from 50% to 70% in plots that received isoxaben. Oxadiazon did not exhibit any residual activity for broadleaf weed control during the following season. No control of prostrate spurge was recorded for isoxaben or oxadiazon when evaluated 8 months after fall application. Isoxaben applied in spring 1994 did not control any broadleaf weeds when the plots were evaluated a year later. When evaluated in the spring of 1995, plots that received isoxaben treatments in the spring of 1994 followed by fall did not provide greater weed control than the same treatments applied only in the fall.

Multiple applications of oxadiazon in 1994 reduced crabgrass cover in 1995 compared to control plots. Isoxaben did not possess any long term activity for crabgrass control.

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[1] Grad. Res. Asst., Assoc. Professor, and Professor, respectively, Va. Polytech. Inst. and State Univ., Dept. Plant Pathol., Physiol., and Weed Sci., Blacksburg, VA 24061.

POSTEMERGENCE WEED CONTROL IN DORMANT HERBACEOUS PERENNIALS

John F. Ahrens and Todd L. Mervosh[1]

ABSTRACT

Winter annual weeds are troublesome to growers of containerized herbaceous perennials who wish to market weed-free plants in the spring or grow them for a second season. Because foliage of most of these ornamentals dies back each fall or winter an opportunity exists to utilize postemergence herbicides to control winter annual weeds either in late fall or early spring. Experiments were conducted from 1993 to 1995 to assess the efficacy and ornamental plant tolerance to herbicides applied in December before winter covering or in March after winter covers were removed.

Glyphosate and glufosinate at 0.75 to 1.0 lb/A controlled weeds such as common groundsel (*Senecio vulgaris* L.), horseweed [*Conyza canadensis* (L.) Cronq.], bittercress (*Cardamine* sp.), and yellow woodsorrel (*Oxalis stricta* L.) with little or no injury to dormant cultivars of plantain lily (*Hosta*), astilbe (*Astilbe*), daylily (*Hemerocallis*), and Siberian iris (*Iris siberica*), but injured grasses such as feather reed grass (*Calamagrostis acutiflora*) and ribbon grass (*Phalaris arundinacea* 'Picta') which remain partially green all winter. However, blue lyme grass (*Elymus arenarius* 'Glaucus') was not injured. Potassium salts of fatty acids caused less injury to the grasses than glyphosate or glufosinate and no injury to the other ornamentals, but resulted in more erratic weed control. An amine formulation of 2,4-D at 1.43 lb ae/A gave excellent control of most weeds without injury to the above grasses or the blue fescue (*Festuca ovina glauca* 'Elijah Blue') but it injured Siberian iris and astilbe in one experiment. By May, seedling weeds started to emerge in containers treated earlier with postemergence herbicides. Isoxaben plus oryzalin at 0.75 + 2.25 lb/A controlled bittercress without injury to plantain lily, daylily, or astilbe and could be expected to provide longer residual control when combined with a postemergence herbicide.

[1] Emeritus Weed Scientist and Assistant Agricultural Scientist, The Connecticut Agricultural Experiment Station, Valley Laboratory, Windsor, CT 06095.

SULFENTRAZONE AND HALOSULFURON FOR PREEMERGENCE WEED CONTROL IN WOODY ORNAMENTALS

Todd L. Mervosh and John F. Ahrens[1]

ABSTRACT

The herbicides sulfentrazone (F 6285) and halosulfuron (MON 12037) have recently gained registrations for use in some crops. These herbicides are active against many broadleaf weeds and sedges; thus they may offer benefits not provided by herbicides currently registered for use in ornamentals. Sulfentrazone and halosulfuron were evaluated for efficacy and woody ornamental tolerance in an experiment which included isoxaben as a standard herbicide. After existing weeds were removed, on June 2, 1995, isoxaben (0.75 lb/A), halosulfuron (0.031 to 0.125 lb/A), sulfentrazone (0.125 to 0.5 lb/A), and combinations of isoxaben (0.75 lb/A) plus sulfentrazone (0.125 to 0.375 lb/A) were sprayed over field plots containing Japanese yew (*Taxus cuspidata*), globe arborvitae (*Thuja occidentalis*), Eastern hemlock (*Tsuga canadensis*), creeping juniper (*Juniperus horizontalis*), and rhododendron (*Rhododendron catawbiense*). Eight weeks after treatments were applied, weeds were hoed and hand pulled from all plots. Plots were evaluated at 2, 5, 9, and 13 weeks after treatment.

Based on visual evaluations, juniper was tolerant of all treatments. Isoxaben did not injure any of the ornamental species. At all rates, halosulfuron caused significant chlorosis and reduction in new growth of yew, and to a lesser degree, of arborvitae and rhododendron. At 13 weeks after treatment, yew foliage remained stunted but was no longer chlorotic, and injury to arborvitae and rhododendron was less apparent. Sulfentrazone treatments caused no visible injury except to hemlock, the new foliage of which was temporarily burned. By 9 weeks after application, no injury was observed. Plant tolerances of sulfentrazone plus isoxaben treatments were similar to those of sulfentrazone alone.

For 9 weeks, all treatments prevented emergence of annual sedge (*Cyperus* sp.), which was extremely dense in untreated plots. At 13 weeks, all treatments containing sulfentrazone continued to provide 85% or greater control of annual sedge; sedge control was 75% or less with halosulfuron and about 50% with isoxaben. Large crabgrass [*Digitaria sanguinalis* (L.) Scop.] control was poor to fair for all individual herbicide treatments; best crabgrass control was provided by isoxaben (0.75 lb/A) plus sulfentrazone (0.375 lb/A). The most prevalent broadleaf weed was prostrate spurge (*Euphorbia supina* Raf. ex Boiss.). Again, control was poor to fair for all treatments except isoxaben plus sulfentrazone.

For the ornamental species and herbicide rates tested, sulfentrazone provided better preemergence weed control and plant safety than did halosulfuron. The potential for these herbicides in ornamental weed control warrants further investigation.

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[1] Assistant Agricultural Scientist and Emeritus Weed Scientist, The Connecticut Agricultural Experiment Station, Valley Laboratory, Windsor, CT 06095.

TOLERANCE OF FALL AND SPRING PLANTED BULBS TO PREEMERGENCE HERBICIDES

Andrew Senesac and Irene Tsontakis-Bradley[1]

ABSTRACT

A field study was conducted in 1993 – 1994 to determine the tolerance of six species of fall planted bulbs to preemergence herbicides applied at different rates and timings. Isoxaben (75DF) at 1.0 and 2.0 lb. ai/A and oryzalin (4AS) at 4.0 and 8.0 lb. ai/A, isoxaben plus oryzalin (80 DF) at 4.0 and 8.0 lb. ai/A, and isoxaben plus trifluralin (2.5% G) at 5.0 and 10.0 lb. ai/A were each applied at three timings: post plant (immediately after bulbs were planted), early post (leaves less than 3 inches), and late post (when leaves were greater than 3 inches). Ten bulbs of each species: tulip (Tulipa 'Balalaika'), narcissus (Narcissus 'Ice Follies'), bulbous iris (Iris *subgenus* Xiphium (Mill.)Spach. 'Ideal'), hyacinth (Hyacinthus orientalis L. 'Delft Blue'), crocus (Crocus 'Giant Yellow'), asiatic lily (Lilium 'Asiatic White') were planted in trenches on October 25, 1993. Treatments were arranged in a Randomized Complete Block design and replicated three times.

Plant quality and growth were measured for each species throughout the following spring. No adverse effects from any of the treatments were detected for narcissus, hyacinth or crocus. At least 50% shoot emergence had occurred in untreated plots when a hard spring frost destroyed the entire bulbous iris crop. Based on shoot number, there did not appear to be any significant harmful effects from the post plant and early post treatments, which were the only timings applied. For asiatic lily, plants, buds, and flowers were counted and weighed. In July, bulb quality and fresh weight were measured. Isoxaben plus oryzalin 80 DF, when applied post plant at the high rate, appeared to cause significant injury and reduced bulb weight. Tulip shoot, flower bud, and bulb number and weight were measured. Injury was caused by all treatments which contained isoxaben, particularly at the high rates and with the sprayed treatments. These treatments appeared to be more injurious when applied at the early post timing. Oryzalin did not cause any significant injury or yield.

In a separate study, in 1993, the same treatments and timings were applied to spring-planted No. 3 grade corms (0.3 oz) of two gladiolus cultivars (Gladiolus x hortulanus 'St. Nacarat' and 'Red Ribbon'). All treatments appeared to be relatively safe and caused no significant injury based on plant vigor ratings and flower fresh weights. However several treatments, particularly the early post isoxaben combination treatments, caused a slight decrease in the pre-flowering plant height of 'Red Ribbon' but not 'St. Nacarat'.

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[1]Weed Science Specialist and Research Technician, Cornell University, Long Island Horticultural Research Laboratory, Riverhead, NY

APPROACHES TO WEED MANAGEMENT IN DIRECT-SEEDED CUTFLOWERS.

Andrew Senesac and Irene Tsontakis-Bradley[1]

ABSTRACT

A field study was conducted to evaluate three different approaches to weed management in direct-seeded annual cutflowers: stale seedbed technique, fumigation, and reduced rates of preemergent herbicides. A field of Riverhead sandy loam with 2.0% O.M. was plowed and disked in mid May, 1995. Stale seedbeds were established by allowing the natural weed population to emerge for 3 weeks before either glyphosate (4L) at 1.5 lb ai/A or paraquat (2.5 WS) at 1.0 lb ai/A were applied. One week after this, flower seeds were handplanted into otherwise undisturbed plots. Fumigation was achieved with an mid-May application of granular dazomet (99%G) Basamid at 350 lb ai/A. Immediately after application, plots were rototilled and either rolled or tarped or left undisturbed prior to being irrigated with 0.5" water. All fumigated plots were rototilled again 2 weeks later and flower seeds were planted one week later. In another set of plots, three preemergent herbicides: metolachlor (7.8 EC) at 1.0 lb ai/A, prodiamine (65 DG) at 0.33 lb ai/a and napropamide (50 DF) at 1.0 lb ai/A were applied individually to freshly tilled plots immediately post plant. All treatments were arranged in a Randomized Complete Block design and replicated four times.

Seeds of the following species were handplanted in all plots on June 16, 1995: China Aster (Callistephus chinensis L. 'Single Rainbow Hybrid'), Bells of Ireland (Molucella laevis L.), Pot Marigold (Calendula officinalis L. 'Princess Nagasaki'), Safflower (Carthamus tinctorius L. 'Lasting Yellow'), Cockscomb (Celosia argentea var. cristata L. Kuntze 'Kureme Corona'), Cirsium (Cirsium japonicum D.C. 'Pink Beauty'), Cosmos (Cosmos bipinnatus Cav. 'Versailles White'), Nagoya Ornamental Kale (Brassica oleracea L. 'Acephala'), Larkspur (Consolida regalis S.F. Gray 'White King'), African Marigold (Tagetes erecta L. 'Cracker Jack'), Sweetpea (Lathyrus odoratus L. 'Mammoth Crimson'), Black-eyed Susan (Rudbeckia hirta L. 'Indian Summer'), Strawflower (Helichrysum bracteatum (Vent.) Andrews 'Monstrosum'), Sunflower (Helianthus annuus L. 'Sonja'), Zinnia (Zinnia elegans Jacq. 'Radiant').

Except for the untreated weedy control, all plots were maintained weed free after an initial weed control rating. Weed control of the native weed population, annual broadleaves and grasses, was good in the dazomet-treated plots. Neither stale seedbed treatment provided adequate weed control, particularly of late germinating species such as common purslane. Napropamide was also ineffective in controlling purslane.

Cutflower quality and yields were highest in the dazomet-treated plots. No yield loss was caused directly by the stale seedbed treatments, although the lack of residual control allowed many weeds to emerge in those plots. A number of cutflowers were injured by the preemergent herbicides, even at the low rates tested. Metolachlor injured six, napropamide injured nine, and prodiamine caused injury to twelve of the fifteen species tested.

[1]Weed Science Specialist and Research Technician, Cornell University, Long Island Horticultural Research Laboratory, Riverhead, NY

THE TOLERANCE OF FOUR CHRISTMAS TREE SPECIES TO CLETHODIM, CLOPYRALID, AND OXYFLUORFEN

Larry J. Kuhns and Tracey Harpster[1]

ABSTRACT

A study was initiated to determine the tolerance of four Christmas tree species to clethodim at 0.25 lb/a in combination with a crop oil concentrate (COC) at 1% (v/v), a nonionic surfactant (NIS) at 0.25% (v/v), clopyralid plus COC, clopyralid plus NIS, clopyralid plus oxyfluorfen plus COC, or clopyralid plus oxyfluorfen plus NIS. In all combinations clopyralid was applied at 0.14 lb/a and oxyfluorfen was applied at 0.4 lb/a. Two control treatments were included: untreated, and clopyralid + NIS.

Four or five year old transplants of Douglas fir [Pseudotsuga menzesii (Mirb)Franco], Fraser fir [Abies fraseri (Pursh)Poir], Colorado spruce (Picea pungens Engelm.), and eastern white pine (Pinus strobus L.) were planted in April, 1994. Treatments were applied to these plants on June 9, 1995. At the time of treatment all of the plants had one to four inches of new growth and were at their most sensitive stage of growth. Each plot was 3 by 25 feet and contained five plants of a species. Each treatment was replicated three times for each species. There were few annual weeds growing around the trees because preemergence herbicides had been applied in the spring. A weedy area adjacent to the block of trees was treated with the same herbicide combinations. The plot size and replications were the same as in the trees.

The air temperature at the time of application was 68°F, the sky was overcast, and there was a 3 to 5 mph wind. Treatments were applied with a test plot sprayer at 30 psi, through an 8004E nozzle, in the equivalent of 20 gpa. All treatments were applied over-the-top of the plants except those containing oxyfluorfen. Treatments including oxyfluorfen were not applied to Colorado spruce,and were applied as directed sprays to the other species. The directed sprays contacted at least the lower half of the plants. The growing conditions for the month following application were excellent.

None of the treatments injured any of the plants. The predominant weeds in the plots were green foxtail [Setaria viridis (L.) Beauv.], quackgrass [Elytrigia repens (L.) Nevski], wild buckwheat (Polygonum convolvulus L.), common ragweed (Ambrosia artemisiifolia L.), Pennsylvania smartweed (Polygonum pensylvanicum L.), wild carrot (Daucus carota L.), common yellow woodsorrel (Oxalis stricta L.), goldenrod (Solidago spp), hemp dogbane (Apocynum cannabinum L.), and common milkweed (Asclepias syriaca L.). Clethodim provided excellent control of the green foxtail and marginal control of the quackgrass. Clopyralid alone provided good control of the ragweed and goldenrod. Including oxyfluorfen in the treatments increased the level of control provided by the clopyralid, and caused severe burning of all of the weeds present except the woodsorrel. Many of the weeds that were less than 6 in. tall were killed, while larger weeds were burned, but recovered. Combinations of clethodim, clopyralid, and oxyfluorfen can be safely applied over-the-top of these four species to control a variety of annual and perennial grasses and broadleaved weeds while getting some preemergence weed control at the same time.

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[1] Prof. of Ornamental Horticulture and Research Associate, Dept. of Horticulture, The Pennsylvania State University, University Park, PA 16802

TOLERANCE OF DWARF BURNING BUSH AT DIFFERENT GROWTH STAGES TO ISOXABEN

S. Salihu, J.F. Derr and K.K. Hatzios[1]

ABSTRACT

Isoxaben is a preemergence herbicide used for broadleaf weed control in ornamentals and turf. Although many ornamental species tolerate isoxaben, certain ones, including dwarf burning bush (*Euonymus alatus* 'Compacta') are injured by this herbicide. An experiment was conducted to determine the effect of isoxaben application timing on dwarf burning bush tolerance. The experimental design was a randomized complete block with four replications and five plants per plot. A dry flowable formulation of isoxaben was applied at three different growth stages of dwarf burning bush: dormant stage (March 14, 1995), leaf emergence/actively growing stage (April 26, 1995) and leaf maturation stage (June 4, 1995). The three different rates of isoxaben were 0.84, 1.69 and 3.39 kg ha^{-1}. A wettable powder formulation of dichlobenil was applied at 4.48 kg ha^{-1} for comparison purposes. Data collected include injury ratings at three different time periods, height and width measurements and percent defoliation.

Isoxaben applied at the dormant and at the leaf maturation stages did not injure dwarf burning bush. Plants which were treated at the leaf emergence stage were injured approximately 30 to 50% at one and three months after treatment at all three rates. The injury symptoms observed were curling of the leaves, smaller leaf size, and downward bending of the stems. Shoot dieback was also noticed at five months after treatment. Isoxaben applied at the leaf emergence stage reduced plant width but not plant height, when compared to untreated plants. Isoxaben applied at the leaf emergence stage caused premature defoliation (60-75%) of dwarf burning bush at five months after treatment as compared to untreated plants. Isoxaben applied at the other two growth stages did not affect plant height or width or cause premature defoliation. Dichlobenil did not cause injury or reductions in height and width of dwarf burning bush at any stage of application. Dwarf burning bush is more tolerant to isoxaben applications at the dormant and leaf maturation stages of growth than at the actively growing stage.

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[1] Graduate Research Assistant, Associate Professor, and Professor, respectively, Va. Polytechnic Institute and State University, Department of Plant Pathology, Physiology, and Weed Science, Blacksburg, VA 24061.

EVALUATION OF DITHIOPYR FOR NURSERY CROP WEED CONTROL

Jeffrey F. Derr[1]

ABSTRACT

Dithiopyr is currently used for preemergence weed control in turfgrass and may have utility as a nursery crop herbicide. Studies were conducted in containers using a pine bark:sand medium to evaluate ornamental crop safety and control of troublesome annual weeds in container nursery production. A 1% granular formulation of dithiopyr was applied at rates ranging from 0.25 to 4.0 lb ai/A in several studies.

Dithiopyr at 0.25 lb/A provided poor control of spotted spurge (Euphorbia maculata L.), sowthistle (Sonchus spp), eclipta (Eclipta prostrata L.), common groundsel (Senecio vulgaris L.), and yellow woodsorrel (Oxalis stricta L.) at 3 weeks after treatment (WAT). Increasing the application rate to 0.5 lb/A resulted in good control of spotted spurge, fair control of sowthistle, poor control of eclipta and common groundsel, and excellent control of yellow woodsorrel. At 1.0 lb/A, dithiopyr gave excellent control of spotted spurge, good control of sowthistle and common chickweed [Stellaria media (L.) Vill.], and poor control of eclipta and common groundsel. By 5 WAT, spotted spurge control was poor at 0.5 and 0.75 lb/A, and good at 1.0 lb/A. Yellow woodsorrel and sowthistle control 5 WAT was poor at 0.5 lb/A, fair at 0.75 lb/A, and good at 1.0 lb/A. Dithiopyr at 2.0 lb/A provided excellent control of spotted spurge, yellow woodsorrel, rice flatsedge (Cyperus iria L.), large crabgrass [Digitaria sanguinalis (L.) Scop.], and eclipta at 4 WAT.

Dithiopyr applied twice at 1.0 and 2.0 lb/A did not affect shoot fresh weight of green liriope (Liriope muscari L.), but did reduce shoot weight in ajuga (Ajuga reptans L.). Dithiopyr at 2.0 lb/A applied twice appeared to reduce shoot weight in English ivy (Hedera helix L.). No reduction in shoot fresh weight of 'Plumosa' juniper (Juniperus horizontalis Moench), white pine (Pinus strobus L.), 'Gloria' azalea [Rhododendron obtusum (Lindl.) Planch.], 'Hogandorn' Japanese holly (Ilex crenata Thunb.), euonymous (Euonymous fortunei) and redtip photinia (Photinia x fraseri Dress) was observed when dithiopyr was applied at 1.0 or 2.0 lb/A . No adverse effect of dithiopyr applied at 2.0 and 4.0 lb/A was noted in black-eyed Susan (Rudbeckia hirta var. pulcherrima Farw.), lanceleaf coreopsis (Coreopsis lanceolata L.), shasta daisy (Chrysanthemum x superbum Bergmans ex. J. Ingram), purple coneflower [Echinacea purpurea (L.) Moench.], and blanket flower (Gaillardia aristata Pursh).

Most ornamental species exhibited excellent tolerance to a granular formulation of dithiopyr. Weed control increased as dithiopyr rate increased, with an application rate of 1.0 to 2.0 lb/A required for acceptable broadleaf weed control.

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

CONTROLLING WEEDS IN CONTAINER GROWN HERBACEOUS PERENNIALS

Larry J. Kuhns, Tracey Harpster, and Alan Michael[1]

ABSTRACT

Finale[2] and Roundup[3] at 1% plus 1% nonionic surfactant, and Scythe[4] at 5%, were applied on March 10, 1995, over-the-top of container grown herbaceous perennials in overwintering structures. The air temperature was 38°F. Each treatment was applied to over 45 plants each of Astilbe 'Europa'; Epimedium x 'Rubrum'; Hosta undulata 'Blue Cadet', and 'Golden Edger'; Hosta sieboldiana 'Frances Williams'; Japanese painted fern (Athyrium nipponicum (Mett.)Hance); ostrich fern (Matteuccia struthiopteris (L.) Tod.); and Rodgersia spp. Weed control was evaluated on April 19 and May 15. Injury was rated on April 25.

On March 27, 1995, Derby[5] at 4lb ai/a, dithiopyr at 0.5 lb/a, metolachlor at 4 lb/a, napropamide at 6 lb/a, pendimethalin at 4 lb/a, and prodiamine at 0.75 lb/a were applied over container grown Astilbe x arendsii 'Erica', Coreopsis verticillata 'Moonbeam', Hemerocallis 'Stella d' Oro', Hosta sieboldiana 'Frances Williams', Rudbeckia fulgida var. sullicantii 'Goldsturm', Sedum x 'Autumn Joy', and Veronica x 'Sunny Border Blue. All were applied as sprays through an 8004E nozzle at 30 psi except the Derby, which was applied with a hand shaker. The air and soil temperatures were 65 and 54°F, respectively. Injury was rated on April 19, May 15, and June 14.

On April 19 the only plant showing injury symptoms from the preemergence herbicide applications was Veronica. Prodiamine caused very slight injury, Derby and napropamide more injury, dithiopyr and pendimethalin moderate injury, and metolachlor severe injury. By May 15 the injured plants were showing signs of recovery, and by June 14 only the plants treated with Derby, metolachlor or pendimethalin still showed unacceptable injury. These plants were slightly smaller than the controls, and their flower bud development was behind that of the controls. It appeared that they would fully recover, but their time of marketing would be delayed. At the April rating period, Coreopsis was not developed well enough to evaluate injury. By the May and June rating periods it was evident that Derby caused severe injury, dithiopyr and metolachlor caused moderate injury, and prodiamine caused a slight reduction in growth. The growth of sedum was stunted by Derby, dithiopyr, and pendimethalin.

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[1] Prof. of Ornamental Horticulture and Research Associate, Dept. of Horticulture, and Regional Ornamental Horticulture Specialist, Cooperative Extension; The Pennsylvania State University, University Park, PA 16802

[2] Finale is 1 lb/gal glufosinate-ammonium

[3] Roundup is 4 lb/gal glyphosate

[4] Scythe is 57% pelargonic acid, Mycogen Corp., San Diego, CA 92121

[5] Derby is a premixed granular formulation of 4% metolachlor and 1% simazine

The predominant weeds in the postemergence treated areas were bittercress (Cardamine parviflora L.) and common groundsel (Senecio vulgaris L.)seedlings. They were lightly, but uniformly distributed throughout the untreated control plants. Liverwort was growing in the ostrich fern. Finale and Scythe treatments reduced the number of weeds present, but not to acceptable levels (Table 1). Roundup almost totally eliminated the weeds. Finale and Roundup controlled the liverwort, Scythe did not. Roundup treated plants stayed weed-free longer and had fewer weed seedlings germinate in the pots during the course of the study. It appeared that it either killed weed seed or imperceptibly germinating weed seed near the soil surface at the time of application. This potential to provide extended weed control will be studied in the future.

Roundup caused unacceptable injury to the Epimedium and Rodgersia. A few plants were killed, most were severely stunted. Plants injured by Roundup rarely outgrow the injury soon enough to be profitably marketed. Finale caused some injury to ostrich fern.

Table 1. Weed control provided by Finale[2] and Roundup[3] at 1% plus 1% nonionic surfactant, and Scythe[4] at 5%, applied on March 10, 1995, over-the-top of container grown herbaceous perennials in overwintering structures. Weed control was rated on April 19 and May 15 on a scale of 1 to 10, with 1=no weeds and 10=more than 11 weeds per pot.

	Weed Control			
	Control	Finale	Scythe	Roundup
April 19	8.1	4.3	5.2	1.2
May 15	8.3	6.0	6.5	2.4

[2] Finale is 1 lb/gal glufosinate-ammonium

[3] Roundup is 4 lb/gal glyphosate

[4] Scythe is 57% pelargonic acid, Mycogen Corp., San Diego, CA 92121

PANSY AND SEDUM TOLERANCE TO PENDIMETHALIN IN CONTAINERS

Beste, C.E., J.P. Donohoe and D.A. Dinkel[1]

ABSTRACT

Ornamental plant production in containers has increased due to the demand for larger plants for instant landscaping and color as an alternative to bedding plants. Pendimethalin (*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine) granular herbicide was evaluated post-transplant for pansy (*Viola tricolor* L., `Majestic GT Yellow') and sedum (*Sedum telephium* L., `Autumn Joy'). Pendimethalin (2.68 G) was applied at 1.0, 2.0 and 4.0 lb ai/A immediately after transplanting the pot-plants into 1 gallon containers on July 19, 1994. Each replicate was one plant per pot and each treatment had 10 replicates. Irrigation was applied daily or as needed. The media for pansy was peat: perlite, 1:8 (v/v) in 1 gallon containers. The 1 inch height pansy seedlings were transplanted with a pot plug size of 3/8 by 3/8 by 1 inch depth. Slight pansy growth reduction with pendimethalin at 2.0 and 4.0 lb ai/A was commercially acceptable and flower production was unaffected. Prostrate spurge (*Euphorbia humistrata* Engelm. ex Gray) was controlled by pendimethalin, 1.0 lb ai/A; however, yellow woodsorrel (*Oxalis stricta* L.) and Pennsylvania bittercress (*Cardamine pensylvanica* Muhl. ex. Willd.) were unaffected. Sedum pot-plants of 2.5 inch height with a pot-plug size of 1.5 by 1.0 by 1.5 inch depth were transplanted into 1 gallon containers of peat: sand: pine bark, 7:13:80 (v/v). Pendimethalin, 4.0 lb ai/A, caused height reduction of sedum and slight retardation of early flowers; however, lower rates did not affect sedum. Weed control was acceptable for prostrate spurge at 1.0 and 2.0 lb ai/A; however, yellow woodsorrel and Pennsylvania bittercress were not controlled at any pendimethalin rate.

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[1]Assoc. Prof., Ag Aide and Ag Technician, Dept. of Hort. and Land. Archit., Univ. of Maryland, Salisbury Facility, 27664 Nanticoke Road, Salisbury, MD 21801-1648.

BURCUCUMBER BIOLOGY AND MANAGEMENT IN CORN

D.T. Messersmith and W.S. Curran[1]

ABSTRACT

Burcucumber (Sicyos angulatus L.) is becoming a serious weed problem in agronomic crops throughout the Northeast. Originally found along stream banks and other damp, shady areas, burcucumber has invaded river bottom and upland fields. Burcucumber seed germinate from early May through August emerging from depths up to 6 inches. Control of burcucumber proves to be a challenge since its germination and growth habits are not fully understood.

In 1995, two field studies were conducted on established populations of burcucumber in corn (Zea mays L.). A tillage and herbicide timing study was conducted at a single location. The study consisted of three tillage regimes and three herbicide treatments. Tillage treatments were moldboard plow/disk, chisel plow/disk, and no-tillage. Atrazine and dicamba (1.6 and 0.5 lb ai/A, respectively) were applied to each tillage treatment, either preemergence or postemergence, and were compared to untreated checks. Nonionic surfactant was added to postemergence treatments at 0.25% (v/v). The postemergence treatments were applied to 3 leaf stage, 6 inch corn and 3 leaf stage burcucumber. A postemergence timing study was conducted at two locations. Prosulfuron, primisulfuron, halosulfuron, and flumichlorac (0.036, 0.036, 0.063, and 0.040 lb ai/A respectively) were applied at a single rate and two postemergence timings. Crop oil concentrate was added to all treatments at 1.0% (v/v). The herbicide treatments were compared to untreated checks. The first timing postemergence treatment was applied to 3 leaf stage, 6 inch tall corn and cotyledonary to 2 leaf stage burcucumber. The second timing was applied to 6 leaf , 12 inch corn and 5 leaf stage burcucumber.

Tillage alone had no effect on burcucumber density. However, postemergence applications were more effective than preemergence treatments with the best control achieved in the no-till/postemergence treatment. Prosulfuron provided better than 95% control of burcucumber, followed closely by primisulfuron. Burcucumber biomass between the prosulfuron and primisulfuron treatments was not different. Flumichlorac and halosulfuron were ineffective at controlling burcucumber. Postemergence application timing had no effect on burcucumber control or biomass.

[1]Grad. Res. Asst. and Asst. Prof. of Weed Sci., Dept. of Agron., The Pennsylvania State University, University Park, PA 16802

RIMSULFURON PLUS THIFENSULFURON COMBINATIONS WITH OTHER CORN HERBICIDES

M. A. Isaacs, H. P. Wilson, Q. R. Johnson, and J. E. Toler[1]

ABSTRACT

Rimsulfuron plus thifensulfuron (Basis) is a prepackaged herbicide combination for POST weed control in corn (Zea mays L.). Two field experiments were conducted in 1995 in a factorial treatment arrangement to evaluate Basis (0, 0.012, and 0.016 lb ai/A) plus either 2,4-D (0, 0.125, and 0.25 lb ai/A) or dicamba (0, 0.125, and 0.25 lb ai/A). Herbicides were applied early POST to 5- to 6-leaf corn and 2- to 4-in weeds or late POST to 7-leaf corn and 7- to 10-in weeds. Treatments included methylated seed oil (MSO) at 1.0% v/v and 30% UAN at 2.0% v/v. Control of giant foxtail (Setaria faberi Herrm.) and common ragweed (Ambrosia artemisiifolia L.) was determined in both studies and common lambsquarters (Chenopodium album L.) and common cocklebur (Xanthium strumarium L.) control were also rated in the Basis plus dicamba study. Additional data collected included corn injury ratings, corn yield, and weed biomass.

In a third experiment, Basis (0.016 lb/A) was evaluated alone and in combinations with primisulfuron (Beacon, 0.018 lb ai/A), prosulfuron plus primisulfuron (Exceed, 0.031 lb ai/A), halosulfuron (Permit, 0.016 and 0.032 lb ai/A), flumetsulam plus clopyralid plus 2,4-D (Broadstrike Plus, 0.21 lb ai/A), nicosulfuron (Accent, 0.016 lb ai/A) and several non acetolactate synthase (ALS)-inhibitor herbicides. Treatments except those with 2,4-D and or dicamba included 1.0% v/v MSO and 30% UAN at 2.0% v/v. Giant foxtail, common lambsquarters, and common ragweed control, corn injury ratings, and corn yields were determined.

Early POST applications of Basis provided good to excellent giant foxtail control but controlled common ragweed only when combined with 2,4-D or dicamba. Combinations of Basis with dicamba controlled all three broadleaf weeds and giant foxtail. Control of giant foxtail was decreased when Basis was combined with 2,4-D. Combinations of Basis with ALS-inhibitor herbicides (except Broadstrike Plus) controlled giant foxtail, common lambsquarters and common ragweed. Control of giant foxtail was decreased when Basis was combined with Broadstrike Plus. Combinations of Basis with certain non-ALS-inhibitor herbicides also provided less giant foxtail control. Late POST applications of Basis were ineffective on giant foxtail, yet provided good control of common ragweed and common lambsquarters.

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[1]Grad. Res. Asst.; Prof., East. Shore Agric. Res. and Ext. Center, Virginia Polytech. Inst., and State Univ., Painter, VA.; Ext. Assoc., Univ. of Delaware, Georgetown, DE.; Assoc. Prof., Clemson Univ., Clemson, SC.

Canada Thistle Regrowth Physiology

W.H. Phillips,II, S. Glenn, L.H. Slaughter, and P.A. Kalnay[1]

Abstract

A greenhouse study was initiated to investigate the influence of Canada thistle [*Cirsium arvense* (L.) Scop.] control treatments on carbohydrate concentration and root and stem (from soil level to lateral root) growth. This data will be used to estimate regrowth potential (stored carbohydrates in reproductive structures) following treatments. Horizontal roots were harvested in early spring from a field in Beltsville, Maryland. Root segments (8 cm long and 3 mm in diameter) were selected and planted in 18-cm pots filled with a peat, bark, and sand media mix. A single plant per pot was allowed to grow to 15 cm prior to treatment. The early harvest control was harvested at the time of treatment application to be a standard measurement of initial storage carbohydrate concentration. The late harvest control was harvested following flowering as regrowth reached 15 cm high. The analysis of those plants was used as the standard measure by which the treated plant carbohydrate concentration would have arrived at if allowed to grow and no treatments were applied. The treatments consisted of paraquat at 0.5 kg/ha and clipping (total removal of the stem to the lateral root). As with the controls, plants were harvested when the regrowth reached 9 cm. Following harvest, roots and stems were separated, immediately frozen in liquid nitrogen and placed in a freeze drier. Upon removal dry weight was obtained. Water soluble carbohydrates were extracted and analyzed for total non-structural carbohydrates (TNC), fructan degree of polymerization (DP), and fructan constituent monosacchrides glucose and fructose. The analysis was conducted using High Performance Anion Exchange Chromatography with Pulsed Amperometric Detection (HPAEC-PAD). Other parameters quantified were dry weight biomass, root to stem ratio (R/S) and shoot count per pot. Root and stem dry weight of the late harvest control were at least twice that of the early harvest control. Late control R/S results were double that of the early control. This indicates similar growth habits yet higher biomass production for the late harvest over the early harvest control. The TNC and fructan DP were similar for both controls, thus the late harvest controls had greater regrowth potential than the early harvest controls due to a greater root biomass. This indicates that Canada thistle root growth does not come at a cost to the concentration of stored carbohydrates. The clipped plants had equivalent root and stem biomass and R/S as the late harvest controls. There was an increase in stem TNC due to an increase of 23% in fructan DP compared to the late harvest control. The root TNC was elevated compared to late season controls due to increased sucrose and not an increased fructan DP. The overall regrowth potential of the clip treatment was increased compared to the late harvest controls. Perhaps the carbohydrates required for flowering of the late harvest controls resulted in reduced regrowth potential. Canada thistle treated with paraquat produced lower root dry weight biomass (0.4g) when compared to the late harvest controls (1.2g), but no difference for stem dry weight biomass or the R/S. There was no difference between the paraquat treatment and either controls for TNC or fructan DP for root or stem. The regrowth potential for those plants treated with paraquat was reduced compared to the late harvest controls and the clipped plants due to the reduced root growth. While paraquat is a contact herbicide it appears that paraquat applications can reduce the regrowth potential of Canada thistle.

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[1] Grad. Asst. / Agric. Res. Tech., Assoc. Prof., Assoc. Prof., Grad. Asst., Agron. Dept., Univ. of MD., College Park, MD 20742

SICKLEPOD (Senna obtusifolia L.) MANAGEMENT IN SOYBEANS (Glycine max) WITH FLUMETSULAM

K.M. Jennings, A.C. York, and J.W. Wilcut[1]

ABSTRACT

Field experiments were established in 1994 to evaluate sicklepod management with systems utilizing flumetsulam compared with standard herbicide systems. Treatments included trifluralin at 0.68 lb ai/A, trifluralin plus flumetsulam at 0.05 lb ai/A, trifluralin plus metribuzin at 0.32 lb ai/A plus chlorimuron at 0.05 lb ai/A, and trifluralin plus imazaquin at 0.123 lb ai/A applied PPI and metolachlor at 1.87 lb ai/A, metolachlor plus flumetsulam, metolachlor plus metribuzin plus chlorimuron, and metolachlor plus imazaquin applied PRE. Each PPI or PRE treatment was present with and without chlorimuron at 0.012 lb/A applied POST. Sicklepod and morningglory species (Ipomoea spp.) control was evaluated 4 WAT.

The Kinston location did not receive an activating rainfall until 18 d after application of soil-applied herbicides. Sicklepod control was similar with trifluralin plus flumetsulam, trifluralin plus metribuzin plus chlorimuron, and trifluralin plus imazaquin, ranging from 63 to 80%. Sicklepod control was poor with all PRE treatments, ranging from 33 to 59%. Chlorimuron applied POST controlled sicklepod 92% or better. Morningglory control was similar with PPI broadleaf treatments, ranging from 76 to 89%. PRE treatments controlled morningglory from 52 to 67%. Chlorimuron applied POST controlled morningglory 86% or better. Yields were similar among all PPI and PRE treatments. Yields were similar with trifluralin or metolachlor alone plus chlorimuron applied POST and with trifluralin or metolachlor plus flumetsulam, metribuzin plus chlorimuron, or imazaquin followed by chlorimuron applied POST.

Conditions at Goldsboro were conducive to good herbicide activity. A high initial sicklepod density was present at this location. PPI broadleaf treatments controlled sicklepod 31 to 44%. Trifluralin followed by chlorimuron controlled sicklepod similarly to a PPI broadleaf herbicide followed by chlorimuron. Sicklepod control was less than 20% with PRE treatments. Control by metolachlor followed by chlorimuron was equal to that with a PRE broadleaf herbicide followed by chlorimuron. Morningglory control by PPI treatments was similar, ranging from 40 to 50% except with trifluralin plus flumetsulam which controlled morningglory 5%. Morningglory control by a PPI broadleaf herbicide followed by chlorimuron averaged 97%, which was no better than control with trifluralin followed by chlorimuron. Metolachlor plus imazaquin controlled morningglory 76% which was greater than with other PRE herbicides. Control with metolachlor plus flumetsulam was no different than control with metolachlor alone. Metolachlor followed by chlorimuron controlled morningglory 93%, which was no different than control from a PRE broadleaf herbicide followed by chlorimuron. Yields were similar with trifluralin or metolachlor alone followed by chlorimuron applied POST and with a broadleaf soil-applied herbicide followed by chlorimuron.

[1]Grad. Res. Asst., Prof., and Assoc. Prof., Crop Sci. Dep., North Carolina State Univ., Raleigh, NC 27695-7620.

Roundup Ready™ Soybean EUP Results

T. E. Dutt and D. J. Mayonado[1]

ABSTRACT

Roundup Ready™ soybeans [Glycine max (L.) Merr.] were tested in an experimental use program in 1995, with the objective of evaluating this seed and herbicide system under real-life situations. Trials were conducted in both conventional and reduced tillage situations and in a range of soybean row widths. The seed was farmer planted and Roundup® (glyphosate) was applied by either farmers or commercial applicators. These EUP trials were conducted at more than 60 locations on over 125 acres across the Midwest and Northeastern United States.

Excellent weed control and crop safety was obtained with timely early postemergence applications of Roundup® herbicide at 3-5 weeks after planting and targeting weeds around 4-6 inches tall. Roundup applications at 24-32 ounces/acre (0.56-0.75 LB AE glyphosate/A) provided weed control that was equal to or better than that provided by commercially competitive treatments. Control of annual grasses to include foxtails (Setaria species) and fall panicum (Panicum dichotomiflorum Michx.) was excellent. Likewise, control of annual broadleaves to include pigweed (Amaranthus species) and velvetleaf (Abutilon theophrasti Medik.) was excellent. Control of common lambsquarters (Chenopodium album L.) and common ragweed (Ambrosia artemisiifolia L.) was better than with commercial standard treatments. Consistent control of giant ragweed (Ambrosia trifida L.), morningglory (Ipomoea species), Eastern black nightshade (Solanum ptycanthum Dun.), and ground cherry (Physalis species) was provided with the 32 ounces/acre rate. This higher rate also provided good control or suppression of perennial weeds to include yellow nutsedge (Cyperus esculentus L.), Canada thistle (Cirsium arvense), common milkweed (Asclepias syriaca L.), and hemp dogbane (Apocynum cannabinum L.). A single, in-crop application of Roundup was generally sufficient for season-long weed control in narrow row (≤ 20 inches) soybeans. A sequential application of Roundup was required about 25-30% of the time in wide row (30 inch) soybeans. A sequential application was also needed in a few situations to get adequate control of hemp dogbane and yellow nutsedge. Although crop safety was generally outstanding, a few instances of temporary chlorosis of soybeans were observed. These symptoms were temporary (1-2 weeks) and they usually occurred only at the highest labeled rate of 64 ounces/acre.

This new technology promises broadspectrum weed control with increased application flexibility and excellent crop safety in soybeans. Roundup Ready™ soybeans will be introduced commercially in 1996.

™ Roundup Ready is a trademark of Monsanto Company
® Roundup is a registered trademark of Monsanto Company.

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[1] Local Product Development Managers, Monsanto Agricultural Group, Fogelsville, PA 18051 and Salisbury, MD 21801 respectively.

PRACTICAL APPROACHES TO THE UTILIZATION OF "ROUNDUP READY" SOYBEANS

B. A. Majek[1]

ABSTRACT

The introduction of soybean (*Glycine max* L.) varieties with genetically enhanced tolerance to glyphosate (Roundup), called Roundup Ready soybeans, may be the most significant event in recent years. Although there is little question that the technology will be adopted, researchers can only speculate about the use patterns farmers will prefer. At least two major use patterns for "Roundup Ready" soybeans are likely. The first use pattern is the exclusive use of Roundup for the control of weeds in soybeans. The use assumes seeding into a weed-free field, achieved either by tillage or an application of Roundup, and subsequent weed control by the application of Roundup postemergence. A single postemergence treatment can result in acceptable weed control in double crop soybeans and in full season beans planted in narrow rows, provided the postemergence spray can be timed to immediately precede canopy closure. An additional postemergence Roundup application may be needed in soybeans planted in traditional wide rows, or if the first postemergence spray does not immediately precede canopy closure. A major advantage of using Roundup exclusively for weed control in soybeans is the freedom to rotate to any other crop after harvest. Disadvantages include the number of spray trips necessary, the careful timing of the postemergence application that may be needed, and the lack of herbicides with a different mode of action in the weed control program for the management of weed resistance development. The second use pattern to consider for "Roundup Ready" soybeans is combined with the use of residual herbicides. As a selective postemergence herbicide in soybeans, Roundup will control or suppress most or all the weeds in the majority of fields. No strict weed size or species limitations affect control, providing a substantial advantage compared to currently registered herbicides. The application of Roundup, tank-mixed with residual herbicides that can be applied either preemergence or postemergence, can reduce the number of times a field must be sprayed, increase the flexibility of the timing of the herbicide application, and utilize herbicides with a variety of modes of action to prevent or delay resistance development. Imazethapyr (Pursuit) and clomazone (Command), at reduced rates, applied early postemergence with Roundup effectively controlled weeds season long without injury to "Roundup Ready" soybeans. Encapsulated clomazone, evaluated as MON 7748, was indistinguishable from Command 4EC. Additional residual soybean herbicides can be applied postemergence. Continued and expanded research is needed. The use of Roundup tank-mixed with residual postemergence herbicides can result in a weed control program that requires only one application, either preemergence, delayed preemergence or early postemergence. Application flexibility could be maximized for farmers and custom applicators that must spray many acres annually.

[1] Prof., Dept. of Extension Specialists, Rutgers University, Bridgeton, NJ 08302

Perennial Broadleaf Weed Control in No-Tillage Soybeans

S. Glenn, P. A. Kalnay, and W.H. Phillips[1]

ABSTRACT

Perennial broadleaf weeds have become a significant problem for soybean producers in the Mid-Atlantic region. Lack of tillage contributes to this problem since the vegetative reproductive structures of these weeds remain undisturbed. Perennial broadleaf weeds have traditionally been difficult to control in no-till soybeans. Studies were conducted at Keedysville and Beltsville, MD in 1994 and 1995 to evaluate new weed control technologies for perennial weed control in no-till soybeans. All herbicides were applied postemergence with a 10-foot boom delivering 19.4 gallons/A at 38 psi to 15- by 35-foot plots. Canada thistle [*Cirsium arvense* (L.) Scop.] and horsenettle (*Solanum carolinese* L.) were 3 to 8 inches high and hemp dogbane (*Apocynum cannabinum* L.) was 6 to 12 inches high at the time of application. Studies comparing row widths were arranged with a split block design and all other studies had randomized complete block designs. There were three replications per treatment in each study. Postemergence applications of 0.6 lbs ai/A glyphosate controlled Canada thistle and horsenettle better in 15-inch soybean rows than 30-inch rows (Table 1). Canada thistle control with 0.75 lbs/A and 1.1 lbs/A glyphosate was similar in 15- and 30-inch rows. Horsenettle control was greater for applications of 1.1 lbs/A glyphosate than 0.6 and 0.75 lbs/A in 15-inch rows. In 30-inch rows, horsenettle control was similar for 0.75 and 1.1 lbs/A glyphosate applications and remained below the control achieved with 1.1 lbs/A glyphosate applications in 15-inch rows. Hemp dogbane control in 30-inch glyphosate-tolerant soybeans increased as the glyphosate rate increased from 0.6 to 1.1. lbs/A. There was no soybean injury associated with any glyphosate treatment in these studies. These studies indicate that Canada thistle, horsenettle, and hemp dogbane can be controlled with glyphosate applications in glyphosate-tolerant soybeans. Control of Canada thistle and horsenettle can be achieved at lower glyphosate rates in 15-inch rows versus 30-inch rows.

[1]Assoc. Prof. and Grad. Res. Assts. Dept. of Agron., Univ. of MD, College Park, 20742.61

Table 1. Canada thistle, horsenettle, and pokeweed control six weeks following applications of glyphosate tolerant, no-tillage soybeans planted in 15- (N) and 30-inch (W) row widths.

Treatment	Rate	Canada thistle Control*		Horsenettle Control*		Hemp Dogbane Control**
		N	W	N	W	W
	(lbs ai/A)	% ***				
Glyphosate	0.6	93a	77b	83b	60c	53c
Glyphosate	0.75	95a	93a	86b	82b	70b
Glyphosate	1.1	100a	100a	100a	87b	95a

*Experiments conducted at Beltsville, MD in 1995.

**Experiments conducted at Keedysville, MD in 1994.

***Means within the paired columns for each weed species followed by the same letter are not significantly different at the 5% level according to Fisher's Protected LSD.

USE OF GLUFOSINATE-AMMONIUM FOR WEED CONTROL IN CORN AND SOYBEANS IN THE NORTHEAST

M.A. Fidanza, W.J. Bertges, D.R. Spak, and E.P. Pieters[1]

ABSTRACT

Glufosinate-ammonium is a non-selective herbicide for the management and control of a wide range of annual and perennial weeds. The ability of a plant to gain resistance to glufosinate-ammonium is accomplished through genetic engineering. Advances in biotechnology have made it possible AgrEvo USA Company to genetically engineer corn and soybeans to be resistant to this herbicide. Glufosinate-ammonium is suitable for use in herbicide resistant crops because of its broad-spectrum weed control properties.

Field trials have demonstrated the effectiveness of glufosinate-ammonium to control a variety of grass and broadleaf weeds. In previously reported studies, genetically altered corn and soybeans exhibited resistance to post-emergence applications of glufosinate-ammonium of $\leq$ 1500 g ai ha^{-1}. Post-emergence applications of this herbicide at rates of 250 to 400 g ai ha^{-1} were effective in efficacy trials with genetically altered corn and soybeans in 1994 and 1995. Successful weed control results in corn and soybeans also were noted when tank-mixing glufosinate-ammonium with other existing postemergence herbicides or applied in combination with preemergence herbicides. Genetically engineered herbicide resistant crops provide an additional approach to selective weed management and control in corn and soybean crops.

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[1]Field Dev. Rep., Field Dev. Mgr., and Prod. Dev. Mgrs.; respectively. AgrEvo USA Company, Wilmington, DE 19808.

MODE OF ACTION OF THE HERBICIDE GLUFOSINATE

D.R. Spak[1]

Glufosinate is a non-selective postemergence herbicide being developed for agricultural and specialty uses. Phosphinothricin, structurally equivalent to synthesized glufosinate herbicide, was first isolated as a metabolite of the bacteria *Streptomyces viridochromogenes*. Glufosinate is absorbed primarily through green plant tissues and has no soil activity as a result of rapid microbial degradation and limited root uptake. Rate of glufosinate uptake has been shown to vary among plant species. Rainfastness similarly varies with plant species and has been shown to range from 20 minutes to 8 hours depending on glufosinate rate and rainfall intensity. Significant acropetal translocation may occur within a treated leaf, whereas the extent of basipetal phloem transport is generally limited but is species dependent. Herbicidal activity is greatest under high temperature, high humidity, and direct sunlight. Activity is also enhanced by the addition of ammonium sulfate apparently as a result of increased glufosinate uptake.

Glutamine synthetase (GS) in chloroplasts and cytoplasm is the primary site of glufosinate action. Glufosinate binds irreversibly to GS, the enzyme which catalyzes the conversion of glutamate plus ammonia into glutamine, an essential step for nitrogen assimilation. Ammonia accumulates within plant tissues several hours after treatment, and is accompanied by a significant decrease in glutamine, glutamate, aspartate, and several other essential amino acids. Herbicidal symptoms are reduced in the dark, as a result of two light-dependent reactions (photorespiration and nitrite reduction) which are primary sources of ammonia. High levels of ammonia is toxic to plants and several mechanisms of cell damage are possible.

Photosynthesis is inhibited by glufosinate and two mechanisms have been proposed. Photosynthesis inhibition may be a direct result of ammonia uncoupling photophosphorylation and/or inhibiting photosystem I and photosystem II reactions, however, evidence suggests that this accounts for only a small reduction of photosynthesis (20%). Alternatively, there is evidence that the inhibition of photosynthesis is not due to ammonia alone, but is primarily the result of glutamine and glutamate depletion. Photorespiration is inhibited by the lack of amino donors (glutamine and glutamate) for the glycolate pathway, and as a result, phosphoglycolate, glycolate and glyoxylate accumulates. Glyoxylate prevents the activation of ribulose bisphosphate carboxylase, the key enzyme in carbon fixation, and directly disrupts photosynthesis. This appears to be the major pathway for glufosinate inhibition of photosynthesis.

Glufosinate provides control of many perennial plant species possessing underground regenerative tissues not controlled by contact or membrane disrupting herbicides. The mechanism for control of regrowth from regenerative tissues is unclear, but may be due to the translocation of glufosinate, or a process associated with depletion/allocation of energy reserves. Susceptibility among plant species is not likely a result of GS isoenzyme sensitivity or rate of glufosinate metabolism, but may be due to rate of uptake and translocation out of treated tissues.

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[1]D.R. Spak. Product Development Manager, AgrEvo USA Company, Wilmington, DE.

USE OF A SPRING-TINE CULTIVATOR FOR PRE-EMERGENCE WEED CONTROL

J.M. Jemison[1] and M.H. Wiedenhoeft[2]

ABSTRACT

Pesticide detections in surface waters have become quite common in recent years. Early season rainfall can erode soil and pesticides into streams and rivers. Delaying pesticide applications by using post-emergence products could reduce the chance of pesticide movement into surface waters. However, problems exist with this approach; some annual grasses and broadleaf weeds are not controlled well with post-emergence chemicals. As a result, some type of pre-emergence or early post-emergence cultivation may provide growers with better control than simply using a post-emergence product. An experiment was conducted to determine: 1) weed control using a spring-tine cultivator in silage corn production; 2) the impact of spring-tine cultivation on corn populations; 3) if after cultivation, yields are influenced by a post-emergence chemical spray; and 4) the optimum number of cultivations to make to get best weed control with and without post-emergence herbicides. The experiment was initiated in May 1995 using a split-plot factorial design with cultivations as main plots and post-emergence spray as sub plots. Treatments were replicated four times. Corn (Agway CO-175) was planted at 28000 seeds/ac, but due to an extended cold wet period, initial plant populations were only 22,200 plants/ac. Cultivations were made with a Lely spring-tine cultivator at the following stages of development: two-leaf stage (2-LS); spike + 2-LS; spike, 2-LS, and fourth leaf stage (4-LS); 2-LS and fifth-leaf stage (5-LS); and spike, 2-LS, and sixth leaf stage (6-LS). A combination of Resource and Accent were each hand-applied at a 0.66 oz/ac rate using a small plot sprayer. Weed samples were taken in mid July and mid August. Three samples were collected from a 0.33 m^2 quadrat per plot on each sampling date. Silage yields were estimated at harvest. Two 5-m rows were harvested, weighed, and six plants were shredded to obtain an estimate of the dry matter content. Our experimental results were influenced by the environmental conditions. Following a cool wet early May, June and much of July was quite dry. During the dry period, corn growth was suppressed. However, weed germination continued during the dry period. With the delayed canopy closure, most of the cultivation treatments were only moderately effective. The cultivator did not significantly reduce plant populations. Cultivating once, twice and three times reduced populations by 5, 7, and 9 percent relative to the control. The only cultivation treatment that was as effective in controlling broadleaf weeds as a post-emergence spray was the Spike, 2-LS, and 6-LS treatment. Yields from plots that were sprayed and cultivated were significantly higher than corn that was just cultivated. Silage yields were generally five tons higher in the post-emergence treatments compared to the cultivated treatments. The best cultivated treatment included the cultivation at the 6-LS. Corn from this treatment had yields over 20 tons/ac, very close to the 21 ton average for all the post-emergence chemical treatments. Broadleaf weed populations were also no different from the sprayed subplot. The likely reason for the success of this combination of cultivations was that rains came within a week following this last cultivation, and this promoted canopy closure before the weeds could become established. This experiment will be repeated over the next few years to see if more favorable weather conditions will improve the success of the cultivation treatments alone.

EFFECT OF SETHOXYDIM RATE AND TIMING ON ALFALFA-GRASS MIXTURES

W. S. Curran, M. H. Hall, and E. L. Werner[1]

ABSTRACT

Greenhouse and field research examined seedling orchardgrass (Dactylis glomerata L. 'Pennalate') and timothy (Phleum pratense L. 'Climax') tolerance to sethoxydim. Both experiments examined two rates and three application timings. In the greenhouse, sethoxydim was applied at 0.094 and 0.141 lb ai/A at the 2-leaf, 4-leaf, and 6-leaf stages of forage grass development. The field study was established at the Penn State Agronomy research farm near Rock Springs, Pennsylvania in 1992 and 1993. The experimental design was a split-split plot randomized complete block with four replications. Grass species were the main plot factor and herbicide application timing was the subplot factor. Herbicide rates were randomized within each timing subplot. Individual plot size measured 6 by 15 feet. Alfalfa (Medicago sativa L. 'Arrow') was seeded in a conventionally tilled seedbed at 10 lb/A. Orchardgrass or timothy grass were seeded with the alfalfa at 3 and 4 lb/A, respectively. Sethoxydim was applied at 0.141 and 0.188 lb/A at the 2- and 4-leaf stages of forage grass development and after the first harvest. Crop oil concentrate was added to all sethoxydim treatments at 1% v/v. An application of 2,4-DB was broadcast at 1.0 lb ai/A over the entire field study in late June to aid in the control of broadleaf weed species. Parameters measured in the field included weed control and forage grass and alfalfa yield. Shoot dry weight reduction was measured in the greenhouse experiment.

In the greenhouse, orchardgrass was more tolerant to sethoxydim than timothy and the tolerance of both grass species was better at the 6-leaf stage than at the 2 or 4-leaf stages. Reduction in grass shoot dry weight for orchardgrass and timothy respectively, ranged from 64 to 75% at the 2-leaf stage to 12 to 32% at the 6-leaf stage. Increasing sethoxydim application rate did not affect grass growth. Results from the field trials were similar to those in the greenhouse. Growth of both grass species was reduced and cumulative yields were small (< 400 lb dry matter/A) the year of application, especially in the early timing (2-leaf stage) treatments. The year following application, orchardgrass yields were generally higher than timothy yields and regardless of grass species, the early timing caused the greatest reduction in grass yield. Alfalfa yield always compensated for any reduction in grass growth. Application of sethoxydim at the 2-leaf stage reduced orchardgrass biomass 47 to 72% and timothy biomass 82 to 97% at the first harvest (late May) the year following application. Application at the 6-leaf stage reduced orchardgrass biomass no more than 20%, while timothy yields were significantly reduced at first harvest the year following application. As in the greenhouse study, sethoxydim rate did not affect the degree of grass tolerance with either species.

These experiments suggest that sethoxydim could be safely used for weed control in certain alfalfa-grass mixtures the year of establishment. However, grass species selection is critical for success. Although some reduction in grass growth will occur the seedling year, orchardgrass persisted and tolerated up to 0.188 lb/A sethoxydim applied at the 4 to 6-leaf stage of growth. Orchardgrass yields were mostly unaffected the year following application. Timothy is less tolerant of sethoxydim than orchardgrass and application during the establishment year can greatly reduce timothy in the mix.

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[1]Asst. Prof. Weed Sci., Assoc. Prof. Forage Prod. and Res. Tech., respectively, Dept. of Agron., The Pennsylvania State University, University Park, PA 16802.

EFFECTS OF LATE-WINTER HERBICIDE APPLICATIONS ON SEMI-DORMANT ALFALFA

H. Menbere and R. L. Ritter*

ABSTRACT

In the mid-Atlantic region, warm temperatures during the Winter may result in alfalfa (Medicago sativa L.) never achieving true dormancy. On the other hand, if plants go dormant, warm temperatures in late Winter/early Spring may cause plants to break dormancy early. In both cases, farmers and custom applicators may be making a herbicide application to alfalfa that has a few inches of Spring growth. Many alfalfa herbicides labeled for dormant application are not labeled for application to non-dormant alfalfa for fear of crop injury. Yet, if weeds exist, how do you achieve control but not injure the crop? The purpose of this study was to examine a variety of herbicides labeled for alfalfa and applied after dormancy had broken to see what effects this would have on subsequent yield.

This study was conducted at the University of Maryland Hayden Farm located in Beltsville, MD. A two-year-old stand of 'Legacy' alfalfa had broken dormancy in early March, 1995. Herbicide applications were made on March 22 when the alfalfa had approximately 2 to 4 inches of growth. Treatments included imazethapyr (Pursuit) at 0.063 and 0.094 lb ai/A; paraquat (Gramoxone Extra) at 0.23, 0.313, and 0.469 lb ai/A; metribuzin (Sencor/Lexone) at 0.375 lb ai/A; terbacil (Sinbar) at 0.375 lb ai/A; bromoxynil (Buctril) at 0.375 lb ai/A; and 2,4-DB (Butyrac) at 1.5 lb ai/A. Phytotoxicity ratings were made in April. Yields were collected in May, June, July and August.

Visual ratings of crop tolerance (phytotoxicity) indicated that the highest levels of foliar injury occurred from all three rates of paraquat, ranging from 23% (low rate) to 35% (high rate) on April 5. A significant amount of foliar injury was also observed from metribuzin and terbacil which averaged 18% and 13%, respectively, on April 5. All of the other treatments averaged less than 10% injury on the April 5 rating. A visual phytotoxicity rating made on April 20 found all rates of paraquat and metribuzin still causing a significant amount of crop injury.

Yield data obtained May 6 indicated lower weights from alfalfa treated with the two highest rates of paraquat and the single rate of metribuzin. With the June and July harvests, no differences were observed between treatments in terms of yield. Yet, the August harvest found the plots treated with the high rate of paraquat and the single rate of metribuzin were yielding the lowest among all the treatments.

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*Agric. Res. Tech. and Assoc. Prof., Agric. Exp. Stn., Agron. Dept., Univ. of MD, College Park, MD 20742.

A SECOND BIOTYPE OF IMIDAZOLINONE-RESISTANT SMOOTH PIGWEED IS CROSS-RESISTANT TO OTHER ALS-INHIBITORS

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

ABSTRACT

A population of smooth pigweed (*Amaranthus hybridus* L.) was identified in 1994 in Oak Hall, VA that was no longer controlled by imazaquin plus pendimethalin (Squadron) following applications of imazaquin (Scepter) in combination with trifluralin or pendimethalin each year since 1986. High smooth pigweed densities were observed in 1991, but were not reported until 1994. Smooth pigweed seeds were collected in the fall of 1994 from the Oak Hall population (R) and from a known acetolactate synthase (ALS)-inhibitor-susceptible (S) population. Greenhouse studies were conducted in 1995 to determine if the R population was resistant to imazaquin and other ALS-inhibitor herbicides.

Smooth pigweed seeds (R and S) were planted in a greenhouse soil mix consisting of State sandy loam (Typic Hapludults), sand, and peat (23:13:1 by wt), and were grown in the greenhouse under natural sunlight with a photoperiod of at least 14 h. Plants were watered as needed and fertilized weekly to maintain active growth. Herbicides were applied POST to R and S smooth pigweed with a greenhouse sprayer in water at 25 gpa with a pressure of 40 psi through flat fan spray tips, and included 0.25% v/v non-ionic surfactant. Herbicides included 0 to 1.5 lb ai/A Scepter, 0 to 2.0 lb ai/A imazethapyr (Pursuit), 0 to 0.016 lb ai/A chlorimuron (Classic), 0 to 0.25 lb ai/A nicosulfuron (Accent), 0 to 0.12 lb ai/A rimsulfuron, 0 to 0.004 lb ai/A thifensulfuron (Pinnacle), and 0 to 0.126 lb ai/A pyrithiobac (Staple).

Percent control of R smooth pigweed did not exceed 75% from 1.5 lb/A Scepter and 2.0 lb/A Pursuit, respectively; whereas nearly complete control (90% or higher) of the S population was obtained with 0.063 to 0.125 lb/A Scepter and 0.031 to 0.063 lb/A Pursuit. Percent control of the R population from 0.008 lb/A Classic was less than 75%, while control of the S population from the same rate of Classic was higher than 80%. Percent control of the R population was more than twice that of the S population 0.015 lb/A Accent. Rimsulfuron rates as low as 0.015 lb/A controlled approximately 85% of both R and S smooth pigweed. Control of R smooth pigweed was approximately 70% with 0.002 lb/A Pinnacle, while control of the S population was higher than 90% with the same rate of Pinnacle. Control of R smooth pigweed was less than 40% from Staple rates as high as 0.126 lb/A, while only 0.032 lb/A Staple controlled approximately 90% of S smooth pigweed. R smooth pigweed is resistant to Scepter and Pursuit, and is cross-resistant - at least at low levels - to Classic, Accent, Pinnacle, and Staple; but not to rimsulfuron.

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[1] Grad. Res. Asst., Prof., and Agri. Res. Sci. A, Virginia Polytech. Inst. and State Univ., Eastern Shore Agric. Res. and Ext. Center, Painter, VA 23420.

RESPONSE OF SETHOXYDIM-COMPATIBLE CORN HYBRIDS TO VARIOUS GRAMINICIDES

M. Isaacs, Q. Johnson, and M. VanGessel[1]

ABSTRACT

Field experiment was conducted in 1995 to evaluate the impact of various graminicides on sethoxydim-compatible corn (Zea mays L.) hybrids. The sethoxydim-compatible corn hybrids were Asgrow 'X66041', Cargill 'X7888PC', and Dekalb 'DK592SR'; a sethoxydim-susceptible hybrid, Pioneer '3394', was also included. All hybrids were seeded at 18,000 seeds/A. All herbicide treatments were applied as broadcast POST treatments with a tractor-mounted sprayer at 25 gpa using 8003 flat fan nozzles and 29 psi. Experimental area was treated PRE with Bicep (atrazine plus metolachlor) at 1.75 qt/A. Treatments were 1X and 4X the labeled rates of sethoxydim, quizalofop, fluazifop-butyl, clethodim, and Fusion (fluazifop-butyl plus fenoxaprop). Nicosulfuron at the labeled rate and an untreated check were included for comparative purposes. All herbicide treatments were applied with a crop oil concentrate at 1% v/v of the total spray volume. Crop injury was rated on 0 to 5 scale (0= no injury and 5= plant death).

Crop injury was rated at 11, 25, and 57 days after treatment (DAT). Since results were very similar for all rating dates, only the 25 DAT evaluation will be discussed. The sethoxydim-susceptible hybrid (3394) was killed by all treatments except nicosulfuron. The hybrid X66041 appeared to be more sensitive to treatments than the other two sethoxydim-compatible hybrids. At the labeled rate, sethoxydim, nicosulfuron, and quizalofop did not injure the sethoxydim-compatible hybrids. Clethodim caused severe crop injury at the labeled rate, with ratings ranging from 4.5 to 5.0 at 25 DAT for the three sethoxydim-compatible hybrids. At the 4X rate, quizalofop, fluazifop-butyl, clethodim, and Fusion severely injured the sethoxydim-compatible hybrids (>3.5 when rated 25 DAT).

Yields were higher with nicosulfuron than other herbicide treatments. Nicosulfuron provided good control of broadleaf weeds that were not controlled with the PRE application of Bicep. The other graminicide treatments had broadleaf weed competition that reduced yields. With sethoxydim-compatible hybrids, the labeled rates of sethoxydim and quizalofop did not reduce yield compared to the untreated check. At the 4X herbicide rate, only the sethoxydim treatment did not reduce yield.

The three sethoxydim-compatible hybrids in this study did not exhibit cross-tolerance to fluazifop or clethodim and only marginal tolerance to quizalofop at the labeled rate. This study also demonstrates that there are options for POST management of volunteer sethoxydim-compatible corn in soybeans and other crops.

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[1]Director, Res. and Educ. Ctr., Ext. Assoc., Assist. Prof., Dept. Plant and Soil Sci., University of Delaware, Res. and Educ. Ctr., Georgetown, DE 19947.

Tolerance and yield of three sethoxydim-compatible corn hybrids and one sethoxydim-sensitive hybrid to various POST graminicides[a]. Injury ratings were taken 25 days after treatment[b].

Trt No	Treatment Name	Rate lb ai/A	Corn Injury 3394	Corn Injury X66041	Corn Injury 7888PC	Corn Injury 592SR	Corn Yield 3394	Corn Yield X66041	Corn Yield 7888PC	Corn Yield 592SR
			-------- 0-5 rating --------				---------- bu/A ----------			
1	QUIZALOFOP COC	0.055	5.0	0.8	0.0	0.0	0	24	38	46
2	FLUAZIFOP-BUTYL COC	0.188	5.0	2.1	2.1	2.4	0	19	19	25
3	FUSION PREMIX *FLUAZIFOP-BUTYL *FENOXAPROP COC	0.16 0.125 0.035	5.0	2.0	1.9	1.4	0	19	22	32
4	SETHOXYDIM COC	0.188	5.0	0.0	0.0	0.0	0	32	34	47
5	CLETHODIM COC	0.125	5.0	5.0	4.9	4.5	0	0	0	0
6	QUIZALOFOP COC	0.22	5.0	4.9	4.8	4.6	0	0	0	0
7	FLUAZIFOP-BUTYL COC	0.75	5.0	4.4	4.1	4.3	0	0	0	0
8	FUSION PREMIX *FLUAZIFOP-BUTYL *FENOXAPROP COC	0.64 0.50 0.14	5.0	4.1	3.5	3.9	0	0	0	0
9	SETHOXYDIM COC	0.75	5.0	0.3	0.0	0.0	0	33	35	46
10	CLETHODIM COC	0.50	5.0	5.0	5.0	5.0	0	0	0	0
11	NICOSULFURON COC	.031	0.0	0.0	0.0	0.0	72	46	59	61
12	UNTREATED CHECK		-	-	-	-	55	41	36	45
LSD (.05) =			0.0	0.4	0.4	0.3	13	13	18	18

[a]The sethoxydim-compatible corn hybrids were Asgrow 'X66041' (X66041), Cargill 'X7888PC' (7888PC), and Dekalb 'DK592SR' (592SR); the sethoxydim-susceptible hybrid was Pioneer '3394' (3394).

[b]Crop injury was rated on 0 to 5 scale (0= no injury and 5= plant death).

TWENTY EIGHT YEARS OF VEGETATION CHANGE AT A RHODE ISLAND UTILITY RIGHT-OF-WAY

Richard Stalter[1]

ABSTRACT

The vegetation found on permanent line transects at a utility right-of-way, Exeter, Rhode Island, was sampled in late May, 1993. The species found at these permanent transects were compared with the vascular flora found at these same transects in May, 1965. Tree sprouts and tall shrub sprouts have been selectively treated with herbicides from 1963 to 1990. Eleven tree species were identified at the transects in 1965; five species were observed in 1993. Gaylussacia baccata, Rubus hispidus and Rubus flagellaris were dominant on the two dry sites in 1993, and occurred at 2 or more transects in 1965. Frequency values for Clethra alnifolia, Rubus canadensis and Salix bebbiana at transects on the wet right-of-way site have declined; Lindera benzoin has been eliminated. Carex pensylvanica and Potentilla candensis have maintained dominance on the dry right-of-way sites. Solidago spp. Lysimachia quadrifolia and Schizachyrium scoparium were dominant or codominant on the dry sites in 1993. Selective herbicide treatment has created a right-of-way dominated by herbaceous and shrubby species.

INTRODUCTION

The objective of this study is to describe the pattern of revegetation of a utility right-of-way constructed in March, 1963. The area discussed herein is located in the Wolf Rocks region of Exeter, Rhode Island, at 41° 31′ North Latitude, 71° 32′ West Longitude. The mesic sites in this region are dominated by white oak (Quercus alba), black oak (Quercus velutina), and red oak (Quercus ruba) while swamps are dominated by red maple (Acer rubrum), American elm (Ulmus americana), and pin oak (Quercus palustris)[1].

Stalter[5] studied 3 sites on this right-of-way in May, 1965. Sites 1 and 2 are dry; site 3 is wet (Figure 1.) The arborescent vegetation in the forest adjacent to sites 1, 2, and 3, was sampled and relative dominance was calculated for trees at each site. White oak (Quercus alba), was the dominant tree at site 1 accompanied by scarlet oak (Quercus coccinea). Quercus alba was also the dominant tree at site 2. Red maple, (Acer rubrum) was the dominant tree of the swamp at site 3.

The soils at mesic sites of this right-of-way are Narragansett fine sandy loams while Merrimac soils are dominant at wet areas[6]. The soils at all three sites are acid in reaction; pH ranged from 5.1 to 5.7 on the two dry sites and was 3.9 at the wet site.

1. Dept. of Biology, St. John's University, Jamaica, N.Y. 11439.

The arborescent and tall frutescent species were clear cut from the right-of-way in March 1963, and the stumps were chemically treated in that year with a four percent solution of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) in No. 2 fuel oil (Lewis Dumalow 1966, personal communication).

The Narragansett Electric Company, owner of the utility right-of-way, formulated a vegetation right-of-way management plan (Lewis Dumalow 1966, personal communication) and contracted with a company dealing with vegetation control. The taller shrubs and trees were sprayed with a 1.5 percent solution of 2,4,5-T in ten percent No. 2 fuel oil in water without disturbing the low-growing frutescent species. This practice continued until 2,4,5-T was banned by the federal government (Von Villas 1993, pers. communication).

The right-of-way was last sprayed with ACCORD/ESCORT in 1990. ACCORD was selectively sprayed directly on trees and tall shrubs "until the vegetation was wet." Concentration was 0.75 to 2 percent, the dose recommended for the control or partial control of woody brush, trees, and undesirable herbaceous vegetation (Von Villas 1993, pers. communication). ESCORT was applied in the above manner at a concentration of 0.5 to 1 ounce per 100 gallons of water in 1990. ROUNDUP was applied to the aforementioned undesirable vegetation, trees, and tall shrubs, in 1986.

METHODS

The vegetation on the three right-of-way sites was sampled by the line intercept method of Canfield[2]. Five 80-foot transects were laid out at each study site and the spacing and positioning of the transects varied according to the study sites. Frequency, percent occurrence of shrub and herb species among each set of five transects at 3 sites on the right-of-way, is presented in Table 1. Only plants found on 2 or more transects, 40 percent frequency or greater, are listed in the table. Nomenclature is according to Gleason and Cronquist[4].

RESULTS AND DISCUSSION

Selective spraying of arborescent vegetation has eliminated most of the trees from the right-of-way. The number of tree species on the right -of-way has been reduced from eleven species in 1965 to five in 1993. Quercus alba, the dominant tree on the dry right-of-way sites in 1965, has been eliminated. Only Acer rubrum, found on 80 percent of the transects at the wet site in 1965, is still common in 1993, 60 percent frequency. Huckleberry (Gaylussacia baccata), is the dominant shrub at the two dry sites. Two dewberrys (Rubus flagellaris and Rubus hispidus) and Gaylussacia baccata are the dominant shrubs at the wet right-of-way site.

Sedge (Carex pensylvanica), is the dominant herb at the dry right-of-way sites with frequency values of 100% Goldenrod (Solidago spp.) and whorled loosestrife (Lysimachia quadrifolia),

also occur at 100% of the transects at both dry sites. Solidago spp., sensitive fern (Onoclea sensibilis) and cattail (Typha latifolia) are dominant herbs at the wet right-of-way, all with 100 frequency. Two sedges (Carex atlantica and Scirpus cyperinus) marsh shield fern (Thelypterus palustris) and skunk cabbage (Symplocarpus foetidus) occur at 80% of the transects.

Stalter[5] sampled the vegetation on the above right-of-way sites in 1965, and compared the frequency and coverage of taxa in the arborescent, shrub and herbaceous strata. White oak (Quercus alba), was the dominant tree of the forest (average cover value 68%) at the 2 dry forest sites accompanied by Quercus coccinea. Selective cutting followed by herbicide treatment reduced the cover value of white oak to 4 and 1.5% respectively, at the two dry right-of-way sites, though white oak had attained 100% frequency at site 1 in 1965. White oak was absent at the right-of-way in 1993.

Red maple was the dominant tree at site 2, the swamp (56% cover, 80% frequency), and at the adjacent right-of-way (80% frequency) in 1965 (Figure 1). Red maple, an herbicide tolerant species[3] was observed on 50% of the transects in 1993. Spicebush (Lindera benzoin), 55% cover, 100% frequency, was the dominant shrub at the forest at site 3. The frequency value of spicebush at the adjacent wet right-of-way was 60% in 1966; this herbicide sensitive shrub was not observed at the right-of-way in 1993. Sweet pepperbush (Clethra alnifolia) was codominant with spicebush in the swamp, (20% cover and 100% frequency) and at the adjacent right-of-way in 1965 (34% cover and 100% frequency). In 1993, the frequency value of Clethra at the right-of-way declined to 40%.

Gaylussacia is an important shrub at the two dry right-of-way sites in 1993, occurring at 60% and 80% of the transects respectively. Rubus flagellaris has maintained its high frequency on the right-of-way at site 1. These aforementioned species were most likely favored by the construction of the right-of-way, as both species increased in frequency and cover immediately after trees were removed to create the right-of-way. Bull briar Smilax rotundifolia is the most common liana at site 2, generally forming an impenetrable tangle of stems. Smilax rotundifolia benefitted by the creation of the right-of-way as it increased in cover when the site was cleared. Smilax rotundifolia covered a large portion of this right-of-way in 1993.

Carex pensylvanica, the most common member of the herbaceous strata at the two forested sites and the right-of-way sites benefitted from tree removal and selective spraying which created a sunny xeric habitat[5]. When the dry forest and right-of-way sites were sampled in 1965, Carex pensylvanica was more common at the right-of-way than in the adjacent forest[6].

Sphagnum spp. was common in the swamp and right-of-way at site 3 where the level of the water table is at or above the level of the ground for long periods of the growing season. Several species

of Carex thrive at the sunny right-of-way with frequency values of 80% or 100% (Table 1). Typha latifolia, Onoclea sensiblis, and Solidago spp. have also invaded the wet right-of-way (Table 1).

In summary, the establishment of the right-of-way, which is periodically subjected to herbicide treatment, has created a community dominated by shrubs and herbs. Trees, which were well represented by stump sprouts when studied by Stalter in 1965, have nearly been eliminated, with the exeption of the herbicide resistant Acer rubrum. Huckleberry and dewberry species were the dominant shrubs on the dry right-of-way sites in 1993. Smilax rotundifolia has benefitted from the creation of the right-of-way, at site 2, where it was observed at all transects, 100 percent frequency, in 1993. Carex pensylvanica, cinquefoil (Potentilla canadensis), Lysimachia quadrifolia, and several grasses are the most conspicuous members of the herbaceous strata at the dry right-of-way sites in 1993.

Sphagnum spp., Carex spp., Solidago spp, Typha latifolia and Onoclea sensiblis are the dominant plants at the wet right-of-way site. The wet right-of-way has a large number of herbaceous plants with high frequency values. The high frequency values for herbaceous species is probably the result of the topography at site 3, as this section of the right-of-way is characterized by numerous slight changes in elevation. These changes in elevation affect species distribution as the water table is near or at the surface of the ground during most of the growing season. Some plants can thrive under the aforementioned conditions, whereas, many plants cannot tolerate flooding for long periods. This factor alone may be responsible for the large number of herbaceous plants at the wet right-of-way site.

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Table 1. A comparison of frequency of plants intercepted by 3 or more line transects at site 1: the forest, 1965 (column 1); right-of-way, 1965 (column 2); and right-of-way, 1993 (column 3). Taxa are grouped according to strata.

Species and Strata	Forest 1965	R-O-W 1965	R-O-W 1993
ARBORESCENTS			
Quercus alba	100	100	0
Prunus serotina	20	80	0
Quercus velutina	20	20	0
Acer rubrum	60	20	0
Quercus coccinea	60	0	20
FRUTESCENTS			
Gaylussacia baccata	100	100	60
Rubus flagellaris	0	40	40
Rhus radicans	60	0	0
Vaccinium angustifolium	80	20	0
Smilax rotundifolia	20	0	0
Rubus hispidus	0	80	100
Vaccinium vacillans	20	0	0
Rubus canadensis	0	20	40
Rhus vernix	0	40	0
HERBS			
Carex pensylvanica	100	100	100
Panicum commutatum	0	100	20
Chimaphila maculata	40	0	0
Potentilla canadensis	0	80	100
Juncus secundus	0	60	0
Maianthemum canadense	20	0	0
Solidago spp.	0	0	100
Lysimachia quadrifolia	0	0	100
Schizachyrium scoparium	0	0	100
Poa compressa	0	0	80
Juncus tenuis	0	00	60
Erigeron sp	0	0	60
Denstaedia punctulobula	0	0	60

SITE PREPARATION WITH DRY-FLOWABLE HEXAZINONE INCREASES STEM VOLUME OF CONTAINERIZED BLACK SPRUCE SEEDLINGS

Phillip E. Reynolds[1] and Michael J. Roden[1]

ABSTRACT

Liquid (VELPAR L) and dry-flowable (VELPAR ULW) hexazinone (2 kg ai/ha) were aerially applied to a northern New Brunswick clearcut to reduce raspberry competition. Treatment occurred in June 1987, with planting of containerized (multipot) black spruce in August of 1987 and 1988. Seedling survival and growth were measured yearly through August 1991. Hexazinone formulation did not affect raspberry control, seedling survival, or growth. Five growing seasons after treatment, raspberry competition was generally less in treated plots than in controls. Seedling survival did not differ among treatments for seedlings planted at either time interval after hexazinone treatment. Seedlings planted 14 months after hexazinone treatment grew poorly compared with those planted 2 months after herbicide treatment. Stem volume of seedlings planted 2 months after hexazinone treatment exceeded that of control seedlings in the 1st growing season after planting and remained greater than that of control seedlings through 1991. Stem volume increases over controls were restricted to the 2nd growing season after planting for seedlings planted 14 months after hexazinone treatment. Fourth-year stem volume of seedlings planted 2 months after hexazinone treatment was correlated with raspberry cover ($r^2 = 0.34$) and height ($r^2 = 0.33$). As raspberry cover or height increased, black spruce stem volume decreased.

INTRODUCTION

Red raspberry [Rubus idaeus L. var. strigosus (Michx.) Maxim.] is often the dominant competitor threatening the establishment of spruce plantations in eastern Canada, and in northeastern Maine (10). Presently, few herbicides effective in controlling raspberry competition are registered for forestry use in Canada. Glyphosate (VISION), a conifer release herbicide, is the primary herbicide used to reduce raspberry competition (3). Recently, two site preparation herbicide products, the liquid (VELPAR L) and granular (PRONONE) formulations of hexazinone were registered for silvicultural use in Canada. Both provide effective raspberry control as certified by their registration labels (3). Registration of the ultra low weight (VELPAR ULW) formulation of hexazinone for aerial application could provide a significant operational advantage, since a typical aircraft in use could treat up to 13 times more area per load with this formulation than with VELPAR L in a water carrier (3). A typical aircraft can treat up to 7 times more area per load with PRONONE than with VELPAR L, depending upon application rate.

This work reports raspberry control through 5 growing seasons after hexazinone site

1. Canadian Forestry Service, 1219 Queen St. E., Sault Ste. Marie, Ontario P6A 5M7.

preparation and survival and growth of black spruce [Picea mariana (Mill.) B.S.P.] seedlings through 4 growing seasons after planting. Evaluations of VELPAR ULW and VELPAR L efficacy for 3 years have shown that both formulations are effective in reducing raspberry cover (8, 9, 11). Spruce tolerance of hexazinone was similar for both formulations (9).

Objectives of this study were: (1) to investigate survival and growth of containerized (multipot), black spruce seedlings planted at different intervals after spring site preparation with differing formulations of hexazinone; (2) to quantify remaining raspberry competition in treated and control plots; and (3) to determine the preferred hexazinone formulation to achieve best seedling survival and growth during the establishment phase of the plantation.

METHODS

Site and experimental design

The clearcut treatment area is on J.D. Irving, Ltd. property near St. Leonard (approximately 47°27' latitude and 67°39' longitude), in northwest New Brunswick at approximately 240 m elevation. The site is located on a gentle, east-facing slope. Soils are fine-textured, including loams, gravely silt loams, and gravely clay loams. Mean sand, silt, and clay content of the soils is 31.4, 42.7, and 25.8%, respectively. The duff layer varies from 1 to 10 cm, organic matter from 3.1 to 12.2%, CEC from 16.9 to 30.4 meq/100 g, and pH from 4.1 to 5.4. Annual precipitation averaged 108 cm, falling mostly as rain between May and October. Approximately 6, 14, 10, 11, 11, and 7 cm of rain was received each month, respectively, from May through October 1987. No rain fell within six hours of hexazinone application. Soil freezing occurred in early November 1987.

The site was clearcut in February 1986 and mechanically site prepared in the summer of 1986, using a 125-ton Letourneau crusher to fell snags and break up residual logging slash. Prior to harvest, the site supported a stand composed of approximately 40% red (Picea rubens L.) and black spruce, 40% balsam fir [Abies balsamea (L.) Mill.], and 20% aspen (Populus tremuloides Michx.). After site preparation, portions of the site not treated with hexazinone rapidly revegetated with a dense cover of raspberries. Other vegetation consisted of grass species (control, 4% and hexazinone treatments, 5%) and fireweed (Epilobium angustifolium L.) (control, 15% and hexazinone treatments, 9 to 13%) by August 1991.

All treatments were replicated 4 times on 1 ha plots using a completely randomized layout. No significant differences in soil characteristics (i.e., pH, organic matter, CEC, % sand, % silt, % clay) were observed among treatments.

Treatments and planting

Liquid hexazinone (VELPAR L, 2 kg ai/ha) was applied in 55 l/ha water on the evening of June 25, 1987 using a Bell 206B helicopter equipped with a Simplex conventional boom and nozzles. Dry-flowable hexazinone (VELPAR ULW, 2 kg ai/ha) was applied on the evening of June 23, 1987 with a modified Simplex seeder slung from the same aircraft. Both applications occurred with no wind, light overcast skies, and temperatures between 13 and

18°C. At least 11 mm or rain was received within 24 hours of each application.

Half of each plot (split-plot design) was planted (2.1 m spacing) in August 1987 and in August 1988 with local containerized (multipot) black spruce stock obtained from the Irving nursery. A total of 288 (i.e., 96 per treatment) seedlings per year planted in 1987 and 1988 were randomly selected and staked for yearly measurement. All staked seedlings were characterized as vigorous or healthy when planted.

Measurements and analysis

Seedling survival (%), height (cm), and basal stem diameter (mm) were measured annually (August). Stem volume (cm^3) was computed using the formula for a cone: area/3 x length = 1/3 x pi x r^2 x height (1). Cover (%) of the dominant competitor, raspberry, was estimated visually within a 1 m radius of each staked seedling to the nearest 5% value. The height of raspberry stems within each quadrant of the circle was measured to the nearest cm.

Analyses of variance (ANOVA's) were performed on black spruce stem volume and raspberry competition data. Treatment means were compared via Tukey's Studentized Range (HSD) Test at 5% level of significance. The frequency of occurrence of live seedlings and those taller than surrounding raspberries was compared with a Likelihood Ratio Chi-Squared (G-Squared) Test (15). Regression analyses were performed on 4th-year seedling stem volume vs. 1991 raspberry cover or height for seedlings planted 2 months after hexazinone treatment.

RESULTS

Five years after treatment, mean raspberry cover had increased to 82% in untreated plots, and was greater ($P = 0.008$) than in plots treated with hexazinone (64% liquid and 56% dry-flowable). Cover did not differ for the two hexazinone treatments. Raspberry height on untreated plots was 43 cm and was greater ($P = 0.012$) than that for VELPAR ULW (26 cm) plots, but did not differ from that for VELPAR L (26 cm) plots.

Seedling survival did not differ among treatments in August 1991, for seedlings planted at either time interval after hexazinone treatment. Survival was 91, 83, and 88% for control, liquid, and dry-flowable seedlings planted in 1987, and 84, 90, and 77%, respectively, for seedlings planted in 1988.

Most (> 90%) seedlings planted in both years into hexazinone plots were taller than surrounding raspberries in 1991. Overtopped seedlings (i.e., 21% and 33% for 1987 and 1988 controls, respectively) generally exhibited poor growth morphology (i.e., tall, skinny, and twisted stems), were characterized by chlorotic or numerous brown needles, and frequently suffered extensive needle loss. The number of seedlings taller than surrounding raspberries did not differ for the two hexazinone treatments.

Seedlings planted 14 months after hexazinone treatment grew poorly compared with those planted 2 months after herbicide treatment. Stem volume increases over controls were

restricted to the 2nd growing season after planting (P = 0.027), for seedlings planted 14 months after site preparation with liquid hexazinone (Figure 1). Stem volume of seedlings planted 2 months after hexazinone treatment exceeded that of control seedlings in the 1st growing season after planting (P = 0.021) and remained greater than that of control seedlings through the 4th growing season (P = 0.004). Fourth-year stem volume of seedlings planted 2 months after hexazinone treatment was correlated with raspberry cover (r^2 = 0.34) and height (r^2 = 0.33) (Figure 2). Stem volume decreased as raspberry cover or height increased.

DISCUSSION

Reducing raspberry competition with hexazinone enhanced black spruce stem volume for multipot seedlings planted 2 or 14 months after spring hexazinone treatment. These growth increases were greatest for seedlings planted 2 months after treatment, likely because of less raspberry competition when planted. Sufficient rainfall was received after the ULW treatment (i.e., 11 mm within 24 hours) to ensure the rapid release of virtually all hexazinone from the dry-flowable granules. Once released, soil persistence probably paralleled that of the liquid VELPAR L formulation, explaining why no significant differences were observed in performance (i.e., efficacy, survival, growth) for the two formulations (12). Once in the soil, hexazinone persists up to 1 year after application (4, 14), but had no apparent negative effect on height or diameter of multipot seedlings (13).

We conclude that spring treatment with VELPAR ULW, followed by planting 2 months after herbicide treatment, offers the best treatment to achieve optimal growth during the establishment phase of the plantation. Since stem volume did not differ for the two hexazinone treatments, operational considerations, including treatment cost, also need to be considered when selecting the best treatment. Operationally, a typical aircraft can treat more area per load with the VELPAR ULW formulation, with considerable cost savings, since this formulation does not require a water carrier. Growth increases over that of untreated seedlings achieved after site preparation with the dry-flowable hexazinone formulation are comparable with those reported by other researchers who have studied spruce growth response following hexazinone site preparation for herbaceous vegetation control (7, 16, 17). They are generally greater than those reported for spruce using other vegetation management techniques such as manual cutting, prescribed burning, and certain types of scarification (2, 5, 6).

ACKNOWLEDGEMENTS

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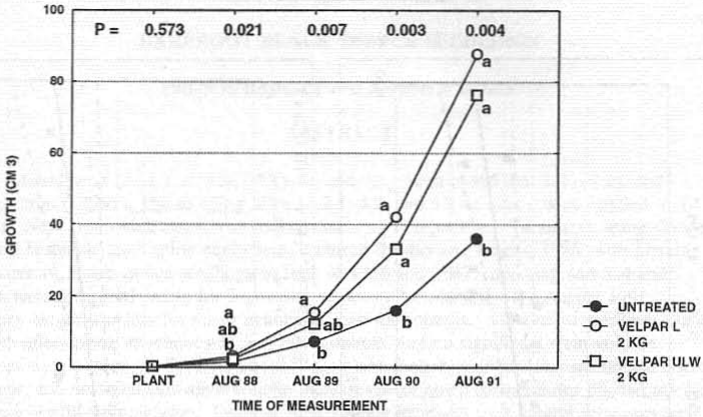
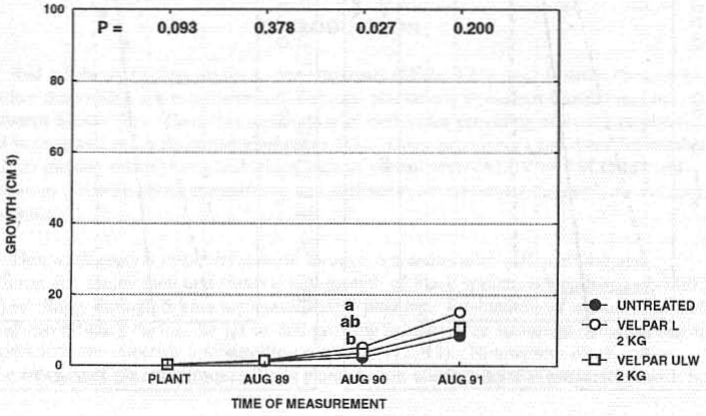
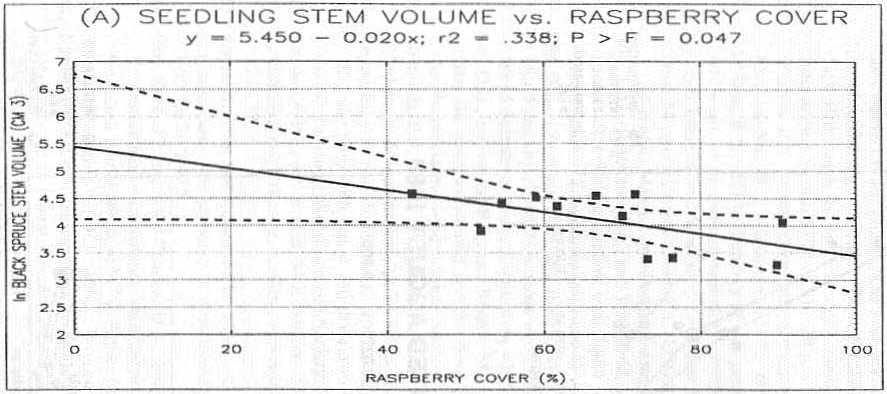
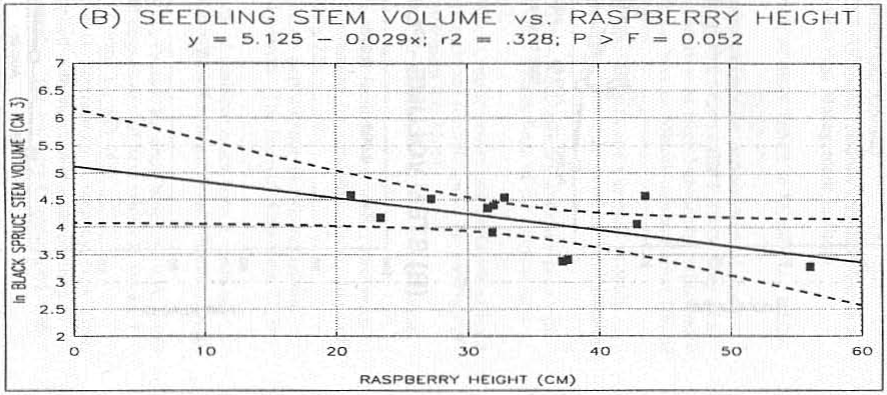
(A) STEM VOLUME - PLANTED AUGUST 1987



(B) STEM VOLUME - PLANTED AUGUST 1988




(A) SEEDLING STEM VOLUME vs. RASPBERRY COVER
y = 5.450 − 0.020x; r2 = .338; P > F = 0.047
ln BLACK SPRUCE STEM VOLUME (CM 3)
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
0
20
40
60
80
100
RASPBERRY COVER (%)


(B) SEEDLING STEM VOLUME vs. RASPBERRY HEIGHT
y = 5.125 − 0.029x; r2 = .328; P > F = 0.052
ln BLACK SPRUCE STEM VOLUME (CM 3)
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
0
10
20
30
40
50
60
RASPBERRY HEIGHT (CM)

SITE PREPARATION WITH SULFOMETURON AND METSULFURON INCREASES STEM VOLUME OF BAREROOT BLACK SPRUCE SEEDLINGS

Phillip E. Reynolds[1] and Michael J. Roden[1]

ABSTRACT

Metsulfuron (ALLY or ESCORT), 36 and 72 g ai/ha (~ 0.5 and 1.0 oz/ac), and sulfometuron (OUST), 150 to 450 g ai/ha (~ 2.1, 4.2, and 6.3 oz ai/ac), were applied to a northern New Brunswick clearcut to reduce raspberry competition. Treatment, using skidder-mounted herbicide application equipment, occurred in May and August 1986, with planting of 2+2, bareroot, black spruce seedlings in June of 1986 and 1987. Seedling survival and growth were measured yearly for 5 growing seasons after planting. By August 1991, raspberry height was less for many treatments than for controls. Survival of seedlings planted 1 month after spring treatment was less than controls, and no significant stem volume increases were observed. Survival of seedlings planted after some summer treatments also was poor, and no significant stem volume increases were noted for seedlings planted after site preparation with sulfometuron. Optimal stem volume increases over control seedlings were observed for seedlings planted 1 yr after spring sulfometuron treatment. These increases occurred sooner than for seedlings planted 1 yr after spring metsulfuron treatment or after summer metsulfuron treatment. Fifth-year stem volume for these seedlings was correlated with raspberry cover ($r^2 = 0.44$) and height ($r^2 = 0.70$), decreasing as raspberry cover or height increased.

INTRODUCTION

Red raspberry [Rubus idaeus L. var. strigosus (Michx.) Maxim.] is often the major competitor threatening the establishment of spruce plantations in eastern Canada and in northeastern Maine (11). Canadian registration of herbicides providing effective raspberry control is reviewed in an accompanying paper (17). Other promising candidates for raspberry control (5) include sulfonylurea herbicides such as metsulfuron (ALLY or ESCORT) and sulfometuron (OUST). Both metsulfuron and sulfometuron may enter target plants via root or foliar uptake.

This work reports raspberry control through 6 seasons after sulfometuron and metsulfuron site preparation and survival and growth of black spruce [Picea mariana (Mill.) B.S.P.] seedlings through 5 growing seasons after planting. Evaluations of metsulfuron and sulfometuron efficacy during the 1st or 2nd growing seasons after treatment demonstrated that both herbicides are effective in controlling raspberry (12, 13). Noteworthy black spruce seedling injury was observed for seedlings planted soon after spring site preparation with both

1. Canadian Forestry Service, Sault Ste. Marie, Ontario P6A 5M7.

herbicides, and also for seedlings planted 10 months after summer treatment with both herbicides (12-14). Seedling mortality increased through August 1989 for all treatments, but was highest for seedlings planted 1 month after spring treatment and for some summer treatments (14, 16). The number of seedlings overtopped by raspberries declined over time, and differences in overtopping between treated and control seedlings were generally significant (15). By August 1989, most seedlings planted into herbicide treatments were taller than surrounding raspberries, whereas most control seedlings were shorter. Overtopped seedlings generally exhibited poor growth morphology (i.e., tall, skinny and twisted stems), were characterized by chlorotic or numerous brown needles, and frequently suffered extensive needle loss. In 1989, the health of seedlings planted approximately 1 year after spring treatment, and taller than surrounding raspberries, was better than that of seedlings that remained overtopped (Reynolds and Roden, unpublished statistical data).

Objectives of this study were: (1) to quantify raspberry competiton in treated and control plots; (2) to investigate survival and growth of bareroot, black spruce seedlings planted at different time intervals after spring, soil-applied, or summer foliar-applied site preparation with differing rates of metsulfuron and sulfometuron; and (3) to determine the best time of treatment, herbicide, and rate to achieve optimal seedling survival and growth during the establishment phase of the plantation.

METHODS

Site and experimental design

The clearcut treatment area is located on J.D. Irving, Ltd. property near St. Leonard (approximately 47°17' latitude and 67°43' longitude), in northwest New Brunswick at approximately 240 m elevation. Soils are fine-textured, including silty clay loams and silty clays. Mean sand, silt, and clay content of the soils is 15.2, 49.9, and 34.8%, respectively. The duff layer varies from 1 to 10 cm, organic matter from 0.6 to 10.5%, CEC from 8.4 to 33.5 meq/100 g, and pH from 3.8 to 6.2. Annual precipitation averages 108 cm, falling mostly as rain between May and October. Approximately 7, 5, 14, 18, 11, and 5 cm of rain was received each month, respectively, from May through October 1986. No rain fell within six hours of either herbicide application. Soil freezing occurred in early November 1986.

The site was clearcut in the fall of 1984 and mechanically site prepared in the summer of 1985, using a 125-ton Letourneau crusher to fell snags and break up residual logging slash. Prior to harvesting, the site supported a stand consisting of approximately 45% balsam fir [Abies balsamea (L.) Mill.], 35% black spruce, and 20% hardwoods composed primarily of aspen (Populus tremuloides Michx.) and a variety of other northern hardwoods. After site preparation, portions of the site not treated with herbicides, were rapidly revegetated with a dense cover of raspberries.

All treatments were replicated 4 times on 0.125 ha plots using a completely randomized layout.. No significant differences in soil characteristics (i.e., pH, organic matter, CEC, % sand, % silt, % clay) were observed among treatments.

Treatments and planting

Soil-applied treatment with metsulfuron, 36 and 72 g ai/ha and sulfometuron, 150, 300, and 450 g ai/ha occurred on May 29 and 30, 1986. Both herbicides were applied in 460 l/ha water using a skidder-mounted hydraulic sprayer equipped with a cluster nozzle. Foliar-applied treatment with metsulfuron, 36 and 72 g ai/ha and sulfometuron, 150 and 300 g ai/ha occurred on August 15, 1986. Both herbicides were applied in 447 l/ha water using the same skidder-mounted hydraulic sprayer and cluster nozzle as in May. All August tank mixes included 0.25% Agral 90.

All control and spring (May) treatment plots were planted (2.1 m spacing) in June 1986 and and in June 1987 with local, 2+2, bareroot black spruce seedlings obtained from the Irving nursery. Summer (August) treatment plots were planted in June 1987 with the same bareroot stock. A total of 480 (i.e., 80 per treatment) seedlings planted in 1986 and 800 seedlings planted in 1987 were randomly selected and staked for yearly measurement.

Measurements and analysis

Seedling survival (%), height (cm), and basal stem diameter (mm) were measured annually (August). Stem volume (cm^3) was computed using the formula for a cone: area/3 x length = 1/3 x pi x r^2 x height (1). Cover (%) of the dominant competitor, raspberry, was estimated visually within a 1 m radius of each staked seedling to the nearest 5% value. The height of raspberry stems within each quadrant of the circle was measured to the nearest cm.

Analyses of variance (ANOVA's) were performed on black spruce seedling stem volume and raspberry competition data. Treatment means were compared via Tukey's Studentized Range (HSD) Test at 5% level of significance. The frequency of occurrence of live seedlings was compared with a Likelihood Ratio Chi-Squared (G-Squared) Test (20). Regression analyses were performed on 5th-year seedling stem volume vs. 1991 raspberry cover or height for seedlings planted in 1987. Where slopes were judged to be statistically significant, analyses of covariance (ANCOVA) were performed to detect significant treatment differences due to application time and herbicide.

RESULTS

Survival of seedlings planted 1 month after spring herbicide treatements was less than controls, and no significant stem volume increases were observed. Survival of seedlings planted 1 yr after spring herbicide treatments was greater (74 to 90%) than that of control seedlings (67%) in August 1991. Survival of seedlings planted after some summer herbicide treatments (i.e., metsulfuron, 36 g ai/ha and sulfometuron, 300 g ai/ha) also was poor (59% and 58%, respectively), and no significant stem volume increases were observed for seedlings planted after site preparation with sulfometuron.

Five growing seasons after planting (GSAP), stem volume of seedlings planted 1 yr after spring sulfometuron treatments did not differ from stem volume of seedlings planted after summer metsulfuron treatments, but did differ from stem volume of seedlings planted 1

yr after spring metsulfuron treatments (Figure 1). Optimal stem volume increases over control seedlings were observed for seedlings planted 1 yr after spring sulfometuron treatment. These increases occurred sooner than for seedlings planted after summer metsulfuron treatment or 1 yr after spring metsulfuron treatment. Significant stem volume increases over control seedlings were first observed 2 GSAP ($P = 0.007$), and continued through the 5th GSAP ($P = 0.030$) for spring sulfometuron treatments. They were first observed 3 GSAP ($P = 0.024$) for summer metsulfuron treatments, and also continued through the 5th GSAP ($P = 0.012$). Significant stem volume increases over controls were restricted to the 3rd ($P = 0.050$) and 4th ($P = 0.029$) GSAP for spring metsulfuron treatments. Five GSAP, seedling stem volume was highest (204 cm^3) for seedlings planted 1 yr after spring treatment with sulfometuron at 450 g ai/ha. Seedling survival also was lowest (74%) for this treatment.

Six growing seasons after treatment (GSAT), raspberry cover had increased to 92% in untreated plots in August 1991, and was greater than in spring plots treated with sulfometuron at 300 and 450 g ai/ha (35% and 30%, respectively; $P = 0.0001$) or in summer (i.e., 5 GSAT) plots treated with metsulfuron at 72 g ai/ha (45%, $P = 0.004$). Raspberry height had increased to 83 cm in untreated plots, and was greater than in spring plots treated with sulfometuron (14 to 46 cm, $P = 0.0001$) or summer plots treated with metsulfuron (36 to 44 cm, $P = 0.002$). Spring treatment with metsulfuron resulted in poorer raspberry control (75 to 88% cover and 56 to 77 cm mean height) than treatment with sulfometuron at 150 g ai/ha (71% cover and 46 cm height).

Fifth-year stem volume of seedlings planted 1 yr after spring sulfometuron treatments was better correlated (Figure 2) with raspberry height ($r^2 = 0.70$) than cover ($r^2 = 0.44$). Stem volume decreased as raspberry competition increased. A linear regression relating 5th-year stem volume to 1991 raspberry height explained up to 48% of the variation in volume for summer metsulfuron treatments (Figure 2B). An analysis of covariance (ANCOVA) for possible treatment differences revealed no significant difference between spring treatment with sulfometuron and summer treatment with metsulfuron (Figure 2B).

DISCUSSION

Reducing raspberry competition with sulfometuron or metsulfuron enhanced black spruce survival and growth for seedlings planted approximately 1 yr after spring herbicide treatment. Reducing raspberry competition with summer metsulfuron treatment also enhanced black spruce seedling growth. Michael (10) reported significant growth increases for loblolly pine (Pinus taeda L.) following release of 1-yr-old seedlings, growing on silty clay soils, with sulfometuron. He did not observe significant growth increases following release with metsulfuron. Release with metsulfuron also resulted in the least herbaceous weed control. D'Anieri (6) observed that loblolly pine growing on coarse-textured soils exhibited greater survival (88 to 90% vs. 28 to 34%) and were taller (1.07 to 1.16 m vs. 0.24 m) than those growing on a fine-textured soil, 2 yrs after their release with either sulfometuron or with imazapyr, a herbicide whose site of action (i.e., ALS inhibitor) is the same as that for sulfonylurea herbicides (3).

Delaying planting by 1 yr improved survival and growth of seedlings planted into spring herbicide treatments. Improved survival and growth of seedlings planted approximately 1 yr after spring treatment were likely due to lower herbicide exposure. Similarly, poor survival and fewer growth increases for seedlings planted 10 months after summer treatment were likely due to greater herbicide exposure. Once in the soil, sulfonylurea herbicides, such as sulfometuron and metsulfuron, can persist for very long periods of time (> 1 yr) and are biologically active at extremely low concentrations, normally much lower than for many other herbicides (3, 4, 7, 19). Greater soil persistence, and concurrent crop injury, occurs in soils with high organic matter content and in soils with neutral or alkaline pH (4).

In this study, survival and height of seedlings planted 1 month after spring herbicide treatments or 10 months after some summer herbicide treatments were adversely affected by exposure to these residues (18). Michael (10) did not observe significant differences in loblolly pine survival following release of 1-yr-old containerized seedlings with sulfometuron or metsulfuron at differing rates (~ 140, 280, and 560 g ai/ha). However, D'Anieri (6) reported lower survival of 1-month-old loblolly pine bareroot stock released with sulfometuron at approximately 336 g ai/ha, compared with survival of seedlings released at approximately 168 g ai/ha. Since stock-type seems to influence seedling survival (i.e., lower for bareroot seedlings), the use of containerized stock may help to increase survival and prevent growth loss caused by prolonged exposure to these residues. Bareroot, black spruce seedlings were presumably very susceptible to herbicide exposure, since they were not established prior to treatment. In addition, poor survival of seedlings planted 10 months after some summer treatments, suggests that black spruce may be a sensitive species when exposed to sulfonylurea residues.

We conclude that spring treatment with sulfometuron, with planting delayed by 1 yr, provided the best treatment to achieve both optimal black spruce seedling survival and growth during the establishment phase of the plantation. Five years after planting, there were no significant differences in survival or stem volume related to sulfometuron rate. Survival was optimized, not significantly, at 300 g ai/ha. Compared with other herbicides, sulfonylurea herbicides are often very expensive to use. Other less expensive silvicultural herbicides (e.g., glyphosate and hexazinone), especially those which permit planting sooner after chemical site preparation, may offer better alternatives for effective weed control and greater black spruce seedling survival and growth. Although expensive, site preparation with sulfometuron and metsulfuron improved growth and/or survival of seedlings over that of untreated seedlings. These growth and/or survival increases are comparable with those reported for spruce using other vegetation management techniques such as manual cutting, prescribed burning, and certain types of scarification (2, 8, 9). The cost of these techniques needs to be carefully compared with that of site preparation with sulfometuron or metsulfuron.

ACKNOWLEDGEMENTS

We thank DuPont Canada, Inc. for financial support for this research. We also thank Forestry Canada, Maritimes Region and J.D. Irving, Ltd. for logistical support. We thank Mssrs. Jamie Corcoran, Pat Marceau, Frank Huston, Alain Ouellette, Pierre Patenaude, and

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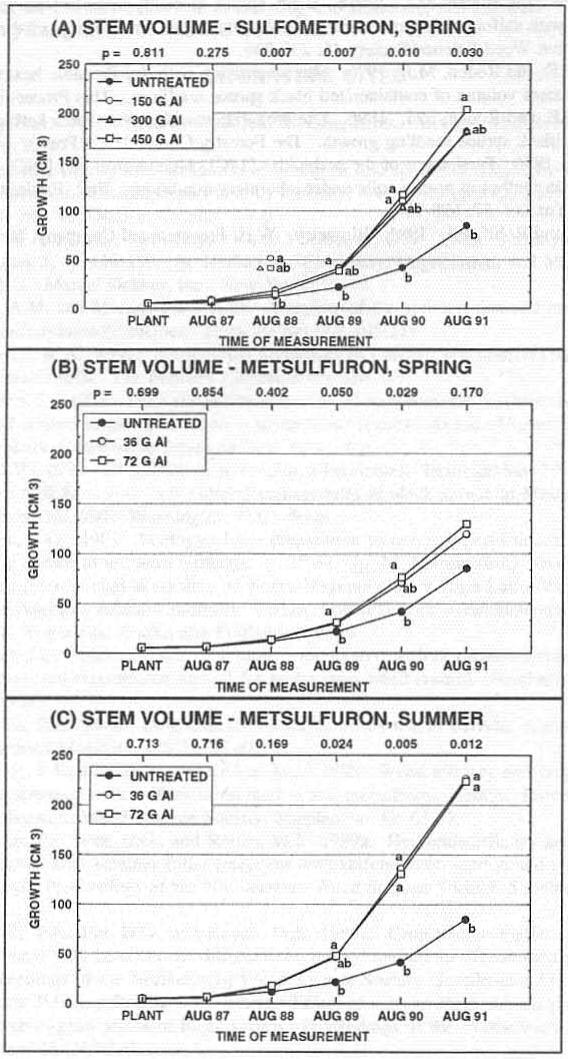
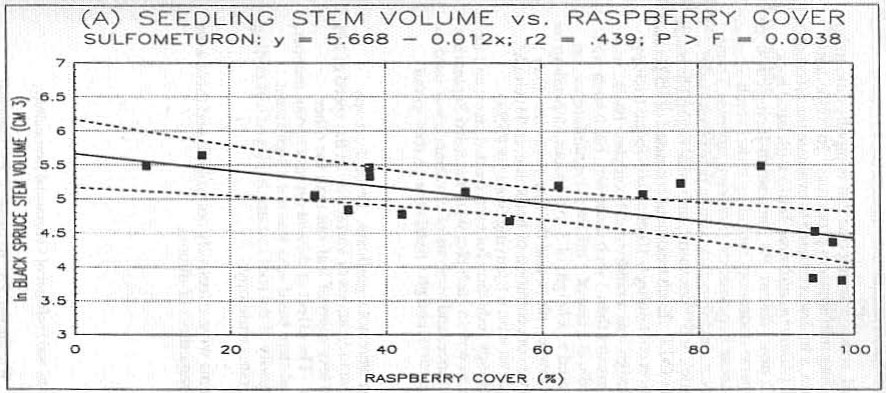
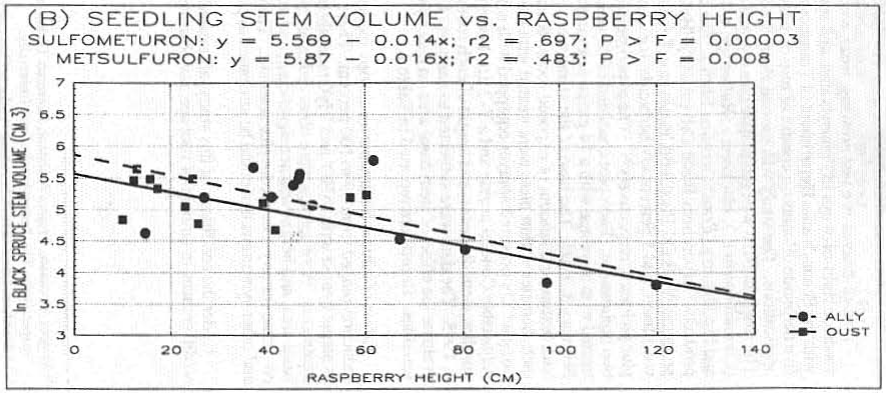

(A) STEM VOLUME - SULFOMETURON, SPRING
p = 0.811 0.275 0.007 0.007 0.010 0.030
UNTREATED
150 G AI
300 G AI
450 G AI
GROWTH (CM 3)
PLANT AUG 87 AUG 88 AUG 89 AUG 90 AUG 91
TIME OF MEASUREMENT
(B) STEM VOLUME - METSULFURON, SPRING
p = 0.699 0.854 0.402 0.050 0.029 0.170
UNTREATED
36 G AI
72 G AI
GROWTH (CM 3)
PLANT AUG 87 AUG 88 AUG 89 AUG 90 AUG 91
TIME OF MEASUREMENT
(C) STEM VOLUME - METSULFURON, SUMMER
0.713 0.716 0.169 0.024 0.005 0.012
UNTREATED
36 G AI
72 G AI
GROWTH (CM 3)
PLANT AUG 87 AUG 88 AUG 89 AUG 90 AUG 91
TIME OF MEASUREMENT


(A) SEEDLING STEM VOLUME vs. RASPBERRY COVER
SULFOMETURON: y = 5.668 − 0.012x; r2 = .439; P > F = 0.0038
ln BLACK SPRUCE STEM VOLUME (CM 3)
7
6.5
6
5.5
5
4.5
4
3.5
3
0
20
40
60
80
100
RASPBERRY COVER (%)


(B) SEEDLING STEM VOLUME vs. RASPBERRY HEIGHT
SULFOMETURON: y = 5.569 − 0.014x; r2 = .697; P > F = 0.00003
METSULFURON: y = 5.87 − 0.016x; r2 = .483; P > F = 0.008
ln BLACK SPRUCE STEM VOLUME (CM 3)
7
6.5
6
5.5
5
4.5
4
3.5
3
0
20
40
60
80
100
120
140
RASPBERRY HEIGHT (CM)
ALLY
OUST

EFFECT OF HERBICIDE DILUENT ON CONTROL OF TREE-OF-HEAVEN WITH BASAL BARK APPLICATIONS

A.E. Gover, J.M. Johnson, C.W. Spackman, T.L. Harpster, and L.J. Kuhns[1/]

ABSTRACT

Tree-of-heaven is a fast growing, weak wooded, root-suckering tree that is rapidly colonizing roadside right-of-ways in Pennsylvania, and spreading into adjacent properties. In cooperation with the Pennsylvania Department of Transportation, a trial was intiated to evaluate the effect of five herbicide diluents on control of tree-of-heaven (*Ailanthus altissima* Mill.) with basal bark applications. The study was located along SR 322, near Newort, PA, on a south-facing cut slope. The site featured a well developed canopy, and a sparse understory including crownvetch (*Coronilla varia* L.), blackberry (*Rubus* spp.), Japanese honeysuckle (*Lonicera japonica* Thunb.), and black cherry (*Prunus serotina* Ehrh.). The diluents tested included three petroleum-based products, 'Arborchem Basal Oil' ('ABO'), 'HyGrade', and 'Penevator'; and two-vegetable based products, 'JLB Oil Plus', and 'Penevator Vegetable Oil'[2/]. Each treatment consisted of 95 percent v/v diluent, and 5 percent v/v herbicide, for a solution containing 0.10 plus 0.05 lb/gal triclopyr plus picloram, respectively[3/]. The experimental design was a randomized complete block, with two replications. Each plot consisted of 20 stems, greater than 1 inch diameter. Each stem was treated with a syringe with a 14 guage pipetting needle at a rate of 1 mL/inch circumference, on February 3, 1995. The base of the stems were covered to a height of 3 to 8 inches, depending on bark texture and amount of exposed roots. Stems between plots, and the few stems less than 1 inch diameter within plots were treated with the same concentration of herbicide, in 'HyGrade', using a CO_2-powered sprayer equipped with a handgun with a Spraying Systems #5500 Adjustable ConeJet nozzle and a Y-2 tip. Percent canopy reduction for each treated stem; and the number, stem diameter, and height of each root sprout within each plot were recorded September 5, 1995. The data were subjected to analysis of variance, and analysis of covariance was used to evaluate the effect of stem basal area on canopy reduction, and plot basal area on root sprout variables. Results are reported in Table 1.

Effect of diluent treatments on canopy reduction were not significant. Percent canopy reduction ranged from 89 to 100 percent. There were indications of variability in the speed of kill, as stems treated with 'ABO' and 'HyGrade' showed less signs of leaf-out than the other treatments. Root sprouts were observed in all plots. The effect of diluent on root sprout number, basal area, and height was not significant, and treated stem basal area was not a significant covariate for any root sprout characteristic. The majority of the root sprouts displayed leaf curling and other symptoms that could be attributed to picloram or triclopyr.

Under the conditions of this study, all treated stems were effectively controlled; and there were no differences in amount of root sprouts observed, regardless of diluent.

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

[2/] 'Arborchem Basal Oil', Arborchem Products Company, Ft. Washington, PA; 'HyGrade', CWC Chemical Company, Cloverdale,VA; 'JLB Oil Plus', JLB International, Vero Beach, FL; 'Penevator', 'Penevator Vegetable Oil', Exacto Chemical Company, Richmond, IL.

[3/] Mix contained 95 percent diluent, v/v, and 5 percent v/v 'Access' herbicide, triclopyr plus picloram, 2 plus 1 lb/gallon, DowElanco, Indianapolis, IN.

Table 1: Percent canopy reduction; and root sprout number, basal area, and height from tree-of-heaven treated with a basal bark solution containing 0.1 plus 0.05 lb/gal triclopyr plus picloram, respectively, using five different diluents. Treatments were applied February 3, 1995, and data were collected September 5, 1995. Each value is the mean of two replications.

Diluent	Canopy Reduction	Root Sprout Number	Root Sprout Basal Area	Root Sprout Height
	(%)	(plants/plot)	(in^2/plot)	(ft)
Arborchem Basal Oil	100	17	0.43	0.9
HyGrade	100	33	1.67	1.0
JLB Oil Plus	89	18	0.56	1.3
Penevator	96	28	0.94	0.8
Penevator Vegetable Oil	95	17	0.98	1.4
Significance Level (p)	0.45	0.56	0.60	0.53
LSD (p=0.05)	n.s.	n.s.	n.s.	n.s.

EFFECT OF BASAL BARK APPLICATION TIMINGS ON THE CONTROL OF TREE-OF-HEAVEN AND SUMAC

Jon M. Johnson, Chad W. Spackman, Larry J. Kuhns, and Arthur E. Gover[1/]

ABSTRACT

As part of a research project funded by the Pennsylvania Department of Transportation, a trial was established to compare two basal bark herbicide treatments, applied at three times, for the control of tree-of-heaven (*Ailanthus altissima* Mill.) and sumac, including smooth sumac (*Rhus glabra* L.) and staghorn sumac (*Rhus typhina* L.). The herbicide treatments were 20% Garlon 4[2/]; and 20% Access[3/], diluted in a petroleum basal oil[4/]. A total of six colonies were chosen for each species. Two colonies were treated at each timing, with each herbicide treatment applied to half of each colony. The treatments were applied at a rate of 1.0 mL/inch of stem circumference at a height of six inches, using a syringe and a 14 gauge pipetting needle. Tree-of-heaven stems were treated near Lewistown, PA, on December 22, 1994; February 1, 1995; and April 6, 1995. Applications were made to sumac on December 21, 1994; January 30, 1995; and April 26, 1995; near State College, PA. The caliper of the treated ailanthus and sumac stems ranged in size from less than 0.25 in to 9 in, with most below 1 in. Visual ratings of percent canopy reduction on the treated stems, and number of resprouts were taken for tree-of-heaven on July 21, 1995. A visual estimate of percent groundcover by resprouts was taken for the sumac plots on September 18, 1995. Results are reported in Table 1.

All treatments for both tree-of-heaven and sumac provided almost 100 percent control of the treated stems.

There was no difference among treatment timings for Garlon 4 on tree-of-heaven. There were differences among timings when Access was used. The number of tree-of-heaven root sprouts in the area treated in February was significantly lower than in the areas treated at the other two times. Also, there was a significant difference between Garlon and Access for the February timing. Fewer root sprouts were observed in the Access plots than in the Garlon treated plots.

The application timing that resulted in the lowest number of resprouts of sumac was April for either herbicide used. Areas treated in December and January with Access had less resprouting than areas treated with Garlon.

All treatments were effective at controlling the treated stems regardless of timing, material, or species treated. Access performed better in controlling root sprouts for tree-of-heaven in the February treatment. Both herbicides provided superior results in the sumac plots when applied in April. This April treatment has not been effective in other demonstration areas in Pennsylvania. This study was developed because of the amount of resprouting that occurred following applications made in April, 1994 to sumac and tree-of-heaven. Perhaps the location of these two plots on a cut slope, the lower density of treated stems, or other environmental factor led to the significant difference found in this April timing. Further work needs to be done to evaluate the validity of this timing difference.

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

2/ Garlon 4 is 4 lb/gal triclopyr, DowElanco, Indianapolis, IN.

3/ Access is 1 plus 2 lb/gal, picloram plus triclopyr, DowElanco, Indianapolis, IN.

4/ HyGrade, CWC Chemical Co., Cloverdale, VA

Table 1a: Number of root sprouts/plot counted July 21, 1995, for tree-of-heaven treated with basal bark herbicide applications on December 22, 1994; February 1, 1995; and April 6, 1995. Each value is the mean of two replications.

		Application Timing		
Herbicide[1/]	Concentration	December	February	April
Garlon 4	20% (v/v)	354 a[2/]	251 a	377 a
Access	20% (v/v)	334 a	96 b	230 a
Significance Level (p)		0.84	0.007	0.35

1/ Garlon 4 is 4 lb/gal triclopyr; Access is 1 plus 2 lb/gal, picloram plus triclopyr. Both products are manufactured by DowElanco, Indianapolis, IN.

2/ Means in a row followed by the same letter are not significantly different (p=0.10) according to Fisher's protected LSD.

Table 1b: Percent cover from root sprouts on September 18, 1995, for sumac treated with basal bark herbicide applications on December 21, 1994; January 30, 1995; and April 26, 1995. Each value is the mean of two replications.

		Application Timing		
Herbicide[1/]	Concentration	December	January	April
Garlon 4	20% (v/v)	85 a[2/]	90 a	8 b
Access	20% (v/v)	52 a	48 ab	4 b
Significance Level (p)		0.09	0.14	0.62

1/ Garlon 4 is 4 lb/gal triclopyr; Access is 1 plus 2 lb/gal, picloram plus triclopyr. Both products are manufactured by DowElanco, Indianapolis, IN.

2/ Means in a row followed by the same letter are not significantly different (p=0.10) according to Fisher's protected LSD.

EFFECT OF HERBICIDE DILUENT ON CONTROL OF ASH, BIRCH, AND CHERRY WITH BASAL BARK APPLICATIONS

Chad W. Spackman, Jon M. Johnson, Larry J. Kuhns, and Arthur E. Gover[1/]

ABSTRACT

As part of an ongoing research project funded by the Pennsylvania Department of Transportation, a trial was established near Port Matilda, PA, comparing the effect of diluents on the control of green ash (*Fraxinus pennsylvanica* Marsh.), black birch (*Betula lenta* L.), and pin cherry (*Prunus pensylvanica* L.) treated with basal bark herbicide applications. The six diluent treatments included three petroleum based products; 'Arborchem Basal Oil' (ABO), 'HyGrade', and 'Penevator Basal Oil'; two vegetable-oil products, 'JLB Oil Plus' (JLB), and 'Penevator Vegetable Oil' (PVO); and 'Dyne-Amic', an organosilicone/methylated seed oil blend. Birch and ash were treated February 14 and 20, 1995, respectively, with a solution containing 95 percent diluent and 5 percent Garlon 4 (v/v)[2/]. Pin cherry was treated February 13, 1995, with a solution containing 95 percent diluent and 5 percent Access (v/v)[3/]. Each treatment for each species was applied to ten stems at a rate of 1.0 mL/inch of stem circumference at a height of six inches, using a syringe and 14 gauge pipetting needle. The diameters for all three species ranged from 0.75 in to 4 in, with an average of 2 in. The experimental layout for each species was a completely randomized design, with each stem being an experimental unit. Visual ratings of percent canopy reduction were taken August 9, 1995. The data were subjected to analysis of variance. Analysis of covariance was used to adjust canopy reduction according to stem caliper in birch. Results are reported in Table 1.

All treatments provided significant canopy reduction for green ash and pin cherry, compared to the untreated check. Canopy reduction in treated green ash ranged from 72 to 95 percent. 'ABO' and 'PVO' were rated highest at 95 and 94 percent, respectively, and provided significantly more canopy reduction than 'Dyne-Amic', rated at 72 percent. 'Dyne-Amic' provided 81 percent canopy reduction in pin cherry, which was significantly less than that provided by the remaining five diluent treatments. Black birch was the most difficult species to control, with adjusted canopy reduction ratings ranging from 54 to 12 percent. The untreated check was rated at 5 percent canopy reduction. 'HyGrade', 'Penevator', 'PVO', and 'ABO' performed similarly, providing 54, 49, 49, and 41 percent canopy reduction, respectively. 'JLB' was rated at 23 percent, and treatments including 'Dyne-Amic' provided only 12 percent canopy reduction.

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

[2/] Garlon 4, 4 lb triclopyr/gal, DowElanco, Indianapolis, IN.

[3/] Access, 1 lb picloram plus 2 lb triclopyr per gallon, DowElanco, Indianapolis, IN.

TABLE 1: Control provided by various basal bark treatments based on visual ratings of percent canopy reduction taken August 9, 1995. Treatments of 5 percent Garlon 4 and 95 percent (v/v) diluent were applied to black birch and green ash stems on February 14 and 20, 1995, respectively. Treatments of 5 percent Access and 95 percent (v/v) diluent were applied to pin cherry stems February 13, 1995. Each value is the mean of ten replications.

	Canopy Reduction		
Diluent	Green Ash	Black Birch[1/]	Pin Cherry
	(%)	(%)	(%)
Arborchem Basal Oil	95	41 ab	100
HyGrade I Basal Oil	91	54 a	100
JLB Oil Plus	83	23 bc	94
Penevator Basal Oil	88	49 a	100
Penevator Vegetable Oil	94	49 a	100
Dyne-Amic	72	12 c	81
Untreated Check	24	5	31
Significance Level (p)	0.0001	0.0002	0.0001
LSD (p=0.05)	21	-	12

[1/] Means adjusted by analysis of covariance according to stem caliper.

INFLUENCE OF ANNUAL HERBICIDE APPLICATIONS AND THE ENVIRONMENT ON SMOOTH CRABGRASS CONTROL

D. P. Martin and J. J. Sullivan[1]

ABSTRACT

Annual spring applications of preemergence herbicides are commonly used in turfgrass culture to control annual weed grasses such as crabgrass. Significant year-to-year variation is observed on the percent crabgrass control, even when factors such as product, rate, competition, etc. appear to be comparable. The objective of this paper is to compare year-to- year variation of temperature and rainfall on percent smooth crabgrass [*Digitaria ischaemum* (Schreb. ex Schweig.) Schreb. ex Muhl] control with pendimethalin applications (1.5 lb ai/A).

Field studies were conducted from 1985 to 1995 on a site with 'Kenblue' Kentucky bluegrass (*Poa pratensis* L.). Maintenance practices were designed to enhance potential crabgrass populations. The study areas were laid out in six by eight foot plots in a randomized complete block design with three replications. The actual treatments were four by eight feet, resulting in a two foot untreated check strip surrounding each plot. Treatments were made with a three nozzle boom assembly on the end of a ChemLawn gun, and charged with a CO_2 pressurized tank worn as a backpack. Pendimethalin at 1.5 lb ai/A as Pre-M 60DG was applied in a number of studies annually between mid-March and the germination date, usually late April. The rate of 1.5 lb was chosen since it is the threshold rate for this geographical area.

Results were averaged for each year. Crabgrass control was acceptable seven of eleven years. For the seven acceptable years crabgrass control averaged 94% with a high of 98% in 1994. Crabgrass control was marginal in 1989 at 85%. Poor crabgrass control was observed in 1987 and 1993 at 73% and 76% respectively. Crabgrass control during the 1995 season was totally unacceptable with an average of 23% control from pendimethalin at 1.5 lb ai/A.

Total rainfall and air temperature averages were calculated by week and by month for May - August and compared to crabgrass failure years. Three of the four failure years had higher than average rainfall in May and June, creating good crabgrass germination and growth conditions. In addition, those years also had a dry August and very hot conditions in July and August, favoring crabgrass growth over Kentucky bluegrass. The marginally unacceptable crabgrass year in 1989 had above average moisture conditions from May - July and below average temperatures. The major factor in 1989 may have been the lack of density in turfgrass stands caused by the 1988 drought.

Temperatures above average one year and average another year also resulted in acceptable crabgrass control. Low moisture conditions through most of the May to August period in those years reduced crabgrass development and competition. Also, wet, cool summers in several other years resulted in less competition and good crabgrass control compared to the hot, wet years. This research has shown that above average rainfall in May/June, followed by dry conditions in August, along with higher than average temperatures in August or July/August, resulted in unacceptable smooth crabgrass control with pendimethalin.

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[1] Dir. of Research and Research Assoc.; TruGreen•ChemLawn; Delaware, OH 43015

PREEMERGENCE CONTROL OF SMOOTH CRABGRASS IN 1995

T. L. Watschke and J. A. Borger, C. R. Shearer[1]

ABSTRACT

Forty preemergence herbicide treatments were applied to a mature stand of perennial ryegrass (Lolium perenne L.) at the Landscape Management Research Center at The Pennsylvania State University. The objectives of the study were; 1) to compare two application timings for selected treatments (March 16, 1995 and April 21, 1995) and 2) to compare efficacy of experimental versus commercial materials. As some treatments were applied using fertilizer as a carrier, all treatments regardless of carrier were maintained at the same nitrogen fertility level. Most March treatments also received a sequential application with the follow-up treatment applied eight weeks after the initial application. Sprayed applications were made using a hand held CO_2 boom sprayer with 6504 nozzles at 30 psi calibrated to deliver 80 gpa. Granular formulations were applied using a shaker jar. Irrigation was applied after application (approximately 0.25 inch) and at various times during the course of the study to maintain the turf free of dormancy. Crabgrass control was rated on August 19, 1995. No phytotoxicity was observed during the course of the study. Benefin plus trifluralin on a 27-3-8 fertilizer at a rate of 1.5 lbs ai/A applied as a sequential treatment, pendimethalin on a 28-3-4 at a rate of 1.5 lbs. ai/A applied sequentially, pendimethalin on a 28-3-4 applied at a rate of 1.5 lbs. ai/A but with the sequential treatment with the 60 WDG formulation, dithiopyr on a 24-4-14 at a rate of 0.25 lbs. ai/A, prodiamine 65 WDG at 0.32, 0.48, 0.65 lbs. ai/A, prodiamine on a 19-4-6 at a rate of 0.75 lbs. ai/A, pendimethalin 60 WDG at 1.5 lbs. ai/A, dithiopyr 1 EC at 0.5lbs ai/A AD444, AD445, and AD446 at 0.125, 0.25, 0.38, and 0.5 lbs. ai/A respectively, all provided at least 90% control of smooth crabgrass which was considered commercially acceptable. Dithiopyr on a 24-4-14 at a rate of 0.25 applied on March 16 provided 96% control, while ethofumesate applied at 0.75 and 1.5 lbs. ai/A, oxadiazon applied at 2.0 lbs. ai/A, prodiamine on a 19-4-6 at a rate of 0.5 lbs. ai/A, and some experimental compounds did not provide acceptable control when the application was made on April 21. Since dithiopyr provides some level of postemerence activity it appears that some germination may have occurred prior to April 21, 1995.

[1] Professor and Research Assistants, respectively, Department of Agronomy, Penn State University, University Park, PA, 16802

CRABGRASS CONTROL IN TURFGRASS FOLLOWING FALL-APPLIED PREEMERGENCE HERBICIDES

P. C. Bhowmik, R. G. Prostak and J. A. Drohen[1]

ABSTRACT

Field experiments were conducted on an established Kentucky bluegrass (Poa pratensis L.) stand to evaluate the spring performance of several fall-applied preemergence herbicides for the control of smooth crabgrass [Digitaria ischaemum (Schreb. ex Schweig. Schreb. ex Muhl.]. Dithiopyr 0.09G (18-5-9) at 0.5 and 0.75 lb ai/A, trifluralin plus benefin 2G at 2.0 and 3.0 lb ai/A, pendimethalin 0.86G (20-4-4) at 3.0 and 4.0 lb ai/A, oxadiazon 2G at 3.0 and 4.0 lb ai/A, prodiamine 0.22G (22-4-10) at 0.5 and 0.75 lb ai/A and bensulide 7G at 6.0 and 8.0 lb ai/A were evaluated. Plots were 3.5' by 10' and the treatments were arranged in a randomized complete block design with three replications. Treatments were applied on October 12, 1994 using a CO_2-backpack sprayer that delivered 50 gpa at 22 psi. Turfgrass injury was rated on a scale of 0 to 100% (0% = no injury and 100% = dead turfgrass) 4 and 45 weeks after treatment (WAT). Crabgrass control was rated on a scale of 0 to 100% (0% = no control and 100% = complete control) 45 and 47 WAT. In 1994, weed control ratings were taken 33 and 40 WAT.

No turfgrass injury was observed 4 WAT (fall) and 45 WAT (spring). Dithiopyr controlled smooth crabgrass over 98% 45 and 47 WAT. Pendimethalin and prodiamine at 4.0 and 0.75 lb/A, respectively controlled smooth crabgrass over 93% 45 WAT. Trifluralin plus benefin controlled smooth crabgrass only 57 to 67% 45 WAT and less control (45 to 50%) was noted 47 WAT. Oxadiazon at the highest rate controlled smooth crabgrass 82 and 70% 45 and 47 WAT, respectively. Bensulide resulted in poor smooth crabgrass control. In our 1994 trial, similar control of large crabgrass with various fall-applied (October, 1993) treatments was noted.

Dithiopyr at 0.5 and 0.75 lb/A, pendimethalin at 4.0 lb/A and prodiamine at 0.75 lb/A controlled smooth crabgrass over 90%. Our results demonstrate the potential use of fall-applied preemergence herbicides for effective crabgrass control in the spring. This type fall-applied treatments would serve as an alternative strategy for annual grass weed control in golf courses, home lawns, and other settings.

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

DISTRIBUTION AND ADAPTATION OF CRABGRASS SPECIES IN THE U. S.

T. J. Kim, J. C. Neal[1], and J. M. DiTomaso[2]

ABSTRACT

Among the 60 species in the genus *Digitaria*, thirteen weedy species infest the United States, but large (*Digitaria sanguinalis*), smooth (*Digitaria ischaemum*) and southern crabgrass (*Digitaria ciliaris*) are the most common. Despite the availability of effective herbicides and continued control efforts, these species continue to be troublesome in most crop areas, and especially in turf. In order to control crabgrasses more efficiently, we need to understand the biological and physiological factors which contribute to its success as a weed. The first step in understanding crabgrass adaptation is to document its distribution geographically and among cropping systems.

We conducted a survey to investigate the geographical distribution and the adaptation in cropping systems of crabgrass species in the United States. In 1995, 117 survey forms were sent to 2 or 3 weed scientists in each state, except for Hawaii. The questions included: 1) which is the most important species in each cropping system of each state, 2) what factors limit the adaptation and distribution of the crabgrasses, and 3) is there any substantial intraspecific variation in crabgrass such as different growth habits, flowering time or phenotypes, etc. We received 72 completed surveys, a 62% return rate.

In the United States, crabgrasses are considered to be important in turf areas and less important in other crops. Generally, both large and smooth crabgrass existed together in the most regions, with smooth crabgrass more abundant in northern than in southern regions. Southern crabgrass existed with large crabgrass in several southern areas including Mississippi, Texas, and Georgia, with few reports of smooth crabgrass in these regions. In Maine, the far northern area, only smooth crabgrass was reported, whereas in Florida, the deep southern region, no large or smooth crabgrass are found, but southern, blanket (*D. serotina*) and india crabgrass (*D. longiflora*) were reported. Most respondents believed that temperature, light and moisture conditions were important in limiting the adaptation and distribution of the species. There were few respondents indicating intraspecific variations of smooth and large crabgrass, but both southern and blanket crabgrass were reported to have some intraspecific variation.

These results suggest several questions: is smooth crabgrass more tolerant to low temperature than large, and vice versa to high temperature; is there any correlation between temperature and light conditions with survival and adaptation of these species; and why are crabgrasses more successful in turf than in other crops. In order to develop long- term and environmentally sound crabgrass management strategies, these questions must be addressed.

[1] Grad. Res. Asst. and Assoc. Professor, Dept. Orn. Hort., Cornell Univ., Ithaca, NY 14853
[2] Asst. Professor, Dept. Vegetable Crops, University of California, Davis, CA

GOOSEGRASS CONTROL IN FAIRWAY TURFGRASSES

M.D. Johnson, S.W. Bingham & P.L. Hipkins[1]

ABSTRACT

Goosegrass *(Eleusine indica* L.*)* ELEIN is considered to be one of the most difficult to control weeds infesting turfgrass grown in the U.S. Preemergence herbicides were used in the these experiments; therefore, experimental areas were selected which contained an abundance of goosegrass residue from the previous year. The experiment sites selected were located on golf course fairways at Giles County C.C. in Pearisburg, VA and at Ivy Hills G.C. in Lynchburg, VA. Both sites were managed under typical golf course fairway conditions. Both sites were treated for broadleaf weed control and fertilized at 1/2 lb N/1000 ft^2 on a monthly basis from April to August. No significant injury was obserevd for any of the treatments in either of these experiments. Turf cover at the Pearisburg site was predominately a mixture of kentucky bluegrass *(Poa pratensis)* POAPR, and perennial ryegrass *(Lolium perenne)* LOLPE. Turf cover at the Lynchburg site was predominately a mixture of common bermudagrass *(Cynodon dactylon)* CYNDA and perennial ryegrass. Goosegrass germination and emergence did not occur until the middle of July as a result of suboptimal germination and development conditions. The objectives of these tests included:, 1) Evaluation of the effectiveness of premergence herbicides for goosegrass and crabgrass control in both cool and warm season turfgrasses, and 2) Evaluation of the effects of these preemergence herbicides on turf cover and quality. Herbicide applications were made in early April and late May. S-5009, S-5041, S-2460, and split applications of oxadiazon and pendimethalin all gave excellent weed control and more than acceptable quality throughout the season. When using dithiopyr and prodiamine multiple applications were needed to effectively reduce goosegrass populations for the entire growing season. Turfgrass cover dramatically effected goosegrass populations. The Pearisburg site had a higher infestation of goosegrass during the period of summer stress to the cool season grasses while the high level of bermudagrass cover at the Lynchburg site aided in reduction of goosegrass populations late into the season.

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[1] Graduate Research Assitant, Professor of Turfgrass Weed Science and Research Associate, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

INCREASING EFFECTIVENESS OF DITHIOPYR BY SEQUENTIAL APPLICATIONS

R. B. Taylorson[1]

ABSTRACT

A field experiment was conducted to examine efficacy of dithiopyr as preemergence vs. preemergence plus early-postemergence sequential treatments in controlling smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.]. The turf was an old stand of mixed Kentucky bluegrass (Poa pratensis L.) and red fescue (Festuca spp.) mowed at 1.75 inches. The experiment was a randomized complete block design with four replications. Plots were five feet wide by eight feet long with a two foot untreated strip between adjacent plots. The soil was a Bridgehampton silt loam. Dithiopyr EC was applied with a backpack sprayer in 40 gpa. All rates are given in lb ai/A. Preemergence treatments were applied on April 21, 1995. Early-postemergence treatments were applied on June 5, when crabgrass was in the 1-2 leaf stage. Crabgrass stands were heavy. Weed control ratings were on a scale of 0-10 with 10 being perfect control and <7 unacceptable. There was no injury observed.

Plots treated at the preemergence stage with 0.125, 0.25, 0.38 and 0.5 lb/A gave effective weed control for about 12 weeks, but by 16 weeks the lower rates were beginning to fail and by 20 weeks (maturing crabgrass) were rated <7. Rates of 0.38 and 0.5 lb/A held for 16 weeks but by 20 weeks gave ratings of 7.3 and 8.6 respectively.

By applying dithiopyr as a sequential treatment at both the preemergence and early-postemergence stages, the efficacy of dithiopyr on a lb/A basis increased substantially. Sequential treatments of 0.06 + 0.06, 0.09 + 0.09, 0.125 + 0.125, and 0.25 + 0.25 lb/A were applied. Control ratings after 16 weeks were high for all treatments and by 20 weeks ratings were 7.1, 6.9, 7.9 and 9.8, respectively. A sequential treatment of 0.25 + 0.125 lb/A gave 20 week ratings of 9.2 as contrasted to 7.3 for a preemergence treatment of 0.38 lb/A.

A standard treatment of 0.75 lb/A prodiamine applied preemergence gave a 20 week control rating of 8.6.

It is suggested that further improvements in efficacy could be achieved by rate, formulation, and frequency adjustments.

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[1] Adj. Prof., Dept. of Plant Sci, Univ. of Rhode Island, Kingston, RI 02881

POSTEMERGENCE CONTROL OF SMOOTH CRABGRASS IN 1995

T. L. Watschke and J. A. Borger, C. R. Shearer[1]

ABSTRACT

Three experiments were conducted in 1995 to evaluate the control of smooth crabgrass after emergence into a mature stand of predominately perennial ryegrass (Lolium perenne L) turf. Two of the studies were conducted when the crabgrass was in the pre-tillering stage (applications made on June 21 and June 23 with sequential applications for selected treatments 14 days later). One study was initiated on July 6 (after crabgrass had begun to tiller). Treatments were applied using a hand-held boom CO_2 powered sprayer with two 6504 nozzles at 30 psi calibrated to deliver 80 gpa. All experiments were rated for crabgrass control on August 19, 1995.

Treatments that provided acceptable control (85%) where crabgrass was in the pre-tillering stage included several different pendimethalin and fenoxaprop combinations (individual rates undisclosed). Both the low and high rate treatments provided acceptable control. Dithiopyr at 0.5 lbs. ai/A and MSMA at 2.0 lbs. ai/A followed by another 2.0 lbs. ai/A 14 days later did not control crabgrass at an acceptable level (82% and 77% respectively).

None of the treatments used in the post-tillering experiment controlled crabgrass at an acceptable level. However, pendimethalin plus fenoxaprop at 1.5 and 0.25 lbs. ai/A respectively provided 70% control from one application.

[1] Professor and Research Assistants, respectively, Department of Agronomy, Penn State University, University Park, PA, 16802

WEED CONTROL PROGRAMS UTILIZING REDUCED HERBICIDE RATES FOR CRABGRASS CONTROL IN BERMUDAGRASS

B. J. Johnson[1]

ABSTRACT

Bermudagrasses (*Cynodon* spp.) are widely used on golf courses, athletic fields, and other recreation areas throughout the southern United States. To maintain a desirable quality turf, herbicides must be included in the overall management program. Crabgrass (*Digitaria* spp.) can be controlled with recommended rates of preemergence (PRE) and postemergence (POST) herbicides. However, because of increasing environmental and regulatory pressures, it may be necessary to reduce the total quantity of herbicides used for weed control in turfgrasses. Therefore, programs were developed to utilize lower herbicide rates for full-season weed control in bermudagrass turf. These programs were: a) sequential applications of PRE and POST herbicides applied at different dates, b) tank-mixes of PRE and POST herbicides applied as a single application after weeds emerge, and c) multiyear use of PRE herbicides applied at reduced rates over years.

Sequential PRE and POST herbicides. PRE herbicides applied late February at 50 to 75% lower than recommended rates in late winter and followed by one timely POST herbicide application in late spring or early summer controlled crabgrass as effectively as the maximum labeled rate of PRE herbicides applied alone. Crabgrass control was effective (≥80%) with the following programs: Ronstar (oxadiazon) (G) at a one-fourth rate (1.0 lb ai/A) and pendimethalin (WDG) at a one-third rate (1.0 lb ai/A) when either herbicide was followed by MSMA at the full rate (2.0 lb ai/A); Barricade (prodiamine) (WDG) at a one-third rate (0.25 lb ai/A) and followed by MSMA at one-fourth rate (0.5 lb ai/A), and Surflan (oryzalin) (AS) at a one-third rate (0.67 lb ai/A) and followed by MSMA at one-half rate (1.0 lb ai/A).

Tank-mixed PRE and POST herbicides. A single May application of one-half rates of Dimension (dithiopyr) (0.25 lb ai/A) or pendimethalin (1.5 lb ai/A) tank-mixed with MSMA at 2.0 lb ai/A controlled 80% or higher crabgrass. However, the tank-mixtures of PRE and POST herbicides were not as effective as sequential PRE and POST herbicides.

Multiyear use of PRE herbicides. PRE herbicides were applied at various rates to the same plots over a 3-year period for crabgrass control. Effective control was maintained during this period when Dimension (0.25 lb ai/A), pendimethalin (1.5 lb ai/A), Barricade (0.38 lb ai/A), and Surflan (1.0 lb ai/A) were applied at one-half rates the first year and followed by one-fourth rates the second and third years. However, Ronstar required a full rate (3.0 lb ai/A) the first year followed by a three-fourth rate the second year, and one-half rate the third year to effectively control crabgrass.

[1]Professor, Crop and Soil Sciences, University of Georgia, Georgia Station, Griffin, GA 30223-1797.

CRABGRASS CONTROL WITH A FENOXAPROP/PENDIMETHALIN CO-FORMULATION - 1995 RESULTS

J. Thomas and D. Spak[1]

A co-formulation of fenoxaprop and pendimethalin was evaluated for season-long post/ preemergence control of crabgrass (*Digitaria* spp.) in cool-season turfgrasses. AGR40500 3.09EC consisted of a 1:34 ratio of fenoxaprop p-ethyl to pendimethalin. In 1995, the second year of evaluation, the objectives were: to evaluate a formulation containing a higher fenoxaprop p-ethyl ratio, to determine optimum use rates and timings of AGR40500, and to evaluate AGR40500 under commercial-type lawn care applications.

The first objective was to determine if a higher ratio of fenoxaprop p-ethyl to pendimethalin (1:25) would provide efficacy and safety advantages over AGR40500. The 1:25 coformulation contained 0.12 lb fenoxaprop p-ethyl and 3.0 lb pendimethalin per gallon. Six studies were conducted throughout the northern U.S. There were no significant differences between formulation ratios applied at equivalent pendimethalin rates. Crabgrass control in August was excellent and averaged 92 and 95% for the 1:34 and 1:25 ratios applied at similar rates of 2.06 and 2.09 lb ai/A, respectively. The lower ratio (1:34) tended to have a greater safety margin. Therefore, the higher ratio (1:25) formulation did not provide an advantage.

The second objective was to determine optimum use rates and timing for AGR40500. Applications of AGR40500 were compared to individual coformulation components and standard preemergence treatments. Six studies were conducted across the transition zone for cool season grasses. Treatments were applied to pre-tillered (1-4 leaf) or tillered crabgrass (1-2 tiller). There was a rate response for pre-tillered applications of AGR40500 applied at 1.54, 2.06, and 3.09 lb ai/A evaluated at the end of the season. The two higher rates provided acceptable season-long control of crabgrass. Crabgrass control was greater with AGR40500 than with either component (pendimethalin or fenoxaprop p-ethyl) applied alone. When applied to tillered crabgrass, AGR40500 provided 91% control vs. 81% for Dimension (0.5 lb ai/A). The amount of fenoxaprop p-ethyl required to control tillered crabgrass was reduced when delivered as a component of the coformulation compared to commercial fenoxaprop p-ethyl applied alone.

AGR40500 was evaluated under commercial-type lawn care applications. Two studies were conducted, one each in a northern and southern location, to evaluate high volume, large droplet applications. Applications of AGR40500 were made at 2.06 and 3.09 lb ai/A with the ChemLawn Gun at a spray volume of 2 gallon water/1000 ft^2. Treatments were compared to a conventional flat fan nozzle application with a spray volume of less than 1 gallon water/1000 ft^2. Results differed between locations. At the northern location, crabgrass control in August was not significantly influenced by application method or rate, and crabgrass control was unacceptable averaging 58%. Crabgrass pressure was unusually high and single applications of many commercial treatments were ineffective. At the southern location, low volume applications of AGR40500 at 2.06 lb ai/A gave acceptable (=>80%) control through late-August. Applications with the ChemLawn Gun were less effective, but loss of control was partially offset by increasing rate or by adding a surfactant at 0.25% v/v. No phytotoxicity was observed in either study. Additional research is needed to evaluate AGR40500 in lawn care application systems.

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[1] Thomas, J. and D. Spak. Product Development Manager, American Cyanamid Company, Princeton, NJ, and AgrEvo USA Company, Wilmington, DE, respectively.

MARYLAND 1994 AND 1995 SMOOTH CRABGRASS, GOOSEGRASS AND PROSTRATE SPURGE CONTROL STUDIES

P.H. Dernoeden[1]

ABSTRACT

Five studies were conducted to assess herbicides for pre- and postemergence smooth crabgrass (*Digitaria ischaemum* [Schreb.] Muhl.), goosegrass (*Eleusine indica* [L.] Gaertn.), and prostrate spurge (*Euphorbia supina* Raf.) control. Perennial ryegrass (*Lolium perenne* L.) turf in Studies I, II, IV and V was grown on a Sassafras sandy loam, pH 6.3 - 6.8 and 1.6 - 1.8% OM. Study III was conducted on creeping red fescue (*Festuca rubra* L. ssp *rubra*) grown a Chillum silt loam with a pH of 6.2 and 2.2% OM. Granulars were applied by shaker bottle and sprayables were applied with a CO_2 pressurized (35 psi) sprayer calibrated to deliver 50 gallons of water per acre. Unless otherwise noted, all preemergence herbicides were applied between 5 and 9 April and sequential applications were made on 24 or 25 May. All sites were irrigated within 24 hrs of each herbicide application and thereafter to prevent drought stress. Plots were 5 by 5 ft and were arranged in a randomized complete block with four replicates. Percent of plot area covered with weeds was assessed visually on a 0 to 100 scale where 0 = no crabgrass and 100 = entire plot area covered. Data were subjected to analysis of variance and significantly different means were separated by Duncan's multiple range test (P = 0.05%).

In Study I, all treatments provided a statistically similar level of smooth crabgrass control (Table 1). Subjectively, only Team, Barricade, Acclaim + Dimension, and Acclaim + Barricade provided commercially acceptable crabgrass control. Pre-M, Barricade, and Acclaim tank-mixes with Dimension and Barricade did not reduce goosegrass cover significantly. Scott's Goosegrass/Crabgrass Control, Ronstar, Dimension and Team provided commercially acceptable goosegrass control.

In Study II, Illoxen (0.25, 0.38, 0.50 lb ai/A = lb/A) did not control crabgrass and was phytotoxic to perennial ryegrass (data not shown). Due to severe pressure, Illoxen plots were sprayed with Drive (0.5 + 1.0 lb/A) to control crabgrass. Illoxen applied on 2 wk intervals from 31 May to 4 August was giving good goosegrass control. Illoxen sprays ended on 4 August, and goosegrass rapidly germinated in Illoxen-treated plots resulting in high populations by 31 August. Drive effectively eliminated crabgrass, but had no effect on goosegrass. Goosegrass seed germinated in abundance in Drive-treated plots following the last spray on 20 July. Acclaim applied every 2 wk from 31 May to 19 August at rates ≥0.04 lb/A provided exceptional crabgrass plus goosegrass control.

Given the severe crabgrass pressure in Study III, exceptional control (i.e., <5% crabgrass cover) was provided by Team 1.15G (1.5 + 1.5 lb/A), pendimethalin 1.21G (1.5 + 1.5 lb/A), Lebanon Dimension 0.09G (0.13 + 0.13 lb/A), and Dimension 1EC (0.25 + 0.25 lb/A) (data not shown). Excellent control was provided by prodiamine 0.22G (0.75 and 1.0 lb/A), and the postemergence treatments of Dimension 1EC (0.63 lb/A) and Lebanon Dimension 0.09G (0.38 lb/A).

Among treatments applied once in April 1995 in Study IV, only Dimension 1EC (0.75 and 1.0 lb/A) and Barricade (0.48, 0.65, 0.75, 0.95 lb/A) provided acceptable crabgrass control (data not shown). Among Dimension sequential application treatments the following rates provided acceptable control: 0.25 + 0.25; 0.38 + 0.38; and 0.5 + 0.5 lb/A. Only Barricade (0.95 lb/A) provided acceptable spurge control. The granular forms of Dimension (0.25 to 0.45 lb/A) in Study V provided excellent postemergence crabgrass control. Dimension 1EC applied at 0.50 and 0.75 lb/A, but not 0.25 or 0.38 lb/A, provided good to excellent postemergence and subsequent preemergence crabgrass control. While there were no significant spurge cover differences among treatments, Dimension G-treated plots (0.38, 0.50 and 0.75 lb/A) had relatively low (<0.3% cover) spurge levels.

[1]Professor, Dept. of Agronomy, Univ. of Maryland, College Park, MD 20742.

Table 1. Preemergence and early post plus preemergence herbicides tank-mixes for smooth crabgrass and goosegrass control, 1994.

		31 August 1994	
	Rate	% area covered	
Herbicide	lb ai/A	Crabgrass	Goosegrass
†Scott's Goosegrass/Crabgrass Control	7.5	7b§	0.4c
†Ronstar 2G	4.0	2b	0.3c
†Dimension 1EC	0.5	4b	0.2c
†Pre-M 60DG	1.5 + 1.5	2b	0.8bc
†Team 2G	1.5 + 1.5	1b	0.3c
†Barricade 65DG	0.65	0b	1.2bc
‡Acclaim 1EC + Dimension 1EC	0.12 + 0.25	1b	4.5a
‡Acclaim 1EC + Barricade 65DG	0.12 + 0.38	<1b	5.1a
Untreated	---	34a	3.1ab

†Preemergence herbicides were applied initially on 20 April and sequential treatments were applied 7 June 1994.

‡Postemergence herbicide tank mixes were applied 7 June 1994 when crabgrass was 1 - 2 L and goosegrass was just beginning to emerge in adjacent, bare ground sites.

§Means in a column followed by the same letter are not significantly different at P = 0.05 according to Duncan's multiple range test.

REDUCING HERBICIDE INPUTS IN FINE FESCUE TURFGRASS

J.A. GRANDE[1]

ABSTRACT

A random survey of 93 northwestern New Jersey single family homesites surrounding the Rutgers University Snyder Research and Extension Farm indicated an average lawn area of 45,714 sq. ft. The existence of these extensive turfgrass areas is based on local zoning ordinances designed to preserve the rural character of the area. Additionally, interviews with local real estate agents indicates most of the homesites are managed by individuals relocating from metropolitan/suburban areas. The average residential turfgrass area in New Jersey is estimated at 6,000 sq. ft. It is common for these homeowners to be overwhelmed at the expense and time to manage these large areas.

On 9/19/90 a study was initiated at the Rutgers University Snyder Research and Extension Farm on a silt loam soil to address "reduced input" issues relative to larger residential turfgrass areas. The turfgrass was managed with lime, fertilizer and irrigation to ensure establishment. Herbicide inputs were aggressively utilized to develop a weed free study. On 4/9/91 the treatment variables were then initiated for the duration of the study. The variables were as follows:

A. Varieties: Bargena Creeping Red Fescue (Festuca ruba) (BCRF), Bighorn Sheeps Fescue (Festuca ovina) (BSF), Aurora Hard Fescue (Festuca longifolia) (AHF).

B. Mowing heights spring to fall (clippings recycled): 2" weekly; 3.5" weekly; 5" spring and fall.

C. Fertility: 1 lb. nitrogen/1,000 sq. ft. (Urea) spring and fall; 1 lb. nitrogen/1,000 sq. ft. (Urea) fall; 1 lb. nitrogen/1,000 sq. ft. (slow release) fall; and no fertilizer.

An analysis of 1995 data relative to turf quality (TQ) (visual rating -0 = dead, 10 = dense and attractive) indicates the following: BSF developed the highest quality turfgrass across all fertilizer treatments when mowed at 2" or 3.5" weekly (TQ>9), TQ of AHF in the same treatments was slightly inferior to BSF but still >9, TQ of BCRF was significantly inferior (TQ<7).

With respect to the non-fertilized treatments, TQ of AHF was slightly superior to BSF and provided the highest overall TQ (10). TQ of BCRF in the 2" and 3.5" mowing treatments was <6.

Weed invasion in the study was primarily broadleaf plantain (Plantago major L.) and dandelion (Taraxacum officinal L.). Weed control was evaluated on a 0% to 100% scale - 0% = complete weed invasion. 100% = complete absence of weeds. All turfgrass varieties x fertilizer treatments mowed two times per year resulted in greater than 90% weed suppression. All treatments containing BSF or AHF mowed at either 2" or 3.5" weekly resulted in greater than 75% weed suppression. All BCRF mowed at 2" or 3.5" weekly resulted in greater than 30% weed invasion.

Results of this five year study suggest some varieties of fine leafed fescues provide significant resistance to weed invasion when managed with no herbicide, fertility or irrigation inputs after a fall and spring establishment period.

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[1]Director, Clifford E. and Melda C. Snyder Research and Extension Farm, Rutgers University, 140 Locust Grove Road, Pittstown, NJ 08867

INTRODUCTION OF A NEW GLYPHOSATE FORMULATION FOR INDUSTRIAL , TURF, AND ORNAMENTAL USE

D. C. Riego

ABSTRACT

After 8 years of research and comprehensive performance trials, Monsanto Company is introducing a new formulation of glyphosate. The new formulation will be called ***Roundup PRO.*** Roundup PRO is formulated and labeled specifically for use in industrial, turf, and ornamental markets. The formulation contains 41% of the active ingredient isopropylamine salt of glyphosate and comes fully loaded with an improved and balanced surfactant system. No additional surfactant is needed in use applications.

With the improved surfactant system, Roundup PRO carries a CAUTION signal word. The oral LD50 is >5000 mg/kg, dermal LD50 is >20,000 mg/kg, inhalation LD50 is 2.0 to 20 mg/l, and skin effect at 72 hours is mild irritation. All are Category IV according to EPA toxicity categories. The eye effect is slight to moderate and is Category III. Both Category III and IV support the CAUTION signal word.

The new surfactant system improves penetration and speeds plant absorption of glyphosate. Weed control performance data supports this. Roundup PRO provides quicker symptom development or faster burndown of weeds, provides enhanced long term vegetation control or efficacy, and results in rainfastness in 1-2 hours.

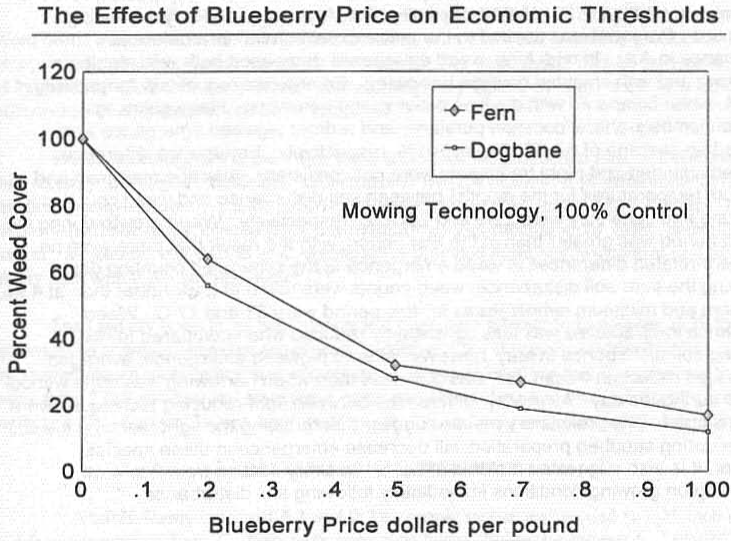
Technical Manager, Industrial, Turf , and Ornamentals, Monsanto Company, 1307 Cottonwood Court, Carmel, IN 46033

Economic Thresholds for Weeds in Wild Blueberry Fields

D.E. Yarborough, M.C. Marra[1]

ABSTRACT

The competitiveness of bracken fern (*Pteridium aquilinum*) and dogbane (*Apocynum androsaemifolium*) with wild blueberries (*Vaccinium angustifolium*) was evaluated, along with two control technologies, weed wiping and mowing, in a three-year field experiment. The results suggest that both bracken fern and dogbane can cause economic damage in wild blueberries, although dogbane is the more competitive weed. Of the two weed control technologies evaluated, weed wiping is the more cost effective and provides better control than mowing. The mowing technology uses no chemicals, however, and might be appropriate for reduced chemical production systems. The experimental results were used to calculate economic thresholds for both weeds. The economic thresholds were found to depend on the cost and effectiveness of the control technology, the competitiveness of the weed species and the expected blueberry price.



[1]Assistant Professor of Horticulture, Department of Applied Ecology and Environmental Sciences, University of Maine, Orono and Associate Professor, Department of Agricultural and Resource Economics, North Carolina State University, Raleigh.

Preliminary Investigations in Photocontrol of Weeds

Robin R. Bellinder and Luis E. Lanfranconi[1]

ABSTRACT

Research on photocontrol of weeds, by plowing and harrowing in the dark, was first reported in northern Germany in the late 1980's. Subsequently, research has been conducted in Denmark, Sweden, and quite recently, in Nebraska and Oregon. In addition to the obvious difficulties encountered with land and seedbed preparation at night, reported results have been highly variable in terms of the weed suppression achieved. Knowing that the area in Europe where the bulk of the research has come from lacks redroot pigweed, a ubiquitous weed in the northeastern U.S., this project was designed to evaluate the effect of photocontrol on weeds common to this region. A rye cover crop was grown on the experimental site and was regulated 2 wk prior to trial initiation with 1.1 kg ai/ha glyphosate. All plots were plowed and harrowed (harrowing included discing and flex-tine cultivation) to establish a fine seedbed. Operations were performed at different times: plow/harrow-day; plow/harrow-night; plow-day, harrow-night; plow-day, harrow-day with shielded tools; and plow-night, harrow-day with shielded tools. All operations were first performed in mid-May and were repeated without plowing in mid-June and late July. Weeds were counted, by species, in 4 1-m^2 stationary quadrats 26, 33, and 18 days after the May, June, and July harrowing operations. Paraquat was applied to the entire experimental area before soil disturbance in July. In mid-June, weed emergence decreased both with nighttime harrowing and with shielded daytime harrowing. Emergence reductions ranged from 11 to 92%, when compared with daytime plowing and harrowing. Hairy galinsoga, common lambsquarters, common purslane, and redroot pigweed emergence were reduced an average of 67, 55, 54, and 41%, respectively. Emergence differences between shielded and night treatments were not consistant. Average maximum and minimum temperatures for the months between soil disturbance and weed counting in May/June and June/July were 23/9 and 28/16 C, respectively. Weed growth during the second period was greater than in the first period, with the result that there were no treatment-related differences in weed emergence at the scheduled counting date. Following the third soil disturbance, weed counts were taken at 2 wk rather than at 4 wk. Maximum and minimum temperatures for this period were 33 and 17 C. Weed emergence in all species was less consistantly reduced when compared to results following soil disturbance in May, however, redroot pigweed emergence, averaged across light reduction treatments, was 33% less than when harrowing was done without shields during the day. As in May, differences between light-reducing techniques were not consistant. The preliminary results suggest that reducing the light reaching the soil surface during seedbed preparation will decrease emergence in these species, however, it is also suggested that this effect is transitory, lasting from 2 to 4 wk, depending on growing conditions immediately following soil disturbance.

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[1]Assoc. Prof. and Visiting Fellow, Dept. of Fruit and Vegetable Science, Cornell University, Ithaca, NY, 14853.

LIMA BEAN TOLERANCE TO FOMESAFEN AND SULFENTRAZONE

C.E. Beste[1]

ABSTRACT

Sulfentrazone preemergence was efficacious for lima beans `Maffei 15' in a loamy sand, 0.7% organic matter at 0.05 lb ai/A; however, 0.10 and 0.20 ai/A caused unacceptable injury. Fomesafen postemergence at the 6 to 7 trifoliate leaf stage of lima beans, with flower buds present, caused unacceptable injury at 0.25. 0.375, 0.50 and 0.75 lb ai/A alone or with oil concentrate additive when applied at ≥ 93 F maximum daily temperature. Imazethapyr, 0.023 lb ai/A, postemergence at the 6 to 7 trifoliate leaf stage reduced lima bean yields. Imazethapyr, 0.125 lb ai/A preemergence severely reduced growth and yield of lima beans. Pendimethalin 1.0, 2.0 and 3.0 lb ai/A preemergence severely injured lima beans.

INTRODUCTION

Lima beans (*Phaseolus lunatus* L.) are grown on about 20,000 A in the Delmarva region. Weed debris must be excluded from the lima beans by effective weed control in production fields or separation techniques during harvest or processing. The weed debris may be poisonous, such as nightshade (*Solanum* spp.) berries and morningglory (*Ipomoea* spp.) seed or it could be offensive to sensory perceptions of the consumer.

Annual morningglory is the major weed escape for the production area of Delmarva and the recently developed herbicides sulfentrazone (*N*-[2,4-dichloro-5-[4-difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]phenyl]methanesulfonamide) and fomesafen (5-[2-chloro-4-(trifluoromethyl)phenoxyl]-*N*-(methylsulfonyl)-2-nitrobenzamide) offer potential for control. Sulfentrazone at 0.05 lb ai/A preemergence provided morningglory control in a Norfolk loamy sand with 0.6% organic matter (1).

Snap and dry beans at the two trifoliate leaf stage were tolerant to fomesafen, 0.38 lb ai/A applied alone or with oil-based or non-oil-based additives (2). However, oil-based additives with fomesafen caused more injury than non-oil-based. Fomesafen alone was less injurious to lima beans at the 2 to 3 trifoliate leaf stage than a commercial formulation of fomesafen with premixed surfactant (3). Acceptable lima bean yields were obtained only with fomesafen alone (3).

MATERIALS AND METHODS

A Norfolk loamy sand, pH 6.1 and 0.7% organic matter was seeded at 1.25 inch depth in 3 ft width rows on June 27, 1995 with baby lima beans (*Phaseolus lunatus* L. `Maffei 15'). The plot size was 9 by 19 ft with 3 rows per plot and the treated area was 6.66 by 19 ft. The

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[1]Assoc. Prof., Dept. Hort. and Land. Archit., Univ. of Maryland, Salisbury Facility, 27664 Nanticoke Road, Salisbury, 21801-1648.

experimental design was randomized complete block with three replications. The spray volume was 24.2 gal/A with an 8003 nozzle pressure of 40 psi for treatment applications of preemergence on June 30 and postemergence on July 26. Crop emergence occurred on July 1. The lima bean stage-of-growth on July 26 was 14 inch height with 6 to 7 trifoliate leaves with racemes of unopened flower buds. The first rainfall after application was 0.46 inches at 28 hours after preemergence and 0.46 inches at 48 hours after postemergence treatments. Irrigation was applied as needed. The study was not cultivated. A center row length of 15 ft was harvested on September 5 for the shelled lima bean weight. The weed population as a percentage of the biomass in the untreated control was 35% goosegrass (*Eleusine indica* (L.) Gaertn.), 30% large crabgrass (*Digitaria sanguinalis* (L.) Scop.), 20% stinkgrass (*Eragrostis cilianensis* (All.) E. Mosher), 5% morningglory, ivyleaf and entireleaf (*Ipomoea hederacea (L.) Jacq.*, *Impomoea hederacea var. integriuscula* Gray), 5% common lambsquarters (*Chenopodium album L.*), and 5% fall panicum (*Panicum dichotomiflorum* Michx.). The untreated control had 100% soil cover on September 5, 1995.

Lima bean growth was visually rated on July 6 and 17, August 3 and September 1. Lima bean necrosis was rated at 8 days after postemergence applications. Bloom retardation was based on the density of white flowers in the raceme and reported as % bloom on August 3.

RESULTS AND DISCUSSION

Most weeds in this study were controlled by the preemergence herbicides metolachlor (2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide) or pendimethalin (*N*-(1-ethylpropyl)-3,4-dimethyl-2, 6-dinitrobenzenamine) ; therefore, weed competition did not affect the growth and yield of the lima beans (Table 1). Pendimethalin caused severe growth and yield reduction as a preemergence treatment which is justifiably prohibited on the label. Lima bean stem swelling was directly correlated with pendimethalin rates. Lima bean, `M-15', was tolerant to sulfentrazone, 0.05 lb ai/A; whereas, 0.10 lb ai/A reduced growth and yield. Significant lima bean injury with sulfentrazone, 0.20 lb ai/A precluded a yield evaluation. Postemergence fomesafen, 0.25 lb ai/A applied alone or with oil concentrate, caused unacceptable lima bean injury. Fomesafen rates of 0.375, 0.50 and 0.75 lb ai/A caused increased injury compared to the 0.25 lb ai/A rate. Fomesafen, 0.5 and 0.75 lb ai/A injury prevented yield determinations. Metolachlor, 3.0 lb ai/A preemergence, appeared to reduce lima bean growth compared to 1.5 lb ai/A; however, this reduced growth did not appear to influence lima bean response to a subsequent imazethapyr ((±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2yl]-5-ethyl-3-pyridinecarboxylic acid), 0.023 lb ai/A application. Imazaethapyr, 0.023 lb ai/A postemergence with flower buds present delayed bloom and reduced yield of lima beans. Preemergence imazethapyr, 0.125 lb ai/A, at 2.5 times the normal use rate caused severe lima beans and yield growth reduction. Pendimethalin appeared to provide some safening from lima bean injury due to preemergence imazethapyr, 0.125 lb ai/A, as compared to metolachlor plus imazethapyr.

The only treatments without morningglory escapes on September 8 were sulfentrazone and imazethapyr, 0.125 lb ai/A preemergence. Lambsquarters population was too erratic for evaluation. Grass control was acceptable with metolachlor and pendimethalin.

Table 1: Baby lima bean `M-15' growth, phytotoxic reactions, yield and weed control with metolachlor, sulfentrazone, pendimethalin, fomesafen and imazethapyr in a Norfolk loamy sand.

Treatment			Lima Beans								
			% Growth				% Necrosis	% Bloom	% Weed Cover	% Weed Control	Yields lb/A
Herbicide	lb ai/A	Method	7/06	7/27	8/03	9/01	8/03	8/03	7/27	9/08	9/05
Weedy	0.0	----	100 a	83 bc	53de	22 de	0 c	92 a	95 a	0 c	680 efg
Handweeded	0.0	----	100 a	100 a	80 a-d	100 a	0 c	93 a	0 c	100 a	2840 a
Metolachlor (8E)	1.5	PRE	100 a	100 a	97 a	97 a	0 c	100 a	2 bc	97 ab	2780 a
Metolachlor Sulfentrazone (75 WP)	1.5 0.05	PRE PRE	98 a	97 ab	95 a	97 a	0 c	97 a	0 c	100 a	2830 a
Metolachlor Sulfentrazone	1.5 0.10	PRE PRE	87 b	17 de	23 fg	63 bc	0 c	20 c-g	0 c	99 a	1330 cde
Metolachlor Sulfentrazone	1.5 0.20	PRE PRE	60 d	5 e	4 g	7 de	17 bc	0 g	0 c	100 a	----
Pendimethalin (WP 60)	1.5	PRE	82 bc	28 d	37 ef	70 b	0 c	55 bc	1 bc	97 ab	1090 c-f
Pendimethalin	3.0	PRE	75 c	7 e	12 fg	12 de	0 c	10 egf	0 c	96 abc	1110 c-f
Pendimethalin	4.0	PRE	75 c	4 e	3 g	8 de	0 c	0 g	0 c	97 abc	270 fg
Metolachlor Fomesafen (2EC)	1.5 0.25	PRE POST[1)]	100 a	100 a	92 a	65 bc	15 bc	60 b	0 c	96 abc	1580 bcd
Metolachlor Fomesafen	1.5 0.375	PRE POST[1)]	100 a	100 a	87 ab	27 d	25 ab	57 b	0 c	99 a	190 g
Metolachlor Fomesafen	1.5 0.50	PRE POST[1)]	100 a	100 a	73 a-d	3 e	22 bc	13 d-g	0 c	94 bcd	---

Table 1 (continued)

Treatment			Lima Beans								
			% Growth				% Necrosis	% Bloom	% Weed Cover	% Weed Control	Yields lb/A
Herbicide	lb ai/A	Method	7/06	7/27	8/03	9/01	8/03	8/03	7/27	9/08	9/05
Metolachlor Fomesafen	1.5 0.75	PRE POST[1)]	100 a	100 a	62 b-e	0 e	43 a	8 efg	0 c	93 cd	---
Metolachlor Fomesafen	1.5 0.25	PRE POST[2)]	100 a	100 a	85 abc	47 c	0 c	47 bcd	0 c	96 abc	750 d-g
Metolachlor Fomesafen	1.5 0.375	PRE POST[2)]	97 a	97ab	77 a-d	22 de	3 c	38 b-f	2 bc	93 cd	210 g
Metolachlor Fomesafen	1.5 0.50	PRE POST[2)]	100 a	100 a	75 a-d	5 de	11 bc	18 d-g	0 c	91 d	---
Metolachlor Fomesafen	1.5 0.75	PRE POST[2)]	98 a	92 ab	58 cde	0 e	42 a	3 fg	3 b	98 ab	---
Metolachlor Imazethapyr (2E)	1.5 0.023	PRE POST[3)]	100 a	100 a	98 a	100 a	0 c	42 b-e	0 c	98 ab	2230 ab
Metolachlor Imazethapyr	3.0 0.023	PRE POST[3)]	88 b	77 c	78 a-d	97 a	0 c	27 b-g	1 bc	99 a	1740 bc
Pendimethalin Imazethapyr	1.5 0.125	PRE PRE	97 a	4 e	13 fg	50 bc	43 a	2 fg	0 c	100 a	730 d-g
Metolachlor Imazethapyr	1.5 0.125	PRE PRE	83 b	6 e	6 g	22 de	30 ab	3 fg	0 c	99 a	440 fg

Means, within columns, followed by the same letter do not differ at the 5% level based on DMRT.

[1)] tank mixed with oil concentrate (Agri-Dex) at 1 quart/A

[2)] no additive

[3)] non-ionic surfactant added at 0.25% v/v.

Sulfentrazone appeared to have efficacy potential in lima beans. Fomesafen was extremely injurious at the 6 to 7 trifoliate leaf stage of lima beans; however, the injury was of such magnitude that additional studies are warranted. The maximum air temperatures in 1995 during and for 10 days after postemergence application ranged from 93 to 99 F and these conditions would have increased potential phytotoxicity. Lima bean stage-of-growth tolerance to postemergence fomesafen should be determined.

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COMPARISON OF THE PHYTOTOXICITY AND EFFECTIVENESS OF RESIDUAL SWEET CORN HERBICIDES

B. A. Majek and J. Hammerstedt[1]

ABSTRACT

Alachlor, marketed as Lasso, Micro-Tech and Partner, and metolachlor, marketed as Dual, have been the herbicides used for residual annual grass control in sweet corn (*Zea mays* L.) by most growers. Recently, a safener has been added to Dual and two new herbicides, dimethamid and acetochlor, have been registered for use in field corn that control a similar spectrum of weeds. Dimethamid has been marketed as Frontier and acetochlor has been marketed as Harness by Monsanto and as Surpass by Zeneca. Both acetochlor formulations contain different safeners to reduce the risk of corn injury. A standard use rate of 1.5 lb ai/A was used to evaluate alachlor and metolachlor. Dimethamid and acetochlor were evaluated at a use rate that was approximately half the rate of alachlor and metolachlor. The weed control observed was similar when the products were compared at those rates. None of the herbicides injured sweet corn treated with the standard use rates. Application rates two to four times higher than standard use rates were necessary to observe crop injury. Alachlor was consistently the least likely herbicide to injure sweet corn. Dual was more likely to cause slight to moderate injury to the crop, but the addition of the safener in the product marketed as Dual II eliminated the increased risk of crop injury. Dimethamid and the acetochlor plus safener formulations evaluated were more likely to cause crop injury to sweet corn when applied at two to four times the use rate than alachlor or metolachlor with the safener.

[1] Prof., Dept. of Extension Specialists, and Soils & Plants Technician, Rutgers University, Bridgeton, NJ 08302

WEED CONTROL IN POTATOES (SOLANUM TUBEROSUM) IN MAINE WITH RIMSULFURON

D. Ganske[1], G. Porter[2], J.R.C. Leavitt[1]

ABSTRACT

Rimsulfuron is a new sulfonylurea herbicide for preemergence and postemergence weed control in potatoes. Extensive field tests and demonstration plots conducted in Maine since 1990 have demonstrated that a groundcracking to early postemergence application of rimsulfuron at 0.25 to 0.38 ounces ai/acre will control several broadleaf and grass weeds including: quackgrass (Agropyron repens L.), mustard (Brassica campestris L. and Brassica rapa L.), wild radish (Raphanus raphanistrum L), false chamomile (Martricaria maritima L. var. agrestis [Knaf] Wilmott) that is 1 to 2 inches high,, and hempnettle (Galeopsis tetrahit L.). A tank-mix addition of metribuzin will control additional weeds, including: common lambsquarters (Chenopodium album L.) and wild buckwheat (Polygonum convolvulus L).

Crop tolerance tests conducted in Maine in 1992 and 1993 demonstrated that rimsulfuron can cause a moderate, transient chlorosis in sensitive potato varieties, but potato stand and yield were equal to the untreated potatoes for every variety tested. Potato varieties varied in sensitivity to rimsulfuron in the following order, from least sensitive to most sensitive: 'Katahdin" = 'Norwis' = 'MaineChip' < 'Atlantic' = 'Russet Burbank' < 'Shepody' = 'Superior'.

In two seed potato emergence tests conducted in Maine, rimsulfuron did not effect the emergence, stand, or yield of 'Katahdin' potatoes grown from seed potatoes that had been harvested the previous year from treated test plots.

Rotational crop tolerance tests and demonstration plot experience conducted in Maine in 1992-1995 have demonstrated that there is no carryover effect from rimsulfuron applied to potatoes before June 30 to these subsequent crops: winter rye (Secale cereal L.), spring oats (Avena sativa L.), spring barley (Hordeum vulgare L.), and peas (Pisum sativum L.).

Magnitude of Residue tests have consistently demonstrated that potato plants sprayed with up to 1.0 ounce ai/acre of rimsulfuron before June 30 produce tubers containing no detectable residues at the 0.05 ppm quantification limit. Therefore the crop tolerance of rimsulfuron in potato tubers was set at 2 times the quantification limit, or 0.1 ppm.

When applied according to label directions, no negative environmental impact has been seen nor is expected from applications of rimsulfuron to potatoes.

Rimsulfuron is a safe and effective herbicide for potato growers.

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[1]Senior Development Rep., Ag. Products Dept., E.I. DuPont de Nemours and Co., Wilmington, DE 19880

[2]Assoc. Prof. of Agronomy, Dept. of Plant, Soil, and Environmental Sciences, Univ. of Maine, Orono, ME 04469

EFFICACY AND PHYTOTOXICITY OF TD 2335-01 IN ONIONS

B. A. Majek and J. Hammerstedt[1]

ABSTRACT

TD 2335-01, also called Flair 2EC, is an experimental formulation of endothall. The product was evaluated in green bunching onions (*Allium cepa* L.) in 1994 and 1995. The application rate both years was 0.75 and 1.0 lb ai/A. In 1994, a postemergence application was made at the flag leaf stage of growth. Moderate injury was observed following the application. Injury symptoms included stunting and necrosis of the tip of the flag leaf. Recovery from the injury progressed slowly. Although later in the season the injury appeared to be less severe, stunting continued to be observed six weeks after application. Excellent, season long-control of hairy galinsoga (*Galinsoga ciliata* (Raf.) Blake) and shepherdspurse (*Capsella bursa-pastoris* (L.) Medik.) was observed at both rates of herbicide evaluated. In 1995, applications were made preemergence, delayed preemergence, at early loop, and at the one- to two-leaf stage of growth. No applications were made at the flag leaf stage of growth due to the injury observed in 1994. None of the TD 2335-01 applications injured the onions in 1995. Hairy galinsoga and smooth pigweed (*Amaranthus hybridus* L.) were effectively controlled by both herbicide rates at all the application times evaluated in 1995, except preemergence treatments. Control of both hairy galinsoga and smooth pigweed were unacceptable when TD 2335-01 was applied immediately after seeding.

[1] Prof., Dept. of Extension Specialists, and Soils & Plants Technician, Rutgers University, Bridgeton, NJ 08302

INTEGRATION OF WINTER ANNUAL COVER CROPS INTO WEED CONTROL SYSTEMS FOR VEGETABLE CROPS

John R. Teasdale and Aref A. Abdul-Baki[1]

ABSTRACT

Winter annual cover crops such as hairy vetch (*Vicia villosa* Roth), crimson clover (*Trifolium incarnatum* L.), and rye (*Secale cereale* L.) produce high rates of biomass by the time most vegetable crops are planted in spring. Residue from these cover crops suppresses weed emergence temporarily but fails to control weeds full season. We developed a system for tomato (*Lycopersicon esculentum* Mill.) production consisting of growing cover crops on beds, flail mowing just before transplanting, and using the residue for early-season weed control in place of preplant herbicides. A postemergence application of 0.56 kg ai ha^{-1} of metribuzin was applied to control emerged weeds and/or cover crop regrowth approximately three weeks after transplanting. A subsequent application of sethoxydim was made as needed to control late-emerging grass weeds. This system was compared to conventional systems with bare soil or black polyethylene mulch during the past five years. Tomatoes grown in a hairy vetch mulch produced greater yield and economic returns than those in conventional systems. Greater leaf area duration accounted for higher yields in hairy vetch than conventional systems. Tomato growth promotion by hairy vetch mulch contributed more to the success of this system than weed suppression.

This system requires the availability of postemergence herbicides to control weeds that will eventually emerge through cover crop residue. Vegetable crops without reliable postemergence herbicides and with a long critical period for weed control will require additional approaches. Management that results in maximum residue biomass and minimum residue decomposition would improve weed suppression by cover crops. Integration of cover crops and cultivation may be practical but potential stimulation of weed emergence by cultivation must be minimized. Research is needed to develop reliable herbicide-free cover crop systems.

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[1]Plant Physiologists, USDA-ARS, Weed Science Laboratory and Vegetable Laboratory, respectively, Beltsville, MD 20705.

Application of Fractals to Describe Weed Distributions

Guangyong Zou and Richard A. Ashley[1]

Introduction

Weeds are wild plant species in cultivated areas. Their distribution possesses similar characteristics to vegetation in the natural environment but is affected by human activities. In weed science, recent research has drawn attention to the need for methods to describe and analyze the spatial distribution of weeds. This represents a new direction that has the potential to enhance the understanding of how weed populations develop, persist, and change across different soils. The results could provide important implications in weed management and sustainable agriculture practice.

Previous studies have shown that weeds could be either regularly or irregularly distributed in crop fields. Irregular or patchy distribution is becoming a new challenge for weed scientists because the traditional assumption of weed distribution in herbicide-centered management could overestimate the yield loss and overuse herbicides. Geostatistical methods are playing an important role in weed distribution analysis (Cardina et al., 1995; Donald, 1994). Weed density variation in spaces has been considered to be composed of 'structural' variation that can be explained, and random error (nugget in geostatistics) which is attributed to sampling scale and measurement error. Reported nugget variance in weed distribution analysis is often a large percentage (up to 100%) of the total variance observed over the range of ca. 20 m. For example, Cardina et al. (1995) reported 65% nugget variance when sampling at only 1m spacing. The high variability at short range of weed distribution has also been reported by Donald (1994). There is no report in weed science about whether this large variability is scale dependent or just 'white noise'. The understanding of this phenomena has important significance in weed sampling, extrapolation and cause probing. The objective of this study is to evaluate scale dependence and to explore the application of fractals (Mandelbrot, 1967) in weed distribution study.

Theory

Ecologists have been aware that ecological patterns can not be neatly described by Euclidean dimensions. A new geometric form, FRACTAL, which exhibits structure at all spatial scales is becoming popular in vegetation and ecosystem stability studies (Palmer, 1988; Sugihara and May, 1990; Meltzer and Hastings, 1992). An simple definition is that a fractal is an object which has detail at all spatial scales, or self-similarity. A circle or a polynomial is not a fractal because it becomes linear upon repeated magnification. A coastline, or even the sea floor, is a fractal because it has detail at all spatial scales (Mandelbrot, 1967). Fractals have been widely demonstrated in natural sciences (Hastings and Sugihara, 1993).

In fractal geometry, an object is described by its dimension (D), which is scale invariant and can be any number between Euclidean dimensions. Sugihara and May (1990) catalogued five methods of obtaining fractal dimension. One of them is by using semivariograms (Mark and Aronson, 1984). A brief summary is presented here. Semivariogram is the key to geostatistics. In fact, the very idea of semivariance is from similarity. A natural way to measure similarity between two numerical values (e.g. Z at two different locations, x_i and x_j) is to compute their difference. Therefore:

[1]Graduate Assistant and Professor, respectively; Department of Plant Science, University of Connecticut, Storrs, CT 06269-4067.

$$similarity = [z(x_i) - z(x_j)]^{-1} \text{ or}$$

$$(similarity)^{-1} = error(q) = E\{[z(x_i) - z(x_j)]^2\}$$

Let h (lag) be the distance between x_i and x_j, i.e., $x_j = x_{i+h}$, and assuming similarity is a function only of h and consequently is not a function of x (position), then

$$[similarity(h)]^{-1} \approx \frac{1}{N}\Sigma[z(x_i) - z(x_{i+h})]^2, \text{ i=1,..., N}$$

N is the number of pairs of points separated by h. Using semivariance instead of similarity, we have

$$2\gamma(h) = \frac{1}{N}\Sigma[z(x_i) - z(x_{i+h})]^2$$

i.e.,

$$\gamma(h) = \frac{1}{2N}\Sigma[z(x_i) - z(x_{i+h})]^2 = kh^{2H}$$

(by power law, see Hastings and Sugihara, 1993)

where k is a constant and H describes the complexity of the surface and has value between 0 and 1. The fractal dimension, D, can be calculated through

$$D = 3 - H = 3 - \frac{1}{2}\frac{\log\gamma(h) - \log k}{\log h}$$

For the Brownian process H=0.5, so D=2.5, the expected variance between two points increase linearly with distance; for H > 0.5, the variance between nearby points is less than that in the Brownian process, but it increases exponentially and exceeds those in the Brownian process when distance is greater than 1 unit. On the other hand, if H < 0.5, variance increases exponentially for short distances and remains nearly constant for distant points. Consequently, a D < 2.5 results in a surface of greater smoothness and persistence, showing a certain degree of trend, while the surface becomes rugged and antipersistent for D > 2.5. As H approaches 0, or D near 3, the surface becomes white noise with no persistence.

Materials and Methods

Fields and sampling This study is a part of the project "Predicting weed infestation in vegetable fields". Three sites representing three crop practices were chosen (Table 1). Sampling dates were 20-30 days after seedbed preparations. Weed counts were taken for common species in each field.

Table 1 Description of the study fields

Field	Crop	Sampling Area (m^2)	Sampling scheme and smallest scale (m)	Sampling quadrat (m^2)	Number of observations
1	pumpkin	30 X 60	systematic, 0.91	0.5	288
2	fallow	30 X 90	nested, 1.42	0.25	123
3	cabbage	20 X 40	grid, 2.83	0.25	116

Statistical analysis Negative binomial distribution (Bliss and Owen, 1958) with the form of

$$p(x) = \left(\frac{\Gamma(k+x)}{\Gamma(k)\Gamma(x+1)}\right)\left(\frac{\mu}{\mu+k}\right)^{x}\left(\frac{k}{\mu+k}\right)^{k}, \mu = \text{mean, k = clumping parameter}$$

was fitted to the count data for individual species within a field, and goodness of fit was examined with a chi-square test. The omni-directional semivariance of weed density was calculated with the EPA program GEOEAS. Double logarithms of semivariance and distance f(h) were used to illustrate the fractal dimensions for each species. Slopes corresponding to three different fractal dimensions were used as null model with which to compare spatial variation of weed density.

Results and Discussion

Results support the idea of clumping or patching of weeds (Table 2). In only 1 out of 7 cases were rejected by chi-square test, which offers evidence for the use of negative binomial distribution as a model of weed spatial distribution. Wiles et al. (1992) reported the same ratio of distributions in North Carolina soybean fields, but the estimated values of k are smaller than those observed by the authors which indicates the effect of sampling scale on the comparison (Richter and Sondgerath, 1990). By the definition of parameter k, the degree of patchy is quite different between crop fields and the fallow field, and crop fields have much lower values (higher patchy) than that of fallow field (lower patchy). The explanation for this may be the mean density of weeds affect the spatial distribution. One would expect random or uniform distribution in a very high weed infestation field. However, galinsoga (*Galinsoga ciliata*, (Raf.) Blake) in a cabbage (*Brassica oleracea* L.) field seems not follow this rule. This might be because galinsoga is of smaller individual size than pigweed (*Amaranthus retroflexus* L.) or lambsquaters (*Chenopodium album* L.). Purslane (*Portulaca oleracea* L.) in a pumpkin (*Cucurbita pepo* L.) field exhibited the same situation as that of galinsoga. Contrary to results of Wiles et al. (1992), this study shows that the k value is a species and field characteristic. Attempts to use one common value of k for a group of weed populations might be impossible. The above results support the idea of using negative binomial distribution to estimate the proportion of field for a given weed density (e.g., weed-free area), but gives no indication of multi-dimension distribution of weeds or the distribution beyond the sampling grid. Fractal concepts will provide these estimates.

Table 2 Fit of parameter values of the negative binomial distributions

Species	Field 1			Field 2			Field 3		
	k	mean	x^2,df	k	mean	x^2, df	k	mean	x^2, df
pigweed	1.53	1.81	5.66, 5	8.13	4.71	16.87, 8			
purslane	0.76	8.11	*31.78, 12						
lambsquaters	0.61	3.45	7.53, 8	2.64	5.16	13.99, 11	1.07	2.64	10.31, 5
galinsoga							1.19	8.03	15.98, 15

* The fit of negative binomial distribution was rejected (P=0.01).

Double logarithms of semivariance and sampling scale of four species as they occurred in three fields are shown in Figures 1. Because of nonlinearity of semivariance functions, the distributions of all species except lambsquarters in cabbage field are 'pseudo-fractals'. As the case for distribution fit, the

semivariance functions are species and field dependent. This agrees with the fact that crop practices affect individual species distribution. In data analysis, 'white noise' is equivalent to homogeneity where fractal dimension close to 3 for a surface. This also equals complete spatial independence. Figure 1A and 1D show pigweed distributions in pumpkin and fallow fields respectively. As in the above results, pigweed shows spatial independence in the fallow field whereas it exhibits complexity in the pumpkin field, which is samll-scale heterogeneous patches embedded in middle-scale homogenous patches and middle-scale patches made up large-scale heterogeneous patches. Lambsquarters in these two fields have the same trend (Figure 1C and 1E) but at different scales. That is, there is a large-scale linear trend with other scale noise which means lambsquarters distributions consist of homogeneous patches embedded in heterogeneous patches. The opposite distribution of lambsquarters is in the cabbage field (Figure 1F), that is, the whole sampling area is composed of homogenous patches but these patches themselves consist of heterogeneous small patches. Figure 1B shows purslane distribution in the pumpkin field, which illustrates statistically self-similarity. That is, large scale patches are the cumulative manifestation of small-scale patches. Figure 1G shows that galinsoga distribution has the same pattern as lambsquarters in this field.

The semivariance in Figure 1 also indicates that the fractal dimensions are greater than 3, the dimension of an Euclidean volume, at some scales. The same problem was encountered by Meltzer and Hastings (1992). It might be the artifact of spurious periodicity (Journel and Huijbregts, 1978). It is noted that weed patches in fields are complicated, e.g., homogeneous patches could be composed of heterogeneous patches and vise versa, which is expressed in fractal dimension breakups at various scales. The unstable dimension may be caused by multiscale processes (Burrough, 1983), which provides the reason for using the multi-variogram model in geostatistical methods (i.e., kridging) to more accurately map weed density.

This work verifies that the patchy spatial distribution of weeds has characteristics of fractals. Using the context of the fractal concept could provide the appropriate sampling scale for prediction of weed population and corresponding yield loss, and consequently, establish the foundation of herbicide recommendations and weed management.

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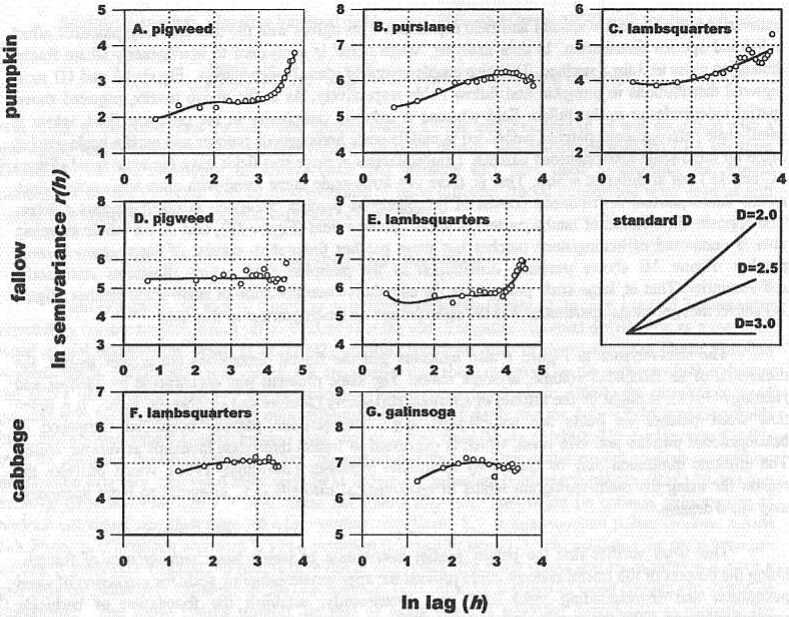

Figure 1 Semivariogram functions [ln *r(h) vs* ln *h*] for pigweed, purslane, lambsquarters, and golinsoga densities in pumpkin, fallow, and cabbage fields. Slopes corresponding to three different fractal dimensions are shown for comparison.

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Potential Herbicides for Dry Beans

Jed B. Colquhoun and Robin R. Bellinder[1]

ABSTRACT

Field studies were conducted to evaluate potential new herbicides in dry beans (*Phaseolus vulgaris* L.) at the H.C. Thompson Vegetable Research Farm, in Freeville, NY, and at Olson Farms, Ontario County, NY in 1995. The herbicides included flumiclorac (0.027 lb ai/A, POST); CGA 248757 (0.0036, 0.0044, 0.0132 lb ai/A, POST); sulfentrazone (0.3125, 0.375 lb ai/A, PRE); halosulfuron (0.075 PRE, 0.031 lb ai/A POST); and chloransulam-m (0.031, 0.039 lb ai/A PRE; 0.016 lb ai/A POST). Weed species evaluated were: hairy nightshade (*Solanum sarachoides* Sendtner) and hairy galinsoga (*Galinsoga ciliata* Raf. Blake) at Olson Farms, and common lambsquarters (*Chenopodium album* L.) at the Thompson Farm. Sulfentrazone (both rates) controlled greater than 95% of all weeds evaluated, but delayed bean emergence and stunting reduced yields. Hairy galinsoga control was excellent when CGA 248757 or flumiclorac were applied, however, only CGA 248757 provided adequate control of hairy nightshade. Although both herbicides caused 20 to 30% stunting and chlorosis 4 days after treatment (DAT), by 21 DAT no injury symptoms were visible, and yields were not reduced. Halosulfuron, applied PRE, controlled common lambsquarters and hairy galinsoga, but was ineffective when applied POST, and failed to control hairy nightshade at either timing. Chloransulam-m, PRE and POST, provided excellent hairy nightshade and hairy galinsoga control, however, control of common lambsquarters was poor. Despite causing early stunting, neither PRE nor POST applications of chloransulam-m or halosulfuron reduced yields.

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

COMBINING CULTIVATION AND INTERSEEDED COVER CROPS FOR WEED CONTROL IN CABBAGE

Riikka Rajalahti and Robin R.Bellinder[1]

ABSTRACT

Interseeded oats (*Avena sativa* L.), hairy (*Vicia villosa* L.)and lana vetch (*Vicia dasycarpa* L.) in combination with cultivation were evaluated for their potential to suppress weeds in transplanted cabbage (*Brassica oleracea*) in 1995. The cover crops were interseeded following 1, 2, or 3 cultivations 10 (between- and in-row), 20, or 30 (between-row) days after transplanting (DAT). The chemical standard included metolachlor (1.7 kg/ha) applied 48 hr after transplanting and pyridate (1.0 kg/ha) applied 3 wk after transplanting. For comparison, a weedy check and three cultivated checks (10, 20, or 30 DAT) were included. Weed suppression was inadequate with all three cover crops when interseeded 10 or 20 DAT, but significantly better than the weedy check or cultivation alone 10 or 20 DAT. Cultivation 30 DAT alone or in combination with the cover crops provided good weed control. Yields of the chemical standard and cultivation 10 DAT, with or without the three cover crops were equivalent. When cultivated 2 or 3 times, both with or without cover crops cabbage yields were significantly greater than the chemical standard and equivalent to the handweeded control.

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

POTENTIAL IMPACT OF HERBICIDE-RESISTANT GERMPLASM ON PRODUCTION AND MANAGEMENT OF ROW CROPS

A. C. York[1]

ABSTRACT

Development of herbicide-resistant crops (HRC) is an exciting and perhaps logical progression in weed science. This technology will offer a number of potential benefits and perhaps some liabilities, and it likely will have major impacts on row crop production and the pest management industry.

An obvious benefit of HRC technology will be additional options and flexibility in managing difficult-to-control weeds. It will offer a means to control species that currently cannot be controlled in some crops or require specialized applications. It will provide options for species that currently can be controlled only at the risk of injuring the crop. Convenient overtop applications may replace tedious directed applications. The technology may give more growers the confidence and the tools to adopt total POST programs and integrate economic thresholds into management decisions. The technology can lead to use of more environmentally acceptable herbicides and offer alternatives to herbicides in jeopardy of cancellation or greater restrictions on use because of environmental or other concerns.

Growers are extremely excited about HRC technology, seeing it as an easier and more economical solution to weed management. One can argue, however, that HRC technology will require greater management skills. Not only must growers avoid obvious problems of drift and unintentional application to non-resistant crops, but they also must be alert for population shifts that likely will occur with heavy reliance on a single herbicide program. Planning will be required in cases where volunteer crop plants can be problems in rotational crops. At least initially, locally adapted cultivars with desired characteristics such as disease or nematode resistance may not be available. The impact of HRC on economics of crop production is unclear; much depends upon premiums charged for the technology and competition in the marketplace.

A major potential benefit will be in the area of resistance management. Evolution of resistant biotypes is a growing problem and will escalate as more herbicides with similar mechanisms of action are used widely not only in monocultures but also in rotations. In too many cases, control of certain problem weeds is limited to herbicides with a single mechanism of action. HRC offer the only short-term solution for managing certain resistant biotypes. More importantly, HRC technology can assist in avoiding further resistance evolution if used wisely. If not used wisely, HRC technology can exasperate the problem. HRC will allow more opportunities to use herbicides with different mechanisms of action, a key component of any resistance management strategy. One may question the wisdom of using certain HRC if it means greater use of herbicides with mechanisms of action prone to resistance evolution, and there are specific examples of such HRC.

HRC will likely cause some shifts in cropping systems. An obvious shift will be more no-tillage in crops where lack of adequate weed control currently limits no-till production. If harvesting equipment can be developed, there may also be a shift to "ultra narrow" rows in crops typically grown in wide rows to facilitate cultivation and directed herbicide application.

Impact of HRC on the agrichemical industry, both basic manufacturing and distribution, is largely speculative at this time. Many within the industry are concerned that widespread usage of relatively few herbicides on HRC could force some manufacturers and distributors out of business. That could have an adverse long-term impact through reduced development of new products, less service, and reduced competition in the market place.

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[1]Prof., Dept. of Crop Science, North Carolina State University, Raleigh, NC 27695-7620.

IMPACT OF HERBICIDE RESISTANT GERMPLASM ON ROW-CROP VARIETY DEVELOPMENT

A. K. Walker[1]

ABSTRACT

Asgrow Seed Company is a leader in the transferral of new agriculture technology to the farm level. Asgrow Seed Company has been at the forefront in releasing new herbicide tolerant soybean varieties and corn hybrids. Asgrow Seed Company first introduced STS® soybeans in 1993, IMI™ corn in 1994, Roundup Ready® soybeans in 1996, Poast Compatible™ corn in 1996, and plans to release Liberty Link™ corn in 1997 and Liberty Link™ soybeans in 1998.

The Roundup Ready® soybeans and Liberty Link™ corn and soybeans are products of transformation, whereas STS® soybeans, IMI™ corn and Poast Compatible™ corn are products of mutagenesis programs. These herbicide tolerant crops allow cost effective, post-emergent weed control with wider application windows and excellent crop safety.

Our Concept Farms provide the demonstration, evaluation, and transferral of these technologies directly to the user. We have observed a rapid adoption of these new varieties and hybrids.

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[1]Worldwide Director of Soybean Research, Asgrow Seed Company, 5926 Highway 14 East, Janesville, WI 53546

POTENTIAL IMPACT OF HERBICIDE-RESISTANT CROPS ON SPECIALTY AND MINOR CROPS

L.P. Gianessi[1]

ABSTRACT

Certain crops, such as soybeans, corn and cotton, have largely been the focus of using biotechnology to engineer cultivars to tolerate herbicides. The large acreage of these crops offers the potential of substantial economic gain if growers switch to the use of the herbicide that is used with the engineered crops. Not much attention has been given to the engineering of vegetable or fruit crops for the purpose of developing herbicide-resistant cultivars. The small acreage of these crops do not warrant a substantial amount of research and development expenditures to develop the resistant cultivars and register the associated herbicide use. In addition, gene transformation may lead to some negative effect on an important agronomic trait, such as size, shape, yield, taste, or processing characteristics - all of which are very important in the production of fruit and vegetable crops. If herbicide-resistant cultivars do not possess all commercially important characteristics, they will not be developed.

The greatest impact of herbicide-resistant crops in fruit and vegetable production may be an inadvertent effect associated with the introduction of herbicide-resistant crops for major field crops. If field crops are engineered to tolerate certain contact post-emergence broad-spectrum herbicides, and growers switch to their use, it would be likely that the use of residual herbicides would decline in field crops. Significant declines in usage in field crops is often economic justification for a registrant to suspend production of a product. Since certain residual herbicides that might decline in usage are also widely used on fruit and vegetable acreage, a significant decline in field crop usage may lead to canceled herbicide registrations for fruit and vegetable crops as well. Thus, the inadvertent effect of the development of herbicide-resistant cultivars for field crops may be canceled herbicide registrations for minor crops.

Weed control options for fruit and vegetable production are limited and expensive. A considerable amount of hand-labor is required for weeding many fruit and vegetable crops. In the future, it may be the case that genetic engineering will be routine, and significantly less costly than it is today. It may be the case that fruit and vegetable crops will be genetically engineered to tolerate the same broad-spectrum herbicides which are likely to be used with genetically-altered field crops. However, for the foreseeable future, fruit and vegetable growers will have few new herbicide options for weed control from either genetic engineering or from the introduction of new, selective herbicides for use with non-engineered cultivars.

[1] Senior Research Associate, The National Center for Food and Agricultural Policy, 1616 P Street, N.W., First Floor, Washington, D.C. 20036

HERBICIDE RESISTANT TURFGRASSES: POTENTIAL AND CONCERNS

Peter R. Day[1] and Lisa Lee[2]

ABSTRACT

Several genes for resistance to herbicides that control grasses (Ignite or bialophos; Pursuit, an imidazolinone) have been introduced into cell lines of various cultivars of creeping bentgrass (*Agrostis palustris* Huds). Two methods were used--protoplast transformation and the gene gun. Greenhouse and field trials of clonally propagated plants regenerated from the cell lines show useful levels of resistance. Tests of seeds from transgenic mother plants carrying the *bar* gene pollinated by normal bentgrass in a containment greenhouse show that resistance to Ignite is transmitted to the next generation. These transgenic bentgrass lines are of potential interest to breeders and greenskeepers since they offer a simple means of controlling such grass weeds as*Poa annua*.

There are two concerns, one scientific the other economic, that now limit the perceived value of herbicide resistant turfgrass. Creeping bentgrass is not an important weed in agriculture although it is a weed in bluegrass lawns. The risk of horizontal spread of herbicide resistance to other species and genera that are weeds is seen as a potential drawback that could limit the usefulness of herbicide resistance in the major field crops. In fact, *A. palustris* is not known to be sexually compatible with *A. alba* and *A. scabra* or with other genera such as *Eragrostis*. The second concern questions the size of the potential market for herbicide sales to greenskeepers or of royalty returns on seed sales. These are admittedly small in comparison to the major crops but are nevertheless locally important and could be rewarding if the forms were widely adopted.

[1]Director and Professor Genetics, Center for Agricultural Molecular Biology (AgBiotech), Cook College/Rutgers University, New Brunswick, NJ 08901-0231

[2]Assistant Research Professor, Center for Agricultural Molecular Biology (AgBiotech), Cook College/Rutgers University, New Brunswick, NJ 08903-0231

PERFORMANCE OF EARLY PRE-PLANT TREATMENTS OF EXP 31130A IN ANNUAL WEED CONTROL IN NO-TILLAGE CORN

P. C. Bhowmik, R. G. Prostak and J. A. Drohen[1]

ABSTRACT

A field experiment was conducted in 1995 to determine the effectiveness of EXP 31130A in controlling annual grass and broadleaf weeds in field corn under a no-tillage system. EXP 31130A was evaluated alone at 1.5, 1.88, 2.25 and 3.0 oz ai/A and in combinations at 1.5 and 2.25 oz ai/A with 1.0 lb ai/A of either acetochlor or metolachlor. Plots were 6.7' by 20' and the treatments were replicated three times in a randomized complete block design. 'Ciba 4385' corn (Zea mays L.) was planted on May 9, 1995. Treatments were applied early pre-plant (EPP) on April 26 (10 days prior to planting), using a CO_2-backpack sprayer that delivered 20 gpa at 22 psi. Corn height was determined at 5 and 9 WAT (weeks after treatment). Control ratings of large crabgrass (Digitaria sanguinalis L. Scop.), yellow foxtail [Setaria lutescens (Weigel) Hubb.], fall panicum (Panicum dichotomiflorum Michx.) and common lambquarters (Chenopodium album L.) were estimated 2, 4 and 8 WAT. Silage and grain yields were also determined.

No corn injury was observed at any growth stage (2, 4 or 8 WAT). EXP 31130A applied early pre-plant treatments showed excellent burn-down activity. EXP 31130A at 1.5 to 3.0 oz/A effectively controlled large crabgrass 2 WAT. However, only the highest rate (3 oz/A) provided greater than 90% control 8 WAT. The lower rates provided reduced control of large crabgrass 4 and 8 WAT, resulting in moderate weed competition. EXP 31130A at all rates controlled yellow foxtail 2 WAT. Yellow foxtail control was reduced with all rates except the 3 oz/A rate 4 and 8 WAT. EXP 31130A also controlled common lambsquarters and redroot pigweed 8 WAT, but the lower rates did not control redroot pigweed effectively. EXP 31130A at all rates effectively controlled horseweed [Conyza canadensis (L.) Cronq.]. In contrast, EXP 31130A was ineffective in controlling sulfur cinquefoil (Potentilla recta L.). EXP 31130A at 2.25 oz/A when combined with either acetochlor or metolachlor at 1.0 lb/A controlled large crabgrass, fall panicum, yellow foxtail, common lambsquarters and redroot pigweed.

Grain yields for all EXP 31130A treatments (1.5 to 3.0 oz/A) ranged from 33 to 119 bu/A. Combinations of EXP 31130A at 2.25 oz/A with metolachlor and acetochlor resulted in higher yields than that with the 1.5 oz/A rate alone. Corn silage yields followed a similar trend.

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

PREEMERGENCE ACTIVITY OF EXP 31130A IN ANNUAL WEED CONTROL IN CORN

P. C. Bhowmik, R. G. Prostak and S. Kushwaha[1]

ABSTRACT

A field experiment was conducted in 1995 to evaluate the effectiveness of EXP 31130A in controlling annual grass and broadleaf weeds in field corn under a conventional tillage system. EXP 31130A was evaluated alone at 0.75, 1.13, 1.5, 1.88 and 2.25 oz ai/A and in combinations at 1.5 oz ai/A with acetochlor, metolachlor, alachlor and dimethenamid. Plot were 6.7' by 20' and replicated three times in a randomized complete block design. 'Ciba 4385' corn (Zea mays L.) was planted on May 2, 1995. Treatments were applied preemergence on May 3, 1995 using a CO_2-backpack sprayer that delivered 20 gpa at 22 psi. Corn height was determined at 6 and 10 WAT. Control ratings of large crabgrass (Digtaria sanguinalis L. Scop.), fall panicum (Panicum dichotomiflorum Michx.), yellow foxtail (Setaria lutescens (Weigel) Hubb.), common lambquarters (Chenopodium album L.), and redroot pigweed (Amaranthus retroflexus L.) were estimated 2, 4 and 7 WAT. Silage and grain yields were also determined.

Slight bleaching injury (18%) to corn was observed 2 WAT only at the highest rate (2.25 oz/A) of EXP 31130A applied PRE. However, injured corn plants completely recovered by 4 WAT. EXP 31130A at 1.88 to 2.25 oz/A effectively controlled large crabgrass and fall panicum 7 WAT, although the lower rates resulted in reduced control (70 to 80%). EXP 31130A at 1.88 to 2.25 oz/A effectively controlled yellow foxtail up to 4 WAT and only 80% control was observed 7 WAT. EXP 31130A at 1.5 oz/A when combined with acetochlor, metolachlor, alachlor, or dimethenamid controlled yellow foxtail over 90% 7 WAT. All EXP 31130A treatments including combinations effectively controlled redroot pigweed and common lambquarters up to 7 WAT.

No differences in grain and silage yields from EXP 31130A treatments (0.75, 1.13, and 1.5 oz/A) were observed. The yields (82 to 105 bu/A) from these treatments were significantly less, reflecting competition from late germinating weeds due to short residual control with lower rates. The higher rates (1.88 and 2.25 oz/A) of EXP 31130A yielded significantly higher silage (23 and 29 ton/A) and grain (146 and 187 bu/A) yields, compared to the silage (4 ton/A) and grain (14 bu/A) yields from the untreated control. The cultivation treatment yielded 29 tons/A of silage and 182 bu/A of grain. All combination treatments resulted in excellent silage yields (27 to 29 tons/A) and grain yields (146 to 190 bu/A). Our results with EXP 31130A treatments show great potential for annual weed control in field corn.

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

ANNUAL WEED CONTROL IN CONVENTIONAL AND NO-TILL FIELD CORN WITH EXP31130A

Frank J. Himmelstein and Robert J. Durgy[1]

ABSTRACT

The development of EXP31130A has introduced a new herbicide family for preemergence weed control in no-till and conventional field corn (Zea mays L.). Three field studies were conducted in Storrs, CT in 1995 to evaluate EXP31130A alone and in combination with other herbicides for large crabgrass [Digitaria sanguinalis (L.)Scop.], common lambsquarters [Chenopodium album L.], and redroot pigweed [Amaranthus retroflexus L.] control. Herbicides were applied with a CO_2 backpack sprayer delivering 20 gpa at 32 psi. Weed control was assessed by both visual ratings, and weed biomass samples taken from a 2.25 ft^2 quadrant from the center of each plot. Corn grain yields were determined by hand harvesting 12 ft of two center rows in each plot. All studies were randomized complete block designs with four replications. Studies 1 and 2 were no-till sites. Study 3 was a conventional site. Treatments were applied 10 days preplant in study 1, and preemergence in studies 2 and 3. Treatments in study 1 included EXP31130A alone (1.5, 1.88, and 2.25 oz ai/A) and in combination with metolachlor [(Dual II)1 lb ai/A] and acetochlor [(Harness)1 lb ai/A] at 1.5 and 1.88 oz ai/A. Treatments in study 2 included EXP31130A alone (1.13, 1.5, and 1.88 oz ai/A) and in combination with metolachlor (1 lb ai/A) and acetochlor (1 lb ai/A) at 1.13 and 1.5 oz ai/A. Metolachlor (2 lb ai/A) in combination with atrazine (1.0), flumetsulam + clopyralid [(Broadstrike Plus) 0.214 lb ai/A] and imazethapyr[(Pursuit) 0.063 lb ai/A]; acetochlor (1.75 lb ai/A) in combination with atrazine (1.0), halosulfuron + safener [(Battalion) 0.075 lb ai/A]; and [flumetsulam + metolachlor (Broadstrike + Dual) 1.92 lb ai/A] were also included in studies 1 and 2. Treatments in study 3 included EXP31130A alone (0.75, 1.13, 1.5 and 1.88 oz ai/A) and in combination with acetochlor (1 lb ai/A), metolachlor (1 lb ai/A), alachlor [(Lasso MT) 1.25 lb/A) and dimethenamid [(Frontier) 0.6 lb ai/A] at 1.5 oz ai/A. Pendimethalin [(Prowl) 1.25 lb ai/A] alone and in combination with acetochlor (1 lb ai/A), metolachlor (1 lb ai/A), alachlor (1.25 lb/A) and dimethenamid (0.6 lb ai/A) were also included in study 3. All herbicide treatments in each study provided excellent control of large crabgrass, redroot pigweed and common lambsquarters throughout the season. Weed control was similar among all treatments. No corn injury was observed following herbicide application. Herbicide treatments increased average corn grain yields 22%, 31% and 57% compared to the checks in studies 1, 2, and 3 respectively. There were no differences in corn grain yields among herbicide treatments in each study. EXP31130A, at considerably reduced use rates, can provide effective weed control as compared with currently available herbicides.

[1]Extension Educator-Integrated Crop Management, and Res. Asst., respectively, University of Connecticut, Storrs, CT 06269

EFFICACY AND PHYTOTOXICITY OF EXP 31130A IN NO-TILL AND CONVENTIONALLY PLANTED FIELD CORN

B. A. Majek[1]

ABSTRACT

Field corn (*Zea mays* L.) grown using conventional tillage practices was not injured when treated preemergence with EXP 31130A at 0.047, 0.071, 0.094, and 0.141 lb ai/A. All the rates except the lowest rate evaluated effectively controlled barnyardgrass (*Echinochloa crus-galli* (L.)Beauv.) through late July. Applications made early preplant or preemergence to field corn planted using a no-till production system at 0.094, 0.118, 0.141, or 0.188 lb ai/A did not injure the crop, but weed control was more variable. EXP 31130A applied early preplant controlled emerged common ragweed (*Ambrosia artemisiifolia* L.) at all rates evaluated, but emerged common lambsquarter (*Chenopodium album* L,) was more difficult to control. Only the highest rate evaluated controlled common lambsquarter when applied early preplant. None of the rates evaluated early preplant effectively controlled giant foxtail (*Setaria faberi* Herm.) or wild buckwheat (*Polygonum convolvulus* L.) that emerged after application. Preemergence treatments, applied two weeks after the early preplant treatments, controlled emerged common ragweed, but did not control common lambsquarter. Giant foxtail which emerged after application, was controlled by all the rates evaluated, but wild buckwheat was not controlled by EXP 31130A.

1 Prof., Dept. of Extension Specialists, Rutgers University, Bridgeton, NJ 08302

EXP31130A: A NEW PREEMERGENCE HERBICIDE FOR CONVENTIONAL TILLAGE CORN.

T.E. Vrabel, J.P. Cartier, D.G. Mosier and W. Duckworth[1]

ABSTRACT

EXP31130A, a formulation of isoxaflutole (proposed common name), is a member of a new class of isoxazole herbicides from Rhone-Poulenc Ag Company which disrupt pigment biosynthesis in susceptible plant species. EXP31130A is formulated as a 75 percent water dispersible granule which is ideal for use with water soluble packaging technology.

EXP31130A was evaluated in 1995 in 166 conventional tillage field trials conducted by Rhone-Poulenc in the United States. It was evaluated in preemergence and early preplant applications applied either alone or in combination with other preemergence herbicides. Results from these trials have shown that EXP31130A provides excellent selective control of both grass and broadleaf weeds in corn (*Zea mays* L.) at low use rates. EXP31130A applied alone preemergence at rates of 52 to 105 g ha^{-1} provided excellent control of velvetleaf (*Abutilon theophrasti* Medik.), common ragweed (*Ambrosia artemisiifolia* L.), lambsquarters (*Chenopodium album* L.), redroot pigweed (*Amaranthus retroflexus* L.), common waterhemp (*Amaranthus tuberculatus* (Moq.)J.D. Sauer), kochia (*Kochia scoparia* (L.)Schrad.), Pennsylvania smartweed (*Polygonum pensylvanicum* L.), eastern black nightshade (Solanum), Venice mallow (*Hibiscus trionum* L.), wild mustard (*Sinapsis arvensis* L.), giant foxtail (*Setaria faberi* Herrm.), fall panicum (*Panicum dichotomiflorum* Michx.), wooly cupgrass (*Eriochloa villosa* (Thunb.)Kunth) and barnyardgrass (*Echinochloa crus-galli* (L.)Beauv.). Application of 132 g ha^{-1} of EXP31130A gave excellent control of green foxtail (*Setaria viridis* (L.)Beauv.) and yellow foxtail (*Setaria glauca* (L.) Beauv.). Under dry conditions following preemergence application performance was improved by shallow incorporation of EXP31130A.

Excellent activity on this weed spectrum was observed in early pre plant applications of EXP31130A at 140 g ai ha^{-1} applied up to 21 days prior to planting. In early pre plant applications applications 105 g ai ha^{-1} combined with either 1.12 kg ai ha^{-1} of metolachlor or acetochlor was comparable in efficacy to EXP31130A 140 g ai ha^{-1} applied alone for broadleaf weed control and was superior for yellow or green foxtail control. Under dry conditions, control of weed seedlings less than 2.5 cm tall occurs following rainfall. This "kickback" or "herbicidal recharge" efficacy is observed for over 6 weeks following application.

[1]Rhone-Poulenc Ag Company, Research Triangle Park, NC 27709

EXP31130A: A NEW PREEMERGENCE HERBICIDE FOR NO TILL CORN.

T.E. Vrabel, J.P. Cartier, W.S. Striegel and W. Duckworth[1]

ABSTRACT

EXP31130A, a formulation of isoxaflutole (proposed common name), is a member of a new class of isoxazole herbicides from Rhone-Poulenc Ag Company which is formulated as a 75 percent water dispersible granule. It is ideal for use in no till and minimum till applications since it does not tie up on surface trash and does not photodegrade.

EXP31130A was evaluated in 1995 in 27 no till field trials conducted by Rhone-Poulenc in the United States. It was evaluated in preemergence and early preplant applications applied either alone or in combination with other preemergence herbicides. Results from these trials have shown that EXP31130A provided excellent selective control of both grass and broadleaf weeds in corn (*Zea mays* L.) at low use rates. EXP31130A applied alone preemergence at 105 g ai ha^{-1} provided excellent control of velvetleaf (*Abutilon theophrasti* Medik.), common ragweed (*Ambrosia artemisiifolia* L.), and lambsquarters (*Chenopodium album* L.). Applications of 140 g ai ha^{-1} provided additional excellent control of common waterhemp (*Amaranthus tuberculatus* (Moq.)J.D. Sauer), Pennsylvania smartweed (*Polygonum pensylvanicum* L.) and giant foxtail (*Setaria faberi* Herrm.). Combinations of EXP31130A at 105 g ai ha^{-1} with either 1.12 kg ai ha^{-1} metolachlor or acetochlor provided excellent control of the afforementioned weeds and added control of green foxtail (*Setaria viridis* (L.)Beauv. and yellow foxtail (*Setaria glauca* (L.) Beauv.). These treatments provided comparable control to full rate applications of atrazine plus metolachlor, atrazine plus acetachlor and atrazine plus cyanazine.

Early preplant applications of EXP31130A at 140 g ai ha^{-1} in combination with either 0.38 kg ai 2,4-D or 0.56 kg ai glyphosate provided excellent burndown control of difficult to control weeds such as dandelion (*Taraxacum officinale* Webber in Wiggers) and marestail (*Conyza canadensis*(L.) Cronq.) and excellent preemergence control of weeds such as velvetleaf, common waterhemp, Pennsylvania smartweed, common ragweed, lambsquarters, barnyardgrass (*Echinochloa crus-galli* (L.)Beauv.), giant foxtail and green foxtail.

[1]Rhone-Poulenc Ag Company, Research Triangle Park, NC 27709

WEED CONTROL OPTIONS WITH IMAZETHAPYR IN IMIDAZOLINONE-RESISTANT FIELD CORN

Frank J. Himmelstein, Robert J. Durgy [1]

ABSTRACT

Imazethapyr (Pursuit) has shown to be an effective weed control option in imidazolinone-resistant field corn (Zea mays L.) in Connecticut. Two 1995 field trials evaluated seven preemergence herbicides applied alone and in combination with imazethapyr or pendimethalin (Prowl). The studies were split plot designs with three replications. The main plots were imazethapyr (preemergence 0.063 lb ai/A, and early postemergence 0.063 lb ai/A), pendimethalin (preemergence 1.5 lb ai/A), and the preemergence herbicides applied alone (PRE). The sub-plots were thiafluamide + metribuzin [(Axiom) 0.3 and 0.6 lb ai/A], metolachlor [(Dual II)1 and 2 lb ai/A], dimethenamid [(Frontier)0.59 and 1.17 lb ai/A], acetochlor [(Harness)0.88 and 1.75 lb ai/A], alachlor [(Lasso MT)1 and 2 lb ai/A], acetochlor + safener [(Surpass) 0.9 and 1.8 lb ai/A], and pendimethalin [0.75 and 1.5 lb ai/A). Herbicides were applied with a CO_2 backpack sprayer delivering 20 gpa at 32 psi. Weed control was assessed by both visual ratings, and weed biomass samples taken from a 2.25 ft^2 quadrant from the center of each plot. Weed species included fall panicum [Panicum dichotomiflorum Michx.], common lambsquarters [Chenopodium album L.], redroot pigweed (Amaranthus retroflexus L.), common ragweed [Ambrosia artemisiifolia L.] and velvetleaf (Abutilon theophrasti Medik.) and giant foxtail [Setaria faberi Herrm.]. Velvetleaf was the dominant weed at the Coventry site. Excellent velvetleaf control was obtained with the pendimethalin or imazethapyr combinations. Average velvetleaf dry matter yields were reduced 97% for the pendimethalin and imazethapyr combinations, and 36% for the PRE treatments compared to the check (2904 lb/A). Average corn grain yields were increased 99% (167 bu/A) for the pendimethalin and imazethapyr combinations and 37% (115 bu/A) for the PRE treatments when compared to the check (84 bu/A). Fall panicum, giant foxtail, and velvetleaf were the dominant weeds at the Lebanon site. Good to excellent annual grass control was obtained with all treatments. Annual grass dry matter yields were reduced 89% for the PRE treatments, and 98% for the pendimethalin and imazethapyr combinations compared to the check (5935 lb/A). Velvetleaf proliferated in plots with PRE treatments alone. Average velvetleaf dry matter yields were 34 lb/A for the pendimethalin and imazethapyr combinations compared to 1008 lb/A for the PRE treatments. Average corn grain yields were increased 185% (194 bu/A) for the pendimethalin and imazethapyr combinations and 131% (157 bu/A) for the PRE treatments compared to the check (68 bu/A). Pendimethalin and imazethapyr were the only herbicides that gave effective velvetleaf control. Pendimethalin applied alone gave the least effective giant foxtail control.

[1]Extension Educator-Integrated Crop Management, and Res. Asst., respectively, University of Connecticut, Storrs, CT 06269

WEED CONTROL IN PURSUIT TOLERANT (IR) CORN OVERSEEDED WITH CROWNVETCH AND BIRDSFOOT TREFOIL

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

ABSTRACT

Farmers interested in improving the environment, saving soil, enhancing productivity, and providing food and cover for wildlife can use crownvetch (Coronilla varia L.) and birdsfoot trefoil (Lotus corniculatus L.) as perennial living mulches. This practice also provides more flexibility in meeting soil erosion criteria, including increasing the amount of corn that can be grown on sloping cropland than otherwise would be allowed.

Crownvetch was initially promoted as a roadside ground cover to stabilize the soil on steep banks and suppress the invasion of weeds and woody perennials. It will provide the same benefits on cropland and can be used as a permanent living ground cover for corn, soybeans (Glycine max L.), small grains and forages. It hinders surface water runoff and greatly reduces soil erosion and the associated nutrient and pesticide runoff from even the steepest slopes. It also provides up to 40 lb of nitrogen per acre and gives farmers the flexibility to produce the crops on wider contour strips or fields with no contour strips with equipment designed for large fields. Unfortunately this practice has not been adopted because of the high cost (≈$10/lb) of crownvetch seed and the problem with slow establishment.

With the recent introduction of imidazolinone resistant (IR) corn and a weed control program based on imazethapyr, it became possible to establish some legume ground covers in corn without injuring the corn or the ground cover. After it was discovered that birdsfoot trefoil was tolerant to imazethapyr, it was decided to mix birdsfoot trefoil with crownvetch at very low seeding rates, 4 + 1 lb/A respectively, to reduce the overall cover crop seed cost to $15 to $20/A. The birdsfoot trefoil provides quick cover but gradually thins out over a period of years as a result of crownvetch competition and chemical suppression, leaving a predominately crownvetch cover.

An attempt to get farmers interested in using a birdsfoot trefoil/crownvetch living mulch system was made in 1995. To make the input costs more attractive, two seed growers were willing to provide the crownvetch and birdsfoot trefoil seed for half the cost (≈$7.50/A) for farmers who were interested in putting out demonstration plots about 10 acres in size. Pioneer Hi-Bred International Inc. and Hoffman Seeds Inc. provided three units of imazethapyr tolerant corn at half the cost (≈$15.00/A) for the same demonstration plots. Am. Cyanamid provided imazethapyr at half the cost (≈$7.50/A) in packets that covered exactly 10A. The total cost of these inputs was $30/A and the growers were billed directly by the input provider. All other inputs such as fertilizer were paid by the farmer.

Ten farmers identified by county agents, crop improvement association scouts, or nutrient management technicians working for the county conservation districts, initially indicated an interest in establishing demonstration fields. Of the ten, only seven actually got the corn and cover crop seeded. All of the demonstration fields were planted conventionally except for one location planted with a no-till drill into soybean stubble. Every field had an excellent birdsfoot trefoil stand by midsummer and most had at least one crownvetch plant per sq. meter. However, due to the extremely dry weather in 1995, the corn suffered severely from drought and in a couple of fields appeared to be suffering more when the cover crop was present. Annual weed control was excellent in all but two locations where common lambsquarters (Chenopodium album L.) was not effectively controlled. Imazethapyr is known to be weak on common lambsquarters so an alternative control will be necessary before this living mulch program can be widely adopted.

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[1] Prof. of Weed Sci. and Assist. Prof. of Weed Sci., Dept. of Agronomy, Pennsylvania State University, University Park, PA. 16802

BASIS A NEW SULFONYLUREA HERBICIDE FOR POSTEMERGENCE WEED CONTROL IN CORN (Zea Mays L.)

D.D. Ganske, S.K. Rick and T. Chicoine [1]

ABSTRACT

Basis herbicide is a new early postemergence product for grass control in field corn developed by DuPont Agricultural Products. A 2:1 premix of rimsulfuron and thifensulfuron methyl, Basis controls both grass and broadleaf weeds. Product registration was received in late 1994 with initial sales targeted to the upper midwest corn belt in 1995. Basis is formulated as a 75% water dispersible granule. The rate of Basis is one third ounce product per acre and it is packaged in a four acre soluble packet. The marketing area will be expanded to included several northeast states in 1996.

Application timing for Basis is spike up to before the third corn collar is emerged. Application may be aerial or by ground. For best results, cultivation is recommended when Basic burndown and residual activity is complete or if new grass has emerged. A nonionic surfactant at a rate of 0.25 - 0.5% volume/volume and an ammonium nitrogen fertilizer must be included. Restrictions for use with or over various insecticides vary with corn varieties. Basis may be mixed with several broadleaf herbicides to expand the weeds controlled. Basis is rainfast in four hours and susceptible grasses are controlled in 7-14 days. No soil pH restrictions are given for following crop rotational intervals.

[1] Sr. Develop. Reps. and Product Develop. Spec., E.I. Dupont De Nemours & Co (Inc)., Wilmington, DE 19805

BASIS A NEW SULFONYLUREA HERBICIDE FOR POSTEMERGENCE WEED CONTROL IN CORN (Zea Mays L.)

D.D. Ganske, S.K. Rick and T. Chicoine [1]

ABSTRACT

Basis herbicide is a new early postemergence product for grass control in field corn developed by DuPont Agricultural Products. A 2:1 premix of rimsulfuron and thifensulfuron methyl, Basis controls both grass and broadleaf weeds. Product registration was received in late 1994 with initial sales targeted to the upper midwest corn belt in 1995. Basis is formulated as a 75% water dispersible granule. The rate of Basis is one third ounce product per acre and it is packaged in a four acre soluble packet. The marketing area will be expanded to included several northeast states in 1996.

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WEED MANAGEMENT SYSTEMS IN CORN WITH PROSULFURON

J. H. Choate and J. W. Wilcut[1]

ABSTRACT

Field studies were conducted at Attapulgus, GA in 1993 and 1994 and in Plains, GA in 1993 to evaluate weed control and corn response to prosulfuron.

Twenty herbicide systems were evaluated and included combinations of PRE and POST applications. Systems one to six received prosulfuron at 0.018, 0.027 or 0.036 lb ai/A applied PRE alone or followed by a POST application of nicosulfuron at 0.031 lb ai/A. Systems seven to nine were identical to systems one to three except, they also received a PRE application of metolachlor at 1.5 lb ai/A. Systems 10 to 15 received a POST application of prosulfuron at the three aforementioned rates alone or in mixture with nicosulfuron. Additional systems included: metolachlor applied PRE; metolachlor plus atrazine at 1.5 lb ai/A PRE; atrazine plus nicosulfuron POST; metolachlor plus atrazine PRE followed by nicosulfuron POST; and a weedy check. All POST treatments received a nonionic surfactant at 0.25% (v/v). Herbicide applications were applied with a CO_2 backpack sprayer at 20 GPA and at 20 psi.

Prosulfuron applied alone PRE or POST, at all rates, controlled yellow nutsedge less than 50% Metolachlor plus prosulfuron PRE and nicosulfuron plus prosulfuron POST controlled yellow nutsedge at least 61 and 69%, respectively.

Morningglory species (IPOZZ) control with prosulfuron alone applied PRE or POST was at least 72%. This apparent control may be partially due to uncontrolled Texas panicum. The addition of a POST application of nicosulfuron following prosulfuron PRE improved IPOZZ control to at least 95%.

Sicklepod control with prosulfuron alone applied either as a PRE or POST application was at least 66 and 68%, respectively. This apparent control is probably due to uncontrolled Texas panicum. The addition of nicosulfuron POST to prosulfuron used either PRE or POST increased control to 94 and 79%, respectively, compared to prosulfuron applied alone.

Florida pusley was controlled at least 97% with prosulfuron applied as a PRE or POST application. No control of Texas panicum or southern crabgrass was observed with prosulfuron applied PRE or POST alone.

Metolachlor PRE gave 99% control of Florida pusley and southern crabgrass, 74% control of yellow nutsedge, but controlled Texas panicum, sicklepod, and IPOZZ less than 34%. Atrazine plus metolachlor PRE controlled IPOZZ, sicklepod, and Texas panicum 69, 28, and 24%, respectively. Metolachlor plus atrazine PRE followed by nicosulfuron POST controlled IPOZZ, Texas panicum, southern crabgrass, and Florida pusley at least 94% and provided 73% or more control of yellow nutsedge and sicklepod.

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[1]Grad. Res. Assist. and Assoc. Prof., Crop Sci. Dept., North Carolina State Univ., Raleigh, NC 27695-7620.

POSTEMERGENCE YELLOW NUTSEDGE CONTROL IN FIELD CORN

Russell R. Hahn[1]

ABSTRACT

Field experiments were conducted in central NY from 1993 through 1995 to evaluate mid and late postemergence (MPO and LPO) herbicide applications for yellow nutsedge (*Cyperus esculentus* L.) control in field corn (*Zea mays* L.). Herbicides were applied LPO in a randomized complete block design with four replications in 1993. A split-plot design with four replications was used in 1994 and 1995 with time of application as main plots and herbicide treatments as subplots. Herbicides were applied in water to 10-by 25-ft plots using 80015 flat spray tips in 25 gpa of spray solution. Annual grass and broadleaf weeds were controlled with preemergence (PRE) applications of dicamba at 0.5 lb ai/A and/or pendimethalin at 1.5 lb ai/A. All MPO and LPO applications included 1% (v/v) of a petroleum-based crop-oil concentrate.

In 1993, LPO applications were made when nutsedge was 8 to 10 inches tall. Standard treatments of 1 lb ai/A of bentazon or 1.5 lb ai/A of the bentazon/atrazine premix provided 73 and 75% nutsedge control respectively 5 weeks after treatment (WAT). Nutsedge control with 0.58 oz ai/A of primisulfuron or 0.94 lb ai/A of pyridate was not different from the standard treatments. Halosulfuron applications of 0.25 or 0.5 oz ai/A controlled 90 and 95% of the nutsedge respectively. Grain corn yields from the bentazon, bentazon/atrazine premix, and 0.25 oz/A rate of halosulfuron were similar and averaged 133 bu/A compared with 97 bu/A for the PRE dicamba plus pendimethalin treatment.

MPO and LPO applications were made when nutsedge was 3 to 5 and 8 to 12 inches tall respectively in 1994. Time of application had no influence on late-season nutsedge control ratings with 2 lb ai/A of atrazine or 0.94 lb/A of pyridate. Control ratings with LPO applications of the standard treatments of 1 lb/A of bentazon or 1.5 lb/A of the bentazon/atrazine premix averaged 88% while their MPO counterparts averaged 68%. Nutsedge control with MPO applications of 0.75 oz/A of halosulfuron or of 0.58 oz/A of primisulfuron was higher than with LPO applications. Control with halosulfuron and primisulfuron dropped from 98 to 86% and 83 to 54% respectively with delayed application.

In 1995, MPO and LPO applications were made when nutsedge was 3 to 4 and 6 to 8 inches tall respectively. Unlike the two previous seasons, precipitation was well below normal from the date of planting until treatment. Treatments that provided an acceptable level of control at both times of application were 0.75 oz/A of halosulfuron alone and the combination of 0.37 oz/A of halosulfuron plus 0.94 lb/A of pyridate. Halosulfuron alone provided 90 and 75% nutsedge control while the combination of halosulfuron plus pyridate provided 83 and 75% nutsedge control respectively when applied MPO and LPO. An acceptable level of nutsedge control was also obtained with MPO applications of 0.5 lb/A of bentazon plus 0.37 oz/A of halosulfuron and with 0.47 lb/A of pyridate plus 0.37 oz/A of halosulfuron. Each combination controlled 84% of the nutsedge.

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

COMMON RAGWEED CONTROL IN FIELD CORN WITH POSTEMERGENCE HERBICIDES

Frank J. Himmelstein, Robert J. Durgy [1]

ABSTRACT

Common ragweed [Ambrosia artemisiifolia L.]infestations have increased in field corn [Zea mays L.] in Connecticut where postemergence herbicides are not used and the use of triazine herbicides have been eliminated or resistance to these herbicides may have occurred. A field study conducted at Storrs, CT. in 1995 evaluated postemergence herbicides for common ragweed control in field corn. The experimental design was a split plot with three replications where dicamba (Banvel) applications were the main plots and the other herbicide treatments were the sub-plots. Dicamba was applied at 0 and 0.125 lb ai/A alone and in combination with nicosulfuron (Accent) at 0.016 and 0.031 lb ai/A, primisulfuron (Beacon) at 0.018 and 0.036 lb ai/A, flumiclorac (Resource) at 0.020 and 0.040 lb ai/A, halosulfuron (Permit) at 0.016 and 0.032 lb ai/A, and prosulfuron + primisulfuron (Exceed) at 0.018 and 0.036 lb ai/A, dicamba at 0.125 lb ai/A, rimsulfuron + thifensulfuron (Basis) at 0.016 lb ai/A, metribuzin (Sencor) at 0.094 lb ai/A, imazethapyr (Pursuit) at 0.063 lb ai/A, and pyridate (Tough) at 0.94 lb ai/A. Herbicides were applied with a CO_2 backpack sprayer delivering 20 gpa at 32 psi. Weed control was assessed by both visual ratings, and weed biomass samples taken from a 2.25 ft^2 quadrant from the center of each plot. Corn grain yields were determined by hand harvesting 12 ft of two center rows in each plot. Common lambsquarters [Chenopodium album L.], was also present at the study area. Field corn 'Pioneer 3395 IR' was planted on May 23, 1995 and metolachlor (Dual) was applied preemergence to the entire area at 2.0 lb ai/A. Postemergence treatments were applied on June 16, 1995. The range in plant growth stage and height at the time of application was as follows: corn, 6 leaves, 10-12 inches; common ragweed, 2-12 leaves, 0.2-3 inches; and common lambsquarters, 4-24 leaves, 0.4-3 inches. Common lambsquarters and common ragweed control was excellent for all treatments when dicamba was included. When applied alone the primisulfuron, prosulfuron + primisulfuron, halosulfuron, and dicamba treatments resulted in excellent ragweed control; the imazethapyr, rimsulfuron + thifensulfuron, and flumiclorac treatments resulted in fair to good control; and the nicosulfuron, pyridate and metribuzin treatments resulted in poor control. Common lambsquarters increased with the halosulfuron and imazethapyr treatments and the low rate of primisulfuron applied alone. Herbicide treatments increased average corn grain yields (133 bu/A) 172% compared to the untreated check (49 bu/A). Average corn grains yields were increased when dicamba was tank mixed with the nicosulfuron, pyridate, and metribuzin treatments. Corn grain yields were similar between the other treatments.

[1]Extension Educator-Integrated Crop Management, and Res. Asst., respectively, University of Connecticut, Storrs, CT 06269

POSTEMERGENCE BURCUCUMBER CONTROL IN CORN

M. G. Schnappinger, D. B. Vitolo, and S. W. Pruss[1]

ABSTRACT

Burcucumber (*Sicyos angulatus* L.) is a weed that reduces yields in corn (*Zea mays* L.) and interferes with harvest due to the growth habit of the vines. Control of burcucumber by the preemergence herbicides is usually less than satisfactory due to the weed's ability to germinate throughout the growing season.

Replicated field trials were conducted during 1994 and 1995 in Connecticut, Delaware, Maryland, New York, and Pennsylvania to evaluate postemergence herbicides for the control of burcucumber. Herbicides applied alone or in combination included atrazine, dicamba, halosulfuron-methyl (Permit), primisulfuron (Beacon), or primisulfuron + prosulfuron (Exceed).

Exceed applied alone provided very good control at most locations as did the Beacon combination with dicamba. Tank mixing Exceed with either atrazine or dicamba improved control and were the best treatments at several locations. Overall control of burcucumber was poor with either Permit or dicamba.

TABLE 1. Control of Burcucumber in Corn with Labeled Rates of Postemergence Herbicides at 6-12 Weeks After Treatment.

	LOCATION AND YEAR				
HERBICIDE	CT-94	PA-95	DE-95	MD-95	NY-95
	% CONTROL				
EXCEED 57WG	83	77	87	/	94
EXCEED 57WG + ATRAZINE 4L	/	80	93	100	98
EXCEED 57WG + DICAMBA 4E	/	82	87	100	95
BEACON 75WG + DICAMBA 4E	83	60	77	100	77
PERMIT 75WG + DICAMBA 4E	/	23	/	100	0
DICAMBA 4E	73	20	/	/	37

[1] Senior Scientist, Senior Research Specialist, and Regional Manager, respectively, Ciba Crop Protection, Washington, PA 15301

WEED CONTROL IN BERMUDAGRASSES OVERSEEDED WITH COOL-SEASON GRASSES

B. J. Johnson[1]

ABSTRACT

Annual bluegrass (*Poa annua* L.) is a common winter annual that grows abundantly in turfgrasses throughout the United States. It is especially a severe problem where bermudagrass (*Cynodon* spp.) golf greens are overseeded in the fall with cool-season grasses. Preemergence (PRE) and postemergence (POST) herbicides have controlled annual bluegrass effectively in non-overseeded bermudagrass. However, the selection of herbicides applied for annual bluegrass control in overseeded bermudagrass is limited. This occurs because most herbicides must be applied 60 to 90 days before overseeding to obtain good germination of the overseeded cool-season grasses. In contrast, herbicides applied at this time generally do not control annual bluegrass consistently.

Rubigan (fenarimol) can safely be applied 2 weeks prior to bermudagrass greens overseeded with perennial ryegrass (*Lolium perenne* L.), but must be applied 2 to 4 weeks before overseeding roughstalk bluegrass (*Poa trivialis* L.). However, Rubigan did not provide consistent full-season annual bluegrass control. The control by late February from a total 4.5 lb ai/A rate ranged from 63 to 99%. The lower control occurred in years that had normal winter temperatures that favored optimum annual bluegrass growth.

The tolerance of roughstalk bluegrass from PRE herbicides applied in the spring for summer weed control varied with herbicides. When applied in mid-March, the injury was the lowest with Team (trifluralin + benefin), pendimethalin, Barricade (prodiamine), and bensulide, and the highest with Surflan (oryzalin). The injury to roughstalk bluegrass was intermediate when treated with Ronstar (oxadiazon), XL (oryzalin + benefin), Dimension (dithiopyr), Regalstar (benefin + oxadiazon) and goosegrass crabgrass control (bensulide + oxadiazon).

Prograss (ethofumesate) effectively controlled annual bluegrass ($\geq$80%) when applied to bermudagrass greens overseeded with perennial ryegrass. To maintain effective control, Prograss must be applied at 1.0 lb ai/A following overseeding in October and at the same rate one month later. Maximum injury to perennial ryegrass from October and November treatments at these rates was 26%. The injury was less when Prograss treatments were delayed until November and December.

Xanthomonas campestris pv. *poannua* has potential as a biological control agent for annual bluegrass control in bermudagrass overseeded with perennial ryegrass. However, maximum annual bluegrass control by early April was approximately 50% when isolate MB 245 was applied in three applications in January and February. The control was improved slightly (65%) when the isolate was applied in seven applications from mid-September through mid-March.

[1]Professor, Crop and Soil Sciences, University of Georgia, Georgia Station, Griffin, GA 30223-1797.

ANNUAL GRASS WEED CONTROL IN FAIRWAYS AND ROUGHS IN NORTHERN AND TRANSITION ZONE REGIONS

P.H. Dernoeden[1]

ABSTRACT

The primary annual grass weeds in fairways and roughs in the Northeastern U.S. include crabgrass (*Digitaria* spp.), particularly smooth crabgrass (*D. ischaemum* [Schreb.] Muhl.), goosegrass (*Eleusine indica* [L.] Gaertn.), and occasionally foxtails (*Setaria* spp.). Annual bluegrass (*Poa annua* L.) is an enigmatic weed with genetically diverse annual and perennial biotypes. Dalliasgrass (*Paspalum dilatatum* Poir.) and smooth paspalum (*P. laeve* Michx.) are warm-season perennial grasses that are often confused as being annuals. Seed of crabgrass begin to germinate in late spring with peak germination periods occurring in May and June. Goosegrass seedlings appear in June, but high levels of seed germination occurs in July and August. Annual bluegrass seed germination begins in September, ceases during winter if soils become frozen, and resumes germination in March or April. Little or no *P. annua* seed germination occur during summer.

Where a chronic problem, the most effective approach to crabgrass, goosegrass and foxtail control is through the application(s) of preemergence herbicides. The most commonly used products on fairways and roughs where turfgrasses other than creeping bentgrass are grown include the following: benefin, bensulide, DCPA, dithiopyr, oxadiazon, pendimethalin, prodiamine, and a pre-packaged mix of benefin plus trifluralin. Bensulide and DCPA are used less commonly because they provide poor goosegrass control. Only bensulide, a bensulide plus oxadiazon pre-packaged mix, dithiopyr and prodiamine are labeled for use on creeping bentgrass fairways. There is great variation in recommended rates of these herbicides among northern, transition zone and southern regions. Generally in northern regions low label rates applied once prior to weed seed germination provides satisfactory control; whereas, sequential applications are suggested for most products in the transition zone.

Postemergence crabgrass and foxtail control can be achieved effectively with fenoxaprop, DSMA and MSMA. For the organic arsenicals, lower rates applied in multiple applications are suggested to reduce potential discoloration to cool-season grasses. Fenoxaprop can stunt and discolor cool-season grasses, particularly when applied during cool and moist periods. On creeping bentgrass fairways, fenoxaprop may be applied at low rates in multiple applications beginning when crabgrass or goosegrass are in the 1 to 3 leaf stage. Fenoxaprop, however, is phytotoxic to bermudagrass and may cause long periods of chlorosis in zoysiagrass fairways. Fenoxaprop provides effective postemergence goosegrass control; whereas, the organic arsenicals are ineffective. Diclofop is an excellent goosegrass graminicide, but it may only be used on bermudagrass in some southern states. Diclofop is phytotoxic to most other turfgrasses.

Annual biotypes of *P. annua* can be safely and effectively controlled in perennial ryegrass with one or two late fall applications of ethofumesate. Ethofumesate may be used at lower rates to partially control *P. annua* in creeping bentgrass and Kentucky bluegrass. Ethofumesate is phytotoxic to bermudagrass, zoysiagrass and many other cool-season grasses. Most preemergence herbicides can reduce annual bluegrass seed germination if applied in late summer. The level of control, however, is normally unacceptable. Furthermore, use of a preemergence herbicide on cool-season turf in late summer is not recommended because it would likely conflict with overseeding practices. Bermudagrass fairways, however, in more southern locations may be treated with either oxadiazon, prodiamine or other products for preemergence *P. annua* control.

[1]Professor, Dept. of Agronomy, Univ. of Maryland, College Park, MD 20742.

BERMUDAGRASS SUPPRESSION IN CREEPING BENTGRASS GREENS

B. J. Johnson[1]

ABSTRACT

The encroachment of bermudagrass (*Cynodon* spp.) into creeping bentgrass (*Agrostis stolonifera* L.) greens can cause severe contamination where both grasses are grown. Since the growth habit of both grasses is different, this results in a poor quality putting surface. When the mixed turf is left untreated, bermudagrass populations increase rapidly during the summer months when creeping bentgrass is under stress from high temperatures, high humidity, and intensive disease pressure.

Tupersan (siduron) has been the recommended herbicide to use for suppressing bermudagrass in bentgrass greens. However, bermudagrass response to Tupersan treatments is variable. Therefore, to improve the consistency of bermudagrass suppression, experiments were conducted with herbicides and plant growth regulators (PGRs) to determine the timing, rates, and frequency of applications needed to suppress bermudagrass effectively in creeping bentgrass greens.

Tank mixes of Prograss + Cutless (ethofumesate + flurprimidol) applied at 1.5 + 0.75 lb ai/A in early April (when bermudagrass started to break dormancy) effectively suppressed bermudagrass for 8 weeks. The suppression was effective throughout the summer with Prograss + Cutless when the full rate (1.5 + 0.75 lb ai/A) was applied in April and followed by four applications at a one-fourth rate (0.38 + 0.19 lb ai/A). The suppression by early September was 72% for Tifgreen, 74% for Tifway, and 93% for common bermudagrass. Timing of the repeated applications was important for optimum bermudagrass suppression. The first reduced rate application should be made 6 weeks after the initial application and then repeated at 3-week intervals.

Prograss + Cutless applied at 1.5 + 0.75 lb ai/A in April caused moderate to severe injury (26 to 45%) to creeping bentgrass. The injury to creeping bentgrass was foliar discoloration with no effect on stand density. Turf recovery occurred within 3 to 5 weeks after treatment. The injury to creeping bentgrass was higher when Prograss + Cutless treatments were made in late spring and summer, than when applications were made when temperatures were cooler in April. This is why reduced Prograss + Cutless treatments are necessary during the warmer temperatures. The injury to creeping bentgrass during the spring and summer from reduced rates of Prograss + Cutless was within an acceptable level (<30%).

The quality of creeping bentgrass was higher (17 to 31%) in 2 of 3 years when iron (Fe) (LawnPlex source) was applied at 1.5 lb/A in April with Prograss + Cutless. The response to Fe with repeated Prograss + Cutless treatments at reduced rates in May occurred in 1 of 3 years. These results show that creeping bentgrass treated with Fe and Prograss + Cutless will not always respond with a darker green color. When it does, it will occur more frequently when applied with Prograss + Cutless in cooler temperatures than in warmer temperatures.

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[1]Professor, Crop and Soil Science, University of Georgia, Georgia Station, Griffin, GA 30223-1797

EFFECTS OF ROOT PRUNING HERBICIDES ON TURFGRASS SPECIES

P. C. Bhowmik[1]

ABSTRACT

A good weed management strategy integrates the judicious use of herbicidal treatments when necessary along with regular turfgrass maintenance practices. Among all weed control methods, preemergence weed control strategies are commonly used. The soil applied preemergence herbicides control weeds by inhibiting or pruning root meristems of germinating seedlings.

What are root pruning herbicides? Root pruning herbicides are those which inhibit root meristematic activity in susceptible plants by disrupting the cell division process. Susceptible plants include crabgrasses, foxtails and other grass species as well as several broadleaf weeds. Commonly used herbicides that affect root pruning are listed in Table 1.

Dinitroaniline herbicides are known as mitotic inhibitors. In the cell division process, these herbicides inhibit the formation of microtubules (fibre-like protein strands) onto which newly replicated chromosomes must align and become attached before cell division can proceed. Thus, these herbicides interfere with cell division by binding to tubulin. The effects often observed in dinitroaniline treated grass roots is abnormal enlargement (swelling) of root tips. This is known as club root system on root tips. General symptoms of susceptible plants include nonemergence of germinating seedlings, stunting of plants with lack of lateral roots or severely pruned roots in the herbicide treated-zone. Broadleaf weeds may develop a swollen and cracked hypocotyl and callus tissue at the base of the stem. Emerged grass shoots are thick and stunted, often with a purple or reddish discoloration.

There are other classes of herbicides that may have similar effects on turfgrass roots (Table 1). Dithiopyr, a pyridine class herbicide, inhibits mitosis. However, it does not bind to tubulin but to another protein that may be a microtubule associated protein (MAP). Dithiopyr results in shortening of microtubule that can form spindle fibre. It results in club-shaped root tips. Isoxaben, a benzamide class herbicide, is also known to affect cell division process in root meristematic regions. It inhibits cell wall biosynthesis in susceptible plants.

There are two unclassified herbicides that also cause root inhibition of susceptible plants. DCPA inhibits mitosis probably by affecting phragmoplast microtubule arrays and cell wall formation. Bensulide inhibits root elongation and cell division. It may directly inhibit mitosis, resulting binucleated cells.

All of the above-mentioned herbicides are currently recommended for use in established turfgrass species. For over 30 years weed scientists have evaluated these compounds not only

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

for herbicidal effectiveness but also for their impact on root and overall growth of turfgrass species. However, the use of one herbicide on a yearly-basis at a rate higher than normal recommended rate can cause inhibition or suppression of root growth of established turfgrass species.

There are techniques which can be used to estimate the effects of herbicides on root growth, including the quality of turfgrass. Root strength, root biomass, tiller production, rhizome or stolon production, and overall growth of turfgrass species are some of the parameters.

In a year-old Kentucky bluegrass (Poa pratensis L.) study, root growth was not adversely affected in all herbicide treated plots since no differences in root strength was detected 4 weeks after treatment (WAT). However, root strength 8 WAT was significantly lower with pendimethalin, dithiopyr, benefin, and prodiamine than the root strength of the untreated check (69 psi). Root strength from the prodiamine (0.8 kg ha^{-1}) treated plot was lowest (42 psi) 8 WAT. The root strength in the oxadiazon (4.5 kg ha^{-1}) treated plot was equivalent to the strength of the untreated check. At 12 WAT, the dithiopyr treated plot resulted in the lowest root strength (42 psi), followed by pendimethalin, benefin, and prodiamine (48 to 49 psi), and oxadiazon (55). Regrowth of treated turf plugs (8 WAT) in sand culture in the greenhouse

Table 1. Commonly used turfgrass herbicides that affect root pruning.

Class	Mechanism of action	Chemical name	Trade name	Symptoms
Dinitroaniline	Inhibits mitosis, binds to tubulin	Benefin Benefin plus trifluralin Pendimethalin Prodiamine	BALAN TEAM PRE-M BARRICADE	Fail to emerge; emerged grass shoots are thick and stunted; root tips become thickened and stubby
Pyridine	Inhibits mitosis, Does not bind to tubulin	Dithiopyr	DIMENSION	Swelling of root tips
Benzamide	Inhibits cell wall biosynthesis	Isoxaben	GALLERY	Root clubbing, swelling, root hair distortion
Unclassified				
	Inhibits cell division and cell wall formation	DCPA	DACTHAL	Fails to emerge
	Inhibits root enolgation and cell division; inhibits mitosis	Bensulide	BENEFIN	Root and shoot growth inhibition

showed no harmful effects on root length, tiller production, rhizome number, or root dry weight. In summary, spring application of herbicides to cool-season turfgrass species seeded the previous fall could reduce turfgrass root strength, turfgrass density and overall turf quality.

In another study, the maximum turfgrass injury (38%) and thinning of Kentucky bluegrass was observed with the highest rate (4.5 kg/ha) of trifluralin plus benefin. Benefin alone at 4.5 kg/ha also injured Kentucky bluegrass. In general, higher rates of benefin (3.3 and 4.5 kg/ha) and the premix combination of trifluralin plus benefin (3.3 and 4.5 kg/ha) inhibited tiller production and rhizome growth of Kentucky bluegrass 4 and 8 WAT. Pendimethalin and prodiamine did not inhibit either tiller production or rhizome growth. However, prodiamine at 2.2 kg/ha reduced root regrowth (not significantly) of Kentucky bluegrass.

In another study, 'Baron' Kentucky bluegrass was tolerant to dithiopyr up to 1.7 kg/ha. Root regrowth, tiller and rhizome numbers were unaffected with this rate of dithiopyr. Kentucky bluegrass treated with one annual spring application of dithiopyr for three consecutive years showed no adverse effects. Perennial ryegrass (Lolium perenne L.) was also tolerant up to 1.7 kg/ha of dithiopyr. No injury was noted with any of the treatments after three years of annual application of dithiopyr. Root regrowth, tiller and rhizome numbers were unaffected by various rates of dithiopyr, and turfgrass quality was acceptable. On a putting green, 'Penncross' bentgrass (Agrostis palustris Huds.) was tolerant to dithiopyr up to 1.1 kg/ha. A slight injury (13 to 18%) was noted with dithiopyr treatments (1.7 to 2.2 kg/ha). None of the treatments reduced root regrowth or stolon production. One annual spring application of dithiopyr (0.3 to 1.1 kg/ha) for three consecutive years caused no adverse effects on the quality of the bentgrass on the putting green.

In summary, one annual application of commonly recommended preemergence herbicides at recommended rate for 2 to 3 consecutive years did not cause root pruning or did not adversely affected the overall growth and quality of turfgrass specie. However, growth and development is dependent upon the rate of a given herbicide and the turfgrass species.

INTERACTIONS BETWEEN HERBICIDE USE AND TURFGRASS DISEASES

Bruce Martin[1]

ABSTRACT

Herbicides are valuable tools for the maintenace of quality turfgrass stands. Most grasses have good tolerance to labelled postemergence herbicides, with direct injury usually confined to transient phytotoxicity. Sometime, postemergence herbicides have been associated with increased disease severity from pathogens attacking foliage. For example, we examined the use of triazine herbicides and Rhizoctonia blight (Rhizoctonia solani Kuhn) in warm-season turfgrasses. The use of triazine herbicides, particularly atrazine, resulted in increased severity and damage to centipedegrass (Eremochloa ophiuroides (Munro) Hack) and St. Augustinegrass (Stenotaphrum secundatum (Walt.) Kuntze) by Rhizoctonia blight.

Cool- and warm-season turfgrasses vary in their tolerance to preemergence herbicides. Some may inhibit new root development, thus affecting turf growth and recovery from injury. These effects are not easily recognized by turfgrass managers. The situation becomes even more complicated when diseases are involved. For instance, our research has shown that response of bermudagrass (Cynodon spp. L.) turf from nematode injury varies with preemergence herbicides. When preemergence herbicides were applied in early March in South Carolina, and fenamiphos nematicide applied in mid-April, turf quality response varied in summer months depending on the herbicide. Results showed that use of oxadiazon usually resulted in sustained increased turf quality compared with other herbicides.

It is important that research identifies and quantifies positive and negative aspects of the use of combinations and sequential applications of pest management products to develop truly integrated pest management.

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[1]Assoc. Prof., Dept. of Plant Pathology and Physiology, Clemson University, Pee Dee Research and Education Center, Florence, SC 29501

GROWTH REGULATORS AND POA ANNUA

T. L. Watschke[1]

ABSTRACT

The use of plant growth regulators on Poa annua was first attempted as a method to reduce Poa annua in mixed swards with other cool season species. Mitotic inhibitors, such as mefluidide, are very effective in the suppression of seedheads. It was hypothesized that by significantly reducing seedhead production, competitiveness and persistence of Poa annua would be reduced over time. However, long term studies have shown that Poa annua can actually increase in population as a result of seedhead suppression due, in part, to an increase in environmental stress tolerance. Consequently, many golf course superintendents use mitotic inhibitors to improve Poa annua quality through reduction in the amount of seedheads.

With the commercialization of growth regulators that reduce growth by limiting cell elongation (gibberelin inhibitors), a chemical tool became available for golf course superintendents which allows them to manipulate plant competition in favor of species other than Poa annua (particularly bentgrass Agrostis spp.). Gibberelin inhibitors differentially suppress Poa annua which allows the other species to favorably compete. Conversion of mixed swards to predominately bentgrass instead of Poa annua is a somewhat slow process, but has been accomplished in a number of locations. Applications can be made to all areas of the golf course, even the greens.

[1] Professor, Department of Agronomy, Penn State University, University Park, PA, 16802

Presidential Address

Delivered January 3, 1995 at the

49th annual meeting of the

Northeastern Weed Science Society

Boston Marriott Copley Place
Boston, Massachusetts

Wayne G. Wright
Indianapolis, Indiana

DOING MORE WITH LESS, THE NEWSS TODAY

A warm welcome to all attending the 49th annual meeting of the Northeastern Weed Science Society. Also, welcome to the Boston Marriott Copley Place. The hotel has excellent facilities for our meeting and the staff is committed to assisting us to have a successful meeting. The hotel location in the historic back bay area of Boston is ideal. I encourage you to take time to enjoy some of the historical, cultural and other activities nearby while here.

We were privileged to have Dr. Robert Helgeson, Dean of the College of Food and Natural Resources, University of Massachusetts; deliver the welcoming address. Thanks Bob for the warm welcome and thought provoking comments on the problems and future directions needed to continue advancement of weed science and agriculture. Also congratulations to those receiving awards. Further, I look forward to Dr. Waggoner's message.

Tom Vrabel and the program committee have worked hard to develop a program that contains something for everyone. The entire program addresses our meeting theme, "The Role of Herbicides in Environmental Management." Individual sections have been strengthened. Three symposia and a special rights-of-way session will communicate the significant positive role herbicides occupy in production agriculture, industrial vegetation management and turf and ornamentals management. The general symposia will highlight the positive role, contribution and compatibility of herbicides in managing today's natural resources in concert with social and environmental concerns. The forestry symposia will include operational considerations and the overall positive role herbicides play in the forest and wildlife management scheme. The rights-of-way session will include mechanical, conventional herbicide, and selective vegetation programs and

integration of these programs into successful sustainable rights-of-way management systems. The turf and ornamental symposia will be conducted in association with the Massachusetts Extension Service, New England Golf Superintendents Association and the Green Industry Alliance. The program includes current quality programs, NEWSS outreach and training and information on communicating with the public.

The Northeast is an organization of diverse individuals that whether they be from industry, academia, or government work as a team with a common goal. It is this close working relationship that has established this society as a creditable and mature organization capable of leading the way on tough regional and national issues. It is interesting to note that the recent CAST issue paper "Challenges Confronting Agricultural Research at Land Grant Universities" is struggling with how do you do more with less. The authors indicate that to address the needs for research the Experiment Stations must display initiative and imagination to develop innovative approaches to increasingly complex research problems. They further suggest that the challenge for publicly supported research is to build unique private/public partnerships or jointly supported consortia for agricultural research. Working together -- like the Northeast does routinely.

PEOPLE RECOGNITION Recognition of people is important and serves as a measure of accomplishment. At the risk of omitting a key contribution, here are some examples of recent accomplishments by society members. Bob Sweet, serves on the Executive Committee, is our CAST representative and is preparing a history of the NEWSS. Ed Beste, chair and host of the Collegiate Weed Contest, and his committee: Henry Wilson, Ed Kee, Rick Beardsmore, Dave Mayonado, Gary Schnappinger, Russ Hahn and many others are to be commended for an excellent contest. It's a lot of work but a prime example of teamwork. Thanks for a job well done. Thanks also to Rich Bonanno for awareness and direction on legislative issues including position on EPA testing requirements, risk assessments, and providing leadership on issues where the NEWSS should be involved. Robin Bellinder represented the NEWSS and WSSA well in helping prepare and present a consensus position paper for the EPA/USDA sponsored Pesticide Use/Risk Reduction Workshop. Few weed scientists were invited. Her clear, concise, full of facts paper communicates weed science position and concerns well. Robin, thanks for your efforts. Also, thanks to the Executive Committee for your help and council during the past year.

MORE WITH LESS I struggled a long time to come up with a title for this talk. I thought of many but it really came to me one day when I was discussing the program contents with Dean Helgeson. I settled on "Doing More with Less - The NEWSS Today." Last year our president, Ron Ritter, pointed out the concerns downsizing and consolidation in industry and university systems were creating regarding people and funding. At the same time, increased demand for training and education programs at the grower and dealer levels was increasing due to expanded federal programs for certification, state land management programs, product training, and many

other proposed state administered programs. Today, I would like to expand on these concerns.

First lets review the history of agriculture and the NEWSS for perspective. The farm population grew rapidly. The number of farms peaked at over 6 million in the 1910 - 1940 era. Since then, they have declined to 1.9 million in 1992. This is only 1.9% of the U. S. population. Likewise, the USDA has proposed reduction of their field offices by 35% or 1274 offices. In the Northeast, 40% or 187 offices would be closed. More concern for doing more with less.

The NEWSS was formed in 1947, in response to the exciting potential use of the phenoxy herbicides as selective weeding agents in crops. Purpose of the NEWSS was simple and is unchanged today. It was to provide a meeting place and forum for exchange of research and education information concerning weed control and to promote close working relationships among academia, industry and government.

Membership of weed scientists in the NEWSS grew rapidly as industry expanded efforts to develop new herbicides. Academia expanded to study physiology and mode of action. Government expanded to regulate and address residues, tolerances and food safety. Expansion peaked in 1967 with over 700 members, then dropped quite rapidly to 365 in 1977. Since then, membership has remained in the 365 to 320 range. This raises a concern as to whether future critical mass will be maintained to adequately represent weed science interests in the Northeast.

Today industry and universities lead in NEWSS member numbers but the organization remains diverse. Job responsibilities are many and varied compared to mainly research in the past. As consolidation and attrition continue, there is much concern that these positions are not being filled. We are losing the critical mass necessary to train our future weed scientists and conduct the applied and basic research necessary to maintain herbicides as an integral and critical part of production programs.

An added concern is the education and training of future weed scientists. A survey of all agricultural schools that grant weed science degrees is in progress. Results from a cross section of 25 schools show - in 1994 only 39 MS and 26 Ph.D. degrees were completed. This is an average of only 1.6 and 1.0 per state. Enrollment towards weed science degrees in 1995 is 90 MS and 86 Ph.D. students. This averages only 3.6 and 3.4 per state. Of even more concern is the number of weed science courses taught per institution; undergraduate 1.5 and graduate 1.7. These numbers, even if doubled, raise many questions and concerns. Will the universities maintain the critical mass needed to train and supply the weed scientists needed in the future? At the same time will they continue the needed research, extension and training? Obviously, there will be more required, with less resources necessitating some change in how it is accomplished.

SCIENTIFIC ISSUES NEWSS members continue to be involved with key weed science issues. The Past Presidents are committed to gather and assemble NEWSS records and serve as curator until a permanent archive location is identified. They will also assist Bob Sweet with the NEWSS History mentioned earlier. The legislative committee has been active and effective but we must get more members involved in legislative activities. NEWSS members are a key technical source for herbicide and weed science information. An active education, training and outreach program for various trade organizations is in place and should continue. Consensus was reached with the NCWSS that a joint meeting would be beneficial but not immediately feasible due to scheduling. In the interim, NEWSS programs were supplied for the NCWSS annual meeting and an invitation to attend our meeting was included in their newsletter. Time was spent developing ideas for special recognition of our 50th annual meeting next year.

Brad Majek and I participated in a Washington, D.C. visit with WSSA and other regional officers which involved interaction with several congressional agricultural committees. Helping to select two new Congressional Science Fellows allowed further evaluation of the value of this program. The Fellow Program is an excellent opportunity to provide scientific input to the political process in Congress. This program deserves continued NEWSS support. We continue to be active in WSSA and CAST. Both are rising in stature as creditable sources of technical herbicide and weed science information useful in shaping public policy in Washington. Continued NEWSS and individual support are needed.

KEY 1995 ISSUES The 1995 Farm Bill debates will continue and be challenging and complex. Major parts to watch are subsidies, CRP extension and negotiated reduction in payments, environmental and sustainable agriculture issues, and policies promoting soil and water conservation. Watch closely and be ready to supply scientific input to support acceptable policy.

Food Safety and dietary exposure of children to how much pesticide residue is allowable on or in foods will receive much attention. Are children different and at higher risk? The NAS report on Pesticides in the Diets of Infants and Children will be part of the database. Legislation to overhaul the nation's pesticide laws will be proposed. Risk versus benefit, one standard for both raw and processed food may be proposed; greater margin of safety tolerances and cumulative effects will receive more attention. Food safety will be a major issue in 1995.

EPA and the current administration are committed to reducing the use of pesticides. Their plan is to reduce pesticide use by 50% by the end of the decade and want 75% of the crop acreage under IPM programs by year 2000. We must continue scientific input to shape an acceptable policy for continued herbicide use.

Actions to update FIFRA will continue. Included will be food safety issues and fixing the Delancy Clause and developing an acceptable policy to deal with the Circle of Poison issue on worldwide residues and tolerances.

Legislation to address water pollution is stalled in Congress. Many controversial issues must be resolved regarding both surface runoff and groundwater. Key points are point versus non-point source pollution including urban, agricultural and construction site pollution and increased protection of watersheds and wetlands.

The issue of multiple chemical sensitivity and validity of chemical sensitivity registers will continue. Proponents continue to maintain some people are super sensitive to any and all synthetic chemicals. Recently, the medical community has become more vocal against this issue. As more clinical case histories are developed there is little to no data supporting chemical sensitivity claims.

Obtaining adequate Competitive Grants and Experiment Station funding for weed science continues to be a problem. Competition with many more entomologists and pathologists for research dollars is real. The only solution to suggest is to encourage submitting only quality requests backed with solid data showing project value.

There is little doubt the NEWSS is doing more with less today and functioning well. The society is the epitome of vitality and people working together. Members are enthusiastic, dedicated champions of projects and issues, and committed to ensuring the society continues to serve its membership. With today's pressures it is hard for people to laugh at themselves. Rather, they look for the hard hitting, destructive, "I gotcha." Not good. Humor is a great medicine. It is a key ingredient to making work fun, tolerable, and more productive. The executive committee and others have it. I urge you to continue to express it. You and the Society will benefit. To close - I would like to leave you with a description of a weed scientist. It describes NEWSS members well.

WHAT IS A WEED SCIENTIST

A *Weed Scientist* is a pin on a map to the administrator, an overloaded expense account to the auditor, a program implementor to the manager or department head, a smile and wisecrack to the secretary and a purveyor of knowledge to the public.

A *Weed Scientist* needs the endurance of Hercules, the tact of a diplomat, the charm of a politician and the brain of a computer.

A *Weed Scientist* must be impervious to insult, indifference, anger, scorn or complaint.

A *Weed Scientist* must have the stamina to work all day, drive all night and be on the job fresh at 7:00 am.

A *Weed Scientist* wishes for: better products, higher salary, smaller territory, more ethical users, more understanding management and a more humane public. But, being an optimist, completes field plans and meetings anyway.

The *Weed Scientist* lives or dies by the research reports written and meetings given. Days are spent in a tedium of planes and cars for the privilege of spending countless night in cheerless hotel rooms.

Each morning the *Weed Scientist* awakens to cheerfully do it all over again.

Yet for all that, they are absolutely certain that tomorrow will be better and there is nothing they would rather be than a ***Weed Scientist!***

It has been an honor and a privilege to serve as your president. I feel very good about turning this position over to Brad Majek. I know he will provide solid leadership. Thank you for this opportunity.

SEEDING INTERVAL OF KENTUCKY BLUEGRASS AND PERENNIAL RYEGRASS AFTER MON 12000 APPLICATION; AND EUP STATUS OF MON 12000 FOR YELLOW NUTSEDGE CONTROL IN TURF.

D. C. Riego and R. B. Taylorson

ABSTRACT

MON 12000 is a sulfonyl urea currently being developed by the Agricultural Group of Monsanto Company for control of sedges and many broadleaf weeds in corn, milo, sugar cane, and in turf. The proposed name is **halosulfuron.** The approved trade name for turf is **MANAGE** herbicide.

Research, product development, and university testing of MON 12000 in turf has been conducted since 1987. Results show that a rate of 0.03 lb ai/A provides excellent yellow nutsedge control in turf in the northern states while a rate of 0.06 lb ai/A is needed for control in the southern states. In areas with severe nutsedge infestation, or where regrowth or regeneration from seeds, rhizomes, or tubers occur, a sequential application of 0.03 lb ai/A 6-10 weeks will provide full season control. MON 12000 exhibited excellent safety to all major cool season turf species such as creeping bentgrass, kentucky bluegrass, perennial ryegrass, tall fescue, fine fescue, and buffalograss; and warm season turf species such as bermudagrass, centipedegrass, bahiagrass, St. Augustinegrass, and zoysiagrass.

In 1993, MON 12000 was tested in commercial use conditions under an experimental use permit (EUP) in 20 states and extended in 1994 in 32 states. EUP results in golf courses, landscapes, and LCO applications involving both broadcast and spot or spray to wet applications confirm the small, replicated plot data previously collected.

One of the questions asked by endusers in the EUP is the seeding interval of turf after MON 12000 applications. One of the university trials conducted in 1994 to address this issue was at the University of Rhode Island. Kentucky bluegrass and perennial ryegrass was broadcast and raked into replicated split plots treated with MON 12000 at 0.03, 0.06, and 0.125 (4X rate) lb ai/A, with an untreated check. Seeding was done at O, 7, 14, and 30 days after MON 12000 treatment. Percent kentucky blurgrass and perennial ryegrass stand and vigor were collected 4, 6, 8, and 10 weeks after treatment. Data indicate that kentucky bluegrass and perennial ryegrass can be seeded safely 2 and 4 weeks, respectively, after MON 12000 treatment at the rates of up to 0.125 lb ai/A.

Technical Manager, Industrial, Turf, and Ornamentals, The Agricultural Group of Monsanto, Carmel, IN 46033 and Adjunct Professor, University of Rhode Island, Kingston, RI 02881

LOW VOLUME BACKPACK APPLICATION TECHNIQUE AND PERFORMANCE OF ACCORD HERBICIDE PLUS TANK MIXES FOR BRUSH CONTROL IN UTILITY RIGHTS OF WAY.

Domingo C. Riego

ABSTRACT

The most efficient and effective way to apply herbicides in utility rights of way (ROW) used to be aerial application. It may still is and many still uses it. Some utility ROW managers also use ground broadcast applications, using a radiarc or some form of cluster nozzles, simulating aerial applications. This is also pretty effective. However, probably the most popular method of vegetation management in utility ROW is through the use of mechanical methods and use of high volume hand held sprays. But recently, the use of low volume backpack LVBP sprayers has become very popular and many have adapted to this technique, using the program in conjunction with one or combinations of the management tools described.

There are many reasons why LVBP technique has become recently popular. Mechanical methods and high volume spray are expensive. Ground broadcast is sometimes impractical. Aerial application is cost effective, but exposure is high and risky, though perceived in most cases. LVBP techniques is simple, economical, low risk, low visibility, and most of all - it works!

LVBP application is not new. Homeowners, landscapers, vegetation control manager have all use it. The basic tool is a backpack sprayer. One basic change is nozzle choice where swivel type set up are very popular. Two nozzles can be used interchangeably, preferably a straight stream or a 15 degree flat fan at one end and a 40 degree at the other end, with 04-08 openings. The 40 degree nozzle is ideal for short brush of up to 5 feet tall, while the 15 degree nozzle is ideal for 5-10 feet brush. Straight streams can be used in more than 10 feet brush by spraying using a Z method from top to bottom. Both sides of the tree maybe sprayed if the target brush is tall with dense foliage. Target volume is 10-20 GPA, with 50% spray coverage. These are distinct differences versus conventional backpack and high volume spraying.

One of the reasons why LVBP technique works is because of the products sprayed with it. Accord herbicide, by the Agricultural Group of Monsanto Company, makes the technique effective because Accord is a truly translocated herbicide. Accord can also be applied in tank mix with Arsenal herbicide

by American Cyanamid Company or Escort herbicide by Dupont Company. These compounds have complimenting mode of actions that make the treatments very efficaceous.

The following are treatment have been thooughly tested and are recommendations for low volume backpack applications:

	HERBICIDE TREATMENT	RATE
1.	ACCORD	7% V/V
2.	ACCORD	10% V/V
3.	ACCORD + ARSENAL 2WS	5% V/V + 0.25% V/V
4.	ACCORD + ARSENAL 2WS	5% V/V + 0.50% V/V
5.	ACCORD + ESCORT	5% V/V + 2 OZ/A

Add a non-ionic surfactant at 0.50% V/V.

Technical Manager, Industrial, Turf, and Ornamentals, The Agricultural Group of Monsanto, Carmel, IN 46033.

ECONOMICS OF SELECTIVE VEGETATION CONTROL ON ELECTRIC RIGHTS-OF-WAY

Anthony W. Johnson, III[1]

ABSTRACT

Electric Utilities in the Northeastern United States have maintained vegetation along rights-of-way utilizing selective herbicide applications to control undesirable vegetation for several decades. The benefits of a selective control approach are well documented in numerous studies performed throughout the US over the past thirty to forty years. The noted benefits of a selective control program are; reduced target stem densities, reduced herbicide use and reduced maintenance costs over time. Northeast Utilities, and it's subsidiary operating companies, The Connecticut Light & Power Company (CL&P) and The Hartford Electric Light Company (HELCO), have employed selective control practices since the early 1960's. Both companies have experienced the reductions noted above in varying degrees. However, a comprehensive evaluation of the results of a long term selective approach has never been performed to determine the exact reductions, and overall vegetation management benefits. The driving factor in any utility rights-of-way vegetation control program is cost. With projected reductions in budgets, especially in vegetation control, it is paramount that a selective management program not only be effective in the control of undesirable vegetation but efficient in the use of marginal maintenance costs.

INTRODUCTION

Selective vegetation control requires the elimination of undesirable tree species on a cyclical basis. The focus of the selective control program during the 1970's and 1980's was to eliminate only those tree species capable of growing tall enough to contact the overhead electric conductors. These species were designated as undesirable and, therefore, target species. The normal maintenance cycle was initially 6 to 7 years during the 1970's and early 80's. This was reduced to 6 years since the mid 1980's. Selective control involved the application of selective and non-selective herbicides to each individual target stem base (basal) or stem and foliage (stem-foliar). Both methods required the application of herbicides in a high-volume mixture. Basal applications included a 1.5% herbicide concentration in oil carrier and stem foliar applications required a similar 1.5% herbicide concentration in water. Over the past fifteen years there have been several different basal herbicides employed, however, only one foliar herbicide material was used.

A review of almost twenty years of application records was performed to identify over time the benefits of the selective control program. Application summaries contain pertinent information on the acreage treated, the application methods employed, the herbicides used, the amounts of herbicide mixture applied and the total costs for an individual right-of-way project. The summaries have been maintained beginning in the mid 1970's extending into the early 1990's. Records were matched for the same project areas spanning two to three maintenance cycles. During the period for which summaries are available, no quantitative analysis of stem densities of

[1] Senior Scientist, System Forestry Section , Northeast Utilities, Berlin, CT 06141-0270

target species were performed. The benefits obtained or inferred are based solely on the information provided through comparisons of application rates and costs from one cycle to the next. Conclusions are not supported by quantitative analysis of actual target species reductions.

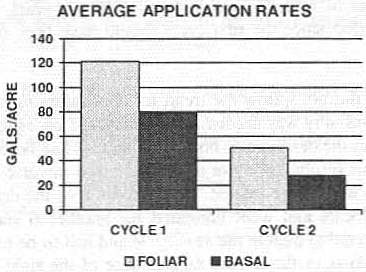
MATERIALS AND METHODS

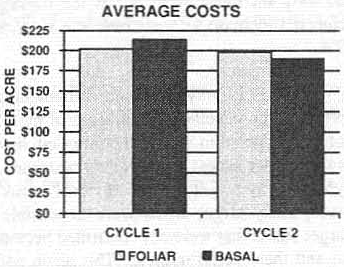
The materials used for the study involved nothing more than the application summaries for numerous rights-of-way projects over the last 18 years. Initially, projects covering the same right-of-way line or lines were grouped together so that the data from the summary records can be compared from one cycle to the next. Data obtained from the summaries and used for the analysis includes acres treated, amounts of herbicide mixture applied per acre and average costs per acre. Since basal stem applications were the primary herbicide treatment method employed, there is substantially more data for these projects than for those maintained through stem-foliar applications. Stem-foliar applications were limited to public water supply watershed areas only.

Data for each application method was compiled and graphed to show average application rates and costs in the first and second cycles. Percent changes in application rates and costs were also graphed to show the cost benefits, if any, derived from the selective maintenance approach.

RESULTS AND DISCUSSION

The summary report data was graphed to show the improvements or reductions in the application rates and costs per acre over the course of one cycle. Below are two sets of graphs that depict the reductions in average amounts of herbicide mixtures applied and average costs per acre for both basal and foliar methods.



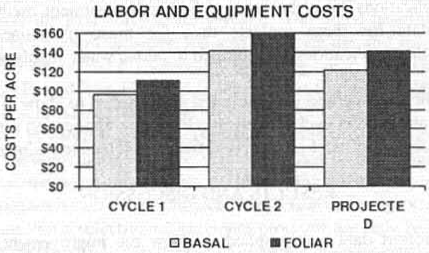


The graphs clearly show a reduction in average application rates for both basal and foliar applications. The costs have also been reduced but not as dramatically. Application rates were reduced on average by 64% on basal projects but costs only dropped 11%. On foliar projects application rates were reduced by 58% but here again, costs only dropped by 2%.

Initial conclusions drawn from the reductions in herbicide mixtures applied leads us to the conclusion that target stem densities must have been reduced in order to obtain the significant reductions in mixture volumes applied per acre. This is the first benefit of a selective program -

reduced amounts of herbicide used, and is consistent with the goals of an integrated approach to vegetation control.

The cost reductions did not keep pace with the reductions in herbicide use. Although there is a slight correlation between application rate reductions and cost reductions, one would expect a greater reduction in maintenance costs than actually occurred. There are basically two components of cost; the herbicide mixture and the contractor labor and equipment. Because of the significant reductions in the amount of herbicides applied, the reason for the higher than expected costs must lie within the labor and equipment component. If the mixture costs are removed from the average costs shown above, the resulting labor and equipment costs for each maintenance cycle are as follows:



The data clearly shows that there were significant increases in the cost of labor and/or equipment in the second cycle. According to the chart, these costs rose 48% on basal projects and 44% on foliar projects. If the average rate of inflation was included (4% per year), the projected increase in costs over the six-year period since the first cycle should have been only 27%.

To find out why labor and equipment costs did not follow the trend for application rates, a review of the vegetation conditions of the rights-of-way was needed. Essentially, the undesirable or target vegetation was well controlled, however, the desirable or non-target species had become so dense that access was severely restricted. This resulted in more time required to traverse the rights-of-way to get to the individual stems that were to be treated. Also, because of the dense cover, many target stems were impossible to locate and went untreated for another 6 years. Target stems that were not controlled became too tall to treat in the next cycle and had to be hand cut and then stump treated. This again added costs to the overall maintenance of the right-of-way.

Not only were untreated stems growing too tall to treat but certain tree species were found to be quite capable of reaching heights in excess of 12 feet from seed or root sucker within the six year period between scheduled maintenance. Species such as poplar (Populus deltoides, P. tremuloides), red maple (Acer rubrum), birch (Betula alleghaniensis, B. populifolia) and sassafras (Sassafras albidum) major rights-of-way species in Southern New England, can invade and become established or re-establish quite readily in cleared and opened rights-of-way areas. As time between maintenance years increases, the amount of targets taller than 12 feet also increases.

The longer the time period, the more stems in excess of 12 feet, the more time required to cut and treat, the higher the overall maintenance costs in a given year.

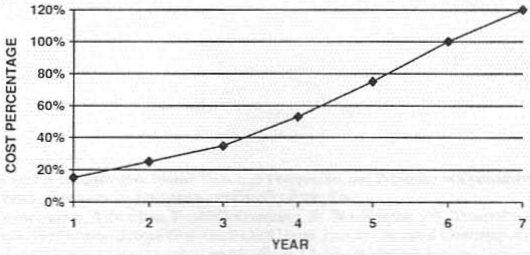
In essence, two fundamental problems were identified that resulted in the higher than expected maintenance costs. First, a limited target species list and, second, a maintenance cycle that was too long.

In 1991, Northeast Utilities revised the rights-of-way specifications to incorporate the two-zone vegetation control concept (wire zone - border zone). The list of target species ("undesirable" as opposed to "capable") was expanded to include low growing tree species as well as tall or dense growing shrubs. The intent was to eliminate any vegetation over eight feet in height from the wire or conductor zone. The tall shrubs and low growing trees were retained when necessary and again, selectively, within the side or border zones on the edges of the rights-of-way. Because of the densities of the now undesirable vegetation to be controlled, the reliance on basal applications as the primary method of chemical control was completely changed over to foliar and stem-foliar methods. In the mid 1980's over 85% of the acreage maintained in a given year was through basal herbicide applications. In 1993, this percentage dropped to less than 7% of the total acreage treated. Foliar applications became less selective as applications were essentially made to large areas of overgrown brush, shrubs and vines.

The change in specifications has not resulted in reduced savings. With the change in specifications came a period when rights-of-way vegetation control became a practice of reclaiming lost rights-of-ways. At this time, NU is still in the first cycle of the new program which will not be completed until 1996 or 1997. Present maintenance costs are even greater now than they were in the second cycle data shown above. Current maintenance costs are in excess of $250 to $300 per acre for basal or foliar herbicide applications. More herbicide is being applied to more acreage in an effort to regain a maintainable level of vegetation. This is inconsistent with the goals of an IPM program.

The second area were change is required but has not yet been implemented is the reduction in cycle length. Studies have shown that as time increases between maintenance, target species increase with a subsequent increase in costs.

The following graph shows the estimated costs of control for different years based on the actual costs of a 6 year program.



The chart shows the estimated cost savings associated with maintenance in varying years in comparison to a six-year cycle. According to the data, if vegetation maintenance were performed in the fifth year there would be an estimated cost savings of 25% over the maintenance costs in the sixth year. Therefore, if cycle lengths were reduced one to two years, there would be a net savings of 25% to 45% over the current six-year cycle.

This would be the estimated savings in the maintenance year only. The total costs over time will be less under the four-year cycle. However, the conversion to a four-year cycle will cost more initially during the first cycle. The cost in each of the maintenance years as well as the total cost over twelve years would be as follows:

	4-YEAR CYCLE	6-YEAR CYCLE
	Year 1 - $250	Year 1 - $250
	Year 4 - $138	Year 6 - $250
	Year 8 - $100	Year 12 - $250
	Year 12 - $90	
Totals:	$578	$750

The maintenance costs in each maintenance year of the four-year cycle are gradually reduced over the course of several cycles whereas the costs in each maintenance year of the six-year cycle are not. If both cycles start with an initial cost of $250 per acre and the estimated cost savings of a four-year vs. six-year cycle are used, the overall cost savings in year 12 would be $172 per acre or 23% with the four-year program. The estimated cost per acre in the fourth cycle of the four-year program would be only $90. Although this is significantly lower than the $250 per acre cost for the six-year cycle, it is consistent with actual maintenance cost figures for three other New England utilities currently on a four-year cycle.

In conclusion, a selective management approach is economical only if proposed maintenance practices consider not only current vegetation conditions but also future vegetation conditions. Maintenance will only be cost effective if performed on a timely cycle.

EFFECT OF SPRAY ADJUVANTS ON BRUSH CONTROL PROVIDED BY LOW VOLUME APPLICATIONS OF FOSAMINE PLUS IMAZAPYR

A.E. Gover, C.W. Spackman, R.W. Parks III, and L.J. Kuhns[1/]

ABSTRACT

As part of an ongoing research project funded by the Pennsylvania Department of Transportation, a trial evaluating the effect of different adjuvant types and concentrations on brush control provided by low-volume foliar applications of fosamine ammonium (fosamine) plus imazapyr at below recommended rates was conducted on the right-of-way of Interstate 80, near Snow Shoe, PA. The adjuvant treatments included no additional adjuvant; 'Clean Cut' at 0.5 percent v/v; 'Penevator 9' at 0.25, 0.5, and 1.0 percent v/v; and 'Quik-Wet' at 0.125, and 0.25 percent v/v[2/]. The herbicide solution contained fosamine plus imazapyr at 14.4 plus 0.30 g/L, respectively[3/], while recommended rates are 24 plus 1.2 g/L, respectively. The treatments were applied using a lever-actuated, piston pump backpack sprayer and a handgun equipped with a Spraying Systems #5500 Adjustable ConeJet nozzle with a Y-2 tip. Targeted spray coverage was approximately 90 L/ha. The experimental design was a randomized complete block with two replications. Each plot was treated with 2 L of spray solution, which treated an average of 149 stems. Plot size range was approximately 0.05 to 0.075 ha. The most common species was red maple (*Acer rubrum* L.), followed by black cherry (*Prunus serotina* Ehrh.), and red and white oak (*Quercus rubra* L. and *Q. alba* L.). Other species included quaking aspen (*Populus tremuloides* L.), green ash (*Fraxinus pennsylvanica* Marsh.) and hawthorn (*Cretageus* spp.). Applications were made to one replication on September 16 and 17; and the second replication on September 29, 1993. An intermittent drizzle fell during applications on September 16 and 17. Conditions were dry on September 29. All treated stems in each plot were visually rated for percent canopy reduction on July 7 and 15, 1994, using four species groups (maple, cherry, oak, other), and four height classes (0-1.5, 1.5-3.0, 3.0-4.5, and greater than 4.5 m). Results are reported in Table 1.

The combined species data were subjected to analysis of variance. Analysis of covariance evaluating effect of target height on control was not significant. Replication was not a significant source of variation, suggesting that light rainfall is not detrimental to low volume foliar applications of fosamine plus imazapyr. Effect of spray adjuvant was not significant for any individual species groups, or for the combined data. The formulation of fosamine used in this study includes a surfactant, and this may have obscured any potential effects from additional adjuvants. Future testing of this type should focus on herbicides that are formulated without surfactants; or even lower concentrations of herbicide when formulations include surfactants, as the amount of control achieved in this test was unexpected.

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

[2/] 'Clean Cut' crop oil concentrate, Arborchem Products Company, Ft. Washington, PA; 'Penevator 9' crop oil concentrate and 'Quik-Wet' organosilicone based surfactant blend, Exacto Chemical Company, Richmond, IL.

[3/] Spray solution contained 'Krenite S' plus 'Arsenal' herbicides at 3.0 plus 0.125 percent v/v, respectively.

Table 1: Effect of spray adjuvants on percent canopy reduction due to low volume applications (approx. 90 L/ha) of a solution containing fosamine ammonium and imazapyr at 14.4 and 0.30 g/L, respectively. Applications were made September 16,17, and 29, 1993. Visual ratings of canopy reduction were taken July 7 and 15, 1994. Numbers in parentheses are number of stems treated. Values reported are the means of two replications.

Adjuvant	Application Rate	All Species	Red Maple		Black Cherry		Red and White Oak		Other[1/]	
	(% v/v)	(	percent canopy reduction							)
none	- - -	84	84	(147)	98	(21)	87	(44)	81	(124)
Clean Cut	0.5	83	90	(89)	94	(116)	84	(54)	60	(67)
Penevator 9	0.25	88	90	(103)	95	(128)	77	(39)	72	(31)
Penevator 9	0.5	88	78	(72)	94	(64)	87	(38)	93	(60)
Penevator 9	1.0	89	96	(152)	100	(4)	79	(61)	77	(30)
Quik-Wet	0.125	84	86	(260)	90	(12)	80	(45)	72	(29)
Quik-Wet	0.25	80	84	(207)	20	(1)	90	(30)	59	(56)
Significance Level (p)		0.85								
LSD (p=0.05)		n.s.								

[1/] Includes green ash, trembling aspen, and hawthorn.

EFFECTS OF SPRAY VOLUME, HERBICIDE CONCENTRATION, AND ADJUVANTS ON EARLY SEASON CONTROL OF CHERRY AND MAPLE WITH TRICLOPYR

A.E.Gover, C.W. Spackman, R.W. Parks III, J.M. Johnson, and L.J. Kuhns[1/]

ABSTRACT

As part of an ongoing research project funded by the Pennsylvania Department of Transportation, a trial evaluating seven treatments to compare the effects of application volume, herbicide concentration, and adjuvant type on control provided by early season applications with triclopyr was established near State College, PA. The treatments consisted of three low volume applications of triclopyr[2/], methyl oleate[3/] spray adjuvant, and water at percentages of 12.5/37.5/50, 6.25/18.75/75, and 2.5/7.5/90 v/v, respectively. High volume treatments consisted of triclopyr alone at 1.5 percent v/v, with either methyl oleate or a crop oil concentrate[4/] at 3.0 percent v/v; and triclopyr plus a premix of 2,4-D plus 2,4-DP[5/] at 1.5 plus 1.0 percent v/v, respectively, with either methyl oleate or crop oil concentrate, at 3.0 percent v/v. All treatments were applied with a CO_2-powered, single nozzle sprayer equipped with a Spraying Systems #5500 adjustable ConeJet, at 30 psi. Low volume treatments were applied with a Y-2 tip, and high volume treatments were applied with an X-12 tip. Treatments were applied April 28 and May 2, 1994, to ten stems each of red maple (*Acer rubrum* L.) and 50 stems each of black cherry (*Prunus serotina* Ehrh.). Phenology for both species ranged from bud swell to approximately 25 percent leaf out. The experimental layout was a completely randomized design, with ten replications. Each plot consisted of one red maple and five black cherry plants. Visual ratings of percent canopy reduction were taken between September 8 and 29, 1994. Results are reported in Table 1.

The data were subject to analysis of variance, and orthogonal contrasts were run on the high volume treatments to compare methyl oleate and crop oil concentrate, and presence or absence of 2,4-D plus 2,4-DP in the treatment. Canopy reduction ranged from 35 to 89 percent in red maple, and 44 to 72 percent in black cherry. The low values for each species were for the low volume application of triclopyr/methyl oleate at 6.25/18.75 percent v/v, respectively. The integrity of this treatment is suspect, as both the 2.5/7.5 and 12.5/37.5 percent v/v treatments of triclopyr/methyl oleate performed better on each species.

Among the high volume treatments, the effect of spray adjuvant was significant for red maple (P=0.008), as mixtures with crop oil concentrate averaged 85 percent canopy reduction, compared to 68 percent for methyl oleate treatments. The effect of spray adjuvant type was not significant for black cherry. The effect of adding 2,4-D plus 2,4-DP to each mix was significant in black cherry, and nearly significant (P=0.09) in red maple. Control of red maple was reduced with the addition of 2,4-D plus 2,4-DP; and control of black cherry was enhanced.

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

2/ Garlon 4, 4 lb triclopyr/gallon, DowElanco, Indianapolis, IN.

3/ Emerest 2301, Henkel Corporation - Emery Group, Cincinnati, OH.

4/ Clean Cut, Arborchem Products Co., Inc., Fort Washington, PA

5/ Weedone 170, 1.85 lb 2,4-D + 1.85 lb 2,4-DP/gallon, Rhone-Poulenc, Research Triangle Park, NC.

TABLE 1: Visual rating of canopy reduction of red maple and black cherry resulting from treatments applied April 28 and May 2, 1994. Ratings were taken between September 8 and 28, 1994. Each value is the mean of 10 replications.

Treatment	Application Rate	Application Volume[1/]	Red Maple Canopy Reduction	Black Cherry Canopy Reduction
	(%v/v)		(%)	(%)
triclopyr[2/]	12.50	Low	80	67
methyl oleate[3/]	37.50			
triclopyr	6.25	Low	35	44
methyl oleate	18.75			
triclopyr	2.50	Low	67	54
methyl oleate	7.50			
triclopyr	1.50	High	75	57
methyl oleate	3.00			
triclopyr	1.50	High	89	58
crop oil concentrate[4/]	3.00			
triclopyr	1.50	High	60	65
2,4-D + 2,4-DP[5/]	1.00			
methyl oleate	3.00			
triclopyr	1.50	High	81	72
2,4-D + 2,4-DP	1.00			
crop oil concentrate	3.00			
Significance Level (p)			0.0001	0.0007
LSD (p=0.05)			18	12
Contrasts-High Volume Applications:				
'adjuvant: methyl-oleate vs. COC'			0.008	0.4
'2,4-D + 2,4-DP: with vs without'			0.09	0.005

1/ All applications were made with a handgun containing a Spraying Systems #5500 Adjustable ConeJet nozzle. Low volume applications were made with a Y-2 tip, high volume applications were made with an X-12 tip.

2/ Garlon 4, 4 lb triclopyr/gallon, DowElanco, Indianapolis, IN.

3/ Emerest 2301, Henkel Corporation - Emery Group, Cincinnati, OH.

4/ Clean Cut, Arborchem Products Co., Inc., Fort Washington, PA

5/ Weedone 170, 1.85 lb 2,4-D + 1.85 lb 2,4-DP/gallon, Rhone-Poulenc, Research Triangle Park, NC.

COMPARISON OF LOW VOLUME APPLICATIONS OF TWO PICLORAM:2,4-D FORMULATIONS TO LOCUST, CHERRY, AND OAK

A.E. Gover, C.W. Spackman, R.W. Parks III, and L.J. Kuhns[1/]

ABSTRACT

As part of an ongoing research project funded by the Pennsylvania Department of Transportation, a trial comparing brush control provided by the currently labeled picloram:2,4-D amine salt formulation with an experimental dry formulation with the same 1:4, picloram:2,4-D ratio, was established near State College, PA. The amine formulation (Tordon 101M) contains the triisopropanolamine salts of picloram and 2,4-D, at 0.54 plus 2.0 lb ae/gallon, respectively. The water dispersable granule formulation (NAF-8) contains 75 percent active ingredient. Each formulation was applied at 0.625 and 1.25 lb ae/ac, to black locust (*Robinia pseudoacacia* L.), black cherry (*Prunus serotina* Ehrh.), and red (*Quercus rubra* L.) and blackjack oak (*Q. marilandica* Muench.). Each treatment was applied to 10 stems of each plant, with each stem serving as a replicate in a completely randomized design. Treatment dosage in lb ai/ac was administered based on the canopy index (canopy width*canopy height) of each plant. Black locust were treated with a carrier volume of 10 gal/ac, on August 24, 1993. At this dilution, the NAF-8 treatments required repeated agitation during the application. Cherry and oak were treated on Septembe 8, at 15 gal/ac, which resolved the dilution problems seen at 10 gal/ac. Treatments were applied at 30 psi with a CO_2-powered backpack sprayer equipped with a Spraying Systems MeterJet and a rollover-valve nozzle with 1502 and 4002 flat fan spray tips. All treatments included at crop oil concentrate[2/] and a drift control agent[3/], each at 0.25% v/v. Black locust was visually rated for percent defoliation October 6, 1993. On October 8, the oaks were rated for percent defoliation and percent fall coloration of the remaining foliage, and cherry was rated for percent leaf drop and percent necrosis of remaining foliage. All species were visually rated for percent canopy reduction on July 5, 1994. Results are reported in Table 1.

Locust response to the treatments was the most dramatic, as the checks were not yet showing fall color, and severely injured plants were defoliated or had hanging necrotic leaves, and were showing bark cracking on the main stem. Initial oak symptoms were not as clear, and had to be rated as a function of defoliation and coloration of remaining leaves. At the first rating, the cherry had dropped most of their leaves, but there were differences in the amount of necrosis in the remaining leaves. Data were subjected to analysis of variance, and orthogonal contrasts were used to evaluate the effect of formulation, rate, and to compare the treatments with the untreated check. The treatments were significantly different than the check for all ratings except for initial leaf drop in cherry. Tordon 101M provided more initial defoliation of locust, but there were no significant differences due to formulation or rate on final canopy reduction, which ranged from 77 to 95 percent. The effect of rate was significant on canopy reduction in oak, as the 1.25 lb ai/ac rate averaged 94 percent, compared to 80 for 0.625 lb ai/ac. The effects of formulation and rate were not significant on the canopy reduction of cherry, as all treatments provided excellent control, ranging from 93 to 98 percent.

Except for initial defoliation of locust, NAF-8 provided the same efficacy as Tordon 101M, though the dry formulation does not mix as readily as the liquid formulation at volumes less than 15 gal/ac.

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

[2/] Penevator 9, Exacto Chemical Co., Richmond, IL.

[3/] Sta-Put, Nalco Chemical Co., Chicago, IL.

TABLE 1: Injury ratings from foliar herbicide treatments applied to black locust on August 24, 1993; and black cherry, and red and blackjack oak on September 8, 1993, near State College, PA. Black locust were treated at 10 gal/ac, and cherry and oak were treated at 15 gal/ac, based upon the canopy index (height * width). Defoliation, fall coloration, and foliar necrosis were rated October 6 and 8, 1993; and final canopy reduction was rated July 5, 1994. Each injury value is the mean of 10 replications.

		Black Locust		Red and Blackjack Oak			Black Cherry		
Treatment	Application Rate picloram:2,4-D	Defoliation Oct 6, 1993	Canopy Reduction Jul 5, 1994	Defoliation	Fall Coloration	Canopy Reduction Jul 5, 1994	Leaf Drop	Foliar Necrosis	Canopy Reduction Jul 5, 1994
	(lb ai/ac)	(----------	----------	- - - Oct 8, 1993 - - -		% ----------	- - - Oct 8, 1993 - - -		)
Tordon 101M	0.125:0.5	93	95	14	80	80	74	67	96
Tordon 101M	0.25:1.0	95	87	45	86	90	57	92	99
NAF-8	0.125:0.5	84	81	24	91	80	73	67	93
NAF-8	0.25:1.0	75	77	25	96	97	70	70	98
Untreated Check	- - -	2	1	0	69	5	69	0	10
Significance Level (p)		0.0001	0.0001	0.020	0.082	0.0001	0.46	0.0001	0.0001
LSD (p=0.05)		12	23	26	n.s.	19	n.s.	28	2
Contrasts:									
'101M vs NAF-8'		0.002	0.15	0.54	0.16	0.59	0.40	0.25	0.43
'0.625 vs 1.25'		0.41	0.44	0.086	0.39	0.045	0.16	0.17	0.091
'Treated vs Check'		0.0001	0.0001	0.012	0.018	0.0001	0.93	0.0001	0.0001

49th Annual Business Meeting
of the
NORTHEASTERN WEED SCIENCE SOCIETY
Boston Marriott Copley Place, Boston, Massachusetts, January 4, 1995

I. Call to Order:

The 49th Annual Business Meeting was called to order by Wayne Wright (President) at 4:01 PM on Wednesday, January 4, 1995.

II. Acceptance of Minutes:

Jack Dobson moved to accept the minutes of the 48th Annual Business Meeting as written in Volume 49, Proceedings of the NORTHEASTERN WEED SCIENCE SOCIETY pages 194-196. The motion was seconded by Prasanta Bhowmik. Wayne asked if there was any discussion, without any, the membership unanimously approved the minutes.

III. Necrology Report:

Brian Olson asked the membership if anyone was aware of any recent or past members of the Northeastern Weed Science Society that may have died in the past year. Will Evans stated James E. Esposito had died. James was a formulation chemist with AmChem from 1960 - 1978. Ray Taylorson stated that Harold Cure had died. Harold conducted weed control research in turf at USDA - Beltsville from the late 1950's through the early 1960's, before he went to the Univ. of Missouri. Brian Olson asked the membership to observe a moment of silence in memory of these two individuals.

IV. Executive Committee Reports:

Wayne Wright asked the membership to review the annual reports in the handout. Wayne announced that Ron Ritter has available the NEWSS constitution and Manual of Operating Procedures in the back of the room.

Officers:
W. G. Wright, President
B. A. Majek, President-Elect
T. E. Vrabel, Vice President
B. D. Olson, Secretary/Treasurer
R. L. Ritter, Past President

Committees:
R. D. Sweet, CAST Representative
J. C. Neal, Editor
A. R. Bonanno, Legislative
J. F. Derr, Public Relations
L. J. Kuhns, Research Coordinator
M. P. Whalen, Sustaining Membership
D. B. Vitolo, WSSA Representative

V. Secretary/Treasurer, Brian Olson:

Income for NEWSS exceeded expenses in 1994 by $4,790.14. Attendance at the 49th annual meeting as of Wednesday, January 4 was 300. Projected attendance at the 1995 meeting including the Thursday Turf session should be about 325. The attendance in Baltimore in 1994 at the Hyatt was 330. Brian reminded the graduate students participating in the Graduate Student Paper contest to bring their hotel receipts to the registration desk Thursday morning between 7:30 and 10:00 AM to receive a reimbursement.

VI. Audit Report:

Rob Hedberg and Sid Bosworth reviewed the books and found everything in order. Acceptance of the audit report was moved and seconded by Bob Sweet and Prasanta Bhowmik, respectively, and approved by the membership.

VII. Awards:

A. Research Poster Contest:

Wayne introduced Jules Jaeger chair of the Research Poster awards committee. Jules thanked committee members Ed Beste, Matt Mahoney and Dan Kunkel. Jules asked Bill Sciarappa of BASF, sponsor of the awards, to come forward and present the checks.

- 1st place winner was J.C. Neal and C.C. Morse, "A Comparison of Broadleaf and Blackseed Plantains Identification and Control."
- 2nd place winner was E.L. Werner and W.S. Curran, "Using the Economic Threshold Concept as a Determinant for Velvetleaf Control in Field Corn."

B. Graduate Student Paper Contest:

Wayne introduced Prasanta Bhowmik, chair of the Graduate Student Paper awards committee. Prasanta thanked committee members Ron Ritter, Stan Pruss, and Jack Dobson. Prasanta commented that the 15 papers were very good. Prasanta asked Bill Sciarappa of BASF, sponsor of the awards, to come forward and present the checks.

- 1st place winner was S. Salihu, J.F. Derr and K.K. Hatzios, "Tolerance of Nursery Crops to Isoxoben."
- 2nd place winner was J.A. Ackley, H.P. Wilson and T.E. Hines, "Rimsulfuron in Potatoes."
- Honorable mention was J.B. Colquhoun and R.R. Bellinder, "Integrating New Cultivation Tools and Banded Herbicides for Weed Control in Sweet Corn."

C. 1994 Collegiate Weed Contest:

Wayne asked Ed Beste, host of the 1994 collegiate weed contest, to come forward and comment about the contest, held August 2 at the University of Maryland, Salisbury Facility. Wayne asked the membership to show their appreciation for Ed and his efforts with a round of applause. Thirty graduate and 14 undergraduate students competed in the contest. Teams, from Univ. of Guelph, Nova Scotia College of Agriculture, North Carolina State Univ., Virginia Tech, Pennsylvania State Univ., Cornell Univ., Univ. of Maryland and State Univ. of New York at Cobleskill were present.

- Brian Manley of Virginia Tech was the individual graduate student winner, Ted Webster of N.C. State and Andy Ackley from the Virginia Tech placed second and third, respectively.
- In the undergraduate individual division, Robert Moloney of Univ. of Guelph placed first, Jed Colquhoun of Cornell and Catherine Gauthier of Guelph both placed second and Chuck Bornt of SUNY-Cobleskill placed third.
- Graduate team winners were: first place, Virginia Tech Brian Manley, Andy Ackley, John Eberwine and Mark Czarnota; and second place, North Carolina State Univ., Lee Prachaska, Ted Webster, Roger Batts and Tony White.
- Undergraduate team winners were: first place, Univ. of Guelph Laurie Weber, Robert Moloney, Catherine Gauthier, and John McAdams; and second place, Nova Scotia Ag. Col. Laura Hooper and Tracy Shinner.

VIII. Photo Contest:

Ron Ritter, chair of the Photo Contest judging committee, thanked committee members Gar Thomas, John Grande and Richard Beardmore.

A. Slide competition:

- 1st place, Joe Neal, Cornell Univ.
- 2nd place, Joe Zawiervcha, BASF Corp.
- 3rd place, Hiwot Menbere, Univ. of Maryland

B. Print competition:

- 1st place, Russ Hahn, Cornell Univ.
- 2nd place, Bill Phillips, J.C. Ehrlich Chemical Co., Inc.

IX. **Special Recognition Award:**

Ron Ritter presented Brian Olson with a special recognition award for his service to the society as secretary/treasurer.

X. **Presentation of Gavel:**

Wayne Wright, Past-President, presented the gavel to incoming President Brad Majek. Brad thanked Wayne for his service to the society and presented Wayne with a plaque commemorating his service as President.

XI. **New Business:**

A. Resolutions Committee:

John Meade was chair of the resolutions committee. John was not able to attend the annual meeting. In his absence Rich Bonanno read the following resolution to the membership. Bob Sweet moved to accept the resolution as read and Prasanta Bhowmik seconded the motion. Brad asked for any discussion, without any, the membership unanimously approved the resolution as follows:.

Whereas, weeds are a major cost to United States consumers in terms of increased food and fiber prices, decreased food and fiber quality, loss of native vegetation and lower quality recreational areas and,

Whereas approximately 70% of all pesticides used in agriculture are herbicides and,

Whereas losses of crops due to weeds exceeds the combined losses of crops due to insects and diseases, the cost of weed control to the public plus the losses due to uncontrolled weeds is in the tens of billions of dollars annually.

Whereas the Agricultural Research Service (ARS) of the United States Department of Agriculture (USDA) has had a leading research effort in Weed Science over the past 40 years and also since Weed Science has had a separate National Program Leader since the inception of the National Program Staff in ARS, it is vital to American agriculture and the American people that this national Weed Science Program be maintained and directed separately by a National Program Leader with expertise in Weed Science. Therefore, be it resolved that the Northeastern Weed Science Society strongly supports the filling of this critical position as soon as a qualified person can be found.

President Majek asked if there were any other resolutions from the membership. Gary Schnappinger asked if he could read a proposed resolution regarding the special review of atrazine, simazine and cyanazine. Jack Dobson moved to accept the resolution and Stan Pruss seconded the motion. The membership debated the pro's and con's of the resolution for twenty minutes until Jack Dobson moved to withdraw his previous motion and Jim Steffel seconded the withdrawal. Bob Sweet moved that "the society take a proactive position on the triazine special review issue." Rich Bonanno seconded the motion. After more discussion Jim Parrochetti moved "to table the motion while the membership conducts the election for secretary/treasurer and Vice-President. Meanwhile individuals interested in working on the proposed triazine special review resolution worked with Gary Schnappinger." The motion was seconded by Prasanta Bhowmik. After the election Bob Sweet moved to withdraw his previous motion and Rich Bonanno seconded the withdrawal. Gary Schnappinger read a resolution. Jack Dobson moved to accept the resolution as read and Jim Steffel seconded the motion. Brad called for discussion, without any, the membership unanimously approved the resolution as follows:

Whereas the herbicide atrazine, simazine, and cyanazine are currently under special review by the U.S. Environmental Protection Agency and,

Whereas these herbicides are a significant part of the effective, and economical weed control programs in crops such as corn, sorghum, tree fruits, turf-grass, rangeland, and ornamental crops and,

Whereas atrazine, simazine, and cyanazine are critical components of conservation tillage crop production systems which are vital for the protection of our nation's soil and water resources and,

Whereas the continued use of these herbicides is important to assure a continued plentiful supply of healthy and economical food for the American people.

Therefore be it resolved that the members of the Northeastern Weed Science Society encourage the U.S. Environmental Protection Agency to conduct an expeditious and fully scientific review of the risk/benefit data and until such time as the data shows otherwise the Northeastern Weed Science Society fully supports registration and judicious use of atrazine, simazine and cyanazine.

B. Nominating Committee Report:

Prasanta Bhowmik, chair, thanked nominating committee members Bill Curran, Tim Dutt, Will Evans, and Bob Devlin. The committee presented Rich Bonanno and Joe Neal to the membership as candidates for Vice President. President Majek asked if there were any nominations from the floor. With no new nominations, Wayne Wright moved to close the nominations for Vice President and Tom Vrabel seconded the motion. The ballots for vice president were passed out to the membership. While the ballots were being counted, Prasanta presented Andy Senesac to the membership as the nominee for secretary/treasurer-elect. Brad Majek asked if there were any nominations from the floor. Without any, Jack Dobson moved that the nomination for secretary/treasurer be closed and Max McCormack seconded the motion. The membership unanimously approved Andy Senesac as secretary/treasurer-elect. In a close race Prasanta Bhowmik announced that Joe Neal was elected vice president by the membership.

C. Election of 1995 Nominating Committee:

Brad asked for nominations from the floor for the nominating committee. Frank Himmelstein, Steve Dennis and Bill Sciarappa were nominated. Jack Dobson moved to close the nominations and Max McCormick seconded the motion. Stan Pruss moved that the membership approve the three nominees to the nominating committee and Jack Dobson seconded the motion. The membership unanimously approved the nominating committee candidtates. STAN GORSKY

D. Collegiate Weed Contest:

President Majek announced that the 1995 NEWSS collegiate weed contest will be hosted by Robin Bellinder at Cornell Univ., August 7-8.

E. Meeting Site for the 1996 Annual Meeting:

President Majek reminded the membership that the 50th Annual Meeting will be held at the Williamsburg Lodge and Convention Center, Williamsburg, Virginia, January 2-5, 1996.

F. Other business:

No other new business was presented by the membership.

XII. Executive Committee:

Brad Majek, NEWSS President, introduced the 1995-6 Executive Committee.

Tom Vrabel, President-Elect; Joe Neal, Vice President; Brian Olson, Secretary/Treasurer; Andy Senesac, Secretary/Treasurer-Elect; Wayne Wright, Past-President; Bob Sweet CAST Representative; Scott Glenn, Editor; Rich Bonanno, Legislative; Jeff Derr, Public Relations; Bill Curran, Research Coordinator; Dave Mayonado, Sustaining Membership; and Dave Vitolo, WSSA Representative.

XIII. Adjournment:

President Majek asked for a motion to adjourn. Prasanta Bhowmik moved that the annual meeting adjourn and Jack Dobson seconded the motion. The membership unanimously approved the motion to adjourn at 5:25 PM.

NEWSS financial statement for fiscal year 1994.
November 1, 1993 - October 31, 1994

INCOME:	
Sustaining membership	$3,500.00
Membership	$4,200.00
Registration	$9,430.78
Proceedings	$7,720.00
Awards	$600.00
Interest	$1,141.12
Coffee Break Support	$750.00
Weed Contest	$4,259.65
Other Income	$169.55
Subtotal	$31,771.10
EXPENSE:	
Administration	$1,695.83
Annual Meeting	$11,316.95
Proceedings	$3,748.95
NEWSS NEWS	$2,663.85
Awards	$985.95
Weed Contest	$4,569.43
Miscellaneous	$2,000.00
Subtotal	$26,980.96
Total Income/Expense (1994)	$4,790.14
Balance forwarded from NOW account (1993)	$26,956.58
Balance forwarded from savings certificate (1993)	$14,142.37
TOTAL NET WORTH	**$44,938.03**

October 31, 1994 Savings Certificatte Account (IDS Financial Services, Inc.	$14,623.59
October 31, 1994 Checking Account (National Bank of Geneva)	$32,580.52
Outstanding checks as of October 31, 1994	($2,266.08)
Total	$44,938.03

The NORTHEASTERN WEED SCIENCE SOCIETY checking account and savings certificate were reviewed by the undersigned and are in order.

D. Holley, Jan 4, 1994

Sidney Bennett Jr. Jan 4, 1995

Executive Committee Reports of the NORTHEASTERN WEED SCIENCE SOCIETY
Presented at the 49th Annual Business Meeting
Boston Marriott Copley Place, Boston, Massachusetts, January 4, 1995

President
Wayne Wright

The 49th annual meeting of the Northeastern Weed Science Society is nearly over. Early planning by the Executive and Program Committees concentrated on strengthening the program in several areas and providing sessions that would include subjects of interest to everyone. The program developed should prove to be one of our best. The Boston Marriott Copley Place is a good site for our meeting. The hotel and Back Bay area also offer excellent restaurants, shopping and numerous historical sites within easy walking distance.

The NEWSS and its members continue to be active in Society activities and involved with key weed science issues. It is this member willingness to serve and dedication that makes the NEWSS a dynamic society. Some of the areas of involvement promoted and directed by the Executive Committee in 1994 include: formal request and acceptance by the Past President's Committee to gather and assemble NEWSS historical records and serve as the temporary curator, Bob Sweet's continued development of NEWSS History, legislative committee members actively involved with EPA, FDA and USDA on critical weed science issues, continued educational and training outreach program through symposia with turf and ornamental and USGA trade associations and state vegetable extension programs, consensus with the North Central Weed Science Society Executive Staff that a joint meeting would be beneficial but not immediately feasible with dialogue to continue, ideas to recognize our 50th anniversary during the 1996 meeting and continued NEWSS and individual support of CAST. Further, the NEWSS continues to support other activities such as the Congressional Science Fellow program, Collegiate Weed contest, WSSA, CAST and the Washington delegation visit.

Expansion on some of the above is necessary to properly communicate value and appropriate recognition. Bob Sweet's effort on the NEWSS History is commendable. It will be complete for the 50th anniversary meeting. Rich Bonanno and Robin Bellinder have addressed critical legislative issues well. Rich has provided significant input and direction to EPA on vegetable grower needs and practices and direction for sensible risk analysis. Robin did an outstanding job of representing WSSA and NEWSS in an address to participants of an EPA/FDA/USDA Pesticide Use/Risk Reduction Workshop. Pesticide Reduction was the issue. She used good documentation to explain current use practices and need of herbicides which established a logical and defensible position for continued herbicide use. Many have questioned the value of the Congressional Science Fellow Program. Wright and Majek participated in the Washington Delegation of weed society presidents. In addition to helping select two new candidates a strong message received was that the Fellow Program is an excellent opportunity to provide scientific input to the political process in Congress. This program deserves continued NEWSS support. Also, Washington contacts are very supportive of CAST objectives and praise the quality of unbiased scientific publications. NEWSS and individual support is needed. To further commitments with the NCWSS and article inviting their members to our annual meeting was included in the Newsletter and programs were available at their registration desk. Ed Beste and his Collegiate Weed Contest committee of Henry Wilson, Ed Kee, Rick Beardmore, and Dave Mayonado plus many others are to be commended for the time and effort expended to make the contest an excellent learning experience for all contestants.

The Executive Committee and society members have accomplished much during 1994. As President, thanks to all for your help and council. It has been a truly rewarding experience.

President-Elect
Bradley A. Majek

The site for the 1996 meeting of the Northeastern Weed Science Society will be held January 2 to 5 at the Colonial Williamsburg Lodge and Convention Center. The city was chosen based on recent surveys of the membership conducted at the annual meeting and the outstanding attendance at the same site in 1987. Unlike the 1987 meeting, a meal plan will NOT be part of the arrangement at the hotel. Meals will be up to the individual to obtain. The hotel has agreed to sell coffee and donuts at breakfast and sandwiches at lunch in the registration area if the society requests the service. Rooms will be $70.00 per night, single or double occupancy. Parlor rooms for hospitality suites will be $120.00 per night. Audiovisual equipment will be complimentary. Members may provide their own beverages for consumption in hospitality suites.

Beverages served in public areas must be provided by the hotel according to local law.

Tom Vrabel

Vice President

The program for the 49th annual meeting of the Northeast Weed Science Society featured a general session, 3 symposia, a research poster session, and 8 individual paper sections addressing various issues affecting weed science. The General Session included remarks by Dr. Robert G. Helgeson, Dean, College of Food and Natural Resources, University of Massachusetts and the presidential address by Wayne G. Wright, DowElanco. Featured speaker Dr. Paul E. Waggoner, Distinguished Scientist, The Connecticut Agricultural Experiment Station, provided an overview and insight into how the earth's residents need to address future food production needs and keep a balance with the habitat needs of wildlife.

To better serve member interests and to continue the Society's outreach efforts to user groups of weed science products and technologies, symposia addressing key issues and problems were developed. These symposia topics included the role of herbicides in environmental management, interactions between wildlife and forestry vegetation management, and weed control in turf, landscape, and ornamental crops.

One hundred twenty-six papers were presented at the 1995 meeting. Their breakdown by section was:

Section	Chairperson	# 1995 Papers
Poster Session	W. Phillips, Univ. of MD	19
Agronomy	D. Glenn, Univ. of MD, D. Mayonado, Monsanto	23
Indust., Forest. & Conservation	M. McCormack, Univ. of ME, W. Sherksnas, DowElanco	27
Turfgrass & Plant Growth Regulators	R. Taylorson, Univ. of RI, D. Spak, AgrEvo	33
Ornamentals	D. Kunkel, IR-4, A. Senesac, Cornell Univ.	10
Vegetables & Fruit	D. Ganske, DuPont, R. Bellinder, Cornell Univ.	9
General Symposia		5
Total		126

Fifteen graduate students presented papers. Site selection for the 1997 meeting will be influenced by the participation at several of the special symposia conducted at the meeting. Tentative plans are to hold the 1997 meeting either in a New England city or at a city in the New York/Philadelphia area.

Secretary / Treasurer

Brian D. Olson

Attendance at the 1994 annual meeting in Baltimore was 335 compared to 315 the previous year in Baltimore because of the Thursday agronomy program that was a joint meeting the local agricultural chemical associations. Total membership for 1994 was 315.

In 1994, income exceeded expenses by $4,790.14. As of October 31, 1994 the net worth of the NEWSS was $44,938.03.

The layout for the 1994 Newsletters was conducted by Jeff Derr and assembled and mailed by the secretary/treasurer to the membership in April, August and November. Mailings regarding the 49th annual meeting were sent to former NEWSS members in August and November.

NEWSS Financial Statement

INCOME:	
Sustaining membership	$3,500.00
Membership	$4,200.00
Registration	$9,430.78
Proceedings	$7,720.00
Awards	$600.00
Interest	$1,141.12
Coffee Break Support	$750.00
Weed Contest	$4259.65
Other Income	$169.55
Subtotal	$31,771.10
EXPENSE:	
Administration	$1,695.83
Annual Meeting	$11,316.95
Proceedings	$3,748.95
NEWSS NEWS	$2,663.85
Awards	$985.95
Weed Contest	$4,569.43
Miscellaneous	$2,000.00
Subtotal	$26,980.96
Total Income/Expense (1993)	$4,790.14
Balance forwarded (NOW account (1993))	$26,956.58
Balance forwarded (Savings certificate (1993))	$14,142.37
TOTAL NET WORTH	$44,938.03

Past President

Ron Ritter

As Past-President and Chair of the Awards Committee, this past year has been a busy one in preparation for the Annual Meeting. Part of the

General Session on Tuesday morning encompasses the awards for Award of Merit and Distinguished Member Award. We have some outstanding individuals nominated and selected as recipients of these awards. Please congratulate these individuals when you have a chance for their contributions to the Society. Larry Kuhns and his committee have also selected a number of individuals worthy of recognition for the Innovator of the Year Award and the Applied Research Award. While it's only January, it's not too early to start thinking about nominations for next year's recipients!

During the Business Meeting on Wednesday, the Constitution of the NEWSS and the Manual of Operating Procedures (MOP) for the NEWSS will be available for distribution. Please pick up a copy of each. Many of you may be unfamiliar with the procedures and policies of the Society. The MOP in particular has been updated and contains all the necessary information you may need regarding the yearly operation of the NEWSS.

One new award we instigated this year is the Outstanding Photographer Award. Categories for color prints and color slides have been established. We hope to have all entries available for viewing during the poster session. I am sure that there are some excellent photographers within the Society. Please think about entering this contest next year. You have all year to get that perfect slide or color print ready for next year's contest!

I have certainly enjoyed serving the Society and look forward to meeting with many of you throughout the course of the meeting.

CAST

Robert Sweet

Within the past year CAST adopted a new long range strategic plan and goals. One of the major new components, i.e., to sponsor work done on important agricultural issues is being implemented January 23-25 in Washington, DC. CAST is sponsoring a national workshop on "Sustainable Agriculture and the 1995 Farm Bill". Of course the traditional farm groups and legislative committees will be well represented. However a significant additional component will be active participation by numerous groups we call "environmentalists". CAST hopes this meeting will lead to a better understanding amongst all groups. Also it should make legislators more aware of how their decisions impact economic sustainability as well as the quality of the environment.

CAST will continue its effort to provide legislators and the public with written materials on agriculture issues.

I encourage all members of NEWSS to become individual members of CAST. Our society pays about $1.35 per member. Your $30.00 individual membership really helps CAST carry on its efforts to provide legislators and the public with a better understanding of important agricultural issues.

Editor

Joseph C. Neal

Number of abstracts in the Proceedings of the 1995 meeting were up by about 15% over 1994, resulting in an increase in the page count from 218 in 1994 to 251 in 1995. This increase is reflected in a concomitantly similar increase in the publication cost.

Less than 20% of the abstracts were received before the published due date. The membership is encouraged to be more prompt in submitting abstracts and papers. Very few abstracts required format revision. Thanks to all the authors who formatted their abstracts and papers properly! Remember, if you are using a dot matrix printer, the output will not reproduce as well as a laser printed or typed manuscript. To improve the overall quality and appearance of the Proceedings, all authors are encouraged to provide the best quality, camera-ready copy that is feasible.

By the January board meeting, the cumulative index should be up to date for 1995, 1994, 1993, and 1992.

It has been suggested that we include in the supplement the individual and team winners in the collegiate weed science contest. I support this suggestion.

Legislative

A. Richard Bonanno

This past year, Dr. Robin Bellinder (NY) and Dr. Dan Kunkel (IR-4) served on the NEWSS Legislative Committee. Highlights of this past year's activities follow.

On February 2-3, 1994 EPA and USDA held a well-attended workshop in Washington, D.C. to address how to meet the Clinton Administration's goal of reducing pesticide use over the next few years. Both Rich Bonanno and Robin Bellinder attended. This "Pesticide Use/Risk Reduction Workshop" was the next step in the process of pesticide reform and was designed to solicit input from many groups on how best to accomplish two specific goals of the Clinton Administration.

To follow up on this continuing issue, WSSA President Alex Ogg has created a "Pesticide Use/Risk Reduction Response Team Committee". Robin Bellinder (Cornell) will chair this committee. Last year, Robin organized symposia at both the NEWSS and WSSA annual meetings which dealt with pesticide

reduction efforts in the U.S. and abroad. Rich Bonanno has also been appointed to this committee.

EPA/USDA held a second workshop in Washington in June to continue discussion on the Administration's plan to reduce pesticide use in the U.S. This workshop had limited discussion, however, and used a format of presentations by many individuals. Dr. Robin Bellinder, chair of the WSSA "Pesticide Use/Risk Reduction Response Team" committee was an invited speaker. Her comments centered on many issues that were raised by Weed Scientists at the February workshop.

Funding for IR-4 has been reduced in the new Federal budget. After receiving a sizable increase this year to $6.75 million, the Administration's budget called for an additional increase to $10.4 million next year. Congress however has decided to make 10% cuts in many programs and has recommended that the budget be reduced next year to $5.7 million. This will virtually eliminate funding for the Biorationals program and severely hurt the ornamentals program.

WSSA is reviewing its support of Congressional Science Fellows. A special committee was created to consider the possibility of a more active presence for WSSA in Washington. Rich Bonanno served on this committee. As an alternative to a Congressional Science Fellow, the committee was asked to consider the idea of hiring a liaison who would be in Washington full time to act as a conduit for putting legislative and executive branch staff in contact with WSSA and/or other weed science groups and vice versa.

On July 27, the House Agriculture Subcommittee on Department Operations and Nutrition approved H.R. 1627, the Food Quality Protection Act of 1993, by Congressman Lehman (D-CA), a bill to reform and update the nation's pesticide and related food safety laws. The legislation, as approved by the subcommittee would revise both FIFRA and FFDCA. The intent of the bill is to improve EPA's current registration timeliness; promote IPM research; expedite registration of reduced risk and minor use pesticides; replace the Delaney Clause with a single science-based negligible risk standard which takes into account health, nutrition, and consumer benefits; and allow states to regulate the sale or use of pesticides, while prohibiting local governments from doing the same (i.e. local preemption).

H.R. 967, the Minor Crop Protection Act, passed the House but did not pass the Senate. Unofficially, it was learned that Senators Kennedy and Leahy, blocked the bill from reaching the floor. The Minor Crop Farmer Alliance hopes to have the bill considered early in the next Congress.

Worker Protection regulations are still on target for taking effect on January 1, 1995. In response to a petition submitted by NASDA this summer, EPA will likely propose changes to the regulations for crop consultants and irrigation workers.

In a September 1994 Progress Report, Tobi Colvin-Snyder, chair of EPA's Product Performance Guidelines Work-group, announced that drafts of the first two sections of the proposed guidelines are complete and would be distributed shortly. The sections that have been completed are the introduction and guidelines for tests of crop uses. The third section will be guidelines for tests of non-crop uses.

As you are likely already aware, Secretary of Agriculture Mike Espy will resign effective December 31, 1994. He said that investigations into his ethics are too distracting to his work in USDA. He considered his greatest accomplishment, however, to be the final approval for the reorganization and down-sizing of USDA.

In an update on the Pesticide Use/Risk Reduction Initiative ("Initiative") issued in August 1994, EPA, USDA, and FDA stated that the federal government is committed to work with all affected interests (including commodity organizations and public interest groups) to form a partnership and develop a plan which reduces the risk posed by pesticides while maintaining cost-effective pest control methods. The Office of Pesticide Programs (OPP) coordinates EPA efforts with this Initiative. The lead for the Initiative within OPP will be phased in to OPP's new pilot division, Biopesticides and Pollution Prevention Division. Although no specific information is yet available, highlights of the Initiative involve: 1) both agricultural and non-agricultural uses of pesticides; 2) two early focal points: the development of commodity-specific use/risk reduction goals by October 1994 and the enrollment of 75% of agricultural acreage in IPM programs by the year 2000; 3) The reduction of risk associated with the use of high risk pesticides; and 4) reductions in dietary risks posed to infants and children, risks to humans associated through other exposure pathways such as occupational exposure, and risks to environmental and ecological resources.

The 75% IPM adoption mentioned in the Use/Risk Reduction Initiative will be spearheaded by USDA. USDA is currently drafting a document that will detail how this adoption will be accomplished. One point of interest is that USDA estimates that approximately 50% of the minor crop acreage is currently using IPM strategies. It also appears that in the major crops where herbicides account for the most use, IPM strategies will include greater use of postemergence herbicides and significantly more herbicide banding.

Public Relations

Jeff Derr

Three issues (April, August, and November 1994) of the NEWSS newsletter were assembled. Information on the 1994 NEWSS meeting in Baltimore, along with photographs of the 1994 Executive Committee, the award winners, symposium speakers, past presidents, and the passing of the gavel, were included in the April 1994 newsletter. The photos were taken by Grant Jordan. The August issue contained information on accommodations, call for papers, and an advance program for the 1995 annual meeting in Boston. The August issue also contained information on the 1994 NEWSS student competition that was held in Salisbury, including pictures of the winners. Photographs at the contest were taken by Tom Watschke and Jeff Derr. The November issue contained additional information on the upcoming meeting in Boston, along with biographical sketches of the candidates for NEWSS offices.

For the 1995 meeting in Boston, information on the program was sent to approximately 50 organizations and trade magazines. The release advertised the upcoming meeting and provided a contact person for additional information. Information on the special turf and ornamentals symposium was sent to approximately 15 organizations in New England. Information on the 1995 meeting was also submitted to the WSSA, SWSS, and NCWSS newsletters. Photographs of the NEWSS Executive Committee and the winners of the student contest were submitted to the WSSA newsletter. Photographs from the 1994 meeting were sent to Bob Sweet for the archives.

Research Coordinator

Larry J. Kuhns

The research coordinator worked in the following areas in 1994:

1. Completed all the requirements of the twelve states in the northeast that authorized credits for the 1994 annual meeting, insuring that all qualified attendees who completed the necessary paperwork received pesticide recertification credits for attending the meeting. Completed the paperwork necessary to obtain authorization from the twelve states to offer recertification credits for the 1995 annual meeting.

2. Coordinated the scheduling of the weed science field days in the northeast.

3. Solicited reports from the chemical companies regarding new chemistry or name changes, and worked with the editor in updating the herbicide indices for the program and the proceedings.

4. Solicited nominees for the Innovator of the Year and Applied Research Awards. Prepared the statements for the awards brochure.

5. Conducted a survey of weed science graduate students recently graduated or currently in programs in state universities in the United States.

Sustaining Membership

Mark P. Whalen

Sustaining Membership in the society have increased for the third year in a row. In 1994, thirty-five companies were members. The 1995 effort has yielded thirty-five committed companies on the sustaining member list. Six companies also contributed to the coffee breaks that occur during the meeting. Along with membership solicitation, position announcements have been collected and made available to the society during the program. These announcements will be forwarded to the WSSA display at the national meeting.

WSSA Representative

David Vitolo

The 35th annual meeting of WSSA will be held January 31 - February 3, 1995 at the Sheraton Hotel in Seattle, WA. The 36th Annual Meeting will held February 6-9, 1996 at the Marriott and Omni Hotels in Norfolk, VA. Orlando, FL will be the site of the 197 meeting.

A major challenge faced by WSSA is making sure our input is heard in Washington by the legislative and executive branches of government. To this end WSSA continues to support Congressional Science Fellows, with the support of NEWSS and other regional and national societies. Philip Schwap and Brad Inman have been named for 1994-1995. The Presidents Delegation visited Washington on May 18-19, 194. Delegations visited BLM, USDA/ARS, USDA/IPM and staff members of the Senate Ag Committee. WSSA is considering funding a Washington liaison, either full- or part-time staff in contact with WSSA. A five minute video to educate congressional staffers on the effects of weeds has been proposed, and prototype funding has been granted.

The 7th Edition of the "Herbicide Handbook" is scheduled for December, 1994.

Action was taken on many subjects requiring input or position on behalf of the NEWSS. In order for our society to maintain it's voice in the WSSA, NEWSS representation on WSSA committees is essential. Members, please volunteer.