ANNUAL RYEGRASS CONTROL IN NO-TILL CORN

H. Menbere and R. L. Ritter*

ABSTRACT

Control of annual ryegrass (Lolium multiflorum Lam.) in no-till corn (Zea mays L. 'Pioneer 3394') was studied in 1993 at the Poplar Hill Research Farm located in Quantico, MD. Soil type was a silt loam with 1.8% organic matter and a pH of 5.8. Corn was planted on April 29, 1993 into a natural stand of annual ryegrass with a John Deere 7000 planter set for 30 in rows. Individual plots were 10 ft by 25 ft. Treatments were replicated three times. Herbicide applications were made with a CO2 pressurized backpack sprayer that delivered 18 gpa at 20 psi. Ryegrass control was evaluated visually on a scale of 0 to 100, with 0 equaling no control and 100 equaling total plant dessication. Corn yields, obtained from the two center rows of each plot, were obtained with a standard field combine.

Gramoxone Extra (paraquat) was evaluated at 0.47, 0.625, and 0.94 lb ai/A in combination with Bicep (metolachlor plus atrazine) and applied at planting. While initial ryegrass control was good [80% at 2 weeks after treatment (WAT)], control dropped to 18% or less at 8 WAT with all combinations. Roundup (glyphosate) was evaluated at 0.5, 0.75, 1.0, 1.5, and 2.0 lb ai/A in combination with Bicep and applied at planting. The 0.5 and 0.75 lb ai/A rates of Roundup provided poor ryegrass control (< 60%) at 2 WAT, and by 8 WAT, averaged < 25% control. The higher rates of Roundup provided fair control (> 70%) at 2 WAT, and by 8 WAT, the 1.0, 1.5, and 2.0 lb ai/A rates averaged 63, 80, and 93% control, respectively. Ignite (glufosinate) was evaluated at 0.5, 0.75, 1.0, and 1.5 lb ai/A in combination with Bicep and applied at planting. All combinations provided < 20% control 8 WAT. Beacon (primisulfuron-methyl) and Accent (nicosulfuron) in combination with X-77 (nonionic surfactant) at 0.25% v/v, were evaluated postemergence. Ryegrass averaged 8 to 10 in tall at application. At 4 WAT, ryegrass control with Beacon averaged 30 and 77% with 0.018 and 0.036 lb ai/A, respectively. At 4 WAT, ryegrass control with Accent at 0.016 and 0.031 lb ai/A averaged 90 and 95% control, respectively.

In conclusion, ryegrass control with Gramoxone Extra was poor with all rates tested. Roundup, at 1.5 or 2.0 lb ai/A, provided good control (> 80%) when evaluated 8 WAT. All rates of Ignite provided poor ryegrass control. Beacon applied postemergence at 0.036 provided fair control (> 70%) 4 WAT, while Accent applied postemergence at 0.018 or 0.036 lb ai/A provided good to excellent control (> 90%) 4 WAT.

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

CGA-152005 COMBINATIONS FOR THE CONTROL OF TRIAZINE RESISTANT BROADLEAF WEEDS IN CORN

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

ABSTRACT

CGA-152005 was evaluated as a postemergence herbicide for corn (Zea mays L.) in replicated field trials at locations in Maryland, New York, Ohio, and Pennsylvania from 1990-1993. Weeds present were triazine resistant biotypes of velvetleaf (Abutilon theophrasti Medik.), redroot pigweed (Amaranthus retroflexus L.), and common lambsquarters (Chenopodium album L.). In all cases, CGA-152005 was applied with either a non-ionic surfactant or crop oil concentrate.

CGA-152005 applied at 0.009-0.036 LB AI/A provided excellent control of redroot pigweed, velvetleaf, and lambsquarters which were three inches or less in height. However, complete control of larger weeds was not obtained, especially at rates of 0.009-0.018 LB AI/A. CGA-152005 applied in drought situations was less effective than when moisture conditions were more ideal.

Both the initial and late season control of larger weeds was improved significantly where low rates of CGA-152005 (0.009-0.018 LB AI/A) were combined with dicamba (0.07-0.125 LB AI/A) or 2,4-D (0.125-0.25 LB AI/A) were applied. Control of nine inch lambsquarters was excellent with the tank mixtures. These combinations also provided excellent control under drought conditions. In all cases, weed control with the combinations was equal or superior to CGA-152005 applied alone at the full label rate of 0.036 LB AI/A. Crop selectivity was excellent for all treatments.

CGA-152005 is an effective new postemergence compound for the control of a wide range of broadleaf weeds in corn and offers an alternative to those herbicides currently available. Combinations with dicamba or 2,4-D offer an opportunity to effectively control larger weeds and improve efficacy when applications are made under adverse weather conditions.

[1] *Field Research Representatives, Registration Specialist, and Regional Manager, respectively, Ciba Plant Protection, Washington,PA 15301*

DEVELOPMENT OF PREDICTIVE MODELS FOR WEED INFESTATION

Sister Jeanne-Yolaine Mallet and Richard A. Ashley[1]

ABSTRACT

A multiple regression analysis was run to predict future infestation of weed species in corn fields in Connecticut. *Chenopodium album (L.)*, common lambsquarters and *Digitaria* species, crabgrass results are presented. Three different procedures were selected and their results compared:

The best R^2 analysis.
Stepwise regression procedure.
Backward elimination procedure.

In most cases, best R^2 analysis and backward elimination procedure were either identical or similar while stepwise regression procedure often differed from the two other methods. This was the case for the two species mentioned.

Significant factors for common lambsquarters were pH, Ca, Mg, K, NO_3 and seed count. Factors for crabgrass species were Ca, Mg, P, K and seed count.

[1]Professor of Horticulture; Department of Plant Science, University of Connecticut, Storrs, CT

Dodder Control With MON-13211 in Cranberry and Alfalfa[1]

R.M. Devlin[2], P.C. Bhowmik[3], S.J. Karczmarczyk[4], and I.I. Zbiec[4]

Abstract

Greenhouse studies on dodder control in cranberry and alfalfa were conducted with the experimental herbicide MON-13211 [methyl-2-difluoromethyl-4-isobutyl-5-(4,5-dihydro-2-thiazolyl)-6-trifluromethyl-3-pyridinecarboxylate]. The data collected indicate that MON-13211 could be used as a selective postemergence control of dodder in cranberry and alfalfa. MON-13211 inhibited twining and caused dodder stem tops to swell and produce small amounts of chlorophyll. Growth of dodder was almost totally inhibited. The rates of MON-13211 used were 0.56, 1.13, 2.25, and 3.38 kg/ha, with good control being observed even at the lowest rate of application.

Introduction

Dodder (Cuscuta campestris Yunck.) is an obligate stem and leaf parasite of numerous broadleaf plants. It is particularly destructive to cranberry (Vaccinium macrocarpon) culture in southeastern Massachusetts and to alfalfa (Medicago sativa) seed farming on the west coast. Preemergence herbicides have been found that selectively control dodder in both crops. However, preemergence control is almost always inadequate because it requires that herbicides be applied where dodder is anticipated, not where it actually is. What is needed is a selective postemergence control. Greenhouse studies with the experimental herbicide MON-13211 indicate that a selective postemergence control of dodder in the afore mentioned crops is possible.

Methods and Materials

To enhance dodder germination one g samples of a 50/50 mixture of dodder and alfalfa seeds were gently ground in sand for one minute using a mortar and pestle. Each sample contained ap-

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

3/ Prof., Dept. of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

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

proximately 200 dodder seeds. The scarified seeds were spread on the surface (64 cm^2) of potting soil contained in styrofoam pots (one sample per pot) and lightly covered with soil.

For studying the postemergence control of dodder on cranberry, cuttings of cranberry vines were planted in pots (177 cm^2 surface area) containing a 50/50 mixture of sand and peat. After the cranberry plants were well established, scarified dodder seeds (1.5 g samples) were added to the pots.

All experiments were done in the greenhouse. No special control of physical conditions was attempted, but all comparable treatments were made simultaneously and so were subjected to the same fluctuations of the greenhouse environment. Applications of MON-13211 at 1.12, 2.24, and 3.38 kg/ha were made 42 days after dodder germination. MON-13211 applications were made with 5 ml of water for alfalfa studies and 10 ml of water for cranberry studies and with the aid of a small atomizer at a pressure of about 70 kPa. Fresh weight and dry weight were recorded 21 days after treatment.

For pigment experiments mature dodder on a cranberry bog was treated with different rates of MON-13211. After 21 days dodder stem tips were harvested for pigment analysis. The tips were analyzed for chlorophyll and carotenoid content according to the methods of Devlin et al. (2). The amount of chlorophyll present, in ug of chlorophyll per g of fresh tissue extracted, was calculated according to the equations of Arnon et al. (1). The amount of carotenoid pigments present, in ug of carotenoids per g of fresh tissue extracted, was calculated according to the equation of Schnarrenberger and Mohr (3).

Postemergence control of dodder at an early stage of growth on cranberry was also studies. The procedures described above were followed except dodder was treated 14 days after germination and percent control was evaluated 14 and 21 days after treatment. All experiments were replicated four times and the data were subjected to analysis of variance.

Results and Discussion

In all treatments application of dodder inhibited twining and caused dodder stem tips to swell and produce small amounts of chlorophyll. Growth of dodder was almost totally inhibited.

When applied to dodder at an early stage of growth, almost complete control was demonstrated by 0.56 kg/ha MON-13211. For example, 0.56 kg/ha applied to 14 day old dodder attached to cranberry vines showed 63.8 % control after 14 days and 97.5% control after 21 days (Table 1). Higher rates of MON-13211 (1.12 & 2.24 kg/ha) gave 100% control of early dodder growth when evaluated 21 days after treatment (Table 1). Good tolerance by cranberry was observed for all rates of MON-13211 applied.

Table 1. Effect of MON-13211 on dodder control in cranberry. Dodder was 14 days old when treated. Evaluations were made 14 and 21 days after treatment.

MON-13211 (kg/ha)	14 days	21 days
0.28	47.5 a*	88.8 a*
0.56	63.8 b	97.5 b
1.12	75.0 c	100.0 b
2.24	77.5 c	100.0 b

* Means followed by the same letter are not significantly different at the 1% level.

Application of MON-13211 to mature dodder (42 days old) growing on cranberry vines completely inhibited the growth of dodder stems and stem twining. Data collected 21 days after treatment showed a dramatic drop in dodder fresh weight and dry weight. For example, MON-13211 at 1.12 kg/ha caused a 68% drop in dodder fresh weight and a 45% drop in dry weight (Figure 1). Aside from the reddening of some leaves at the higher rates of MON-13211 applied, the cranberry vines were tolerant of the herbicide.

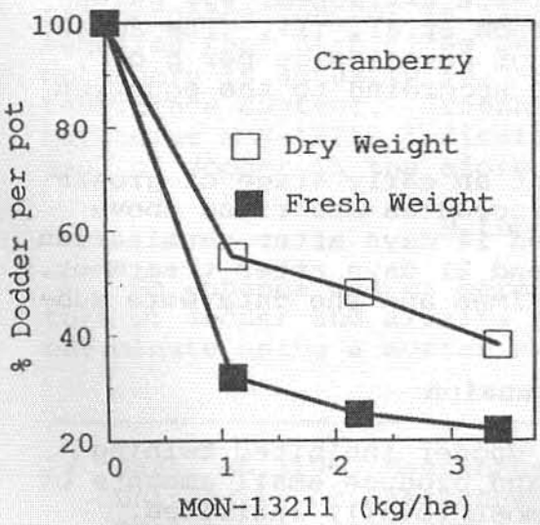

Figure 1. Effect of MON-13211 on the control of mature dodder in cranberry. The fresh and dry weights of dodder were recorded 21 days after treatment.

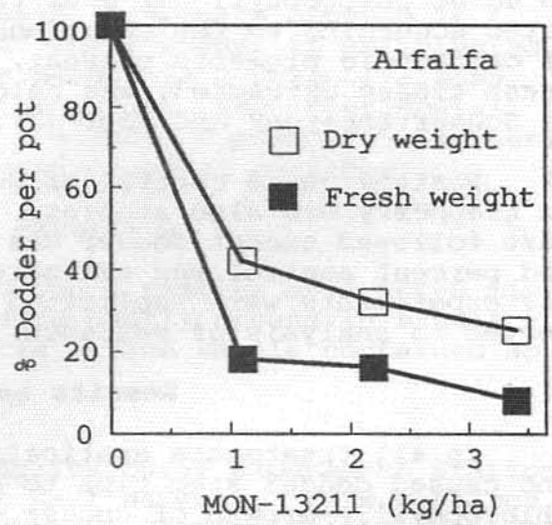

Figure 2. Effect of MON-13211 on the control of mature dodder in alfalfa. The fresh and dry weights of dodder were recorded 21 days after treatment.

Similar results were obtained with mature dodder growing on alfalfa. Application of MON-13211 at 1.12 kg/ha caused an 82% drop in dodder fresh weight and a 58% drop in dry weight when recorded 21 days after treatment (Figure 2). Good tolerance to MON-13211 was exhibited by alfalfa.

Pigment synthesis in dodder stem tips was stimulated by MON-13211. Stem tips of dodder treated with 1.12, 2.24, and 3.38 kg/ha MON-13211 showed percent increases in total chlorophyll of 670, 723, and 752, respectively (Figure 3, Table 2). With the same rates the percent increases in carotenoid content were 482, 484, and 506, respectively (Table 2). Note in Figure 3 that more chlorophyll b was produced than chlorophyll a. This is an unusual circumstance since plants generally produce much more chlorophyll a than chlorophyll b.

Figure 3. Effect of MON-13211 on the chlorophyll content in dodder strm tips. T Chl = total chlorophyll.

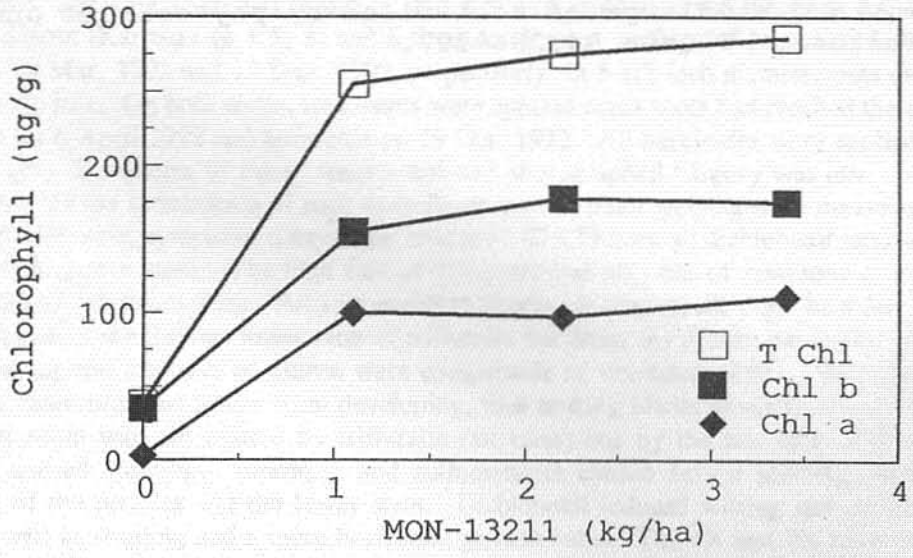

Table 2. Effect of MON-13211 on pigment development in dodder stem tips. TChl = total chlorophyll; Car = carotenoids.

MON-13211 (kg/ha)	Chl a (ug/g)	Chl b (ug/g)	TChl (ug/g)	Car (ug/g)
0.00	2.9	35.1	38.0	298.1
1.12	100.0	154.8	254.7	1437.5
2.24	97.4	177.4	274.6	1442.2
3.38	111.1	174.9	285.9	1507.2
LSD 5%	14.7	24.7	21.0	105.9
1%	20.6	34.6	29.4	148.4

Although the experiments discussed in this study were conducted primarily in a greenhouse, the data collected suggest that MON-13211 could be used as a postemergence control of dodder on cranberry and alfalfa. This is especially true if the dodder is treated at an early stage of growth.

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HERBICIDE CONTAMINANT INJURY SYMPTOMS ON GREENHOUSE-GROWN POINSETTIA AND GERANIUM

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

ABSTRACT

Herbicide contaminants are an ever-present possibility in commercial greenhouse crop production. Contamination may result from vapor or spray drift from herbicides used within or near greenhouses, or from the use of contaminated potting media components, fungicides, fertilizers, water, etc. When herbicide contamination is suspected, diagnosticians are often unable to make an accurate diagnosis as the relative safety and symptoms of injury from common herbicides on greenhouse crops are largely unknown. Therefore, this study was conducted to document the injury symptoms from common herbicides and the doses required to induce those symptoms in two major greenhouse crops.

Poinsettia var. "Red Hagg" and geranium var. 'Red Satisfaction' were treated with 1/2X, 1X and 2X field use-rates of several herbicides labeled for non-crop and nursery crop weed control. Herbicides and rates of application were dichlobenil (Casoron) @ 3, 6, and 12 lb ai/A, trifluralin (Treflan) @ 2, 4, and 8 lb ai/A, imazapyr (Arsenal) @ 0.5, 1, and 2 lb ai/A, sulfometuron (Oust) @ 53, 106, and 212 oz ai/A, and diuron (Karmex) @ 1.5, 3, and 6 lb ai/A. Rooted cuttings of geranium and poinsettia were planted on 20 Mar. 1992 and 15 Sept. 1992, respectively, in 5 1/2 inch diameter pots using a peat moss + vermiculite mix. On both crops, treatments were applied when roots had reached the edge of the pot - - geranium on 6 April 1992 and poinsettia on 29 Oct. 1992. All herbicides were applied as drenches in 60 ml per pot. Symptoms of injury were noted and photographed. Injury was also visually estimated periodically. At the termination of each test, above-ground plant weights were measured.

On poinsettia, symptoms 8 days after treatment (DAT) from all dichlobenil rates were wilting and swelling of the upper stem. The high rate of trifluralin and all rates of imazapyr caused stunting and black streaks on the lower stem. All sulfometuron treatments caused wilting. At 8 DAT there were no injury symptoms from the two lower rates of trifluralin nor from any diuron treatment. By 25 DAT only plants receiving the low rate of diuron were comparable to untreated plants. Trifluralin, even at the lowest rate, prevented red bracts from developing, thus making plants unmarketable.

Geranium was not injured by trifluralin (all rates) nor by the low rate of diuron. All other treatments caused stunting. Imazapyr and sulfometuron caused severe stunting, and chlorosis and blackening of the petioles and the lower stem. Dichlobenil induced wilting and chlorosis of the new growth as well as stunting and a more horizontal growth habit. The 1X and 2X rates of diuron caused severe leaf spotting.

In summary, although both plant species exhibited surprisingly high tolerance of herbicides in the potting mix, the injury symptoms observed on poinsettia, especially the absence of fully developed bracts, from most treatments, would make these plants unmarketable. Geranium plants showed even higher tolerance of herbicides in the potting mix and a total absence of injury from trifluralin, even at 2X rates. Where injury occurred, plants lacked the "characteristic" injury symptoms generally associated with the herbicides tested.

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[1]Technician and Extension Weed Scientist, Long Island Hort. Res. Lab., Riverhead, NY 11901, and Assoc. Prof., Dept. Flor. & Orn. Hort., Cornell Univ., Ithaca, NY 14853, respectively.

LEAF COVER MEASUREMENTS FOR VELVETLEAF THRESHOLDS IN FIELD CORN

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

ABSTRACT

Field experiments were conducted from 1991 through 1993 to determine the effect of velvetleaf (Abutilon theophrasti Medik.) density on field corn (Zea mays L.) grain and silage yields and to determine the feasibility of using relative leaf cover as a predictor of corn yield loss due to velvetleaf. Velvetleaf densities of 0, 1, 2, 4, 8, and 16/m^2 were established and maintained by handweeding 10- by 30-ft plots arranged in a randomized complete block design with four replications. Metolachlor at 2 lb ai/A was applied preemergence to control other weeds. Relative area occupied by velvetleaf and corn canopies was determined using an optical point frame. Corn grain and silage yields were determined by hand harvesting 27 ft of the center two rows in each plot. Analysis of variance and regression were used to examine the relationship between leaf cover and corn grain and silage yields.

In 1991, corn yields decreased with increasing velvetleaf density. With no velvetleaf, grain and silage yields were 161 bu/A and 21.3 T/A respectively. Grain yields were reduced 15, 30, 33, and 48% and silage yields were reduced 15, 29, 35, and 47% with velvetleaf densities of 2, 4, 8, and 16/m^2 respectively. When velvetleaf was in the cotyledon to two-leaf stage and corn was in the two- to three-leaf stage velvetleaf cover explained 71% of the variability in silage yields while the ratio of velvetleaf to corn cover only explained 33% of the variability. When velvetleaf had two to four leaves and corn was in the four- to five-leaf stage, velvetleaf cover and the ratio of velvetleaf to corn cover had r^2 values of 58 and 71 respectively when regressed against silage yields. Regression results were similar for subsequent cover readings and the trends were similar for grain and stover yields.

Results from 1991 support the theory that relative leaf cover acts as a predictor of corn yield and that the economic threshold for velvetleaf in corn might be less than two velvetleaf/m^2. Consequently, a velvetleaf density of one/m^2 was added to experiments conducted in 1992 and 1993. With above normal precipitation in 1992, corn yields did not decrease with increasing velvetleaf density. In 1993, only the 16 velvetleaf/m^2 density reduced corn grain and silage yields compared with the handweeded treatment. With little or no corn yield response to increasing velvetleaf density, leaf cover parameters were of limited value in explaining yield variability in 1992 and 1993. Variability among years suggests that additional research would be needed to determine the value of leaf cover readings and to establish economic thresholds for velvetleaf in corn.

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[1]Assoc. Prof., Dept. of Soil, Crop and Atmospheric Sci., Cornell Univ., Ithaca, NY 14853; Coop. Ext. Agent, Lewis Co., Lowville, NY 13367; and Asst. Prof. Dept. of Soil, Crop and Atmospheric Sci., Cornell Univ., Ithaca, NY 14853

Mow-Kill Regulation of Winter Cereals Grown for Spring No-Till Crop Production

E.D. Wilkins and R.R. Bellinder[1]

Field studies were conducted to determine the influence of developmental stage on mow-killing winter wheat and grain rye. Both crops were drill-seeded in September of 1991 and 1992. In the spring, a sickle bar mower was used to cut plants 10 cm above the soil surface at 2 week intervals, beginning in early May and continuing through June. Biomass was collected and dried at mowing, and at 4 and 8 wk after mowing. Wheat was clipped at four stages in 1992: first node, second node, 75% heading, and milky kernal. In 1993, mowing was done at first node, last leaf, boot, and watery ripe kernal. Wheat biomass, when mowed at first node, was 4450 and 2020 kg ha^{-1} in 1992 and 1993, respectively. When cut at this stage, primary tiller apices were below 10 cm, and subsequent regrowth was vigorous. Mulch biomass harvested 8 wk later exceeded that collected at mowing. Mowing plants prior to 75% heading consistantly yielded over 1000 kg ha^{-1} regrowth 8 wk later. Wheat cut after flowering had biomass of 15480 and 9280 kg ha^{-1} in 1992 and 1993 respectively, but less than 30 kg ha^{-1} total regrowth. Rye was mowed at three stages in 1992 (first node, boot, and 100% heading) and four stages in 1993 (second node, boot, 100% heading, and watery ripe kernal). First mowing produced 4530 and 2140 kg ha^{-1} biomass in 1992 and 1993. When clipped before boot, more than 50% of the total rye biomass was due to regrowth. This growth was from primary tiller elongation. Rye mowed at boot yielded 6920 and 7840 kg ha^{-1}, in 1992 and 1993 respectively, and regrowth measured 910 and 1130 kg ha^{-1} 8 wk later. Mowing after flowering resulted in no measurable regrowth. Rye was less tolerant of mowing than wheat, as tillers of higher order were less vigorous in rye. Soil temperatures were affected most by biomass at mowing rather than regrowth. Earliest mowings in both wheat and rye reduced soil temperatures 3.5^{o} C compared to bareground temperatures, while latest mowings lowered temperatures 6.0^{o} C. Photosynthetically active radiation (PAR) was measured 8 weeks after mowing at solar noon 10 cm above the soil surface. Regrowth biomass was significantly correlated to PAR intercepted (r^2=-0.85). First node mowings transmitted between 30% and 40% PAR, while latest mowings transmitted more than 90%. Although late-killed mulches produced large amounts of biomass and had minimial effect on light interception, the late mowing date may limit the types of crops grown in mow-killed mulches.

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[1]Grad. Res. Asst., and Assoc. Prof. Dept. Fruit and Veg. Science. Plant Sci. Bldg. Cornell Univ., Ithaca, NY 14853-0327.

NEWEEDS 2.0: A COMPUTER-ASSISTED WEED IDENTIFICATION SYSTEM FOR THE NEWSS REGION

R.H. Callihan, R.T. Dobbins, and S.L. Carson[1]

ABSTRACT

An expert system for computer-assisted weed identification was prepared for diagnostic work, extension and classroom teaching in the NEWSS region. The system consists of a floppy disk, that uses less than 400 k of RAM and disk space, with a user's manual that includes simple instructions, a short tutorial, a species list, and illustrations of each plant characteristic in the data base. This IBM-compatible system aids the non-botanist to quickly identify every weed species depicted in the ten most-used illustrated weed identification guides in the NEWSS region (1,2,4,6,8,10,11,13,14,15), 780 species in all. To aid the user in verifying identifications, the page numbers where each species is found are listed for each of those illustrated guide books, as well as in the five floras most widely used by extension in the region (3,5,7,9,12). The data base includes a compilation of the most readily observable plant recognition characteristics as well as technical characteristics for the specialist. Unlike dichotomous keys that force a rigid sequence of decisions, the program employs independent, random-access, user-selectable menus. This allows the user to describe a specimen based on characteristics that are observable by a novice and that are illustrated in the manual. A weed is identified to species with a very few characteristics, and validated by comparing the specimen with illustrations in weed identification guides or floras. The average user can learn to use this system in a half-hour. This software, reviewed by one or more specialists in each state within the NEWSS region, is currently used in university classroom teaching and extension programs for teaching weed recognition principles, and for handling routine weed identifications.

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[1]Prof. of Agron., Programmer/Analyst, and Lab. Aide, Dept. of Plant, Soil and Ent. Sci., Univ. of Idaho, Moscow, ID 83843.

Plant Growth and Safening Studies With MON-12000[1]

R.M. Devlin[2], P.C. Bhowmik[3], S.J. Karczmarczyk[4], and I.I. Zbiec[4]

Abstract

The herbicidal effect of MON-12051 (50% WP formulation of MON-12000) on the growth of wheat, corn, radish, and pea was studied. Wheat, and to a less extent corn, were relatively tolerant of MON-12051. Radish and pea were very sensitive to the herbicide. For example, application of 10 nM MON-12051 significantly reduced shoot and root growth of radish and pea. The safeners dichlormid and MON-13900 were tested for their ability to protect corn from the herbicidal activity of MON-12051. Both safeners gave only partial protection.

Introduction

The experimental compound MON-12000 [methyl-3-chloro-5-(4,6-dimethoxypyrimidin-2-ylcarbamoylsulfamoyl)-1-methylpyrazole-4-carboxylate] is a new sulfonylurea herbicide that has shown preemergence and postemergence broad spectrum weed control in corn, sugarcane, and turfgrass (1,2,3,4).

In the present study the effect of MON-12051 on the growth of corn (*Zea mays* L.), wheat (*Triticum aestivum* L.), radish (*Raphanus sativus* L.), and pea (*Pisum sativum* L.) was determined. Also the safening influence of dichlormid (2,2-dichloro-*N*,*N*-di-2-propenylacetamide) and MON-13999 [3-dichloroacetyl-5-(2-furanyl)-2,2-dimethyl-oxazolidine] against the herbicidal activity of MON-12051 in corn was studied.

Methods and Materials

Growth studies. The seeds were soaked for 6 h in different concentrations of MON-12051 (50% WP). The treated seeds were sown in 8-cm diameter styrofoam pots (15 seeds per pot) containing moist vermiculite. The bottom of the pots were punctured several times to allow good drainage and the seeds were covered with moist vermiculite to a depth of about one cm. Petri dish halves were used as holders for the pots to catch drainage and as an indirect method of providing water and nutrients. The plants were grown in a growth chamber under constant conditions of light

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2/ Prof., Cranberry Experiment Staiton, Univ. of Massachusetts, East Wareham, MA 02538.

3/ Assoc. Prof., Dept. of Plant and Soil Sciences, Univ. of Massachusetts, Amherst, MA 01003.

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

(152 uE $m^{-2}s^{-1}$, 16 h light, 8 h dark) and temperature (22 ± 1°C). After shoot emergence 40 ml of 1/2 strength Hoagland solution were applied daily to each pot. After 10 days (wheat), 12 days (pea), 14 days (corn), and 20 days (radish) the seedlings were removed from the pots and the roots thoroughly washed. The ten largest seedlings (determined by shoot length) from each pot were selected and their shoot and root length and dry weight determined.

Safening studies. For safening experiments corn seeds were soaked for 6 h in a 1.5 mM solution of either dichlormid or MON-13999. The treated seeds were sown in 8-cm stryofoam pots containing moist vermiculite that had previously been treated on the surface with 10 ml of herbicide solution. The seeds were covered with untreated moist vermiculite to a depth of about one cm. The seeds were germinated and grown as described in the growth studies. After 14 days the seedlings were removed from the pots and the roots thoroughly washed. The ten largest seedlings (determined by shoot length) from each pot were selected and their shoot and root length and dry weight determined. All experiments were replicated four times and all data were subjected to analysis of variance.

Results and Discussion

Growth studies. Although both wheat and corn were relatively tolerant of MON-12051, wheat was much more so than corn. For example, application of 1 mM MON-12051 caused a 10% reduction in wheat shoot length and a 1% reduction in shoot dry weight (Table 1). The same rate of MON-12051 caused a 51% reduction in corn shoot length and a 36% reduction in shoot dry weight (Table 2).

Table 1. Effect of MON-12051 on the growth of wheat.

MON-12051 (mM)	SHOOT Length (mm)	SHOOT Dry Wgt (mg/pl)	ROOT Length (mm)	ROOT Dry Wgt (mg/pl)
0	197	15.0	116	9.3
0.1	196	16.3	120	10.0
0.5	184	14.3	95	8.5
1.0	177	14.8	90	8.5
5.0	143	12.5	78	7.3
10.0	119	10.0	65	6.5
LSD 5%	8.9	1.51	10.7	1.04
1%	12.1	2.05	14.6	1.42

Root growth also reflected the difference in tolerance to MON-12051 between wheat and corn. At 1 mM MON-12051 wheat root length and dry weight were reduced 22 and 9%, respectively (Table 1). In contrast, corn had a 40% reduction in root lenght and a 55% reduction in root dry weight (Table 2).

Table 2. Effect of MON-12051 on the growth of corn.

MON-12051 (uM)	SHOOT Length (mm)	SHOOT Dry Wgt (mg/pl)	ROOT Length (mm)	ROOT Dry Wgt (mg/pl)
0	181	53.5	216	53.3
20	175	54.8	200	52.5
50	170	55.3	202	46.5
100	155	52.8	183	37.5
500	123	43.3	161	29.0
1000	88	34.0	129	23.8
LSD 5%	8.8	4.23	16.2	3.72
1%	11.9	5.73	22.0	5.04

Both radish and pea were very sensitive to MON-12051. Radish treated with 10 nM MON-12051 had a 21% reduction in shoot length and a 29% reduction in shoot dry weight. Root reductions in length and dry weight were 15 and 17%, respectively (Table 3). Note that radish was several orders of magnitude more sensitive to MON-12051 than wheat (Table 1,3).

Table 3. Effect of MON-12051 on the growth of radish.

MON-12051 (nM)	SHOOT Length (mm)	SHOOT Dry Wgt (mg/pl)	ROOT Length (mm)	ROOT Dry Wgt (mg/pl)
0	68	59.5	20.3	6.0
1	64	52.5	20.3	6.3
10	54	42.5	17.3	5.0
100	47	34.5	13.8	3.8
500	42	31.0	11.3	3.3
1000	25	14.5	10.5	1.8
LSD 5%	3.5	7.67	1.7	1.18
1%	4.7	10.39	2.4	1.60

Sensitivity of pea to MON-12051 was similar to that of radish. For example, 20 nM caused a 23% reduction in shoot length and a 31% reduction in shoot dry weight. At the same rate pea root length was not affected but root dry weight was reduced 18% (Table 4).

The above growth studies suggest that NON-12051 would make an excellent selective broadleaf herbicide in corn and especially wheat.

Safener studies. Dichlormid only partially safened corn from the herbicidal effects of MON-12051. Application of 50 uM MON-12051 caused a 40% reduction in shoot length and a 33% reduc-

tion in shoot dry weight. With the addition of 1.5 mM dichlormid those reductions were reduced to 18 and 8%, respectively (Table 5). At the above rate of MON-12051 root length was inhibited 26% and root dry weight 38%. In the presence of 1.5 mM dichlormid root growth in length was completely protected and root dry weight only reduced 17% (Table 5).

Table 4. Effect of MON-12051 on the growth of pea.

MON-12051 (nM)	SHOOT Length (mm)	SHOOT Dry Wgt (mg/pl)	ROOT Length (mm)	ROOT Dry Wgt (mg/pl)
0	162	70.5	94	27.3
5	161	67.3	95	26.8
10	150	60.3	91	23.8
20	125	48.5	94	22.3
50	91	33.3	84	19.5
100	54	19.8	73	16.3
LSD 5%	6.1	4.81	7.8	2.04
1%	8.3	6.55	10.7	2.79

Table 5. Effect of dichlormid (Dichlor) as a safener against the herbicidal activity of MON-12051 in corn.

12051 (uM)	Dichlor (mM)	SHOOT Length (mm)	SHOOT Dry Wgt (mg/pl)	ROOT Length (mm)	ROOT Dry Wgt (mg/pl)
0	0	142	44.5	174	55.5
0	1.5	143	43.5	185	49.5
10	0	103	32.5	179	42.5
10	1.5	128	43.0	184	48.5
50	0	85	30.0	128	34.5
50	1.5	116	41.0	178	46.0
100	0	77	24.8	107	32.5
100	1.5	109	40.5	164	40.5
500	0	56	20.8	60	21.5
500	1.5	94	36.0	72	36.5
LSD	5%	13.8	5.80	27.4	5.71
	1%	18.5	7.78	36.8	7.65

Similar to dichlormid, MON-13999 partially protected corn from the herbicidal activity of MON-12051. For example, corn treated with 50 uM MON-12051 had a 51% reduction in shoot length and a 46% reduction in shoot dry weight. With the addition of

1.5 mM MON-13999 reductions in shoot length and dry weight were 24 and 26%, respectively (Table 6). At the same herbicide rate root length was reduced 43% and root dry weight 54%. When 1.5 mM MON-13999 was added growth in root length was completely protected and root dry weight was only reduced 24% (Table 6).

Table 6. Effect of MON-13999 as a safener against the herbicidal activity of MON-12051 in corn.

		SHOOT		ROOT	
12051 (uM)	13999 (mM)	Length (mm)	Dry Wgt (mg/pl)	Length (mm)	Dry Wgt (mg/pl)
0	0	153	46.0	166	48.0
0	1.5	154	44.5	180	46.3
10	0	82	29.5	124	26.5
10	1.5	135	40.0	181	44.0
50	0	75	25.0	95	22.0
50	1.5	116	34.0	162	36.5
100	0	70	20.0	84	19.3
100	1.5	110	30.5	155	35.5
500	0	62	17.8	61	17.3
500	1.5	87	26.0	114	27.5
LSD	5%	16.0	7.11	18.4	5.62
	1%	21.4	9.52	24.6	7.53

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WEED CONTROL IN NARROW-ROW NO-TILL CORN IN THE MARYLAND COASTAL PLAIN

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

ABSTRACT

Field studies were initiated in 1991 at Beltsville, MD, to evaluate corn (Zea mays L.)-weed responses to 76 or 38 cm row spacings and preemergence herbicide treatments. The experimental design was a randomized complete block with four replicates. Herbicide treatments included atrazine at 1.7 and 1.1 kg ai ha^{-1} in tank mixtures with metolachlor, imazamethabenz, primisulfuron, nicosulfuron, quinclorac, or V53482. Herbicides were applied in a volume of 374 L ha^{-1} to debris covered soil surfaces. Weed control evaluations and crop harvests were made in the fall of each year (1991 through 1993). Average weed covers in the 76 cm rows were 41, 38, and 81% for 1991 through 1993, respectively. In the 38 cm rows weed covers averaged 18, 18, and 55% for the same periods of time. Pitted morningglory (Ipomoea lacunosa L.) was the dominant weed each year in both row spacings across most treatments. Estimated ground cover attributed to pitted morningglory averaged 14 and 8% in the 76 and 38 cm rows, respectively, in 1991 and 1992. In 1993, pitted morningglory averaged 45 and 40% ground cover in the 76 and 38 cm rows, respectively. Pitted morningglory growth was not noticeably influenced by corn row spacing. In 1993 pitted morningglory ground cover was lowest in plots treated with atrazine plus quinclorac. However these treatments were highest in smooth pigweed (Amaranthus hybridus L.) ground cover. Grain yields in the 76 cm rows ranged from 1130 to 8090 kg ha^{-1} and from 1630 to 8650 kg ha^{-1} in the 38 cm rows across all three years.

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[1]Research Agronomist USDA-ARS, Beltsville, MD 20705, and Weed Scientist, IR-4, New Market, MD, 21774.

WEED CONTROL IN NO-TILL CORN WITH REDUCED USE OF PREEMERGENCE HERBICIDES

S. Glenn and W. H. Phillips, II[1]

ABSTRACT

In Western Maryland, Triazine-resistant weeds and perennial weeds have become prominent in no-tillage corn. Often POST herbicides are applied to control these weeds since existing PRE herbicide programs are ineffective. Most POST herbicide treatments are applied in addition to a full PRE program. This research was conducted to determine if PRE herbicides can be reduced or eliminated when POST herbicides are applied in no-tillage corn. An experiment conducted in 1992 and repeated in 1993 compared weed control with POST herbicides following PRE applications of 1.6 lbs/A atrazine plus 2.0 lbs/A metolachlor vs 2.0 lb/A metolachlor alone. Atrazine had no effect on perennial broadleaf weed control, common lambsquarters (Chenopodium album L.) control, or weed encroachment following POST applications of 0.031 lbs/A nicosulfuron or 0.18 lbs/A primisulfuron tank mixed with 0.25 lbs/A 2,4-D or 0.13 lbs/A dicamba. In a large plot study, at planting (AP) applications of 0.5 lbs/A paraquat, 1.6 lbs/A atrazine, and 2.0 lbs/A metolachlor provided poor control of hemp dogbane (Apocyanum cannabinium L.) (0%), giant foxtail (Sataria faberii Herrm.) (37%), common lambsquarters (30%), and smooth pigweed (Amaranthus hybridus L.) (47%) 8 weeks after treatment (WAT). However, POST applications of 0.031 lbs/A nicosulfuron plus 0.13 lbs/A dicamba produced 80, 92, 100 and 97% hemp dogbane, giant foxtail, common lambsquarters and smooth pigweed control, respectively, when only paraquat was applied AP. Nicosulfuron plus dicamba produced similar control of these weeds when no AP treatments were applied, but early season competition from common chickweed [Stellaria media (L.) Vill.] stunted the corn and reduced corn yield. In a separate experiment, POST herbicides were studied in no-tillage corn following AP applications of only paraquat. POST applications of 0.5 lbs/A dicamba controlled common lambsquarters (98%) but not giant foxtail (0%). Tank mixture of 0.031 lbs/A nicosulfuron with 0.5 lbs/A dicamba improved giant foxtail control (73%). However, reducing the rate of dicamba in the tank mixture to 0.13 lbs/A increased giant foxtail control (88%) and common lambsquarters control (97%) remained similar. These studies suggest that residual PRE herbicide applications may not be necessary when a broad spectrum POST program is applied.

[1]Assoc. Prof., Grad. Res. Asst., Deparment of Agronomy, University of Maryland, College Park, MD 20742.

Effect of Imazethapyr Application Rate and Timing on Seedling Alfalfa-Grass Mixtures

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

ABSTRACT

Imazethapyr was examined for its potential use in new seeding alfalfa-orchardgrass and alfalfa-timothy mixtures. The study was established at the Russell E. Larson Agricultural Research Center near Rock Springs, Pennsylvania in both 1991 and 1992. 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. 'Arrow' alfalfa 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. Imazethapyr was applied at three different rates (0.047, 0.063, and 0.094 lb ai/A) and three different application timings in relation to grass size (2 to 4 inches tall, 4 to 6 inches tall, and post harvest). A non-ionic surfactant was added to all the treatments. Sethoxydim plus 2,4-DB were added to the study at 0.188 and 0.75 lb/A, respectively, for comparison. In 1992 Butyrac(2,4-DB) was broadcast at 1.0 lb ai/A over the entire study in late June to aid in the control of broadleaf weed species. Parameters evaluated included weed control, grass tolerance and total yield.

In 1991, because of drought, the first harvest was not taken until the second season of the study. The seedling year following application indicates that orchardgrass was more productive than timothy as shown in grass yields. Grass tolerance for both species was greatest with the 4 to 6 inch application timing, with tolerance decreasing at later application timings. Alfalfa yields were significantly lower when mixed with orchardgrass probably due to the competitive nature of this grass species. Total yield was not significantly affected by grass species.

In 1992, orchardgrass was initially more productive than timothy, but by the end of the second season timothy significantly out-produced orchardgrass. As in 1991, grass tolerance increased with later application timings, with the post harvest timing having the greatest yield. Alfalfa yields were not significantly affected by grass species in 1992. Grass species had a significant effect on total yield with timothy plots yielding the highest. Imazethapyr rate did not have a significant effect on grass yield in 1991 or 1992. Both years of the study sethoxydim plus 2,4-DB decreased grass yield more than any other treatment. The differences in orchardgrass and timothy production for 1991 and 1992 are probably a result of very different growing seasons during the establishment year. The hot and dry 1991 season along with the late third application timing had a negative effect on the growth of timothy that was not apparent in the more normal conditions of 1992. Apparently timothy is not as competitive as orchardgrass so it never fully recovered and as a result yielded poorly.

The potential use of imazethapyr in alfalfa-grass mixtures looks more feasible for orchardgrass than for timothy, however application rate and timing appear important for either species. Timothy appears to lack the initial competitive growth and tolerance that orchardgrass demonstrates. With both grass species application timing was much more critical than application rate.

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

YIELD ANALYSIS AND COMPETITIVE INTERACTIONS OF SOYBEAN WITH CANADA THISTLE

W. H. Phillips, II and S. Glenn[1]

ABSTRACT

Interactions of Canada thistle [Cirsium arvense (L.) Scop.] and soybean [Glycine max (L.) Merr.] grown together in a field was studied in 1993. A field, previously fumigated with methyl bromide was planted on June 18 with Manokin soybean (20-inch row spacings). On the day of planting Canada thistle was transplanted at 0, 16, 32, and 48 plants per 12 feet of soybean row either adjacent to the row or 12 inches from the row. The thistle transplants originally were from 3-inch root segments of greenhouse grown Canada thistle, separately potted and grown to 1 to 2 inches high prior to transplanting. Height of soybean and Canada thistle and Canada thistle shoot counts were obtained periodically during the growing season. In August, when soybean canopy closure was complete and flowering was about to begin Canada thistle shoot counts peaked. Canada thistle shoot production was greatest from plots where plants were transplanted between the rows compared with adjacent to the row. Canada thistle shoot counts from plots originally transplanted at 16, 32, and 48 plants per 12 feet of row were 53, 84, and 188 plants, respectively, for between row transplants and 39, 52, and 115 plants, respectively, for adjacent to the row transplants. New shoots were found up to 30 inches from the original shoot. After soybean canopy closure and flowering had occurred the Canada thistle shoot counts dropped dramatically. This thistle die back was probably due to shading effects of soybean on Canada thistle. Canada thistle had no effect on soybean height during this experiment; however, Canada thistle plants transplanted adjacent to the soybean row grew taller than those transplanted between rows. No flowering of Canada thistle occurred during this first year of this study. Yield data will be presented at the meeting.

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

A TWO YEAR STUDY ON WIRESTEM MUHLY MANAGEMENT IN NO-TILL CORN

V. K. Nandula and W. S. Curran[1]

ABSTRACT

Wirestem muhly (Muhlenbergia frondosa (Poir) Fern.), a warm-season perennial grass, is a problem for no-till and reduced-till corn producers. It begins growth late in the spring, and goes dormant early in the fall (late September). Previous research with wirestem muhly has examined glyphosate as well as certain postemergence grass herbicides such as sethoxydim, haloxyfop, and fluazifop. Nicosulfuron and primisulfuron, two herbicides belonging to the sulfonylurea herbicide family, are active on several perennial grasses like johnsongrass and quackgrass, but their effectiveness on wirestem muhly is not clear. A two-year study was conducted in central Pennsylvania in 1992 and 1993 to evaluate the performance of these two herbicides on wirestem muhly.

Two field studies, one dealing with herbicide timing and rate and the other, an adjuvant study, were initiated at two locations with established natural populations of wirestem muhly. In the first study, glyphosate was applied as a preplant application at 1.14 kg ai ha^{-1}, and nicosulfuron and primisulfuron postemergence at three application timings. A split application was also included for nicosulfuron and primisulfuron. The three application timings correspond to different growth stages of wirestem muhly (15 to 20 cm tall at post 1, 25 to 30 cm at post 2, and 40 cm at post 3). Crop oil concentrate was included with all post applications. In the adjuvant study, four different adjuvants including nonionic surfactant (NIS), crop oil concentrate (COC), crop oil concentrate + urea-ammonium nitrate liquid fertilizer (UAN), and methylated vegetable oil concentrate (MVOC) were evaluated with the two sulfonylureas. Nicosulfuron and primisulfuron were applied at half and full rates with each additive. All treatments were applied at the post 2 growth stage. Visual ratings of weed control were taken 1, 2, 4, 6, 12, and 16 weeks after planting. Early and late season wirestem muhly biomass samples were taken from each plot. Similar studies were carried out in the greenhouse.

In 1993, the 2X rates of nicosulfuron and primisulfuron were substituted for the 1/2X rates. Also, atrazine + simazine, atrazine + crop oil concentrate, and atrazine + cyanazine were included in the treatment list. An organosilicone methylated vegetable oil (OMVOC) was included in the adjuvant study.

During both seasons, glyphosate was totally ineffective in controlling wirestem muhly. Nicosulfuron was consistently better than primisulfuron. Generally, the high rate performed better than the low rate. Split application timings proved to be best. Both herbicide and timing affected wirestem muhly growth. None of the treatments provided greater than 84% control. Both in 1992 and 1993, MVOC was the most effective adjuvant in suppressing wirestem muhly growth, and NIS the least.

Results from this research suggest that herbicide, timing and adjuvant are important factors to be considered for wirestem muhly control. Nicosulfuron with MVOC applied when wirestem muhly was 15 to 20 cm tall or applied in a split timing was most effective. However, tillage and crop rotation should also be considered to improve overall wirestem muhly management.

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

HERBICIDE SUSCEPTIBILITY AND BIOLOGICAL FITNESS OF TRIAZINE-RESISTANT AND SUSCEPTIBLE COMMON LAMBSQUARTERS

R.J. Parks, W.S. Curran and G.W. Roth[1]

ABSTRACT

Past research has suggested that herbicide resistant weeds may show an increased sensitivity to other herbicides with similar modes of action (known as negative cross resistance). Reduced fitness levels in triazine-resistant common lambsquarters (Chenopodium album L.) compared to traizine-susceptible common lambsquarters as characterized by herbicide susceptibility and growth vigor may be an important consideration in planning and implementing weed control programs involving triazine-resistant weeds. A number of studies were undertaken during 1992-93 to quantify the fitness differences among several populations of triazine-resistant and susceptible common lambsquarters in terms of herbicide susceptibility and growth vigor.

In order to characterize the herbicide sensitivity of a susceptible population of lambsquarters compared to a resistant one, greenhouse studies were undertaken in which both biotypes were treated with five different herbicides: bentazon, bromoxynil, dicamba, pyridate and thifensulfuron. The herbicides were applied at four different rates and the plants were harvested for dry weights ten days after treatment.

Non-competitive growth studies were conducted in which lambsquarters plants from a susceptible and a resistant population were planted in a greenhouse and in a field and harvested incrementally over time in order to determine various growth characteristics including leaf area and biomass production.

Herbicide studies showed significant population effects with bentazon, bromoxynil and dicamba, wherein the resistant population displayed greater sensitivity to the herbicides than the susceptible population. Both biotypes showed a similar response when treated with pyridate and thifensulfuron.

Growth studies indicated that the susceptible populations tested reached greater values for a number of variables measured including leaf area and plant dry weight. The susceptible populations out-performed the resistant populations for the majority of harvest dates. However, the values equalized for resistant and susceptible lambsquarters as the populations reached maturity.

In conclusion, the triazine-resistant lambsquarters in these experiments showed less fitness than the susceptible lambsquarters in terms of growth vigor and sensitivity to several herbicides.

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

POSTEMERGENCE APPLICATIONS OF METRIBUZIN IN FIELD CORN

B. S. Manley, H. P. Wilson, T. E. Hines, J. A. Ackley,
E. S. Hagood, and C. W. Swann[1]

ABSTRACT

Field studies were conducted in 1991, 1992, and 1993 to evaluate metribuzin (Sencor) alone and in different tankmix combinations for corn (Zea mays L.) tolerance and postemergence broadleaf weed control. The experimental design was a randomized complete block with either three or four replications. Studies were conducted in Painter, Va. on a State sandy loam soil (1991, 1992 and 1993), in Suffolk, Va. on a State fine loamy sand (1992), and in Whitethorne, Va. on a Ross silt loam soil (1992). Corn varieties varied with location but all were commercially available. Treatments in Painter were applied with a tractor-mounted plot sprayer delivering 26 gpa at a pressure of 30 psi; in Suffolk with a unicycle sprayer delivering 20 gpa at a pressure of 20 psi; and in Whitethorne with a CO_2 backpack sprayer delivering 22 gpa at a pressure of 21 psi.

Sencor was applied alone and in combinations at 0.06 (1991) and 0.09 (1992 and 1993) lb ai/A. Dicamba [Banvel (0.25 lb ai/A)] and 2,4-D (0.25 lb ai/A) were applied alone and in combination with Sencor, while bentazon [Basagran (0.5 lb ai/A)] was applied only in combination with Sencor. Bentazon plus atrazine [Laddock (1.04 lb ai/A)] and dicamba plus atrazine [Marksman (0.8 lb ai/A)] were included as standards. Various adjuvants were included according to commercial use patterns.

Corn injury varied with the highest injury occurring at Painter and little to no injury occurring at Suffolk and Whitethorne. At the Painter location in 1992, the highest injury resulted from the combination of Sencor and Basagran; whereas, in 1993, injury caused by the combinations of Sencor with 2,4-D, Banvel or Basagran was similar and higher than that from all other treatments. Weed control also varied with location and year. The addition of 2,4-D, Banvel or Basagran to Sencor enhanced the control of common lambsquarters (Chenopodium album L.) and ivyleaf morningglory [Ipomoea hederacea (L.) Jacq.] in Painter; common ragweed (Ambrosia artemisiifolia L.) in Painter and Suffolk; and prickly sida (Sida spinosa L.) and giant ragweed (Ambrosia trifida L.) in Whitethorne. The combinations of Sencor with 2,4-D, Banvel, or Basagran provided season-long control of common lambsquarters, common ragweed, burcucumber (Sicyos angulatus L.) and Pennsylvania smartweed (Polygonum pensylvanicum L.) and was comparable to that provided by Laddock or Marksman. However, Laddock and Marksman provided better control of ivyleaf morningglory than did the combinations of Sencor with 2,4-D, Banvel or Basagran. Tankmixing Sencor with other broadleaf herbicides is required if Sencor is to provide adequate broadleaf weed control in corn; however, there is potential for significant corn injury to develop following application of these tankmixes.

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[1]Grad. Res. Asst., Prof., Agri. Res. Sci. A, and Grad. Res. Asst., Eastern Shore Agric. Exp. Stn., Painter, Va. 23420; Prof., Dept. of Plant Path., Phys., and Weed Sci., Blacksburg, Va. 24061; Prof., Tidewater Agric. Exp. Stn., Suffolk, Va. 23437; Va. Polytech. Inst. and State Univ.

YELLOW NUTSEDGE CONTROL WITH ACETOLACTATE SYNTHASE-INHIBITING HERBICIDES

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

ABSTRACT

Field studies were conducted on a State sandy loam soil (Typic Hapludults) near Painter, Va. in 1991, 1992 and 1993 to evaluate several commercially available and experimental acetolactate synthase (ALS) -inhibiting herbicides for yellow nutsedge (Cyperus esculentus L.) control. Herbicides were applied postemergence to 4- to 6-leaf yellow nutsedge with a tractormounted sprayer. Spray volume was 26 gpa at 30 psi and herbicides were applied through flat fan tips. Although several herbicides were applied at a range of rates, this paper reports results obtained from single rates that are either labeled or that the authors believe will be labeled for control of one or more species in the future. All spray mixes contained an adjuvant. The following herbicides were applied at the rates indicated in mixes containing 0.25% (V/V) non-ionic surfactant (X-77): 0.008 lb ai/A chlorimuron (0.5 oz/A Classic), 0.03 lb ai/A rimsulfuron (2 oz/A DPX-E9636) and 0.03 lb ai/A MON-12037 (0.7 oz/A Permit). Additional herbicides applied in mixes containing 1% crop oil concentrate (Agridex) at one rate each were: 0.03 lb ai/A nicosulfuron (0.7 oz/A Accent), 0.036 lb ai/A primisulfuron (0.75 oz/A Beacon) 0.03 lb/A rimsulfuron (2 oz/A DPX-E9636), 0.004 lb ai/A thifensulfuron (0.25 oz/A Pinnacle) 0.03 lb ai/A DPX PE350 (1.0 oz/A Staple) and 0.028 lb ai/A CGA-152005 (9 oz/A). Imazethapyr, the only imidazolinone herbicide included, was applied at 0.063 lb ai/A (2.8 oz/A Pursuit) in a spray mix containing methylated sunflower oil (Scoil) at 1%. The experimental design was a randomized complete block in 1991 with three replications at each of two adjacent sites; in 1992 and 1993 a single site with four replications was used.

Ratings of yellow nutsedge control were highest from MON-12037 (90%) and chlorimuron (70%) and yellow nutsedge plant heights were 50% shorter than the control. Yellow nutsedge control by nicosulfuron, primisulfuron, DPX-E9636, and DPX-PE350 was approximately 60% and yellow nutsedge height was reduced an average of 20% by these herbicides.

Imazethapyr provided less than 40% yellow nutsedge control while thifensulfuron and CGA 152005 had little activity against yellow nutsedge.

Results obtained in these studies confirm that yellow nutsedge control depends on the specific ALS-inhibiting herbicide and can vary from near 0 to 90%. It is likely that commercial control could be higher as a result of crop competition and shading, and preemergence herbicide applications.

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

ALFALFA CONTROL STRATEGIES FOR NO-TILL CORN AND BARLEY

R. D. Myers and S. Glenn[1]

ABSTRACT

Crop rotations including alfalfa (Medicago sativa L.) are common on Maryland dairy farms. Alfalfa becomes the primary weed when crops are no-till planted into existing alfalfa stands. An experiment was conducted in 1992 and 1993 to evaluate alfalfa control in no-tillage corn. The study was arranged as a split plot design with the plots (45 x 150 feet) being split into subplots which were cut for hay prior to treatment or uncut. In 1992, control of uncut alfalfa following at planting (AP) applications of 2.0 lbs/A glyphosate plus 0.38 lbs/A dicamba (87%) or 2,4-D (85%) was greater than 2.0 lbs/A glyphosate (60%) or 0.5 lbs/A paraquat plus 0.38 lbs/A paraquat (62%) 9 weeks after treatment (WAT). Alfalfa control was reduced when alfalfa was cut for hay prior to herbicide treatment compared with uncut alfalfa. However, the glyphosate plus dicamba and glyphosate plus 2,4-D treatments produced 70 and 65% control of cut alfalfa, respectively. Corn yield was greater in uncut alfalfa plots compared with cut alfalfa plots. Yield of corn treated with glyphosate plus dicamba was greater than yield of corn treated with glyphosate applied alone or paraquat plus 2,4-D. In 1993, alfalfa control was similar to the control in 1992, except control of cut alfalfa treated with glyphosate plus 2,4-D (53%) was less than that by glyphosate plus dicamba (73%). In a separate experiment, alfalfa control in no-till barley [Hordeum vulgare (L.) Wysor] was evaluated. Herbicide treatments were applied AP which was 4 weeks following the fifth alfalfa cutting. The plots (45 feet x 150 feet) were arranged in a randomized complete block design with 3 replications. Glyphosate applied at 1.0, 1.5, and 2.0 lbs/A produced 83, 97, and 100% alfalfa control, respectively, 3 WAT. Alfalfa control with 1.5 lbs/A glyphosate plus 0.38 lbs/A 2,4-D was 92%. The following spring alfalfa was completely controlled (100%) by all herbicide treatments. Barley yield was greatest for plots treated with 1.0 lbs/A glyphosate or 1.5 lbs/A glyphosate plus 0.38 lbs/A 2,4-D. These treatments were the slowest to kill alfalfa and perhaps allowed a more gradual release of nitrogen.

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[1]Grad. Res. Asst. and Assoc. Prof., U. S. Naval Dairy Farm, Gambrills, MD 20154 and Dept. of Agronomy, University of Maryland, College Park, MD 20742.

WEED CONTROL IN CORN AND SOYBEANS WITH FLUMETSULAM

R. L. Ritter and H. Menbere*

ABSTRACT

Broadstrike (flumetsulam or DE-498) was recently approved for use in corn (Zea mays L.) and soybeans [Glycine max (L.) Merr.]. It belongs to the sulfonylurea family of herbicides and its activity is primarily on broadleaf weeds. It will be utilized in corn and soybeans as a package-mix containing Broadstrike plus Dual (metolachlor). Also, in soybeans, another package-mix will be available as a combination of Broadstrike plus Treflan (trifluralin). One of the unique features of Broadstrike is its ability to provide good control of triazine-resistant ('TR') broadleaf weeds. Experiments were established in 1992 and 1993 to study Broadstrike's herbicidal activity in corn and soybeans.

In 1992 and 1993, Broadstrike plus Dual was evaluated for the control of 'TR' smooth pigweed (Amaranthus hybridus L.) and 'TR' common lambsquarters (Chenopodium album L.) in no-till corn. Early preplant versus preemergence applications were evaluated for 'TR' smooth pigweed control, while only preemergence applications were evaluated for 'TR' common lambsquarters control. Early preplant applications of Broadstrike plus Dual provided fair to good control of 'TR' smooth pigweed early in the season. Yet, by mid- to late-season, these same applications were providing poor 'TR' pigweed control. On the other hand, preemergence applications provided good season-long control of 'TR' smooth pigweed. Preemergence applications of Broadstrike plus Dual also provided good season-long control of 'TR' common lambsquarters. No corn injury was observed in any of these studies. Preemergence control of giant ragweed (Ambrosia trifida L.) was also studied with Broadstrike plus Dual in corn. Good early-season control was observed. Yet, by mid-season, poor control was observed.

In soybeans, Broadstrike plus Dual was evaluated in full-season no-till soybeans and in full-season conventional soybeans. Early preplant applications of Broadstrike plus Dual in full-season no-till soybeans resulted in poor annual grass control by mid-season. Split applications [1/2 labeled use rate (LUR) early preplant followed by 1/2 LUR preemergence] provided good season-long annual grass control. Other weeds studied in soybeans that Broadstrike plus Dual or Broadstrike plus Treflan showed good activity on include common lambsquarters, common ragweed (Ambrosia artemisiifolia L.), and common cocklebur (Xanthium pensylvanicum Wallr.). No soybean injury was observed over the 2 yr time period.

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

V-23031: A NEW POSTEMERGENCE BROADLEAF WEED HERBICIDE FOR CORN AND SOYBEANS.

T.G. Bean, A.R. Kurtz and J.R. Aleck[1]

ABSTRACT

V-23031 (Trademark: Resource® Herbicide) is a new N-phenylphthalimide derivative herbicide being developed for U.S. markets by Valent U.S.A. Corporation. V-23031 is a fast-acting, contact postemergence herbicide for use in soybeans [Glycine max (L.) Merr.] and corn (Zea mays L.). Studies conducted in the United States from 1987 to 1993 have demonstrated that soybeans are tolerant to V-23031 plus an adjuvant at .03 to .09 kg ai/ha. Corn is tolerant to over-the-top broadcast applications of V-23031 at .03 to .046 kg ai/ha, and to postemergence directed sprays at .03 to .06 kg ai/ha. V-23031 is rapidly degraded in soil and water and will not adversely affect groundwater or rotational crops.

Velvetleaf (Abutilon theophrasti Medik.) is especially sensitive to V-23031. Velvetleaf is controlled up to the six-leaf stage by V-23031 applications of .03 kg ai/ha and up to the 10-leaf stage by V-23031 applications of .06 kg ai/ha. In soybeans, velvetleaf up to 90 cm in height can be controlled with .09 kg ai/ha of V-23031. Tank mixes with other postemergence soybean broadleaf herbicides including bentazon, chlorimuron,imazaquin, imazethapyr or lactofen have resulted in enhanced control of velvetleaf and other problem broadleaf weeds such as black nightshade (Solanum nigrum), common ragweed (Ambrosia artemisiifolia), common lambsquarters (Chenopodium album L.) and redroot pigweed (Amaranthus retroflexus L.). Tank mixes with other postemergence broadleaf corn herbicides including atrazine, dicamba, nicosulfuron or 2,4-D have resulted in enhanced control of velvetleaf as well as other broadleaf weeds such as common lambsquarters and redroot pigweed. Broadleaf weeds ,other than velvetleaf, are most sensitive to V-23031 treatments in the 2-leaf to 4-leaf stage.

An experimental use permit (EUP) program was conducted in 1993. A total of 65 trials (33 in soybeans and 32 in corn) were conducted in 20 states. In growers' evaluations, the performance of V-23031 compared favorably to grower standards for crop safety and weed control in tank mixes and alone on tall velvetleaf. A similar EUP program is scheduled to be conducted in 1994.

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[1]Field Market Development Scientists, Valent U.S.A. Corporation, Walnut Creek, CA 94596

BROADLEAF AND GRASSY WEED EMERGENCE IN FULL-SEASON AND DOUBLE-CROP SOYBEANS.

J.O. Yocum and W.S. Curran[1]

ABSTRACT

Weekly weed emergence counts were made in no-till and conventional-till soybeans planted full-season and planted after small grain harvest (double-crop) during 1991 and 1992 in Southeastern Pennsylvania. The climatic conditions were different for the two years. The 1991 growing season was drier and warmer than normal; while 1992 was slightly drier but cooler than normal. Weed numbers were higher in 1991 than in 1992, but there were more late season emergence of weeds in 1992. In both years, more weeds emerged in soybeans planted full season. Peak weed emergence generally occurred after a significant rain event; and both years, the peak of total weed emergence occurred the first week of June. Also in both years, most of the weeds were emerged by July 30.

Tillage effects upon weed emergence were variable. Yellow nutsedge (Cyperus esculentus L.) populations were greater in no-till both years; but for other species giant foxtail (Setaria faberi Herrm.), common lambsquarters (Chenopodium album L.), and redroot pigweed (Amaranthus retroflexus L.), emergence varied due to tillage during the two years.

In both years, soybeans planted after small grain harvest had significantly less giant foxtail and nutsedge than in soybeans planted full season. Depending upon the year, common lambsquarters and redroot pigweed emergence was spread over a longer time period. In 1991, 40% of the lambsquarters and 41% of the pigweed emerged in soybeans planted after small grain harvest; but in 1992, only 29% of the lambsquarters and 8% of the pigweed emerged in double-cropped soybeans.

[1]Senior Res. Assoc. and Ass't Prof. of Weed Sci., Department of Agronomy, The Pennsylvania State University, University Park, PA 16802

EFFECT OF FERTILIZATION AND MOWING ON HIGHWAY RIGHT-OF-WAY TURF GROWTH AND WEED COMPETITIVENESS

N.P. Cain[1] and K. Wannop[2]

The effect of three mowing heights and five rates of nitrogen fertilizer on roadside turf were studied in two highway right-of-way (ROW) locations near Strathroy, Ontario. The research examined the impact of these treatments on turf density and growth, and whether weed infestations were reduced in response to the treatments. This study was part of a program on integrated vegetation management approaches to roadside weed and brush control.

Two separate experiments were set out on turf immediately adjacent to the gravel shoulder of a four-lane controlled access highway. One site had predominantly tall fescue (Festuca arundinacea Schreb.) while the other site had a mixture of rough bluegrass (Poa trivialis L.) and red top (Agrostis alba Amer. auctt.). The plots were mowed at three heights, 10, 15 and 20 cm (4, 6 and 8 in) with an unmowed control. Plots were mowed in June and September from 1991 to 1993. One application of fertilizer was applied on August 28, 1991. Five rates of nitrogen fertilizer were applied from 35 to 95 kg ha^{-1} (31.3 to 84.8 lb ac^{-1}) combined with 70 kg ha^{-1} (62.5 lb ac^{-1}) each of phosphorus and potassium fertilizers. Core samples were taken in fall 1992 from selected treatments to evaluate plant dry weights. Sweet clover (Melilotus sp.) and wild carrot (Daucus carota L.) were broadcast seeded in fall 1992 and spring 1993 respectively.

The 20 cm mowing height and the unmowed treatment resulted in higher density ratings than the lower mowing heights. Density and colour of the turf increased with increasing rate of nitrogen. The effect of the treatments on density was still evident in 1993 although the range of effect was reduced compared to 1992. In June and August 1993, there were fewer weeds in the plots that were mowed at 20 cm or not mowed. Weed number generally fell as the rate of nitrogen fertilizer increased, levelling off by the 80 kg ha^{-1} treatment.

The turf that was composed of rough bluegrass and red top was generally denser than the tall fescue turf, responded more rapidly and to a greater degree to the treatments and had lower weed numbers overall.

The 20 cm mowing height and the unmowed treatment increased the density of ROW turf and reduced weed infestations. Increasing rates of nitrogen fertilizer application as part of a complete fertilizer also improved ROW turf density and reduced the level of weed infestation.

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[1] Research Scientist, Ont. Ministry of Transportation, Res. and Dev. Branch., 1201 Wilson Ave., Downsview, Ont. M3M 1J8

[2] Manager, Fairview Res. Farms, RR3, Harriston, Ont., N0G 1Z0

EFFECT OF APPLICATION DATE ON RESPONSE OF TALL AND FINE FESCUES TO APPLICATIONS OF METSULFURON METHYL OR CHLORSULFURON

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

ABSTRACT

The sulfonylurea herbicides metsulfuron methyl and chlorsulfuron are commonly used for broadleaf weed control along Pennsylvania roadsides. They may be used in tank mixes with other herbicides to improve the spectrum of broadleaved weeds controlled, or they may be used in combination with turf growth regulators. Both herbicides have growth regulator-like activity, and are particularly suppressive to tall fescue (Festuca arundinacea Schreb.) when applied with mefluidide in the vegetative to early reproductive phases of spring growth. As part of a cooperative research project with the Pennsylvania Department of Transportation, a trial was initiated to determine if time of application of metsulfuron methyl or chlorsulfuron affected the response of tall fescue or fine fescues to these herbicides. Treatments including an untreated check; metsulfuron methyl alone at 0.019 and 0.038 lb ai/a, and at 0.019 lb ai/a plus 1.1 lb ae/a of triclopyr amine; and chlorsulfuron alone at 0.023 and 0.047 lb ai/a, and 0.023 lb ai/a plus 1.1 lb ae/a of triclopyr amine were applied to stands of tall fescue and fine fescue at the Landscape Management Research Center on May 4, June 1, June 30, August 7, and September 2, 1992. The tall fescue area was a stand of 'Transition Blend' tall fescue, previously maintained at 3.5 in. The fine fescue area was a mixture of hard fescue (Festuca longifolia Thuill.), creeping red fescue (Festuca rubra L.), and chewings fescue (Festuca rubra ssp. commutata L.) maintained at 2.5 in. The experimental design for both grasses was a randomized complete block with a split-plot treatment arrangement and three replications. Application date was the whole-plot factor, and herbicide treatment was the sub-plot factor. Individual plots were 3 by 15 ft. The treatments were applied with a CO_2-powered, hand-held sprayer delivering 15.8 gal/a at 24 psi with Spraying Systems 8002 spray tips. Prior to each application, each study area was mowed at 3.0 in, with clippings collected. All treated plots in the tall fescue test were harvested May 29, June 30, July 31, September 1, and September 30, 1992; and May 11, 1993. Treated fine fescue plots were harvested May 29, June 30, July 31, September 1, and October 6, 1992; and May 12, 1993. Harvests were taken with a 20 in rotary mower cutting at 3.0 in.

There was a significant interaction between application date and herbicide treatment for both grasses, and the yields following the herbicide treatments are reported for each application date in Tables 1 and 2. Yields of tall fescue were reduced by the herbicide treatments at the first harvest following the May 4, June 1, Aug. 7,and Sept. 2 applications, with the greatest suppression occurring following the May 4 application. Following the June 30 application, only the chlorsulfuron at the high rate, or in combination with triclopyr, caused a reduction in growth. The growth of the herbicide treated tall fescue recovered from the initial suppression, and there was no reduction in the yields compared to the untreated check at the second harvest following application for any of the application dates. The herbicide treatments caused discoloration of the tall fescue after each application. By the time of the second harvest the discoloration was not apparent, as the growth in the herbicide treated plots was from new tillers and had better color than the grass in the untreated areas.

The fine fescues were not as sensitive to the herbicides as the tall fescue. Significant treatment effects were only seen at the first harvest following the May 4 and September 2 applications, and the differences between the treated and untreated plots were not as great. Like the tall fescue, growth of the herbicide treated fine fescue increased following the first harvest. Discoloration of the turf only occurred following the May 4 application, and it was not as severe as occurred with the tall fescue.The most severe discoloration and reduction in growth of both the tall and fine fescues occurred when the grasses were most actively growing in early spring.

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

TABLE 1: 1992 dry weight yields and 1993 fresh weight yields of tall fescue treated with metsulfuron methyl or chlorsulfuron on five different dates in 1992. Each value is the mean of three replications, and is reported as pounds of dry or fresh matter per 1000 ft^2 (lbs/M).

Application Date	Treatment	Application Rate	Harvest Date May 29	Jun 30	Jul 31	Sep 1	Sep 30	May 11
		(lb ai/a)	(----------lb dry matter/M				----------)	(lb fresh/M)
May 4	untreated check	- - -	19.1	9.8	6.2	11.0	7.3	38.7
May 4	metsulfuron	0.019	3.5	8.3	8.5	8.6	6.1	31.8
May 4	metsulfuron	0.038	4.5	8.1	13.0	12.4	7.9	40.1
May 4	metsulfuron + triclopyr	0.019 + 1.1	4.1	10.6	9.8	9.2	6.4	34.4
May 4	chlorsulfuron	0.023	4.5	11.1	9.9	12.9	8.2	42.8
May 4	chlorsulfuron	0.047	5.0	8.6	8.5	11.9	8.5	42.7
May 4	chlorsulfuron + triclopyr	0.023 + 1.1	5.6	11.7	8.1	10.6	7.3	36.2
Significance Level (p)			0.0001	0.5054	0.1646	0.4615	0.1630	0.4525
LSD (p=0.10)			2.7	n.s.	n.s.	n.s.	n.s.	n.s.
Jun 1	untreated check	- - -		8.1	6.4	8.8	6.3	34.4
Jun 1	metsulfuron	0.019		2.7	7.2	9.5	6.4	28.7
Jun 1	metsulfuron	0.038		4.9	9.4	10.2	7.6	34.4
Jun 1	metsulfuron + triclopyr	0.019 + 1.1		4.6	10.2	12.2	8.0	38.8
Jun 1	chlorsulfuron	0.023		4.1	8.7	8.1	7.9	34.8
Jun 1	chlorsulfuron	0.047		3.3	7.4	9.6	7.5	36.3
Jun 1	chlorsulfuron + triclopyr	0.023 + 1.1		2.3	4.7	8.7	6.8	29.0
Significance Level (p)				0.0075	0.0094	0.3230	0.1252	0.2556
LSD (p=0.10)				2.1	1.4	n.s.	n.s.	n.s.
Jun 30	untreated check	- - -			5.8	8.2	6.4	33.1
Jun 30	metsulfuron	0.019			5.3	11.7	7.3	36.5
Jun 30	metsulfuron	0.038			4.7	11.1	7.4	33.8
Jun 30	metsulfuron + triclopyr	0.019 + 1.1			5.3	12.6	7.9	37.7
Jun 30	chlorsulfuron	0.023			4.0	9.8	7.9	37.7
Jun 30	chlorsulfuron	0.047			2.2	8.9	8.2	36.7
Jun 30	chlorsulfuron + triclopyr	0.023 + 1.1			3.4	8.9	8.0	33.6
Significance Level (p)					0.0468	0.1291	0.7101	0.9784
LSD (p=0.10)					1.8	n.s.	n.s.	n.s.
Aug 7	untreated check	- - -				12.2	8.7	43.5
Aug 7	metsulfuron	0.019				7.9	10.4	40.0
Aug 7	metsulfuron	0.038				6.2	8.0	41.5
Aug 7	metsulfuron + triclopyr	0.019 + 1.1				6.9	9.1	36.9
Aug 7	chlorsulfuron	0.023				6.7	8.7	39.1
Aug 7	chlorsulfuron	0.047				6.3	7.1	40.2
Aug 7	chlorsulfuron + triclopyr	0.023 + 1.1				6.5	7.1	42.1
Significance Level (p)						0.0751	0.1978	0.9797
LSD (p=0.10)						3.3	n.s.	n.s.
Sep 2	untreated check	- - -					9.5	39.9
Sep 2	metsulfuron	0.019					4.4	43.1
Sep 2	metsulfuron	0.038					4.6	42.1
Sep 2	metsulfuron + triclopyr	0.019 + 1.1					4.6	43.0
Sep 2	chlorsulfuron	0.023					4.5	39.6
Sep 2	chlorsulfuron	0.047					3.3	39.4
Sep 2	chlorsulfuron + triclopyr	0.023 + 1.1					4.9	46.7
Significance Level (p)							0.0001	0.8367
LSD (p=0.10)							1.0	n.s.

TABLE 2: 1992 dry weight yields and 1993 fresh weight yields of a fine fescue mixture treated with metsulfuron methyl or chlorsulfuron on five different dates in 1992. Each value is the mean of three replications, and is reported as pounds of dry or fresh matter per 1000 ft^2 (lbs/M).

Application Date	Treatment	Application Rate	Harvest Date May 29	Jun 30	Jul 31	Sep 1	Oct 6	May 12
		(lb ai/a)	(lb dry matter/M)					(lb fresh/M)
May 4	untreated check	- - -	16.6	9.1	5.0	5.9	7.6	34.6
May 4	metsulfuron	0.019	7.7	7.5	6.1	6.2	8.1	31.5
May 4	metsulfuron	0.038	6.2	7.7	6.2	6.7	8.5	36.2
May 4	metsulfuron + triclopyr	0.019 + 1.1	9.1	7.0	6.6	6.8	9.1	32.0
May 4	chlorsulfuron	0.023	11.8	6.0	6.6	7.2	9.0	34.3
May 4	chlorsulfuron	0.047	10.0	7.1	6.8	7.4	8.8	35.0
May 4	chlorsulfuron + triclopyr	0.023 + 1.1	10.4	7.7	5.6	7.1	9.9	34.5
Significance Level (p)			0.0001	0.5004	0.3365	0.4031	0.3705	0.8914
LSD (p=0.05)			1.8	n.s.	n.s.	n.s.	n.s.	n.s.
Jun 1	untreated check	- - -		8.8	5.2	6.1	8.4	34.6
Jun 1	metsulfuron	0.019		7.0	5.0	7.0	10.1	34.9
Jun 1	metsulfuron	0.038		7.6	6.6	7.3	10.7	40.5
Jun 1	metsulfuron + triclopyr	0.019 + 1.1		8.6	6.4	7.3	9.4	35.3
Jun 1	chlorsulfuron	0.023		9.7	6.9	8.4	10.0	39.5
Jun 1	chlorsulfuron	0.047		7.4	6.4	8.2	11.4	40.2
Jun 1	chlorsulfuron + triclopyr	0.023 + 1.1		7.6	6.2	7.9	9.6	40.7
Significance Level (p)				0.3060	0.0592	0.0572	0.1741	0.7845
LSD (p=0.05)				n.s.	n.s.	n.s.	n.s.	n.s.
Jun 30	untreated check	- - -			7.0	7.4	10.2	45.5
Jun 30	metsulfuron	0.019			6.6	8.2	11.3	38.8
Jun 30	metsulfuron	0.038			5.2	8.6	12.7	46.4
Jun 30	metsulfuron + triclopyr	0.019 + 1.1			7.8	9.9	14.1	55.9
Jun 30	chlorsulfuron	0.023			6.7	7.7	12.3	45.4
Jun 30	chlorsulfuron	0.047			6.6	8.5	12.1	50.4
Jun 30	chlorsulfuron + triclopyr	0.023 + 1.1			6.1	8.0	11.3	39.9
Significance Level (p)					0.0871	0.0975	0.0748	0.2029
LSD (p=0.05)					n.s.	n.s.	n.s.	n.s.
Aug 7	untreated check	- - -				7.1	9.0	35.9
Aug 7	metsulfuron	0.019				5.4	10.0	35.3
Aug 7	metsulfuron	0.038				6.1	12.6	54.2
Aug 7	metsulfuron + triclopyr	0.019 + 1.1				5.8	11.4	44.7
Aug 7	chlorsulfuron	0.023				7.2	10.5	47.2
Aug 7	chlorsulfuron	0.047				6.4	9.4	39.8
Aug 7	chlorsulfuron + triclopyr	0.023 + 1.1				9.1	10.4	39.9
Significance Level (p)						0.4189	0.1280	0.2374
LSD (p=0.05)						n.s.	n.s.	n.s.
Sep 2	untreated check	- - -					8.4	29.5
Sep 2	metsulfuron	0.019					6.6	41.6
Sep 2	metsulfuron	0.038					4.6	31.8
Sep 2	metsulfuron + triclopyr	0.019 + 1.1					5.9	35.2
Sep 2	chlorsulfuron	0.023					8.4	39.4
Sep 2	chlorsulfuron	0.047					6.6	33.2
Sep 2	chlorsulfuron + triclopyr	0.023 + 1.1					4.7	25.3
Significance Level (p)							0.0103	0.1069
LSD (p=0.05)							2.2	n.s.

GROWTH RESPONSE OF SYCAMORE, OAK, ASH, AND TULIPTREE TO SOLID IMPLANT TREATMENTS OF FLURPRIMIDOL

J. P. Sterrett[1], P. L. Burch[2], Kent Redding[2], D. G. Luster[1], and P. T. Kujawski[1]

ABSTRACT

American sycamore (*Platanus occidentalis*), red oak (*Quercus rubra*), white ash (*Fraxinus americana*), and tuliptree (*Liriodendron tulipifera*) shade trees ranging from 11- to 18-years-old located in Frederick, MD, were treated with flurprimidol tree implants to determine growth inhibition efficacy.

Solid tree implants, consisting of flurprimidol in a starch carrier tablet, were inserted into 3/8-inch holes drilled 1 inch below the bark at the base of the tree and spaced evenly around the trunk. Sycamore was treated with 0.0, 1.0, or 1.5 g ai flurprimidol/inch diameter breast height (dbh); oak, ash, and tuliptree were treated with 0.0, 0.5, or 0.75 g ai flurprimidol/inch dbh. Crown diameter and terminal height were measured at treatment time in September 1992 and again in August 1993. Also, crown index (crown diameter^2 by height growth), which is an estimate of biomass, was determined.

After one growing season, the height growth of all species treated was inhibited by the flurprimidol implants, but crown diameter growth was not inhibited compared to untreated controls. The small, dark green leaves and shortened internodes characteristic of a trunk or soil injection application of flurprimidol were not obvious on any of the four species even though height growth was inhibited. Crown index was reduced on white ash and tuliptree but not on sycamore or red oak.

Based on previous basal drench experiments with flurprimidol in the same research area, growth inhibition, especially crown diameter growth, will probably be more evident during the second growing season.

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[1]USDA, Agricultural Research Service, Bldg. 1301, Ft. Detrick, Frederick, MD 21702.

[2]DowElanco, Quad III/4, 9002 Purdue Rd., Indianapolis, IN 46268.

BRUSH CONTROL PROVIDED BY FALL BROADCAST APPLICATIONS OF COMBINATIONS OF FOSAMINE AMMONIUM OR GLYPHOSATE WITH IMAZAPYR

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

ABSTRACT

As part of an ongoing research project funded by the Pennsylvania Department of Transportation (PennDOT), a trial evaluating brush control provided by imazapyr combined with fosamine ammonium (fosamine) or glyphosate, was established October 6, 1992. Repeated trials and field experience have demonstrated the effectiveness of fosamine plus imazapyr combinations to provide control of roadside brush with fall applications. Addition of imazapyr to the fosamine greatly increases the control spectrum, while maintaining the slow onset of symptoms desired by PennDOT. A difficulty with the combination has been finding rates that would limit control to the treated portion of the target brush, without sacrificing broad spectrum control.

Fosamine ammonium at 4.5, 5.6, or 6.7 kg/ha, in combination with 0.070 kg/ha imazapyr; and glyphosate plus imazapyr at 3.36 plus 0.070 kg/ha, respectively, were applied to brush at the edge of a utility right-of-way on the grounds of The Pennsylvania State University. Treatments were applied with a CO_2-pressurized plot sprayer equipped with a Radiarc[2/] spray head, delivering 280 L/ha at 207 kPa at a speed of 1.8 m/s, to a 4.0 m vertical swath in 60 m plots. All treatments included a spray oil adjuvant at 0.25 percent (v/v)[3/]. The predominant species were green ash (Fraxinus pennsylvanica Marsh.), black cherry (Prunus serotina Ehrh.), red oak (Quercus rubra L.), tatarian honeysuckle (Lonicera tatarica L.), and black locust (Robinia pseudoacacia L.). Visual ratings of brush control were taken for each plant in the treated area September 21, 1993, using a scale of 1 to 7, where '1' = no control, '5'= complete control of treated branches, '6'= control beyond treated branches, and '7'= complete control of the plant. Smaller plants that were completely controlled were assigned ratings of '5' if it appeared the entire plant was sprayed, or a '7' if only the side of the plant facing the sprayer was treated.

All treatments provided excellent control of black cherry, tatarian honeysuckle, green ash, and all oak species, which included red oak, white oak (Quercus alba L.), bear oak (Quercus ilicifolia L.), and pin oak (Quercus palustris L.) (Table 1). Reducing the rate of fosamine reduced the control of black locust, while the glyphosate combination completely killed this species. Control of hickory with the glyphosate combination was variable, as one plant approaching 5 m in height was completely controlled, while another marked for fall coloration at treatment had only slight injury. Glyphosate plus imazapyr caused only slight injury to the one red maple (Acer rubrum L.) in the treatment area. Impact of the treatments on the understory was difficult to determine as there was very little herbaceous growth present at treatment due to brush density. There was herbaceous growth scattered throughout the treated area when the study was rated.

Reducing the fosamine rate from 6.7 to 4.5 kg/ha in combination with imazapyr had little effect on the degree of control provided, except on black locust. The desired decrease in control of branches not treated was not achieved.

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

[2/] Waldrum Specialties, Inc., Doylestown, PA.

[3/] Clean Cut, Arborchem Products, Inc., Ft. Washington, PA.

TABLE 1: Average control ratings for brush treated October 6, 1992. Visual ratings were taken September 21, 1993 using a scale of 1 to 7, where '1'= no control, '5'= control of treated branches, '6'= partial control beyond treated branches, and '7'= complete control of plant without full coverage. Numbers in parentheses indicate number of plants in the treatment area. A '- -' indicates the species was not present in the treatment area.

	Herbicide Application Rates (kg ai/ha)			
Species	fosamine (6.7) plus imazapyr (0.07)	fosamine (5.6) plus imazapyr (0.07)	fosamine (4.5) plus imazapyr (0.07)	glyphosate (3.4) plus imazapyr (0.07)
	[---------- Average Control Rating (number of plants) ----------]			
oak[1/]	6.2 (14)	6.3 (3)	6.3 (12)	6.1 (22)
black cherry	6.6 (28)	5.8 (10)	6.0 (6)	5.8 (5)
tatarian honeysuckle	7.0 (28)	7.0 (6)	7.0 (10)	6.7 (21)
green ash	6.4 (7)	6.1 (13)	6.5 (4)	7.0 (1)
black locust	6.7 (6)	- - - -	4.8 (5)	7.0 (6)
Carya spp.	6.3 (3)	- - - -	6.8 (6)	4.5 (2)
European buckthorn	6.0 (1)	7.0 (3)	- - - -	7.0 (2)
bigtooth aspen	7.0 (2)	7.0 (12)	- - - -	- - - -
white pine	4.0 (2)	- - - -	- - - -	2.5 (2)
multiflora rose	- - - -	- - - -	7.0 (1)	7.0 (1)
Norway spruce	- - - -	2.0 (3)	- - - -	- - - -
black birch	- - - -	5.0 (2)	- - - -	- - - -
boxelder maple	- - - -	- - - -	7.0 (2)	- - - -
black walnut	- - - -	- - - -	5.0 (2)	- - - -
autumn olive	- - - -	- - - -	- - - -	6.0 (1)
red maple	- - - -	- - - -	- - - -	2.0 (1)
red pine	5.0 (1)	- - - -	- - - -	- - - -
Cretageus spp.	- - - -	- - - -	- - - -	7.0 (1)
flowering dogwood	5.0 (1)	- - - -	- - - -	- - - -
American elder	7.0 (1)	- - - -	- - - -	- - - -

1/ Primarily red oak, but also included white oak, bear oak, and pin oak .

SOME ECOLOGICAL OBSERVATIONS OF A RHODE ISLAND UTILITY RIGHT-OF-WAY

Richard Stalter [1]

Abstract

The vegetation found on permanent line transects on a utility right-of-way, Exeter, Rhode Island, was sampled in late May, 1993. Three sites, 2 dry and one wet, were selected for study. Gaylussacia baccata, Rubus hispidus and R. flagellaris were woody dominants on the two dry sites, with Smilax rotundifolia codominant at one site. Rubus hispidus and R. flagellaris are dominant on the wet site. Important herbaceous vegetation include: Carex pensylvanica, Potentilla canadensis, Solidago spp., Lysimachia quadrifolia and Schizachyrium scoparium at the dry sites while Solidago spp., Onoclea sensibilis, Sphagnum spp. and Typha latifolia were dominant on the wet site. Selective herbicide treatment of tree stump sprouts and tall shrub sprouts have eliminated or reduced the number of these undesirable taxa from the right-of-way.

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 rubra) 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 Stalter[5] sampled the arborescent vegetation in the forest adjacent to sites 1, 2, and 3, and calculated relative dominance (percent basal area) values 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.

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[1] Dept. of Biological Sciences, St. John's University, Jamaica, NY 11439

The soils on dry sites of this right-of-way are Narragansett fine sandy loams while Merrimac soils are dominant in 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].

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]. Fifteen 80-foot transects were laid out 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 & DISCUSSION

Selective spraying of arborescent vegetation has eliminated most of the trees from the right-of-way. *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 transents at the wet site in 1965, occurred at only three transects in 1993. The number of tree species on the right-of-way has been reduced from eleven species in 1965 to five in 1993. Huckleberry (*Gaylussacia baccata*), is the dominant shrub at the two dry sites. Two

dewberrys (Rubus flagellaris and Rubus hispidus) are also common at the dry right-of-way sites. Rubus flagellaris 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 a frequency value of 100% Goldenrod (Solidago spp.) and whorled loosestrife (Lysimachia quadrifolia), also occur at 100% of the transents 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.

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 exception of the herbicide resistant Acer rubrum[3]. Huckleberry and dewberry species were dominant on the dry right-of-way sites in 1993. Smilax rotundifolia has benefitted from the creation of the right-of-way, as bull briar was more abundant at the dry site, site 1, in 1993 than when studied by Stalter in 1965. Carex pensylvanica, cinquefoil (Potentilla canadensis), Lysimachia quadrifolia, little blue-stem (Schizachyrium scoparium) and several grasses are the most conspicuous members of the herbaceous strata on the dry right-of-way sites. The wet right-of-way site is dominated by Sphagnum spp., Carex spp., Solidago spp., Typha latifolia and Onoclea sensiblis.

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Table 1. Frequency values of shrubs on a Rhode Island right-of-way, sampled in late May, 1993.

Species	Site 1	Site 2	Site 3
Gaylussacia baccata	60	80	-
Rubus flagellaris	40	80	60
Smilax rotundifolia	-	100	-
Rubus hispidus	100	20	80
Clethra alnifolia	-	-	40
Rubus canadensis	40	40	40
Parthenocissus quinquefolia	-	40	60
Cornus amomum	-	-	60
Rhododendron viscosum	-	-	40

Table 2. Frequency values of herbs grasses and sedges on a Rhode Island right-of-way sampled in late May, 1993.

Species	Site 1	Site 2	Site 3
Carex pensylvanica	100	100	-
Panicum commutatum	20	40	-
Potentilla canadenis	100	80	-
Osmunda cinnamomea	-	-	60
Symplocarpus foetidus	-	-	80
Scirpus cyperinus	-	-	80
Solidago spp.	100	100	100
Aster spp.	-	-	60
Onoclea sensibilis	-	-	100
Lysimachia quadrifolia	100	100	-
Schizachyrium scoparium	100	40	-
Poa pratensis	80	60	
Juncus tenuis	60	-	-
Erigeron strigosus	60	-	-
Thelypterus palustris	-	-	80
Typha latifolia	-	-	100
Carex howei	-	-	80

DEER DENSITY EFFECTS ON PIN CHERRY IN ALLEGHENY HARDWOOD CLEARCUTS

Stephen B. Horsley[1]

ABSTRACT

Deer density is one of the most important factors affecting the species composition of vegetation in Pennsylvania's Allegheny hardwood forest. Changes in species composition are caused both directly by removal of palatable species by white-tailed deer (Odocoileus virginianus virginianus (Boddaert)) and indirectly by facilitation of increased abundance of unpalatable species which subsequently interfere with establishment of other plants. Pin cherry is a short-lived tree which arises from seeds present in the forest floor seed bank. Large numbers of the species typically germinate following large-scale disturbances such as windthrow, fire, or clearcutting in the forests of the northern United States and Canada. We evaluated the role of deer and forest cutting on vegetation at four 160 acre sites for 10 years in a large enclosure study where deer were maintained at densities of 0, 10, 20, 38, and 64 animals/sq mi. At each site, 10% of the area was clearcut, 30% was thinned and 60% remained uncut. The study showed that in clearcuts deer density was an important factor regulating the abundance of pin cherry stems and the species composition of commercial hardwood regeneration. Pin cherry was highly palatable to deer. After 10 years at densities of 38 or 64 deer/sq mi more than 75% of the regeneration sample plots were dominated by relatively unpalatable black cherry; fewer than 25% were dominated by pin cherry. Most of these stems were found in slash piles where deer could not reach them. At 0, 10, and 20 deer/sq mi dominance of regeneration sample plots by pin cherry averaged 50 to 75%, but was as high as 85%. There was an inverse relationship between the proportion of plots dominated by pin cherry 3 years after cutting and the proportion of plots dominated by commercial species of regeneration 10 years after treatment. Where pin cherry density was high, survival of shade-intolerant, intermediate tolerance and tolerant hardwood species was low. Since Allegheny hardwoods generally lack sources of very shade-tolerant regeneration, such as sugar maple and hemlock, interference with less shade-tolerant species of regeneration is significant for management of forest lands receiving low deer impact, such as fenced sites. Use of a shelterwood harvest sequence avoids this situation, since most pin cherry die in the shade of the shelterwood overstory.

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

ASSESSING VARIATIONS IN NON-ARBORESCENT VASCULAR SPECIES DIVERSITY OVER TIME IN ALLEGHENY HARDWOODS

Todd E. Ristau[1], Stephen B. Horsley[2], and Larry H. Mc Cormick[1]

ABSTRACT

Species diversity is an important attribute of biological communities, sometimes thought to be an index of community health and stability. The importance of species diversity as an indicator of community well-being was recognized in the National Forest Management Act of 1976 which requires that plant and animal diversity be maintained or improved by forest management activities on National Forest lands. Diversity of plants is difficult to measure because some have life cycles which last only a few weeks, while others last for months. Thus, time and frequency of sampling are important factors in assuring an adequate assessment of plant species diversity.

During the 1992 and 1993 growing seasons, a study was conducted to determine the seasonality of non-arborescent vascular species found in Allegheny hardwood forests. Four 20 acre stands, located on the Allegheny National Forest were sampled in the middle of each month from May through August. A split plot design was used to provide replication at each location. Thirty 1-milacre plots were located systematically throughout each area. At each of these plots, the non-arborescent vascular species present were recorded, and percent of the plot covered by each species was estimated ocularly. Species richness and several indices were calculated to compare differences among sampling times.

The results showed that certain species such as trout lily and dwarf ginseng were only present in May. Species such as hayscented and New York fern were present in juvenile form early in the growing season, but their foliage was not fully expanded until the end of June, making abundance difficult to assess until the July and August sample times. Diversity consists of two components 1) richness, or number of species and 2) evenness, or equitability of abundances. Indices which combine these two attributes showed that May was different from all other months (alpha=0.05). When diversity was measured as richness alone, the number of species present in May was the same as that in June, but May differed from July and August. When diversity was measured as evenness alone, the only difference was between May and June where May was more even than June. Our study suggests that adequate assessment of non-arborescent vascular plants in Allegheny hardwood stands requires sampling at least two times during the growing season, once early in the growing season and once later in the growing season.

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1 M.S. candidate and Associate Professor, School of Forest Resources, The Pennsylvania State University, University Park, PA 16802.

2 Plant Physiologist, USDA Forest Service, NEFES, Warren, PA 16365.

ESTER AND CARRIER FORMULATIONS FOR THIN-LINE BASAL APPLICATION

J.J. Bollig, S.M. Zedaker and S.R. Peter[1]

ABSTRACT

Formulated mixtures of triclopyr and picloram (Access) are effective when used as basal sprays for capable tree control. Current formulation employs triclopyr butoxyethyl ester (BEE) and a polymolecular picloram isooctyl ester (IOE). Monomolecular ethylheptyl ester formulations (EHE) of picloram that are more favorable to regulatory agencies can be manufactured. Efficacies may also be improved using non-volatile carriers, and varying the rates of triclopyr and picloram. The purpose of this study was to determine if different ester formulations (EHE vs. IOE), carriers, and triclopyr/picloram concentrations could improve the performance of the current formulation when used in a standard kerosene carrier.

Two hundred and forty rootstocks of 15-year-old red maple (Acer rubrum), chestnut oak (Quercus prinus), and hickory (Carya spp.), and 120 rootstocks of yellow-poplar (Liriodendron tulipifera) were randomly assigned one of six ester-carrier-rate treatment combinations (Table 1). Diameter at application heights (DAH) ranged from 1.0 to 8.0 cm. In early spring, treatments were applied at a rate of 0.5 ml/2.5 cm DAH (about 1/4 to 1/3 the standard application rate) using a syringe and completely encircle the stem. One year after treatment, the rootstocks were assessed for efficacy using an arcsine-pretransformed scale of crown necrosis. The scale used was: 0=0%, 1=15%, 2=50%, 3=85% and 4=100% necrosis. Analysis of covariance was used to detect treatment differences, with pretreatment diameter as the covariate. Fisher's LSD test was used for mean separation.

One year after treatment it was evident that yellow-poplar was the easiest to control, followed by red maple, hickory and chestnut oak. The standard IOE market formulation in kerosene was more efficacious than the EHE formulation in kerosene with the same active concentrations (Table 1). However, when used with vegetable oil carriers, the EHE formulation's effectiveness either equalled or exceeded the IOE formulation in kerosene. The aliphatic carriers were less effective. Although separations were achieved within species, increasing the picloram rate and decreasing the triclopyr rate did not increase efficacy when all species were considered.

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[1] Research Specialist, Professor and Graduate Research Assistant, Dept. of Forestry, Virginia Polytechnic Institute and State University, Blacksburg, VA 20461.

Table 1. Foliar necrosis and mortality (1YAT) for thin-line basal treatments applied at a rate of 0.5 ml/ 2.5 cm of basal diameter. Summer 1992 Ester/Carrier Study, Fishburn Forest, Blacksburg, Virginia.

Treatment[a]	Red Maple[b]	Chestnut Oak	Yellow-Poplar	Hickory	Average
[Picl(form)/Tric/Carrier]	<----------	----------	(percent)	----------	---------->
			Necrosis		
0.25 IOE/0.5/Kerosene	87 c[c]	34 bc	93 b	73 bc	72 c
0.25 EHE/0.5/Kerosene	48 a	14 ab	90 ab	52 ab	51 a
0.25 EHE/0.5/Veg. Oil	93 c	28 abc	94 b	93 d	77 d
0.25 EHE/0.5/Aliphatic	67 b	13 a	94 b	76 c	62 b
0.125 EHE/0.75/Veg. Oil	93 c	41 c	87 ab	89 d	77 cd
0.125 EHE/0.75/Aliphatic	89 c	31 bc	81 a	52 a	63 b
			Mortality		
0.25 IOE/0.5/Kerosene	66 c	26 bc	78	42 a	53 b
0.25 EHE/0.5/Kerosene	29 a	11 ab	74	30 a	36 a
0.25 EHE/0.5/Veg. Oil	81 c	19 abc	80	79 b	65 c
0.25 EHE/0.5/Aliphatic	47 b	8 a	80	44 a	45 a
0.125 EHE/0.75/Veg. Oil	77 c	34 c	66	74 b	63 bc
0.125 EHE/0.75/Aliphatic	72 c	20 abc	59	29 a	44 a

[a] Picloram/Triclopyr rates are lbs. ae. per gallon of formulation. IOE is a polymolecular isooctyl ester and EHE is a monomolecular ethylheptyl ester.

[b] Values represent the means of 40 stems/treatment for red maple, chestnut oak and hickory, and 20 stems/treatment for yellow-poplar.

[c] Numbers within columns followed by same letter not significantly different at $p = 0.05$ from analysis of covariance using basal diameter as the covariate.

EFFECTS OF RATE AND TIMING OF GLYPHOSATE APPLICATION ON FOREST VEGETATION

F.W. Bell[1], C. Hollstedt and Dr. Azim Mallik

ABSTRACT

To assist field foresters in making the most effective use of Vision, a field study was established, in 1990, to examine and demonstrate the seasonal susceptibility of Canada blue-joint grass to Vision. The trial, a completely randomized factorial design, was established approximately 60 km west of Thunder Bay, Ontario. The two factors were application rate (1.1 and 1.7 kg a.e. glyphosate/ha) and timing (July 19, Aug. 1, Aug. 15, Aug.29, Sept. 10, and Sept. 26). The two rates represent the most frequently used application rates in northwestern Ontario in 1990 and the six timings cover the potential window of conifer release with Vision. Each treatment was replicated three times. Treatment plots measured 20 m by 40 m. Ten circular sample plots (1.13 m radius) were systematically located within the treatment plots.

Vision was applied from a carbon dioxide powered backpack sprayer with a No. 9 flat-fan nozzle at a nozzle pressure of 16 p.s.i. An extended boom was used to allow chemical dispersal at four meters above ground level.

Pre-spray measurements were made in late summer 1990 and post-spray measurements were conducted mid-July to early August 1991, 1992 and 1993. Percent cover and average height of Canada blue-joint grass, as well as other plant species, were recorded each time. Percent cover estimations were recorded in five percent classes.

Samples of blue-joint grass were collected at the time of each spray and stage of phenological development was recorded. To computerize the phenological observations, Dierschke's (1970) coding system was used. Two codes, one for vegetative development and the other for reproductive development, were assigned to each observation.

A Kruskal-Wallis test revealed that there were significant differences between the times of application, but not between the rates of application. Applications made in late August provided significantly better control of Canada blue-joint grass than applications made at other times (Table 1). Control provided by the August 15 sprays was potentially reduced by a 6 mm rainshower that occurred shortly after application .

In conclusion, August or early September applications of Vision will provided control of blue-joint grass. For greatest control, with the least amount of herbicide, late August applications are recommended. The late August timing corresponds with the end of shoot elongation and mid- to late seed maturation of Canada blue-joint grass.

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[1]Forest Vegetation Management Scientist, Ontario Forest Research Institute, Sault Ste. Marie, ON P6A 5N5

Table 1. Ranking and of median percent cover of Canada blue-joint grass in 1991 based on time of application.

Rate (kg a.e./ha)	Spray Date					
	July 19	Aug. 1	Aug. 15	Aug. 29	Sept. 10	Sept.29
1.1	17.50a[1]	4.58ab	23.83a	3.16b	8.75ab	17.92a

1 Values followed by the same letter are not significantly different.

EFFECTS OF MANUAL MECHANICAL AND HERBICIDE CONIFER RELEASE ON NORTHWESTERN ONTARIO ECOSYSTEM PROCESSES

R. A. Lautenschlager, F. Wayne Bell and Robert G. Wagner[1]

ABSTRACT

A study has been established in northwestern Ontario, ~70 km southwest of Thunder Bay, near Fallingsnow lake, to examine the effects of alternative, and standard (aerial herbicides) vegetation management techniques on: vegetation, wildlife, and ecosystem processes in regenerating spruce plantations. The study has 4 blocks with 5 treatment plots ($\geq$4 ha)/block. Treatments include: manual release (brushsaw), mechanical release (Silvana Selective), aerial application of 2 herbicides (Vision® - a.i.= glyphosate, Release* - a.i. = triclopyr), and no treatment (control). In addition each Vision® plot contains a 40 X 50 m sub-plot where vegetation will be treated annually with Vision® during the expected 5 years of study. Mean survival and growth figures obtained from these sub-plots will document survival and productivity potential.

This cooperative study is being led by researchers with the **Vegetation Management Alternatives Program (VMAP)**, a component of the Ontario Ministry of Natural Resources (OMNR) Sustainable Forestry Program at the Ontario Forest Research Institute (OFRI). Researchers at the OFRI are responsible for monitoring vegetation changes, forage availability, crop-trees, small mammals, and brushsaw productivity. Other major cooperators include: other OMNR groups - Northwest Region Science and Technology - moose [Alces alces](food quality and habitat use) and technology transfer, Thunder Bay District (South) - field support, spray operations, and public relations; Lakehead University - arthropods (below & above ground), gastropods, songbirds; University of Guelph - amphibians & reptiles, soil descriptions, and soil nutrient dynamics; Sault College - technical support; Natural Resources Canada - spray deposit; Forest Engineering Research Institute of Canada - machine productivity; Monsanto Canada Inc. and DowElanco Canada Inc. - herbicides, herbicide off-target movement.

Pre-treatment data for all components was collected during the 1993 growing season. Herbicide treatments were applied in mid-August 1993, and manual and mechanical treatments were applied in late- October 1993. Results from this integrated study will contribute to the highest priority forestry research areas in Canada [Forestry Chronicle (1992)68:752-756]. Specifically it will provide data on: effects of "weed" management, alternatives to chemicals, and intensive forest management on the forest ecosystem; environmental effects of early stand management; forest growth and yield; and environmental consequences of increased productivity.

[1] Ontario Forest Research Institute, 1235 Queen St. East, Sault Ste. Marie, Ontario.

ONTARIO'S VEGETATION MANAGEMENT ALTERNATIVES PROGRAM (VMAP)

R.G. Wagner[1]

ABSTRACT

In 1991, the Minister of Natural Resources announced Ontario's Sustainable Forestry Program. The intent of this program is to shift provincial forest policy, research, and practice in a direction that will more fully incorporate concepts of sustainable development. Recognizing the need to advance forest regeneration practices, one initiative started under this program is the Vegetation Management Alternatives Program (VMAP). The goal of the VMAP is to develop approaches to managing forest vegetation that can reduce dependence on herbicides in Ontario's forests. This goal is being accomplished by developing alternatives to current uses of forest herbicides, and by gaining a better understanding of forest ecosystems.

The program is being accomplished through research, education and field delivery:

The **Adaptive Research** component of the program focuses on applied research to: 1) develop alternative treatments; 2) document crop tree and ecosystem responses; and 3) develop decision-support models for vegetation management. Current research trials are examining the use of sheep, mulches, cover crops, manual cutting, mechanical equipment, prescribed burning, and ground-applied herbicides as alternatives to aerial herbicide application. Many of these studies also are examining the effects of alternative treatments on vegetation dynamics, crop tree growth and survival, and wildlife uses.

The **Fundamental Research** component focuses on advancing the basic sciences that support forest vegetation management. This effort involves research institutions across Canada. Current projects concentrate on: 1) ecosystem dynamics; 2) biological methods of weed control; and 3) the social interface with vegetation management.

Education efforts include: 1) an Advanced Forest Herbicides Course; 2) continuing education (including many workshops, conferences, newsletters, technical reports, software, etc.); and 3) public education events about vegetation management practices.

The **Field Delivery** component relies on four regional Science and Technology Development Units. These units provide a regional focus for client access, technology transfer and education, expertise on local forestry problems, and assistance with adaptive research projects. The field delivery effort helps ensure that alternative practices are transferred to operational programs.

The VMAP currently has over 80 ongoing projects. A 1992/93 annual report with details of these projects is available upon request at the above address or by calling 705/946-2981.

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[1] Program Leader, Ontario Forest Research Institute, P.O. Box 969, 1235 Queen Street East, Sault Ste. Marie, Ontario P6A 5N5

Most foresters also consider fireweed to be a serious competitor threatening conifer seedling establishment and growth. Forest sites are routinely mechanically site prepared prior to planting, and most sites are released with glyphosate within one or two years after planting (1, 3). Glyphosate is also used to release naturally regenerated sites. Other herbicides routinely used to control these species include liquid and granular hexazinone formulations applied prior to planting (7, 11).

Early research clearly demonstrated that liquid hexazinone is effective in controlling raspberry competition (10). Three years after treatment, raspberry cover was dramatically reduced, and fireweed cover dramatically increased (6). Raspberry and fireweed cover were found to be strongly correlated to the health and growth of 2+1, bareroot, white spruce [Picea glauca (Moench) Voss] seedlings planted one year after hexazinone treatment. Increases in raspberry cover were directly correlated to decreases in health and growth of the seedlings. Conversely, increases in fireweed cover were directly correlated to increases in seedling health and growth. In 1987, half of the original blocks treated with hexazinone in 1984, were retreated with glyphosate (12). By 1989, this release treatment had resulted in a shift from fireweed and raspberry to grass species. The release did not result in any apparent decline in white spruce health, but enhanced growth over control seedlings. The increase was modest and short-term, lasting only one year.

This paper is an extension of this previous research, and presents data collected in August 1989 relating to raspberry and fireweed density, height, and biomass and to standing crop nutrient pools. Objectives of this study were to (a) assess natural development of raspberry competition following clearcutting and mechanical site preparation, (b) to assess fireweed succession after treatment with liquid hexazinone, and (c) to compare nutrient pools contained in the above-ground biomass of the two species.

METHODS

The study area is located on J.D. Irving, Ltd. land in northwestern New Brunswick near the town of St. Leonard (6, 10, 12). The site was clearcut during the winter of 1980-81 and mechanically site prepared in April 1985, using a 125-ton Letourneau crusher to fell snags and break up residual logging slash. Prior to harvesting, the site supported a stand of northern hardwoods. In May 1984, portions of the site were aerially treated with liquid hexazinone (2, 3, and 4 kg ai/ha). Two 4 ha replicates of each treatment rate, plus two 4 ha control blocks were established. In September 1987, one replicate of each treatment was retreated with glyphosate.

In August 1989, raspberry and fireweed productivity were sampled in the remaining control block (raspberry only) and the remaining 3 and 4 kg ai hexazinone blocks (fireweed only). Sampling was intended to quantify natural development of raspberry in the control and succession of fireweed in blocks site prepared with hexazinone. Within these blocks, four 1 m^2 areas were sampled for each species. Sample areas were selected to ensure 100% cover. Within each sample area, stem density and minimum and maximum height were determined. Destructive sampling consisted of dividing tissues into leaf, stem, or root components. These were bagged, and removed to the laboratory for oven-drying at 80°C.

Tissue samples were analyzed by A & L Canada Laboratories East, Inc. (London, Ontario) for nutrient contents. Tissues were ground, ashed via a modified dry-ashing procedure, and extracted using dilute HCl (unpublished procedure developed by A & L Canada Laboratories East to prevent loss of P, S, and B during extraction; Dr. Ravi Kanipayor, personal communication). Samples were then analyzed for P, K, Mg, Ca, S, Zn, Cu, Fe, Mn, B, Al, and Na by inductively coupled plasma (ICP) spectrometry. Tissues were also ground and Kjeldahl extracted for total N, and samples were analyzed using a Technicon autoanalyzer. NO_3 was extracted with 1 N HCl, and colorimetrically determined using a Technicon autoanalyzer.

Analyses of variance (ANOVA's) were performed on measured or calculated parameters.

RESULTS

Mean dimensional characteristics for raspberry (nine years after clearcutting) and for fireweed (six years after site preparation with hexazinone) are presented in Table 1. Stems weighed more than other tissues. Above-ground raspberry biomass was 734 g/m^2, compared with 588 g/m^2 for fireweed. Total raspberry biomass for all tissues, including roots, was 1108 g/m^2. Stem biomass for raspberry and fireweed differed, but leaf biomass and height did not. Differences in density and above-ground biomass ($p = 0.074$) were nearly significant.

TABLE 1. Mean density, height, and biomass of raspberry and fireweed after site disturbance or hexazinone treatment.

Measurement	**Raspberry**		**Fireweed**		
	mean	std. err.	mean	std. err.	p =
Density (stems/m^2)	60.5	8.0	40.2	3.5	0.092
Height (cm)					
minimum	49.2	8.7	62.5	5.7	0.31
maximum	177.2	33.2	196.0	6.6	0.65
average	113.2	13.7	129.2	4.8	0.38
Biomass (g/m^2)					
roots	373.6	63.8	-	-	-
stems	548.5	26.6	384.6	33.7	**0.016**
leaves	185.6	13.9	203.0	10.3	0.42

Nutrient concentrations differed for several elements, including N, P, K, Ca, Na, B, Zn, and Mn, and were generally higher for raspberry (Table 2). Nutrient standing crop values differed for several elements including N, P, Ca, S, B, Zn, Mn, Fe, and Cu, and were generally higher for raspberry (Table 3). Standing crop values for above-ground tissues (i.e., stem + leaf) differed for several elements including N, P, Zn, and Mn ($p = 0.034$, 0.029, 0.002, and 0.046, respectively), and were higher for raspberry. Significant differences in tissue NO_3 content and NO_3 standing crop were unobserved (Table 4).

TABLE 2. Raspberry and fireweed elemental concentrations for above-ground tissues.

Measurement	Raspberry		Fireweed		
	mean	std. err.	mean	std. err.	p =
% N					
stem	0.67	0.22	0.66	0.04	0.81
leaf	**2.42**	0.12	1.64	0.09	**0.004**
% P					
stem	0.09	0.01	0.11	0.01	0.23
leaf	**0.32**	0.04	0.19	0.01	**0.034**
% K					
stem	0.36	0.04	**0.98**	0.14	**0.011**
leaf	**1.9**	0.13	1.03	0.14	**0.008**
% Mg					
stem	0.07	0.004	0.10	0.01	0.12
leaf	0.26	0.01	0.34	0.03	0.071
% Ca					
stem	0.31	0.03	0.43	0.04	0.078
leaf	0.89	0.08	**1.6**	0.21	**0.036**
% S					
stem	0.035	0.002	0.038	0.002	0.54
leaf	0.14	0.005	0.36	0.21	0.41
% Na					
stem	0.01	0.0	**0.02**	0.004	**0.05**
leaf	0.02	0.002	0.02	0.002	1.00
ppm B					
stem	**11.0**	0.8	8.2	0.4	**0.037**
leaf	33.2	1.1	38.2	3.4	0.27
ppm Zn					
stem	**66.5**	4.7	30.8	3.4	**0.002**
leaf	53.0	5.3	**83.8**	5.8	**0.014**
ppm Mn					
stem	295.2	54.2	208.0	60.1	0.39
leaf	**1300.2**	249.7	330.0	69.1	**0.018**
ppm Fe					
stem	41.2	10.3	17.5	1.6	0.097
leaf	109.8	7.1	122.8	8.3	0.34
ppm Cu					
stem	5.0	0.4	4.5	0.2	0.36
leaf	9.8	0.4	10.2	0.6	0.59
ppm Al					
stem	53.8	14.0	57.8	3.6	0.82
leaf	240.2	26.2	202.5	20.3	0.36

TABLE 3. Raspberry and fireweed elemental standing crop values (**g/m²**) for above-ground tissues.

Measurement	Raspberry		Fireweed		
	mean	std. err.	mean	std. err.	p =
Nitrogen					
stem	**3.67**	0.21	2.50	0.18	**0.011**
leaf	4.46	0.32	3.35	0.35	0.086
Phosphorus					
stem	0.49	0.02	0.40	0.03	0.10
leaf	**0.58**	0.04	0.39	0.04	**0.036**
Potassium					
stem	1.90	0.16	3.93	0.81	0.078
leaf	3.54	0.38	2.15	0.40	0.072
Magnesium					
stem	0.39	0.02	0.38	0.06	0.84
leaf	0.49	0.04	0.71	0.09	0.096
Calcium					
stem	1.64	0.10	1.63	0.17	0.97
leaf	1.61	0.06	**3.26**	0.48	**0.025**
Sulfur					
stem	**0.19**	0.01	0.14	0.004	**0.003**
leaf	0.26	0.02	0.72	0.42	0.38
Sodium					
stem	0.06	0.003	0.08	0.01	0.21
leaf	0.03	0.01	0.04	0.01	0.66
Boron					
stem	**0.006**	0.0003	0.003	0.0004	**0.004**
leaf	0.006	0.0003	0.008	0.001	0.14
Zinc					
stem	**0.04**	0.001	0.01	0.001	**0.000**
leaf	0.01	0.001	**0.02**	0.002	**0.011**
Manganese					
stem	0.17	0.04	0.08	0.02	0.086
leaf	**0.25**	0.06	0.06	0.01	**0.032**
Iron					
stem	**0.02**	0.01	0.01	0.001	**0.050**
leaf	0.02	0.001	0.02	0.003	0.18
Copper					
stem	**0.003**	0.0001	0.002	0.0001	**0.002**
leaf	0.0018	0.0002	0.0021	0.0002	0.45
Aluminum					
stem	0.03	0.01	0.02	0.001	0.42
leaf	0.04	0.004	0.04	0.01	0.80

TABLE 4. Raspberry and fireweed nitrate concentrations and standing crop values for above-ground tissues.

Measurement	Raspberry		Fireweed		
	mean	std. err.	mean	std. err.	p =
NO_3 concentration (%)					
stem	0.43	0.18	0.32	0.22	0.76
leaf	0.57	0.22	0.22	0.03	0.22
NO_3 standing crop (g/m^2)					
stem	2.46	1.16	1.53	1.09	0.63
leaf	0.99	0.33	0.44	0.07	0.21

DISCUSSION

There are few other reports of raspberry or fireweed productivity in the literature (2, 4, 5, 13-15). Raspberry establishment in nature is associated with site disturbance where light, nutrients (i.e., especially N), and moisture have become abundant (14). These conditions prevail (2, 5, 14) with clearcuts, spruce budworm damage, or where the overstory has been removed (e.g., herbicide release). Lautenschlager (2) observed that raspberry shoot/root ratios declined as site conditions became unfavorable for growth of raspberries.

Monthy (4) observed that raspberry density generally increases rapidly after disturbance, peaking at year 3, and gradually decreasing thereafter. He reported densities of approximately 50 stems/m^2 at year 3 and 13 stems/m^2 at year 16. Roberts and Dong (13) reported average raspberry height to be 80 cm four years after site disturbance. They observed that germination, survival, and height were greater for disturbed than for undisturbed sites. Whitney (14) also reported that productivity increases rapidly, and peaks at approximately 1000 g/m^2 during the fourth year after disturbance. Whitney (14) reported above-ground net primary productivity to be approximately 800 g/m^2 at year 4, and similar to 1127 g/m^2 reported by Whittaker (15). Raspberry stem density reported here is slightly higher than that reported by Monthy (4) at year 3 and raspberry standing crop is slightly less than that reported by Whitney (14, i.e., 1353 g/m^2) at year 4. Whitney (14) reported root biomass to be 272 g/m^2 at year 4, with a corresponding shoot/root ratio of 2.17. The present shoot/root ratio of 1.47 suggests that site conditions have not yet become unfavorable for raspberry growth.

Nutrient concentrations found in raspberry tissues suggest that this species is a greater competitor for most nutrients, including nitrogen, than fireweed. Since nitrogen is the nutrient most correlated with enhancing conifer seedling growth, we conclude that the shift to fireweed after hexazinone site preparation was beneficial to the growth of white spruce. This shift likely explains why healthier and larger seedlings were found growing in association with fireweed, whereas smaller, less healthy seedlings were observed growing in association with raspberry (6). We suspect that raspberry may also be a more serious competitor for light and moisture, and recommend that additional studies be pursued to quantify competition for

these resources.

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INTERACTION OF LANDSCAPE FABRICS, MULCHES, AND METOLACHLOR

Jeffrey F. Derr[1]

ABSTRACT

The effect of various landscape fabrics, mulches, and metolachlor placement on weed control was investigated in a field trial. Five plants each of euonymous (Euonymous japonicus) and London planetree (Platanus x acerifolia 'Columbia') were planted in a straight row in each plot. Plot size was 6 feet by 15 feet. Fabrics were slit in the middle to allow installation around the landscape plants. Fabrics evaluated were: a homeowner and commercial grade of Weed-X, homeowner and commercial grade of Typar, Pro-5 Weed Barrier, and Duon. A two inch depth of either shredded pine bark or a lava rock mulch was placed above the landscape fabrics. The mulches were also applied without a landscape fabric. Metolachlor (Pennant 5G) was applied at 4.0 lb ai/A either under or above the two mulches. Metolachlor was also applied either prior to fabric installation, or after mulch was placed above the landscape fabric. One set of plots received no mulch, landscape fabric, or herbicide.

Yellow nutsedge (Cyperus esculentus) shoots were counted four weeks after metolachlor application. Annual grasses [mixture of large crabgrass (Digitaria sanguinalis), goosegrass (Eleusine indica), fall panicum (Panicum dichotomiflorum), and yellow foxtail (Setaria glauca)] and carpetweed (Mollugo verticillata) were counted in each plot six weeks after metolachlor application.

More yellow nutsedge shoots were observed in the pine bark alone treatment than in lava rock applied alone. Fewer yellow nutsedge shoots were found in landscape fabric plus lava rock treatments than in landscape fabric plus pine bark plots. More yellow nutsedge shoots were observed when metolachlor was applied above pine bark mulch compared to application under pine bark mulch. Excellent yellow nutsedge control was observed when metolachlor was applied either above or under lava rock. When combined with pine bark mulch, both grades of Weed-X, and the commercial grade of Typar gave greater yellow nutsedge control than Pro-5 Weed Barrier or Duon. The two mulches completely controlled carpetweed when applied alone or in combination with a landscape fabric or metolachlor. Fewer annual grasses were observed in lava rock plots than in pine bark mulch plots. Fewer annual grasses were found in landscape fabric plus pine bark mulch treatments than in plots receiving only pine bark. No annual grasses were found in Weed-X plots. Herbicide placement, choice of landscape fabric, and mulch type all can impact weed control in landscapes.

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

IR-4 Ornamental Program Update[1]

Daniel L. Kunkel and J. Ray Frank[2]

ABSTRACT

During the past five years the IR-4 project has funded nearly 2,000 research trials to support new ornamental registrations. Approximately 1,200 of these trials were conducted with herbicides. Herbicides researched for their potential use in landscape and ornamental production included: asulam, benefin + oryzalin, bentazon, bifenox, chlorimuron, DCPA, dicamba, fluazifop-p-butyl, lactofen, metolachlor, metolachlor + simazine, napropamide, oryzalin, oxadiazon, oxyfluorfen, oxyfluorfen + oryzalin, oxyfluorfen + pendimethalin, pendimethalin, sethoxydim, simazine, sulfometuron-methyl and trifluralin. During this five year period, 830 reports were sent to pesticide manufacturers in support of new ornamental registrations, over five hundred of these reports were for herbicides. Since 1989, over 450 new ornamental uses (265 for herbicides) have been added to pesticide labels due to research supported by the IR-4 project.

[1] New Jersey Agricultural Experiment Station Publication, No. A - 27200-06-93, Supported by State, U.S. Hatch Act and other U.S. Department of Agriculture funds.

[2] Herbicide Project Coordinator and Ornamental Coordinator, IR-4 Project, Cook College, Rutgers University, New Brunswick, NJ

MANAGING HAIRY VETCH AS A COVER CROP IN NURSERIES OF WOODY ORNAMENTALS

John F. Ahrens[1]

ABSTRACT

Hairy vetch (Vicia villosa Roth.) as a cover crop can reduce soil erosion and nitrogen fertilizer requirements, provided it can be killed in the spring. Uncontrolled vetches can become serious weed pests in nursery plantings. In experiments conducted over 20 years ago we found dichlobenil effective in controlling established vetch in nurseries.

Experiments were conducted on sandy loam soils in 1992 and 1993 to determine residual effects of spring herbicides on establishment of hairy vetch in late August and effects of postemergence herbicides on control of established hairy vetch the following spring.

Residues of isoxaben at 0.5 or 1.0 lb/A plus oryzalin at 1.5 lb/A applied in early June 1992 reduced stands of vetch seeded in late August. However, reapplication of isoxaben plus oryzalin in early May 1993 had no effect on hairy vetch seeded in August. Residues of oryzalin plus lactofen 0.8 lb/A, oxyfluorfen 0.4 lb/A or clopyralid 0.5 lb/A had no effect on vetch establishment in either year.

Hairy vetch overtopped low growing ornamentals by early May in Connecticut. Early control is essential to prevent overtopping and subsequent plant disfigurement. Early applications may also be necessary to reduce the injury potential of herbicides that are more safely applied before bud break of ornamental plants.

In one experiment herbicides were sprayed over Taxus 'Densiformas' just before bud break. Herbicides ineffective in controlling established hairy vetch included oxyfluorfen, 0.4 to 1.6 lb/A, lactofen, 0.2 to 0.8 lb/A, or glyphosate 0.25 to 0.75 lb/A. Imazaquin gave poor control at 0.5 lb/A and good control at 1.0 lb/A; both rates injured Taxus. Imazapyr 0.125 or 0.25 lb/A also gave good control but injured Taxus. Sulfometuron methyl 0.19 oz/A gave 90% control with slight chlorosis in Taxus. Clopyralid 0.125 lb/A plus oxyfluorfen 0.4 lb/A and 2,4-D butoxy ethanol ester 0.5 or 1 lb a.e./A gave excellent vetch control without Taxus injury.

In a second experiment with sprays over actively-growing ornamentals, clopyralid 0.125 lb/A gave complete control of vetch and no significant injury to Taxus cuspidata, hemlock (Tsuga canadensis), Cotoneaster salicifolia or Juniperus horizontalis plumosa compacta 'Andorra Compacta' and only slight injury to Forsythia intermedia 'Lynnwood Gold'.

These preliminary experiments indicate future possibilities for managing hairy vetch as a cover crop in certain woody ornamentals.

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

COMPARISON OF SHARPSHOOTER® FORMULATIONS

[1]R.H. Uva, [2]A.F. Senesac, and [3]J.C. Neal

ABSTRACT

Trials were conducted on established birdseye pearlwort (Sagina procumbens L.), and on 11 seedling weeds to compare the 18% and 60% (MYX-6121) formulations of Sharpshooter (saturated fatty acids). Herbicide trials were conducted in a greenhouse at Cornell University in the spring and summer of 1993 to compare the efficacy of two Sharpshooter formulations on established birdseye pearlwort. Plants were treated with 18% and 60% Sharpshooter formulations (11 oz/qt), glyphosate (1.5 lb ai/A), and diquat (1 lb ai/A), each at 30 GPA. A rapid response occurred with the diquat and Sharpshooter treatments, the foliage turned yellow and brittle. By 14 days after treatment plant recovery had taken place in the Sharpshooter and diquat treatments; a second application was applied to all treatments. The 60% Sharpshooter formulation, diquat, and glyphosate, all controlled established birdseye pearlwort. Diquat controlled established pearlwort with 2 treatments; it appears likely that glyphosate would have controlled 100% with 1 treatment. By two months after the initial treatment, recovery took place in plants treated with both Sharpshooter formulations, consequently, repeated applications would be needed to control established birdseye pearlwort. The 60% formulation controlled established pearlwort better than the 18% formulation. Recovery did not take place in the diquat and glyphosate treatments.

Trials on seedling weeds were conducted at the Long Island Horticultural Research Laboratory in the summer of 1993. Sharpshooter 18% formulation was applied at doses equivalent to the high label rate (11 oz/qt) at different spray volumes (25, 50, and 100 GPA). Sharpshooter 60% was applied at 25, 50, and 100 GPA both at amounts equivalent to the active ingredient, and at the same dilutions as the Sharpshooter 18% treatments. Diquat was applied at 1 lb ai/A in 25 GPA for comparison. Pigweed (Amaranthus spp.), galinsoga (Galinsoga spp.), mouseear chickweed (Cerastium vulgatum L.), and yellow woodsorrel (Oxalis stricta L.) seedlings were controlled by all treatments. Hairy bittercress (Cardamine hirsuta L.), common groundsel (Senecio vulgaris L.), common chickweed [Stellaria media (L.) Vill.], and birdseye pearlwort were controlled with each fatty acid treatment applied at 100 GPA, and by diquat. At 100 GPA the 18% and 60% formulations gave similar control, except for horseweed [Conyza canadensis (L.) Cronq.], which was controlled better by the 18% formulation. At low spray volume amounts the 18% formulation provided slightly better control. Any difference between formulations can be ameliorated by increasing the spray volume.

With both formulations, higher sprayer volume provided better control of most species. At low spray volumes, Sharpshooter 18% formulation worked as well or better on most of the seedling weeds than the 60% formulation; any difference between formulations can be ameliorated by increasing the spray volume. However, the new formulation was significantly better on established birdseye pearlwort. On seedlings no difference was observed between the low and the high rate for the 60% formulation, suggesting the rate could be reduced without sacrificing efficacy. The newer 60% formulation is less viscous, easier to handle in mixing and when cleaning spray equipment, and provided better control of established pearlwort than the 18% formulation. However, to retain comparable seedling weed control, as the 18% formulation, the 60% formulation must be applied at high gallonage (approximately 100 GPA).

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[1]Technician, Dept of Floriculture and Ornamental Hort., Cornell Univ., Ithaca, NY 14853
[2]Weed Science Specialist, Cornell Cooperative Extension, Long Island Horticultural Research Laboratory, Riverhead, NY 11901
[3]Assoc. Prof., Dept. of Floriculture and Ornamental Hort., Cornell Univ., Ithaca, NY 14853

EVALUATION OF PREEMERGENCE HERBICIDES FOR WOODY AND HERBACEOUS CONTAINER GROWN-ORNAMENTALS

Andrew F. Senesac[1]

ABSTRACT

In 1992 and 1993, several herbicide combinations were evaluated for crop safety on a number of container-grown woody and herbaceous ornamentals. A separate study was conducted to examine efficacy in controlling several annual weed species.

The combination treatments: trifluralin plus isoxaben applied at 4.0 and 1.0 lb/a, oryzalin plus isoxaben applied at 3.2 and 0.8 lb/a, oryzalin plus benefin applied at 2.5 and 2.5 lb/a, oxadiazon plus butralin applied at 4.0 and 6.0, simazine plus metolachlor applied at 1.0 and 4.0 lb/a and oxyfluorfen plus pendimethalin applied at 2.0 and 1.0 lb/a were well tolerated by most of the species tested. These included: California privet (Ligustrum ovalifolium L.), andorra juniper (Juniperus horizontalis 'Plumosa' Moench.), Japanese holly (Ilex crenata Thunb.), false cypress (Chamaecyparis obtusa Endl.), azalea (Rhododendron sp. 'Hersey Red'), forsythia (Forsythia x intermedia Zab.), lilac (Syringa x Prestoniae McKelv.), dahlia (Dahlia 'mixed hybrids'), and astilbe (Astilbe 'mixed hybrids').

All herbicide combinations provided very good to excellent control of: annual bluegrass (Poa annua), horseweed (Conyza canadensis), and hairy galinsoga (Galinsoga ciliata). Common chickweed (Stellaria media) was poorly control by oxadiazon plus butralin, but generally well controlled by the other treatments. Yellow woodsorrel (Oxalis stricta), was well controlled by all treatments, except simazine plus metolachlor in one of the two years.

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

PREEMERGENT HERBICIDES FOR FIELD NURSERY STOCK

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

ABSTRACT

Two tests were conducted to evaluate annual dicot and grass weed control: one in Ithaca, NY (silty clay loam) and one in Riverhead, NY (sandy loam). Treatments included MON 12051 @ 0.031, 0.062, and 0.125 lb ai/A; isoxaben @ 0.25, 0.38, and 0.5 lb/A; and F6285 @ 0.25, 0.5, and 0.75 lb/A. Also compared were metolachlor (Pennant) 7.8EC and 55DF @ 3 lb/A, SAN 582 (Frontier) @ 1.5 lb/A, and norflurazon @ 2.4 lb/A; each applied alone or in combination with oryzalin (Surflan) @ 2 lb/A or prodiamine (Barricade) @ 0.75 lb/A. These treatments were compared to a "chemical standard" of simazine + oryzalin @ 1 + 2 lb/A. Weeds in the Ithaca test included hairy galinsoga (*Galinsoga ciliata*), lambsquarters (*Chenopodium album*), triazine resistant pigweed (Powell's amaranth, *Amaranthus powellii*), black nightshade (*Solanum nigrum*), and a mixture of summer annual grasses including smooth crabgrass (*Digitaria ischaemum*), giant foxtail (*Setaria faberi*), and witchgrass (*Panicum capillare*). Weeds in Riverhead included barnyardgrass (*Echinochloa crus-galli*), fall panicum (*Panicum dichotomiflorum*), large crabgrass (*D. sanguinalis*), pigweed (*Amaranthus* spp.), lambsquarters, ragweed (*Ambrosia artemisiifolia*), and western salsify (*Tragopogon dubius*).

Mon 12051 controlled ragweed @ 0.031 lb/A; galinsoga, salsify and pigweed @ 0.062 lb/A; and lambsquarters @ 0.125 lb/A, but did not control annual grasses or black nightshade. F6285 controlled nightshade, pigweed, lambsquarters, and grasses @ 0.25, but was less effective on galinsoga. Isoxaben did not control grasses, ragweed, or salsify. In Riverhead, pigweed and lambsquarters were controlled. In contrast to that and to previous years' data, isoxaben did not adequately control lambsquarters or pigweed @ 0.5 lb/A and galinsoga control was 83% in the Ithaca test.

Metolachlor EC and DF @ 3 lb/A provided similar weed control. Grasses were completely controlled; lambsquarters, ragweed and salsify were not controlled; and galinsoga control was short-lived with only 50% control at the end of the season. In Riverhead pigweed was controlled but not in Ithaca. Weed control with SAN 582 @ 1.5 lb/A was similar except pigweed control was better than with metolachlor in Ithaca (58% vs. 25%), but slightly worse in Riverhead. Galinsoga control was slightly better than with metolachlor. Nightshade control was good with both acetanilide herbicides. Combining acetanilide herbicides with oryzalin provided good to excellent control of all weeds in this test -- comparable to the oryzalin + simazine "standard".

Norflurazon @ 2.4 lb/A controlled grasses, ragweed, and salsify; suppressed galinsoga by 50%; but did not control nightshade. Lambsquarters and pigweed were controlled 100% in Riverhead but <20% in Ithaca. Combining norflurazon with 0.75 lb/A prodiamine resulted in poor control of galinsoga and nightshade but good to excellent control of all other species in both tests.

These data demonstrate broad spectrum weed control with acetanilide + dinitroaniline herbicide combinations. In general, isoxaben, metolachlor, and norflurazon were less effective in the Ithaca test than in previous years or in the Riverhead experiment. In Ithaca, treatments were delayed by weather. Once treated, no rainfall occurred before weed seedling emergence. In contrast, the Riverhead test was irrigated after treatment. Experimental herbicides such as MON12051 and F6285 have strengths on certain important weed species suggesting they may be useful in combinations with other herbicides for weed control in nursery stock. In preliminary tests, of the products tested herein, only F6285 caused significant injury to woody ornamentals.

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[1]Assoc. Prof., Dept. Flor. & Orn. Hort., Cornell Univ., Ithaca, NY 14853 and Weed Science Specialist, Cornell Coop. Extn., L.I. Hort. Res. Lab., 39 Sound Ave., Riverhead, NY 11901, respectively.

CONTROLLING COMMON MUGWORT IN NURSERIES

L. Kuhns, S. Guiser and D. Suchanic [1]

ABSTRACT

Common mugwort (*Artemisia vulgaris* L.) is an aggressive, persistent, perennial weed that commonly infests nurseries. Nurserymen have long complained that applications of glyphosate provide only temporary, incomplete control. The purpose of this study was to evaluate the control of mugwort with several postemergence herbicides, alone or in combination; and dichlobenil, a preemergence herbicide with the ability to control some perennial weeds, alone or in combination with the postemergence herbicides. Simazine was included in three treatments to provide longer-term preemergence control of mugwort seedlings.

Herbicide treatments (Table 1) were applied to a dense, well established, uniform stand of mugwort growing in a field of American arborvitae (*Thuja occidentalis* L.) approximately 2 m tall in southeast Pennsylvania. Treatments containing glyphosate, triclopyr, and clopyralid were applied on August 27, 1992 to actively growing mugwort as a directed spray to the lower 45 cm of the arborvitae. On December 18, 1992, dichlobenil was applied alone and to two sets of plots previously treated with glyphosate, triclopyr or clopyralid. On April 8, 1993 simazine was applied to one set of the plots. On June 7, 1993, clopyralid was applied to plots that had previously been untreated or treated with clopyralid alone. All herbicides except dichlobenil were applied with a CO_2-pressurized plot sprayer through 11004 nozzles in water equivalent to 18 gpa at 30 psi. Dichlobenil was applied as a four percent granular product through a shaker jar. Mugwort control was rated on June 7, 1993 and September 22, 1993.

Dichlobenil applied alone at 8 lbs ai/A provided almost complete control of mugwort when rated in June. For this reason the effect of the glyphosate, triclopyr, clopyralid or simazine applied in combination with the dichlobenil could not be determined at this time. However, by September there was some regeneration of the mugwort in the plots treated with dichlobenil alone. Areas treated with triclopyr or clopyralid and dichlobenil, with or without simazine, remained almost totally free of mugwort throughout the growing season. Gyphosate plus dichlobenil provided no better control than dichlobenil alone in September, though the same combination with simazine added provided total control of mugwort at that time.

August applications of glyphosate at 2 lbs ai/A and the combination of glyphosate plus triclopyr at 1.5 lbs ai/A each provided fair control through June 7, but by September the mugwort had almost fully recovered. August applications of triclopyr at 1.5 lbs ai/A did not provide satisfactory control at either rating date. Single applications of clopyralid in August or June did not provide acceptable control. Sequential applications of clopyralid in August and June provided improved, but still unacceptable, control in September.

Triclopyr was the only herbicide that caused injury to arborvitae. Arborvitae foliage that was contacted by the directed spray turned brown.

This study confirmed that glyphosate, the postemergence herbicide most commonly used in nurseries today, will not control mugwort with one application. Triclopyr and clopyralid applied alone provide even less control. Dichlobenil provides outstanding control of mugwort but its use is restricted by its potential to injure some species of nursery stock. Further study of sequential applications of clopyralid and glyphosate should be conducted to determine the number of applications needed to control mugwort, and the best times to make them.

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[1] Professor, Department of Horticulture, and County Agents, respectively, The Pennsylvania State University, University Park, PA.

Table 1. Control of common mugwort (*Artemisia vulgaris*) following herbicide treatments. Values are the means of three replications. Rating of 1 indicates no control; 10 indicates complete control.

Herbicide[1/]	lb. ai/A	Application date(s)	Mugwort Control June 7	Mugwort Control Sept. 22
1. glyphosate	2.0	8/27/92	6.7	2.7
2. triclopyr	1.5	8/27/92	2.3	2.7
3. glyphosate +	1.5	8/27/92	6.3	3.0
triclopyr	1.5			
4. clopyralid	0.25	8/27/92	1.7	4.7
clopyralid	0.4	6/7/93		
5. dichlobenil	8.0	12/18/92	9.8	8.3
6. glyphosate	2.0	8/27/92	9.9	9.0
dichlobenil	8.0	12/18/92		
7. triclopyr	1.5	8/27/92	9.9	9.7
dichlobenil	8.0	12/18/92		
8. clopyralid	0.25	8/27/92	9.9	10.0
dichlobenil	8.0	12/18/92		
9. glyphosate	2.0	8/27/92	10.0	10.0
dichlobenil	8.0	12/18/92		
simazine	3.0	4/8/93		
10. triclopyr	1.5	8/27/92	10.0	9.9
dichlobenil	8.0	12/18/92		
simazine	3.0	4/8/93		
11. clopyralid	0.25	8/27/92	10.0	10.0
dichlobenil	8.0	12/18/92		
simazine	3.0	4/8/93		
12. clopyralid	0.4	6/7/93	-	3.7
13. untreated	-	-	1.0	1.0
LSD (P= 0.05)			(1.2)	(1.5)

1/ The following products were used for each active ingredient:
glyphosate - Roundup, Monsanto, St. Louis, MO
triclopyr - Redeem, DowElanco, Indianapolis, IN
clopyralid - Stinger, DowElanco, Indianapolis, IN
dichlobenil - Casoron 4G, Thompson-Hayward Chemical Co., Kansas City, KS
simazine - Princep 4L, CIBA, Greensboro, NC

PREEMERGENCE YELLOW NUTSEDGE CONTROL USING MON 12037

W.D. Ward and J. F. Derr[1]

ABSTRACT

Experiments were conducted in 1992 to determine the effectiveness of MON 12037 for preemergence control of yellow nutsedge in ornamental crops. Plots were in a randomized complete block with four replications, and were 6 feet wide by 25 feet long. The entire study was treated with oryzalin prior to planting to control annual weeds. Five liners each of 'Natchez' crape myrtle (Lagerstroemia indica), 'Rosebud' azalea (Rhododendron spp.), and 'Coral Beauty' cotoneaster (Cotoneaster dammeri) were planted per plot. Plots were treated May 5, 1992. Crape myrtles were 10 to 12 inches tall, azaleas were 5 inches tall, and cotoneasters were 4 to 5 inches tall at treatment. MON 12037, in a 75 DF formulation, was applied at 0.031, 0.063, 0.125, and 0.25 lb a.i./acre. For comparison, metolachlor at 2 and 4 lb/A, imazaquin at 0.125 lb/A, and chlorimuron at 0.03 lb/a were included in the evaluation. Also included were a weedy check and a hand-weeded check. Plots were rated visually at 5 and 9 weeks after treatment (WAT) for yellow nutsedge control and crop injury. MON 12037 at 0.031 lb/A gave 59% yellow nutsedge control at 5 WAT and 30% control at 9 WAT. At 0.063 lb/A, control increased to 74% and 50%, respectively. Increasing the rate to 0.125 lb controlled yellow nutsedge 90% and 71% at 5 and 9 WAT, respectively, while at the 0.25 lb rate, control increased to 99% and 71%, respectively. Chlorimuron, in comparison, gave 90% control at 5 WAT and 73% control at 9 WAT. Metolachlor at 2 lb/A gave 95% control at 5 WAT and 76% at 9 WAT, while at 4 lb/A, control was 99% at 5 WAT and 95% at 9 WAT. Imazaquin gave 30% control at 5 WAT and 0% control at 9 WAT. While MON 12037 gave fair yellow nutsedge control at 0.25 lb/A, this rate caused 21% injury in azalea, 53% injury in cotoneaster, and 24% injury in crape myrtle. Chlorimuron produced similar injury levels as the 0.25 lb rate of MON 12037. Metolachlor at 4 lb/A, however, caused only 11% injury in azaleas, 4% in cotoneaster, and 3% in crape myrtle 9 WAT. While MON 12037 applied preemergence will suppress yellow nutsedge, it does not appear to be as safe or effective as metolachlor in woody ornamental crops.

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[1]Graduate student and Associate Professor, respectively, Va. Polytech. Inst. and State Univ., Hampton Roads Ag. Expt. Sta., Virginia Beach, VA 23455.

A COMPARISON OF EQUIPMENT FOR MECHANICAL WEED CONTROL IN THE CROP ROW

C. L. Mohler[1]
Jane Mt. Pleasant
James Frisch

Weed control, corn grain yield and net return were compared for nine mechanical cultivation regimes, a weedy check, a broadcast application of pendimethalin and atrazine, and pendimethalin and atrazine followed by cultivation with a row crop cultivator. Tools used included a John Deere rotary hoe, Case/IH rotary hoe, Lely weeder, Lilliston rolling cultivator, Lilliston rolling cultivator equipped with disk gangs, John Deere row crop cultivator, and three combinations of Bezzerides' spyders, spring hoes, torsion weeders and spinners mounted on a row crop cultivator. All treatments with only mechanical control received two cultivations with either a rotary hoe or the Lely weeder plus two cultivations with a row oriented machine.

An economic analysis showed herbicides plus cultivation with the row crop cultivator was the most expensive treatment, and the weedy check the least. Costs of all nine cultivation only treatments were close to that of the broadcast herbicide treatment.

Results differed greatly among the three years of the study. In 1991 dry weather and late planting led to low weed densities, and no difference in yield among treatments. In 1992, wet weather caused cultivations to be late and prevented the final cultivation entirely. Consequently, yield was substantially higher in the herbicide treatments than in most of the cultivator treatments. Because the Lely weeder was better than the rotary hoes at controlling large weeds when the early cultivations were delayed, the treatment which included the Lely had fewer weeds and a yield which approached that obtained with broadcast herbicides. In 1993, weather was not a critical controlling factor. Differences in weed control among the cultivator treatments were minor. Herbicides were more effective in controlling annual broadleafs and grasses, but hedge bindweed and yellow nutsedge were better controlled by the cultivators. In balance, the annuals were more important competitors, and yield was higher for the herbicide treatments.

Although the cultivators differ radically in their modes of action, these differences did not usually result in large differences in weed control or crop yield.

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1. Sr. Research Associate, Section of Ecology and Systematics, and Assistant Professor and Graduate Research Assistant, Department of Soil, Crop and Atmospheric Sciences, Cornell University, Ithaca, NY 14853.

TIME OF CULTIVATION IN CORN: EFFECTS ON WEED LEVELS AND GRAIN YIELDS

J. Mt. Pleasant[1] and R. F. Burt

ABSTRACT

Field studies were established to determine if timing of a single cultivation affected weed levels or grain yields when weed control in corn (*Zea mays* L.) consisted of cultivation alone or combinations of mechanical and chemical practices. The experiment was initiated in 1992 at the R. Musgrave Research Farm in Aurora, NY and continued in 1993. Data is reported from 1993.

Experimental design was a randomized complete block in a split-plot arrangement. Main-plot treatments consisted of: 1) broadcast herbicide plus cultivation (BCAST + CULT); 2) band herbicide plus cultivation (BAND + CULT); and 3) cultivation only (CULT ONLY). Subplots were time of cultivation based on stage of corn development: 2, 4, 6 and 8 leaf stages. Treatments with broadcast herbicide only (BCAST ONLY) and no weed control (NO CONTROL) were also included. Broadcast herbicide treatments in 1993 used atrazine at 1.17 kg ai ha^{-1}, pendimethalin at 1.68 kg ai ha^{-1} and metolachlor at 2.24 kg ai ha^{-1}. Similar rates were applied in a ten-inch band over the corn row for the band treatments. Weed counts were taken approximately 5-7 days after each cultivation. Weed biomass was measured in September and corn was harvested as grain in October.

Weed numbers were higher when measured on July 20 following the last cultivation in CULT ONLY (93 plants m^{-2}) compared to BAND + CULT (43 plants m^{-2}) and BCAST + CULT (10 plants m^{-2}). At this sampling date (July 20) weed numbers were highest in corn cultivated at the 2-leaf stage (84 plants m^{-2}), intermediate in corn cultivated at the 4-leaf stage (53 plants m^{-2}) and lowest in plots cultivated at the six or eight-leaf stages (30 and 27 plants m^{-2}). There was no interaction between weed control practice and time of cultivation.

Among weed control practices, weed biomass was highest in CULT ONLY (1157 kg ha^{-1}) while biomass measurements in BAND + CULT (348 kg ha^{-1}) and BCAST + CULT (100 kg ha^{-1}) were the same. Time of cultivation had no effect on weed biomass nor was there an interaction between weed control practice and time of cultivation.

Grain yields were lowest under CULT ONLY (5759 kg ha^{-1}); yields of BCAST + CULT (6476 kg ha^{-1}) and BAND + CULT (6201 kg ha^{-1}) were not different. Time of cultivation had no effect of grain yields and there was no interaction between weed control practice and time of cultivation.

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

COMPARISON OF COVER CROPS FOR STRIP-TILL CORN IN SWITZERLAND

N. L. Hartwig, H.U. Ammon and C. Bohren[1]

ABSTRACT

Four cover crops were seeded conventionally on July 23, 1992 following a winter wheat harvest at the Swiss Federal Research Station for Agronomy in Zürich-Reckenholz. The cover crops were a winter hardy turnip (Brassica rapa L.), a mixture of perennial ryegrass (Lolium perenne L.) and white clover (Trifolium repens L.), white clover alone and crownvetch (Coronilla varia L.). The purpose of this research was to find a suitable ground cover for soil erosion control and to reduce the nitrogen requirement and/or potential for nitrogen leaching into the ground water from land used for corn production in Switzerland. The corn was planted with a strip till planter which left 55 cm untilled between the corn rows. The cover crops between the corn rows were either mowed or suppressed with herbicides to reduce competition with the corn crop.

Research on the use of crownvetch as a living mulch for agronomic crop production was started at Penn State in 1975. Research in Switzerland started at about the same time using a winter hardy turnip, perennial ryegrass and clover which were common cover crop or forage species on dairy farms in Switzerland. Initially getting good corn stands on the heavy clay soils in Switzerland was a problem until the development of the strip till planter which rototills a 8 in. strip in front of the conventional corn planter. Corn planting problems were solved in the U.S. when no-tillage corn planters were developed by commercial farm machinery companies in the early 70's. Emphasis in recent years in both Europe and the U.S. has been on ways of reducing soil erosion as well as run-off losses of both nutrients and pesticides from row crops. A permanent crownvetch living mulch has been found to do an excellent job of this and the search is on to find similar species that will fit into various crop rotations in the U.S. and Europe.

Suppressing these cover crops so they don't compete with the corn crop without totally killing them still remains a problem. If left unsuppressed, the cover crop almost always overwhelms the corn crop or results in intolerable yield losses. Low toxicity herbicides do exist that can be used to kill the cover crop for no-till or strip till corn but that then requires the reestablishment of the cover crop if the benefits of the cover crop are to be maintained. If the cover crop could be suppressed without killing it, reestablishment wouldn't be necessary. For some cover crops, herbicides have been found that will do this and a flail mower for mowing between the corn rows has been developed in Switzerland that will accomplish this as well.

The trial design was a randomized split plot with suppression treatments nested in cover crops with three replications. Cover crops were planted in 59 by 46 ft. blocks. Cover crop suppression and herbicide or mowed weed control treatments were applied to six 9.84 by 46 ft. sub-plots within each cover crop block. The turnips were flail chopped before corn planting. The whole trial received a combined total of 145 lb/A in row and sidedressed nitrogen . Nitrogen deficiency was only visually apparent for corn in the ryegrass/clover cover.

The data presented in Table 1 shows the impact of the four cover crops suppressed by mowing or various herbicides on weed control, cover crop cover, and the growth and yield of corn. Corn silage yields were determined by harvesting two rows from the middle of each plot. There was no recovery growth from turnips after the initial chopping and corn yields were excellent regardless of treatment used. All suppression treatments in white clover and crownvetch allowed some cover crop recovery growth without a loss in corn yield. Corn silage yields in ryegrass + clover were significantly reduced due to competition, probably for nitrogen, for all treatments except glyphosate which eliminated ryegrass early enough to reduce competition.

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[1] Prof. of Weed Sci., Dept. of Agronomy, Pennsylvania State University, University Park, PA. 16802; Research Scientist and Technician, Swiss Federal Research Station for Agronomy, Zürich-Reckenholz, Switzerland.

Table 1. Impact of cover crop and various cover crop suppression treatments on weed control, cover crop cover, and corn height and yield.

No.	Cover Crop	Treatment[a] and Date	Application Rate[b]	Weed Control 6/28	Total Living Cover 6/9	Total Living Cover 6/28	Corn Silage Height 6/28	Corn Silage Yield 65% H_2O
			(lb ai/A)	(%)	(%)	(%)	(in)	(Tons/A)
1.		Roundup 5/12	0.67	98.a[c]	0	0	42.a	25.40 a
2.	'Buko'	Sailor 5/25	1.0	83.ab	0	0	40.a	22.91 b
3.	Turnips	Lg 730 5/25	1.5	98.a	0	0	43.a	23.35 ab
4.		Trilox 5/25	2.8	98.a	0	0	44.a	25.58 a
5.		Mowed (2x) 5/25 & 6/10	----	93.ab	0	0	44.a	23.05 b
6.		Untreated Check	----	72.b	0	0	42.a	24.36 ab
		Average		90	0	0	42.5	24.11
7.	'Westerwold'	Roundup 5/12	0.67	100.a	57.a	33.b	36.a	23.85 a
8.	& English	Roundup 5/12	1.33	100.a	41.ab	31.b	38.a	23.10 a
9.	Ryegrass	Titus (2x) 5/25 & 6/8	2 + 2 gm	100.a	23.b	1.c	30.b	18.79 b
10.	plus	Titus (2x) 5/25 & 6/8	3 + 3 gm	100.a	35.ab	1.c	28.b	19.31 b
11.	White Clover	Mowed (2x) 5/25 & 6/10	----	100.a	52.ab	40.b	30.b	21.00 ab
12.		Untreated Banvel Check - 5/25	----	100.a	53.ab	67.a	26.b	15.25 c
		Average		100	44	29	31.3	20.22
13.	'Milkanova'	Titus (2x) 5/25 & 6/8	2 + 2 gm	100.a	17.c	16.c	42.a	22.15 a
14.	White Clover	Titus (2x) 5/25 & 6/8	3 + 3 gm	100.a	18.c	19.c	44.a	24.00 a
15.	+	Titus (2x) 6/8 & 6/10	2 + 2 gm	100.a	40.b	35.b	38.a	24.34 a
16.	'California'	Titus (2x) 6/8 & 6/10	3 + 3 gm	99.b	45.ab	38.b	38.a	25.60 a
17.	Ladino	Mowed (2x) 5/25 & 6/10	----	99.b	50.a	70.a	44.a	25.03 a
18.	Clover	Roundup 5/12	1.33	100.a	20.c	48.b	46.a	24.62 a
		Average		100	32	38	42.0	24.29
19.		Nothing + Stomp 5/12	0 + 1.18	100.a	8.ab	48.a	46.ab	24.37 a
20.		Urlac + Stomp 5/12	1.78 + 1.18	99.b	5.c	10.b	48.a	24.03 a
21.	'Penngift'	Dasul + Stomp 5/25	16 gm + 1.18	100.a	8.ab	38.a	46.ab	25.39 a
22.	Crownvetch	Titus + Stomp 5/25	3 gm + 1.18	100.a	10.a	43.a	43.b	25.07 a
23.		Mowed (2x) 5/25 & 6/10	----	98.c	5.c	5.b	44.ab	24.03 a
24.		Urlac + Titus 5/25	1.78 + 3 gm	100.a	4.c	9.b	46.ab	24.85 a
		Average		99	7	26	45.5	24.62

[a] Active ingredients: — Active Ingredient rates/A

Sailor (37.5% WP) = chlormesulone (Mikado) + pyridate (Tough) at 0.4 + 0.6 lb/A
Lg 730 (55% WP) = atrazine + chlormesulone + pyridate at 0.6 + 0.27 + 0.6 lb/A
Trilox (43.5% WP) = atrazine + alachlor + pyridate at 0.7 + 1.5 + 0.6 lb/A
Roundup (4 lb/gal) = glyphosate at 0.67 & 1.33 lb/A
Dasul (0.33 lb/gal) = nicosulfuron at 16 gm/A
Titus (25% DF) = rimsulfuron at 2 or 5 gm/A split
Stomp (2.73 lb/gal) = pendimethalin at 1.18 lb/A
Urlac (4 lb/gal) = cyanazine at 1.78 lb/A

[b] Very low rates are reported in grams ai/acre
May 10 - Corn planted and treated with Solocam (terbuthylazin + metolachlor at 1 + 1.5 lb ai/A) in a 12" band over the corn row.

[c] Means within each cover crop followed by the same letter are not significantly different at the 5% level according to Duncan's New Multiple Range test.

EFFECT OF A RYE COVER CROP ON WEED CONTROL AND CORN GROWTH AND YIELD

W. S. Curran, E. L. Werner, and G. W. Roth[1]

ABSTRACT

Cover crops are promoted for reducing soil erosion, providing or scavenging nitrogen, and possibly suppressing weed growth and competition. Cereal rye is a common cover crop that is inexpensive to establish, has good winter hardiness and has been widely accepted by northeastern dairy producers. A winter rye cover crop can be killed with a preplant herbicide prior to no-till corn planting or harvested as a forage which provides additional feed to the livestock producer. The effect that rye stage of growth or forage removal at corn planting time have on weed control and corn establishment and yield are uncertain. The objectives of the following study were to determine the effect of rye kill date and rye forage removal on herbicide performance and corn growth and yield.

The studies were established in 1992 and 1993 at the Russel E. Larson Agricultural Research Center in central PA and the Southeastern Agricultural Research Center near Lancaster, PA. Cereal rye was seeded in early to mid October at 2.2 bu/A and killed the following spring two weeks before corn planting or at corn planting by applying 1.0 lb ai/A glyphosate. Additional treatments included removing the above-ground rye biomass using a forage chopper and plots not seeded to rye. All treatments received the glyphosate burndown treatment. Within the four cover-crop treatments (rye-early, rye-late, ryelage, and no-rye) residual herbicide treatments included 0.5, 0.75, or 1X the recommended rates of atrazine plus dicamba applied preemergence or postemergence. In addition, all plots were treated preemergence with 1.5 lb ai/A metolachlor.

Rye cover crop growth and yields were normal in three locations and below normal in the forth location over the two-year period. Above ground rye biomass at corn planting time ranged from 1300 (rye-early) to 4900 (rye-late) lb/A (dry-wt basis). Corn population was significantly reduced or unaffected by the rye cover crop. Populations were lower in the late kill rye treatments both years at the SE location and in all rye treatments at the SE location in 1993. Early season corn height was shorter in the ryelage treatments in three of four experiments, but varied in height in the other cover treatments. The most consistent weed species included giant foxtail (Setaria faberii Herrm.), common lambsquarters, (Chenopodium album L.), and smooth pigweed (Amaranthus hybridus L.). Weed density varied within cover treatments, but generally was lowest in the no rye treatments. Herbicide rate by cover crop interactions were common, particularly with the preemergence treatments. The lower preemergence rates tended to be less effective in rye residue plots, compared to no rye. The postemergence treatments overall tended to be more consistent and less rate dependent. The untreated checks always had the highest weed populations. The effect of cover on corn yield was variable, but yields tended to be highest in the no-cover plots. Yields were consistently lowest in the untreated herbicide plots.

In summary, a rye cover crop has the potential to impact corn establishment with the late kill rye treatments having the greatest likelihood of reducing corn stand. The impact of a rye cover crop on growth and yield was variable, but harvesting the rye for forage prior to corn planting did not eliminate some negative effects. Weed populations were either similar within the cover crop treatments, or tended to be lower in the absence of a rye cover crop. The reduction in weed control in the rye cover was due to less effective preemergence herbicide activity at the lower rates in the rye residue compared to no-rye.

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

NICOSULFURON COMBINATIONS WITH BROMOXYNIL OR DICAMBA FOR ANNUAL WEED CONTROL IN CORN

Russell R. Hahn[1]

ABSTRACT

Field experiments were conducted from 1990 through 1993 to evaluate nicosulfuron with bromoxynil or dicamba for annual weed control in corn (Zea mays L.). A randomized complete block design with four replications was used in each. Herbicides were applied in water using 80015 flat fan spray tips on a bicycle sprayer calibrated to deliver 25 gpa of spray solution. Applications were made when corn was in the four- to five-leaf stage except in 1991 when corn had seven leaves.

Four experiments were conducted near Aurora, NY. Combinations of nicosulfuron at 0.5 oz ai/A with bromoxynil at 0.25 or 0.38 lb ai/A or dicamba at 0.25 or 0.5 lb ai/A controlled wild mustard [Brassica kaber (DC.) L.C. Wheeler] and common ragweed (Ambrosia artemisiifolia L.) equal to, or better than nicosulfuron alone. In 1990, when treatments were applied with 1% (v/v) crop-oil concentrate (COC) plus 4% (v/v) 28% N, nicosulfuron controlled 85% of the green foxtail [Setaria viridis (L.) Beauv.] while control was reduced to 67 and 50% when applied with 0.25 and 0.5 lb/A of dicamba respectively. In 1991, when treatments were applied with 0.25% (v/v) of nonionic surfactant (NIS), nicosulfuron controlled 97% of the green foxtail while control was reduced to 90 and 86% when applied with 0.25 or 0.38 lb/A of bromoxynil respectively. Green foxtail control was not reduced when 4% (v/v) 28% N was added to these bromoxynil combinations. In 1992, nicosulfuron with bromoxynil or dicamba provided good to excellent (90 to 100%) control of velevetleaf (Abutilon theophrasti Medik.), common ragweed, and wild mustard. Green foxtail control ranged from 85% to 90% and was not lower than with nicosulfuron alone. In 1993, nicosulfuron with 0.25 or 0.5 lb/A of dicamba or with 0.25 lb/A of bromoxynil provided 90 to 95% green foxtail control while the combination with 0.38 lb/A of bromoxynil reduced control to 79%.

A fifth experiment was conducted near Etna, NY to determine the effect of adjuvants on crop safety and weed control. Treatments were applied with 0.25% (v/v) NIS, 1% (v/v) COC, or 1% (v/v) methylated sunflower oil (MSO). Combinations were also applied with or without 4% (v/v) 28% N. All combinations showed significant corn injury 11 days after application. Nicosulfuron plus bromoxynil at 0.38 lb/A caused more injury than nicosulfuron alone or in combination with dicamba at 0.25 lb/A. The addition of bromoxynil or dicamba did not reduce yellow foxtail [Setaria glauca (L.) Beauv.] control when 28% N was added. When 28% N was omitted, yellow foxtail control was reduced with bromoxynil and dicamba when COC was the adjuvant and with bromoxynil when MSO was the adjuvant.

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

PERENNIAL WEED CONTROL IN NO-TILLAGE CORN WITH POSTEMERGENCE HERBICIDES

S. Glenn and W. H. Phillips[1]

ABSTRACT

Perennial weed control in no-tillage corn (Zea mays L.) was studied in large plots (35 ft x 75 ft) in 1992 and 1993 at Washington County, Maryland. All plots were treated with 0.5 lbs/A paraquat, 2.0 lbs/A metolachlor, and 0.25% (by vol) X-77 at planting (AP). Some treatments included AP applications of 1.6 lbs/A atrazine. POST treatments were applied when corn was 10 inches high (7 inches for 0.5 lbs/A dicamba) in 1992 and 7 inches high in 1993. Treatments applied in 1992 were applied to the same plots in 1993. AP applications of paraquat plus metolachlor plus atrazine did not control hemp dogbane (Apocyanum cannabinium L.), wild blackberry (Rubus allegheniansis Porter), pokeweed (Phytolacca americana L.), or horsenettle (Solanum carolinense L.) 8 weeks after treatment (WAT). In 1992, POST applications of 0.031 lbs/A nicosulfuron plus 0.25% (by vol) X-77 produced 60, 78, 70, and 50% hemp dogbane, wild blackberry, pokeweed, and horsenettle control, respectively. Tank mixtures of nicosulfuron plus 0.25 lbs/A 2,4-D or 0.13 lbs/A dicamba increased ($p < 0.05$) hemp dogbane, pokeweed, and horsenettle control compared with nicosulfuron applied alone. POST applications of 0.036 lbs/A primisulfuron plus 0.25% (by vol) produced less hemp dogbane (40%) and wild blackberry (40%) control, equal pokeweed control (62%), and greater horsenettle control (73%) than nicosulfuron applied alone. Tank mixtures of 0.25 lbs/A 2,4-D or 0.13 lbs/A dicamba plus 0.018 lbs/A primisulfuron improved hemp dogbane, wild blackberry, pokeweed (dicamba combinations only), and horsenettle (2,4-D combinations only) control compared with 0.036 lbs/A primisulfuron alone. In 1992, combinations including 0.031 lbs/A nicosulfuron produced better hemp dogbane and wild blackberry control compared with primisulfuron combinations. POST applications of 0.5 lbs/A dicamba produced 80, 73, 70, and 83% hemp dogbane, wild blackberry, pokeweed, and horsenettle control, respectively. Perennial weed control 11 months following treatments was greatest with nicosulfuron and primisulfuron tank mixtures with 2,4-D or dicamba but control was less than 50%. In 1993, perennial weed control was similar to that obtained in 1992 for nicosulfuron, and dicamba applied alone. However, control of hemp dogbane, wild blackberry, and pokeweed was generally greater with tank mixtures of nicosulfuron or primisulfuron with 2,4-D or dicamba in 1993 compared with 1992. Perhaps the effects of the 1992 tank mixture treatments was enhancing weed control in 1993. In both years of the study, there was no advantage of AP applications of 1.6 lbs/A atrazine.

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

Burcucumber Control in Field Corn

Q.R. Johnson and F.J. Webb

Abstract

Field experiments were conducted in 1992 and 1993 to evaluate several herbicide programs for their ability to control burcucumber (Sicyos angulatus L.) in field corn (Zea mays L.).

With the application of standard preemergence corn herbicide programs, burcucumber generally does not compete with corn to the extent that yields are significantly reduced. However, due to the climbing growth habit of burcucumber, escapes and subsequent flushes can cause serious impediments to corn harvest.

Prior to recent atrazine label revisions, as much as three to four pounds active ingredient of atrazine per season was often recommended for burcucumber control, usually as a 50/50 preemergence/postemergence split. With the maximum total annual rate for atrazine now at 2.5 lb ai/A, and the possibility for further rate reductions yet uncertain, the need to investigate alternative herbicide programs is evident.

Several herbicide treatments were compared to a metolachlor (2.0 lb), atrazine (1.0 lb), and simazine (1.0 lb) preemergence check which provided a two year average of 29% late season burcucumber control. A similar treatment with 2.0 lb of atrazine preemergence provide an average 52% late season control, while a pre/post split treatment with 1.50 lb of atrazine preemergence plus 1.0 lb of atrazine and crop oil concentrate postemergence provided 90% late season control in 1993. Season moisture and postemergence application timing appear to play important roles in the efficacy of atrazine on burcucumber as evidenced by a late season rating of only 70% control with a 2.0 lb/1.0 lb pre/post atrazine split in 1992.

Postemergence applications of nicosulfuron and primisulfuron at the two to six inch burcucumber stage provided good season long control at all applied rates. The addition of dicamba as a tank mix partner did not appear to enhance the efficacy of these products. Postemergence applications of thifensulfuron, dicamba, dicamba plus atrazine (Marksman), bentazon plus atrazine (Laddok), and Mon 12037 also provided good burcucumber control at applied rates. CGA-152005 and fluniclorac were evaluated in 1993 and provided good to very good season long control when applied postemergence. Preemergence applications of CGA-152005 provided little to no control, and preemergence applications of Mon 12041 provided only poor to fair season long burcucumber control.

University of Delaware
BURCUCUMBER CONTROL IN FIELD CORN*

No.	Treatment	Form.	Rate	Unit	Stage	SIYAN 6-15-92	SIYAN 8-21-92	SIYAN 10-1-92	SIYAN 6-16-93	SIYAN 7-7-93	SIYAN 9-22-93
1	METOLACHLOR	8 E	2.00	lb ai/A	PE	87.5 bc	46.3 g	25.0 b	78.8 f	43.8 f	32.5 g
1	ATRAZINE	90 DF	1.00	lb ai/A	PE						
1	SIMAZINE	90 D	1.00	lb ai/A	PE						
1	CHECK										
2	METOLACHLOR	8 E	2.00	lb ai/A	PE	96.8 a	95.8 a	55.0 ab	93.8 ab	60.0 e	50.0 f
2	ATRAZINE	90 DF	2.00	lb ai/A	PE						
2	SIMAZINE	90 D	1.00	lb ai/A	PE						
3	METOLACHLOR	8 E	2.00	lb ai/A	PE	81.3 de	80.0 f	70.0 a	98.3 a	28.8 h	25.0 h
3	ATRAZINE	90 DF	1.00	lb ai/A	PE						
3	SIMAZINE	90 D	1.00	lb ai/A	PE						
3	MON 12041	15 DF	.075	lb ai/A	PE						
4	METOLACHLOR	8 E	2.00	lb ai/A	PE				25.0 g	0.0 i	0.0 i
4	CGA-152005	5 WP	.014	lb ai/A	PE						
5	ATRAZINE	90 DF	1.00	lb ai/A	POST	99.0 a	95.8 a	70.0 a			
5	COC		1.00	% v/v	POST						
6	ATRAZINE	90 DF	1.00	lb ai/A	POST				92.5 abc	99.0 a	90.0 abc
6	COC		1.00	% v/v	POST						
7	NICOSULFURON	75 D	.016	lb ai/A	POST	83.8 cde	86.5 de	66.8 a	83.8 def	90.8 c	81.3 de
7	COC		1.00	% v/v	POST						
8	NICOSULFURON	75 D	.031	lb ai/A	POST	81.3 de	95.8 a	51.8 ab	88.8 bcd	97.0 abc	85.0 cd
8	COC		1.00	% v/v	POST						
9	NICOSULFURON	75 D	.016	lb ai/A	POST				84.5 def	94.8 abc	78.8 e
9	DICAMBA	4 EC	.25	lb ai/A	POST						
9	X-77		.25	% v/v	POST						
10	PRIMISULFURON	75 D	.018	lb ai/A	POST	83.8 cde	93.3 abc	71.3 a	85.0 def	90.8 c	82.5 de
10	COC		1.00	% v/v	POST						
11	PRIMISULFURON	75 D	.036	lb ai/A	POST	83.8 cde	95.0 ab	72.5 a	86.3 cde	92.3 bc	87.0 bcd
11	COC		1.00	% v/v	POST						
12	PRIMISULFURON	75 D	.018	lb ai/A	POST				78.8 f	98.0 ab	87.5 bcd
12	DICAMBA	4 EC	.25	lb ai/A	POST						
12	X-77		.25	% v/v	POST						
13	THIFENSULFURON	25 D	.004	lb ai/A	POST	83.8 cde	90.0 cd	87.5 a	87.0 cde	92.5 abc	91.3 abc
13	X-77		.25	% v/v	POST						
14	DICAMBA	4 EC	.25	lb ai/A	POST	82.5 de	91.3 bc	67.5 a	86.3 cde	97.5 ab	91.8 ab
15	DICAMBA	1.1 L	.275	lb ai/A	POST	85.0 cd	82.5 f	75.0 a	83.8 def	99.0 a	89.5 abc
15	ATRAZINE	2.1 L	.525	lb ai/A	POST						
16	MON 12037	75 DF	.032	lb ai/A	POST	82.5 de	81.3 f	67.5 a	85.0 def	78.8 d	81.3 de
16	X-77		.25	% v/v	POST						
17	MON 12037	75 DF	.048	lb ai/A	POST	80.0 e	83.8 ef	80.0 a	81.3 ef	75.0 d	85.0 cd
17	X-77		.25	% v/v	POST						
18	CGA-152005	5 WP	.028	lb ai/A	POST				83.3 def	73.8 d	91.3 abc
18	COC		1.00	% v/v	POST						
19	FLUNICLORAC	.60 EC	.026	lb ai/A	POST				84.5 def	37.5 g	90.0 abc
19	COC		.50	% v/v	POST						
20	NICOSULFURON	75 WG	.031	lb ai/A	POST				0.0 i	92.8 abc	86.3 bcd
20	BENTAZON	1.66 L	1.1	lb ai/A	POST						
20	ATRAZINE	1.66 L	1.1	lb ai/A	POST						
LSD (.05) =						4.1	3.7	33.3	5.7	5.5	5.3
Standard Dev.=						2.88675	2.61752	23.2670	3.99906	3.89536	3.74666
CV =						3.38	3.11	33.77	5.30	5.22	4.97

Means followed by same letter do not significantly differ (P=.05, Duncan's MRT)
* This is a partial listing of the total of all treatments evaluated in 1992-93.
Postemergence treatment #5 was preceded by a preemergence application of treatment #2. Postemergence treatments #6 thru #19 were preceded by a preemergence application of treatment #1.

EFFECT OF ORGANOSILICONE SURFACTANTS ON NICOSULFURON AND PRIMISULFURON ACTIVITY AGAINST FOUR WEED SPECIES

J.Sun, C.L. Foy and H.L. Witt[1]

ABSTRACT

Experiments were conducted in the greenhouse in 1993 to investigate the effects of the organosilicone-based surfactants, Kinetic[2], Dynamic[2], Silwet L-77[3], Silwet 408[3], and Sylgard 309[4] on nicosulfuron and primisulfuron activity against four weed species. Agridex[2], methylated soybean oil[5] and Rigo Oil Concentrate[5] were included for comparison. Velvetleaf (*Abutilon theophrasti* Medicus), redroot pigweed (*Amaranthus retroflexus* L.), green foxtail [*Setaria viridis* (L.) Beauv.], and barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] were seeded in 15-cm pots containing a commercial potting mix. Weeds species were uniform 10 to 13 cm tall at the time of treatment. Nicosulfuron was applied at 17 and 35 g ai/ha and primisulfuron was applied at 20 and 40 g ai/ha each with and without the adjuvants. Organosilicone surfactants were included at 0.25% (v/v) and the other adjuvants were included at 1.0% (v/v). Treatments were applied in 94 L/ha of water using a CO_2-charged, continuous moving belt laboratory sprayer. Experimental design was a randomized block with four replications. Control ratings were made at 10-day intervals and shoot fresh weights of weed species were recorded when the majority of the plants were killed. Response to nicosulfuron and primisulfuron varied among the four species. Redroot pigweed was controlled by both herbicides at both rates. Green foxtail and barnyardgrass were controlled only by nicosulfuron. Velvetleaf was controlled by primisulfuron, but not by nicosulfuron. However, both herbicides at both rates applied with the organosilicone surfactants were more effective than when applied alone. The effect of organosilicone surfactants on herbicidal activity varied with weed species, sometimes being equal to, better or poorer than with conventional adjuvants.

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[1]Grad. Res. Asst., Prof. and Lab. Spec. Sr., Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.
[2]Helena Chemical Co., Memphis, TN 38137.
[3]Union Carbide Chemicals and Plastics Co., Inc., Tarrytown, NY 10591.
[4]Dow Corning Corp., Midland, MI 48686.
[5]Willur-Ellis Co., Nappanee, IN 46550.

Nutsedge and Broadleaf Weed Control with Postemergence Applications of MON 12000 in Northeastern Corn

D.J. Mayonado[1], W.S. Curran[2], E.S. Hagood[3], R.R. Hahn[4], B.A. Majek[5], R.L. Ritter[6], F.J. Webb[7], H.P. Wilson[8]

MON 12000, formulated as a 75% dry flowable, was evaluated for postemergence control of yellow nutsedge (Cyperus esculentus L.) and annual broadleaf weeds in Northeastern field corn. Replicated field studies were conducted over 2 years in Delaware, Maryland, New Jersey, New York, Pennsylvania and Virginia.

MON 12000 applied alone at 0.016 lbs ai/A provided greater than 90% control of common ragweed (Ambrosia artemisiifolia L.), common cocklebur (Xanthium strumarium L.) and pigweed species (Amaranthus sp.). MON 12000 applied alone at 0.032 lbs ai/A provided greater than 90% control of the above mentioned weeds as well as giant ragweed (Ambrosia trifida L.), velvetleaf (Abutilon theophrasti Medik.), and yellow nutsedge. MON 12000 at 0.016 lbs ai/A plus 0.125 lbs ai/A of either 2,4-D or dicamba provided greater than 90% control of the above mentioned broadleaf weeds plus common lambsquarters (Chenopodium album L.). Postemergence applied combinations of MON 12000 at 0.032 lbs ai/A plus nicosulfuron applied at 0.032 lbs ai/A provided control of many broadleaf weeds and grasses. Field corn injury was minimal with all combinations tested.

[1] Product Development Representative, The Agricultural Group of Monsanto Company, Salisbury, MD 21801
[2] Asst. Prof. of Weed Science, Dept. of Agronomy, The Pennsylvania State University, University Park, PA 16802
[3] Prof., Dept. of Plant Path., Physiol., Weed Science, VA Polytech. Inst. and State Univ., Blacksburg, VA 24061
[4] Assoc. Prof., Dept. of Soil, Crop and Atmospheric Sci., Cornell Univ., Ithaca, NY 14853
[5] Extension Specialist in Weed Science, Rutgers Research and Development Center, Bridgeton, NJ 08302
[6] Assoc. Prof. Agronomy Dept., University of Maryland, College Park, MD 20742
[7] Weed Specialist, University of Delaware, Georgetown, DE 19947
[8] Prof., Dept. of Plant Path., Physiol., Weed Science, Eastern Shore Agric. Exp. Stn., VA Polytech. Inst. and State Univ., Painter, VA 23420

CONTROL OF BROADLEAF WEEDS WITH CGA-152005

D. B. Vitolo, M. G. Schnappinger, C. M. Moseley,
S. W. Pruss and J. W. Peek /1

ABSTRACT

CGA-152005 is an herbicide being developed by Ciba Plant Protection for control of broadleaf weeds in corn (Zea mays L.). When applied postemergence at 20 to 40 g ai/ha, CGA-152005 provides selective control of most common annual broadleaf weed species. Grasses, sedges and nightshades (Solanum spp.) are not controlled with CGA-152005. In addition to postemergence activity, CGA-152005 provides residual, preemergence control of most broadleaf weeds.

CGA-152005 was evaluated as a postemergence herbicide for corn in replicated field trials at locations in Maryland, New York, Ohio and Pennsylvania in 1993. CGA-152005 provided very good to excellent control of Velvetleaf (Abutilon theophrasti Medik.), hedge bindweed (Calystegia sepium (L.) R. Br.), common ragweed (Ambrosia artemisiifolia L.), common lambsquarters (Chenopodium album L.), common cocklebur (Xanthium stramonium L.) and redroot pigweed (Amaranthus retroflexus L.). In all cases, CGA-152005 was applied with either a non-ionic surfactant or crop oil concentrate.

CGA-152005 is rapidly metabolized in corn shoots, and crop tolerance is excellent. CGA-152005 has shown no dependence on field corn hybrids for tolerance. In the central and southern United States, crop rotations will be liberal following use of CGA-152005. In more northern states, certain crop rotation restrictions will be necessary. All testing required for full registration has been completed and a complete data package will be submitted to the EPA in February, 1994. An EUP for further evaluation in corn is scheduled for 1994, and full registration is expected in 1995.

CGA-152005 is an excellent new postemergence compound for the selective control of a wide range of broadleaf weeds in corn.

/1 Field Research Representatives, Regional Manager and Research Manager, Ciba Plant Protection, Washington, PA 15301

EFFECTS OF COMPETING VEGETATION ON THE REGENERATION OF OAK STANDS IN CENTRAL PENNSYLVANIA

L. H. McCormick[1]

ABSTRACT

For the past century, the forests of central Pennsylvania have been dominated by oaks. Today these maturing forests are being harvested, and new forests are being established. In many instances, the new forests are under stocked and comprised of less desirable hardwoods. Oaks no longer dominate many of the recently established stands. While there are no conclusive answers to the problem of regenerating oak stands, competition from herbaceous and woody plants does play a role. Hay-scented fern, mountain laurel, sweet fern, and blueberry commonly form extensive, dense communities which limit the establishment and growth of desirable tree species. Studies comparing the growth of planted hardwood seedlings in the presence and absence of hay-scented fern have shown two to four fold differences in height growth after four years. Sufficient information exists to make control recommendations for some competing species, while additional information is needed for other species. Despite these technical considerations, there is currently little interest or effort made in controlling competing species in forestry operations in central Pennsylvania.

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[1] Assoc. Prof. of Forest Resources, School of Forest Resources, The Pennsylvania State University, University Park, PA 16802.

CROP TREE MANAGEMENT FOR CENTRAL APPALACHIAN HARDWOOD FORESTS

Thomas M. Schuler [1]

ABSTRACT

Crop tree management is the selection and release of specific trees that produce benefits consistent with the landowner's property goals. Management of crop trees can enhance timber values, wildlife habitats, aesthetics, or water quality and can be applied in both precommercial and commercially operable stands. Precommercial treatments can be designed to alter species composition, favor desirable trees of better quality, and increase individual tree diameter growth thus shortening rotation length. Studies of commercial operations of crop tree management have also shown that this technique can be used to establish regeneration in the central Appalachian region.

Crop tree management is based on the principle that a predictable number of trees per unit of area will dominant the stand at maturity in even-aged stands. Consequently, stand treatment efforts are minimized by only removing trees that are competing with the selected crop trees, often numbering 50 to 75 per acre in precommercial operations. From a timber production standpoint this is quite different from traditional thinning practices which tend to target a specific reduction in full site occupancy rather than focusing on fully releasing selected, individual trees. The diverse species mix of many central Appalachian hardwood, even-aged stands is especially suitable for crop tree management because of the wide range of values and benefits derived from each species.

Information drawn from specific studies on when and how to apply crop tree management is summarized, including a discussion of release methods, leave tree marking, seedling and sprout origin fitness, and aesthetic effects of treatments. Crop tree management guidelines for producing benefits related to timber, wildlife, aesthetics, and water quality are reviewed.

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[1]Research Forester, USDA Forest Service, Northeastern Forest Experiment Station, Parsons, WV 26287

DEVELOPING A DEGREE-DAY MODEL TO PREDICT SMOOTH CRABGRASS EMERGENCE

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

ABSTRACT

Current information on the environmental requirements for smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.] seed germination is limited. A reliable method is needed to determine when to expect major crabgrass germination periods and when germination ceases during a season. Although effective control of smooth crabgrass can be obtained with pre- and postemergence herbicides, the ability to predict crabgrass seed germination and subsequent germination periods would allow turfgrass managers to implement more efficient control strategies. Therefore, the objectives of this study were to develop a method of predicting when initial smooth crabgrass seed germination occurs, when the major germination period(s) occur, and how long into the season to expect smooth crabgrass seed germination. Air and soil temperature measurements were used to develop degree-day models to predict the timing and extent of crabgrass seedling emergence.

In 1992 and 1993 field studies were conducted on stands of Kentucky bluegrass (Poa pratensis L.) with a history of a heavy smooth crabgrass infestation. Plots were 1.5 by 3.0 m and were arranged in a randomized complete block with four replications. Smooth crabgrass emergence was monitored weekly from April to August under two mowing heights of 3.7 cm and 6.4 cm. The site was mowed bi-weekly with a rotary mower. Crabgrass seedlings were counted weekly and removed from three, 100 cm^2 fixed grids per plot. An environmental monitoring system (CR10 Measurement and Control Module, Campbell Scientific, Logan, Utah) was installed on 1 April 1993 to record air and soil temperatures. Air temperatures were measured 30 cm above the soil surface. Soil temperatures were measured under both mowing heights at three depths: 1) 0.0 cm where sensors were placed adjacent to plant crowns; 2) 2.5 $\pm$ 0.5 cm soil depth; and 3) 5.0 $\pm$ 0.5 cm soil depth. Air and soil temperatures were measured and recorded at 5 minute intervals, averaged on an hourly basis, and stored in the CR10 Control Module until transferred to a laptop computer for data processing and analysis. In 1992, a similar method for monitoring crabgrass seed germination and temperatures was employed.

Fewer smooth crabgrass seedlings emerged in turf maintained at 6.7 cm versus 3.4 cm in both years. In 1992, crabgrass emergence was first observed on 26 April. Average minimum and maximum air temperatures for the week of 19 to 25 April 1992 were 8 and 21°C; respectively, and average minimum and maximum soil temperatures at crown level were 13 and 20°C; respectively. During the 1992 major emergence period of 15 June to 13 July, average minimum and maximum air temperatures were 14 and 27°C; respectively, and average minimum and maximum soil temperatures at crown level were 20 and 31°C; respectively. In 1993, crabgrass emerged on 21 April. Average minimum and maximum air temperatures for the week of 13 and 20 April 1993 were 6 and 19°C; respectively. The average minimum and maximum soil temperatures at crown level were 10 and 18°C; respectively. During the major emergence period of 17 May to 12 July 1993, average minimum and maximum air temperatures were 16 and 28°C; respectively. The average minimum and maximum soil temperatures at crown level were 20 and 30°C; respectively at this time.

From the 1992 and 1993 field data measurements 12°C was determined as the threshold temperature used to construct smooth crabgrass seed germination degree-day models. Degree-day models to predict the timing and extent of crabgrass emergence were developed for the turf at both mowing heights using air and soil temperatures separately.

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

Preemergence and Postemergence Crabgrass Control with Dithiopyr Fertilizer Formulations.

M.A. Czarnota, S.W. Bingham and L. Hipkins[1]

ABSTRACT

Dithiopyr fertilizer combinations were evaluated for preemergence and early postemergence control of large crabgrass [*Digitaria sanguinalis* (L.) Scop.] and smooth crabgrass [*Digitaria ischaemum* (Schreb.) Muhl.]. The influence of dithiopyr fertilizer combinations on the quality of Kentucky bluegrass [*Poa pratensis* (L.) cv. 'Plush'] was also evaluated. The test sites were located at VPI&SU Turfgrass Research Center. The turfgrass was vertical mowed, aerified, and overseeded with crabgrass at 0.25 lb/1000 ft^2 in early spring to promote crabgrass emergence and growth. Turfgrass height was maintained at 1.25 inches through the growing season. The preemergence test was applied on April 22 and postemergence test on June 2.

The emulsifiable concentrate (EC) formulation of dithiopyr at 0.38 lb ai/A, plus a 10-10-10 fertilizer applied separately, gave excellent preemergence control of crabgrass and was used as a standard. With preemergence dithiopyr fertilizer combinations, MON 45108 (20-3-5), MON 45109 (20-3-5), MON 65109 (18-3-12), MON 45170 (18-4-10), and MON 65156 (18-5-9) provided excellent control at 0.250 lb ai/A. MON 65110 (18-3-8) and MON 45173 (22-0-11) provided good control at 0.188 lb ai/A. The granule size of the fertilizer herbicide formulation appeared to influence the level of crabgrass control, which was poor with low rates. Over the first eight week period, the quality of the turfgrass was maintained at a high level with all the fertilizer dithiopyr combinations. By mid-September only the high rates of MON 65110 and MON 65156 provided acceptable quality. From the data it appears that dithiopyr fertilizer combinations (0.25 lb ai/A) provided equal control of crabgrass as compared with the 0.38 lb ai/A of dithiopyr (EC) plus fertilizer applied separately.

It appears that postemergence control of crabgrass with dithiopyr fertilizer combinations was not adequate. Consequently, further research is necessary to determine whether it is possible to provide postemergence control of crabgrass with such fertilizer herbicide combinations.

[1]Grad. Res. Asst., Prof., and Res. Assoc., Dept. Plant Pathol., Physiol., Weed Sci.

SMOOTH CRABGRASS SEED SOURCE AND GROWTH STAGE EFFECTS ON QUINCLORAC EFFICACY

S. J. Koo and J. C. Neal[1]

ABSTRACT

Quinclorac has been shown to be an effective herbicide on smooth crabgrass [*Digitaria ischaemum* (Shreb. ex Schweig) Shreb. ex Muhl] without turf injury in several locations. However, in our field conditions, quinclorac efficacy has been inconsistent. Several factors such as drought, irrigation schedule, spray coverage, and smooth crabgrass biotype and growth stage, have been found to affect quinclorac efficacy. In greenhouse experiments, smooth crabgrass collected in Ithaca, New York appeared to be somewhat tolerant than that collected in Marysville, Ohio and Kingston, Rhode Island. Contrary to reports from neighboring states, New York biotype required greater doses for adquate control at advanced growth stages. This year, we compared three biotypes in the field to comfirm these previously observed biotype differences and dose response.

Three smooth crabgrass biotypes, collected in New York, Ohio, and Rhode Island, were established in a field located in Ithaca, New York. The field was pre-sterilized by methyl bromide fumigation. On July 13, about 200 seeds of each biotype were sown in 3 by 0.5 ft squares spaced 1 ft apart in 3 by 5 ft plots . Quinclorac (75 % DF) was applied at three growth stages: 2-leaf to 5-tiller (seedling stage, August 12), 7- to 10-tiller (tillering stage, August 19), and 15- to 20-tiller (mature stage, August 31). Quinclorac rates were 0.12, 0.25, 0.5, and 0.75 kg ai ha^{-1} for seedling stage, 0.25, 0.5, 0.75, and 1.0 kg ha^{-1} for tillering stage, and 0.25, 0.5, 0.75, 1.0, and 1.25 kg ha^{-1} for mature stage treatment. Herbicide treatments were made using a CO_2-pressurized backpack sprayer calibrated to deliver 280 L ha^{-1}. Crabgrass control was visually evaluated 4 weeks after treatment. Using regression analysis, rates to achieve 50 % control (GR_{50}) were calculated.

Rate responses and GR_{50} of smooth crabgrass are shown in Figure 1 and 2. All the smooth crabgrass biotypes were more tolerant at advanced growth stages. Tolerance of New York and Ohio biotypes increased similarly across growth stages, however, that of Rhode Island biotype increased less noticebly. Thus, Rhode Island biotype was more susceptible than the others at tillering and mature stages. This result further indicates that smooth crabgrass becomes greatly tolerant as the growth stage advances, and biotype differences may exist at later stages. Practically, seedling stage treatment of quinclorac would avoid inconsistent control resulting from smooth crabgrass growth stage and biotype differences.

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[1]Grad. Res. Asst. and Assoc. Professor, repectively, Cornell University, Ithaca, NY 14853

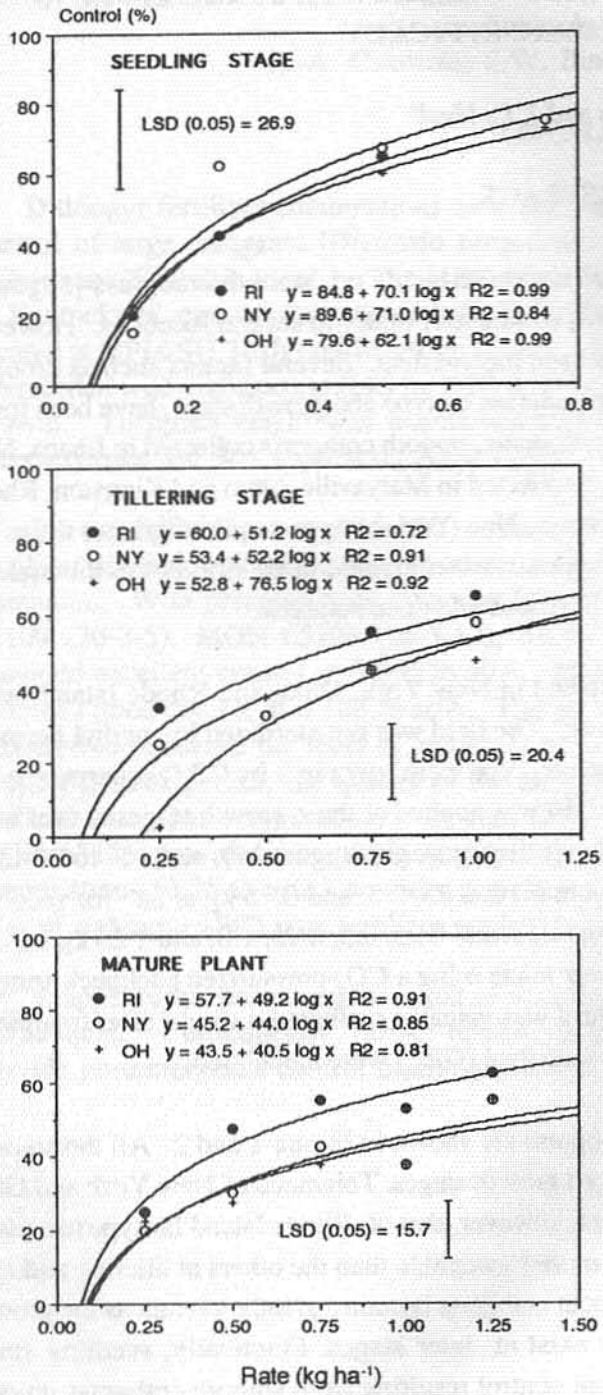

Figure 1. Rate response of smooth crabgrass biotypes at three growth stages.

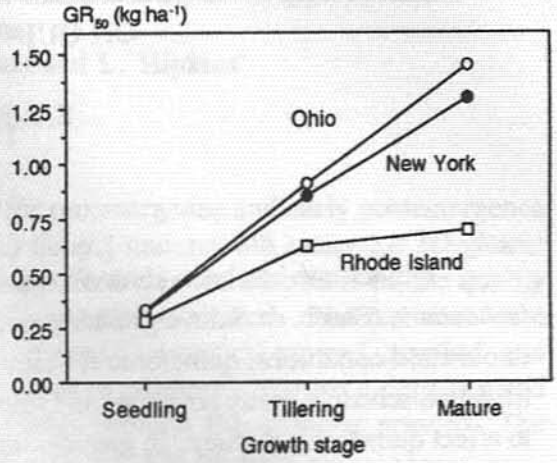

Figure 2. GR_{50} of smooth crabgrass biotypes at three growth stages.

RESPONSES OF ROUGHSTALK BLUEGRASS (*Poa trivialis* L.) TO SEVERAL POSTEMERGENCE HERBICIDES[1]

R. G. Prostak and R. D. Ilnicki[2]

ABSTRACT

Roughstalk bluegrass (POATR) is a cool season grass named for its retrorsely rough stem. Turf-type varieties such as Laser, Sabre and Colt are commercially available. It is commonly a weed in turfgrass seed production and in turf grown for sod where the characteristic greenish-yellow color, aggressive stoloniferous growth habit, and poor tolerance to heat and drought create aesthetically objectionable patches.

Field studies were initiated in the spring of 1992 to develop a control program in a Kentucky bluegrass (*Poa pratensis* L. POAPR) turf. Some sulfonylurea herbicides along with several other herbicides were evaluated. Spring and fall applications were applied to 'Nassau' Kentucky bluegrass sod that was sown September 1990 with roughstalk bluegrass seed as a contaminant. Compounds with selectivity in the field were further evaluated in a greenhouse study. Four varieties of roughstalk bluegrass: Danish Common, Laser, Sabre and Colt and six varieties of Kentucky bluegrass: Princeton Tiger, Midnight, Baron, Classic, Kenblue and Eagleton were sown in seven inch containers. Quizalofop at 0.045, 0.07 and 0.095 lb/A, nicosulfuron at 0.015, 0.03 and 0.045 lb/A, fenoxaprop at 0.1, 0.3 and 0.5 lb/A and quinclorac at 5, 8 and 11 lb/A were applied to all varieties.

Evaluations were made periodically on turf injury. Quinclorac was the most active of the herbicides studied and was more injurious to POATR than to POAPR, with the exception of the POAPR variety 'Eagleton'. The injury produced on POATR was more severe than either quizalofop or nicosulfuron. Quizalofop produced greater injury to POATR than POAPR; injury was greatest on POATR between 3 to 5 WAT but later recovered. Similarly, nicosulfuron also produced greater injury to POATR than to POAPR with the exception of the POAPR variety 'Princeton Tiger', but injury symptoms persisted longer with nicosulfuron than quizalofop. Fenoxaprop had little or no effect on POATR and POAPR. Further experimentation is underway to evaluate repeat or sequential applications.

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[1] New Jersey Agricultural Experiment Station Publication No. K-12274-1-93.

[2] Graduate Research Assistant and Professor Emeritus of Weed Science, Department of Plant Science, Rutgers University, New Brunswick, NJ 08903.

Influence of Diclofop on Transition from Overseeded Perennial Ryegrass to Bermudagrass

M.D. Johnson, S.W. Bingham, and P.L. Hipkins

ABSTRACT

The objectives of this research were 1) To evaluate the use of diclofop for optimiziation of perennial ryegrass (Lolium perenne L.) composition in a mixed perennial ryegrass bermudagrass (Cynodon dactylon (L.) Pers.) fairway cover and 2) To evaluate the effects of diclofop on the bermudagrass growth and quality.

The test sites were located at Tuscarora Country Club near Danville, VA and VPI & SU Turfgrass Research Center at Blacksburg, VA. The bermudagrass areas were overseeded with perennial ryegrass in the fall of 1991 at Tuscarora Country Club and in the fall of 1992 at the Turfgrass Research Center. Single diclofop applications at 0.5, 1.0, and 1.5 lb ai/A treatments were applied on May 12, May 26, June 8 and June 23. Selected treatments received additional diclofop at two to four weeks after the initial application. The test areas received normal bermudagrass fairway mowing, fertilization, and irrigation.

The quality of the bermudagrass was related to the reduction of ryegrass groundcover. In the Blacksburg experiment single applications of diclofop at 1 lb ai/A, applied on May 26, provided acceptable turf quality in July. The turf quality was unacceptable with single treatments applied on May 12 and June 22. Various split applications which provided a total of 1.5 to 3.0 lb ai/A of diclofop during May to June gave the best turf quality through the summer. There was a slight discoloration of the bermudagrass two weeks after treatment with the 1.0 to 1.5 lb ai/A rates; however, in early July the bermudagrass returned to a normal color. The best timing for control of ryegrass with single applications of diclofop at 1.5 lb ai/A was late May to early June. The untreated check plots remained 50 to 60 percent ryegrass through the summer while diclofop at 1.0 to 1.5 lb ai/A provided 90 to 95 percent control of ryegrass.

At Tuscarora Country Club the quality of the turf was less than acceptable in late June with the exception of diclofop(1 lb ai/A) applied on May 13. Various split applications of 2 and 3 lb ai/A total during the summer gave the most consistent high quality bermudagrass. The quality in August was more than acceptable in all treatments with the exception of the 0.5 lb ai/A rate applied on June 10 and July 24.

The maturity of the ryegrass appears to be a factor in the control of ryegrass with diclofop. The percent reduction in ryegrass was greater in Blacksburg(seeded fall of 1992) than at Tuscarora Country Club(seeded in the fall of 1991).

GROWTH SUPPRESSION AND PERENNIAL RYEGRASS QUALITY AS INFLUENCED BY TRINEXAPAC-ETHYL AND DITHIOPYR

H. C. Wetzel and P. H. Dernoeden[1]

ABSTRACT

The plant growth regulator (PGR) trinexapac-ethyl (trade name Primo) recently was introduced into the marketplace. Numerous questions have arisen regarding the general use of this PGR as well as its compatibility with other products. The objective of this research was to assess growth suppression and perennial ryegrass tolerance to trinexapac-ethyl when used in combination with dithiopyr 1EC (trade name Dimension). Both products are often applied during the same time period.

The turf was a blend of 'Palmer', 'Prelude', and 'Repell' perennial ryegrass (*Lolium perenne* L.). All treatments were initially applied 23 Apr 1993 using a CO_2 pressurized (35 psi) sprayer calibrated to deliver 50 gpa of water. The rates and dates of all treatments appear in Table 1. The study area was irrigated prior to applying all treatments and thereafter to maintain adequate soil moisture. Turf was mowed to a height of 0.85 inches on Friday of each week. The morning prior to mowing, turfgrass quality ratings and height measurements were collected. Turfgrass quality was determined visually on a 0 to 10 scale where 0 = turf brown or dead; 8 = minimum acceptable level of quality for a fairway; and 10 = optimum greenness and uniformity. Turfgrass height measurements were obtained by using a centimeter ruler attached to a round disk. Three random measurements were taken per plot and averaged. Plots were 5 by 5 ft, and were arranged in a randomized complete block with four replications. Data were subjected to analysis of variance and significantly different means were separated by the Duncan's multiple range test.

Primo applications were made 23 Apr, 21 May and 18 Jun; whereas, Scott's TGR and Cutless were applied 23 Apr and 4 Jun. Turfgrass quality was reduced by Primo during the first three weeks following the initial application, but not thereafter (Table 1). It was noted about one week after treatment that Primo-treated plots exhibited leaf tip yellowing. Turf recovered in a few weeks. By 18 June, most Primo-treated plots appeared to exhibit a more dense, dark green turf when compared to untreated turf, however, quality was not improved significantly. Scott's TGR, Cutless, and Dimension applied alone had no visual influence on turf quality.

Adopting an epidemiological model [Area Under The Disease Progress Curve (AUDPC)] to the canopy height data allowed cumulative turfgrass canopy height measurements to be compared among the treatments over time. Area under the growth progress curve (AUGPC) data were compared during three separate periods corresponding to Primo applications (data not shown). Data collected over the first 4 weeks after the initial treatment showed that Dimension (0.50 lb/A) applied one week prior to Primo (0.262 lb/A) negated the PGR effects of Primo. Normal growth suppression was observed, however, when Dimension was applied in tank mix combination with Primo or when it was applied one week after Primo. The antagonism between Primo and Dimension applied one week prior to Primo was only observed during the period of 30 Apr to 21 May. Thereafter, the normal level of reduction in turfgrass growth occurred when Primo was reapplied to those plots previously treated with Dimension on 16 Apr. During the second AUGPC period (28 May to 18 June), only Primo had significantly reduced canopy height. Primo applied at 0.262 lb/A only reduced growth significantly when compared to the 0.175 lb/A rate during the second AUGPC period. Cutless and Scott's TGR (reapplied 4 Jun), as well as Primo reduced growth in the third AUGPC period (25 Jun to 9 Jul). Data indicate that Dimension should not be applied for at least one week prior to Primo.

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

Table 1. Perennial ryegrass quality as influenced by plant growth regulators. Silver Spring, MD - 1993.

Treatment[†]	Rate: 23 Apr lb ai/A	Turf quality 30 Apr	7 May	14 May	21 May	Rate: 21 May lb ai/A	Turf quality 28 May	4 Jun	Rate: 4 Jun lb ai/A	Turf quality 11 Jun	18 Jun	Rate: 18 Jun lb ai/A	Turf quality 25 Jun	2 Jul	9 Jul
		----------0-10 scale----------					-----0-10 scale-----			-----0-10 scale-----			----------0-10 scale----------		
Primo 1EC	0.175	7.7d[‡]	7.9c	7.9d	7.9a	0.175	8.1a	8.4abc	0.0	8.2a	8.5a	0.175	8.3a	8.1a	8.1a
Primo 1EC	0.262	8.1bc	8.0c	8.0bcd	8.0a	0.262	8.1a	8.5ab	0.0	8.2a	8.5a	0.262	8.3a	8.1a	8.1a
Dimension 1EC	0.50	8.2abc	8.6a	8.2abc	8.1a	0.0	8.1a	8.0c	0.0	7.9a	8.0b	0.0	7.9a	7.8a	8.2a
Dimension 1 wk Prior to Primo[‡]	0.50/0.262	8.5a	8.5ab	8.3ab	8.1a	0.0+0.262	8.1a	8.1abc	0.0	8.0a	8.1ab	0.0+0.262	8.1a	7.9a	8.1a
Dimension 1 wk After Primo[‡]	0.50/0.262	7.9cd	7.9c	7.9cd	8.0a	0.0+0.262	8.2a	8.6a	0.0	8.3a	8.2ab	0.0+0.262	8.1a	8.2a	8.0a
Dimension 1EC + Primo 1EC	0.50+0.262	7.6d	7.9c	8.1bcd	8.0a	0.0+0.262	8.1a	8.3abc	0.0	8.3a	8.2ab	0.0+0.262	8.1a	8.1a	8.1a
Scott's TGR 50W	0.50	8.2abc	8.2bc	8.1bcd	8.0a	0.0	8.1a	8.2abc	0.25	8.1a	8.2ab	0.0	8.0a	7.9a	8.2a
Cutless 50W	0.50	8.4ab	8.5ab	8.5a	8.2a	0.0	8.4a	8.1bc	0.25	8.1a	8.2ab	0.0	8.0a	8.1a	8.2a
Untreated	---	8.3ab	8.2bc	8.3abc	8.2a	---	8.4a	8.2abc	---	8.0a	8.1ab	---	8.1a	8.1a	8.1a

[†]Dimension treatments were applied only one time; Primo was applied three times; and Scott's TGR and Cutless were applied twice.

[‡]Dimension applied 1 week prior to Primo was applied 16 April; whereas, Dimension applied 1 week after Primo was applied 30 April 1993.

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

EFFECT OF FLURPRIMIDOL ON POA ANNUA AND CREEPING BENTGRASS IN THE GREENHOUSE, 1993

T. L. Watschke and K. Kallenbach[1]

ABSTRACT

Flurprimidol (Cutless) can be used for application to mixed creeping bentgrass (Agrostis palustris) and annual bluegrass (Poa annua) swards for the purpose of shifting the existing plant population in favor of creeping bentgrass. To study more closely the basis for such population shifts, a greenhouse experiment was conducted in 1993 to evaluate flurprimidol treated creeping bentgrass for stolon growth and annual bluegrass basal tillering rate. Six tillers of Penncross creeping bentgrass were planted into 55 individual styrofoam containers on February 13, 1993. After planting, the tillers were topdressed with sterilized sand to control weeds and prevent soil surface cracking. The planted containers were placed in a shallow pan of water to maintain optimal soil water conditions.

Six tillers of annual bluegrass harvested from the Penn State golf course were used in the same manner as the bentgrass. Fifty-five containers were planted with six individual tillers per container on February 21, 1993. After rooting, the plants were clipped to a height of 1 inch. On March 20, 1993, the internodal lengths were measured on the bentgrass stolons. At least five stolons per container were measured. The measured stolons were tagged with an identification number in order to continually monitor the same stolons throughout the duration of the study. Annual bluegrass tillers were counted to obtain an average number of tillers per plant. All six plants per container were counted individually and the average taken for each container.

On March 24, 1993, the flats were treated with flurprimidol at 0.25, 0.3, and 0.5 lbs ai/A with an enclosed greenhouse sprayer. Each rate of application had 5 replications, and five flats were left untreated as a check. After treatment, the flats were returned to the greenhouse and were not cut after treatment. Internodal lengths and tiller counts were taken every 30 days for 2 months after treatment.

Flurprimidol application to bentgrass caused a decrease in internodal length at the high rate. At the lowest rate (0.25 lbs ai/A), the internodes had a 3 percent increase in internodal length. At the two higher rates (0.3 and 0.5 lbs ai/A), the internodes had a 18.5 percent reduction in internodal length when measured at 30 DAT. The untreated plants had a 32 percent increase in internodal length for this same time period. At 60 DAT the untreated plants were not different in internodal length than treated plants. Bentgrass exhibited some phototoxicity one week after treatment, but the slight discoloration was not evident after 30 days. Tiller counts for annual bluegrass showed that the lowest rate of flurprimidol did not cause a significant difference at 30 DAT or 60 DAT. The number of tillers increased almost 150 percent in thirty days for untreated or those that received 0.25 lbs ai/A and increased 250 percent at 60 DAT. For the 0.3 lb ai/A rate, the tiller increase was reduced 100 percent at 30 DAT and 160 percent at 60 DAT. The 0.5 lb ai/A rate reduced the tiller increase to 90 percent at 30 DAT and 130 percent at 60 DAT. Discoloration was not as evident on the annual bluegrass compared to bentgrass, however the plants were more noticeable dwarfed particularly when compared to untreated plants. In addition, the annual bluegrass did not resume normal growth as quickly as the bentgrass plants.

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[1]Prof. and Res. Asst., respectfully, Dept. of Agronomy, Penn State Univ., Univ. Park, PA 16802

HERBICIDE SAFETY TO REPLACEMENT VINES IN ESTABLISHED GRAPE VINEYARDS

Andrew F. Senesac and Alice Wise[1]

ABSTRACT

In established grape vineyards (Vitis vinifera) in the Northeast, vine loss due to disease and winter damage can range from 5 to 15 percent per year. Installing young replacement vines is a task that continually challenges vineyard managers. Because of the investment in money and labor, growers are naturally interested in establishing young replacement vines under the most favorable conditions for their optimal growth. A potential impediment to successful establishment is the herbicide(s) that a grower may be applying in the vineyard.

A field study was conducted to determine how the activity of preemergent herbicides is affected by three different methods of planting and application. Nursery plants of 'Chardonnay' on 'C3309' root stock were grown in one gallon containers for one year before treatment. At the time of treatment, the plants, which had five leaves at least partially emerged, were planted in a Riverhead sandy loam with 2% O.M. Plants were transplanted in one of three ways: 1) planted and treated, 2) holes were dug, soil was treated and vines were planted, 3) holes were dug, soil was treated and vine roots were dipped in an activated charcoal slurry and planted. The herbicide treatments, which were applied at the labeled rate (1X) and at four times the labeled rate (4X) were: oryzalin (2.0 and 8.0 lb/a), simazine (2.0 and 8.0 lb/a), diuron (1.6 and 6.4 lb/a), norflurazon (2.0 and 8.0 lb/a). The plants were evaluated during the growing season and vines and roots were harvested 108 days after treatment.

The results suggest that oryzalin was the safest of the four herbicides tested. Although some temporary injury occurred with both rates when the vines were planted and treated, by mid-summer no injury was visible on any vine treated with oryzalin. There was some temporary injury from both rates of simazine when vines were planted and treated. There was significantly more injury when the vines were planted into treated soil. However, this injury was completed neutralized if the roots were dipped in activated charcoal prior to planting. At both rates, norflurazon and diuron caused severe injury to the vines whether they were applied before or after planting. Diuron was safened more by activated charcoal than norflurazon was, but at the 4X rate, both herbicides caused unacceptable injury.

The results suggest that the choice of herbicide program and planting method can greatly affect the degree of injury that a young replacement vine sustains when installed in an established vineyard.

1/Weed Science and Grape Specialists, Cornell Cooperative Extension, Long Island Horticultural Research Laboratory, Riverhead, NY 11901.

EFFECT OF EXPRESS ON BUNCHBERRY IN WILD BLUEBERRY FIELDS

David E. Yarborough and Timothy M. Hess[1]

ABSTRACT

Bunchberry has been increasing in Maine wild blueberry fields with the use of Velpar. Spring application of Express suppressed bunchberry without injury or yield loss to wild blueberry.

INTRODUCTION

Bunchberry (*Cornus canadensis* L.) has invaded spaces in and among commercial wild blueberry (*Vaccinium angustifolium* Ait.) clones. Bunchberry invades barren areas left open by applications of Velpar more rapidly than blueberries (Yarborough and Bhowmik, 1993) and produces an undesirable fruit. It has a similar growth pattern to blueberry making selective control difficult (Yarborough and Bhowmik, 1989). While glyphosate may be used to suppress pure stands of bunchberry, there is no selective measure for bunchberry growing within the blueberry clone. Earlier trials (Yarborough and Hess, 1993) indicated a June application of Express (tribenuron methyl) suppressed bunchberry and stimulated blueberry buds but produced a slight reduction in yield.

The objective of this experiment was to test the effectiveness of Express at different rates and dates, to suppress bunchberry and to assess its effect on yield of the wild blueberry.

METHODS

A split block experiment was set out at Blueberry Hill Farm, Jonesboro, ME on a Colton sandy loam soil in May 1992. The experimental design had four rates, applied on one of three dates with six replications for a total of 72 plots. Plot size were 3 by 16 feet with 3 by 16 foot alleyways with two, 1 ft^2 count plots per plot. Pre-treatment bunchberry counts were taken in May and treatments applied on May 29 or June 17 or on May 29 and September 14, 1992 at 0, 0.14, 0.28, or 0.57 oz ai/a. Phytotoxicity was evaluated in June 1993 using a scale of 0 to 10 with 0 having no injury and 10 being dead. Number of bunchberry were counted again in June 1993 and plots were harvested in August 1993. Data were analyzed by analysis of variance using the SAS GLM procedure (SAS, 1985).

RESULTS

Effectiveness of Express in reducing bunchberry increased with the later applications and bunchberry number decreased as rate increased (Figure 1). Blueberry phytotoxicity increased with rate but the late fall application resulted in excessive injury to the blueberry (Figure 2). Blueberry yield was not reduced at any rate of Express for the early or late spring applications but showed a decline with higher rates of Express when applied in the fall.

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[1]Assistant Professor of Horticulture and Research Associate, Department of Plant, Soil and Environmental Sciences, University of Maine, 04469-5572

Figure 1. Effect of Rate and Timing on Bunchberry Numbers

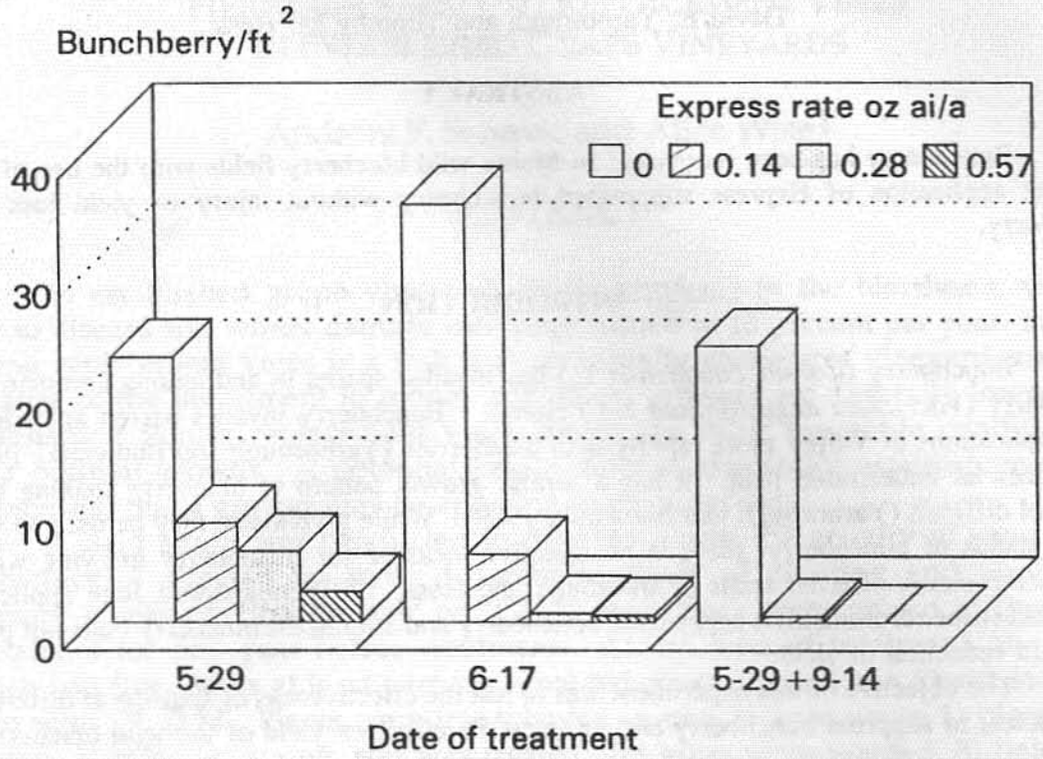
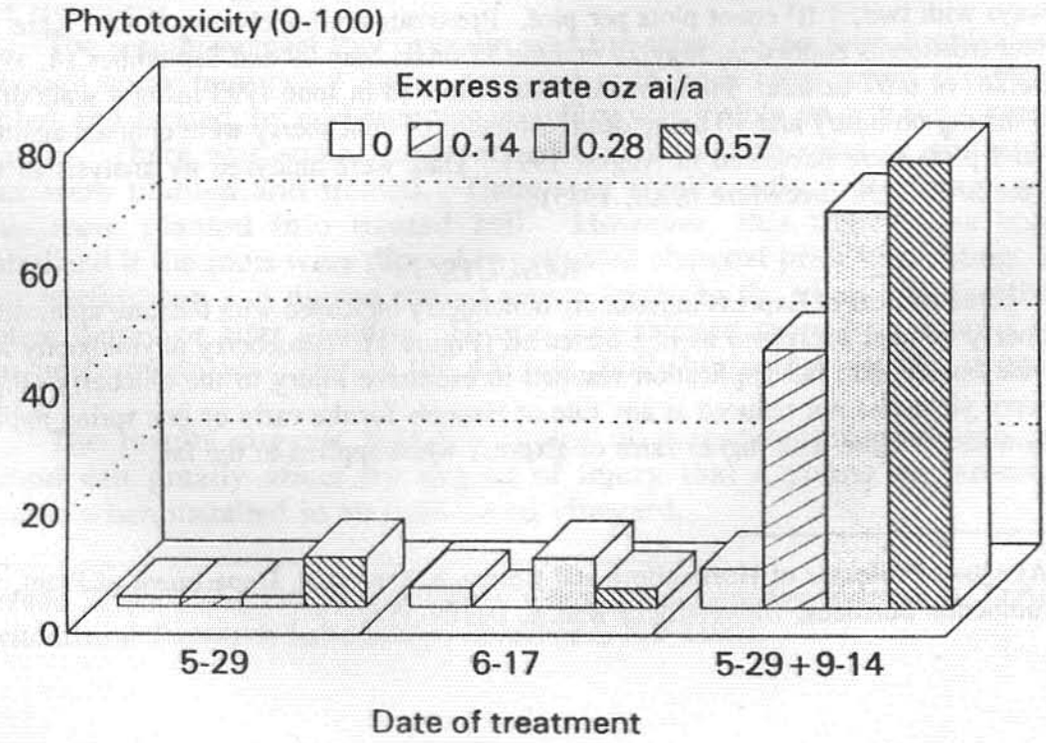


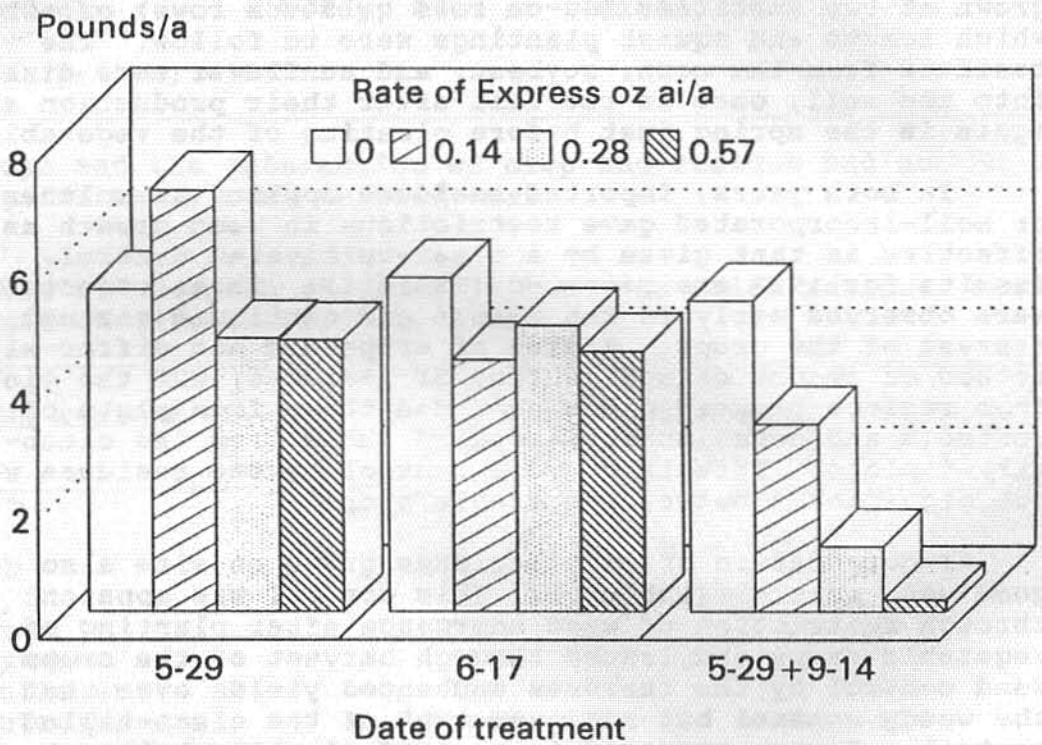
Figure 2. Effect of Rate and Timing on Blueberry Phytotoxicity



CONCLUSION

Express applied in early to late Spring at 0.14 to 0.57 oz ai/a effectively reduced bunchberry number without significantly injuring blueberry or reducing blueberry yield. Fall application resulted in significant blueberry injury and reduction in yield. Since bunchberry is not a competitor with blueberry (Yarborough and Bhowmik, 1993) an immediate increase in yield was not expected. However, if bunchberries are not in the interclonal spaces, blueberry plants will fill in and yield will increase over time. More experiments are planned to support registration of Express for use in wild blueberry fields in Maine.

Figure 3. Effect of Rate and Timing on Blueberry Yield



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USE OF CROP RESIDUES FOR WEED CONTROL IN VEGETABLE CROPS

Allen V. Barker and Prasanta C. Bhowmik

The objectives of this research were to evaluate the effects of plant residues for weed control in vegetable crops. Two experiments were conducted. In the first experiment, which was conducted in 1992 and in 1993, chopped residues of corn (Zea mays L.), soybean (Glycine max Merr.), and sunflower (Helianthus annuus L.) were imported into field plots and applied as mulches (24 Mg/ha) or incorporated into the soil (6, 12, or 24 Mg/ha). Weed control was evaluated in tomato (Lycopersicon esculentum Mill. 'Celebrity' and zucchini squash (Cucumis pepo melopepo Alef. 'Black Beauty'. In the second experiment, corn, soybean, and sunflower were grown at two densities (90-cm rows or 30-cm rows) on sites in which tomato and squash plantings were to follow. The residues from the corn, soybean, and sunflower were disked into the soil, once in the fall after their production and again in the spring just before planting of the vegetables.

In both years, imported residues applied as mulches or soil-incorporated gave restrictions in weed growth as effective as that given by a clean-cultivated control. Results for 1993 are reported (Table 1). These effects were observed early in the season and continued through harvest of the crops. Yields of crops did not differ with method or amount of application of residues, but the yields from residue-treated plots exceeded those from plots of weedy controls and occasionally exceeded those from the clean-tilled plots. Effects of weed control by the residues were not significant between vegetable crops.

Incorporation of crop residues grown on site also gave good weed control (Table 2). This control was apparent through restriction of weed emergence after planting of vegetable crops and lasted through harvest of the crops. Weed control by the residues enchanced yields over that of the weedy control but not over that of the clean-tilled control. Squash appeared to respond slightly better to the residue treatments than the tomatoes did.

The benefits of the residues appears to be in the reduction in labor for mid and late season weed control. With the imported residues, some benefits may have been obtained from nitrogen contained in the residues.

Professors, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Table 1. Biomass of weeds in plots in which residues were applied (harvests of weeds taken on August 26, 1993, about 12 weeks after planting).

Residue	Amount and method of application of residues			
	Incorporated (Mg/ha)			Mulched (Mg/ha)
	6	12	24	24
	Weed mass, g m^{-2} (dry weight)			
Corn	28	16	7	14
Soybean	20	18	17	41
Sunflower	13	25	11	75
Controls :	Weedy, 560		Clean, 16	

LSD ($p \leq 0.05$) = 29.

Crops and the interaction of crop and residue had no significant effect on weed mass.

Table 2. Biomass of weeds in plots in which residues were grown on-site (August 26, 1993)

Crop residue	Method of residue production	
	90-cm rows	30-cm rows
	Dry weights, g m^{-2}	
	Tomato	
Corn	317	150
Soybean	181	161
Sunflower	119	90
Controls:	Weedy, 629	Clean, 214
	Squash	
Corn	21	38
Soybean	53	93
Sunflower	30	32
Controls:	Weedy, 818	Clean, 51

LSD ($p \leq 0.05$) = 30

Results of ANOVA: Residues, $p \leq 0.01$; Crops, $p \leq 0.07$; Interaction, $p \leq 0.01$.

POTATO VARIETAL TOLERANCE TO E9636 APPLIED PRE- AND POST- EMERGENCE

S. F. GORSKI[1] and T. PRZEPIORKOWSKI[2]

ABSTRACT

Field experiments were conducted at the Horticulture Research Farm of The Ohio State University in Columbus, OH during the 1993 season. Four different varieties of potatoes, 'Atlantic', 'Langlade', 'Superior', and 'Conosoga', were planted in randomized complete blocks which were replicated 3 times. This was done for both a pre- and a post- emergence study. Various rates of E 9636 alone and in combination with metribuzin were applied to the experimental area either preemergence or postemergence to the crop. Weed control and crop phytotoxicity evaluations were made approximately 14 and 30 days following both the pre- and post-emergence applications.

The addition of metribuzin to E 9636 improved control of the common annual grasses and broadleaf weeds. Weed control was excellent when E 9636 was applied preemergence at a rate of 0.0238 lbs ai/A in combination with metribuzin at 0.25 lb ai/A. Preemergence weed control was significantly lower when the metribuzin was excluded from the tank mixture or was reduced to 0.1875 lb ai/A. There was no evidence of crop phytotoxicity during the growing season and yields were acceptable.

Postemergence weed control with E 9636 was superior to that obtained with preemergence applications. Weed control was near perfect with E 9636 alone and the addition of metribuzin to the tank mixture did little to improve weed control. There was no visible phytotoxicity to any of the potato varieties and yields were acceptable.

[1]Professor, Department of Horticulture, The Ohio State University, Columbus, OH.
[2]Visiting Scientist from the Department of Horticulture, Warsaw Agriculture University, Warsaw, Ploand. Current address, Department of Horticulture, The Ohio State University, Columbus, OH.

Efficacy and Phytotoxicity of MON 12000 in Cucumbers and Snap Beans

B. A. Majek[1]

ABSTRACT

No crop injury was observed when MON 1200 was applied to cucumbers at rates between 0.009 and 0.038 lb ai per acre. Slight stunting occurred when the rate was increased to 0.056 lb ai per acre, and injury increased as rate increased. Cucumber stunting was moderate at 0.11 lb ai per acre. Preemergence applications of MON 12000 to cucumbers effectively controlled common lambsquarter (Chenopodium album L.), smooth pigweed (Amaranthus hybridus L.) and hairy galinsoga (Galinsoga ciliata (Raf.) Blake) at 0.038 lb ai /a. Postemergence applications caused less crop injury than the preemergence applications. No cucumber injury was observed when MON 12000 was applied with nonionic surfactant to cucumbers with two to three true leaves at rates between 0.008 and 0.032 lb ai per acre. Smooth pigweed and hairy galinsoga control was excellent, but common lambsquarter control was poor when MON 12000 was applied to cucumbers postemergence. No significant crop injury was observed when MON 1200 was applied to snap beans at 0.038 or 0.076 lb ai per acre. Preemergence applications of MON 12000 to snap beans effectively controlled common purslane (Portulaca oleracea L.), common lambsquarter, smooth pigweed and hairy galinsoga at 0.038 lb ai /a. Postemergence applications were also safe when applied to snap beans at 0.008 and 0.016 lb ai per acre with nonionic surfactant. Common purslane, smooth pigweed, and hairy galinsoga control was excellent, but common lambsquarter control was poor when MON 12000 was applied to snap beans postemergence.

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

PREDICTION OF WEED INFESTATION

Sister Jeanne-Yolaine Mallet and Richard A. Ashley[1]

ABSTRACT

Conventional approaches to weed management have been dominated by herbicide technology. Contamination of surface and groundwater and weed species resistance to particular herbicides lead researchers to seek more comprehensive approaches to weed control and new ways of using existing products. Most weed control treatments rely on residual herbicides applied in the spring prior to weed and crop emergence. Weed management decisions cannot therefore be made in relation to species composition and relative abundance.

A study was conducted in order to explore the possibilities of predicting future weed infestations to further develop weed management recommendations in relation to the species present in the soil. The most abundant and most frequent species identified in corn fields in Connecticut were *Amaranthus retroflexus (L.)*, redroot pigweed; *Chenopodium album (L.)*, common lambsquarters; *Digitaria* species, crabapple species; *Panicum* species and *Stellaria media (L.)*, chickweed. The prediction was based on the soil seed bank and soil factors that influence seed germination, seedling emergence and plant growth.

Predictive equations wee developed. R^2 values indicated that it seems possible to predict future infestations of *Amaranthus, Chenopodium, Digitaria* and *Panicum* species. Soil fertility factors such as pH, nitrate, phosphorus, calcium, potassium and magnesium levels were significant components of predictive equations for one or more species. The presence and level of significance of the parameters varied among species.

[1]Professor of Horticulture; Department of Plant Science, University of Connecticut, Storrs, CT

TIMING APPLICATIONS OF METOLACHLOR ALONE AND IN COMBINATION WITH METRIBUZIN TO TRANSPLANTED TOMATOES

R.J. DURGY AND R.A. ASHLEY[1]

ABSTRACT

Metolachlor was evaluated in a field study on tomatoes (Lycopersicon esculentum L.) cv 'Pilgrim' using varying rates and application times. The rates used were 1.68 and 3.36 kg ai/ha. The applications were made pretransplant, preplant incorporated and post-transplant. The pretransplant and preplant incorporated applications were made on June 25, 1993. Transplants were planted on June 28, 1993 and sprayed on July 2, 1993 for the post transplant treatments. All metolachlor treatments were applied with and without metribuzin. Metribuzin was sprayed postemergence on July 19, 1993 at a rate of 0.56 kg ai/ha. Tomatoes were harvested on Sept 24 and Oct 1,1993. Significant differences occurred between treatments. Treatments were evaluated for weed control and their effect on yield. Plots treated with metribuzin and metolachlor yielded significantly higher than metolachlor alone. Treatments applied post-transplant and preplant incorporated yielded significantly higher than pretransplant treatments. No difference was found between the two rates of metolachlor.

INTRODUCTION

Weed control in fresh market tomatoes is critically important because of their high market value. Metribuzin 4-amino-6-tert-butyl-3- (methylthio)-as-triazin-5(4H)-one is effective on many broadleaf and grass weeds, but not all. It is generally recommended to use metribuzin in combination with trifluralin A,A,A-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine or sethoxydim 2-[1-(ethoxyimino) butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one for adequate grass control. Metolachlor 2-chloro-N-(2-ethyl-6- metylphenyl)-N-2-methoxy-1-methylethyl acetamide could be useful in combination with metribuzin in tomato weed

1. Graduate Asst. and Prof. of Horticulture respectively, The University of Connecticut, Dept. of Plant Science

control programs as metolachlor controls many problem weeds, such as eastern black nightshade (Solanum ptycanthum Dun.) and galinsoga (Galinsoga parviflora Cav.), which triflurolin and sethoxydim do not. The purpose of this experiment was to evaluate the effectiveness of metolachlor alone and in combination with metribuzin.

MATERIALS AND METHODS

The experiment was conducted in the summer of 1993 on the University of Connecticut Plant Science Research Farm in Mansfield, CT. Plots were 1.5 meters by 3.0 meters arranged in a randomized complete block design. Fertilizer (15-15-15) was applied at a rate of 750 kg/ha. Herbicide applications were made with a CO_2 pressurized backpack sprayer delivering 187 L/ha.

Metolachlor was applied on June 25, 1993 for the pre-transplant and preplant incorporated treatments. Incorporation was done by hand with an iron rake. Tomatoes were hand planted on June 28, 1993. The post-transplant treatment of metolachlor was applied July 2, 1993 to allow time for the transplants to establish. Rainfall of 0.46 inches occurred on July 3. The postemergence treatments of metribuzin were applied on July 19. Treatments are described in Table 1. The average height of weeds was 3.8 cm. The predominant weeds present were common ragweed (Ambrosia artemisiifolia L.), redroot pigweed (Ameranthus retroflexus L.) and common lambsquarters(Chenopodium album L.).

Weed samples were taken on Aug 26, 1993. The sample size was 45 cm by 45 cm, randomly assigned in each plot. Weeds were separated by species and dry weights taken.

Tomatoes were harvested on Sept 24 and Oct 1. A hard frost occurred after the first harvest so all remaining fruit of marketable size was harvested on Oct 1. Yield data was taken from the middle five plants of each plot.

RESULTS AND DISCUSSION

Weed control was improved when the combination of metribuzin and metolachlor was used compared to metolachlor

alone. Ragweed and lambsquaters control was not significantly different from the weedy check. Pigweed control was significantly better in all treatments than the weedy check. No difference could be determined between the two rates of metolachlor. Nor were there any differences between the application times.

There were significant differences between treatments when yield was analyzed. Treatments with metribuzin yielded significantly higher than those with metolachlor alone. The preplant incorporated and post-transplant treatments yielded significantly higher than the pretransplant treatments. This could be due to the lack of rain for the pretransplant treatments and the timely rain for the post-transplant treatments. There was no difference between the two rates of metolachlor.

Metolachlor caused slight damage to the transplants at the high rate when sprayed post-transplant but did not reduce yield. In fact, the metolachlor post-transplant treatment plus metribuzin postemergence was the second highest yielding, behind the weed free check.

CONCLUSION

Metolachlor in combination with metribuzin gave effective weed control in transplanted tomatoes. Preplant incorporated and post-transplant applications of metolachlor were more effective than preemergence applications. Minor crop injury was observed with post-transplant applications of metolachlor but no yield reduction resulted. When metolachlor alone was applied, yields were reduced compared to the weed free control.

TABLE 1 treatment	yield kg/plot	weed wt gm/plot pigweed
metolachlor 1.68 kg ai/ha pre	3.8 d e	2.33 c
metolachlor 1.68 kg ai/ha pre +metribuzin 0.56 kg ai/ha post	5.7 d e	0.00 c
metolachlor 3.36 kg ai/ha pre	6.1 c d e	3.00 c
metolachlor 3.36 kg ai/ha pre +metribuzin 0.56 kg ai/ha post	7.5 b c d	0.00 c
metolachlor 1.68 kg ai/ha ppi	6.2 c d e	1.33 c
metolachlor 1.68 kg ai/ha ppi +metribuzin 0.56 kg ai/ha post	10.5 a b	0.00 c
metolachlor 3.36 kg ai/ha ppi	3.2 e	19.33 b
metolachlor 3.36 kg ai/ha ppi +metribuzin 0.56 kg ai/ha post	6.9 b c d e	0.00 c
metolachlor 1.68 kg ai/ha post	5.2 d e	2.67 c
metolachlor 1.68 kg ai/ha post +metribuzin 0.56 kg ai/ha post	10.0 a b c	0.00 c
metolachlor 3.36 kg ai/ha post	6.4 c d e	4.33 c
metolachlor 3.36 kg ai/ha post +metribuzin 0.56 kg ai/ha post	10.7 a b	0.00 c
no weed control	5.0 d e	43.67 a
hand weeded control	11.9 a	0.00 c

Duncans MRT, means followed by different letters are significant at the 5% level.

Innovative Mechanical Weed Control Systems for Snap Beans, Sweet Corn, and Transplanted Broccoli

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

Abstract

The recent trend toward restricting agricultural pesticide use, coupled with the public's concern for the environment and economic concerns of growers, has led to an interest in reducing herbicide use. In response to this situation, a study of 'innovative' mechanical cultivation systems was conducted in 1993 in three crops: snap beans, sweet corn, and transplanted broccoli. The objective of this research was to identify cultivation systems that could provide season-long weed control without adversely affecting yields. The study included five cultivation implements, used individually or in combination with another cultivator, and a chemical standard. The five implements were: two flex-tine cultivators for 'broadcast' weeding both over and between crop rows(one with row-modifying capabilities); a traditional row-crop cultivator; a rolling 'spider gang' cultivator; and a brush hoe. The cultivation treatments consisted of each implement used by itself, and each of the 'broadcast' weeders used once for early season weed control complemented by each of the inter-row implements for late season weed control. The chemical standards were: metolachlor + atrazine(2.2 + 1.1 kg ai/ha), metolachlor + bentazon(2.2 + 1.1 kg ai/ha), and metolachlor(1.7 kg ai/ha) in sweet corn, snap beans, and broccoli, respectively. Successful weed control programs and high yields were achieved in snap beans, particularly with the implement combinations. The brush hoe, in combination with either flex-tine cultivator, had the fewest number of weeds and highest yield of any treatment. Yields and weed control with a single brush hoe cultivation were comparable to the chemical standard. Control of in-row weeds was superior with the flex-tine cultivators used alone, but yields were decreased by competition from late-emerging between-row weeds. Final crop stands and yields of broccoli were greater when the implements were used alone rather than in the combinations. Due to environmentally-caused herbicide stress, growth of the herbicide treated plants was slowed and yields were reduced. Good season-long weed control was achieved with a single use of the brush hoe and yields were high despite significant crop injury. While providing only moderate weed control, crop injury was least and yields were highest with the row crop cultivator. Weed control both in- and between-rows was not successful with either flex-tine cultivator in broccoli. In-row weed control was inadequate with all the implements when used in sweet corn. This was partially a function of incomplete mechanical control and the slow early-season growth of the corn. Season-long weed control in sweet corn by cultivation alone was not feasible.

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

Effects of Surfactants on Fomesafen and Bentazon Injury in Snap and Dry Beans

Gregory R. Comeau, Robin R. Bellinder[1], and Michael Orfanedes[2]

Dry beans and snap beans (Phaseolus sp.) were treated with either bentazon (0.5 lbs ai/A) or fomesafen (0.38 lbs ai/A) in combination with various surfactants to measure phytotoxic effects on yields. Five classes of surfactants were tested: spreader/stickers (Activate Plus®, X-77®, Induce®), petroleum oil concentrates (Prime Oil®, Agridex®, DASH®, Clean Crop®), vegetable oil concentrates (Prime Oil II®, Soydex®), methylated vegetable oils (Methoil®), and organosilicon-containing materials (Sylguard 309®, Dyne Amic®, Kinetic®). Metolachlor (1.5 lbs ai/A) was applied preemergence, to all experimental sites. At application all beans had two fully expanded trifoliate leaves. Fomesafen injury was generally less in dry beans than in snap beans, and the injury tended to be more severe with the oil-based than with the non-oil-based surfactants. However, in all cases injury was outgrown by two weeks after application. Yields were not affected by the early season injury. Despite high temperatures and humidity on the day of treatment, the initial bentazon application did not cause injury. Therefore, the bentazon (1.0 lb/ai) treatments were reapplied to ensure a response. Within each class of surfactants injury varied and differences were not significant. Snap bean yields decreased when bentazon was applied with Sylguard 309® and X-77®. When identical bentazon + surfactant treatments were applied in a Genesee County trial under low temperatures and moderate humidity, injury with the different surfactants did not occur. Yields of all treatments were equivalent. In a fouth study, phytotoxic effects of organosilicon-containing surfactants were also observed when applied with bentazon at 0.5 and 1.0 lb ai. Although yield differences were seldom significant, there was a consistant trend towards lower yields with the high rate of bentazon, regardless of surfactant. Additionally, when the high rate of bentazon was combined with Sylguard 309® and X-77® synergism may have caused significant yield reductions. Surfactants applied alone had no effect on yield.

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[1]Grad. Stud. and Assoc. Prof., Department of Fruit and Vegetable Science, Cornell University, Ithaca, NY. 14853.

[2]Reg. Ex. Spec. NYS Cooperative Extention, Batavia, NY 14020

Fallow Cultivation, Stale Seedbed, and Conventional Tillage Influence Weed Control in Cucumbers

E.D. Wilkins and R.R. Bellinder[1]

Field experiments were conducted to study the season-long influence of pre-plant weed control techniques in cucumbers. Plots established on a silt loam soil were: conventionally tilled (CT) (moldboard plowed and disked); fallow cultivated (FC) (shallow cultivation twice in fall, and three times in the spring); and stale seedbed (SS) (disked in early May, sprayed with 1.1 kg ha^{-1} glyphosate 3 and 1 wk before planting). In 1992, three treatments were superimposed on each pre-plant system: an untreated check; ethalfluralin (0.8 kg ha^{-1}) pre-emergence (PRE) plus a post-emergence (POST) program (0.6 kg ha^{-1} bentazon + 0.2 kg ha^{-1} sethoxydim + 1.25% v/v COC); and naptalam + bensulide (2.2 kg ha^{-1}, 3.4 kg ha^{-1}) PRE plus the POST program. In 1993, four programs were tested: an untreated check; cultivation as-needed; POST herbicides only; and ethalfluralin PRE plus the POST program. In 1992, early and late season weed control were highly correlated. Weed numbers were lower in SS and FC untreated checks 60 days after planting (DAP) when compared to CT untreated checks (48, 128, and 204 m^{-2} respectively). Similarly, weed biomass in checks was 3x lower in FC and SS than in CT. Both PRE herbicides provided equivalent weed suppression, and herbicide programs obscured the effect of the pre-plant systems. In 1993, weed populations were lower, with untreated checks in SS, FC, and CT having similar weed populations 60 DAP (18.0, 24.0, and 38.8 m^{-2} respectively), and pre-plant systems had no measurable influence. Weed biomass decreased to 77.6 g m^{-2} in POST alone plots compared to 359.6 g m^{-2} in untreated checks (averaged across all pre-plant systems). Bentazon + sethoxydim, without residual herbicides, did not provide adequate control, since redroot pigweed (*Amaranthus retroflexus* L.) was the primary broadleaf species. Cultivation and ethafluralin + POST program provided effective suppression of weed biomass in all pre-plant systems. Yields in SS and FC untreated checks were greater than CT checks in both years. However, these yields were lower than yields of treatments where post-plant herbicides or cultivation were applied. In 1992, yields in CT, FC, and SS did not differ when either PRE herbicide was applied. However, cucumber yields were 26200 kg ha^{-1} with ethalfluralin compared to 23100 kg ha^{-1} with naptalam + bensulide (averaged across pre-plant systems). In 1993, yields were greater in SS than CT or FC, despite non-significant weed control differences. Highest yields were obtained in ethalfluralin SS (28500 kg ha^{-1}), but this was not significantly different from SS or FC cultivation yields.

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[1]Grad. Res. Asst., and Assoc. Prof. Dept. Fruit and Veg. Science. Plant Sci. Bldg. Cornell Univ., Ithaca, NY 14853-0327.

POSTEMERGENCE DPX - E9636 FOR POTATOES AND RESIDUAL SOIL EFFECTS.

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

ABSTRACT

Postemergence E9636 0.03 lb ai/A applied at 35 days after planting potatoes (Solanum tuberosum L., 'Superior') provided 94 and 67% weed control at 27 and 47 days, respectively after treatment without cultivation on a Norfolk loamy sand (0.7% OM). E9636 at 0.06 lb ai/A, postemergence provided similar weed control as the 0.03 lb ai/A rate. Postemergence E9636 controlled goosegrass (Elucine indica L.), stinkgrass (Eragrostis cilianensis (All.) E. Mosher), large crabgrass (Digitaria sanguinalis (L.) Scop.), annual morningglory (Ipomoea spp.), carpetweed (Mollugo verticillata L.), henbit (Lamium amplexicaule L.) and purslane (Portulaca oleracea L.). Common lambsquarters (Chenopodium album L.) control was 60% early and increased to 85% at 27 days after treatment for both rates of E9636. The combination of E9636 with metribuzin (0.03 plus 0.25 lb ai/A and 0.06 plus 0.50 lb ai/A) did not improve weed control except for lambsquarters control. Lambsquarters control was 98% with E9636 plus metribuzin combinations; whereas, E9636 alone provided only 85% control. E9636 alone provided 67% weed control at 47 days after treatment, whereas, the combination of E9636 plus metribuzin had 88% weed control.

E9636 at 0.03 and 0.06 lb ai/A caused 4 and 5% necrosis, respectively, at 27 days after treatment, however, E9636 in combination with metribuzin did not cause necrosis.

Potato yields were not obtained due to a reduced plant population caused by excessive spring rains after planting. However, following potato digging and discing, rotational crops were planted 66 days after the herbicide applications. Injury was not observed for the following crops: cucumber (slicers) (Cucumis sativus L., 'Striker'); snap beans (Phaseolus vulgaris L., 'Strike'); kale (Brassica oleracea var. acephala, 'Vates'); and soybeans (Glycine max L., 'SS-516').

[1]Assoc. Prof., Ag Aide, and General Technician, Dept. of Horticulture, Salisbury Facility, University of Maryland, Salisbury, MD 21801.

TOMATO TRANSPLANT TOLERANCE TO METOLACHLOR

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

ABSTRACT

Tomato (Lycopersicon esculentum L., 'Sunny') transplants as bare root plants or plug-plants grown in plug-pots of 1 7/8 inch diameter by 2 1/4 inch depth with soil-less media were evaluated on a Norfolk sandy loam (0.7% OM) for tolerance to metolachlor at 1.0, 1.5 or 2.0 lb ai/A applied preplant incorporated (ppi) or post-transplant. Trifluralin at 0.5 lb ai/A, preplant incorporated and an untreated hand-weeded control were included for comparison. At 22 and 35 days after transplanting, all metolachlor treatments reduced the size of plug-pot transplants, whereas, bare-root plant growth was significantly reduced by only the ppi metolachlor treatments. Trifluralin did not affect tomato growth. Tomato size was significantly larger for plug-pots compared to bare root transplants.

Early harvest yield was unaffected by any treatment, however, a trend for reduced yield occurred with bare root transplants treated with metolachlor, 1.5 and 2.0 lb ai/A, ppi. Early yield of plug-pot transplants was significantly greater than bare-root transplants.

Mid-season yields indicated that metolachlor, ppi significantly reduced yields of bare root transplants compared to plug-pot transplants; whereas, post-transplant applications of metolachlor did not affect yields of bare-root or plug-pot transplants. The total yield of three harvests was not significantly different from the handweeded control, however, metolachlor, 1.5 and 2.0 lb ai/A, ppi with bare root transplants had significantly lower yields than trifluralin, 0.5 lb ai/A, ppi. Tomato yields with metolachlor post-transplant were equivalent to trifluralin, ppi. Metolachlor and trifluralin with cultivations were efficacious for weed control.

[1]Associate Prof., Ag Aide, and General Technician, Dept. of Horticulture, Salisbury Facility, University of Maryland System, Salisbury, MD 21801.

DIFFERENTIAL TOLERANCE OF POTATO VARIETIES TO POSTEMERGENCE DPX-E9636 AND METRIBUZIN

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

ABSTRACT

DPX-E9636 should be useful for control broadleaved weeds and grasses in potato (Solanum tuberosum L.) cropping systems. It may be effectively applied postemergence to the potato crop; however, potato varieties differ in their tolerance to a number of postemergence herbicides. This project was conducted to determine if selected potato varieties displayed differential tolerance to DPX-E9636, applied alone or in combination with metribuzin.

DPX-E9636 (0.035 or 0.070 kg ai ha^{-1}) and metribuzin (0.28 or 0.56 kg ai ha^{-1}) were applied postemergence, either alone or in combination, in field experiments conducted during 1992 and 1993 at Presque Isle, Maine. Additional rates of 0.0175 and 0.14 kg ai ha^{-1} of DPX-E9636 and metribuzin, respectively, were added during 1993. Response of six potato varieties was studied during each year. During 1992, the potato plants were generally 8 to 20 cm in height at application, while the 1993 plants ranged from 13 to 30 cm. All postemergence applications applied during 1992 contained 0.25% non-ionic surfactant. Surfactant was used during 1993 for all treatments containing DPX-E9636, but not when metribuzin was applied alone. Broadleaved weeds were controlled each year with a preemergence application of metribuzin (0.56 and 28 kg ai ha^{-1} during the two respective years).

Variety x herbicide interactions in crop injury symptoms occurred during both years. Injury in response to DPX-E9636 was much more severe during 1993 than 1992. Shepody and Superior were least tolerant to DPX-E9636. In both varieties moderate leaf chlorosis was observed within a week of application. Atlantic and Russet Burbank were less sensitive than Superior, but less tolerant than Katahdin, Norwis and MaineChip, which showed only mild chlorosis.

Shepody was clearly the most sensitive variety to treatments containing metribuzin (with or without DPX-E9636). The higher rates of metribuzin caused severe chlorosis and partial burndown during 1992. Less metribuzin injury was observed during 1993 due to lower application rates and the omission of surfactant when metribuzin was applied alone. Superior and Atlantic displayed moderate levels of leaf chlorosis in response to metribuzin. Russet Burbank was sensitive to metribuzin during 1992, but not during 1993. Katahdin, Norwis and Mainechip were quite tolerant to metribuzin. Treatments containing postemergence metribuzin (alone or with DPX-E9636) at either rate, significantly reduced yield of Shepody during 1992. Treatments receiving postemergence metribuzin were among the lowest yielding for Superior and Atlantic during 1992, while yields of Russet Burbank, Mainechip, Katahdin and Norwis were not affected by postemergence metribuzin. There was no evidence that DPX-E9636 decreased yield of any variety in either year; however, combinations of the two herbicides were generally detrimental for Shepody, Superior and Atlantic in both years.

[1]Associate Professor and Assistant Scientist; Department of Plant, Soil and Environmental Sciences, University of Maine, Orono, ME 04469-5722

GROUND-CRACK AND POSTEMERGENCE DPX-E9636 APPLICATIONS FOR WEED CONTROL IN POTATOES

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

ABSTRACT

The experiments reported in this paper were conducted to determine the best DPX-E9636 timing and rate strategies for control of both broadleaved weeds and quackgrass (Agropyron repens L) in potatoes. DPX-E9636 (rates from 0.0087 to 0.069 kg ai ha^{-1}) and metribuzin (0.07 to 0.28 kg ai ha^{-1}) were applied alone or in selected combinations in field experiments conducted during 1992 and 1993 at Presque Isle, Maine. Rates of metribuzin increased proportionately with increasing rates of DPX-E9636. The 'Katahdin' potato variety was used in these experiments. The predominant weeds on the experimental sites were quackgrass, mustard spp. (primarily Brassica campestris L. and Raphanus raphanistrum L.), common lambsquarters (Chenopodium album L.) and wild buckwheat (Polygonum convolvulus L.). Application timings were compared which ranged from preemergence to the crop to postemergence. All ground-crack and postemergence applications contained 0.25% non-ionic surfactant. Crop injury, weed control, and crop yield data were collected.

When applied with metribuzin and preemergence to both weeds and crop, DPX-E9636 did not enhance weed control relative to metribuzin applied alone. Delaying application to the ground-crack stage of crop emergence allowed many weed seeds to germinate and begin seedling growth. Consequently, DPX-E9636 applied alone at ground-crack provided effective control of most weeds. Control of mustards was excellent, while lambsquarters and wild buckwheat control was fair to good. Quackgrass control from the ground-crack applications of DPX-E9636 was good and represented a significant improvement relative to metribuzin applied alone. Delaying application timings to early postemergence and postemergence timings often slightly improved quackgrass control, but broadleaved weed control was not improved. DPX-E9636 control of common lambsquarters and wild buckwheat was often slightly improved by tank-mixing with metribuzin; however, mustard and quackgrass control was not improved by the metribuzin addition. Postemergence DPX-E9636 provided more effective wild radish control than postemergence metribuzin. Broadleaved weed control was generally not affected by rates of postemergence DPX-E9636; however, full-season quackgrass control improved slightly as the rate of DPX-E9636 was increased.

Crop yields were strongly reduced by early-season weed competition and generally improved as weed control improved. Application timing strategies need to control broadleaved weeds soon after crop emergence with either metribuzin (preemergence or ground-crack timings) or the tank-mix (ground-crack timing). DPX-E9636 provided control of quackgrass which can be enhanced by somewhat later application timings, especially when quackgrass shoots emerged over an extended time period.

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[1]Assistant Scientist and Associate Professor; Department of Plant, Soil and Environmental Sciences, University of Maine, Orono, ME 04469-5722

The Effect of E9636 on Weed Control and Potato Yield

J. B. Sieczka and J. F. Creighton

Abstract

E9636, alone and in combination with metribuzin, was evaluated in experiments conducted in 1992 and 1993 on Long Island, New York. Post-emergence application of E9636 at rates ranging from 0.125 oz to 0.5 oz/A caused short term phytotoxicity on 'Superior' and 'Norwis' potatoes (*Solanum tuberosum* (L.). Yield loss was associated with weed pressure or the 0.5 oz/A rate of E9636 applied post-emergence in 1993. Control of smartweed (*Polygonum pensylvanicum* L.) was achieved when E9636 was used at rates of 0.25 oz/A in combination with metribuzin at 2 oz/A. Best annual weed control was achieved when metribuzin at 8 oz/A plus metolachlor of 32 oz/A was applied pre-emergence.

Hedge bindweed (*Calystegia sepium* (L.) R. Br.) growth was retarded from post-emergence applications of E9636 at 0.5 oz/A, but commercial control was not attained.

Justification

Purpose of this experiment was to evaluate the performance of E9636 in the controlling of annual weeds and hedge bindweed in potatoes .

Materials and Methods

Experiments were established in 1992 and 1993 at the Long Island Horticultural Research Laboratory (LIHRL) and on commercial potato farms in Riverhead. The randomized complete block design was used in all experiments with four replications at the LIHRL and three replications at the commercial sites. Data on phytotoxicity, annual weed control and potato yield were collected at the LIHRL. Hedge bindweed control and phytotoxicity to potatoes and hedge bindweed data were collected at the commercial farm sites. Standard growing practices were employed both years at both locations. The variety 'Superior' was grown at the LIHRL and 'Norwis' was grown in 1992 and 'Allegany' in 1993 at the commercial farm locations. Plot size was two-34 inch rows x 20 feet. Yield data and evaluations were taken on the center 15 feet. Applications were made with a $C0_2$ hand-held sprayer delivering 40 gal/A at 38 psi. Application dates are listed in the tables.

Results

LIHRL Experiments:

1992: Phytotoxicity was observed on all E9636 treatments (Table 1). Shortly after application, phytotoxicity symptoms were noted. Symptom severity increased as rates increased. The symptoms consisted of mottling and slight crinkling of the leaves. They were short-lived and fourteen days after application most had

disappeared. Post-emergence applications of metribuzin did not result in phytotoxic effects.

The primary weed species was smartweed. All chemical treatments provided significantly better weed control than the untreated control. The best weed control was achieved by the pre-emergence application of metribuzin at 8 oz/A plus metalachlor at 32 oz/A. E9636, alone at all rates, did not provide season long control. Satisfactory control was achieved when E9636 was combined with metribuzin. Post-emergence applications of metribuzin alone at rates of 2 and 3 oz/A resulted in poor weed control, however, the 4 oz/A rate provided relatively good control of smartweed.

Yields were not affected directly by E9636. The lowest yields were associated with poor weed control.

1993: All of the post-emergence applications of E9636 resulted in some phytotoxicity (Table 2). None was observed as a result of the pre-emergence treatments. The symptoms were transient and were not present at the June 16th evaluation. Smartweed pressure was light and annual grass pressure was even less. However, ratings taken on August 16, 1993 show treatment effects. The weed control rating of the pre-emergence application of E9636 at 0.5 oz/A plus metribuzin at 4 oz/A was not different than the control. Post- emergence applications of E9636, used alone, provided marginal control. In most cases, the addition of metribuzin improved control. The pre-emergence application of metribuzin at 8 oz/A plus metolochlor at 32 oz/A provided the best weed control and did not result in phytotoxicity. Yields were depressed slightly when 0.5 oz E9636/A was applied post-emergence. There were no treatment effects on specific gravity.

Hedge Bindweed:

Results in Tables 3 and 4 show that post emergence applications of E9636 had an effect on hedge bindweed. Weed growth was retarded but plants eventually grew out of the symptoms. In 1992, immediately before the second post-emergence application, the experimental area was hilled and untreated rhizomes were introduced. Control ratings after that date were inconclusive.

In 1993, the effect of the split applications on hedge bindweed growth was evident until the middle of the growing season. However, commercial control was not achieved.

Conclusions

E9636 can be used to control smartweed in potatoes. To be effective it should be used as a post-emergence spray when weeds are small. Some phytotoxicity should be expected especially on 'Superior' and 'Norwis' varieties. The symptoms are short-lived and do not affect yield at rates below 0.5 oz/A. Weed control is improved when metribuzin is included in the application. Some effect of E9636 was observed on hedge bindweed, however, commercial control was not achieved.

Long Island Table 1. The effect of E 9636 on weed control and phytotoxicity on 'Superior' potatoes, Riverhead -1992.

Treatment			Phytotoxicity			POLYP Weed Control Ratings					Yield	
											Total	2 - 4"
Chemical	Rate oz ai/A	Timing	5/28	6/3	6/9	5/28	6/3	6/9	8/3	8/21	cwt/A	cwt/A
E9636	0.25	Post	7.3	7.5	9.5	6.3	7.3	7.3	7.0	6.3	391	332
E9636	0.38	Post	7.5	6.8	9.3	3.8	7.0	7.0	6.5	4.8	389	346
E9636	0.50	Post	7.3	6.5	8.8	6.3	7.5	8.3	7.5	6.5	400	352
E9636+metribuzin	0.25+2.0	Post	7.8	7.8	9.0	4.8	8.8	10.0	8.0	7.0	391	348
E9636+metribuzin	0.38+3.0	Post	7.5	7.3	9.3	6.0	9.0	10.0	8.8	7.8	453	404
E9636+metribuzin	0.50+4.0	Post	7.8	6.3	8.5	5.8	9.5	10.0	8.8	8.3	383	345
metribuzin	2.0	Post	9.3	9.3	9.5	6.3	8.3	8.3	4.5	2.8	348	291
metribuzin	3.0	Post	9.0	9.3	9.0	5.3	9.0	10.0	7.0	5.8	392	337
metribuzin	4.0	Post	9.5	9.0	9.5	6.3	9.3	10.0	8.0	7.5	385	341
metribuzin+metolachlor*	8.0+32.0	Pre	9.0	9.0	9.3	10.0	10.0	10.0	9.5	8.8	392	340
Control			9.3	9.5	9.8	5.5	1.8	3.5	1.3	0.8	342	295
Fisher's Protected LSD (0.05)			(1.0)	(0.9)	(0.9)	(2.2)	(2.0)	(2.1)	(1.6)	(2.3)	(68)	(69)

Planted 4/07/92, roto beat 8/26/92, harvested 8/26/92. Within row spacing 9.3". Fertilizer applied at a rate of 1000 lbs/A of 10-20-20 in bands at time of planting, 60 lbs N/A of ammonium nitrate topdressed on 5/28/92. Area was hilled on 6/12/92. Plot size 2 rows x 20', data collected from 2 rows x 15', 4 replications.

*The preemergence spray of metolachlor and an inadvertant application of linuron at 0.38 lb ai/A were applied on 4/15/92. Lexone at 0.5 lb ai /A was applied on 4/29/92.

Postemergence sprays included 0.25% v/v non-ionic adjuvant (X-77) and were applied on 5/26/92.

Weed control rated on a scale of 0 to 10, 0 = no control, 5 = 50% control, 10 = 100% control.
Phytotoxicity rated on a scale of 0 to 10, 0 = 100% dead plants, 5 = 50% green and vigorous plants, 10 = 100% green and vigorous plants.

Long Island Table 2. The effect of E9636 on weed control, phytotoxicity, total yield, marketable yield, and specific gravity on Superior' potatoes, Riverhead - 1993

Treatment							Weed control				
	Rate		Phytotoxicity				POLYP	ECHCG	Yield (cwt/A)		Specific
Chemical	(oz ai/A)	Date	5/27	6/2	6/8	6/16	8/16	8/16	Total	2 to 4	Gravity
Season -122 days											
E9636	0.125	5/24/93	8.0	9.0	9.8	10	8.8	8.0	500	461	71
E9636	0.25	5/24/93	7.8	8.8	9.8	10	10.0	6.5	498	451	69
E9636	0.38	5/24/93	7.0	8.0	9.5	10	10.0	7.0	498	451	70
E9636	0.5	5/24/93	7.0	8.0	9.5	10	10.0	6.8	444	398	69
E9636 + metribuzin	0.125 + 1	5/24/93	8.0	9.0	10.0	10	8.8	4.8	540	493	69
E9636 + metribuzin	0.25 + 2	5/24/93	7.8	8.5	9.8	10	10.0	8.0	478	436	71
E9636 + metribuzin	0.38 + 3	5/24/93	7.5	8.1	9.5	10	9.3	9.3	526	471	70
E9636 + metribuzin	0.5 + 4	5/24/93	7.5	8.3	9.6	10	10.0	7.3	467	429	70
E9636 + metribuzin	0.5 + 4	4/29/93	9.9	10.0	10.0	10	7.5	5.5	495	448	70
E9636 + metribuzin + metolachlor	0.25+2+32	4/29/93	7.8	8.3	9.9	10	10.0	8.5	472	424	70
E9636 + metribuzin	0.25+2	5/24/93									
E9636 + metribuzin	0.25 + 2	5/24/93, 6/2/93	8.0	9.0	7.0	10	10.0	6.8	497	456	69
E9636 + metribuzin	0.5 + 4	5/24/93, 6/2/93	7.3	8.0	6.3	10	10.0	8.5	445	407	71
metribuzin + metolachlor	8 + 32	4/29/93	9.8	10.0	10.0	10	10.0	9.0	518	471	71
Control	-	-	10.0	10.0	10.0	10	7.5	5.8	522	476	70
Fisher's Protected LSD (0.05)			(0.5)	(0.4)	(0.3)		(3.0)	(4.4)	(42)	(43)	(NS)

Planted: 4/19/93,Vine killed: 8/19/93, Harvested: 10/11/93. Within row spacing: 9.3". Fertilizer was baunded at planting at a rate of 1000 lbs/A of 10-20-20 in bands at planting time, 60 lb N/A of ammonium nitrate topdressed on 5/26/93. Area was hilled on 6/16/93. Plot size 2 rows x 20', data collected from 2 rows x 15', 4 replications.

Preemergence application-4/29/93. Postemergence application-5/24/93, 6/2/93

Weed control rated on a scale of 0 to 10, 0= no control, 5 = 50% control, 10 = 100% control

Phytotoxicity rated on a scale of 0 to 10, 0= 100% dead plants, 5 = 50% green and vigorous plants, 10 = 100% green and vigorous plants.

All E9636 treatments applied with a non-ionic adjuvant (0.25% v/v dilution of AG-98)

Long Island Table 3. The effect of E 9636 on hedge bindweed and phytotoxicity on 'Norwis' potatoes, Riverhead -1992.

Treatment		Phytotoxicity				Weed Control Ratings Hedge Bindweed			
Chemical	Rate oz ai/A	5/27	6/3	6/9	6/15	5/27	6/3	6/9	6/15
E9636	0.25	6.7	10.0	9.7	8.7	5.7	5.7	4.7	5.0
E9636	0.50	6.3	9.7	10.0	9.0	5.7	5.7	5.0	5.7
E9636+metribuzin	0.25+2.0	7.3	10.0	10.0	9.3	4.3	4.0	3.7	5.0
E9636+metribuzin	0.50+4.0	7.3	9.7	10.0	9.0	3.7	4.0	4.0	5.3
metribuzin	2.0	9.0	10.0	10.0	9.3	3.0	0.7	0.0	0.3
Control		10.0	10.0	10.0	9.0	3.7	0.0	0.0	0.7
Fisher's Protected LSD (0.05)		(1.4)	(NS)	(NS)	(NS)	(NS)	(1.0)	(1.0)	(1.1)

Treatments applied on 5/21/92. All treatments received 0.25 % v/v non-ionic adjuvant (X–77).
E9636 was applied at (0.25 oz ai/A) to the four E9636 treatments on 6/12/92.
Area was hilled on 6/14/92 and bindweed plants were distributed from other portions of the field.
* Late season observations showed no effect of treatments on bindweed control.

Long Island Table 4. The effect of E9636 on weed control and phytotoxicity, on Allegany potatoes, Riverhead. - 1993

			CAGSE Phytotoxicity		CAGSE Weed Control			
Chemical	Rate (oz ai/A)	Date	6/14/93	6/17/93	6/21/93	6/24/93	6/28/93	7/6/93
Control	-	-	10.0	10.0	0.0	0.0	0.0	0.0
E9636	0.5 + 0.5	6/11, 6/21	7.3	7.3	5.7	4.7	3.7	3.7
Significance level			(0.05)	(0.01)	(0.01)	(0.05)	(0.01)	(0.01)

Planted: 4/20/93 . Fertilizer applied at a rate of 2500 lbs/A of 8-16-8 in bands at planting time, 45 lb N/A topdressed.
Plot size 2 rows x 20', 3 replications.
Postemergence application-6/11/93, 6/21/93
Phytotoxicity symptoms were not evident on potato plants.
Phytotoxicity rated on a scale of 0 to 10, 0 =dead plants, 5 = 50% damage, 10 = vigorous plants.
Weed control rated on a scale of 0 to 10, 0 = no control, 5 = 50% control, 10 = 100% control.

NONCHEMICAL WEED CONTROL IN CABBAGE

M. D. Orzolek, J. H. Murphy and J. Ciardi

ABSTRACT

Early weed infestation in vegetable crops reduces both early and total marketable yield and quality. Even if escape weeds (12" tall or larger) are later killed by a postemergence herbicide application, their skeletons can cause yield loss because of the competition for light, temperature modification within the plant canopy, and interference with pesticide applications. In addition, weeds can also serve as a resevoir for insect and disease organisms, especially viruses. Use of postemergence herbicides can solve many of the weed escape problems in some vegetable crops. However, since vegetables are considered minor crops by pesticide manufacturers, there are several crops which have few or no herbicides labelled for weed control during the growing season.

The research was conducted at the Horticulture Research Farm, Russell E. Larson Research Center, Rocks Springs, PA. Weeds in transplanted cabbage [Brassica oleracea L. (Capitata group)] were controlled by the following methods: none, flaming weeds at 2 to 4 leaf statge of growth with a propane gas burners, mowing vegetative growth of weeds several times during the growing season, planting annual ryegrass (Lolium multiflorum)between the rows after cabbage establishment, and use of a pretransplant herbicide, oxyfluorfen at 0.25 lbs a.i./A. All treatments except for the pretransplant herbicide application were implemented after cabbage had been established. The cabbage cultivar 'Rio Verde' was transplanted on July 1, 1993.

The best annual weed control treatment was the annual rye grass planted between the cabbage rows (living mulch) followed by flaming, the oxyfluorfen application, and then mowing. The none treatment resulted in extremely high populations of common lambsquarter (Chenopodium album L.), smooth (Amaranthus hybridus L.) and redroot pigweed (Amaranthus retroflexus L.). In addition, the highest plant vigor (cabbage) was observed in the oxyfluorfen and living mulch treatments followed by mowing and than flaming. The no weed control treatments had the poorest vigor and smallest cabbage plants. The flaming treatment did not affect cabbage growth in 3 of the 4 replicated plots, but did cause significant plant injury in the first replication because the flaming units were not properly aligned in relation to the cabbage transplants. It was also observed that when the cabbage plots were being flamed for weed control, flea beetles that were feeding on the plants were also killed at the same time. It appears that flaming may produce both weed and insect control on selected vegetables. There had been no apparent reduction of cabbage growth from rye establishment; however, rye does not compete well with or suppress growth of perennial weeds such as Canada Thistle (Cirsium arvense L.) or horseradish (Armoracia rusticana). From this initial work, it appears that there are alternate forms of weed control that can be used in place of herbicides depending on the crop grown and weed species type and population present in the field.

[1]Professor, Extension Associate, and Graduate Student; Department of Horticulture
The Pennsylvania State University, University Park, PA 16802

Table 1. The effect of nonchemical weed control treatments on the vigor of and weed control in 'Rio Verde' cabbage, Horticulture Research Farm, Rock Springs, PA - 1993.

Treatment	Injury rating 8/4/93	Vigor rating[Z] 8/17/93	Weed control rating[Y] 8/4 PGW	8/17 LBQ
Flaming	5.0	7.3	9.0	8.8	9.4
Living mulch	0.0	9.5	9.0	9.6	10.0
Mowing	1.0	8.8	4.6	6.8	8.5
Herbicide	0.0	9.6	8.6	9.4	9.1
Weedy check	0.0	7.9	0.0	0.0	0.0

[Z]Vigor and injury ratings based on the following scale: 0 - visibly vigorous growth with no injury to 10 - plants dead.
[Y]Weed control ratings based on the following scale: 0 - no weed control to 10 - 100% weed control. PGW = smooth and redroot pigweed. LBQ = common lambsquarter.

Table 2. The effect of nonchemical weed control treatments on the yield of 'Rio Verde' cabbage, Horticulture Research Farm, Rock Springs, PA - 1993.

Treatment	No marketable heads/plot	Total weight (lbs)	Avg. head weight (lbs)	No. immature plants
Flaming	28.0	65.9	2.4	6.3
Living mulch	36.3	112.1	3.1	0.8
Mowing	38.3	100.1	2.6	0.5
Herbicide	37.0	118.4	3.2	0.0
Weedy check	34.0	61.9	1.8	2.0

VARIETY SENSITIVITY OF POTATOES TO E9636 AND METRIBUZIN

Ed Kee and Tracy Wootten[1]

In 1992, various rates of E9636 and metribuzin, both alone and in combinations, were applied post-emergence to two varieties of potatoes, 'Belrus' and 'Superior'. No phytotoxic effects were experienced and weed control was generally good to excellent. E9636 was applied at rates ranging from 0.5 oz. active ingredient/acre to 1.0 ounce. Metribuzin rates ranged from 4 to 8 ounces active ingredient/acre.

Also in 1992, E9636 was applied post-emergence to 25 varieties of potatoes at 1 ounce active ingredient/acre. No significant phytotoxicity was experienced and weed control was excellent. Potato varieties tested were from the Round White, Russet, and Red classes.

In 1993, various rates of E9636 and metribuzin, alone and in combination, were applied at an early post stage (plants 4" high), and late post (plants 12-14" high) to the variety 'Superior'. Excellent lambsquarter and grass control was obtained, with minimal to no phytotoxic effects.

An Experimental Use Permit was granted for one commercial farm. Weed control was excellent, with outstanding purslane control. Yields were equivalent to adjoining commercial acreage. 'Norwis' and 'Superior' were the varieties.

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[1]Extension Vegetable Crops Specialist, and Extension Associate, University of Delaware, R.D. #6, Box 48, Georgetown, DE

Ethalfluralin Tolerance in Cucurbits

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

Ethalfluralin (Curbit®) is registered for use on cucumbers (*Cucumis sativus*), muskmelons (*Cucumis melo*), and watermelons (*Citrullus lanatus*). Due to the lack of registered herbicides for all cucurbits, there is considerable interest among growers to extend the use of ethalfluralin to include other members of the Cucurbitaceae. However, members of the same botanical family but of different genera, frequently exhibit differential tolerance to herbicides. Studies were conducted in 1993 to evaluate phytotoxicity and the potential for yield reductions in three representatives of *Cucurbita pepo* (zuchinni squash, acorn squash, and pumpkin) and one representative of *Cucurbita maxima* (Hubbard squash). Ethalfluralin (1.5 and 3.0 kg ai/ha) was applied preemergence after seeding. Treatments were compared to untreated weedy checks. Crop injury was described as stunting or slowed growth and occurred in all four crops and at both ethalfluralin rates. The injury ranged from a low of 8 and 10% in Hubbard squash to a high of 18 and 22% in pumpkins, when evaluated one week after emergence. A month later, slight stunting was still evident in all crops treated with 3.0 kg ethalfluralin. At this time, stunting in acorn squash and pumpkin weedy checks was equal to or greater than in the ethalfluralin treatments. Numbers of fruit harvested in the large-fruited species (pumpkins and hubbard squash) were not significantly different from the number harvested in the respective weedy checks. The total weight of harvested fruits and weight/fruit however, although not significant, tended to be greater when ethalfluralin was applied. Thirty-six, 29, and 26% of the total number of pumpkins were green at harvest in the weedy check, the 1.5 kg, and the 3.0 kg ethalflualin treatments, respectively. In the smaller-fruited species (acorn and zuchinni), numbers of fruit and total weights were reduced in the weedy checks however, weight/fruit remained unchanged. Yields in all crops (both numbers and weights) decreased in the order: ethalfluralin 1.5 kg> ethalfluralin 3.0 kg > weedy check.

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[1]Assoc. Prof. and Res. Assoc. Dep. Fruit and Vegetable Science, Cornell Univ. Ithaca, NY 14853.

CRABGRASS CONTROL IN 1992 AND 1993

P. C. Bhowmik[1]

ABSTRACT

Field experiments were conducted on an established Kentucky bluegrass (Poa pratensis L.) to evaluate preemergence and postemergence activity of several herbicides in large crabgrass [Digitaria sanguinalis (L.) Scop.] control. All treatments were applied to 1 by 3 m plots with a CO_2-backpack sprayer at a pressure of 22 psi in 50 gpa. Preemergence treatments were applied on April 25, 1992 and April 23, 1993. Postemergence treatments were applied to the 2- to 3-leaf stage (June 16, 1993) and to the 1- to 3-tiller stage (July 8, 1993) of crabgrass. Turfgrass injury was rated on a scale of 0 to 100% (0%=no injury and 100%=dead turfgrass) and turfgrass density was rated on scale of 1 to 9 (where 1=thin stand and 9=dense stand). Weed control was rated on a scale of 0 to 100% (where 0%=no weed control and 100%=complete control) 4, 8, 12 and 15 weeks after treatment (WAT).

In 1992, both oxadiazon formulations (Bio and Clay) at 2 to 4 lb/A controlled crabgrass effectively with no turfgrass injury. The combination of oxadiazon (Bio) and dithiopyr at 2.0 + 0.125 lb/A, prodiamine at 0.65 lb/A, Mon 25134 (0.1G) at 0.125, 0.188, and 0.25 lb/A controlled large crabgrass over 95% 12 WAT. The corn gluten at 872 lb product/A provided 90% crabgrass control 6 WAT, while the same treatment resulted in 80 and 75% control 11 and 15 WAT, respectively. The split applications of corn gluten applied preemergence at 872 lb product/A product followed by an application of 872 lb product/A 60-day later did not improve crabgrass control over the single application. In general, turfgrass density improved considerably due to corn gluten treatments. Similar results were observed in 1993.

In 1993, various fertilizer formulations of dithiopyr (Lebanon 0.045G, and 0.090G) and (Anderson 0.040G, 0.072G, and 0.103G) applied preemergence showed no significant differences in crabgrass control. The lowest rate (0.063 lb/A) of dithiopyr controlled crabgrass over 90% 12 WAT. Dithiopyr at 0.188 lb/A (Lebanon 0.09G) gave 90% crabgrass control, while the same rate of dithiopyr (Anderson, 0.103G) gave only 75% crabgrass control when the treatments were applied at the 2- to 3-leaf stage of crabgrass. In another trial, the combination of fenoxaprop and pendimethalin at 0.1 + 1.5 lb/A gave 75% crabgrass control compared to only 32% control with fenoxaprop (0.1 lb/A) or pendimethalin (1.5 lb/A) alone, while the same combination at 0.2 + 1.5 lb/A gave 97% control compared to 89% control with acclaim (0.2 lb/A) alone. The combination of dithiopyr and MSMA (0.25 + 1.00 lb/A) provided 91% control compared to 67% control with dithiopyr alone, while the combination of fenoxaprop and MSMA at 0.125 + 1.0 lb/A gave only 63% control. These treatment combinations when applied at the 1- to 3-tiller stage resulted in 70 to 80% control except the combination of dithiopyr and MSMA (0.25 + 1.0 lb/A) which controlled large crabgrass over 95%. None of these treatments showed any objectionable turfgrass injury.

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

CONTROL OF SMOOTH CRABGRASS IN 1993

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

ABSTRACT

A preemergence study and two postemergence studies were conducted in 1993 for smooth crabgrass control in a mixed cool season turf. The herbicides applied in the preemergence study were applied at 75 gpa using a CO_2-backpack sprayer equipped with a two nozzle boom. Control ratings were made on August 10 and none of the treatments caused significant injury to the desired turf. The site was a mixed Kentucky bluegrass (Poa pratensis L.), perennial ryegrass (Lolium perenne L.), fine fescue (Festuca spp.). Treatments were applied on April 26, 1993. Dithopyr formulated on fertilizer from three sources (Lebanon, Andersons, and Knox) provided acceptable control at all rates (0.063, 0.094, 0.125, and 0.188). Acceptable control was considered to be 85 percent or greater. One fertilizer carrier (Knox) was applied with two different granule sizes (small and large) and the smaller size had somewhat better efficacy at the lower rates. Dithopyr was also applied as a sprayed EC and nonfertilizer granule (0.1 G) at rates of 0.125 (split application with eight week interval), 0.38, and 0.5 lbs ai/A and all rates and formulations provided acceptable control. Other treatments that provided acceptable control were; FN 9056, NAF 65, EXP 30742B, EXP 31068A, EXP 30911A, oxadiazon, pendimethalin, bensulide, 22094, benefin + trifluralin, and prodiamine. The herbicides in the post or combination pre/post study were applied at 40 gpa using a CO_2-backpack sprayer equipped with a two nozzle boom. Treatments were applied on June 17 when crabgrass was in the two and three leaf stage. The turf was predominately perennial ryegrass. Control was rated on August 17 and there was no injury from any treatment. Acceptable control was considered to be 85 percent. The following treatments provided acceptable control; dithiopyr (Anderson fertilizer carrier) at 0.375 lbs ai/A and a pendimethalin + fenoxaprop combination (ai rates unknown). Fenoxaprop 1 EC at 0.1, 0.2, and 0.25 nor dithiopyr 1 EC at 0.375 ai/A provided acceptable control. Pendimethalin alone at 1.5 lbs ai/A provided up to 25 percent control. Pendimethalin plus fenoxaprop combinations at rates of 1.5 + 0.1, 1.5 + 0.2, 1.5 + 0.25 lbs ai/A respectively, provided a degree of control that approached commercial acceptance, but was rated in the 70 to 80 percent range. It appears that when smooth crabgrass is in the two to three leaf stage, the control provided by fenoxaprop is a function of leaf canopy interception. Increasing the rate did little to improve control because young crabgrass plants did not intercept the spray application. The addition of pendimethalin appears to enhance control by supplying preemergence protection against later germinating crabgrass and a degree of postemergence control of very young seedlings (single leaf stage) that do not sufficiently intercept the applied fenoxaprop. Application methods for a second postemerge study were the same as in the previous one, with the exception of the application date (which in this case was July 18). Smooth crabgrass was in the 1 to 3 tiller stage of growth. The control rating date was August 17 and commercially acceptable control was again considered to be 85 percent. The following treatments provided acceptable control; fenoxaprop at 0.18, 0.20, and 0.25 lbs ai/A respectively, MSMA (with a 14 day sequential application with both rates 2 lbs ai/A), pendimethalin plus fenoxaprop at 1.5 + 0.2 and 1.5 + 0.25 lbs ai/A, and a combination of pendimethalin and fenoxaprop (ai rates unknown). Pendimethalin applied alone at 1.5 lbs ai/A did not provide control greater than 8 percent as most of the smooth crabgrass had germinated by July 18 and most of that which had germinated was beyond the single leaf stage of growth. Dithiopyr 1 EC at 0.5 lbs ai/A did not provide acceptable control nor did fenoxaprop at either the 0.10 or 0.12 lbs ai/A rates.

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[1]Prof. and Res. Asst., respectfully, Dept. of Agronomy, Penn State Univ., Univ. Park, PA 16802

PREEMERGENCE SMOOTH CRABGRASS, ANNUAL BLUEGRASS, WOODSORREL AND PROSTRATE SPURGE CONTROL

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

ABSTRACT

Two preemergence smooth crabgrass (Digitaria ischaemum), woodsorrel (Oxalis stricta) and prostrate spurge (Euphorbia supina) studies were conducted adjacent to each other on a mature stand of perennial ryegrass (Lolium perenne). Turf was mowed to a height of 2.0 inches and was irrigated to prevent drought dormancy. All herbicides were applied 7 April and sequentials were applied 26 May 1993. The test site was irrigated immediately following each application. Most crabgrass seed germination occurred in June and July. Sprayable herbicides were applied with a CO_2 pressurized (35 psi) sprayer calibrated to deliver 50 gpa water. Granulars were applied with a shaker bottle. Soil was a sandy loam with a pH of 6.3 and 1.5% OM. Plots were 5 by 5 ft, and were arranged in an randomized complete block with four replicates. All data were subjected to the analysis of variance and significantly different means were separated by Duncan's multiple range test. Weed cover was assessed visually using a 0 to 100% linear scale. Woodsorrel and spurge ratings exceeding 0.5% and 2.0%; respectively were judged to be objectionable weed levels. The invasiveness of these broadleaf weeds was masking crabgrass cover and these weeds were controlled on 4 Aug using a mix of 2,4-D + MCPP + dicamba. Smooth crabgrass cover ratings exceeding >5% cover would be considered unacceptable for professionally managed, high quality turf.

In Study I, outstanding woodsorrel control was provided by the following: Team (3.0 lb/A); Dimension 1EC (0.5 lb/A); Barricade (1.0 lb/A); and pendimethalin (1.5 + 1.5 lb/A). All treatments also greatly reduced spurge populations, but unacceptable control was provided by Dimension 0.1G; Dimension 1EC (0.38, and 0.125 + 0.125 lb/A); and pendimethalin (2.0 lb/A). Excellent spurge control (i.e., ≤2% cover) was provided by Team (1.5 + 1.5 lb/A); Barricade (all rates); pendimethalin (1.5 + 1.5 lb/A, 3.0 lb/A); and Gallery + Team. All treatments reduced crabgrass populations, but poor control was provided by Team (2.0 lb/A); pendimethalin (2.0 lb/A); and Gallery + Team. Commercially acceptable crabgrass control was provided by Team (1.5 + 1.5 lb/A); all Dimension and Barricade treatments; and pendimethalin (3.0, and 1.5 + 1.5 lb/A).

In Study II, all treatments except Dimension (0.125 lb/A) reduced woodsorrel populations significantly. Unacceptable woodsorrel control was provided by: Dimension (0.125; 0.188; 0.063 + 0.063; 0.125 + 0.063; 0.125 + 0.125 lb/A) and Barricade (0.325 + 0.325 lb/A). Plots treated with Dimension (0.5; 0.125 + 0.250 lb/A) and Pre-M (1.5 + 1.5 lb/A) were completely free of woodsorrel. Conversely, many treatments did not reduce spurge significantly. Good spurge control (i.e., <5% cover) was provided by Pre-M (1.5 + 1.5 lb/A); Barricade (0.325 + 0.325 lb/A); and Dimension (0.5; 0.125 + 0.250; 0.250 + 0.125 lb/A). Poor to fair smooth crabgrass control was provided by the following Dimension treatments: 0.125; 0.188; 0.250; and 0.063 + 0.063 lb/A. Dimension applied at 0.125 + 0.063 was marginally acceptable. All other treatments provided excellent crabgrass control.

In Study III, herbicides were applied to a fairway on 3 Sept 1992 to control annual bluegrass (Poa annua). Methods of application and plot design were the same as previously described. Data collected in April 1993 revealed that none of the treatments provided exceptional annual bluegrass control, but all herbicides reduced P. annua cover significantly (data not shown). Very good control (88%) was provided by Barricade (0.65 lb/A). Fair to good control (74-80%) was provided by Dimension (0.38 or 0.50 lb/A) and LescoSan (15.0 lb/A). Poor control (42%) was provided by Ronstar (4.0 lb/A).

[1]Professor and research assistant; respectively. Dept of Agronomy., Univ of Maryland, College Park, MD 20742.

GRANULAR POSTEMERGENT CRABGRASS CONTROL

Cait C. Morse and J. C. Neal[1]

ABSTRACT

The objective of this study was to evaluate granular formulations of graminicides for postemergent control of smooth crabgrass. Treatments were applied in early June when the crabgrass was at the 2-4 leaf stage. The turf was perennial ryegrass cut at 2" three days prior to treatment. The soil was moist but the foliage was dry at the time of application.

Treatments included quinclorac on biodac (S4109), dithiopyr 0.1 G (MON25134), and fluazifop 1G. These herbicides were each applied at three rates and at selected rates in combination treatments. Rates were quinclorac at 0.75, 1.0, and 1.25 lb ai /A, dithiopyr at 0.25, 0.38, and 0.5 lb ai/A, and fluazifop at 0.125, 0.25, and 0.5 lb ai/A. Combination treatments were fluazifop + dithiopyr at 0.125 + 0.38 lb/A, respectively, fluazifop + dithiopyr at 0.25 + 0.38, and quinclorac + dithiopyr at 0.75 + 0.38 lb/A. Also included were two three-way combinations which included a granular formulation of Confront (clopyralid + triclopyr), S4281, for broadleaf weed control. Combinations and rates for these treatments were fluazifop + dithiopyr + Confront at 0.25 + 0.5 + 0.75 (lb ae/A) and quinclorac + dithiopyr + Confront at 0.75 + 0.38 + 0.75 lb /A, respectively. For comparison, a "standard" spray application of fenoxaprop + dithiopyr at 0.125 + 0.38 was included.

Of the granules tested, quinclorac provided the most rapid control -- 80 to 93% control within one week. Dithiopyr required more time to suppress the crabgrass and only the high rate, 0.5 lb/A, provided > 80% control. Fluazifop at 0.5 lb/A controlled crabgrass but recovery and new germination rapidly decreased control ratings; lower rates were ineffective. Additionally, in fluazifop treated plots an increased incidence of dollar spot was noticed. However, this was patchy and quite variable, precluding reliable ratings. Another factor that may have affected control in the fluazifop treated plots was the physical characteristics of the granules. The fluazifop granule was very fine, light, and the % ai load too high for adequate coverage at the use rates. In comparison, the physical characteristics of the quinclorac and dithiopyr granules were good.

The only treatments to provide greater than 90% control at the end of the season were the "standard" fenoxaprop + dithiopyr spray and the combination of quinclorac + dithiopyr + Confront granule. Other treatments providing statistically comparable control were quinclorac at 1.25 lb/A, dithiopyr at 0.5 lb/A, quinclorac + dithiopyr at 0.75 + 0.38, fluazifop + dithiopyr at 0.25 + 0.38, and the three-way combination of fluazifop + dithiopyr + Confront at 0.25 + 0.5 + 0.75.

These data suggest that postemergent control of crabgrass in turf with granular herbicides is possible. Optimum control was obtained with combination treatments of quinclorac + dithiopyr; however, results with other combinations were sufficiently encouraging to warrant further testing.

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[1]Technician and Assoc. Prof., respectively, Dept. Flor. & Orn. Hort., Cornell Univ. Ithaca, NY 14853

POSTEMERGENT ANNUAL GRASS CONTROL IN BENTGRASS TURF

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

ABSTRACT

Tests were conducted to evaluate the efficacy of crabgrass (*Digitaria* spp.)and goosegrass (*Eleusine indica*) control strategies for creeping bentgrass turf. Labeled bentgrass rates of fenoxaprop (Acclaim), 0.032 lb ai/A, were applied alone or in combination with dithiopyr (Dimension). Additionally, diclofop (Illoxan) was evaluated alone and in combination with dithiopyr. Smooth crabgrass (*Digitaria ischaemum*) was treated at the 2 to 4 leaf stage using a sprayer equipped with flat fan nozzles and calibrated to deliver 30 GPA at 40 psi. Weed control was visually evaluated at approximate 2-week intervals throughout the season. In a separate area, injury to Penncross creeping bentgrass (*Agrostis palustris*) mowed at 1/4 and 1/2 inch 3-times per week was evaluated. Turf injury was rated weekly.

Crabgrass was controlled by fenoxaprop @ 0.032 lb ai/A applied at 14-day intervals; however, late season germination reduced control ratings after treatments were halted. Single applications of 0.06 to 0.12 lb/A effectively controlled emerged crabgrass, but as observed with the low rate, late germination reduced control. Dithiopyr at $\leq$0.38 lb/A did not control emerged crabgrass. Combining fenoxaprop @ 0.032 lb/A plus dithiopyr at $\geq$0.18 lb/A provided acceptable season-long crabgrass control. However, combinations with 0.09 lb/A dithiopyr did not provide acceptable control at the end of the season. Diclofop did not control crabgrass.

Diclofop at $\geq$0.75 lb/A consistently controlled 1-leaf to 4-tiller goosegrass; however, fenoxaprop @ 0.032 lb/A provided erratic results. At the L.I. Res. Lab., fenoxaprop controlled goosegrass whereas on a golf course site, essentially no control was achieved. Mowing practices varied between sites; therefore, mowing to treatment intervals were compared for fenoxaprop @ 0.032 lb/A and diclofop at 0.75 lb/A. Diclofop efficacy was not affected by mowing intervals and again controlled goosegrass nearly 100%. Fenoxaprop efficacy was reduced when applied from 4 to 24 hr after mowing; however, the amount of reduction (40 to 50%) was not comparable to the lack of control at the golf course site. Treatments applied 1 to 24 hr before mowing controlled goosegrass.

Injury to Penncross creeping bentgrass was greater at 1/4 inch than at 1/2 inch mowing height. At 1/2 inch, fenoxaprop injury was barely noticeable; however at 1/4 inch turf yellowing was significant to unacceptable over a 4-week period. Combining fenoxaprop with dithiopyr slightly increased the initial injury but 1/2 inch cut turf had recovered by 1 week, and 1/4 inch cut turf had recovered by 2 weeks after treatment. As a single application of the tank mix controlled crabgrass, this treatment would be preferable to repeated applications of fenoxaprop which extended the time turf was expressing injury symptoms. Diclofop caused some yellowing on bentgrass. The degree of yellowing was rate dependent. On 1/2 inch cut turf, injury was significant only at 1 lb/A, whereas, 1/4 inch turf was injured by the lowest rate, 0.38 lb/A. Time to complete recovery was dependent upon mowing height and rate, but turf had recovered from diclofop treatments by 2 weeks.

These data suggest that tank mixing fenoxaprop at 0.032 lb/A with 0.18 to 0.25 lb/A dithiopyr will control smooth crabgrass with less overall bentgrass injury than repeated applications of fenoxaprop. Goosegrass control with this low rate of fenoxaprop was variable for reasons not yet fully understood. Diclofop controlled goosegrass consistently and had acceptable safety on creeping bentgrass but did not control crabgrass.

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[1]Assoc. Prof. and Technician, Dept. Flor. & Orn. Hort., Cornell Univ., Ithaca NY 14853; Technician and Extension Weed Scientist, Cornell Univ. Long Island Hort. Res. Lab., 39 Sound Ave., Riverhead, NY 11901, respectively.

CONTROL OF ANNUAL BLUEGRASS WITH ETHOFUMESATE - FIELD STUDIES AND EFFECTS OF BIOTYPE AND GROWTH STAGE

R. B. Taylorson[1] and D. R. Spak[2]

Seed from 15 biotypes of annual bluegrass (Poa annua L.) originating from GA, IA, MI, PA, RI, and 'Penncross' creeping bentgrass (Agrostis palustris Huds.) were planted in pots of sterile soil in late-August, 1992, and subsequently treated twice with ethofumesate (PROGRASS SC) at 0.75 lb ai/A according to the following schedules: preemergence plus 28 DAP (days after planting), 28 plus 56 DAP, and 56 plus 84 DAP. The pots were kept out-of-doors in Kingston, RI and watered, fertilized, and clipped as necessary. In the pre- plus 28 DAP treatment, stand thinning was very high (95-100%) for all biotypes except one (51%), and creeping bentgrass stands were thinned 30%. In the 28 plus 56 DAP treatment, control of the biotype least susceptible to the pre- plus 28 DAP was 53%; control of other biotypes ranged from 84 to 100%. Creeping bentgrass was unaffected by 28 plus 56 DAP or 56 plus 84 DAP treatments. In the 56 plus 84 DAP treatment, only two biotypes were controlled by ethofumesate while the others were only moderately affected (13-65%). Differences in susceptibility among susceptible biotypes became evident with later growth stages. In a similar study in Lancaster, PA, biotypes were treated twice with ethofumesate (PROGRASS EC or SC) either at 28 plus 49 DAP (2-3 tillers) or 56 plus 77 DAP (8-12 tillers). Seeding dates were staggered by 28 days to achieve two different growth stages at the time of treatment. 'Putter' creeping bentgrass was used as a reference. Biotypes and creeping bentgrass were controlled with 28 plus 49 DAP treatments. The 56 plus 77 DAP treatment gave 72 to 95% control of biotypes and had little effect on creeping bentgrass. The biotype that exhibited reduced susceptibility in the RI trial was controlled by only 10%. The SC and EC formulations were equally effective.

A field study, initiated in RI in the fall of 1992, examined the effects of sequential treatments of ethofumesate (PROGRASS SC) on annual bluegrass control and tolerance of 'Penncross' creeping bentgrass sod mowed at 0.25 inches. Ethofumesate was applied 2, 3 or 4 times at 0.5 or 0.75 lb ai/A in 47 GPA in late-September (S), October (O), and November (N) at 20 or 30 day intervals. An additional application was made in April (A), 1993. Periodic observation during the fall indicated little or no turf injury or control of annual bluegrass. Observations during the following spring revealed control of annual bluegrass up to 94% and no turf injury. The most effective treatments were 0.75 lb/A applied three times during S, O, and N, or O, N, and A and two times during O and N. The 0.5 lb/A treatment applied four times at 20-day intervals during the fall gave 91% control. Slightly less effective treatments were 0.75 lb/A in S, O, and A (83% control) and S and O only (89% control). Other treatments at 0.5 lb/A gave less than 80% control, regardless of timing. The study suggests the later treatments (November) were more effective than those including September treatments.

1 Adjunct Prof., Dept. of Plant Sci., Univ. of RI, Kingston, RI 02881
2 NOR-AM Chemical Co., Narvon, PA 17555

EFFECTS OF SEVERAL POSTEMERGENCE HERBICIDES ON SPOTTED CATESEAR (*Hypochoeris radicata* L.)[1]

R. G. Prostak and R. D. Ilnicki[2]

ABSTRACT

Catsear, a perennial broadleaf weed and member of the Asteraceae, is occasionally present in lawns and turf areas in central New Jersey. An experiment was initiated at the Rutgers Plant Science Research Center in Freehold, New Jersey to evaluate several postemergence broadleaf herbicides for its control.

Treatments were applied on September 25, 1993 using a hand-held, CO_2 propelled backpack sprayer calibrated to deliver 40 gallons per acre in a randomized complete block design with four replications. Applications were made using a two nozzle boom on plots of 3.5 by 15 feet.

Treatments consisted of several broadleaf herbicides including 2,4-D, dichlorprop, dicamba, mecoprop, MCPA, triclopyr, clopyralid, and quinclorac alone and in several combinations of each other. Plants treated with clopyralid at 0.38 lb/A and the combination of clopyralid and triclopyr at 0.56 and 0.19 lb/A, respectively, showed greatest activity at 7 DAT, and triclopyr alone at 0.5 lb/A showed little activity. The pattern continued at the 25 DAT evaluations at which time injury with clopyralid and the clopyralid - triclopyr combination was severe, but triclopyr alone showed little or no injury to catsear. At both the 7 and 25 DAT evaluation, the phenoxys, phenoxy combinations, and quinclorac produced only moderate injury compared to clopyralid and the clopyralid - triclopyr combination. The combination of 2,4-D and dicamba produced greater initial activity then either 2,4-D or dicamba alone. Additional evaluations will be made to determine if these initial responses will ultimately lead to death of catsear.

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[1] New Jersey Agricultural Experiment Station Publication No. K-12274-2-93.

[2] Graduate Research Assistant and Professor Emeritus of Weed Science, Department of Plant Science, Rutgers University, New Brunswick, NJ 08903.

NUTSEDGE CONTROL WITH MON 12000 AND E.U.P. TRIAL RESULTS IN TURF

T. E. Dutt and D. C. Riego[1]

ABSTRACT

MON 12000 is a new sulfonylurea herbicide being developed by Monsanto Company. Testing since 1987 has shown excellent safety of this product on turfgrasses for selective weed control.

Trials were established on a perennial ryegrass (Lolium perenne L.) golf course fairway in New Jersey to compare MON 12000 with bentazon for the control of yellow nutsedge (Cyperus esculentus L.). The test area was heavily and uniformly infested with nutsedge, and treatments were applied postemergence from early June through late August 1992. Control of nutsedge was evaluated during the 1992 and 1993 seasons. Single applications of 0.062 lb ai/A MON 12000 and 1.5 lb ai/A bentazon provided good control through the 1992 season and poor control through the 1993 season. Sequential MON 12000 treatments of 0.031-0.062 lb ai/A followed by 0.031 lb ai/A applied 6-weeks later provided excellent control through the 1992 season, good-excellent control in June 1993, and fair-good control in September 1993. Sequential bentazon treatments of 1.0-1.5 lb ai/A followed by 1.0 lb ai/A applied 3 to 6-weeks later provided fair-good control through the 1992 season and poor-fair control through the 1993 season. Results indicate that MON 12000 is more effective than bentazon in providing long-term control of yellow nutsedge in turf (Tables 1 and 2).

Applications of MON 12000 were made on turf through commercial equipment under an experimental use permit (E.U.P.) in 1993. A total of 23 cooperators (17 golf course superintendents and 6 lawn care operators) applied the product on over 40 acres of turf across the Northeastern states of Maryland, New Jersey, Ohio and Pennsylvania. Sequential applications to control any regrowth of nutsedge were made at only 10% of the locations. Cooperators were very satisfied with control obtained from applications of 0.031 and 0.062 lb ai/A of MON 12000. No injury was observed on the various cool-season turfgrasses, with the exception of perennial ryegrass where some discoloration and stand reduction was reported at 3 of the 17 locations where it was the primary turf cover.

Results indicate that 0.031-0.062 lb ai/A MON 12000 is effective for control of yellow nutsedge in turf under Northeastern conditions. A sequential treatment of 0.031 lb ai/A may be necessary to maintain control if significant regrowth of nutsedge occurs.

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[1]Senior Development Specialists, The Agricultural Group of Monsanto Company, Bangor, PA and Carmel, IN, respectively.

TABLE 1: Long-term control of yellow nutsedge on a perennial ryegrass golf course fairway with single and sequential applications of MON 12000 and bentazon (Medford Lakes, NJ).

Treatment[1]	Rate LB AI/A	% Control of Yellow Nutsedge 9-28-92	6-16-93	9-29-93
MON 12000	0.031	34 b	20 b	18 b
MON 12000	0.062	88 a	64 a	55 ab
MON 12000	0.031 + 0.031	96 a	91 a	75 a
bentazon	1.5	86 a	60 a	33 ab
bentazon	1.5 + 1.0	90 a	78 a	73 a
LSD (.05)		25	32	40

[1]Initial treatments applied June 8, 1992; sequential bentazon treatment applied 3 weeks later on June 29, 1992; and sequential MON 12000 treatment applied 6 weeks later on July 20, 1992. X-77 surfactant at 0.5% v/v added to MON 12000 treatments, and crop oil concentrate at 1% v/v added to bentazon treatments.

TABLE 2: Long-term control of yellow nutsedge on a perennial ryegrass golf course fairway with sequential applications of MON 12000 and bentazon (Medford Lakes, NJ).

Treatment[1]	Rate LB AI/A	% Control of Yellow Nutsedge 9-24-92	6-16-93	9-29-93
MON 12000	0.031 + 0.031	100 a	100 a	93 a
MON 12000	0.062 + 0.031	100 a	100 a	92 a
bentazon	1.0 + 1.0	72 b	23 b	0 b
LSD (.05)		6	18	3

[1]Initial treatments applied July 20, 1992 and sequential treatments applied 6 weeks later on August 31, 1992. X-77 surfactant at 0.5% v/v added to MON 12000 treatments, and crop oil concentrate at 1% v/v added to bentazon treatments.