CHLORIMURON AND LINURON MIXTURES FOR POSTEMERGENCE BROADLEAF WEED CONTROL IN SOYBEANS

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ABSTRACT

Seven field studies in 1987 and two in 1988 were conducted to evaluate chlorimuron and linuron at 9 and 108 g ai/ha, respectively, alone and in combination for postemergence broadleaf weed control and soybean [Glycine max (L.) Merr.] tolerance. Treatments contained 0.125% v/v nonionic surfactant. Herbicide mixtures provided excellent early postemergence control of redroot pigweed (Amaranthus retroflexus L.) and smooth pigweed (Amaranthus hybridus L.) whereas linuron alone did not adequately control these species. Combinations of chlorimuron and linuron significantly reduced populations of common lambsquarters (Chenopodium album L.), jimsonweed (Datura stramonium L.), ivyleaf morningglory [Ipomoea hederacea (L.) Jacq.], entireleaf morningglory (Ipomoea hederacea var. integriuscula Gray), and pitted morningglory (Ipomoea lacunosa L.). Addition of 2,4-DB at 34 g ai/ha significantly increased control of common lambsquarters and morningglory species. Soybean injury in the form of leaf necrosis, chlorosis, and internodal shortening was observed 3 to 7 days after treatment (DAT). Soybeans recovered 21 to 25 DAT and exhibited significant reduction in yield in 1987.

Chlorimuron plus linuron are currently marketed as a pre-packaged mixture for preemergence broadleaf weed control in soybeans. Based on average prices, current costs of postemergence herbicides vary between $17.25 to $37.00/hectare. The application of chlorimuron plus linuron at 9 and 108 g ai/ha, respectively, would cost the grower approximately $7.50/ hectare. This combination has potential for providing an inexpensive alternative for broadleaf weed control in soybeans.

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THE UTILITY OF HOE-039866 IN NO-TILL SOYBEANS

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ABSTRACT

Field trials conducted in Maryland since 1981 have shown the utility of HOE-039866 as a knock-down herbicide for use in no-till soybean [Glycine max (L.) Merr.] production. Research has been conducted in both full-season and double-crop no-till soybeans. Control of existing vegetation with HOE-039866, especially horseweed [Conyza canadensis (L.) Cronq.], seems to require a minimum use rate of 0.8 kg/ha. In comparison, glyphosate application rates of 1.12 to 1.68 kg/ha were required to achieve comparable horseweed control. With paraquat, split applications were necessary to effectively control horseweed. Here, an early preplant application of paraquat at 0.28 kg/ha, generally in combination with 2,4-D, followed by an at-planting application at 0.28 kg/ha were required.

Control of annual grasses was not consistent with HOE-039866. For full-season no-till soybeans, split applications of HOE-039866 in combination with a preemergence grass herbicide, provided best season-long annual grass control. Here, an early preplant application of HOE-039866 at 0.4 kg/ha followed by an at-planting application of 0.4 kg/ha were necessary. With double-crop no-till soybeans, rates of HOE-039866 from 0.8 to 1.7 kg/ha were examined. Early-season grass control ratings indicated that good (≥80%) control could be obtained at rates of 1.1 kg/ha or higher. Yet, late season ratings indicated fair (60-80%) control with all rates tested.

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DECREASING RATES OF NONSELECTIVE HERBICIDES IN DOUBLE-CROP NO-TILL SOYBEANS

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ABSTRACT

Field studies were conducted in 1988 at five locations in Virginia to evaluate lower rates of nonselective herbicides when tank-mixed with chlorimuron plus linuron in double-crop no-till soybeans [Glycine max (L.) Merr.].

The objective was to determine the lowest rate of glyphosate, paraquat, or HOE-0661 required to provide commercially acceptable "burndown" of vegetation present at planting when used in combination with chlorimuron plus linuron. Glyphosate, paraquat, and HOE-0661 were applied at rates ranging from 0.11 to 0.56, 0.08 to 0.40, and 0.11 to 0.56 kg/ha respectively. Chlorimuron plus linuron was tank-mixed with the aforementioned herbicides at 0.50 kg/ha. Chlorimuron plus linuron was also applied alone at this same rate. All treatments were applied preemergence with CO_2 pressurized backpack sprayers delivering 220 l/ha at a pressure of 210 kilopascals. In addition, all treatments contained 0.5% v/v non-ionic surfactant. Ratings were taken at 3, 8, and 12 weeks after treatment and plots were hand harvested in the fall. The weeds evaluated included large crabgrass [Digitaria sanguinalis (L.)Scop.], giant foxtail (Setaria faberi Herrm.), common ragweed (Ambrosia artemisiifolia L.), tropic croton (Croton glandulosus var. septentrionalis Muell.-Arg.), prickly sida (Sida spinosa L.), jimsonweed (Datura stramonium L.), and redroot pigweed (Amaranthus retroflexus L.).

Preliminary results indicate chlorimuron plus linuron applied in the absence of nonselective herbicides at 4 locations provided "burndown" equivalent to treatments containing these compounds. This was not the case at the Northumberland Co. study, which was very dry at the time of herbicide application. At this location, the lowest rate of glyphosate, paraquat, or HOE-0661 provided control equivalent to the highest rates of these herbicides, and all treatments containing nonselective herbicides were superior to chlorimuron plus linuron used alone.

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Evaluation of Herbicide Systems in Southeastern Virginia Soybeans

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Field studies were conducted in soybeans [Glycine max (L.) Merr. 'Deltapine 675'] in 1988 to evaluate weed control and crop response to early postemergence applications of thiameturon, thiameturon plus chlorimuron, acifluorfen plus chlorimuron, with surfactant and 30% nitrogen (N). Thiameturon at all rates (2.2, 2.9, and 4.4 g ai/ha) provided excellent season-long control (greater than 98%) of common lambsquarters (Chenopodium album L.), poor control (less than 35%) of common ragweed (Ambrosia artemisiifolia L.), and fair control (70-80%) of common cocklebur (Xanthium strumarium L.) and morningglory species (Ipomoea sp.). Chlorimuron combinations provided greater than 97% control of common cocklebur, 70% or greater for common ragweed, and 81% or greater control for morningglory species. Acifluorfen-chlorimuron combinations provided excellent season-long control of the aforementioned weed species. Soybean injury increased with thiameturon and/or chlorimuron rates. The addition of chlorimuron to thiameturon increased visual estimates of soybean injury compared to thiameturon or chlorimuron alone. Yields equivalent to the weed-free check were obtained with thiameturon-chlorimuron and acifluorfen-chlorimuron combinations.

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Preplant Incorporated and Preemergence Combinations in Soybeans

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ABSTRACT

Field studies were conducted in soybeans [Glycine max (L.) Merr. 'Pella'] to evaluate efficacy of trifluralin, metribuzin, and metolachlor combinations as tank mixes and premixes alone and in combination with imazaquin and/or clomazone. Treatments were applied preplant incorporated and compared to preemergence applications.

Excellent control of pigweed (Amaranthus spp. L.), lambsquarters (Chenopodium album L.), and velvetleaf (Abutilon theophrasti L.) was achieved with preplant incorporated treatments. No additional efficacy could be detected with additions of imazaquin or clomazone to any of the tank mix or premix combinations. Furthermore, all preemergence combinations applied performed poorly, because of lack of moisture.

INFLUENCE OF TIMING AND FERTILIZER SOLUTIONS ON POSTEMERGENCE IMAZETHAPYR APPLICATIONS TO SOYBEANS

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ABSTRACT

Imazethapyr is unique among postemergence soybean herbicides in its ability to control existing weeds and provide residual control. Field trials were conducted in the northeastern states to further define the effect of timing of application and the use of fluid fertilizers in the spray solution on weed control. Imazethapyr was applied postemergence at an early and late timing at rates of 0.047, 0.063, and 0.078 lb ae/A. All imazethapyr treatments included a nonionic surfactant at 0.25% (v/v). In addition, several of the treatments included 10-34-0, a fluid fertilizer, at 1 qt/A. The first application was made when weeds were in the 1 to 2 leaf stage and soybeans were in the first trifoliate. The later application occurred when weeds had reached the 4 to 6 leaf stage and soybeans were in the fourth trifoliate. Weed control and crop injury ratings were made 2, 4, and 8 weeks after application.

The addition of 10-34-0 to the late postemergence imazethapyr treatments improved control of common lambsquarters, ivyleaf morningglory, velvetleaf, and giant foxtail from 7 to 20% at 2 weeks after treatment ratings. The fertilizer had little effect on early postemergence treatments. Control of common lambsquarters was best from early applications, while ivyleaf morningglory control was unaffected by time of application. Jimsonweed and velvetleaf control improved slightly at the late application although the early treatments also provided acceptable control. Ivyleaf morningglory and velvetleaf control was much better with imazethapyr applied late postemergence than with a bentazon and acifluorfen tank mix, demonstrating the versatility of imazethapyr. Soybeans were very tolerant of postemergence applications of imazethapyr, regardless of the additive included in the spray solution.

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PROTECTION OF WHEAT AGAINST RESIDUAL CLOMAZONE ACTIVITY

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ABSTRACT

Field and greenhouse studies were conducted to evaluate rotational crop response of wheat (Triticum aestivum L.) from preplant incorporated, preemergence, and no-till applications of clomazone to soybeans and to determine the ability of phorate to protect wheat against clomazone injury. Although some early bleaching was observed, no reductions in wheat height or stand were found from preplant incorporated applications at 0.6 to 1.1 kg/ha. Wheat injury, height, and stand reductions were observed from three formulations (emulsifiable concentrate, wettable powder, and Formulation A) of clomazone preemergence applications at 1.1 kg/ha. Formulation A provided more residual activity than wettable powder and emulsifiable concentrate formulations. Rotational wheat injury from no-till applications were minimal; no stand reductions were observed although wheat height reductions were found at the 1.7 kg/ha rate of clomazone. Seed treatments of phorate at 0.2 and 0.5% protected wheat from clomazone injury in both field and greenhouse studies. However, phorate treatments reduced wheat germination and stand. Wheat stands were reduced 70% by the 0.5% phorate treatment. Significant wheat height reductions were observed at 0.5% phorate. Phorate reduced clomazone injury in wheat, but phorate injury to wheat was severe.

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Intercropping Soybeans with Subterranean Clover

F. E. Katz and R. D. Ilnicki

ABSTRACT

In an effort to find alternatives to herbicides in crop production, subterranean clover or subclover [*Trifolium subterranean* L.] has been evaluated as a living mulch in corn which did provide both weed control and nitrogen to the crop. The objective of this research was to examine the feasibility of intercropping soybeans [*Glycine max* L. Merr. 'Pella'] with subclover thus providing an alternative crop utilizable in this system. Plots were established in a split split block design with clover vs. fallow as the main plots. These were then split with the following treatments: double disking, fall seeded barley to aid in subclover establishment, glyphosate for subclover and weed control, and an untreated check. These sub plots were further split with soybeans planted no-till in 15- and 30-inch rows.

Plots were sampled for biomass accumulation four times throughout the growing season. At each sample date one meter of soybean row was harvested for dry weight and a 0.25m^2 area sampled for weed biomass determination. Four counts per plot were made to determine the soybean population. Two rows of every plot (4 rows in 15 inch row spacing) were harvested on October 28th for yield.

Subclover reduced soybean dry weight but did not affect soybean stand (population). This was true throughout the season where at harvest soybeans in subclover were shorter and internode length reduced. Yield data have not been determined to date. Subclover reduced weed biomass by as much as 90%.

Subplot treatments such as disking and glyphosate application decreased weed control provided by subclover. However, glyphosate treated clover provided weed control comparable to the living mulch during the early season. Subclover treated with glyphosate had marginally better soybean growth. At the second sample date glyphosate treatments had the highest soybean dry weight followed by disking, then living mulch or fallow alone and with barley stubble.

Row spacing had no effect on weed biomass but under these growing conditions soybean dry weights were greater in the 15 inch row spacings.

CORN GROWTH AND YIELD IN A SUBTERRANEAN CLOVER LIVING MULCH SYSTEM [1]

M.J.Else and R.D.Ilnicki [2]

Mulches composed of living or dead plant material are a promising weed control technology and may benefit growers by reducing herbicide costs, soil erosion, and by helping to conserve soil moisture. Subterranean clover (Trifolium subterraneum L.) shows a great deal of potential as a mulch crop because of the excellent weed control it has been found to provide and because it is a winter annual, dying out during the period when competition with crops would be greatest. An experiment was conducted to compare corn growth and yields in different living and dead mulch systems. Treatments consisted of a subterranean clover (sub clover) living mulch, a mowed rye mulch, a tilled treatment, and a treatment of dead common chickweed (Stellaria media L.) which resulted when a second sub clover variety failed to overwinter, leaving a dense stand of chickweed. Emergence, growth, and development of corn were delayed in the sub clover plots compared to the other three treatments. These effects were thought to be largely due to poor seed placement and coverage resulting from mechanical difficulties associated with planting into the dense sub clover stand. Early in the season aboveground corn plant dry weights were approximately 80% greater in the tilled plots and approximately 40% greater in the rye and chickweed plots than in the sub clover plots. By tasselling, however, there was only a 35% difference in corn plant dry weights between the tilled and sub clover treatments. Corn biomass was intermediate in the rye and chickweed plots. Yield, however, was lowest in the rye and chickweed plots and significantly higher in the tilled and sub clover plots. Thus factors other than plant biomass must have affected yields. It seems probable that greater soil moisture and reduced weed interference in the sub clover plots contributed to the better-than-expected yields in those plots.

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[1] New Jersey Agricultural Experiment Station Publication No. J-15274-1-88.

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SIGNIFICANCE OF NATIONAL AGRICULTURAL PESTICIDE IMPACT ASSESSMENT PROGRAM TO NORTHEAST AGRICULTURE

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The USDA/State National Agricultural Pesticide Impact Assessment Program (NAPIAP) was organized by USDA in 1976. During its 12 year history, it has been in the forefront of responding to federal regulatory activity impacting pest control technology. The overall program has several major objectives: (1) the development of biologic/economic assessment reports for pesticides having currently registered uses, (2) analyzing and critiquing EPA proposed regulatory programs, (3) providing funding to federal and state scientists to initiate data-gap research in support of the continued registration of pesticide uses under Special Review by EPA, (4) supporting pesticide use surveys and needs and (5) initiating commodity assessment activity to determine the overall impact resulting from the loss of currently registered uses of pesticides and the effectiveness of alternative control measures, including, chemical, biological and mechanical. Many scientists in the Northeast have served on biologic/economic assessment teams, obtained funding through the regional NAPIAP in support of data-gap research and responded to requests for research data and use information in support of the federal/state program. Looking to the future, EPA will likely place 12-15 pesticide active ingredients under Special Review each year. This reflects a highly accelerated program for NAPIAP. The decisions of EPA regarding reregistration will have a major impact on Northeastern agriculture and overall pest control technology recommendations and control measures. A significant number of these compounds will be herbicides. The bottom line is that NAPIAP needs your support and involvement.

UPDATE ON IMAZETHAPYR DEVELOPMENT AND REGULATORY STATUS

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ABSTRACT

Imazethapyr has been under research and development for weed control in soybeans (Glycine max, L.) and other leguminous crops since 1982. It is unique in its broadspectrum of broadleaf and grass activity from both soil and foliar applications. Imazethapyr is unusual for a postemergence broadleaf herbicide in that it provides season-long weed control.

Imazethapyr has been used by growers for two years under emergency use registrations (Section 18, FIFRA) on edible beans (Phaseolus spp.), and soybeans. Additionally, soybean growers have had experience with imazethapyr for two year under Experimental Use Permits. EUP testing consisted of 594 trials in 1987 and 344 trials in 1988. An application was submitted to the EPA in November, 1987 for the registration of imazethapyr on soybeans. The registration is expected to issue in the first quarter of 1989. Product will be available to growers in two formulations: PURSUIT® 2AS (2 lb. ae/gal) and PURSUIT® PLUS 3CE (imazethapyr and pendimethalin, 0.2 and 2.8 lb./gal, respectively). The recommended use rates will be 0.063 lb. ae/A, and 0.063 lb. ae plus 0.88 lb./A for the PURSUIT and PURSUIT PLUS formulations. Extensive field testing has shown wheat (Triticum aestivum, L.) and field corn (Zea mays, L.) to be safe when planted as rotational crops following an imazethapyr application. The planting restriction will be four months for wheat and nine and one-half months for corn. The application for registration of imazethapyr on edible beans, peas (Pisum sativa) and lentils (Lens culinaris, Medic) has been submitted to the EPA; the registration is expected in 1989. The registrations for use on peanuts (Arachis hypogaea, L.) and alfalfa (Medicago sativa, L.) are expected in in 1990 and 1992, respectively.

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VELVETLEAF CONTROL IN FIELD CORN

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ABSTRACT

Herbicide combinations were compared for velvetleaf (Abutilon theophrasti Medik.) control in field corn (Zea mays L.). Experiments were conducted on a Hamlin silt loam soil with 5.4% organic matter in Livingston County, New York from 1983 through 1986 and in 1988. The plot area was heavily infested with velvetleaf. Seedbed preparation included spring plowing and discing. A randomized complete block design with four replications was used in each experiment. Herbicide treatments were applied in water to 10 by 25 ft plots using 8003 flat spray tips mounted on a compressed air bicycle sprayer calibrated to deliver 30 gpa of spray solution. Control ratings shown in Table 1 were made in July or August.

The results in Table 1 confirm previous results that have shown early postemergence (EPO) applications of pendimethalin in combination with atrazine or cyanazine are more effective than their preemergence (PRE) counterparts for velvetleaf control. These differences are striking in years when rainfall for herbicide activation is below normal. As a result, these EPO combinations have become standard treatments for velvetleaf control in New York fields that have no yellow nutsedge (Cyperus esculentus L.). Although the EPO combination of pendimethalin plus cyanazine is more likely to injure field corn than the combination of pendimethalin plus atrazine, it is the preferred choice for velvetleaf control when annual grasses are also a problem.

Velvetleaf control ratings in Table 1 indicate that a similar relationship exists between PRE and EPO applications of pendimethalin plus dicamba. In 3 out of 4 years this combination was used, the EPO treatments provided better velvetleaf control than their PRE counterparts. Other EPO combinations that provided good to excellent velvetleaf and annual grass control are cyanazine plus atrazine and cyanazine plus dicamba. Split applications of 2 lb ai/A of metolachlor applied PRE followed by either 0.5 lb ai/A of dicamba or 2 lb ai/A of atrazine plus an oil concentrate-surfactant blend postemergence were not as consistent in controlling velvetleaf as the EPO pendimethalin combinations. An experimental herbicide, SC-0051 at rates of 0.25 or 0.5 lb ai/A applied PRE in combination with 2 lb/A of metolachlor or postemergence following PRE applications of metolachlor provided excellent velvetleaf control (data not shown) at this location.

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Table 1. Velvetleaf control ratings with pre- and postemergence herbicide combinations for field corn in Livingston County, New York from 1983 through 1986 and in 1988.

Herbicides	Rate lb/A	When App.	Velvetleaf Control[a] '83	'84	'85	'86	'88	Ave.
Pendimethalin Atrazine	1.5 1.5	PRE PRE	4.8	7.3	6.3	8.4	9.1	7.2
Pendimethalin Atrazine	1.5 1.5	EPO EPO	8.3	8.5	9.5	9.8	9.1	9.0
Pendimethalin Cyanazine	1.5 2.0	PRE PRE	4.8	7.0	6.5	8.3	8.0	6.9
Pendimethalin Cyanazine	1.5 2.0	EPO EPO	7.3	8.5	9.5	9.8	9.1	8.8
Pendimethalin Dicamba	1.5 0.5	PRE PRE	7.5	6.0	8.0	9.3	--	7.7
Pendimethalin Dicamba	1.5 0.5	EPO EPO	8.8	7.8	9.4	9.1	--	8.8
Cyanazine Atrazine	2.0 1.5	EPO EPO	6.5	8.8	9.5	9.8	8.8	8.7
Cyanazine Dicamba	2.0 0.5	EPO EPO	7.8	8.5	9.5	9.8	9.4	9.0
Metolachlor Dicamba	2.0 0.5	PRE EPO	6.8	7.3	6.8	8.3	6.0	7.0
Metolachlor Atrazine[b]	2.0 2.0	PRE LPO	2.5	8.3	9.5	9.4	6.3	7.2
Control	--	--	0.0	0.0	0.0	0.0	0.0	0.0
LSD (0.05)			1.3	0.8	1.1	1.4	1.0	

[a]Control ratings: 0 = no effect; 10 = complete kill.

[b]Late postemergence (LPO) application of atrazine included 1 qt/A of an oil concentrate-surfactant blend.

EFFICACY OF TRIDIPHANE ON TRIAZINE RESISTANT COMMON LAMBSQUARTERS

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ABSTRACT

Field observations in 1986 indicated that tridiphane had good activity against triazine resistant common lambsquarter (TR-CL) (*Chenopodium album* L.) in the Phelps region of New York state. The purpose of this study was to determine the efficacy of tridiphane on TR-CL. In 1987 and 1988 field trials were established in Phelps and Aurora, NY; Wooster, OH; and Campbellsport and Beechwood, WI to determine the efficacy of early post-emergence (EPO) applications of tridiphane alone (0.5, 0.75, and 2.0 lb/A) and in combination with atrazine (1.5 and 2.0 lb/A), and cyanazine (2.0 lb/A) on TR-CL. All treatments without cyanazine contained 1qt/A of crop oil concentrate (COC). In Phelps each plot was separated by a 5 ft buffer strip treated (EPO) with atrazine (1.5 lb/A) & cyanazine (2.0 lb/A) as a check for TR-CL. In 1987, a pre-emergent application of metolachlor (1.5 lb/A) was applied to all plots at Aurora and Phelps for grass control. The study design in each trial was a randomized complete block with 3 or 4 replications per treatment. Treatments in each trial were applied with a plot sprayer that delivered 20 to 30 gallons of diluent per acre. For specific treatments, application and rating dates, spray volume, and replications per treatment see Table 1.

A laboratory study was designed to closely examine the effect tridiphane (.125, .25, .50, and .75 lb/A) and atrazine (1.5 lb/A), alone, and in combination, on triazine susceptible (TS-CL) and TR-CL. All treatments were applied with 1% v/v COC. Seed of TR-CL was collected from the Phelps site in 1987 and TS-CL was purchased from Valley Seed Service (P.O. Box 9335, Fresno, CA 93791). Treatments were applied on 4/6/88 with a track sprayer calibrated to deliver 30 gallons of diluent per acre. Percent kill was rated 4 weeks after treatment (WAT) and plant height was measured 2, 4, and 6 WAT.

Tridiphane (.5 lb/A), at sites B, C, and D provided about 30% greater control of TR-CL than triazine treatments alone and at site A the increase was 70% (Table 1). The greater performance of tridiphane at sites A and C versus sites B and D, respectively, was do mainly to good growing conditions (adequate rainfall) in 1987 versus poor conditions (dry) in 1988. Control of TR-CL with tridiphane was not as great in Ohio and Wisconsin compared to New York. In all trials the TR-CL that grew in plots treated with tridiphane and triazine were stunted compared to untreated plants. This effect was clearly demonstrated in the laboratory where TR-CL plants treated with tridiphane (.125 to .75 lb/A) were half the height of atrazine treated plants (Table 2.). The stunting, possibly caused by meristem inhibition, is greatest during periods of good growing conditions and can provide commercially acceptable control of TR-CL as seen in site A and 1986. In the laboratory tridiphane killed 70-98% of the TS-CL plants and none of the TR-CL (Table 2). The remaining, live TS-CL plants were half the size of the TR-CL plants 2 WAT. These data suggests that the resistance to atrazine in TR-CL seed from Phelps also reduces the stunting activity of tridiphane.

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Table 1. Efficacy of tridiphane on triazine resistant common lambsquarter in the field at seven sites in 1987 and 1988.

Treatments	lb/A	Percent control of triazine resistant common lambsquarter						
		Site A	Site B	Site C	Site D	Site E	Site F	Site G
1. Tridiphane & crop oil conc. (COC)	0.5/1qt	73	30	83	45	-	13	-
2. Tridiphane & COC	0.75/1qt	-	-	-	-	53	-	-
3. Tridiphane & COC	2.0/1qt	97	42	86	-	-	-	-
4. Tridiphane & atrazine & COC	0.5/1.5/1qt	84	48	83	43	-	23	10
5. Tridiphane & atrazine & COC	0.75/2.0/1qt	-	-	-	-	82	-	-
6. Tridiphane & atrazine & COC	2.0/1.5/1qt	99	67	86	-	-	-	-
7. Tridiphane & cyanazine	0.5/2.0	-	60	-	45	96	29	14
8. Atrazine & cyanazine	1.5/2.0	0	0	50	10	-	-	-
9. Atrazine & COC	1.5-2.0/1qt	-	-	-	-	20	20	0
10. Cyanazine	1.5-2.0	-	-	-	-	56	1	0
11. Check (untreated)		0	0	0	0	0	0	0
State		NY	NY	NY	NY	WI	WI	OH
Town		Phelps	Phelps	Aurora	Aurora	Campb.*	Beech.*	Woos.*
Treatment date		5/27/87	6/4/88	6/17/87	6/24/88	6/1/87	5/26/88	6/2/88
Rating date		7/13/87	7/15/88	7/5/87	8/19/88	7/13/87	7/15/88	7/15/88
Gallons per acre		24	24	30	30	25	25	20
Replications		3	3	4	4	4	4	4

* Campb. = Campbellsport, Beech. = Beechwood, Woos. = Wooster.

Table 2. Efficacy of tridiphane and atrazine combinations on triazine resistant and susceptible common lambsquarter in the laboratory[a].

Trt #	lb/A[b]		% Kill 4 WAT[c]		Plant height (cm)				
					2 WAT		4 WAT		6 WAT
	tridiphane	atrazine	TS-CL	TR-CL	TS-CL	TR-CL	TS-CL	TR-CL	TR-CL
1.	-	-	0	0	9.5	10.8	21.0	21.0	22.5
2.	-	1.5	100	0	.0	9.5	.0	23.0	27.0
3.	0.125	-	71	0	2.5	5.0	11.0	9.8	10.5
4.	0.125	1.5	100	0	.0	5.0	.0	8.8	12.0
5.	0.25	-	98	0	2.3	4.5	5.3	9.3	12.8
6.	0.25	1.5	100	0	.0	3.8	.0	8.3	10.5
7.	0.5	-	88	0	2.0	3.0	8.8	7.3	13.0
8.	0.5	1.5	100	0	.0	3.0	.0	9.3	12.3
9.	0.75	-	93	0	1.5	3.0	5.8	8.3	10.8
10.	0.75	1.5	100	0	.0	2.8	.0	8.8	12.8

[a] Triazine resistant common lambsquarter (TR-CL) seed was collected from the field trial in Phelps, NY and triazine susceptible common lambsquarter (TS-CL) seed was purchased from Valley Seed Svc., Fresno, CA.

[b] All treatments were applied with 1% v/v of crop oil concentrate. Treatments were applied on 4/6/88 with a track sprayer calibrated to deliver 30 gpa.

[c] WAT = weeks after treatment.

INTERACTION OF DPX-V9360 WITH BROADLEAF HERBICIDES FOR WEED CONTROL IN CORN

C. C. Zhao, J. R. Teasdale, and C. B. Coffman[1]

ABSTRACT

DPX-V9360 is a new postemergence grass herbicide for corn (Zea mays L.). The objective of this research was to determine the efficacy of tank-mixtures of DPX-V9360 with broadleaf herbicides for weed control in corn. This experiment was conducted at two locations at Beltsville, Maryland in 1988. Corn was treated with postemergence applications of 0, 9, 18, 35, 70, and 105 g/ha of DPX-V9360 alone or tank-mixed with atrazine, cyanazine, dicamba, 2,4-D, DPX-M6316, or pyridate, respectively. A non-ionic surfactant (X-77) at 0.25% v/v was added to all treatments including DPX-V9360 and DPX-M6316. Corn was in the 4-leaf stage in experiment 1 and the 7-leaf stage in experiment 2 at the time of application. Field experiment 1 indicated excellent control of giant green foxtail (Setaria viridis var. major (gaudin) Pospichel) and smooth pigweed (Amaranthus hybridus L.) with 9 to 105 g/ha of DPX-V9360 applied alone or tank-mixed with atrazine, cyanazine, dicamba, 2,4-D, DPX-M6316, or pyridate. Smooth pigweed was apparently triazine resistant since atrazine and cyanazine alone did not control this weed. Common ragweed (Ambrosia artemisiifolia L.) and curly dock (Rumex crispus L.) control was not achieved with DPX-V9360 alone. However, all of the other herbicides except pyridate provided excellent control of common ragweed and curly dock both alone and tank-mixed with DPX-V9360. No corn injury was observed with any treatment. Because of the severe drought this year, no yield data was obtained from this experiment. The field in experiment 2 contained one dominant weed species, redroot pigweed (Amaranthus retroflexus L.), which was in an advanced stage of development (5-12 leaf stage) at the time of application. DPX-V9360 was highly effective at controlling redroot pigweed at this leaf stage. Tank-mixture with each of the other herbicides in this experiment did not interfere with redroot pigweed control by DPX-V9360. The only other herbicide which effectively controlled redroot pigweed in this experiment was DPX-M6316. There was no visual injury to corn from any of these treatments. None of the herbicides tank-mixed with DPX-V9360 significantly changed corn yield compared to DPX-V9360 alone except for 2,4-D. Corn yield was reduced by 2,4-D because corn plants were beyond the stage recommended for applying 2,4-D safely.

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POSTEMERGENCE QUACKGRASS CONTROL IN FIELD CORN

P. C. Bhowmik and B. J. Germond, Sr[1]

ABSTRACT

Selective postemergence quackgrass [Agropyron repens (L.) Beauv.] control in corn has been an active area of research for the last several years. Field experiments were conducted to (1) evaluate postemergence activity in quackgrass control, (2) determine the optimum growth stage of quackgrass, and (3) identify, if any, corn injury. In one study, DPX-V9360 (Dupont) at 0, 70, 140, 280, and 420 g ai/ha was evaluated with (X-77 and APSA-80) or without a surfactant. In second study, four rates of DPX-V9360 at 0, 35, 70, and 105 g/ha and three growth stages of quackgrass were evaluated. In third study, the postemergence activity of DPX-V9360 (0 to 140 g/ha) was compared with CGA-1368 (Ciba-Geigy) (0 to 30 g/ha).

Plots were 3 by 6 m and the treatments were replicated three times either in a randomized block design or in a split-plot design. Corn 'Agway 584S' was planted on May 11, 1988 in 75 cm rows at a density of 62,800 plants/ha. A blanket preemergence treatment of alachlor and linuron at 1.7 and 1.1 kg/ha was applied for annual weed control. Postemergence treatments were applied on June 3, June 21, and July 1, 1988, respectively, when the quackgrass was at the one- to three-leaf, four- to six-leaf, and seven- to 10-leaf stage, with a CO_2 backpack sprayer at a pressure of 152 kPa in 189 L/ha. Quackgrass control was rated two weeks after treatment (WAT), 5 WAT, and 9 WAT.

Corn 'Agway 584S' was tolerant to all rates of DPX-V9360. The postemergence activity was similar whether applied with X-77 or APSA-80. At 3 WAT, DPX-V9360 at g/ha controlled quackgrass by 70%, while it gave 100% control at 140 g/ha. DPX-V9360 effectively controlled quackgrass, regardless of all rates (70 to 420 g/ha). A significant reduction in large crabgrass [Digitaria sanguinalis (L.) Scop.] plants in plots treated with DPX-V9360 compared to untreated plots. In general, DPX-V9360 provided greater preemergence activity in large crabgrass control than CGA-136872.

In the second study, no significant differences in quackgrass control were observed with DPX-V9360, whether the treatment was applied at the one- to three-leaf stage, four- to six-leaf stage, or seven- to 10-leaf stage of quackgrass. However, at 3 WAT, lower rate (35 g/ha) exhibited only 35% control, but the same treatment resulted in 63% quackgrass control later in the season. There was an apparent decline in quackgrass control when treatments were applied at the one-to three-leaf stage of quackgrass.

In the third study, corn was safe to both DPX-V9360 and CGA 136872 at all rates. DPX-V9360 at 20, 35, 70, 105, 140 g/ha and CGA 136872 at 15, 20, 25, or 30 g/ha controlled quackgrass more than 90% 5 WAT. At 9 WAT, DPX-V9360 at 140 g/ha and CGA-136872 at 30 g/ha significantly reduced quackgrass shoot number to 100 and 167 shoots/m^2, respectively, compared to 1550 shoots/m2 in untreated plot. Our results demonstrate great potential for selective postemergence quackgrass control in corn.

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CORN-WEED INTERACTIONS WITH LONG-TERM CONSERVATION TILLAGE MANAGEMENT

C. B. Coffman[1]

ABSTRACT

Long-term conservation tillage research was established on Maryland's Coastal Plain to investigate corn and weed responses to continuous management programs. Plots were on a Codorus silt loam soil with a history of row crop production for at least a decade prior to our arrival. Field corn (Zea mays L.) was sown annually using no-tillage or minimum tillage protocols. Selected tank mixtures of preemergence and pre-plant incorporated herbicides were applied annually over the five-year duration of the project. Herbicide treatments included combinations of atrazine with simazine, alachlor, cyanazine, EPTC, or butylate, and a combination of cyanazine with alachlor. Contact herbicides included paraquat or glyphosate. Response data included weed cover, distribution and frequency of individual weed species, crop and weed growth, and crop yield. Weed cover, averaged over all treatments, increased over the duration of the investigation from 2% to 63%. Weed species stabilized by the third year of the study with fall panicum (Panicum dichotomiflorum Michx.), smooth pigweed (Amaranthus hybridus L.), and giant foxtail (Setaria faberi Herrm.) as the dominant members of the flora. Fall panicum increased from the first to the third year of the project. Smooth pigweed began to increase by the third year and became the most abundant dominant weed by the fourth and fifth years. However, the contribution of smooth pigweed to the weed flora was less in the triazine-alachlor treatments than in the triazine-triazine treatments. Perennial weeds did not achieve dominant status in herbicide treated plots. White heath aster (Aster pilosus Willd.) increased its contribution to ground cover from 0% in the first year to 88% in the fifth year in the untreated control plots. Mean corn grain yields over all treatments decreased from 4510 kg/ha to 2505 kg/ha for the first and fifth years, respectively, reflecting increased weed pressure.

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THE USE OF PARAQUAT ON FIRST YEAR ALFALFA

Sidney C. Bosworth and Robert G. Hartzler[1]

ABSTRACT

Until recently, paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) was labeled only for alfalfa (Medicago sativa L.) stands over one year old and could be applied either during the winter/spring alfalfa dormant period or between cuttings (up to five days after cutting). The objective of this study was to look at the effect of paraquat applied between cuttings and during early spring on the yield and stand density of alfalfa less than one year old.

In 1986 and 1987, three trials were conducted at the Rock Springs Agronomy Research Farm, Penn State University, in which paraquat was applied on alfalfa during the first year of the stand. The alfalfa stands were relatively weed free; therefore, the effects of treatments could be measured without the confounding effects of weeds. Paraquat was applied at a rate of 0.28 kg/ha. X-77, a nonionic surfactant, was added and applied at a rate of 1.2 g/l water. Applications were made within five days after cutting. Treatments included either a single annual application following each forage harvest or repeated applications following each harvest.

In Trial 1, alfalfa was late summer seeded with treatments and harvests imposed the following growing season. In Trial 2 and Trial 3, alfalfa was spring seeded and treatments applied the year of planting. All trials had 4 replications. Yield and plant population was determined at each cutting during the seeding year and at the first harvest the next year (in Trial 1 and Trial 2).

Plant populations and forage yields were not significantly affected by single applications following harvest. However, in one experiment, repeated paraquat application following the first three harvests did result in a significant yield reduction at the fourth harvest.

Table 1. Effect of between cutting applications of paraquat on alfalfa dry matter yields.

Application Timing	Trial 1 Harvest Number 2	Trial 1 Harvest Number 3	Trial 1 Harvest Number 4	Trial 2 Harvest Number 2	Trial 2 Harvest Number 3	Trial 3 Harvest Number 2	Trial 3 Harvest Number 3
	kg/ha						
Control	2925	4034	2267	2926	1895	2783	4916
1st harvest	2595	4091	2183	3030	1858	2989	4841
2nd harvest	-	3953	2194	-	1887	-	5022
3rd harvest	-	-	2079	-	-	-	-
All harvests	2701	3826	1981	2819	1937	2636	4730
LSD (0.05)	ns	ns	205	ns	ns	ns	ns
C.V.	10.0	6.4	6.4	10.1	5.1	9.3	4.9

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WEED CONTROL IN ALFALFA WITH POSTEMERGENCE HERBICIDES[1]

K. G. Hoffman, R. D. Ilnicki, A. J. Enache and F. E. Katz[2]

ABSTRACT

A field study was conducted at Adelphia, N.J. in 1988 to evaluate several postemergence herbicides for efficacy in a first year stand of alfalfa (Medicago sativa L.). Treatments were made during the dormant stage (March 29) and following the first harvest (June 1). Herbicides applied during the dormant season were: bromoxynil, norflurazon, pyridate, and 2,4-DB. Herbicides applied immediately after the first harvest were: BAS-517, fluazifop, haloxyfop, hexazinone, pyridate, quizalofop, sethoxydim and thiameturon. Sequential treatments were also included in the study and consisted of herbicides applied in the dormant season followed by herbicides applied after the first harvest. These sequentials were: bromoxynil followed by thiameturon; pyridate followed by sethoxydim or fluazifop; 2,4-DB followed by BAS-517, haloxyfop or quizalofop; norflurazon followed by itself; and paraquat followed by itself.

No injury to alfalfa stand or vigor resulted from any of the herbicides applied. Of the herbicides applied during the dormant period, control of winter annuals was greatest for paraquat and norflurazon and least for 2,4-DB. All others were slightly less effective than norflurazon. These weed control responses persisted after the second harvest. Of the herbicides applied after the first harvest, weed control (primarily annual grasses) was greatest for hexazinone and paraquat. However, all other treatments achieved greater than 80% control. Of the sequential treatments, weed control was greatest for paraquat followed by itself, and norflurazon followed by itself. Still effective, but slightly less weed control was obtained with bromoxynil followed by thiameturon and 2,4-DB followed by haloxyfop. The weed control achieved by the sequentials persisted into the season. With regard to alfalfa yields from the second harvest (first harvest data was not collected), only paraquat followed by itself resulted in a reduction in yield.

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[1] New Jersey Agricultural Experiment Station Publication No. J-15472-1-88

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PLANT RESPONSES TO DINOSEB AND FLUAZIFOP-P OR SETHOXYDIM COMBINATIONS

R. A. Pfeifer, R. H. Vaughan, and D. L. Linscott[1/]

ABSTRACT

Field studies in 1982 and 1985 suggested that tank-mixing dinoseb (1.12 kg/ha) and either sethoxydim (0.224 kg/ha) or fluazifop (0.224 kg/ha) increased injury on seedling alfalfa (Medicago sativa L.) compared to a treatment of dinoseb alone and that annual grass control was inhibited by a tank mix. Further field work was performed in 1986 and 1988 in an attempt to substantiate these observations and to evaluate the effectiveness of sequential treatments in eliminating these problems. Greenhouse studies were also performed and produced results comparable to those obtained in the field.

While visual injury of alfalfa did appear to be increased by a tank mix in the 1982 and 1985 studies, this was not evident in the later experiments. No significant differences in alfalfa yield due to tank mixing the grass selective herbicide and dinoseb were found; sequential and tank mixed treatments produced virtually identical alfalfa yields. Broadleaf weed control was not appreciably different between tank mixed and sequential treatments. Grass control was inhibited when either grass selective herbicide was applied in a tank mix with dinoseb in 1986 and 1988. Sequential treatments did eliminate much of this antagonism although in some instances a degree of antagonism was still present when dinoseb was applied before the grass selective herbicide.

Droplet composition was investigated as a factor influencing decreased grass control. Five µL droplets of spray solutions of dinoseb alone, dinoseb + fluazifop-P, and dinoseb + sethoxydim were applied to leaves of alfalfa, redroot pigweed (Amaranthus retroflexus L.) and barnyardgrass [Echinochloa crus-galli (L.) Beauv] to study the effects of droplet composition on spreading of the spray droplet. The results suggest that the greatly increased droplet spreading of the spray solution containing both a grass selective herbicide and dinoseb on barnyardgrass may contribute to reduced uptake of the grass selective herbicide by this species. The increased droplet size may reduce the concentration gradient across the leaf or physiologically isolate the material from the vascular system of the plant thereby decreasing uptake and subsequent translocation of the herbicide.

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SELECTIVE CONTROL OF WEED GRASSES IN NEW PLANTINGS OF TIMOTHY AND ORCHARDGRASS ALONE AND WITH ALFALFA

D.L. Linscott and R.H. Vaughan[1]

ABSTRACT

Annual grass weeds can inhibit establishment of perennial forage grasses. Field experiments were conducted in 1985 and 1986 to determine the effectiveness of fenoxaprop for annual grass weed control in seedling 'Climax' timothy (Phleum pratense L.), and 'Penlate' orchardgrass (Dactylis glomerata L.), each growing alone or in a mixture with 'Oneida' alfalfa (Medicago sativa L.). The purpose was to determine the stage of early development that the perennial grasses were most tolerant of fenoxaprop, concomitant with the most appropriate application rate of the herbicide.

Fenoxaprop was applied to both grass and grass-legume mixtures at 0, 0.08, 0.12, 0.16 kg/ha in 260 l/ha of water at 40 kPa pressure. Stage of growth at time of treatment follows:

		1st	2nd	3rd
1985	timothy	3 leaf	4 leaf	4 to 5 leaf
	orchardgrass	3 leaf	4 to 5 leaf	6 leaf
1986	timothy	2 to 3 leaf	4 leaf	5 leaf
	orchardgrass	2 to 3 leaf	4 to 5 leaf	6 leaf

For control of broadleaf weeds, all grass plots received a broadcast application of 2,4-D at 0.55 kg/ha and the alfalfa-grass plots received 0.8 kg/ha 2,4-DB in 1986 and 0.8 kg/ha bentazon in 1985. Forage yields and composition were determined the year of planting and the year following.

Fenoxaprop, at all doses applied, controlled the annual grasses satisfactorily in both timothy and orchardgrass alone or with alfalfa. The time for visible effect on the annual grass species was rate dependent, with the largest quantity of fenoxyprop (0.16 kg/ha) showing the most rapid and lasting effect. The lower rates of fenoxyprop (0.08 and 0.12 kg/ha) gave adequate control albeit with not as rapid effect.

Seedling orchardgrass tolerated fenoxyprop at all rates applied and stages of growth to the sixth true leaf, both when growing alone or with alfalfa. Seedling timothy compared to orchardgrass was more susceptible to fenoxyprop but still exhibited considerable tolerance. Fenoxyprop applied at 0.08 kg/ha at the 2 to 3 leaf stage was tolerated by timothy and it controlled the grass weeds sufficiently. The 0.16 kg/ha rate of fenoxyprop damaged seedling timothy but had no effect on timothy yields the year following planting.

In summary, fenoxaprop is a viable herbicide for selective control of annual grasses in new plantings of timothy or orchardgrass alone or in a mixture with alfalfa.

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BURCUCUMBER RESPONSE TO SULFONYLUREA HERBICIDES

H. P. Wilson and T. E. Hines

ABSTRACT

Separate studies were conducted in 1988 to determine the efficacy of DPX M-6316 and DPX V-9360 for postemergence control of burcucumber (Sicyos angulatus L.) in corn (Zea mays L.). DPX M-6316 was applied at 0.008 to 0.024 lb ai/A to 4-leaf corn and 3 to 4-leaf burcucumber on May 17. Initial corn injury consisting of chlorosis of the upper leaves was rapidly outgrown. Burcucumber control reached a high of about 95% at 2 WAT and did not differ between rates. Control diminished somewhat by late July due primarily to late emerging seedlings but remained above 80%. DPX V-9360 was applied at 0.016 to 0.048 lb ai/A to corn in the 3 to 4-, 5 to 6-, and 7 to 8-leaf stages and to burcucumber up to 10 inches in height at the last application. Although slow to develop, control was nearly complete from all rates and application timings. A natural population of common lambsquarters (Chenopodium album L.) present in this study was controlled to approximately 80% only from the two highest rates of DPX V-9360 applied early. Chlorosis to corn leaves was transient and occurred only from the first two application timings. Corn yields were highest from the early applications and probably reflect the degree of common lambsquarters control.

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POSTEMERGENCE WEED CONTROL IN CORN WITH CGA-136872 AND DPX-V9360

L. M. Kaufman and R. L. Ritter

ABSTRACT

In 1988, a number of field trials were conducted in Maryland to examine the postemergence activity of CGA-136872 and DPX-V9360 in corn (Zea mays L.). In particular, postemergence control of johnsongrass [Sorghum halepense (L.) Pers.], shattercane [Sorghum bicolor (L.) Moench], and triazine-resistant smooth pigweed (Amaranthus hybridus L.) were investigated.

Late-season ratings indicated that neither material provided an acceptable (≥80%) level of season-long johnsongrass control. When either herbicide was applied early-post (johnsongrass in the 3-4 leaf stage), abundant regrowth of the johnsongrass plants occurred, resulting in poor (≤60%) control late in the season. Late-post (johnsongrass in the 6-8 leaf stage) applications were more efficacious. Unfortunately, by then, the competitive nature of johnsongrass resulted in a poor stand of corn. In general, split applications of either product gave best johnsongrass control, with DPX-V9360 providing better control than CGA-136872.

For control of shattercane, both herbicides provided equally effective control. Rates of CGA-136872 or DPX-V9360, as low as 0.02 kg/ha, provided good (≥80%) shattercane control when evaluated 3 weeks after application.

Rates of DPX-V9360 from 0.02 to 0.07 kg/ha provided good control of triazine-resistant smooth pigweed for most of the growing season. No injury to the corn was observed and yields were not affected. With CGA-136872, there appeared to be a rate response regarding control of triazine-resistant smooth pigweed. Rates of 0.03 kg/ha or higher were necessary to provide good seaon-long control. No injury to the corn was observed with CGA-136872, and yields were not affected.

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INFLUENCE OF A CROWNVETCH LIVING MULCH ON DANDELION INVASION IN CORN

N. L. Hartwig[1]

ABSTRACT

The presence of crownvetch (Coronilla varia L. 'Penngift') resulted in a 74% reduction in the invasion of dandelion into no-tillage corn (Zea mays L.) when a short residual herbicide program didn't last long enough to control dandelion seedlings in late summer and fall. The dead mulch of winter rye reduced dandelion numbers 26% but a severe infestation still remained. Due the extreme drought in 1988, corn suffered severely, especially where dandelion were present in large numbers. Corn yields were only 7.4 Mg ha^{-1} for the no mulch treatment compared to 12.4 and 17.2 Mg ha^{-1} in a dead winter rye mulch and a living crownvetch mulch respectively. A crownvetch living mulch had a much greater influence on germinating dandelion seedlings in mid to late summer than the residue of a dead winter rye mulch. There was a trend toward fewer dandelion plants with increasing nitrogen levels but the differences were not significant.

INTRODUCTION

Crownvetch, in 15 years of research at The Pennsylvania State University, has proven to be an excellent perennial living mulch for corn and other crops (1,2,4,5). If managed correctly, it provides sufficient ground cover to almost eliminate soil erosion and surface water runoff without competing excessively with the corn. In fact, five to seven years after crownvetch establishment, no-till corn planted into crownvetch will usually outyield corn planted where there has never been a cover crop (5). The crownvetch needs to be suppressed chemically or mechanically early in the season to allow the corn crop to get ahead of it but it can and should be allowed to recover four to six weeks after corn planting. With crownvetch yields of 600 to 957 kg ha^{-1} by September, control of yellow nutsedge (Cyperus esculentus L.) was 60 to 100% relative to the same herbicide treatments without crownvetch (3). Yellow nutsedge is a perennial that gets started fairly late in the spring compared to most summer annual weeds and doesn't tolerate a lot of shading. The purpose of this research was to compare legume and winter rye (Secale cereale L.) cover crops for a corn-corn-oats-winter wheat/soybean rotation. The data presented in this paper was a chance observation of the effect of a crownvetch living mulch on the control of dandelion (Taraxacum officinale Weber in Wiggers) in no-tillage corn. Dandelion germinates all season long and apparently suffers severe stand reductions where competition is exerted from mid to late season. This rotation study was initiated in 1986 and the data was collected in 1988, two years into the study.

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MATERIALS AND METHODS

The crownvetch for this study was seeded on April 20, 1976 on a Murrill silt loam soil containing about 16% sand, 67% silt, 14% clay and 2.5% organic matter. The area was limed to a pH of 7.0 before seeding and it has been limed since to maintain a pH of about 7.0. A number of trials involving various crop rotations and herbicide treatments have been conducted in this trial area since 1976. Winter rye was broadcast seeded over the top of standing corn at a rate of 66 kg ha^{-1} on Sept. 2, 1987.

Corn 'Pioneer 3475' was planted in 76 cm rows with a 6-row John Deere Maxi-merge no-till planter on May 7, 1987 and May 9, 1988. A row fertilizer (110 kg ha^{-1} of 10-30-10) was applied with the planter followed by 0, 77, and 154 kg ha^{-1} of nitrogen sidedressed as UAN in a band between each corn row in June of both years.

Due to excessive dandelion, especially in the plots without crownvetch, and along with patches of quackgrass (Agropyron repens (L.) Beauv.), the whole trial area was treated with glyphosate [N-(phosphonomethyl)glycine] + 2,4-D ester [2,4-dichlorophenoxy)acetic acid] at 1.1 + 0.55 kg ha^{-1} on May 7, 1987. The dandelion was in bloom and the quackgrass had about 15 to 20 cm new growth. The crownvetch had just begun to break dormancy but was still small enough to not be drastically effected by this treatment. This treatment also took care of the winter rye cover crop. In an attempt to not suppress the crownvetch any more than necessary following the above treatment, a low residual herbicide program of cyanazine [2-((4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl) amino) -2-methylpropanenitrile] + pyridate (6-chloro-3-phenylpyridizine-4-yl-S-octyl carbonthioate) + metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide] at 1.1 + 0.5 + 1.1 kg ha^{-1} was applied on June 2, 1987 when the corn was in the 4 leaf stage and redroot pigweed and annual grasses were 0 to 10 cm. Because of the short soil residue of this treatment, dandelion germinating in mid to late summer were not chemically controlled.

In 1988, in anticipation of needing bentazon [3-(1-methylethyl)-(1H)-2,13-benzothiadiazin-4(3H)-one 2,2-dioxide] + atrazine [6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine] post for Canada thistle (Cirsium arvense (L.) Scop.) control, a low residual treatment of cyanazine + metolachlor at 1.1 + 1.1 kg ha^{-1} was applied May 10 preemergence to the corn. Paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) at 0.275 kg ha^{-1} was used on the winter rye plots only. These treatments had virtually no effect on the dandelion so 2,4-D amine at 0.275 kg ha^{-1} was added to 0.75 kg/ha^{-1} each of bentazon and atrazine applied on June 2 when the corn was in the five leaf stage and Canada thistle 20 to 30 cm. Due to the most severe drought in 100 years, the dandelion recovered but the more 2,4-D sensitive crownvetch was virtually wiped out. Out of fear of losing the trial, it was irrigated once with 50 l m^{-2} of water with an overhead irrigation system in late June.

The dandelion infestation was measured by stretching a 4.57 m (15 ft) tape down the middle of the center rows of a 4.57 by 6.7 m (15 by 22 ft) plot and counting the number of dandelion rosettes that touched the tape. Corn silage yields were determined by harvesting one of the four center rows in each plot after black layer formation and recording fresh weights. A sub-sample was saved from random plots for dry weight determination. An ANOV was run on dandelion numbers and corn silage yields with the SAS statistical package as a split-split-split plot design.

RESULTS AND DISCUSSION

The presence of crownvetch as a living mulch resulted in a 74% reduction in the numbers of dandelion plants relative to the same treatment with no cover crop. Winter rye reduced dandelion numbers 26% which was a significant reduction but a severe infestation still remained. In the no cover check, dandelion provided about a 75% ground cover which resulted in tremendous competition for moisture in 1988, the driest summer in 100 years. Corn yields were only 7.4 Mg ha^{-1} for this treatment compared to 12.4 and 17.2 Mg ha^{-1} in a dead winter rye mulch and a living crownvetch mulch respectively (Figure 1).

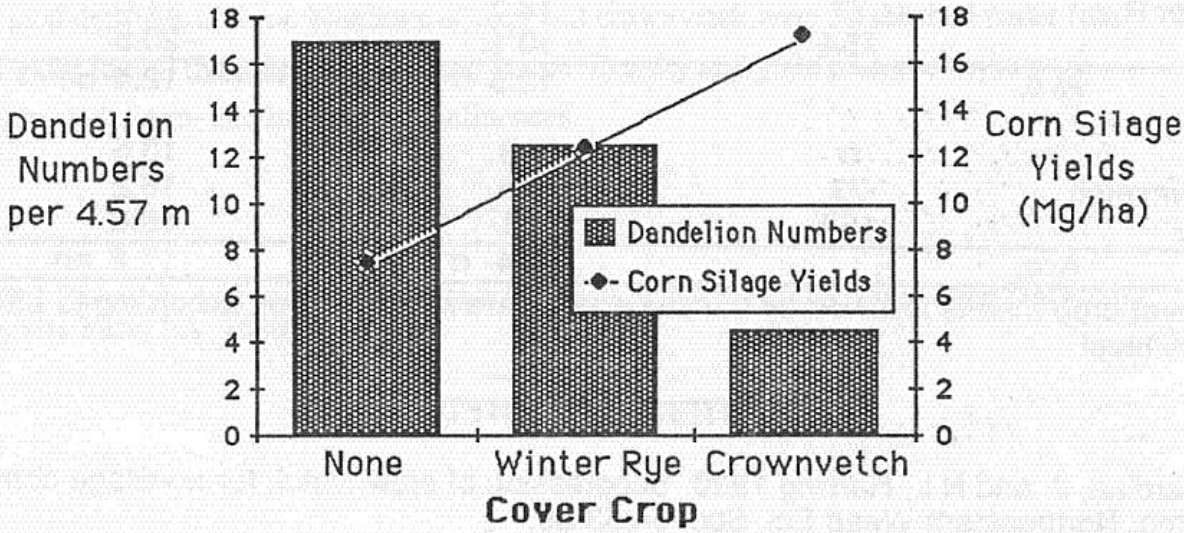

Figure 1. Influence of cover crop on dandelion invasion and corn silage yields.

Although winter rye left a dead mulch after being killed by the paraquat, the effect of the mulch and any allelopathic effect it may have had, resulted in only a small reduction in dandelion numbers.

The nitrogen rate had no effect on dandelion numbers although in the absence of crownvetch the corn growth and presumably competition was increased with added nitrogen (Table 1). In the presence of crownvetch, corn growth and competition was not influenced much by nitrogen.

A crownvetch living mulch had a much greater influence on germinating dandelion seedlings in mid to late summer than the residue of a dead winter rye mulch. Dead mulches may have a bigger influence on germination of weed seedlings early in the season but apparently very little by mid to late season when most of the residue has been broken down by soil microorganisms.

Table 1. Dandelion numbers and corn silage yields for three rates of nitrogen with no cover crop, in dead winter rye mulch or crownvetch living mulch.

Cover Crop	Nitrogen Rate	Dandelion Numbers	Corn Silage Yields
	kg/ha	per 4.57 m	Mg/ha
	0	18.9	3.1
None	77	14.9	9.4
	154	17.3	9.8
Ave.		17.0 a[a]	7.4 c
	0	15.1	5.3
Winter Rye	77	12.3	11.0
	154	10.1	20.8
Ave.		12.5 b	12.4 bc
	0	7.8	13.5
Crownvetch	77	3.4	18.2
	154	2.1	19.8
Ave.		4.4 c	17.2 ab

[a] Cover crop means followed by the same letter are not significant according to LSD at 5% level.

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INVESTIGATIONS INTO WEED SUPPRESSION USING AN INTERCROP OF CORN AND CROWNVETCH

James C. Loughran and N.L. Hartwig[1]

ABSTRACT

An addition series experiment was used to investigate the hypothesis that the association between crownvetch (Coronilla varia L.), when managed as a living mulch, and corn (Zea mays L.) is favorable to corn when the two species are intercropped together under a weed stress. Various total densities and combinations of corn and crownvetch were established under four levels of giant foxtail (Setaria faberi Herrm.) stress. Density and yield measurements were collected to study intra- and interspecific influences.

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ALLELOPATHIC EFFECTS OF PHENOLIC ACIDS ON PEANUT AND RADISH

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ABSTRACT

Gallic, ferulic, and vanillic acids are phenolic compounds known to be allelopathic agents. The allelopathic effects of these acids on germination of on radish (Raphanus sativus L.) and peanut (Arachis hypogaea L.) were examined. Root and shoot length and dry weight were used to determine the effects of these compounds on radish and peanut seedlings. Germination experiments were conducted in petri dishes at 25° C in the dark. Acid concentrations of 0, 5×10^{-5}, 1×10^{-4}, 5×10^{-4}, 1×10^{-3}, 5×10^{-3}, and 1×10^{-2} M were used. Root and shoot lengths of 15 seedlings replicated 6 times were measured at 5 and 10 days after treatment for radish and peanut respectively. Statistical analysis using orthogonal contrasts showed that there was a significant effect of the phenolic acids on inhibition of seed germination at the concentrations of 5×10^{-4} M and above. Root elongation of both plants was also inhibited by the same concentrations.

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EVIDENCE FOR INCREASED HERBICIDE DETOXIFICATION IN TRIAZINE-TOLERANT VELVETLEAF

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ABSTRACT

The physiological basis for triazine insensitivity in a Maryland velvetleaf (*Abutilon theophrasti* Medic.) population was investigated. Assays of thylakoid response, quantum yield of photosynthesis, and chlorophyll a fluorescence in the presence of atrazine were used to compare the Maryland plants with susceptible New York velvetleaf. Thylakoid sensitivity to atrazine, coupled with a recovery of photosynthesis in treated Maryland plants suggests that triazine tolerance in the insensitive velvetleaf is the result of an increased rate of herbicide detoxification.

INTRODUCTION

Velvetleaf is a major cause of economic loss in nearly every agricultural region of the United States. It was estimated in 1984 that velvetleaf infestations in soybean and corn accounted for annual losses totaling approximately $343 million (17). As a result, velvetleaf control is of major concern to agricultural and weed science communities. The triazine herbicides have played an important role in the control of velvetleaf in corn. Recently, however, the first published account of triazine "resistance" in velvetleaf was reported from Maryland (12).

Resistance to the triazine herbicides is not uncommon among weed species. Since the first documented occurrence of a triazine-resistant weed in 1970 (13), 37 other weed species have been reported to possess triazine-resistant biotypes (9). In every case, the mechanism of resistance was found to be the result of an amino acid substitution in the herbicide-binding protein of PSII (5). This alteration decreases the affinity of the protein for triazine molecules, thereby maintaining the flow of electrons through PSII during photosynthesis (18).

Studies involving reciprocal crosses of triazine-susceptible and -resistant biotypes showed that only resistant female parents produced resistant progeny (16). It was concluded from this work that triazine resistance is maternally inherited through cytoplasmic DNA. Recently, Andersen and Gronwald (1) produced similar crosses of triazine-susceptible velvetleaf from Minnesota and "resistant" plants from Maryland. They found that all hybrid velvetleaf plants showed an intermediate response to atrazine. Based on these results, they suggested that the Maryland population of velvetleaf, described by Ritter (12) as triazine-resistant, should more accurately be called triazine-tolerant.

Although corn and other grass species exhibit decreased susceptibility to the triazine herbicides, they are much more sensitive than resistant plants. As a result, they are commonly considered to be triazine-tolerant (4). In these cases, the mechanism of tolerance is associated with an increased rate of triazine degradation to non-phytotoxic metabolites. This has been shown to occur primarily by conjugation

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with glutathione (8, 21).

The objective of these experiments was to determine the physiological basis for the reduction in velvetleaf sensitivity to the triazine herbicides and to propose a possible mechanism of tolerance.

MATERIALS AND METHODS

Plant Materials. Velvetleaf seeds from the triazine-insensitive Maryland population and from a susceptible New York population were germinated and grown under greenhouse conditions. Plants were watered as necessary and fertilized once a week.

Thylakoid Studies. Stroma-free thylakoid membranes were isolated from leaves of 5 week old plants according to the methods of Stowe and Holt (20). Rates of oxygen evolution produced by a photon flux density of 500 μmol photons$\cdot m^{-2} \cdot s^{-1}$ were measured with an electrode before and after the addition of atrazine to each sample. Results are plotted as the percent of the control rate of oxygen evolution versus atrazine concentration.

Photosynthetic Efficiency. Four week old velvetleaf plants were treated with atrazine 80W at 6.7 kg ae/ha. At various time intervals, excised circular leaf discs were placed in an oxygen electrode. Rates of oxygen evolution were measured following exposure to light at varying photon flux densities. The slope of this line was used to calculate the photosynthetic efficiency (quantum yield) in atrazine treated and untreated velvetleaf biotypes.

Fluorescence Studies. Four week old plants were treated with 3.4 kg ae/ha atrazine 80W. Chlorophyll a fluorescence yield was measured on attached leaves at 24 h intervals over a five day period using a fluorometer. The initial dark-adapted fluorescence levels (Fo) and the maximal level produced after three saturating light flashes (Fm) were calculated and presented as the ratio Fm/Fo. This ratio corresponds to the activation state of PSII and reflects the relative photosynthetic capacity of a plant (7).

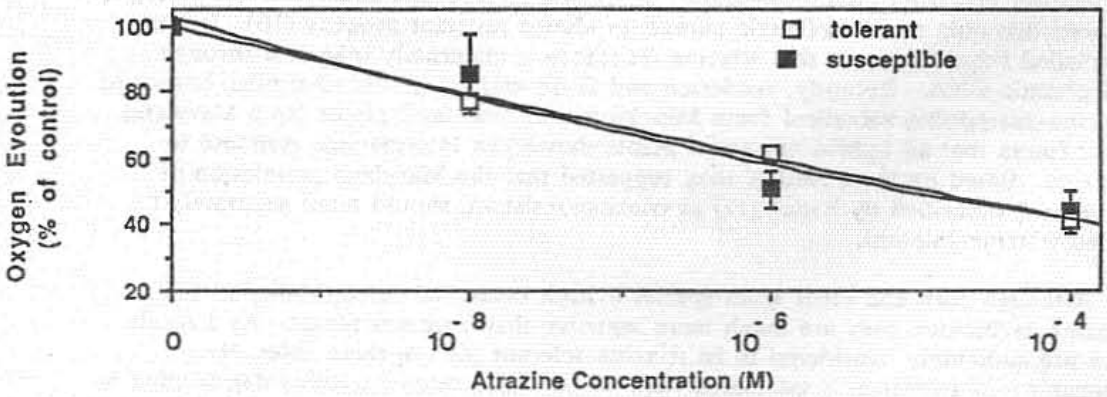

Fig. 1. Inhibition of photosynthetic electron transport by atrazine in chloroplast thylakoids isolated from triazine-tolerant and -susceptible biotypes of velvetleaf. Measurements were replicated at least four times. Bars represent ± SE about the mean. Curve fit to the second degree polynomial.

RESULTS

In our initial experiment, we measured the effect of atrazine on isolated thylakoids. Photosynthetic oxygen evolution in thylakoids from both tolerant and susceptible velvetleaf biotypes was inhibited to a similar extent by atrazine (Fig. 1). The I_{50} value for both biotypes was approximately 10 μM.

In Fig. 2, we measured the change in photosynthetic efficiency over time in excised leaf discs of the velvetleaf biotypes. In the absence of atrazine, tolerant and susceptible velvetleaf plants were similar in their response. Atrazine treatment produced an initial inhibitory effect in both biotypes, reducing photosynthetic efficiency by 75% 2 days after treatment. However, the photosynthetic efficiency of the tolerant Maryland velvetleaf completely recovered after 5 days of treatment.

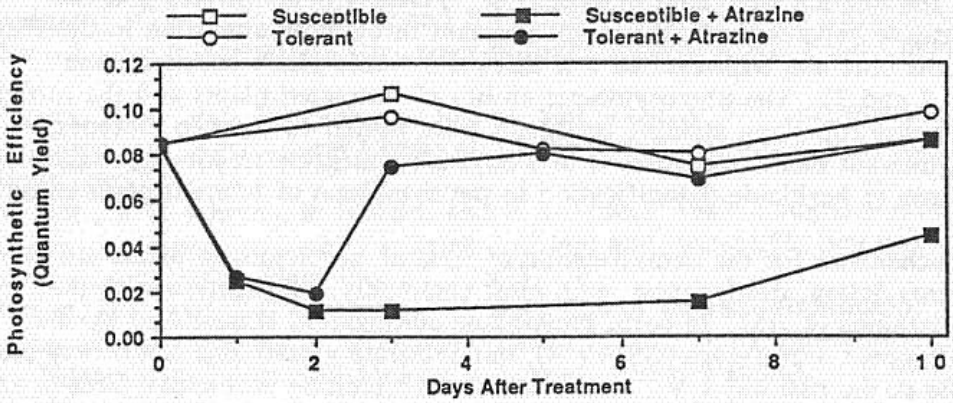

Fig. 2. Photosynthetic efficiency as a measure of oxygen evolution in excised leaf discs of greenhouse-grown triazine-tolerant and -susceptible velvetleaf. Each point represents the slope of the rate of oxygen evolution at several photon flux densities.

Results of fluorescence measurements in intact plants support our findings in the preceding experiment. We measured only a slight difference in the photosynthetic capacity of untreated plants of both triazine-susceptible and -tolerant velvetleaf (Fig. 3). As was observed in Fig. 2, the initial inhibition in photosynthetic capacity in both biotypes was followed by a recovery in the tolerant biotype 3 days after treatment. In contrast, the photosynthetic capacity of the susceptible plants continued to decrease throughout the experiment.

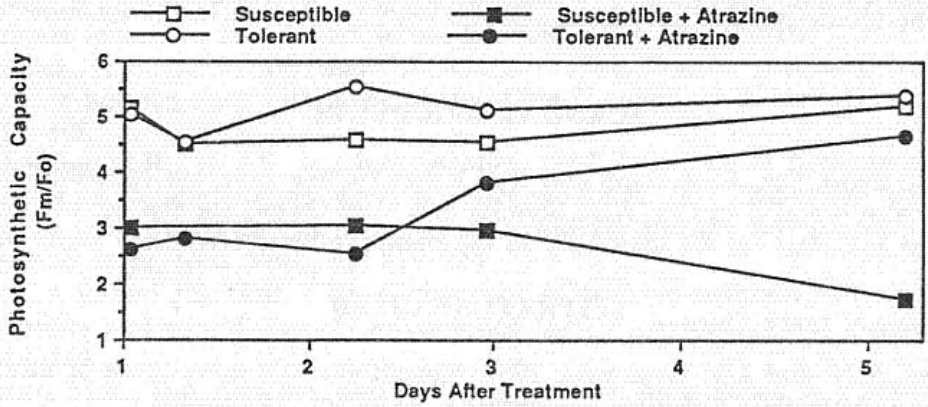

Fig. 3. Photosynthetic capacity as a calculation of fluorescence levels in attached leaves of dark-adapted atrazine treated and untreated triazine-tolerant and -susceptible velvetleaf. Each point represents measurements from one to three leaves of a single plant.

DISCUSSION

The results from several laboratories (3, 6, 10, 11) have shown that the photosynthetic response of triazine-resistant biotypes differ in two ways from that of susceptible biotypes. First, triazine herbicides have no inhibitory effect on photosynthesis in resistant biotypes. Second, photosynthetic efficiency in untreated plants of resistant biotypes is always less than that of susceptible biotypes. Since the biotypes differ by a mutation in a chloroplast protein, these responses are evident in assays using whole plants, leaf discs, or isolated thylakoids. In contrast, the photosynthetic responses of tolerant biotypes are similar to those of susceptible plants, but change over time and differ from one tissue to another.

In our experiments, the inhibitory effect of atrazine on oxygen evolution in isolated thylakoids of the tolerant Maryland biotype (Fig. 1) clearly demonstrates that the triazine-insensitive velvetleaf plants are not resistant through an alteration in the PSII protein. Results obtained with excised leaf discs and whole plants support these findings (Fig. 2 and 3). The photosynthetic ability of untreated plants and the initial inhibitory response following atrazine treatment were similar in the two biotypes. Furthermore, tolerant plants recovered 3 to 5 days after atrazine treatment, suggesting an increased rate of herbicide detoxification in the cytoplasm of tolerant plant cells.

Several mechanisms for the detoxification of triazine herbicides in plants are known, including hydroxylation, dealkylation, and, most commonly, conjugation with the tripeptide glutathione (8, 15). In corn, glutathione conjugation is mediated by the enzyme glutathione-s-transferase (GST) (14), but substrate glutathione levels may play a regulatory role in the pathway (19). With the chloroacetanilide herbicides, Breaux and coworkers (2) found that increased tolerance of crops and weeds was directly related to glutathione levels. They reported a relatively high concentration of glutathione in moderately susceptible velvetleaf, and suggested that increased levels of this substrate may enhance detoxification of these herbicides through conjugation.

The results presented here indicate that velvetleaf is tolerant and not resistant to the triazine herbicides and, thus, supports the findings of Andersen and Gronwald (1). In addition, we propose that triazine tolerance in the Maryland population of velvetleaf is perhaps due to either a triazine-active GST or an increase in endogenous levels of glutathione. The degree of tolerance in velvetleaf would be directly related to the level at which this mechanism is active. In future studies, we will attempt to elucidate the mechanism of triazine detoxification in velvetleaf, and determine the effect of the alteration in herbicide metabolism on growth and seed production in the tolerant biotype.

ACKNOWLEDGEMENTS

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ANALYSIS OF WATER SAMPLES FOR TRIAZINE AND ACETANILIDE HERBICIDES FROM SELECTED WATER SHEDS IN VIRGINIA

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ABSTRACT

Water samples from across Virginia were collected, from selected water sheds. These well and stream samples, which were taken from major corn growing areas, were analyzed for several widely used corn herbicides. These herbicides included atrazine, simazine, cyanazine, alachlor, and metolachlor.

The objective of this study, was to determine if detectable amounts of these herbicides could be found in these water sheds. Seven sites were selected, and three well samples and one stream sample were collected from each site. Samples were collected twice during the growing season, once in May just after herbicide application and then again in late August. The three wells from each site, represent different locations along the water shed. These locations included an upper well, which was above the corn field in the water shed, a middle well which was adjacent to the corn field, and a lower well below the site of application. In each case the stream ran through the water shed, and a sample was taken from the lower end of the water shed. Each 600-ml sample was extracted using methylene chloride and quantified using gas chromatography.

Results indicated that, of the samples taken in May, 16 wells and 6 streams contained low levels of triazine herbicides. These samples ranged from a high of 16.2 ppb to less than 1 ppb. Seven samples contained trace amounts of alachlor, less than 1 ppb. From the samples taken in August, only 10 well samples and 4 streams contained any triazines. No alachlor or metolachlor was found in the samples taken in August. Most of the samples which contained triazines in May also contained some triazines in August, but usually in smaller amounts.

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AN INTRODUCTION TO THE 'NEIGHBORHOOD STUDY' TECHNIQUE

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ABSTRACT

Development of economic thresholds for weed management is dependent in part upon understanding crop and weed interactions such that crop loss can be predicted. Relationships between weeds and crop loss are commonly studied on the population level. An alternative is the neighborhood study,which looks at the performance of a target (crop) plant in relation to its neighbors (weeds). The influence of neighbor number, biomass, coverage, and proximity on the target plant can be examined with this technique. The authors wish to review the development of the neighborhood study, and to illustrate several published neighborhood models using data from a preliminary investigation of the interaction between corn (Zea mays L.) and common lambsquarters (Chenopodium album L.).

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GROWTH OF JOHNSONGRASS FROM VEGETATIVE BUDS

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ABSTRACT

Controlled environment studies were initiated to evaluate the growth of johnsongrass [Sorghum halepense (L.) Pers.] from vegetative buds. In greenhouse studies, regrowth of 30- or 45-cm high johnsongrass derived from seed or 4-node rhizome segments was evaluated following clipping just above the first stem node. Regrowth occurred almost exclusively from the first stem node and crown of johnsongrass. Single shoots grew from the stem node of 97% of the clipped plants, but only 14% from unclipped plants. Shoot production from the crown of clipped johnsongrass was almost 3-times greater than that of unclipped plants. The crown of the unclipped seedling johnsongrass was more developed than the unclipped rhizome plants, producing 60% more new shoots and 59% more rhizome spurs. However, clipped rhizome johnsongrass averaged 2.1 shoots/crown and clipped seedling johnsongrass averaged 1.7 shoots/crown. This suggests that carbohydrates are remobilized from the mother rhizome into the crown. Microscopic evaluation of the bud in the first stem node showed that the bud started to expand within 3 days after clipping the main culm, but mature vascular connections were not present until 5 days after clipping, Thus, vegetative buds do not become a sink for carbohydrates and herbicides until 5 days after destruction of the main culm. In field studies, mowing 24 h following applications of 0.07, 0.13, or 0.19 kg ai/ha fluazifop reduced regrowth of johnsongrass compared to the regrowth from plants treated with fluazifop and not mowed. The rapidly translocated fluazifop was probably remobilized into vegetative buds following the development of vascular connections in response to clipping.

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CONTRIBUTION OF CROWNVETCH WITH AND WITHOUT TILLAGE TO REDROOT PIGWEED CONTROL IN CORN

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ABSTRACT

Crownvetch (Coronilla varia L. 'Penngift') was established in 3.8 m strips alternating with two other legumes as living mulches and a no mulch check on July 20, 1973. A number of trials related to the use of living mulches have been conducted in the trial area since 1974. In 1985 a new set of treatments were imposed on this area including four tillage practices; no-till, conventional and two minimum tillage treatments at right angles to the legume strips. The influence of crownvetch and tillage on the growth and competition of redroot pigweed (Amaranthus retroflexus L.) was the objective of this research.

Crownvetch did not contribute anything to the control of redroot pigweed regardless of the tillage practice used. It would appear that recovery of crownvetch from early season suppression is too slow to have any effect on summer annual weed growth and competition. The presence of crownvetch also had no effect on the stand, height or yield of corn (Zea mays L.). It would seem that any cover crop that could suppress the growth of summer annual weeds might also have the same effect on a summer annual crop such as corn. This is in contrast to results obtained for the competitive control of the perennial weeds yellow nutsedge (Cyperus esculentus L.) and dandelion (Taraxacum officinale Weber in Wiggers) in other research at Penn State.

INTRODUCTION

Crownvetch, in 15 years of research at The Pennsylvania State University, has proven to be an excellent perennial living mulch for corn and other crops (1,2,4,6). If managed correctly, it provides sufficient ground cover to almost eliminate soil erosion and surface water runoff without competing excessively with the corn. In fact, five to seven years after crownvetch establishment, no-till corn planted into crownvetch will usually outyield corn planted where there has never been a cover crop (6). The crownvetch needs to be suppressed chemically or mechanically early in the season to allow the corn crop to get ahead of it but it can and should be allowed to recover four to six weeks after corn planting. With crownvetch yields of 600 to 957 kg/ha by September, control of yellow nutsedge was 60 to 100% relative to the same herbicide treatments without crownvetch (3). Yellow nutsedge is a perennial that gets started fairly late in the spring compared to most summer annual weeds and doesn't tolerate a lot of shading. The purpose of this research was to determine whether a crownvetch living mulch will provide similar control of a summer annual such as redroot pigweed which germinates about the same time corn is planted. A study to determine the influence of tillage and crownvetch on weed control and weed invasion was initiated in 1985. The data presented in this paper was collected in 1986 and 1987, one and two years into the study.

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MATERIALS AND METHODS

The crownvetch for this study was seeded on July 20, 1973 along with two other legumes as living mulches and a no mulch check on a Hagerstown silt loam soil containing about 10% sand, 67% silt, 20% clay and 2.5% organic matter. The area was limed to a pH of 7.0 before seeding and it has been limed since to maintain a pH of about 7.0. A number of trials involving various crop rotations and herbicide treatments have been conducted in this trial area since 1974. In 1985 a new set of treatments were imposed on this area including four tillage practices.

Three primary tillage practices included a moldboard plowing, heavy offset disking or chisel plowing within two weeks of corn planting followed by secondary tillage with a tandem disk. A fourth tillage practice included no-tillage.

Corn 'Pioneer 3475' was planted in 76 cm rows with a 6-row John Deere Maximerge no-till planter on May 14, 1986 and May 8, 1987. No attempt was made to adjust the depth of planting when planting through different tillage treatments.

A row fertilizer (110 kg ha^{-1} of 10-30-10) was applied with the planter followed by 168 kg ha^{-1} of nitrogen broadcast in the form of ammonium nitrate in 1986 and urea in 1987.

The whole trial area was treated with cyanazine [2-((4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl) amino) -2-methylpropanenitrile] + metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide] + pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] at 1.1 + 1.1 + 1.1 kg ha^{-1} on May 19, 1986 after the tillage operations and preemergence to the corn. Due to excessive dandelion, especially in the no-till plots without crownvetch, 2,4-D ester [(2,4-dichlorophenoxy)acetic acid] at 0.55 kg ha^{-1} was tank mixed with the above treatment. Because of the same problem in 1987, along with patches of quackgrass (Agropyron repens L.) and orchardgrass (Dactylis glomerata L.), the whole trial area was treated with glyphosate [N-(phosphonomethyl)glycine] + 2,4-D ester at 1.1 + 0.55 kg ha^{-1} on May 7, 1987. The dandelion was in bloom and the quackgrass and orchardgrass had about 15 to 20 cm new growth. The crownvetch had just begun to break dormancy but was still small enough to not be drastically effected by this treatment. No other herbicide treatment was applied in 1987.

Plot size was 3.8 by 6.1 m with five rows of corn per plot. Redroot pigweed, fall panicum and crownvetch dry matter yields were determined by harvesting a 0.5 m^{-2} area from the center of each plot in mid-August after corn pollination. Random sub-samples of each species were saved for dry weight determination. Corn stand and height measurements were made from the center three rows of each plot in late July each year. Corn yields were determined by harvesting the same center three rows with a mechanical picker-sheller.

The data was analyzed by ANOV with the SAS statistical package as a split-block-split plot design.

RESULTS AND DISCUSSION

In 1986, the chemical weed control was so good there was little room for any additional control by the crownvetch living mulch. In no-till corn, there was a trend toward improved redroot pigweed control in the presence of crownvetch but nothing close to being significant. The chemical weed control was even better in the heavy disked and chisel plowed plots with almost perfect weed control in the conventional tilled plots without the help of any competition from the crownvetch (Table 1).

Table 1. Redroot pigweed, fall panicum, crownvetch and corn yields with and without crownvetch for four tillage practices in 1986 and 1987.

1986 Mulch	Tillage	Redroot Pigweed	Fall Panicum	Crown-vetch	Corn Stand	Corn Height	Corn Yield[a]
		<----lbs dry matter/A---->			(plants/A)	(cm)	(bu/A)
No Mulch	No-Till	415	129	19	20500	175	137
	Heavy Disk	80	9	34	20100	177	155
	Chisel Plow	47	22	27	20400	180	153
	Conv. Till	0	3	7	20500	170	144
Crown-vetch	No-Till	215	125	185	22300	175	152
	Heavy Disk	44	3	181	19800	173	142
	Chisel Plow	89	10	80	20600	176	146
	Conv. Till	7	3	15	20100	165	144
Probability level[b]		0.7222	0.6526	0.1069	0.5506	0.9699	0.3236
LSD (.05)		515	96	156	1674	6	17

1987 Mulch	Tillage	Redroot Pigweed	Fall Panicum	Crown-vetch	Corn Stand	Corn Height	Corn Yield
		<----lbs dry matter/A---->			(plants/A)	(cm)	(bu/A)
No Mulch	No-Till	716	48	55	19000	92	54
	Heavy Disk	817	21	41	22300	95	65
	Chisel Plow	829	32	14	21000	95	76
	Conv. Till	524	80	7	24500	102	97
Crown-vetch	No-Till	772	299	82	17700	94	58
	Heavy Disk	879	16	89	24100	98	48
	Chisel Plow	981	59	34	21600	97	59
	Conv. Till	795	85	20	22300	101	78
Probability level[b]		0.7485	0.6720	0.9138	0.0082	0.4613	0.9202
LSD (.05)		622	120	53	2042	6	29

[a] Shelled corn yields at 15.5% moisture.
[b] Probability level of the treatment not having an effect.

In 1987, except for an early treatment of glyphosate + 2,4-D, no residual herbicides were applied so greater weed pressure could be ensured. The 2,4-D did result in the early suppression of crownvetch which is necessary to allow the corn time to become established (1). The redroot pigweed pressure was indeed heavy in 1987 and it was quite clear crownvetch contributed nothing to its control regardless of the tillage practice used. Although there was much less fall panicum pressure, crownvetch had no effect on its growth either (Table 1).

It would appear that recovery of crownvetch from early season suppression is too slow to have any effect on summer annual weed growth and competition. This is perhaps logical, since crownvetch that would compete with summer annual weeds would probably also compete with the corn. In both years of this trial, it is important to note that crownvetch had no adverse effect on the growth and yield of corn. The suppression of corn height and yield in 1987 relative to 1986 was due to increased weed pressure. Crownvetch can have a competitive effect on yellow nutsedge (3) and dandelion however (5). Yellow nutsedge is apparently susceptible to competition in midsummer and fall after crownvetch has had a chance to recover. The same must be true for the germination and survival of dandelion seedlings.

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WEEDS OF THE SARATOGA NATIONAL HISTORICAL PARK (SNHP)

R. Stalter[1] and Patrick Lynch[2]

ABSTRACT

The weedy taxa of Saratoga National Historical Park (SNHP) were collected and identified during a vegetation inventory of the park during the growing seasons of 1987-1988. Ninety weedy taxa, twenty two percent of the park flora, have been identified. The most abundant weedy taxa are cornflower, *Centaurea spp., loostrife *Lythrum salicaria, brome grass Bromus spp., clover Trifolium spp., dandelion Taraxacum officinale, thyme Thymus serpyllum hawkweed, Hieracium spp. plantain Plantago spp., and red sorrel Rumex acetocella. Tartarian honeysuckle, Lonicera tararica is the most abundant alien woody species in the park.

INTRODUCTION

Saratoga National Historical Park, comprising 1088 ha (2667 acres), is located in Saratoga County New York (latitude 43 00'; longitude 73 38'). The Park is the site of the Battles of Saratoga 1777 which resulted in the defeat of Burgoyne's army. This battle was the most important early victory of the Colonial Army against Britain as the defeat of Burgoyne was instrumental in the recognition of the Americans by France and Spain.

At the time of the battle, 1777, the bottomlands by the Hudson were generally farmed while few farms had been established on the wooded upland sites (Gordon 1987). Lieutenant Wilkinson, an engineer for the British Army prepared a map of the battle. Wilkinson's map of the battlefield shows the area bordering the Hudson as farmland while the area west of the Albany Road (with the exception of Freeman's Farm) as almost entirely forested.

Accounts of the battle indicate that much of the battlefield was covered with woods and/or shrub growth. The slopes of the ravines had been cleared of trees (Gordon 1987) though shrubs were well established on ravine slopes. The growth of the shrubs was so dense that trees did "not have an opportunity to get started." The ravines were so swampy that no effort would have been made by the settlers to clear them.

Portions of the battle site probably contained assorted hardwood species. Gordon (1987) contends that if selective logging had removed the preferred oaks, chestnuts and a few hickories, then poorly formed oaks, red maples, elms, butternuts (Juglans cinera) and basswoods would have been left behind. All of the aforementioned species are present today.

The primary objective of the present study is to identify the exotic weeds of the park. A second objective is to address management questions regarding species composition and dominance and to ascertain specific management options for the manipulation and/or removal of exotic flora at the park. A third objective is to determine a workable definition of the term exotic, since "exotic" species are "weeds" at SNHP.

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Climate

The Park is near the Adirondack Mountain region where the influence of northern mountain climate is manifested by cool summers and relatively long cold winters. The average annual temperature is 7.8 degrees C. Precipitation averages 0.89 m and is fairly evenly distributed throughout the year. Snowfall averages 1.57 m a year and generally covers the ground from November through March.

Geology and Soils

The majority of the Park consists of the Battlefield Unit which lies on rolling hills rising from the alluvial floodplain along the Hudson River. Elevations range from 26 m above sea level along the river to 124 m at the top of Fraser Hill. Numerous glacial ridges and ravines drain east into the Hudson River.

A relatively low but steep escarpment marks the boundary between the hills and the alluvial floodplain of the Hudson River. Soils along the Hudson are often wet and swampy consisting of alluvial clays and loams. The hills rising from the river flats are gravel topped with sands of various descriptions. At a distance of 610m to 732 m west of the escarpment, the sandy character of the soil changes to clay loam with the higher ridges composed of gravel, outcroppings of shale, bedrock and occasional boulders.

Most of the sandy areas near the Hudson are underlaid with clay and deep drainage is poor. Drainage in the clay loam soils is even poorer; surface water often forms ponds and marshes. Twelve major soil associations have been identified. (Soil Conservation Service, in press, 1988).

METHODS

During the growing seasons of 1987-1988, a vegetation inventory of the entire park was conducted and the exotic and natural vegetation identified. A list of exotic species is found in Table 1. A workable utilitarian definition of the term exotic was prepared by consulting 30 scientists who are experts in the field of weed science. Nine of these individuals responded and included the names of species they thought best fit their definition of an exotic species in the northeastern United States in the vicinity of SNHP (Table 2). Native and alien taxa are classified according to Gleason and Cronquist (1963), while nomenclature of cultivated plants follows Bailey (1949).

RESULTS AND DISCUSSION

Of the four hundred five plants species identified at SNHP, ninety plants are not native to the United States. The most abundant of these weeds are Centaurea maculosa, Lythrum salicaria, Bromus spp., Trifolium spp., Taraxacum officinale, Hieracium spp., Melilotus spp., Thymus serpyllum, Daucus carota, Achillea millefolium, Plantago spp., and Rumex acctosella.

Phragmitis australis, Lythrum salicaria, Taraxacum officinale were mentioned by four scientists as troublesome exotic weeds; four individuals also mentioned native Rhus radicans, a native species as a noxious weed. Agropyran repens, Portulacca oleracea, Ailanthus altissima, Glechoma hederacea, Polygonum cuspidatum and Galisoga parviflora were noted by two individuals (Table 2).

Fields comprise 297 ha of the Saratoga Historical Park. All fields are bush-hogged on a rotating basis once every two years. The most common weeds in the fields

are cornflower Centaurea spp., Achillea Achillea millefolium, chrysanthemum Chryanthemum leucanthemum, chichory Cichorium intybus, bouncing bet Saponaria officinalis, Lotus corniculatus, sweet clover Melilotus spp., clover Trifolium spp., St. John's Wort Hypericum perforatum, Japanese knotweed Polygonum cuspidatum, red sorrel Rumex acetocella, five-finger Pontentilla recta, wooly mullein Verbascum thapsus, Queen Ann's lace Daucus carota, teasal Dispsacus sylvestris, and Orientel bittersweet Celastrus orbiculatus. Additional weeds are listed in Table 1.

Mowed portions of the park, comprising 5.24 ha, include roadside right-of-way, memorial areas and the lawn at the visitors center. Taraxacum officinale, Trifolium spp., wood rush Luzula campestris var. multiflora and various members of the Lamiaceae and Plantaginaceae families are the most common weeds in mowed areas of the park. The mowed portions of the park will be mowed in the future. Weeds present in mowed portions of S.N.H.P. today will most probably be present in the future.

The gardens at the Visitor's Center comprise the smallest portion of S.N.H.P. (0.25 ha). Common weeds in the gardens disturbed sites are: carpet weed Mollugo verticillata, Red sorrel, Rumex acetocella, crab grass Digitaria ischaemum, Digitaria sanguinalis, foxtail grass Seteria faberii and members of the Brassicaceae and Caryophylaceae families.

Woods make up the largest percentage of park lands and comprise 786 ha (68%) of the park. Tree species present during the time of the battle are common at the park today, though chestnut, Castanea dentata is represented by an occasional stump sprout. Exotic trees make up only a small portion of the trees present today and include Norway maple Acer negundo, white mullberry Morus alba and buckthorn Rhamnus catharticus. Tartarian honeysuckle Lonicera tartarica is the most abundant exotic woody plant in the park. Oriental bittersweet Celastrus orbiculatus is occasionally present in wooded sites and in open fields.

A plan of vegetation management for the fields of SNHP has been prepared. The fields should be burned in late March to late April following the procedures developed by Niering and Goodwin (1974) and Niering (1983). Fields at the Connecticut Arboretum at Connecticut College burned from 8-12 times from 1968 to 1983 are dominated by Andropogon scoparius whereas on the unburned contiguous controls tree and shrub cover has progressively increased.

Permanent line transects have been established in fields at SNHP. The line transects originate at mile markers on the road that tranverses the park and extend into the fields following a predetermined compass line so that the transects are perpendicular to their point of origin. Permanent quadrats (20 x 100 cm) have been established on the line transects at 5m intervals beginning at a point 10m from the edge of the road. Vegetation in ten fields at SNHP was sampled by the quadrat method in late July and early August 1988. The data from this preliminary study will serve as baseline data when the fields are sampled again in 1989, 1991, 1993 and 1998.

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Table 1 Exotic vegetation of Saratoga Historical Monument, Saratoga County, New York. The concept of families follows that of Cronquist, 1981.

PTERIDOPHYTA

ACERACEAE
Acer negundo

AIZOACEAE
Mollugo verticillata

APIACEAE
Daucus carota
Pastinaca palustris

APOCYNACEAE
Vinca minor

ASTERACEAE
Achillea millifolium
Centauria maculosa
Chrysanthemum leucanthemum
Cichorium intybus
Hieracium aurantiacum
Hieracium floribundum
Hieracium pilosella
Hypochaeris radicata
Lactuca scariola
Sonchus asper
Taraxacum officinale
Tragopogon pratensis
Tragopogon dubius
Tussilago farfara

BORAGINACEAE
Echium vulgare

BRASSICACEAE
Alliaria officinalis
Barbarea vulgaris
Brassica hirta
Lepidium campestre

CAMPANULACEAE
Campanula rapunculoides

CAPRIFOLEACEAE
Lonicera tartarica

CARYOPHYLLACEAE
Arenaria serpyllifolia
Cerastium vulgatum
Dianthus armeria
Lychnis alba
Saponaria officinalis
Stellaria graminea

CELASTRACEAE
Celastrus orbiculatus

CHENOPODIACEAE
Chenopodium album

DIPSACACEAE
Dipsacus sylvestris

FABACEAE
Lathyrus latifolius
Lotus corniculatus
Melilotus alba
Melilotus officinalis
Trifolium agrarium
Trifolium arvense
Trifolium hybridum
Vicia cracca

GERANIACEAE
Geranium molle
Geranium pratense

HUMULACEAE
Cannibus sativa

HYPERICACEAE
Hypericum perforatum

LAMIACEAE
Glecoma hederacea
Lamium amplexicaule
Leonoris cardiaca
Mentha piperita
Prunella vulgaris
Thymus serpyllum

LYTHRACEAE
Lythrum salicaria

MORACEAE
Morus alba

PLANTAGINACEAE
Plantago major
Plantago lanceolata

POACEAE
Agrostis stolonifera
Aira caryopyllea
Anthoxanthum odoratum
Bromus inermis
Bromus japonicus
Danthonia spicata
Digitaria ischaemum
Digitaria sanguinalis
Festuca elatior
Glyceria fluitans
Holcus lanatus
Lolium multiflorum
Phleum pratense
Poa annua
Poa compressa
Poa trivialis
Setaria faberii
S. glauca
S. viridis
S. viridis var. ambigua

POLYGONACEAE
Polygonum cuspidatum
Rumex acetosella
Rumex crispus

RANUNCULACEAE
Ranunculus acris

RHAMNACEAE
Rhamnus catharticus

ROSACEAE
Potentilla recta
Pyrus malus

SAXIFRAGACEAE
Philadelpus coronarius

SCROPHULARIACEAE
Linaria vulgaris
Verbascum thapsus
Verbascum thapsus
Veronica officinalis

SOLANACEAE
Solanum dulcamara

Table 2 A list of exotic weedy species in the vicinity of Saratoga Historical Monument as defined by H. S. Forest[1], H. H. Howard[2], Leopold Raynal and Faust[3], W. Niering[4], Rietsma[5], Robinson[6], D.L. Linscott[7] and McKinley[8] and Shipman[9].

Species

Phragmites australis[1,3,5]
Lythrum salicaria[1,3,5]
Sorghum halpense[1,9]
Myriophyllym spicatum[1]
Potamegeton crispus[1]
Cirsium arvense[2,9]
Crataegus spp.[2,9]
Abutilon theophrasti[2,9]
Agropyron repens[2,7,9]
Cyperus esculentus[2,9]
Portulacca oleracea[2,8,9]
Rhamnus cathartica[3]
Cynanchum nigrum[3]
Solanum dulcamara[3,9]
Taraxacum officinale[3,5,7,9]
Ailanthus altissima[3,5,9]
Celastrus orbiculatus[4]
Lonicera japonica[4,9]
Elaeagnus umbellata[4]
Rhus radicans[4,5,6,9]
Xanthium spp.[5,9]
Cichorium intybus[5,9]
Plantago spp.[5,9]
Glechoma hederacea[5,7,9]
Vicia spp.[6]
Arctium spp[9].
Chenopodium albam[7]
Brassica kaber[7,9]
Setaria glauca[7],
Amaranthum retroflexus[7,9]
Digitaria sanguinalis[7,9]
Stellaria media[7,9]
Cerostiam vulgatum[7,9]
Barbarea vulgaris[7]
Cannabis sativa[7,9]
Potentilla norvegica[7]
Saponaria officinalis[7,9]
Galeopsis tetrahit[7]
Sonchus arvensis[7,9]
Carduus arvensis[7,9]
Lychnis alba[7]
Lamium amplexicaule[7,9]
Veronica sp.[7]
Polygonum cuspidatum[7,8]
Echinochioa crusgali7
Galinsoga parviflora7,8
Malva moshata[7]
Sagina sp. [8]
Alliaria officinalis8

BIOMASS SYNTHESIS AND NITRITE REDUCTASE ACTIVITY AS INDICATORS OF PHYTOTOXICITY OF SOME HERBICIDES[1]

Irena I. Zbiec[2], Robert M. Devlin[3], and Sylwia E. Nowicka[2]

ABSTRACT

The effect of sulfometuron, metsulfuron, CGA-136872, and clopyralid on biomass synthesis in bean leaves was studied. All four herbicides caused increases in fresh weight. Dry weight increases were also observed in bean leaves treated with sulfometuron and metsulfuron but not in leaves treated with CGA-136872 and clopyralid. Nitrite reductase activity was inhibited by tebuthiuron, buthidazole, and to a lesser extent by SC-0774. Norflurazon was relatively inactive in this respect.

INTRODUCTION

Herbicide phytotoxicity can be expressed in a number of ways. For example, many herbicides have an adverse affect on the photosynthetic system of the plant. Klepper (4) screened several compounds known as inhibitors of photosynthesis for their effect on nitrite reduction. Since nitrite is a precursor in the formation of nitrosamines, its accumulation could play an important role in herbicide toxicity.

Herbicide activity can be determined quantitatively by determining the effect of the herbicide on biomass synthesis. Often biomass synthesis is accelerated over a short period of time in plants treated with a herbicide.

The purpose of the present study was to determine if biomass synthesis and nitrite reductase tests could be useful indicators of herbicide activity.

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MATERIALS AND METHODS

For biomass synthesis bean (Phaseolus vulgaris L.) seeds were sown in styrofoam pots containing moist vermiculite and grown in a growth chamber under constant conditions of light (152 $\mu E\ m^{-2}s^{-1}$, 8 h dark, 16 h light) and temperature (21±2 °C). After shoot emergence 50 ml of Hoagland solution was applied daily to each pot. After 14 days of growth herbicide solutions were applied as a mist spray (10 ml per pot). The plants were returned to the growth chamber and grown under the same previously described conditions. Three days after treatment disks, 1.6 cm in diameter, were punched out of the bean leaves with a cork borer and their fresh and dry weight determined. Two disks were taken from one side of each leaf selected for testing. For each solution of herbicide tested 120 disks were taken. Following removal of the disks, the plants were returned to the growth chamber for 24 h under continuous light (152 $\mu E\ m^{-2}s^{-1}$) and a temperature of 25±2 °C. Leaf disks were again taken and their fresh and dry weight determined. This time the disks were taken from the intact half of the leaves selected for testing. All experiments were replicated four times.

The nitrite reductase assays were done according to the methods of Klepper (5) using the top half section of 10 day old wheat (Triticum aestivum L.) leaves. The herbicides tested in the nitrite reductase assays were tebuthiuron {N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]N,N^1-dimethylurea}, buthidazol {3-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-4hydroxy-1-methyl-2-imidazolidinone}, norflurazon[4-chloro-5-(methylamino)-2-(3-(trifluoromethyl)phenyl)-3(2H)-pyridazinone], and SC-0774 (chemistry not released).

The herbicides tested in the biomass synthesis study were sulfometuron {2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]benzoic acid}, metsulfuron {2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoic acid}, CGA-136872 {2[[[[[4,6-bis(difluoromethoxy)-2-pyrimidinyl]amino]carbonyl]amino]sulfonyl]benzoic acid methyl ester}, and clopyralid(3,6-dichloro-2-pyridinecarboxylic acid).

RESULTS AND DISCUSSION

The data presented in Table 1 show that two of the sulfonylureas compounds tested increased biomass synthesis in bean leaves. Bean leaves treated with 0.5 and 1 mM sulfometuron showed fresh weight increases of 32 and 87%, respectively. The same treatment caused dry weight increases of 31 and 50% (Table 1). Significant fresh weight increases were also observed in bean leaves treated with metsulfuron and CGA-136872. However, no increase in dry weight was observed in leaves treated with CGA-236872. Similar to CGA-136872, clopyralid increased fresh weight but had no effect on dry weight (Table 1). Apparently CGA-136872 and clopyralid had no effect on biomass synthesis but did

increase water uptake by the leaves.

Tabel 1. Biomass synthesis in bean leaves treated with hericide. Figures in the table represent $mg/m^2/h$.

Herbicide (µM)	Sulfometuron Fresh Wgt	Sulfometuron Dry Wgt	Metsulfuron Fresh Wgt	Metsulfuron Dry Wgt	CGA-136872 Fresh Wgt	CGA-136872 Dry Wgt	Clopyralid Fresh Wgt	Clopyralid Dry Wgt
0	319	58	412	57	370	87	414	73
250	321	72	420	66	363	81	404	68
500	420	76	481	63	352	87	452	59
750	500	77	539	65	403	92	505	59
1000	597	87	563	77	468	99	600	62
LSD 5%	10.7	4.4	39.6	12.6	36.9	n.s.	28.3	n.s.
1%	14.7	6.0	54.8	17.4	51.0		41.6	

All four of the herbicides tested in this study for their effect on nitrite reductase activity are photosynthesis inhibitors. Tebuthiuron, buthidazole, and norflurazon interfere with electron flow in photosynthesis (2) and SC-0774 inhibits chlorophyll synthesis. Tebuthiuron exhibited by far the most inhibitory activity, causing a very large accumulation of nitrite in wheat leaf tissue. Buthidazole was also quite active in this respect, 200 µM causing a 437% increase in nitrite accumulation. Moderate activity in the nitrite reductase test was observed with SC-0774 while norflurazon was found to be only slightly active (Table 2). This was surprising since pyridazinone herbicides have been shown by Hilton et al. (3) to have strong Hill reaction activity.

Table 2. Nitrite reductase activity and nitrite accumulation in herbicide-treated wheat leaves.

Treatment (µM)	Light Incubation ($nM\ NO_2.g^{-1}.h^{-1}$)	Light Incubation (%)	Dark Incubation ($nM\ NO_2.g^{-1}.h^{-1}$)	Dark Incubation (%)
Control	38	100	159	100
Tebuthiuron				
200	429	1129	698	439
1000	633	1666	860	540
Buthidazole				
200	204	537	246	155
1000	480	1263	672	423
SC-0774				
100	87	229	370	233
500	96	253	374	235
Norflurazon				
200	40	105	198	125
1000	48	126	267	168

Devlin et al. (1) showed that buthidazole increases fluorescence and delays post-luminescence decay in Chlorella vulgaris. Such activity suggests that buthidazole inhibits photosynthetic electron flow. Nitrite reductase is located in the chloroplast and can accept electrons directly from reduced ferredoxin. Thus inhibition of photosynthetic electron flow could cause nitrite to accumulate in green tissue. As shown in this study nitrite accumulates in wheat leaves treated with tebuthiuron, buthidazole, or SC-0774 and then exposed to light or dark conditions. Note that more nitrite accumulates under dark conditions, a situation produced by the absence of light and the presence of the herbicides. Both conditions favor nitrite accumulation by inhibiting the activity of nitrite reductase.

Measuring the effect a compound has on biomass synthesis or nitrite reductase activity appears to be a good way to indicate herbicidal activity. Both tests are relatively simple and rapid enough for screening compounds on a commericial scale.

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PROMOTION OF CURLY DOCK SEED GERMINATION BY VERY LOW FLUENCE RED LIGHT

R. B. Taylorson[1]

ABSTRACT

Curly dock (Rumex crispus L.) seed germination is stimulated by light through the phytochrome system. The magnitude of the response may vary among collections and can be increased greatly by subjecting imbibed seeds to high temperature (e.g. 40C) for two hours prior to light exposure. Such temperature treatments not only increase the total number of seeds responding to a light stimulus, but also increase the sensitivity of the seeds to low light energies. Thus, curly dock seeds imbibed at 20C for two days germinated 15 percent after treament with 1700 uM m^{-2} broad-band red irradiation (a low-fluence phytochrome response) and naught if kept in darkness. Similarly imbibed seeds which also were subjected to 40C for two hours just before light treatment germinated nearly 80 percent after 100 uM m^{-2} red-light treatment. Ten to twenty percent of these seeds, however, germinated after irradiances of 0.1 to 1.0 uM m^{-2} red light. Germination responses to such low irradiances have been termed 'very low fluence responses' (VLFR). The capability for a VLFR suggests that under natural conditions seeds may be stimulated by the low fluences of light perceived by shallowly buried seeds or those under surface litter.

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CONTROL OF CANADA THISTLE GROWING IN A CROWNVETCH GROUNDCOVER

A.E. Gover, N.L. Hartwig, and G.T. Lyman[1]

ABSTRACT

A field study was established in 1988 to evaluate selective control of Canada thistle (Cirsium arvense L.) in a crownvetch (Coronilla varia L.) groundcover along a roadside. The experimental design was a randomized complete block with three replications and a plot size of 1.8 by 6.1 m. Herbicide treatments were applied May 25 and June 15, when Canada thistle was in the pre-bud and bud growth stage, respectively. Treatments were applied with a CO_2 backpack sprayer using Spraying Systems 6504 flat fan nozzles delivering 374 l/ha. Ratings for crownvetch and Canada thistle injury were taken on June 28. On that date, severe Canada thistle injury and acceptable crownvetch tolerance was apparent for May 25 applications of bentazon plus atrazine with crop oil (1.1 + 1.1 kg/ha + 2.6 l/ha), hexazinone (1.1 kg/ha), and clopyralid (0.26 kg/ha); June 15 applications of clopyralid (0.13, 0.26, and 0.40 kg/ha); and a split application of bentazon with crop oil (0.84 + 0.84 kg/ha, 2.6 l/ha crop oil). Ratings were taken on August 2 for injury and regrowth of crownvetch and Canada thistle. The only treatment providing acceptable crownvetch tolerance, Canada thistle control, and Canada thistle regrowth suppression was the split application of bentazon with crop oil (0.84 + 0.84 kg/ha, 2.6 l/ha crop oil). Clopyralid applied on May 25 (0.26 and 0.40 kg/ha) provided acceptable crownvetch tolerance in two of three replications, and also gave complete suppresion of Canada thistle regrowth. Treatments giving acceptable crownvetch tolerance, complete top-kill but incomplete regrowth suppression of Canada thistle included May 25 applications of bentazon plus Dash[2] plus UAN[3] (0.84 kg/ha + 2.6 + 10.4 l/ha) and hexazinone (1.1 kg ha); and June 15 applications of hexazinone (1.1 kg/ha) and atrazine plus crop oil (4.5 kg/ha + 2.6 l/ha). By September 27, all treatments showed some degree of Canada thistle regrowth. Treatments that will be evaluated in 1989 include hexazinone (1.1 kg/ha) applied at pre-bud or bud stage, bentazon plus Dash plus UAN (0.84 kg/ha, 2.6 and 10.4 l/ha), split application of bentazon with crop oil (0.84 + 0.84 kg/ha, 2.6 l/ha crop oil), and clopyralid applied at bud stage (0.26, 0.40 kg/ha).

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2 Proprietary blend of surfactants manufactured by BASF Corporation, Parsippany, NJ 07054

3 Urea-Ammonium Nitrate solution, 30% nitrogen.

Table 1: Summary of Canada thistle activity and crownvetch tolerance based on ratings taken June 28 and August 2, 1988.

	Treatment	Rate	Application[1] Timing	Thistle[2] Activity	Crownvetch[3] tolerance
		(kg ai/ha)	(thistle growth stage)		
1.	untreated check		---	---	---
2.	bentazon + crop oil[4]	0.84	Pre-Bud	1	3
3.	bentazon + crop oil + UAN[5]	0.84	Pre-Bud	1	3
4.	bentazon + crop oil	1.68	Pre-Bud	1	3
5.	bentazon + crop oil	0.84 + 0.84	Both	3	3
6.	bentazon + crop oil + UAN	0.84 + 0.84	Both	1	3
7.	bentazon + crop oil	1.68 + 1.68	Both	1	3
8.	bentazon + Dash[4]	0.84	Pre-Bud	1	3
9.	bentazon + Dash + UAN	0.84	Pre-Bud	2	3
10.	BAS 433 11 H + crop oil	0.97	Pre-Bud	1	3
11.	BAS 433 10 H	1.26	Pre-Bud	1	3
12.	bentazon + triclopyr ester	0.84 + 0.56	Pre-Bud	1	2
13.	acifluorfen	0.42	Pre-Bud	1	3
14.	bentazon + acifluorfen	0.84 + 0.42	Pre-Bud	1	3
15.	bentazon + atrazine + crop oil	1.1 + 1.1	Pre-Bud	1	3
16.	triclopyr ester	0.56	Pre-Bud	1	1
17.	triclopyr ester	1.1	Pre-Bud	1	1
18.	clopyralid	0.13	Pre-Bud	3	1
19.	clopyralid	0.27	Pre-Bud	3	1
20.	clopyralid	0.4	Pre-Bud	3	1
21.	triclopyr ester + clopyralid	0.56 + 0.28	Pre-Bud	3	1
22.	triclopyr ester + clopyralid	0.56 + 0.56	Pre-Bud	3	1
23.	triclopyr ester + clopyralid	1.1 + 0.28	Pre-Bud	3	1
24.	triclopyr ester + clopyralid	1.1 + 0.56	Pre-Bud	3	1
25.	clopyralid + 2,4-D	0.13 + 0.69	Pre-Bud	3	1
26.	clopyralid + 2,4-D	0.26 + 1.40	Pre-Bud	3	1
27.	clopyralid + 2,4-D	0.54 + 2.80	Pre-Bud	3	1
28.	clopyralid + 2,4-D + triclopyr ester	0.13 + 0.69 + 0.56	Pre-Bud	3	1
29.	clopyralid + 2,4-D + triclopyr ester	0.26 + 1.40 + 0.56	Pre-Bud	3	1
30.	clopyralid + 2,4-D + triclopyr amine	0.13 + 0.69 + 0.63	Pre-Bud	3	1
31.	clopyralid + 2,4-D + triclopyr amine	0.26 + 1.40 + 0.63	Pre-Bud	3	1
32.	hexazinone	1.12	Pre-Bud	2	1
33.	triclopyr ester	0.56	Bud	1	1
34.	triclopyr ester	1.12	Bud	2	1
35.	clopyralid	0.13	Bud	3	1
36.	clopyralid	0.27	Bud	3	2
37.	clopyralid	0.4	Bud	3	2
38.	triclopyr ester + clopyralid	0.56 + 0.28	Bud	3	1
39.	triclopyr ester + clopyralid	0.56 + 0.56	Bud	3	1
40.	triclopyr ester + clopyralid	1.1 + 0.28	Bud	2	1
41.	triclopyr ester + clopyralid	1.1 + 0.56	Bud	3	1
42.	clopyralid + 2,4-D	0.13 + 0.69	Bud	3	1
43	clopyralid + 2,4-D	0.26 + 1.40	Bud	3	1
44.	clopyralid + 2,4-D	0.54 + 2.80	Bud	3	1
45.	clopyralid + 2,4-D + triclopyr ester	0.13 + 0.69 + 0.56	Bud	2	1
46.	clopyralid + 2,4-D + triclopyr ester	0.26 + 1.40 + 0.56	Bud	3	1
47.	clopyralid + 2,4-D + triclopyr amine	0.13 + 0.69 + 0.63	Bud	3	1
48.	clopyralid + 2,4-D + triclopyr amine	0.26 + 1.40 + 0.63	Bud	3	1
49.	hexazinone	1.12	Bud	2	3
50.	atrazine + crop oil	4.48	Bud	2	2

1 Pre-Bud stage applications were made May 25, Bud stage applications were made June 15.

2 Thistle activity is rated on a 1-3 scale, 1=incomplete kill of treated vegetation, 2=complete kill of treated vegetation, 3= complete kill of treated vegetation with moderate regrowth suppression.

3 Crownvetch tolerance is rated on a 1-3 scale, 1=unacceptable injury in all plots, 2=some observations of unacceptable injury, 3=no observations of unacceptable injury.

4 Crop oil and Dash were applied at 2.6 l/ha.

5 UAN was appied at 10.4 l/ha

CANADA THISTLE CONTROL IN CROWN VETCH

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ABSTRACT

The experiment was conducted in southwest Virginia along highway rights-of-way. The objectives of this research were (i) to evaluate the efficacy of various herbicides applied post emergence for Canada thistle (Cirsium arvense (L.) Scop.) control and (ii) to evaluate the effect of these herbicides on crown vetch (Coronilla varia L.). The site utilized consisted of established crown vetch for roadside stability grown on rock fill. Treatments were applied on June 10, 1988, with a CO_2 backpack sprayer in 280 L water ha^{-1} delivered at 210 kPa utilizing 8003 flat fan nozzels. All plots measured 2.1 m X 3 m with 3 replications. Canada thistle was in the late bud stage of growth at application, while crown vetch was at 10% bloom.

Anilazine at 3.4 and 6.7 kg ha^{-1} afforded excellent control of Canada thistle, 95 and 92%, respectively, with no notable injury to crown vetch for the 16 week evaluation period. These two treatments resulted in a crown vetch stand of greater density than the nontreated check. Atrazine at 4.5 kg ha^{-1} plus crop oil concentrate (COC) at 4.7 L ha^{-1}, bentazon at 1.1 kg ha^{-1} plus 2.4 L ha^{-1} COC (repeated 7 DAT), and hexazinone at 2.2 kg ha^{-1}, elicited excellent initial control of Canada thistle, 95, 95 and 97%, respectively, but also resulted in severe initial crown vetch injury, 67, 95, and 83%, respectively. By 16 weeks, atrazine plus COC still gave 73% control of Canada thistle with a vetch stand similar to that of the nontreated check. Hexazinone and bentazon plots did not adequately maintain control of the thistle after 16 weeks. However, vetch recovered from hexazinone and bentazon treatments to equal that of the nontreated check. Clopyralid at 0.168, 0.224 and 0.28 kg ha^{-1} resulted in good control of Canada thistle, 70, 77, and 82%, respectively. At 16 weeks, vetch had not recovered from clopyralid injury and substantial regrowth of thistle had occurred.

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PROGRESS REPORT OF 27 HERBICIDE TREATMENTS FOR CONIFER RELEASE - T 34 MD, MAINE

G.R. Schaertl and M.L. McCormack, Jr.[1]

ABSTRACT

A field study and a potted-seedling study were designed to evaluate control of broad-leaf weeds and phenological and physiological changes of conifer crops following release with herbicides. The flat, 33 ha area of the field study is approximately 225 m elevation in T 34 MD, Maine and consists of two blocks that were clear-cut in 1980. Twenty-seven treatments (Table 1) were applied in aqueous mixtures by helicopter to replicated 0.6 ha plots at 46.8 L ha^{-1}. Applications occurred between 0600 and 1330 on 11 September 1987 with near ideal weather conditions. Raindrop[R] RD-5 (D6-C45) nozzles were used to create drops of 750 um volume median diameter. Treatments were applied from lesser to higher concentrations with complete rinses of spray equipment following each herbicide sequence. Pre- and post-treatment data (1 year after treatment) were gathered from three randomly established, permanent line-transects (30.5 m) in each of 54 plots. Additional post-treatment data will be collected in autumn 1989. Differences in canopy cover and height of red maple (Acer rubrum L.), birch (Betula spp. L.), pin cherry (Prunus pensylvanica L. f.), and red raspberry (Rubus idaeus L.) are being evaluated. Growth differences in stem diameter, height, crown diameter, and crown ratio of balsam fir [Abies balsamea (L.) Mill.] and spruce (Picea spp. A. Dietr.) also are being examined. Reduced cover and height of shrubs and hardwood trees range from most effective control in glyphosate- and imazapyr-treated plots to the least effective control in metsulfuron- and triclopyr-treated plots. However, formulated glyphosate with 10 percent (w/w) surfactant does not seem as effective as that with 15 percent surfactant. Sulfometuron seems to be effective as a residual herbicide when mixed with another herbicide. Conifers treated with glyphosate and surfactants MON-8166 and MON-8191 have some chlorotic needles and some necrotic leaders. In imazapyr-treated plots, many conifer leaders and buds are necrotic and needles on the leaders are chlorotic and shortened. The effect of numbered surfactants and AAPOE, FA, IPA surfactant seem similar, i.e. slightly improving control, but d,I-limonene seems less effective.

The potted seedling study will be used to evaluate differences in physiological responses (photosynthesis, respiration, and transpiration rates) and phenological responses (incremental changes in height, stem diameter, and crown) by balsam fir seedlings among treatments 1, 3, 13, 19, and 24 (Table 1). In June 1988, 250 homogeneous, 3-year-old seedlings were transplanted into 3.8 L greenhouse pots and were assigned to five randomized complete blocks. Treatments will be applied in late August 1989 with a CO_2 boom sprayer to simulate aerial applications following pre-treatment data collection. Post-treatment responses will be measured biweekly, commencing 24 h after treatment and continuing until differences stabilize. Study results will be reported in 1990.

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Table 1. Herbicide treatments aerially applied at 46.8 L ha^{-1} plots on Township 34 MD, Maine, on 11 September 1987.

TRT NO.	ACTIVE INGREDIENT	FORMULATION (ai/unit, %surf. w/w)	RATE (kg ai/ha)	ADJUVANT ACTIVE INGREDIENT*	RATE (% v/v)
1	control, no treatment				
2	glyphosate	4lb/gal,15%	2.24	none	0
3	glyphosate	4lb/gal,10%	2.24	none	0
4	glyphosate	4lb/gal,10%	2.24	MON8150+MON8166	0.5+5.0
5	glyphosate	4lb/gal,10%	2.24	MON8161+MON8166	0.5+5.0
6	glyphosate	4lb/gal,10%	2.24	AAPOE,FA,IPA	0.25
7	glyphosate	4lb/gal,10%	2.24	d,I-limonene	0.5
8	glyphosate	4lb/gal,10%	3.36	none	0
9	glyphosate	4lb/gal,10%	3.36	MON8161+MON8166	0.5+5.0
10	triclopyr ester	4lb/gal	0.56		
	+ glyphosate	4lb/gal,10%	1.12	none	0
11	triclopyr ester	4lb/gal	1.12		
	+ glyphosate	4lb/gal,10%	0.56	none	0
12	triclopyr ester	4lb/gal	1.12		
	+ glyphosate	4lb/gal,10%	1.12	none	0
13	triclopyr ester	4lb/gal	2.80	none	0
14	triclopyr ester	4lb/gal	2.80	AAPOE,FA,IPA	0.25
15	triclopyr amine	3lb/gal	2.80	none	0
16	triclopyr amine	3lb/gal	2.80	AAPOE,FA,IPA	0.25
17	triclopyr ester	4lb/gal	2.80		
	+ metsulfuron	60%/lb	0.02	AAPOE,FA,IPA	0.25
18	triclopyr ester	4lb/gal	2.80		
	+ sulfometuron	75%/lb	0.21	AAPOE,FA,IPA	0.2
19	metsulfuron	60%/lb	0.03	AAPOE,FA,IPA	0.2
20	glyphosate	4lb/gal,10%	2.24		
	+ sulfometuron	75%/lb	0.21	AAPOE,FA,IPA	0.2
21	glyphosate	4lb/gal,10%	2.24		
	+ sulfometuron	75%/lb	0.11	AAPOE,FA,IPA	0.2
22	glyphosate	4lb/gal,10%	2.24		
	+ metsulfuron	60%/lb	0.02	AAPOE,FA,IPA	0.2
23	glyphosate	4lb/gal,10%	2.24		
	+ metsulfuron	60%/lb	0.03	AAPOE,FA,IPA	0.2
24	imazapyr	4lb/gal	0.56	AAPOE,FA,IPA	0.2
25	glyphosate	4lb/gal,10%	2.24		
	+ imazapyr	4lb/gal	0.34	AAPOE,FA,IPA	0.2
26	glyphosate	4lb/gal,10%	2.24		
	+ imazapyr	4lb/gal	0.17	AAPOE,FA,IPA	0.2
27	glyphosate	4lb/gal,10%	2.24	MON8166+MON8191	0.25+5.0

* AAPOE = alkylarylpolyoxyethylene glycols, FA = fatty acids, IPA = isopropanol. MON(number) = experimental compounds from Monsanto.

IMAZAPYR HERBICIDE, A TOOL FOR USE IN FORESTRY AND NOXIOUS WEED CONTROL PROGRAMS

R.A. Beardmore[1]

ABSTRACT

IMAZAPYR herbicide (Arsenal®) has been recently labeled for the site preparation and release of several new conifer species. IMAZAPYR herbicide is also registered for the herbaceous release of Loblolly pine (Pinus taeda).

The translocation properties and broad spectrum herbicidal activity of IMAZAPYR result in the control of numerous difficult to control weeds. Field trials with IMAZAPYR herbicide have shown control of Desert camelthorn (Alhagi pseudalhagi, (Bieb.) Desv.), Russian thistle (Salsola iberica, Sennen & Pau), Kochia (Kochia scoparia, (L.) Schrad.), Grey rabbitbrush (Chrysothamnus nauseosus ssp. gaveolens, (Nutt.) Piper), Rush skeletonweed (Chondrilla juncea, L.), Diffuse knapweed (Centaurea diffusa, Lam.), Russian knapweed (Centaurea repens, L.), Yellow starthistle (Centaurea solstitialis, L.), Broom snakeweed (Gutierrezia sarothrae, (Pursh) Britt. & Rushby), Stinging nettle (Urtica dioica, L.), Common reed (Phragmites australis, (Cav.)Trin. ex Steud.), Purple loosestrife (Lythrum salicaria), and Salt cedar (Tamarix ramosissima, Ledeb.). Effective weed control of the respective species has been achieved with the following rates and timings:

WEED SPECIES	RATE(KG AI/HA)	TIMING
ALHPS - Desert camelthorn	0.5	Mid - post
SASKR - Russian thistle	0.4	Early post
KCHSC - Kochia	0.4	Early post
CYTNA - Grey rabbitbrush	1% sol.	Spray to wet
CHOJU - Rush skeletonweed	0.5	Post
CENDI - Diffuse knapweed	0.5	Rosette - E. Post
CENRE - Russian knapweed	1.0	Early post
CENSO - Yellow starthistle	0.75	Early post
GUESA - Broom snakeweed	0.75	Post
URTDI - Stinging nettle	0.5	Post
PHRCO - Common reed	1.0	Post
LYTSA - Purple loosestrife	0.5	Post
TAARA - Salt cedar	1.0	Post

The efficacy of IMAZAPYR on these and other weed species offers plant control managers a valuable new tool for tough weed control problems.

[1] Product Manager, American Cyanamid Company, Princeton, NJ 08540

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CONTROLLING HARDWOOD SPROUTS TO RELEASE PLANTED LARCH FOLLOWING CLEARCUTTING

R. D. Shipman[1]

ABSTRACT

A study was initiated in April, 1980 to evaluate the early survival and growth of two-year old Japanese larch seedlings (Larix leptolepis Sieb. and Zucc. Gord.) planted on a 50-60 year-old mixed upland oak-hickory stand previously clearcut in 1972. Hexazinone, an effective herbicide for controlling a variety of woody and herbaceous vegetation was applied to the soil at the base of competing hardwood sprouts and brush clumps using a Spotgun and pelleted gridballs to release larch seedlings interplanted among sprouting hardwood stumps. Two untreated, planted blocks served as controls, one handchopped and one undisturbed. Seedlings were planted on the 3-acre site in 8 randomized 0.1A non-replicated blocks at a 9 x 9′ spacing. The original stand composition prior to clearcutting was predominantly red oak (Quercus rubra L.) scarlet oak (Quercus coccinea Muenchh.) white oak (Quercus alba L.) black oak (Quercus velutina Lam.) and hickory (Carya spp.). A few white pine (Pinus strobus L.) pitch pine (Pinus rigida Mill.) Virginia pine (Pinus virginiana Mill.) and non-woody herbaceous species, blackberry (Rubus spp.) and grasses were present. The major soil type is a Berks shaly silt loam, with a slope of 8 to 15 percent, developed from dark brownish-gray or yellowish gray medium-acid shales; moisture storage capacity is low, erosion hazard slight and the total soil profile is shallow but well-drained.

Survival and height growth of the ten tallest larch seedlings for each treatment method were assessed at the end of the second growing season (Table 1). Hexazinone (10% ai) gridballs applied in 3 x 3′ and 4.2′ x 4.2 grid patterns at 2 and 4 lb ai/acre resulted in significantly higher survival than the untreated control. Also, significantly higher survival over the control when hexazinone was applied with the Spotgun (4 ml/2" stem diameter) and when 2 gridballs were hand applied per 1" stem diameter to sprout clumps. Both treatments of hexazinone applied in a grid pattern at 2 and 4 lb ai/acre showed significantly greater height growth (96 and 76 cms) than the untreated control plot (60 cm) after two growing seasons.

Based upon a classification system of Poor, Fair, Good, Very Good and Excellent seedling vigor, treatments were ranked in order of least to most effect on planted larch as follows: (1) Gridball 4 lb ai (3 x 3′ grid) (2) Handchopped (3) Spotgun 8 ml/2" dia. (4) Gridball 2 lb ai (4.2 x 4.2′ grid) (5) Two gridballs/clump (6) Spotgun 4 ml/2′ dia. (7) Three gridballs/clump and (8) Control (untreated).

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Table 1. Survival and Growth of Planted Japanese Larch Following Clearcutting[1].

Herbicide	Rate	Treatment Method	Survival (%)[2]	Mean Height (cm)[3]
hexazizone (undiluted)	4 ml/1/2" stem dia.	Spot Gun	69	69
hexazinone (undiluted)	8 ml/1/2" stem dia.	Spot Gun	68	70
hexazinone (10% ai grid ball)	4 lb ai/acre	Grid (3 x 3′)	83 *	96 *
hexazinone (10% ai grid ball)	2 lb ai/acre	Grid (4.2 x 4.2′)	70 *	76 *
hexazinone (10% ai grid ball)	2 grid balls per 1" stem diameter	Hand-applied to sprout clumps	69 *	39
hexazinone (10% ai grid ball)	3 grid balls per 1" stem diameter	Hand-applied to sprout clumps	58	40
untreated (planted)	--	Hand-chopped woody stems	59	62
untreated (planted)	--	Control	52	60

[1] Clearcut June, 1972; 3-acre mixed upland oak-hickory stand.
[2] Planted April, 1980; 2-0 bedrun larch seedlings.
[3] Mean height ten tallest seedlings.

* = Significantly different ($p \leq .05$) from untreated (control) plot.

DETERMINING THE AMOUNT OF TRICLOPYR REQUIRED TO CONTROL ASH AND BIRCH WITH BASAL BARK APPLICATION

Larry J. Kuhns and Gregory T. Lyman [1/]

ABSTRACT

A solution containing 20% triclopyr ester (v/v) and 80% basal oil[2/] (v/v) was applied to stems of green ash (Fraxinus pennsylvanicum Marsh.), and black birch (Betula lenta L.) at 0.5, 1, and 2 ml of solution per 2.54 cm (1 inch) circumference on March 5, 1987. The caliper of each stem was measured 46 cm (18 in) from ground level and the circumference and appropriate dose was calculated. Treatments were applied evenly around the stem at approximately 30-40 cm (12-16 in) from ground level using a hypodermic needle and syringe. Approximately 15 stems were utilized per treatment ranging in size from 5-13 cm (2-5 in) in diameter. Each stem was rated on a scale from 0-5 (0 = no effect, 5 = dead) on August 19, 1987, and June 17, 1988 (Table 1).

Triclopyr ultimately provided the same degree of control of green ash and black birch when applied at the middle or high rates. The high rate provided total control of all stems while the middle rate killed about 80% of the stems of both species. At the time of the first rating all but one of the ash receiving the high rate were dead, but only seven of the birch receiving that treatment were dead. At this rate the ash were more susceptible to rapid kill by the treatment than the birch. At the middle rate of application half of both the ash and birch were dead by the time of the first rating.

Green ash receiving the low rate of application were severely injured early, but there was little change in effect between the first and second rating period, and only three trees died. At the first rating period only one black birch treated with the low rate was dead, but by the time of the final rating eight trees were dead.

The differences in reaction of the two species to the treatments may be related to their bark characteristics. The bark of green ash is dry and corky and may rapidly absorb the chemical. Birch has a waxy bark that initially repels the chemical and makes it spread over a greater length of the trunk. This waxy coating may also result in slower absorption and delayed activity.

All plants that survived treatment with the middle rate had a narrow swath of treated tissue that was not killed. In this swath the xylem, cambium, and phloem were intact and apparently functioning to support the little live tissue that was still evident in the tree crown. This further supports the recommendation that basal bark applications must uniformly and completely encircle the tree trunk for most effective control.

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2/ - Basal Oil is a product of Arborchem Products Inc., Fort Washington, PA.

TABLE 1 - Number of stems of black birch and green ash in each injury rating catagory (0-5). Plants were treated with measured amounts of a solution containing 20% triclopyr ester (v/v) and 80% Basal Oil# (v/v) on March 5, 1987, and rated on Sept. 19, 1987 and June 17, 1988.

	0.5 ml SOLUTION† PER 2.54 cm (INCH) CIRCUMFERENCE		1.0 ml SOLUTION PER 2.54 cm (INCH) CIRCUMFERENCE		2.0 ml SOLUTION PER 2.54 cm (INCH) CIRCUMFERENCE	
GREEN ASH						
CONTROL* RATING	RATING DATES		RATING DATES		RATING DATES	
	AUG. 19,'87	JUNE 17,'88	AUG. 19,'87	JUNE 17,'88	AUG. 19,'87	JUNE 17,'88
	NUMBER OF STEMS		NUMBER OF STEMS		NUMBER OF STEMS	
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	6	3	0	0	0	0
3	7	5	5	1	0	0
4	1	5	3	3	1	0
5	3	3	8	11	14	15
BLACK BIRCH						
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	6	0	0	0	1	0
4	7	6	7	2	7	0
5	1	8	7	11	7	15

#/ Basal Oil is a product of Arborchem Products Inc., Fort Washington, PA.
†/ 0.5 ml solution contains 0.24 g triclopyr ester.
*/ Rating Scale, 0 = No Treatment Effects, 5 = Dead

VEGETATATION MANAGEMENT PROBLEMS IN NORTHERN HARDWOOD AND OAK FORESTS

Stephen B. Horsley[1]

ABSTRACT

A variety of plants interfere with regeneration of northern hardwood and oak forests in the Appalachian Mountain region of the eastern United States. These include ferns (Dennstaedtia punctilobula Thelypteris noveboracensis, Pteridium aquilinum), grasses and sedges, beech (Fagus grandifolia), striped maple (Acer pensylvanicum), Rhododendron (Rhododendron maximum), mountain laurel (Kalmia latifolia), grapevines (Vitis aestivalis), oriental bittersweet (Celastrus orbiculatus) and tolerant hardwood understories containing sourwood (Oxydendrum arboreum), red maple (Acer rubrum), dogwood (Cornus florida), sassafras (Sassafras albidum) and black gum (Nyssa sylvatica). Evidence for interference varies greatly among species. In general, there is inadequate information about how these species interfere with desirable species of regeneration. There is strong evidence that dense ground covers of hayscented, New York and bracken fern interfere with regeneration of both northern hardwoods and oaks and they should be regarded as a problem where large acreages are present. Grasses and sedges often become a problem in regenerating northern hardwood and oak stands after disturbance of the forest floor seed bank. This is particularly true where white-tailed deer (Odocoileus virginianus virginianus) have eliminated much of the desirable advance regeneration. Dense understories of shade tolerant striped maple and beech preclude establishment of desirable advance regeneration in northern hardwood stands. Rhododendron and mountain laural occur as dense understories on an estimated 3 to 6.2 million acres of oak and mixed hardwood forest land in the Appalachian Mountain region. They seem to be responsible for a major shift in species composition away from oak and toward red maple and hemlock. Wild grapevines and oriental bittersweet cause damage and death to the overstory beginning with large sapling and small pole size trees. Tolerant hardwood understories of sourwood, dogwood, red maple, sassafras and black gum play an important role in determining whether oaks are able to grow into the large regeneration stage or reach a dominant crown position after cutting in central and southern Appalachian hardwood stands. An increased research effort is needed to learn how to control these interfering species and promote regeneration of desirable species.

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ARTIFICIAL REGENERATION OF HARDWOODS USING SULFOMETURON

Larry H. McCormick 1/
Todd Bowersox
David Allen

ABSTRACT

Currently many of the harvested hardwood forest stands in Pennsylvania are not being regenerated naturally with desired tree species. A possible solution is to use artificial regeneration involving the planting of seed and/or seedlings of desired hardwoods. Studies conducted over the past five year at Penn State in mixed oak stands show that successful artificial regeneration of hardwoods is possible provided the seed or seedlings are given protection from browsing and predation by animals and freedom from competition by herbaceous plants.

Herbicides are the most effective means of controlling competing herbaceous vegetation which becomes established prior to or shortly after harvest.The major herbaceous competitors in central PA mixed oak stands include hay-scented fern (*Dennstaedtia punctilobula* L.), wild oat-grass (*Danthonia* sp.), and fireweed (*Erechtites hieracifolia* (L.) Raf.). Pre- and post planting applications of glyphosate can provide good control of these competitors,however, repeated applications increases the cost of establishment. Ideally we would like to have a herbicide or combination of herbicides which when applied prior to planting would provide weed control throughout the first and possibly second growing season. Sulfometuron with its pre- and post emergence capabilities when used alone or in combination with glyphosate may provide this type of control.

Since 1985,we have conducted a series of experiments using sulfometuron alone and in combination with glyphosate applied at different rates and times of application with respect to planting.The objectives of the experiments were to evaluate the efficacy of sulfometuron to control selected herbaceous vegetation and to evaluate the phytotoxic effects of sulfometuron on selected tree species. Test rates of sulfometuron methyl ranged from .75 -3.0 oz ai/A (.05-.21 kg ai/ha). Times of sulfometuron application included: application one week prior to tree planting following a previous fall application of glyphosate (1.12 kg ai/ha), application one week prior to planting with no prior or concurrent treatment of glyhosate, and application alone and in combination with glyphosate (1.12 kg ai/ha) in the fall prior to planting. Tree species planted in each trial included red oak (*Quercus rubra* L.), white ash (*Fraxinus americana* L.), yellow poplar (*Liriodendron tulipfera* L.), and white pine (*Pinus strobus* L.). Percent ground cover by herbaceous plant, tree height growth, and percent tree survival were evaluated at the end of the first growing season in each experiment.

The results showed that sulfometuron applied alone or in combination with glyphosate at rates greater than 1.5 oz ai/A in the fall reduced herbaceous ground cover by 98% throughout the first growing season. When applied alone in the spring before leaf-out, sulfometuron effectively controlled grass and broadleaf species but provided virtually no control of hay-scented. In all of the trials, sulfometuron did not significantly affect first year tree survival. Sulfometuron did reduce the first year height growth of the tree species in each of the trials. The stunting effects of sulfometuron increased with increasing rate and was greatest when applied in the spring prior to planting.Further monitoring of the trials is planned to determine the long term net effect on sulfometuron of tree height growth.

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EFFECTS OF POST-EMERGENT HERBICIDES ON SURVIVAL AND GROWTH OF PLANTED HARDWOODS AFTER CLEARCUTTING

R. D. Shipman[1]

ABSTRACT

Interest has increased in planting oaks and other commercially important hardwood species as a result of the many failures in obtaining adequate natural regeneration following clearcutting in Pennsylvania. Deer browsing on unprotected sites restricts seedling growth, whether regeneration is established by sprout growth, natural seeding, or by artificial means (planting or direct-seeding). In the Northern Hardwood (cherry-maple) and oak-hickory forest types of Pennsylvania, successful regeneration by planting or direct-seeding appears feasible only if seedlings are protected from overbrowsing, primarily by the white-tailed deer.

An exploratory study was conducted to determine the nine-year survival and early height growth of closely-spaced (4 x 4′) hardwoods planted two years after complete clearcutting a 50-60 year-old unfenced mixed upland oak-hickory stand in central Pennsylvania. Bromacil (5-bromo-3 sec-butyl-6-methyluracil), simazine (2-chloro-4, 6 bis (ethylamino)-5-triazine) and karbutilate (m-(3,3 dimethylureido) phenyl tert butylcarbamate) was sprayed prior to planting on one-half of six 0.1 acre blocks to control herbaceous weeds. Nursery-run paper birch (*Betula papyrifera* Marsh), red oak (*Quercus rubra* L.), white ash (*Fraxinus americana* L.) and sugar maple (*Acer saccharum* Marsh) were hand-planted on both treated and control plots.

Nine years after planting the above species on the unfenced clearcut, at least 300 surviving trees per acre, 6′ in height or taller, (above browseline) were obtained with: 1-0 bromacil-treated (24 lb/A) and untreated paper birch; 2-0 tandex-treated (12 lb/A) and 1-0 untreated white ash; and 2-0 untreated red oak. Only the 1-0 and 2-0 sugar maple herbicide-treated and untreated plots failed to reach the minimum stocking levels (Tables 1 and 2). Planting at close spacing (overplanting) shows promise for regenerating a stand with several hardwood species without excluding high deer populations. According to results of this study when seedlings are planted at 4 x 4′ spacing (2722 seedlings) only 15% of them must survive and grow beyond the reach of deer after 9 growing seasons to provide adequate stocking.

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Table 1. Nine-year survival percentages of planted white ash, paper birch, red oak, and sugar maple by stock age and treatment.

Species	Stock Age	Herbicide[1] Treatment	Percentage[2] Survival
White Ash	1-0	C	85 a
White Ash	1-0	S2	83 a b
Paper Birch	1-0	C	81 a b
White Ash	2-0	C	72 b
Red Oak	2-0	S4	52 c
Red Oak	2-0	C	47 c
Sugar Maple	1-0	C	47 c
Sugar Maple	2-0	C	40 c
Sugar Maple	1-0	B12	19 d
Sugar Maple	2-0	T20	15 d
White Ash	2-0	T12	5 e
Paper Birch	1-0	B24	4 e

Table 2. Nine-year mean heights of planted white ash, paper birch, red oak, and sugar maple by stock age and treatment.

Species	Stock Age	Herbicide[1] Treatment	Height (in.)[2]
Paper Birch	1-0	C	170 a
Paper Birch	1-0	B24	108 b
White Ash	2-0	T12	60 b
White Ash	1-0	C	56 b
Red Oak	2-0	C	55 b
White Ash	2-0	C	50 b c
White Ash	1-0	S2	47 b c d
Sugar Maple	2-0	C	45 b c d
Red Oak	2-0	S4	41 c d
Sugar Maple	1-0	B12	34 d e
Sugar Maple	2-0	T20	22 e
Sugar Maple	1-0	C	21 e

[1] Treatments: C-Control, S2-Simazine at 2 lb/acre, S4-Simazine at 4 lb/acre, B12-Bromacil at 12 lb/acre, B24-Bromacil at 24 lb/acre, T12-Karbutilate at 12 lb/acre, T20-Karbutilate at 20 lb/acre.

[2] Means not followed by the same letter are significantly different at the 0.05 level.

EVALUATING TOTAL VEGETATION CONTROL MATERIALS FOR FENCELINES

A.E. Gover, L.J. Kuhns, and G.T. Lyman[1]

ABSTRACT

A field experiment was established in 1988 to evaluate the performance of herbicides, applied alone or in combination, for total vegetation control. Nineteen treatments (Table 1), were applied April 21, using a CO_2 test plot sprayer with a single 8004E nozzle, in the equivalent of 294 l/ha. The experimental design was a randomized complete block with three replications and a plot size of 0.9 by 7.6 m. The plots were bare at the time of treatment due to the removal of a hedge the previous summer. In the three weeks following application,the site received 0.4, 0.9, and 3.5 cm respectively, of rainfall. Total precipitation for May and June was 12.8 and 2.9 cm, respectively. Visual ratings for percent cover taken on June 17 (8 WAT), July 12 (12 WAT), August 3 (15 WAT), and September 21 (22 WAT) are listed in Table 1. The dominant species observed included tumble pigweed (Amaranthus albus L.), smooth crabgrass (Digitaria ischaemum Schreb.), witchgrass (Panicum capillare L.), and crownvetch (Coronilla varia L.).

Because of record high temperatures and drought, weed pressure was lower than normal in 1988. The untreated control plots were rated at only 42% cover on June 17, and the plots were still not completely covered on August 3. Sulfometuron methyl alone provided excellent season-long control of all weeds. Under the conditions of this study, the addition of oryzalin, pendimethalin, or oryzalin plus diquat to the sulfometuron methyl did not improve control. Both rates of diuron plus bromacil provided excellent season-long control. Plots treated with diuron alone at 9 kg/ha had 32, 53,and 73% weed cover 12, 15, and 22 WAT respectively. At 18 kg/ha diuron there was 17 and 40% cover 15 and 22 WAT respectively. Imazapyr alone at 2.2 kg/ha provided almost total control through 15 WAT, by by 22 WAT plots had 17% cover. Imazapyr alone at 1.1 kg/ha, or in combination with oryzalin, pendimethalin, or oryzalin plus diquat provided good to excellent control through 15 WAT, but by 22 WAT weeds were rapidly invading and control was poor. Hexazinone at 13.4 kg/ha provided excellent control for 12 weeks, good control through 15 weeks, but by 22 WAT there was 22% weed cover in the plots. At 6.7 kg/ha hexazinone, there was 7, 13, 27, and 55% weed cover at 8, 12, 15, and 22 WAT respectively. The combinations including oryzalin plus simazine, with diquat or glyphosate, did not provide adequate control. By 12 WAT about 20% weed cover was observed in the plots. By 22 WAT, each treatment was rated at over 70% cover.

Sulfometuron methyl, alone or in combination, and diuron plus bromacil provided the best season-long weed control in this study. These compounds must be evaluated under less extreme weather conditions with different weed pressures before specific recommendations can be made.

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Table 1: Percent cover ratings for treatments applied April 21, 1988. Each value is the mean of three observations.

Chemical	Application Rate	Cover June 17 (8 WAT)	Cover July 12 (12 WAT)	Cover August 3 (15 WAT)	Cover September 21 (22 WAT)
	(kg ai/ha)	(%)	(%)	(%)	(%)
imazapyr	1.1	1	1	10	70
imazapyr	2.2	0	0	1	17
imazapyr + oryzalin	1.1 + 2.2	1	1	3	43
imazapyr + pendimethalin	1.1 + 3.4	2	3	9	70
imazapyr + oryzalin + diquat	1.1 + 2.2 + 0.28	0	1	3	48
sulfometuron	0.31	0	1	1	6
sulfometuron	0.63	0	0	0	1
sulfometuron + oryzalin	0.31 + 2.2	0	0	1	4
sulfometuron + pendimethalin	0.31 + 3.4	0	0	1	9
sulfometuron + oryzalin + diquat	0.31 + 2.2 +0.28	0	0	1	3
simazine + oryzalin + diquat	4.5 + 3.4 + 1.7	4	24	52	90
simazine + oryzalin + glyphosate	4.5 + 3.4 + 0.28	3	18	37	72
diuron	9.0	9	32	53	73
diuron	18	2	9	17	40
diuron + bromacil[1]	4.5 + 4.5	2	4	12	9
diuron + bromacil	9.0 + 9.0	1	1	2	1
hexazinone	6.7	7	13	27	55
hexazinone	13.4	1	3	13	22
untreated check	---	42	77	98	100

1 Commercial premix.

DORMANT STEM HERBICIDE TREATMENTS FOR CONTROLLING ROADSIDE BRUSH

Gregory T. Lyman and Larry J. Kuhns[1/]

ABSTRACT

A mixed stand of roadside brush was treated on Feb. 11, 1988 or on March 17, 1988 with a solution containing triclopyr[2/] at 1.5%, 2.0%, or 2.5% v/v in combination with an emulsifiable crop oil[3/] at 2.0% or 3.0% v/v (Table 1). Application was made using a Radiarc[4/] nozzle system calibrated to deliver 700 l/ha (75 gpa) over a 4.6 m (15 ft) swath width. The air and soil temperature on Feb. 11, 1988, was -0.5 and -1° C respectively and there was 15-24 cm (6-10") of snow throughout the treatment area. The air and soil temperature on March 17,1988, was 4 and 0° C respectively. The major brush species present within the test area were oak (Quercus spp.) sassafras (Sassafras albinum, Nutt.), red maple (Acer rubrum, L.), and American chestnut (Castanea dentata, Marsh.). Not all species were present in each plot. Treatments were rated on June 17, 1988 on a scale from 0 to 10 with 0 providing no control and 10 providing total control of all contacted branches.

The degree and uniformity of control was better in plots treated on March 17, as compared to plots treated on February 11. Triclopyr at 1.5% plus emulsifiable crop oil (ECO) at 2.0% applied March 17 provided good control of contacted branches on oak, sassafras, and chestnut though some resprouting occurred on all species. When applied on March 17, the control of oak was the same, but there was less resprouting on contacted branches of sassafras. Triclopyr at 1.5% plus ECO at 3.0 % provided better control of oak, sassafras and chestnut than triclopyr at 1.5% plus ECO at 2.0%, and provided at least the same level of control on oak and sassafras as triclopyr at 2.5% plus ECO at 2.0%. Triclopyr at 2.0% plus ECO at 2.0% applied March 17, provided total control on contacted branches of sassafras and maple, and minor resprouting of oak. Triclopyr at 2.5% plus ECO at 3.0% applied March 17, provided total control of contacted branches of oak, and sassafras. In the plots treated on February 11, oak, sassafras, maple, and chestnut were resprouting. Some injury to understory grasses was evident. The degree of injury increased with the rate of triclopyr and was more severe in plots treated on March 17.

In this study, increasing the amount of ECO seemed to improve control. Another study should be conducted using triclopyr at the same rates used in this work, but increasing the concentration of the ECO.

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2/ Triclopyr ester, 4 pounds per gallon.

3/ Emulsifiable crop oil utilized is formulated as Clean Cut + Pine, a product of Arborchem Products Inc., Fort Washington, PA.

4/ Radiarc is a product of Waldrum Specialties, Ambler, PA

Table 1 - Control of oak, sassafras, maple, and chestnut with triclopyr ester at 1.5, 2.0, or 2.5% (v/v) and emulsifiable crop oil* (2.0 or 3.0% [v/v]) applied in the equivalent of 700 l/ha (75 gpa) on Feb. 11, 1988 and March 17,1988

TREATMENT	RATE	APPLICATION DATE	CONTROL LEVEL OF CONTACTED TISSUE# RATED JUNE, 17 1988			
			OAK	SASSAFRAS	MAPLE	CHESTNUT
Triclopyr Emuls. Crop Oil	1.5% 2.0%	2/11/88	8	8		8
		3/17/88	8	9		
Triclopyr Emuls. Crop Oil	1.5% 3.0%	2/11/88	9	9	9	9
		3/17/88	9	10		
Triclopyr Emuls. Crop Oil	2.0% 2.0%	2/11/88	Application Problem / No Ratings			
		3/17/88	9	10	10	
Triclopyr Emuls. Crop Oil	2.5% 2.0%	2/11/88	9	9		
		3/17/88	9	9		
Triclopyr Emuls. Crop Oil	2.5% 3.0%	2/11/88	9	9	9	9
		3/17/88	10	10		

*-Emulsifiable crop oil used is formulated as Clean Cut + Pine from Arborchem Products Inc., Fort Washington, PA.

#-Rating Scale, 0 to 10, 0=No treatment effects, 10=All contacted portions of the plant are dead.

CONTROL OF CANADA THISTLE AND MUSK THISTLE ON ROADSIDE RIGHTS-OF-WAY WITH CLOPYRALID AND 2,4-D

M. W. MELICHAR and M. P. STAFFORD[1]

ABSTRACT

Canada thistle [Cirsium arvense (L.) Scop.] and musk thistle (Carduus nutans L.) are problem weeds on roadside rights-of-way in the United States and Canada. Populations of these undesirable weed species vary from isolated plants to large dense stands. This population variability necessitates the use of individual and broadcast applications for thistle control.

XRM-5018, an experimental formulation containing 0.38 pound clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) and 2.0 pounds 2,4-D (2,4-dichlorophenoxyacetic acid) per gallon, was tested at different rates in individual foliar and broadcast applications for Canada thistle and musk thistle control in Indiana, Iowa, and Kentucky. A backpack sprayer equipped with a single nozzle was used to apply 0.5, 1.0 and 1.5 percent solutions of XRM-5018 in water to individual thistle plants in Indiana. All plants were sprayed to wet June 6, 1988 and evaluated August 16, 1988. A CO_2 pressurized backpack sprayer equipped with a multiple nozzle hand-held boom was used for broadcast application of XRM-5018 at 0.33, 0.50, 0.67, 1.00, 1.33 and 1.50 gallons per acre. All treatments were applied in water at the equivalent of 30 gallons of herbicide mixture per acre. Treatments were applied in Indiana (June 6, 1988), Iowa (June 8, 1988) and Kentucky (May 23, 1988). Evaluations were completed approximately two months after application.

First year results are presented in Table 1. Musk thistle was killed with individual foliar and broadcast applications of XRM-5018 at all rates tested. Individual foliar treatment of XRM-5018 provided 84, 94, and 94 percent control of Canada thistle at 0.5, 1.0, and 1.5 percent herbicide rates, respectively. Broadcast application of XRM-5018 provided greater than 90 percent control of Canada thistle at all rates except 0.33 and 0.67 gallons per acre in Kentucky tests. Field observations suggest that XRM-5018 also controls wild carrot (Dancus carota L.), prickly lettuce (Lactuca serriola L./Torn.) and common ragweed (Ambrosia artemisiifolia L.).

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[1]Industrial Specialists - Technical Service and Development, Dow Chemical U.S.A., Pittsburgh, Pennsylvania and Indianapolis, Indiana, respectively.

Table 1. Canada thistle and musk thistle control along roadsides in Indiana, Iowa and Kentucky with individual and broadcast applications of XRM-5018 (0.38 lb. 2,4-D and 2.0 lb. clopyralid per gallon).

Herbicide Treatment	Rate		lb ae/A		Thistle Species					
					Canada Thistle			Musk Thistle		
	%[1]	gpa[2]	Clopyralid	2,4-D	IN[3]	IA	KY	IN	IA	KY
					% Control[4]					
Individual	0.5	NA	NA	NA	88	--	--	100	--	--
Individual	1.0	NA	NA	NA	94	--	--	100	--	--
Individual	1.5	NA	NA	NA	94	--	--	100	--	--
Broadcast	NA	0.33	0.13	0.66	--	--	60	--	--	--
Broadcast	NA	0.50	0.19	1.00	--	96	--	--	--	--
Broadcast	NA	0.67	0.26	1.34	98	95	72	100	--	--
Broadcast	NA	1.00	0.38	2.00	97	90	91	100	--	--
Broadcast	NA	1.33	0.51	2.66	99	98	--	100	--	--
Broadcast	NA	1.50	0.57	3.00	--	--	96	--	--	--

NA = Not Applicable
-- = Not Tested
1/ v/v XRM-5018 in water.
2/ gpa of XRM-5018 applied in water at the equivalent of 30 gallons of herbicide mixture per acre.
3/ Tests conducted in Indiana (IN) on 6-6-88, IA (Iowa) on 6-8-88, and Kentucky (KY) on 5-23-88.
4/ All values represent means from three replicates.

FOLIAR HERBICIDE TREATMENTS FOR CONTROL OF ROADSIDE BRUSH

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

ABSTRACT

Eleven brush control treatments (Table 1) were applied to a mixed stand of roadside brush in Crawford County Pa., on September 10-11, 1987 and rated for control on July 14, 1988. The treatments were applied using a Radiarc[2/] spray head calibrated to deliver the equivalent of 700 l/ha (75 gpa). Area calculations were based on a 3.7 m vertical swath height. Brush treated included red maple (Acer rubrum L.), oak (Quercus spp.), ash (Fraxinus spp.), cucumber tree (Magnolia acuminata,L.), beech (Fagus spp.), poplar (Populus spp.), black cherry, (Prunus serotina,J.F.Ehrh.), sassafras (Sassafras albidum, Nutt.), and apple (Malus spp.). Not all brush species were present in each plot. Treatments 1-4 were applied on September 10, and the rest on September 11. Rain fell on the treated area approximately four hours after application on September 11.

Fosamine ammonium (FA) (2%) and FA (1.5%) plus emulsifiable crop oil (ECO) (.25%) exhibited similar control on maple, oak, and ash. All of the contacted oak branches were dead, while some minor sprouting was evident on treated maple and ash branches. FA (1.5%) with triclopyr and FA (1.0%) with triclopyr and ECO exhibited similar control of maple, oak, ash, and beech. These combinations controlled all contacted branches of oak, ash, and beech while herbicide activity was noted above the treated area on maple. Glyphosate provided complete control of contacted portions of ash but poor control of maple and oak . The rains following application may have contributed to the poor control provided by glyphosate. FA with dicamba plus 2,4-D provided total control of oak and contacted sassafras branches, but poor control of magnolia and maple. FA with metsulfuron methyl provided excellent control of maple, oak, and ash with herbicide activity noted above the treated area. Both rates of imazapyr in combination with FA provided complete kill of maple and caused injury above the treated branches on oak and cherry. FA plus imazapyr at 0.14 kg/ha showed excellent control of magnolia, beech, and poplar. Both rates of imazapyr alone provided complete kill of maple (some plants were over 7 m tall) and caused injury beyond treated branches on ash and beech. Contacted branches of oak were killed, but magnolia branches were only injured. Imazapyr at 0.28 kg /ha injured cherry above the treated area. Combining FA with triclopyr, metsulfuron methyl, or imazapyr provided more effective broad sprectrum control than applications of FA or imazapyr alone. Including 0.25% ECO with FA at 1.5% provided control similar to FA alone at 2%.

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2 - Radiarc is a product of Waldrum Specialties, Ambler, PA

TABLE 1: Brush control provided by herbicide treatments applied on September 10-11 1987 in the equivalent of 700 l/ha (75 gpa) of water and rated on July 14, 1988.

TREATMENTS	RATE			CONTROL*								
	% V/V	Kg AI/Ha	Lbs AI/A	MAPLE	OAK	ASH	MAGN-OLIA	BEECH	POP-LAR	CHE-RRY	SASSA-FRAS	APPLE
1. Fosamine ammonium	2.0%	6.7	6.0	4	5	4			4			4
2. Fosamine ammonium	1.5%	5	4.5	4	5	4						
Crop Oil #	0.25%	-	-									
3. Fosamine ammonium	1.5%	5	4.5	6	5	5		5				
Triclopyr ester	0.5%	1.7	1.5									
4. Fosamine ammonium	1.0%	3.4	3.0	6	5	5		5		5		
Triclopyr ester	0.5%	1.7	1.5									
Crop Oil	0.25%	-	-									
5. Glyphosate	1.0%	3.4	3.0	2	2	5						
6. Fosamine ammonium	1.5%	5	4.5	4	7		3				5	
Dicamba + † 2,4-D	0.5%											
7. Fosamine ammonium	1.5%	5	4.5	6	6	6						
Metslufuron methyl	1 oz./A	0.19	0.4									
8. Fosamine ammonium	1.5%	5	4.5	7	6					6		
Imazapyr		0.14	0.1									
9. Fosamine ammonium	1.5%	5	4.5	7	5		6	6	7	6		
Imazapyr		0.28	0.3									
10. Imazapyr		0.14	0.1	7	5	6	3	6				
11. Imazapyr		0.28	0.3	7	5	6	3	6		6		

* Rating Scale:
1 - No Injury
2 - Slight injury to contacted branches
3 - Contacted branches are severely stunted and chlorotic, recovery expected
4 - Some dead tips on contacted branches with some resprouting
5 - All or most of contacted branches are dead
6 - Some branches not contacted by the herbicide are severely injured or dead
7 - Entire plant is dead

\# Emulsifiable crop oil used was Cide-Kick, JLB International Chemical Inc., Vero Beach FL.

† Commercial pre-mix, Banvel 720, containing 1 + 1.9 lb/gallon dicamba + 2,4-D. Manufactured by Sandoz Crop Protection Corporation, Chicago, IL.

TRIASULFURON IN COMBINATION WITH SOME GROWTH REGULATORS IN TURF[1]

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

ABSTRACT

Several experimental and commercially available plant growth regulators (PGRs) were evaluated alone and in combination with triasulfuron for efficacy on three cool-season turfgrasses. Triasulfuron was evaluated for PGR activity as well as for general weed control. Materials were applied in 1988 at the Adelphia Research Center, Adelphia, N.J. The design was a randomized complete block with three replications. Treatments were applied on April 28 and July 18 to Kentucky bluegrass (Poa pratensis L.), tall fescue (Festuca arundinacea Schreb.) and perennial ryegrass (Lolium perenne L.). A CO_2 - propelled backpack sprayer was used with water as the carrier.

In addition to triasulfuron, the PGRs included were: mefluidide, amidochlor, paclobutrazol, and CGA 163935. Rates of triasulfuron alone and in combination with each of the PGRs were .02 and .04 kg/ha. The PGRs alone were also applied at two rates, the higher rate was 25% greater than the lower rate for each compound.

No injury to the turf species was observed following the first treatment. They were applied after complete green-up in the ryegrass and tall fescue and near complete green-up in Kentucky bluegrass. Abundant rainfall following this application may have contributed to the success of this application. Following the second treatment, significant injury was observed in the three species. This application was made during an extensive period of drought with limited irrigation. Injury could not be attributed entirely to chemical application as there was significant billbug (Sphenophorus spp.) damage throughout the field (tall fescue included).

Although there were significant differences amongst each of the turfgrass species, the triasulfuron + CGA 163935 combination at the high rate performed the best. This combination provided a more than 60% reduction in height and 80% reduction in clipping weight. Seedhead suppression was greater than 70%. Paclobutrazol alone at the low rate was the least effective. Color was enhanced by triasulfuron alone, triasulfuron combinations and CGA 163935. Color enhancement was the most pronounced with triasulfuron + CGA 163935 combinations.

Triasulfuron at the high rate performed well as a growth regulator. The weed population was not uniform throughout the field, making it difficult to assess herbicidal efficacy. However, some injury to dandelion (Taraxacum officinale Weber) and annual fleabane (Erigeron annuus L.) was observed six weeks following application.

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1 New Jersey Agricultural Experiment Station Publication No. J-15173-1-88

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BLUEGRASS GROWTH REGULATION AND BROADLEAF WEED CONTROL WITH ACP 2110 PLUS HERBICIDE COMBINATIONS

JENNIFER LANDWEHR VOLLMER AND S. W. BINGHAM[1]

ABSTRACT

The experimental turf growth regulator, ACP 2110, was evaluated alone and in combination with five standard broadleaf herbicides in two studies at the Virginia Tech Turf Research Center, Blacksburg. The objectives of this research were (i) to determine if there was a difference in turf growth regulation when ACP 2110 was applied alone or in combination with broadleaf herbicides and (ii) to determine if there was a significant difference in broadleaf weed control when broadleaf herbicides were applied alone or in combination with ACP 2110. All treatments were applied in 280 L water ha^{-1} and 0.25% v/v nonionic surfactant at 210 kPa to common Kentucky bluegrass (Poa pratensis L.). Treatments for the first study were applied April 25, 1988, to 8 cm turf, mowed twice after 100% green-up. Treatments for the second study were applied August 24, 1988, to 8 cm turf. Each study consisted of three replications in a randomized complete block. Standard rates of 2,4-D, dicamba, 2,4-D plus dicamba, and four commercially available postemergence broadleaf herbicide formulations, 2,4-D plus mecoprop plus dicamba, MCPA plus mecoprop plus dicamba, 2,4-D plus triclopyr and 2,4-D plus dichlorprop were used.

At two weeks there was no significant difference in turf height between ACP 2110 alone, at 0.12 kg ha^{-1}, or in combination with any broadleaf herbicide. At four weeks turf treated with ACP 2110 in combination with 2,4-D plus dichlorprop, dicamba and 2,4-D plus dicamba was significantly taller then turf treated with ACP 2110 alone. There was no difference in turf height between treatments at six weeks. Phytotoxicity occurring from ACP 2110 plus broadleaf herbicide was negligible and not greater than with ACP 2110 alone. Quality ratings for treatments containing both the growth regulator and a broadleaf herbicide were excellent. In contrast, all other treatments exhibited poor quality due to a ragged appearance of the turf from numerous broadleaf weeds or unacceptable turf height.

Weed control with ACP 2110 was slightly greater than or equal to the non-treated check, however, it afforded excellent control of white clover (Trifolium repens L.). Addition of ACP 2110 to the broadleaf herbicides did not affect broadleaf weed control except for control of corn speedwell (Veronica arvensis L.) by 2,4-D plus mecoprop plus dicamba. 2,4-D plus mecoprop plus dicamba alone afforded greater control, 57%, of corn speedwell than when in combination with ACP 2110, with 17% control.

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ACP 2110 Compared with Other PGRs[1]

R. W. Duell, D. A. Smith & D. L. Blackhurst[2]

ABSTRACT

Three rates of two formulations (foliar vs granular) of 2110 were compared against recommended rates of amidochlor and mefluidide on a 13 year old turf of 'Manhattan' perennial ryegrass (lolium perenne L.)-'Fylking' Kentucky bluegrass (Poa pratensis L.). Four replicates were treated after the first trim mow, and four replicates were treated one month later. Half of each of these plots was mowed 23 or 20 days after treated (DAT).

More rain than normal prior to the 23 DAT rating may have contributed to greater than expected discoloration from amidochlor. Embark also discolored foliage more than did foliar applications of 2110. See accompanying data. All three rates of the granular 2110 had statistically superior color quality. The granular carrier was a fertilizer supplying 34 to 57 kg N/ha. At 50 DAT, standard PGRs rebounded to significantly better color quality than for any of the experimental treatments. This color advantage diminished by 72 DAT, and decreased further by 86 DAT. The fertilizer effects of the granular carrier elevated color quality ratings particularly at the median level of application. At 50 DAT and longer, foliage of PGR treated turf consistently had better color than the check. Mowed plots were generally similar to unmowed in terms of turf color.

Suppression of Kentucky bluegrass seedheads was best by mefluidide. Foliar applications of 2110 were more effective in this regard than granular applications. The highest rate of foliar 2110 produced seedhead suppression of Kentucky bluegrasses comparable to that of amidochlor. Ryegrass seedheads, which developed later, were more numerous, and escapes from PGR treatment were therefore unsightly in unmowed plots. Granular applications of 2110 surpressed ryegrass seedstalks better than foliar applications.

Foliar heights 100 DAT were greater with granular 2110 treatments, presumably because of the fertilizer nitrogen stimulation. High rates of the foliar 2110 retained foliar height similar to standard PGRs and significantly shorter than the unmowed checks.

Late applications, in contrast with earlier, encountered hot, dry weather. Rates of granular 2110 were doubled, and nitrogen stimulation, while initially enhancing green color, eventually caused discoloration, particularly of mowed plots. Seedheads of Fylking Kentucky bluegrass were completely eliminated by trim mowing prior to the late application (May 26). Seedheads of Manhattan ryegrass were ready to emerge at this date and no PGR treatment significantly reduced their numbers. High rates of 2110 significantly inhibited ingress of crabgrass (Digitaria sanguinalis L.). The worst invasion of crabgrass resulted from mefluidide applications. Data in addition to the attached are available.

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ACP 2110 COMPARED WITH OTHER PGR's

COLOR QUALITY, EARLY TREATMENT

TREATMENT	RATE (g/ha)	23 DAT UNMOWED COLOR MEAN	50 DAT UNMOWED COLOR MEAN	50 DAT MOWED COLOR MEAN
1. 2110 F	74.1	5.50	6.50	5.75
2. 2110 F	111.2	5.00	6.75	6.50
3. 2110 F	148.2	4.50	6.75	6.75
4. 2110 G	111.2	7.00	6.75	6.00
5. 2110 G	148.2	7.75	6.75	6.75
6. 2110 G	185.3	6.75	6.75	6.75
7. Amido.	2802	3.25	9.00	9.00
8. Mefl.	420	4.00	8.00	8.00
9. Check		6.50	6.00	5.25
LSD		1.4	1.5	1.5

9 = BEST GREEN 5 = ACCEPTABLE

SEEDHEAD COUNT

TREATMENT	RATE (g/ha)	RYE EARLY (.1sq/m)	K.B. EARLY (.1sq/m)	RYE LATE* (.1sq/m)
1. 2110 F	74.1	58.00	13.25	87.50
2. 2110 F	111.2	36.00	14.50	65.50
3. 2110 F	148.2	21.50	4.75	46.50
4. 2110 G	111.2	31.00	24.50	42.25
5. 2110 G	148.2	20.00	20.50	90.00
6. 2110 G	185.3	10.00	21.00	58.50
7. Amido.	2802	11.50	4.50	72.00
8. Mefl.	420	30.25	1.25	62.00
9. Check		58.50	39.00	52.00
LSD @ 1%		36.4	20.7	N.S.

(* note: rates of granular on late treatment are doubled)

FOLIAR HEIGHT EARLY

TREATMENT	RATE (g/ha)	HEIGHT (cm)
1. 2110 F	74.1	19.75
2. 2110 F	111.2	17.25
3. 2110 F	148.2	15.00
4. 2110 G	111.2	20.25
5. 2110 G	148.2	22.00
6. 2110 G	185.3	20.50
7. Amido.	2802	14.75
8. Mefl.	420	16.00
9. Check		24.25
LSD @ 1%		3.8

CRABGRASS RATING LATE

TREATMENT	RATE (g/ha)	RATING MEAN
1. 2110 F	74.1	5.50
2. 2110 F	111.2	6.25
3. 2110 F	148.2	6.25
4. 2110 G	222.4	8.75
5. 2110 G	296.4	8.75
6. 2110 G	370.6	9.00
7. Amido.	2802	8.00
8. Mefl.	420	4.00
9. Check		7.75
LSD @ 1%		2.3

9 = No Crab
5 = Acceptable levels

EVALUATION OF GROWTH REGULATORS ON ROADSIDE TALL FESCUE TURF

G.T. Lyman, T.L.Watschke, and A.E. Gover1/

ABSTRACT

A roadside turf containing primarily tall fescue (Festuca arundinacea Schreb.) was treated with ten chemical combinations on May 11, 1988, using a turf utility vehicle-mounted CO_2 powered spray boom with flat fan nozzles, delivering the equivalent of 327 l/ha of water. The treatments and application rates are listed in Table 1. Plots were 3 by 9.1 m in size and were arranged in a randomized complete block design with three replications. The soil temperature at 0, 1.3, 2.5, 7.6, and 15.2 cm was 17, 18, 16, 12, and 12 ° C respectively. Treatments were evaluated for their effects on turf color, seedhead suppression, broadleaf weed control, and quality. Quality ratings summarized turf color, uniformity of the sward, presence of tall fescue seedheads, and the presence of weeds. Ratings were taken on May 27, (2 weeks after treatment, WAT), June 14 (4 WAT), July 14 (9 WAT), and September 27 (20 WAT).

Two WAT, there was a significant difference in quality between turf treated with ACP-1911x, which had the highest quality rating, and mefluidide plus metsulfuron methyl (MSM), and mefluidide plus ferromec plus dicamba plus pendimethalin, which had the lowest. The turf treated with mefluidide plus ferromec had a significant amount of seedheads present in at least two of the replications. Untreated tall fescue had produced seedheads by this date. There was a significant difference in turf color between the treatments containing MSM or chlorsulfuron which provided the poorest turf color, and mefluidide plus crop oil which provided the best color. Turf treated with mefluidide plus MSM had the lowest color rating at this date.

Four WAT, turf quality for treatments containing ferromec, and mefluidide plus XE-1019 were no different than the untreated check. These treatments did not provide seedhead suppression in any of the plots. An incompatability occurred during mixing of mefluidide plus ferromec plus dicamba, and may have been a factor in the poor seedhead suppression found for these treatments. All other treatments provided significantly better quality than the check. Mefluidide plus MSM provided the highest quality rating.

Rated at nine WAT, mefluidide plus MSM, mefluidide plus chlorsulfuron plus dicamba, ACP-1911x, and glyphosate plus chlorsulfuron provided significantly better quality than all other treatments. Quality differences were due to lack of seedhead suppression and broadleaf weed invasion, as there were no signifcant differences in turf color between any of the treatments.

At 20 WAT, turf quality and broadleaf weed presence were ranked for each replication from best to worst. The treatments that provided the best quality rankings were mefluidide plus MSM, mefluidide plus chlorsulfuron plus dicamba, and glyphosate plus chlorsulfuron. Treatments exhibiting the same amount of broadleaf invasion as the check were mefluidide alone, mefluidide plus ferromec, mefluidide plus crop oil, and mefluidide plus XE-1019. All other treatments had less broadleaf invasion when compared to the check.

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Table 1. The effect of chemical treatments on the color, seedhead suppression,broadleaf weed control, and quality of a tall fescue roadside turf. Treatments were applied on May 11, and rated May 27, June 14, July 14, and Sept. 27, 1988.

Chemical	Kg AI/ Ha	May 27, 1988			June 14,1988				July 14, 1988				Sept. 27, 1988	
		Turf[1/] Color	Seed-[2/] head	Turf[3/] Quality	Turf Color	Seed- Head	Broad-[2/] leaf	Turf Quality	Turf Color	Seed head	Broad leaf	Turf Quality	Broad-[5/] leaf	Turf[5/] Quality
Mefluidide	0.42	5 .7[4/] a-d	1	5.7 ab	4.3 ab	3	2	5.3 bc	5.3 a	3	2	4.3 b	8.3 abc	7.7 abc
Mefluidide Ferromec AC[6/]	0.42 19 l/ha	6.7 ab	2	5.7 ab	4.7 ab	3	1	4.3 cd	5.3 a	3	2	4.0 b	8.0 abc	7.3 abc
Mefluidide Ferromec AC Dicamba	0.42 19 l/ha 0.56	6.0 abc	2	5.3 ab	4.7 ab	3	1	4.3 cd	5.3 a	3	2	3.7 b	2.0 e	5.3 cd
Mefluidide Ferromec AC Dicamba Pendimethalin	0.28 19 l/ha 0.56 1.68	6.0 abc	2	4.7 b	5.0 ab	3	0	4.7 cd	5.3 a	3	1	4.0 b	2.7 de	6.3 bc
Mefluidide Crop oil	0.21 .25 %	7.0 a	1	5.7 ab	5.3 ab	3	1	5.3 bc	5.3 a	2	2	4.0 b	8.7 ab	8.7 ab
Mefluidide Metsulfuron methyl	0.14 0.005	4.0 d	0	4.3 b	5.7 a	0	0	6.7 a	5.3 a	1	1	5.3 a	3.3 de	1.3 e
Mefluidide XE-1019	0.11 0.034	6.3 abc	1	5.3 ab	4.0 b	3	2	4.0 d	5.7 a	3	2	3.7 b	8.3 abc	9.3 ab
Mefluidide Chlorsulfuron Dicamba	0.14 0.013 0.28	4.7 cd	0	5.3 ab	5.3 ab	0	0	6.0 ab	5.7 a	0	1	5.7 a	2.7 de	2.0 e
ACP-1911X	0.36	6.0 abc	0	6.7 a	5.7 a	1	1	6.0 ab	5.3 a	1	1	5.7 a	5.7 bcd	5.0 cd
Glyphosate[7/] Chlorsulfuron	0.21 0.013	5.0 bcd	0	5.3 ab	5.3 ab	0	0	6.3 ab	5.7 a	0	0	6.0 a	5.3 cd	2.7 de
Untreated check	- - -	7.3 a	3	5.0 ab	4.0 b	3	2	4.0 d	5.7 a	3	3	3.7 b	11.0 a	10.3 a

1/ Turf color was rated on a 0 to 9 scale, 0=brown, dead turf, 9=dark green color. Less than 6 is unacceptable
2/ Ratings indicate number of reps in which seedheads and/or broadleaf weeds were present in unacceptable amounts.
3/ Turf Quality was rated on a 0 to 9 scale, 0=dead turf, 9=good weed control, seedhead suppression, and minimal phytotoxicity. Less than 6 is unacceptable.
4/ Means followed by the same letter are not significantly different according to Duncan's Multiple Range Test (P=0.05).
5/ Each replication was ranked for broadleaved weeds (1=least weeds, 11=most weeds) and turf quality (1=best quality-11=worst quality) .
6/ A bonded ferrous iron-urea fertilizer, 15-0-0, manufactured by PBI Gordon Corp., Kansas City, MO.
7/ Sodium sesqui salt of glyphosate.

Methods of Enhancing Fenoxaprop Efficacy Under Drought Stress.

F.S. Rossi, J.C. Neal, and A.F. Senesac 1/

ABSTRACT

The failure of fenoxaprop to provide acceptable control of crabgrass (*Digitaria* spp.) under conditions of moisture stress is well established. Alleviation of the stress with irrigation or enhancement of efficacy with tank mixing remain viable options when applying fenoxaprop. Three separate experiments were conducted in 1988 to determine 1) the effect of alleviating moisture stress with irrigation, 2) tank mixing with pendimethalin to enhance efficacy under field conditions, and 3) simulating drought under the Automated Rainfall Exclusion System for Turfgrass Study (ARESTS) facility using bucket lysimeters and applying fenoxaprop and pendimethalin alone and in combination. Results from the irrigation experiment indicate that optimum control was attained when fenoxaprop was applied the day of the irrigation event and up to two days following. Applications made prior to irrigation and more than two days following were less effective. The second experiment, conducted at three locations on Long Island, New York, involved several rate combinations of fenoxaprop and pendimethalin. The severity of moisture stress was monitored regularly with gypsum blocks, for soil moisture, and pressure chamber measurements of plant water potential taken pre-dawn on the day of application. Application rates were chosen based on results from previous years. Fenoxaprop applied up to 0.40 kg ai/ha provided 45% control and a significant enhancement of control occurred when tank mixed with pendimethalin at 1.68 kg ai/ha. Results from 1988, where soil water potential ranged from -0.7 to -1.0 Mpa and pre-dawn plant water potential ranged from -0.9 to -1.2 Mpa, indicated increased pendimethalin rates for acceptable control were needed. Therefore, a study was performed using bucket lysimeters and the ARESTS facility to simulate drought conditions in the field, maintain fenoxaprop levels, and increase pendimethalin rates to 2.2 and 3.4 kg ai/ha. The data indicate fenoxaprop and pendimethalin alone were ineffective, however the combination with rates of pendimethalin above 2.2 kg ai/ha produce a significant synergistic interaction. Practical implications of these experiments are that irrigation scheduling and tank mixing can over come the reduced efficacy associated with drought stress.

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POSTEMERGENCE HERBICIDES FOR BROADLEAF WEED CONTROL IN TURF

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ABSTRACT

Two field studies were conducted to evaluate postemergent control of various broadleaf weeds in turf. The first study evaluated the control of dandelion (Taraxacum officinale Weber) with DPX-6025 and DPX-6316 in combination with 2,4-D, dicamba, or MCPP and commercial herbicide combinations. The second study evaluated the control of dandelion, and white clover (Trifolium repens L.) with experimental and commercial herbicide combinations. Control was determined by comparing the percent dandelion and clover cover at the time of application to the percent cover at the time of rating.

A randomized complete block design with three replications was used in both studies. Plots were 3 by 10 ft in the first study and 3 by 8 ft in the second study. All treatments were applied with a compressed air powered hand held boom with two 6502 flat fan nozzles spaced 18 inches apart and delivering 655 l/ha. The first study was not irrigated and moisture stress occurred frequently during the test. The second test received enough irrigation to sustain growth.

Treatments in the first study were applied July 30 and rated 10 weeks later. 2,4-D + 2,4-DP + dicamba, 2,4-D + MCPP + dicamba, DPX-6025 + 2,4-D, and DPX-6025 + nitrogen controlled dandelion 80 percent or better. All other treatments provided fair to moderate control, except for all rates of DPX-6316 + nitrogen and the lowest rate of DPX-6025 + nitrogen, which had no control.

Treatments in the second study were applied July 12 and rated 13 weeks later. 2,4-D + 2,4-DP + dicamba and triclopyr + 2,4-D (ester) provided excellent control of dandelion and 2,4-D + 2,4-DP + MCPP, triclopyr + 2,4-D (amine) and MCPA + MCPP + dicamba provided good control of dandelion. 2,4-D + 2,4-DP + dicamba, 2,4-D + 2,4-DP + MCPP, MCPA + MCPP + 2,4-DP, and triclopyr + 2,4-D (amine) provided excellent control of white clover while slightly less control was found for triclopyr + 2,4-D (ester).

It can be concluded from these experiments that control of dandelion (70%) can be accomplished using 2,4-D + 2,4-DP + dicamba, MCPA + MCPP + dicamba, triclopyr + 2,4-D (ester), triclopyr + 2,4-D (amine), 2,4-D + MCPP + dicamba, DPX-6025 + nitrogen, and DPX-6025 + 2,4-D. When control of white clover is also considered, 2,4-D + 2,4-DP + dicamba, 2,4-D + 2,4-DP + MCPP, and triclopyr + 2,4-D (ester) provided at least 70 percent control of both weeds.

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Table 1.0 Control of dandelion in turf with postemergence herbicides applied on July 30, 1988. Rated on October 16, 1988.

Treatment	Rate (kg ai/ha)	Dandelion
		% control
DPX-6025 + N	0.009 + 12.21	-
DPX-6025 + N	0.018 + 12.21	60
DPX-6025 + N	0.035 + 12.21	85
DPX-6025 + 2,4-D	0.018 + 0.84	80
DPX-6025 + Dicamba	0.018 + 0.28	58
DPX-6025 + MCPA	0.018 + 0.56	56
DPX-6316 + N	0.009 + 12.21	-
DPX-6316 + N	0.018 + 12.21	-
DPX-6316 + N	0.035 + 12.21	-
DPX-6316 + 2,4-D	0.018 + 0.84	66
DPX-6316 + Dicamba	0.018 + 0.28	30
DPX-6316 + MCPA	0.018 + 0.56	47
2,4-D + 2,4-DP + Dicamba	0.84 + 0.84 + 0.21	94
2,4-D + MCPP + Dicamba	0.85 + 0.45 + 0.09	89

Table 1.1 Control of dandelion and white clover in turf with postemergence herbicides applied July 12, 1988. Rated on October 20, 1988.

Treatment	Rate (kg ai/ha)	dandelion	clover
		------% control------	
2,4-D + 2,4-DP + Dicamba	0.84 + 0.84 + 0.21	93	100
2,4-D + 2,4-DP + Dicamba	0.56 + 0.56 + 0.14	67	100**
MCPA + MCPP + Dicamba	0.72 + 0.36 + 0.07	32	50*
2,4-D + 2,4-DP + MCPP	0.59 + 0.84 + 0.59	75	100*
MCPA + MCPP + 2,4-DP	0.59 + 0.59 + 0.59	47	98**
Triclopyr + 2,4-D (ester)	0.38 + 0.76	95	70**
Triclopyr + 2,4-D (ester)	0.50 + 1.00	92	70
Triclopyr + 2,4-D (amine)	0.29 + 0.74	28	88**
Triclopyr + 2,4-D (amine)	0.53 + 1.38	70	77
Triclopyr + 2,4-D (amine)	1.06 + 2.76	73	40**
2,4-D + 2,4-DP + Dicamba	0.84 + 0.84 + 0.21	93	100**
MCPA + MCPP + Dicamba	1.09 + 0.55 + 0.11	73	55**

NOTE - * Rating of one replication
** Two replications used to compute average

HERBICIDE TANK MIXES FOR POSTEMERGENCE CONTROL OF SMOOTH CRABGRASS IN TURF

P.H. Dernoeden AND D.B. Davis[1/]

ABSTRACT

All herbicides were applied with flat-fan nozzles in 50 gpa of water at 40 psi. Those study areas involving preemergence herbicide were irrigated within 24 hrs of application. All studies were arranged in a randomized complete block with four replications. Percent of plot area covered by smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.] was determined visually in September 1988.

Postemergence herbicides were applied alone or tank mixed with a preemergence herbicide and applied to areas plugged in July 1987 with either Meyer (Zoysia japonica Steud.) or Emerald (Z. japonica x Z. tenuifolia Wild. ex Trin.) zoysiagrass. When herbicides were applied on 23 May 1988, smooth crabgrass seedlings were in the 2-3 leaf stage. Treatments applied to Meyer (Table 1) that provided excellent (>90%) postemergence and subsequent preemergence control of smooth crabgrass were as follows: MON 15151 1EC (0.5 or 1.0 lb/A), and fenoxaprop tank mixed with either prodiamine, MON 15151, quinclorac or pendimethalin. Meyer cover was improved when competition from crabgrass was reduced by herbicides. At the Emerald site (data not shown in table form) excellent post and subsequent preemergence crabgrass control was provided by DCPA + MSMA (10.5 + 2.0 lb/A) and DCPA (8.0 or 10.5 lb/A) + fenoxaprop (0.12 lb/A). Poor control (23-57%) was provided by oxadiazon 50W (0.5 or 1.0 lb/A) + fenoxaprop (0.12 lb/A); whereas, practically no control (4%) was provided by oxadiazon 50W (0.5 or 1.0 lb/A) + MSMA (2.0 lb/A). Although oxadiazon 50W temporarily yellowed Emerald, none of the treatments caused serious injury to either cultivar of zoysiagrass.

A third, early postemergence test involved quinclorac (1.0 lb/A) applications to smooth crabgrass seedling in the 1-3 leaf stage on 27 May 1988 (data not presented in table form). Regardless of mowing 1 day prior or 3 or 6 days after application or irrigating (1.5 cm) immediately after application versus rain (3 mm) five days after application, quinclorac had provided excellent postemergence and subsequent preemergence control of smooth crabgrass. Quinclorac, however, elicited a chlorosis in Olympic tall fescue (Festuca arundinacea Schreb.), which persisted until mid-July 1988.

The herbicides listed in Table 2 were applied either 29 June when crabgrass had 1-3 tillers or on 9 July 1988 when crabgrass had 3-5 tillers. Excellent (> 90%) control of 1-3 tiller crabgrass was provided by fenoxaprop (0.18 lb/A) and HOE 171 (0.18 lb/A); whereas, HOE 360 (0.09 lb/A) and quinclorac (1.5 lb/A) gave good (80-89%) control. HOE 360 (0.125 lb/A), fenoxaprop (0.25 lb/A), and fenoxaprop (0.18 lb/A) + MON 15151 (0.5 lb/A) provided excellent control of 3-5 tiller crabgrass. Other treatments had provided fair to poor control of tillered crabgrass. MON 15151 and quinclorac appeared to control prostrate spurge (Euphorbia supina Raf.). Because herbicides were applied at about the time spurge seed germinated, it could not be determined if the control was pre or postemergence. Low spurge levels in untreated plots was attributed to a dense, competitive cover provided by crabgrass and perennial ryegrass (Lolium perenne L.) at the time spurge seed germinated.

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Table 1. Early postemergence and subsequent preemergence smooth crabgrass control in Meyer zoysiagrass.

Herbicide*	Rate	Smooth crabgrass** Cover	Smooth crabgrass** Control	Zoysiagrass** Cover
	(lb ai/A)	(%)		
Fenoxaprop 1EC	0.09	33c***	66	67cd
Fenoxaprop 1EC	0.12	72b	27	64cd
Prodiamine 65DG	0.5	28cd	71	69bcd
MON 15151 1EC	0.25	42c	57	56d
MON 15151 1EC	0.50	2e	98	91a
MON 15151 1EC	0.75	1e	99	83abc
Prodiamine 65DG + fenoxaprop 1EC	0.5 + 0.12	2e	98	76a-d
MON 15151 1EC + fenoxaprop 1EC	0.125 + 0.09	10de	90	84abc
Quinclorac 50W + fenoxaprop 1EC	1.0 + 0.09	7e	93	83abc
Pendimethalin 60DG + fenoxaprop 1EC	1.5 + 0.09	1e	99	90ab
Untreated	---	98a	--	25e

*Herbicides were applied 23 May 1988 when smooth crabgrass seedlings were in the 2-3 leaf stage.

**Crabgrass and zoysiagrass cover were visually determined on 2 September and 20 October 1988, respectively.

***Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

Table 2. Postemergence control of smooth crabgrass in an open stand of perennial ryegrass.

Herbicide*	Rate	Crabgrass* stage of growth	Smooth crabgrass** Cover	Smooth crabgrass** Control	Spurge*** Cover
	(lb ai/A)	(tillers)	(%)		(%)
Fenoxaprop 1EC	0.18	1-3	6b+	94	40a
Fenoxaprop 1EC	0.25	3-5	1b	99	38ab
HOE - 360 0.5EW	0.09	1-3	17b	81	41a
HOE - 360 0.5EW	0.125	3-5	4b	96	37ab
HOE - 171 0.5EW	0.18	1-3	6b	94	42a
Quinclorac 50W + crop oil	1.5	1-3	10b	89	9de
MON 15151 1EC + + X-77	0.5	1-3	24b	74	20cd
MON 15151 1EC + X-77	1.0	1-3	19b	79	14cd
MON 15151 1EC + X-77	1.5	3-5	59ab	35	3e
Fenoxaprop 1EC + MON 15151 1EC + X-77	0.18 + 0.5	3-5	4b	96	26bc
Untreated	---	---	91a	—	4e

*Herbicides were applied when crabgrass was either in the 1-3 tiller stage on 29 June 1988 or when crabgrass was in the 3-5 tiller stage on 9 July 1988.

**Smooth crabgrass cover was visually determined on 2 September 1988.

***Prostrate spurge cover was visually determined on 29 July 1988.

+Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

FENOXAPROP-ETHYL IN TURF - A CANADIAN PERSPECTIVE

J.T. Leader [1/]

ABSTRACT

Trials were conducted over a five year period in Ontario and Quebec using fenoxaprop-ethyl (racemic isomer) and fenoxaprop-p-ethyl (resolved isomer) as a post emergent treatment for the control of smooth and hairy crabgrass (Digitaria spp.), green and yellow foxtail (Setaria spp.), barnyard grass [Echinochloa crusgalli (L.) Beauv.] and witch grass (Panicum capillare L.) in all species of cool season turf. Experimental results indicate application rates of 0.2 kg ai/ha of fenoxaprop-ethyl and 0.100 kg ai/ha of fenoxaprop-p-ethyl provide the most consistent control. Applications made prior to a multi tillered stage (before 4 leaves and 3 tillers) provide best control. Tank mixes with phenoxy herbicides cause severe antagonism, where as tank mixes with clopyralid and DPX M6316 show promise. Tank mixes with insecticides show chlopyrifos or carbaryl cause no reduction in grassy weed efficacy or phytotoxicity to turf. Tank mixes with water soluble fertilizers result in a slight reduction in grassy weed control. Applications made with flat fan nozzles provide slightly better control than applications made with nozzles producing droplet sizes greater than 300 microns. All turf species with the exception of seedling Kentucky bluegrass and seedling bentgrass are tolerant to fenoxaprop-ethyl.

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VERONICA FILIFORMIS CONTROL IN COOL-SEASON TURFGRASSES

Joseph C. Neal[1]

ABSTRACT

Slender speedwell (Veronica filiformis) Sm. #VERFI) is a creeping perennial weed for which the current control recommendation is DCPA applied postemergent, at bloom. Golf course superintendents have generally been dissatisfied with this treatment, as areas become reinfested due to incomplete control. Research has been conducted over the past two years to evaluate recently developed herbicides for control of this weed. Results from our 1987 experiments showed that quinclorac provided excellent control when applied at 1.1 to 2.2 kg/ha in May. Experiments were conducted in 1988 to further evaluate this product for slender speedwell control. Five experiments were established to evaluate various rates (0.28 to 1.1 kg/ha), tank mixes (with 2,4-D, triclopyr, chlorflurenol, and 2,4-DPP), application method (volume, nozzles, granular), and the season of application. Treatments were compared to DCPA at 13.4 kg/ha (the recommended control), and to labeled rates of chemical standards for broadleaf weed control: 2,4-D + triclopyr and 2,4-D + MCPP + dicamba (see Table 1).

Results from these tests confirm 1987 observations, in that quinclorac provided control superior to DCPA. May applications at 0.84 kg/ha produced 99% to 100% control of slender speedwell (Table 1). When applied to a monoculture stand of VERFI at bloom, control was less than 90% but significantly superior to DCPA or 2,4-D + triclopyr (Table 1). Rate response studies were conducted in the summer and fall. Control in the summer test was inferior to results from the May experiment, but there was a significant rate response from 0.28 to 0.84 kg/ha. Spray volume (from 5.6 to 935 L/ha) did not affect quinclorac efficacy; however, flat fan nozzle treatments were slightly more effective than flooding nozzle treatments ($P = 0.05$). Results from the fall experiments were incomplete at the time this abstract was prepared, but will be discussed. Tank mixes of quinclorac with other postemergent herbicides did not affect slender speedwell control (Table 1) or turfgrass phytotoxicity. However, the spectrum of weed control was enhanced by tank mixes with 2,4-D in other tests.

Quinclorac caused significant phytotoxicity to a mixed cool season turf (Table 1), expressed as discoloration and reduced turf density. However, the injury ratings were only slightly higher than those for labeled herbicides. Injury was more severe in the summer experiment (data not presented), but the results were confounded by the severe drought during the summer of 1988. In a separate phytotoxicity experiment, quinclorac caused no injury to Kentucky bluegrass, perennial ryegrass, chewing fescue, or tall fescue. This experiment was irrigated.

Results from the past two years of research clearly show that quinclorac produces control of slender speedwell, equal or superior to currently labeled alternatives. Some phytotoxicity may be associated with quinclorac treatment, but further research is needed to refine the factors influencing phytotoxicity and efficacy.

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Table 1. *Veronica filiformis* (VERFI) control in two experiments, evaluated approximately 10 weeks after treatment.

		VERFI Control Evaluations, by Experiment[1]			
	Rate	EXPT #1			EXPT #2
Treatment	kg/ha	%Control	%Cover	Phyto[2]	%Cover
Untreated		7	40	0.7	(100)
Quinclorac[3]	0.84	100	0	3.3	13
Quinclorac	1.1	99	0.3	3.0	--
Quinclorac + 2,4-D amine	0.84 1.1	99	1.7	3.3	13
Quinclorac + triclopyr amine	0.84 1.1	99	0.3	4.0	13
Quinclorac + chlorflurenol	0.84 0.28	99	0.3	3.7	--
Quinclorac + 2,4-DPP	0.84 1.1	100	0	4.0	--
DCPA (6FL)	13.4	87	5	0.3	73
2,4-D + triclopyr (Turflon D)	1.1 + 0.5	50	27	2.7	99
2,4-D + MCPP + dicamba (Trimec)	1.1 +0.6+0.12	60	20	2.3	--
LSD 0.05		15	8.2	2.0	14

[1]Expt 1 was conducted on a mixed cool season turfgrass. Expt. 2 was on a monoculture stand of VERFI where untreated areas had 100% cover of VERFI.

[2]Turfgrass phytotoxicity was visually evaluated on a 0 to 10 scale where 0 = no injury and 10 = 100% dead turf.

[3]All quinclorac treatments also contained 2.3 L/ha of a non-ionic surfactant (BAS 09002S).

PRE- + POSTEMERGENCE HERBICIDE COMBINATIONS FOR SMOOTH CRABGRASS CONTROL IN TURF

S. A. Harrison and T. L. Watschke[1]

ABSTRACT

Several studies were conducted in 1988 to evaluate the potential advantages of pre- + postemergence herbicide tank mixes over individual pre- or postemergence herbicide treatments for single application, full season control of smooth crabgrass (Digitaria ischaemum (Schreb.) Muhl.) in fine turf. Herbicides were applied alone according to local use recommendations or as pre-post tank mixes to maximize the benefits of each component. These included: pendimethalin (1.68 kg/ha), DCPA (11.76 kg/ha), oxadiazon (0.56 to 1.68 kg/ha), MON-15151 (0.14 to 1.12 kg/ha), and MON-15177 (0.14 to 1.12 kg/ha) applied preemergence; fenoxaprop (0.2 kg/ha), MSMA (2.24 kg/ha), MON-15151 (0.56 to 1.68 kg/ha), and MON-15177 (0.56 to 2.24 kg/ha) applied postemergence to crabgrass with up to 5 tillers; and pendimethalin + fenoxaprop (1.68 + 0.09 kg/ha), DCPA + MSMA (8.4 + 2.24 kg/ha), oxadiazon + fenoxaprop (0.56 and 1.12 + 0.14 kg/ha), and oxadiazon + MSMA (0.56 and 1.12 + 2.24 kg/ha) applied as tank mixes to emerging crabgrass.

Results of the various studies are presented in Table 1. Extreme heat and drought conditions resulted in significant variability in soil moisture, crabgrass germination and stage of growth, and herbicide efficacy. Generally, preemergence herbicides exhibited the most consistent and effective control of smooth crabgrass when applied according to recommendations. Postemergence herbicide activity, particularly from fenoxaprop, was extremely variable in both the pre-post tank mixes and the later postemergence applications. With the exception of the oxadiazon + fenoxaprop tank mix, little benefit was realized from the use of the tank mixes over their individual components at normally recommended timings. MSMA (2.24 kg/ha), applied either once or as a 14 day sequential, was the most efficacious postemergence herbicide. Under less than optimum soil moisture conditions, DCPA + MSMA provided more effective control of 1 to 3 leaf crabgrass than pendimethalin + fenoxaprop. Where irrigation was frequent, oxadiazon + fenoxaprop tank mixes were more efficacious than oxadiazon + MSMA when applied to crabgrass beginning to tiller.

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Table 1. Pre-, pre- + post-, and postemergence crabgrass control observed on 8/23/88.

	Crabgrass control (%)
PREEMERGENCE TREATMENTS (applied 4/28/88)	
1. Pendimethalin 60DG (1.68 kg/ha)	96
2. DCPA 6F (11.76 kg/ha)	80
3. Oxadiazon 50WP (1.12 kg/ha)	67
4. Oxadiazon 50WP (1.68 kg/ha)	84
5. MON 15151 1EC (0.14 kg/ha)	73
6. MON 15151 1EC (0.28 kg/ha)	88
7. MON 15151 1EC (0.56 kg/ha)	95
8. MON 15177 0.25G (0.14 kg/ha)	92
9. MON 15177 0.25G (0.28 kg/ha)	93
10. Control % crab cover =	80
PRE-POST (I) TREATMENTS (applied 6/1/88)	
1. Fenoxaprop 1EC (0.2 kg/ha)	11.8
2. " + pendimethalin 60DG (0.2 + 1.68 kg/ha)	78.8
3. Pendimethalin 60DG (1.68 kg/ha)	75.3
4. DCPA 6F + MSMA 6F (8.4 + 2.24 kg/ha)	85.3
5. Control % crab cover =	56.7
PRE-POST (II) TREATMENTS (applied 6/24/88)	
1. Oxadiazon 50WP + fenoxaprop 1EC (0.56 + 0.14 kg/ha)	97.4
2. Oxadiazon 50WP + MSMA 6F (0.56 + 2.24 kg/ha)	73.0
3. Control % crab cover =	90.0
POSTEMERGENCE (I) TREATMENTS (applied 7/16/88)	
1. Fenoxaprop 1EC (0.2 kg/ha)	55.0
2. MSMA 6F (2.24 kg/ha)	86.2
3. MSMA 6F (2.24 kg/ha, 14 day sequential)	97.4
4. MON 15151 1EC (1.12 kg/ha)	72.5
5. MON 15151 1EC (1.68 kg/ha)	81.7
6. Control % crab cover =	73.3
POSTEMERGENCE (II) TREATMENTS (applied 7/15/88)	
1. MON 15177 0.25G (0.56 kg/ha)	72.7
2. MON 15177 0.25G (1.12 kg/ha)	77.6
3. MON 15177 0.25G (1.68 kg/ha)	90.6
4. MON 15177 0.25G (2.24 kg/ha)	96.0
5. Control % crab cover =	78.3

PREEMERGENCE HERBICIDES FOR GRASS CONTROL IN KENTUCKY BLUEGRASS

William J. Chism and S. Wayne Bingham[1]

ABSTRACT

Field research to determine herbicide efficacy for large crabgrass [Digitaria sanguinalis (L.) Scop.] control was conducted in 1987 and 1988. All treatments were applied to 2 by 2 m plots of Plush Kentucky bluegrass at the Turf Research Center at Virginia Tech. Herbicides were applied with either a CO_2 backpack sprayer at 207 kPa with an application rate of 3.21 L/ha or a "Scott" drop type fertilizer spreader for the granular materials.

The 1987 research was on established turf with a high crabgrass population (50 plants / 1.7 m^2 in the controls). The herbicides tested were benefin, benefin + isoxaben, benefin + trifluralin + isoxaben, DCPA, oxadiazon, pendimethalin, and prodiamine. Turf quality was acceptable for all rates of DCPA, oxadiazon, pendimethalin, benefin and benefin combinations. Turf thinning was greatest with Fall applications of prodiamine. Crabgrass was adequately controlled by all treatments except Fall applications of DCPA.

The 1988 research was conducted on Fall seeded Plush bluegrass. Crabgrass failed to emerge in any of the test plots in these experiments. The herbicides tested were MON 15151, MON 15177, prodiamine, oxadiazon, and pendimethalin. Turf quality and turf phytotoxicity was acceptable for all herbicides except the highest rates of MON 15151. Turf thinning was greatest with the high rate of MON 15151.

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PREEMERGENCE CONTROL OF SMOOTH CRABGRASS AND GOOSEGRASS IN MARYLAND IN 1988

P.H. Dernoeden and D.B. Davis[1/]

ABSTRACT

The herbicides evaluated were initially applied between April 6 to 8 and sequentials were applied May 18 or 19, 1988. All test areas were irrigated within 24 hrs of application. All studies were arranged as a randomized complete block with four replications per treatment. Percent of plot area covered by smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.] or goosegrass [Eleusine indica (L.) Gaertn.] was visually determined in September 1988.

Data presented in Table 1 shows that pendimethalin (1.5 + 1.5 lb/A), prodiamine (0.5 or 0.75 lb/A), all three formulations of oxadiazon, MON 15151 (0.5 or 1.0 lb/A) and benefin + trifluralin provided excellent (>90%) control of smooth crabgrass. DCPA provided good (>80%) smooth crabgrass control; however, poor to no preemergence control was provided by bensulide, cinmethylin and quinclorac. In a second study (data not shown in table form) herbicides were applied to a turf that had been inundated with smooth crabgrass in previous years. Although untreated plots had 100% crabgrass cover, MON 15179 0.5G (0.5 lb/A) had provided 98% control, and MON 15151 1EC (1.0 lb/A) and oxadiazon 50W (2.0 lb/A) had provided 85 and 84% control, respectively. Benefin + trifluralin (2.0 lb/A) gave 76% control, while MON 15179 0.5G (0.25 lb/A), pendimethalin 60DG (3.0 lb/A) and oxadiazon 127 gr/L ME (3.0 lb/A) provided between 51 and 60% control. Treatments providing poor (0 to 23%) control were as follows: MON 15151 1EC (0.125, 0.25 and 0.5 lb/A), MON 15179 0.5G (0.125 lb/A), pendimethalin (1.5 lb/A), oxadiazon ME (1.0 or 2.0 lb/A), oxadiazon 50W (1.0 lb/A), and oxadiazon 2G (2.0 lb/A).

At adjacent, preemergence control studies on a golf course fairway, no goosegrass plants were observed until mid-July, 1988. Data collected in September (Table 2), showed that three formulations of oxadiazon (3.0 lb/A), MON 15151 1EC (0.5 or 1.0 lb/A), and pendimethalin 60DG (3.0 or 1.5 + 1.5 lb/A) gave excellent (>92%) goosegrass control. Poor to no preemergence control was provided by cinmethylin or quinclorac. In a second study (no data presented in table form), where herbicides were applied 8 April, prodiamine 65DG (0.75, 1.0 or 1.5 lb/A), oxadiazon 2G (4.0 lb/A), pendimethalin 60DG (3.0 or 1.5 + 1.5 lb/A), and MON 15151 1EC (1.0 lb/A) provided excellent (94%) control of goosegrass. When oxadiazon 2G (2.0 lb/A) application was delayed until 19 May, excellent (92%) preemergence goosegrass control was also achieved.

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

Herbicide*	Rate	Crabgrass** Cover	Control
	(lb ai/A)	(%)	
DCPA 6F	10.5	14d***	80
DCPA 6F	10.5 + 5.2	12d	83
Pendimethalin 60DG	1.5 + 1.5	<1d	99
Pendimethalin 60DG	3.0	12d	83
Prodiamine 65DG	0.5	2d	97
Prodiamine 65DG	0.75	<1d	99
Quinclorac 50W	1.0	59b	17
Quinclorac 50W	1.5	80a	0
Oxadiazon ME	3.0	2d	97
Oxadiazon 2G	3.0	0d	100
Oxadiazon 50W	3.0	0d	100
Benefin + Trifluralin 2G	2.0 + 1.0	<1d	99
Bensulide 4EC	10.0	35c	53
Mon 15151 1EC	0.5	1d	99
Mon 15151 1EC	1.0	0d	100
Cinmethylin 7EC	1.0	75a	0
Cinmethylin 7EC	2.0	71ab	0
Untreated	---	71ab	--

*Herbicides were initially applied 6 April and sequential treatments were applied 18 May 1988.

**Cover was visually assessed on 6 September 1988.

***Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

Table 2. Preemergence control of goosegrass in a mixed perennial ryegrass (Lolium perenne L.) and common bermudagrass (Cynodon dactylon L.) fairway.

Herbicide*	Rate	Goosegrass** Cover	Control
	(lb ai/A)	(%)	
Oxadiazon 127 gr/L ME	3.0	1c***	98
Oxadiazon 50W	3.0	0c	100
Oxadiazon 2G	3.0	0c	100
Mon 15151 1EC	0.5	5c	92
Mon 15151 1EC	1.0	2c	97
Pendimethalin 60DG	3.0	2c	97
Pendimethalin 60DG	1.5 + 1.5	<1c	99
Quinclorac 50W	1.0	65a	0
Quinclorac 50W	1.5	38b	38
Cinmethylin 7EC	1.0	55ab	10
Cinmethylin 7EC	2.0	34b	44
Untreated	---	61a	--

*Herbicides were applied 8 April and the sequential treatment was applied 19 May 1988.

**No goosegrass was observed in the test site until mid-July and goosegrass cover was visually determined 6 September 1988.

***Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

Effect of Crabgrass Growth Stage on Efficacy on MON 15151.

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ABSTRACT

The ability of a herbicide to provide consistent control is largely dependent on proper application timing. Experiments were conducted in 1988 on a fallow area and on a Kentucky bluegrass turf to determine preemergent activity of MON 15151. Results indicate excellent preemergent control of crabgrass(*Digitaria* spp.) on the turf with 0.56 kg ai/ha and 0.84 kg ai/ha on the fallow area. A postemergent trial was performed on a drought stressed area with rates of MON 15151 between 0.28 and 1.68 kg ai/ha compared with fenoxaprop and MSMA at recommended rates. A linear rate response was demonstrated for early and late post applications of MON 15151. Early post MON 15151 applications to untillered crabgrass were more effective than fenoxaprop, but not as effective as MSMA. Drought conditions at the early post timing prevented fenoxaprop from affording more than 37% control, while MSMA, less influenced by drought, exhibited 88% control. Middle post treatments following rainfall to 1 to 3 tillered crabgrass were not significantly different at rates above 0.56 kg ai/ha, therefore did not exhibit a rate response, and were less effective than fenoxaprop and MSMA. Treatments of MON 15151 applied to crabgrass with more than 3 tillers were consistently less effective than early and mid post treatments at corresponding rates. Late post applications demonstrated a linear rate response, with a minimum of 1.4 kg ai/ha required to provide >80% control. Further, late post rates above 1.4 kg ai/ha were as effective as fenoxaprop and more effective than MSMA, which normally requires multiple applications particularly at late timings. Overall results of MON 15151 suggest excellent performance as a preemergent, early timing treatments at rates above 0.56 kg ai/ha to be most effective and comparable to MSMA, while providing better control than fenoxaprop under droughty conditions. Applications to tillered crabgrass requires rates above 1.12 kg ai/ha to be as effective as standard treatments.

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PREEMERGENCE CONTROL OF CRABGRASS, SPURGE AND OXALIS AND PRE-POST, POST CONTROL OF CRABGRASS IN TURF

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ABSTRACT

Five lawn studies were initiated in 1988, four had Kentucky bluegrass (Poa pratensis L.) and one red fescue (Festuca rubra L.). Control of crabgrass [Digitaria ischaemum (Schreb.) Muhl.], prostrate spurge (Euphorbia supina Raf.) and oxalis (Oxalis spp.) with herbicides was evaluated. The herbicides, formulations, rates and dates of application are shown in Table 1. Ethofumesate was applied May 5 in the April 20 study. Granular materials were applied by hand and sprays at 75 GPA. In the pre-post and post trails X-77 at 5% V/V was added to MON-15151. SDS66707 was used at 43.56 oz/A. Plots were 16 to 20 sq ft with 3 or 4 replications. Heavy rainfall started 16 hours after post treatments. Other trials had rainfall or irrigation 1 to 4 days later. Weed control was based on cover in check plots. Oxalis control included bensulide plots and spurge (Apr. 6 study) included treatments with heavy spurge. Crabgrass and oxalis germinated from early May to early July. Most spurge germinated in June. Crabgrass in the pre-post study was in the 1-4 leaf stage with later germination. In the post study crabgrass ranged from several leaf to 6 tillers. Results of the studies are shown in Table 1.

Pre crabgrss. Bensulide, DCPA, flumetralin, MON-15151, pendimethalin and two applications of ethofumesate provided excellent control (90-100%). Good (80-89%) to excellent control was obtained with ethofumesate, oxadiazon and prodiamine (red fescue injury at .75 lb rate). Control from benefin + trifluralin ranged from fair (70-79%) to excellent. Isoxaben results were poor to fair. The following formulations provided similar results: DCPA WP and F, oxadiazon G, WP and ME, MON-15151 G and EC, and prodiamine G and WDG.

Pre-post crabgrass. Ethofumesate, fenoxaprop and MSMA applied to 1-4 leaf crabgrass with later germination provided less than 62% control. MON-15151 (.5 lb) gave excellent control, showing pre and post activity. Higher rates than those successful for pre control appear necessary. Injury in one of four KB lawns was noted at the .75 lb rate. Good to excellent control was obtained by combining fenoxaprop or MSMA with DCPA or MON-15151 and fenoxaprop with pendimethalin or prodiamine. A second MSMA treatment improved control.

Post crabgrass. Fenoxaprop EC or EW gave good to excellent control of tillered crabgrass. The SUPER formulation was more effective but caused greater KB injury. Two applications of MSMA, with or without SDS66707, provided excellent control, however, KB was injured. SDS66707 reduced the degree of injury. MON-15151 (1.5 lb) provided fair control.

Pre spurge and oxalis. Excellent control of spurge was obtained with isoxaben and MON-15151 (1 lb). Fair to excellent spurge results were provided by DCPA, pendimethalin and prodiamine. Spurge results with benefin + trifluralin were poor to good and with oxadiazon poor to fair. Bensulide, ethofumesate, fenoxaprop and MSMA were the least effective materials. The most effective herbicides for oxalis control were DCPA, MON-15151, oxadiazon and pendimethalin. Fair oxalis control was provided by isoxaben and poor control with benefin + trifluralin, bensulide and prodiamine.

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Table 1. Control of smooth crabgrass, prostrate spurge and oxalis in 1988.

TREATMENT		% CRABGRASS CONTROL					% PREEMERGENCE CONTROL			
		PREEMERGENCE			PRE-POST	POST	SPURGE			OXALIS
		KB	KB	RF	KB	KB	KB	KB	KB	KB
HERBICIDE	LB ai/A	4/6	4/20	4/20	6/2	7/26	4/6	4/20	6/2	4/6
benefin + trifluralin G	2.0	75	99	–	–	–	52	88	–	51
bensulide EC	10(4/6)12(4/20)	91	98	–	–	–	23	10	–	0
DCPA WP	10.5	–	98	–	–	–	–	95	–	–
DCPA F	10.5	91	–	–	–	–	78	–	–	95
ethofumesate EC	1.5	–	–	89	60	–	–	–	33	–
" " "	1.5 (+617)	–	–	97a	–	–	–	–	–	–
fenoxaprop SUPER	.09	–	–	–	–	95b	–	–	–	–
fenoxaprop EW	.18	–	–	–	–	96a	–	–	–	–
fenoxaprop EC	.09	–	–	–	–	76	–	–	–	–
" "	.12	–	–	–	57	–	–	–	13	–
" "	.18	–	–	–	–	89a	–	–	–	–
fenoxaprop EC										
+ DCPA F	.12 + 7.5	–	–	–	88a	–	–	–	99	–
+ MON-15151 EC	.09 + .5	–	–	–	–	92a	–	–	–	–
+ " " "	.12 + .125	–	–	–	84a	–	–	–	77	–
+ " " "	.12 + .25	–	–	–	96a	–	–	–	65	–
+ oxadiazon WP	.12 + 1.0	–	–	–	77	–	–	–	32	–
+ pendimethalin WDG	.12 + 1.5	–	–	–	95	–	–	–	99	–
+ prodiamine WDG	.12 + .75	–	–	–	95	–	–	–	95	–
flumetralin EC	1.5	–	–	99	–	–	–	–	–	–
" " "	3.0	–	–	99a	–	–	–	–	–	–
isoxaben DF	.75	20	78	–	–	–	100	99	–	79
MON-15179 G	.125	–	94	–	–	–	–	19	–	–
" " "	.25	–	100	99	–	–	–	96	–	–
" " "	.5	–	100	100a	–	–	–	100	–	–
MON-15151 EC	.125	–	92	–	–	–	–	44	–	–
" " "	.25	–	95	–	73a	–	–	63	84	–
" " "	.5	95	100	–	98a	40	63	98	79	99
" " "	.75	–	–	–	99b	–	–	–	87	–
" " "	1.0	94	100	–	–	59	92	100	–	99
" " "	1.5	–	–	–	–	77a	–	–	–	–
MSMA S	1.0	–	–	–	–	42	–	–	–	–
" "	2.0 (+6/15)	–	–	–	62	–	–	–	23	–
" "	2.0 (+8/10)	–	–	–	–	100c	–	–	–	–
MSMA S + SDS66707	2.0 (+8/10)	–	–	–	–	99b	–	–	–	–
MSMA S + DCPA F	1.5 (+6/15)+7.5	–	–	–	98	–	–	–	99	–
" " " "	2.0 + 7.5	–	–	–	88	–	–	–	100	–
MSMA S + MON-15151 EC	1.0 + .25	–	–	–	94	–	–	–	85	–
" " + " " "	1.0 + .5	–	–	–	–	79	–	–	–	–
MSMA S + oxadiaxon WP	2.0 + 1.0	–	–	–	78	–	–	–	56	–
oxadiazon G	2.0	–	95	96	–	–	–	33	–	–
" "	2.5	80	–	–	–	–	23	–	–	94
oxadiazon WP	2.0	–	99	–	–	–	–	78	–	–
oxadiazon ME	2.0	–	95	–	–	–	–	42	–	–
pendimethalin WDG	1.5	–	95	98	–	–	–	86	–	–
" " "	2.0	92	–	–	–	–	70	–	–	99
prodiamine WDG	.5	–	–	99	–	–	–	–	–	–
" " "	.75	88	100	99b	–	76	99	–	–	39
prodiamine G	.5	–	–	99a	–	–	–	–	–	–
Weed cover in checks		76%	47%	54%	93%	93%	6%	16%	18%	9%
Evaluation date		7/25	8/11	8/15	8/10	9/8	8/1	8/11	8/10	7/25

a, b, c Turf injury rated on a scale of 0 to 10: 10 = brown and 2.0 or higher considered objectionable: a = 1 to 1.9, b = 2 to 2.9 and c = 4.0 maximum during test period.

EVALUATION OF ACP-2110 AS A TURFGRASS GROWTH REGULATOR

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ABSTRACT

ACP-2110, an experimental plant growth regulator (PGR), was evaluated in a field trial in the spring and summer of 1988 at the University of Rhode Island Turf Research Farm, Kingston, Rhode Island. The test area was a dense, twelve-year-old lawn of 90% red fescue (Festuca rubra L. 'Pennlawn') and 10% perennial ryegrass (Lolium perenne L.) and Kentucky bluegrass (Poa pratensis L.). Treatments and rates of application are shown in Table 1. A non-ionic surfactant was added to treatments containing ACP-2110 at a rate of 0.25% v/v. PGR's were applied in 75 GPA water with a CO_2 sprayer equipped with a 3-nozzle boom covering a swath 4.5 ft. wide. Plots were 4.5 ft. wide and 25 ft. long with four replications in a randomized complete block design. The area was mowed five days before treatment and had reached 100% green-up by the April 26,1988 treatment date. Two days after treatment 2.27 inches of precipitation fell on the area. An application of benomyl (2.7 lb ai/A) and chlorothalonil (1.4 lb ai/A) was made two weeks after treatment when red thread (Laetisaria fuciformis) was noted in the area. Six weeks after treatment (June 7), two-thirds of each plot was mowed to a height of approximately 1.5 in. One-third of this area was allowed to regrow for the duration of the test while the remaining third was mowed weekly to 1.5 in.

All PGR treatments were effective in suppressing growth for up to six weeks. The least growth occurred in plots treated with ACP-2110 at .10 and .13 lb up to six weeks after treatment. Where plots had been mowed six weeks after treatment and allowed to grow for four weeks, there were no differences in height between treated and untreated plots.

Seedhead suppression ranged from 85% for amidochlor to 99% for mefluidide. Seedhead density greater than 25 seedheads/sq. ft. was considered objectionable for this test site. Seedheads in all treated plots were stunted and less noticeable than those in control plots. Seedhead density was considered objectionable with the .07 lb rate of ACP-2110, however the .10 lb rate resulted in good suppression and the .13 lb rate provided 98% control.

Turf injury was noticeable although not objectionable with ACP-2110 treatments at the .07 and .10 lb rates. At the .13 lb rate however, injury became objectionable by the fourth week and persisted through the sixth week. Turf injury from mefluidide became objectionable during the fourth week after treatment but diminished by the sixth week. Injury from amidochlor was nearly objectionable at four weeks after treatment and had become more severe by the sixth week. In the unmowed turf at eight weeks after treatment PGR-treated turf, especially those with suppressed seedheads, had better quality than either the mowed or unmowed check plots. Disease, primarily red thread, was prevalent throughout the test area. The poor quality of the mowed checks was due to disease as well as mowing discoloration.

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Table 1. Effect of PGR's on turf height and seedhead suppression.

TREATMENT	RATE (lb ai/A)	HEIGHT WAT: 2	4	6	8	10	HEIGHT OF TURF MOWED 6 WAT[1] 8	10	R. FESCUE SEEDHEADS SQ. FT. 10
		in.							
1. ACP-2110	.07	2.7	3.8	4.8	6.1	6.7	3.4	3.7	54 (89)[2]
2. "	.10	2.7	2.8	3.8	6.0	6.1	3.7	3.5	20 (96)
3. "	.13	2.5	3.0	3.3	4.9	6.0	3.5	4.1	9 (98)
4. mefluidide 2S	.38	2.8	3.5	4.8	5.9	6.4	3.6	3.7	2 (99)
5. amidochlor 4F	2.5	2.7	3.5	4.3	6.1	7.7	3.7	3.9	75 (85)
6. UNMOWED CHECK	-	3.7	5.3	7.0	9.4	9.6	3.8	3.9	492 -
7. MOWED CHECK	-	2.9	1.9	1.8	1.5	1.5	1.5	1.5	- -

[1]One-third of each block was mowed to 1.5 in. 6 WAT (June 7) and allowed to regrow.
[2]Numbers in parentheses indicate % control.

Table 2. Effect of PGR's on turf quality.

TREATMENT	RATE (lb ai/A)	TURF INJURY[1] WAT: 2	4	6	TURF QUALITY[2] UNMOWED 8	MOWED 6 WAT 8	MOWED 6,7,8 WAT 8
1. ACP-2110	.07	1.0	1.4	1.3	5.5	5.0	4.3
2. "	.10	.8	1.4	1.5	5.2	6.0	5.3
3. "	.13	.9	2.2	2.5	5.5	6.1	5.3
4. mefluidide 2S	.38	1.0	2.2	1.3	6.3	4.6	4.3
5. amidochlor 4F	2.5	.8	2.1	3.7	3.4	4.0	2.5
6. UNMOWED CHECK	-	.4	.2	.4	2.2	2.5	2.8
7. MOWED CHECK	-	.7	3.2	3.0	3.0	3.0	3.8

[1]Visual rating on a scale of 0-10. 0=no injury, 10=dead turf and >2.0 considered objectionable.
[2]Visual rating on a scale of 0-10. 0=100% brown turf, 10=100% green turf. Includes the effect of such factors as seedheads, uniformity, disease and mowing on overall appearance.

PGRs x Turfgrass Cultivars 1988[1]

R. W. Duell, D. A. Smith & A. I. Farrell[2]

ABSTRACT

Five PGRs were applied in 3 replicates to 18 month-old turfgrass cultivars that had been maintained as industrial quality turf. Differential spring green-up was noted among the 18 cultivars. The 26th of April was chosen as the compromise date for treatment at which time dormancy was overcome but seed stalk development would not be too far advanced. Half of each plot was trim-mowed 20 days after treatment (DAT).

Mefluidide caused more discoloration of the 4 Kentucky bluegrass (KB) (Poa pratensis L.) cultivars than other PGRs, 20 DAT. See attached data. Tall fescues (TF) (Festuca arundinacea Schreb.)were growing more rapidly, and 6 cultivars of this species were discolored much less. The 2 ryegrasses (Lolium perenne L.) and 6 fine fescues (Festuca spp.) were intermediate in degree of discoloration by PGRs. ACP 2110 was the best chemical on 'Palmer' ryegrass, but caused notable discoloration in 'Repell' ryegrass and 'Banner' Chewings fescue. Mefluidide at the recommended rate, or at 1/3 rate plus a 1/3 rate of 2110 caused minimal discoloration in 1 of 2 sheeps fescues and 2 hard fescue cultivars. At 51 DAT, "rebound", particularly color improvement of KB cultivars treated with mefluidide, became apparent. Mefluidide-treated fine fescues generally had better color than untreated checks.

'Troy' KB was further advanced at time of treatment, and seedheads were not controlled well by any PGR, but mefluidide controlled all others. ACP 2110 was least effective in controlling seedheads. At 1/3 rates of these 2 PGRs, combined control of seedheads was acceptable for the 3 turf type cultivars of Kentucky bluegrass. All PGRs provided good seedhead control on the TF cultivars with the exception of marginal control of KY31 by amidochlor. Eptam and amidochlor controlled seedheads of both ryegrasses and 'Fortress' spreading fescue, but not Banner chewings fescue. Seedheads of early-flowering 'Reliant', 'Spartan' hard fescues and 'Bighorn' sheeps fescue were not controlled well by any of the PGRs. Seedhead height generally parallelled seedhead count. Many of the hard and sheep fescue seedheads were so short as to escape mowing, but tall enough to appear unsightly after mowing.

An earlier application date for the fine fescues and Troy KB might have resulted in acceptable control of seedheads. Amidochlor controlled seedheads and foliar growth better this season because of greater than normal rainfall following treatment. Several suggestions of synergism appear throughout the data with 1/3 rates of mefluidide plus ACP 2110. Ratios of these PGRs should be further researched, over an array of cultivars of various species.

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PGR's X TURFGRASS CULTIVARS 1988

COLOR RATING 20 DAT		KENTUCKY BLUEGRASS CULTIVARS			
TREATMENT	RATE(g/ha)	MERION	TROY	MYSTIC	BARON
1.Mefluidide	420	3.3	3.3	2.7	3.7
2.Eptam	1135	6.0	5.0	5.3	6.3
3.Amidochlor	2802	4.3	5.0	4.7	6.3
4.ACP 2110	45.4	5.3	6.0	6.0	5.7
5. .3 #1 & 4		4.3	5.3	4.0	4.3
6.Check		7.7	7.7	8.0	8.0
LSD @ 1%		2.2	2.1	1.6	2.3

SEEDHEAD COUNT (.1sq m)					
1.Mefluidide	420	0.0	26.3	0.0	0.0
2.Eptam	1135	0.0	40.7	2.7	7.7
3.Amidochlor	2802	4.0	42.7	5.7	25.7
4.ACP 2110	45.4	34.3	52.0	10.3	47.3
5. .3 #1 & 4		0.3	32.7	0.0	2.3
6.Check		45.0	63.3	11.7	80.7
LSD @ 5%			NS		40.1
@ 1%		12.3		8.1	

SEEDHEAD HEAD HEIGHT (cm)					
1.Mefluidide	420	0.0	17.0	0.0	0.0
2.Eptam	1135	0.0	17.3	5.0	11.0
3.Amidochlor	2802	18.3	32.0	18.3	18.7
4.ACP 2110	45.4	22.0	49.3	26.0	21.0
5. .3 #1 & 4		4.0	43.7	0.0	5.0
6.Check		39.7	69.3	30.7	31.3
LSD @ 1%		12.8	19.5	13.6	15.9

FOLIAR HEIGHT (cm)					
1.Mefluidide	420	11.7	21.0	14.3	12.7
2.Eptam	1135	9.7	14.3	11.7	10.0
3.Amidochlor	2802	10.0	20.3	11.7	10.7
4.ACP 2110	45.4	14.7	29.3	14.3	14.7
5. .3 #1 & 4		11.0	24.7	12.7	11.3
6.Check		21.0	40.0	14.0	16.3
LSD @ 5%		5.3		NS	
@ 1%			5.2		3.7

% CULTIVAR PERSISTING 133 DAT					
1.Mefluidide	420	11.7	21.0	14.3	12.7
2.Eptam	1135	9.7	14.3	11.7	10.0
3.Amidochlor	2802	10.0	20.3	11.7	10.7
4.ACP 2110	45.4	14.7	29.3	14.3	14.7
5. .3 #1 & 4		11.0	24.7	12.7	11.3
6.Check		21.0	40.0	14.0	16.3
LSD @ 5%		5.3		NS	
@ 1%			5.2		3.7

FALL AND SPRING APPLICATIONS OF HERBICIDES FOR TALL FESCUE CONTROL AND OVERSEEDING EFFECTS

Peter H. Dernoeden[1/]

ABSTRACT

Chlorsulfuron, metsulfuron and diclofop were assessed for safety and effectiveness in controlling tall fescue (Festuca arundinacea Schreb.) in Kentucky bluegrass (Poa pratensis L.) in two separate studies. In Study I (Table 1), herbicides were applied in the fall to a bluegrass blend of Merit + Midnight + Touchdown + Sydsport; whereas, in Study II the herbicides were applied in spring to Merion. Herbicides were applied in both studies at the rates shown in Table 1 in 50 gpa of water carrier. Tall fescue control was determined by counting the number of plants in each plot. Cover was visually determined on a 0 to 100% scale (0 = brown or dead turf; 100 = entire plot area green), and overall quality was visually assessed on a 0 to 10 scale (0 = brown or dead turf; 10 = optimum color and density).

In Study I, herbicides were applied sequentially on 25 September and 30 October 1987. High rates of metsulfuron and diclofop reduced cover prior to the second application on 27 October. Except for chlorsulfuron, all other herbicide-treated plots had reduced cover on 22 December. While most treated plots exhibited improved cover during February and March, turf treated with diclofop (3.0 lb/A) did not recover until April and metsulfuron plots (0.125 + 0.125 lb/A) did not recover until October 1988.

Between 1 June and 9 July 1988 no rain occurred and turf was severely drought stressed in Study I. After rain (0.7 in on 10 July), plots rated on 12 July for cover showed that chlorsulfuron and metsulfuron treated turf had been more severely drought damaged than diclofop or untreated turf (Table 1). Following frequent rain, plots had recovered dramatically by 11 August, but chlorsulfuron and metsulfuron-treated turf did not completely recover until October 1988. Prior to the drought, chlorsulfuron plots exhibited better quality than other herbicide-treated turf. Metsulfuron and diclofop treated turf exhibited fair to poor quality until 21 April at which time only those plots treated with low rates of the aforementioned herbicides possessed improved quality.

Data collected 15 June showed that all chlorsulfuron and metsulfuron treatments had provided >93% control of tall fescue; whereas, diclofop had provided 34-50% control. In Study II (data not shown), spring (15 April + 12 May 1988) applications of the same herbicide rates generally provided poor to fair tall fescue control. The high rate of chlorsulfuron (0.125 + 0.125 lb/A), metsulfuron (0.125 + 0.125 lb/A) and the low rate of diclofop (2.0 + 2.0 lb/A) had provided 55%, 76% and 52% tall fescue control, respectively. Hence, fall applications of chlorsulfuron (0.06 + 0.06 lb/A) provided the best combination of turf safety and tall fescue control. Turf treated with either chlorsulfuron or metsulfuron in the fall of 1987, however, was more adversely affected by the June 1988 drought than diclofop or untreated turf. The Study II test area was disk-seeded (about 120 days after treatment) with a blend of Cimmeron + Bonanza + Apache tall fescue on 8 September 1988. Data collected 19 October 1988 showed that none of the herbicide treatments had reduced tall fescue germination (data not shown).

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Table 1. Selective tall fescue control in a Kentucky bluegrass sod with herbicides and subsequent effects on cover and overall turfgrass quality.

		1987															1988							
		27 Oct	24 Nov		22 Dec		24 Feb		23 Mar		21 Apr		15 June				12 Jul	11 Aug		7 Sept		18 Oct	
Herbicide*	Rate	Cover	Cover	Quality	Cover	Quality	Cover	Quality	Cover	Quality	Cover	Quality	Cover	Quality	T.fescue	Control	Cover	Cover	Quality	Cover	Quality	Cover	Quality
	(lb ai/A)	(%)	(%)	(0-10)	(%)	(0-10)	(%)	(0-10)	(%)	(0-10)	(%)	(0-10)	(%)	(0-10)	(no/plot)	(%)	(%)	(%)	(1-10)	(%)	(0-10)	(%)	(0-10)
Chlorsulfuron 75DG	0.06+0.06	98a**	98a	8.4ab	98a	8.0a	98ab	7.5a	99a	7.4a	100a	9.1a	98a	7.3ab	7c	93	26cd	77b	5.0b	85bc	5.7b	98a	8.0a
Chlorsulfuron 75DG	0.125+0.125	96a	98a	8.0b	98a	7.8b	99a	7.3a	99a	7.1a	99a	9.0a	98a	7.4a	1c	99	18d	75b	4.8b	82c	5.4b	98a	7.7a
Metsulfuron 60DG	0.06+0.06	90a	96a	7.0c	86b	6.2c	92b	6.5b	95ab	6.2b	98a	8.2b	98a	7.2ab	5c	95	8d	78b	4.9b	87b	5.6b	97a	7.8a
Metsulfuron 60DG	0.125+0.125	36c	48b	4.2e	28d	3.9e	32d	4.0d	54c	4.1d	74b	3.9d	90b	5.5c	1c	99	31cd	74b	4.9b	84bc	5.4b	98a	8.2a
Diclofop 3EC	2.0 + 2.0	89a	96a	7.1c	90b	6.6c	96ab	6.7b	95ab	6.0b	99a	7.8b	98a	7.2ab	50b	50	54bc	92a	6.0a	96a	7.4a	99a	7.7a
Diclofop 3EC	3.0 + 3.0	71b	82a	5.8d	78c	5.2d	85c	5.7d	84b	5.0c	95a	6.1c	97a	6.6b	66b	34	69ab	90a	6.0a	96a	7.3a	99a	7.6a
Untreated	---	100a	100a	9.0a	100a	8.4a	100a	7.5a	100a	7.4a	100a	9.0a	98a	7.1ab	100a	---	86a	92a	6.5a	96a	7.5a	99a	7.5a

*Herbicides were applied 25 Sept and 30 October 1987.

**Means in a column followed by the same letter are not significantly different at the 5% level according to the Bayes LSD.

PREEMERGENCE ACTIVITY OF MON 15151 FOR SMOOTH CRABGRASS CONTROL IN KENTUCKY BLUEGRASS TURF

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ABSTRACT

A field trial was conducted in Delaware, OH to evaluate the performance of MON 15151 1EC for smooth crabgrass (Digitaria ischaemum Schreb.) control at three stages of development: preemergence, early-postemergence, and mid-postemergence. The study was initiated on a Blount clay loam soil supporting a thatch-free Kentucky bluegrass (Poa pratensis L. 'Kenblue') turf overseeded the previous fall with smooth crabgrass. The site was maintained at 3.8 cm height and irrigated frequently. Experimental design was a randomized complete block with three replications of 1.2 by 2.4 m treatment plots. Adjacent to each treatment plot a 0.6 by 2.4 m strip was left untreated to monitor weed growth. Chemical treatments were applied at 1627 L ha^{-1} as a tank mixture with 2.25% N (w/v) prepared from a 17-2-5 analysis fertilizer solution of urea, ammonium polyphosphate, and potassium chloride. Applications were made in a single pass using a CO_2-propelled three-nozzle boom sprayer equipped with 8010LP TeeJet® nozzles operating at 3.2 L min^{-1} flow rate $nozzle^{-1}$. Percent crabgrass ground cover was visually estimated on August 15. Values were transformed and subjected to analysis of variance.

MON 15151 applied at 0.28 kg ha^{-1} on April 1, 20 days preemergence, provided acceptable crabgrass control. Excellent control was achieved with MON-15151 at 0.42 kg ha^{-1} and with pendimethalin at 1.68 kg ha^{-1}. Turf injury, evident as slight stand thinning, was observed with MON 15151 at 1.12 kg ha^{-1} while lower use rates were safe to the turf.

Early postemergent applications of MON 15151 to 1 to 3-leaf crabgrass on May 16 provided excellent control at 0.28 kg ha^{-1} and was not statistically different ($p = 0.05$) from pendimethalin at 1.68 kg ha^{-1}.

Delaying postemergent applications until crabgrass had initiated tillering on June 30 resulted in unacceptable control from pendimethalin and rates of MON 15151 below 0.84 kg ha^{-1}. All rates of MON 15151 initially discolored and stunted crabgrass growth, but weeds were outgrowing injury symptoms at the lower rates by 42 days after treatment. All rates of MON 15151 resulted in better crabgrass control compared to pendimethalin, while a tank mixture of 1.68 kg ha^{-1} pendimethalin plus 0.28 kg ha^{-1} fenoxaprop-ethyl provided control statistically equal ($p = 0.05$) to MON 15151 at 0.56 kg ha^{-1}.

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CONTROL OF BROADLEAF WEEDS IN TURF WITH CLOPYRALID AND TRICLOPYR COMBINATIONS

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ABSTRACT

Numerous studies in 1987 showed various ratios of clopyralid and triclopyr amine provided broad spectrum control of broadleaf weeds in turf (Proc. Northeast. Weed Sci. Soc. 42:179, 181, 183, 185, and 187). From these and other data an optimum ratio of clopyralid to triclopyr (1:3) was chosen. A premix formulation (XRM-5085) of clopyralid (0.75 lb ae/gal) and triclopyr (2.25 lb ae/gal) amine was developed and tested in 1988 to determine the efficacy of post-emergence applications on broadleaf weeds in turf.

The efficacy of the premix formulation of clopyralid and triclopyr was compared with other commercially available premix formulations of 2,4-D + triclopyr, both ester and amine, and 2,4-D + MCPP + dicamba in ten separate studies. Three studies were located in Geneva, NY; two in Ithaca, NY; one in each Silver Spring and Woodbine, MD; and three in Kingston, RI. Study design in all tests was a randomized complete block with treatments replicated three or four times. Treatments were applied with a CO_2 plot sprayer delivering 50 to 80 gallons of diluent per acre. Broadleaf turf weeds present in one or more studies were broadleaf plantain (*Plantago major* L.), dandelion (*Taraxacum officinale* Weber), ground ivy (*Glechoma hederacea* L.), healall (*Prunella vulgaris* L.), buckhorn plantain (*Plantago lanceolata* L.), red sorrel (*Rumex acetosella* L.) thymeleaf speedwell (*Veronica serpyllifolia* L.), wild violet (*Viola arvensis* Murr.), white clover (*Trifolium repens* L.), and yellow woodsorrel (*Oxalis stricta* L.). For specific weeds present in each study, application dates, rating dates, spray volume, and replications per treatment see Table 1.

The high rate of clopyralid (.188 lb/A) and triclopyr (.563 lb/A) provided more consistent control of white clover, dandelion, buckhorn and broadleaf plantain than the intermediate rate (.141 and .422 lb/A, respectively) and the control was equal to the commercial premixes (Table 1). In two studies ground ivy control was excellent (99-100%) with two different rates of clopyralid (.125 and .141 lb/A) and triclopyr (.374 and .422 lb/A). In separate trials clopyralid and triclopyr provided 73% control of wild violet (.125 and .374 lb/A, respectively) and 80% control of yellow woodsorrel (.141 and .422 lb/A, respectively). An early application (4/30/88) of clopyralid and triclopyr at the Woodbine site provided greater control of red sorrel than did a later application (5/21/88) at Silver Spring. Some control of healall was observed with clopyralid and triclopyr but was not commercially acceptable. Over all ten sites the premix formulation of clopyralid and triclopyr provided commercially acceptable control of many major broadleaf weeds found in turf in the Northeast.

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Table 1. Postemergence broadleaf weed control in turf with a premix of clopyralid and triclopyr compared to other commercial premixes in ten trials in 1988.

Treatments[a]	lb/A	Percent Control									
		TAROF[b]	TRFRE	PLALA	PLAMA	PRUVU	VIOAR	VERSE	GLEHE	OXAST	RUMAC
---- Geneva, NY, Seneca Lake C.C.-------		Applied 5/24/88,			Rated 7/25/88,		Replications - 4,			80 GPA	
Clopyralid + triclopyr	.094/.281	85	100	-	-	63	-	-	-	-	-
Clopyralid + triclopyr	.141/.422	88	100	-	-	75	-	-	-	-	-
Clopyralid + triclopyr	.188/.563	93	100	-	-	74	-	-	-	-	-
2,4-D + triclopyr	1.04/.401	88	100	-	-	96	-	-	-	-	-
2,4-D + MCPP + dicamba	.761/.405/.079	90	96	-	-	100	-	-	-	-	-
---- Geneva, NY, Seneca Lake C.C. ------		Applied 8/4/88,			Rated 9/30/88,		Replications - 4,			80 GPA	
Clopyralid + triclopyr	.141/.422	96	100	100	-	83	-	-	-	-	-
2,4-D +triclopyr	1.04/.401	99	100	100	-	100	-	-	-	-	-
2,4-D + MCPP + dicamba	.761/.405/.079	96	99	100	-	100	-	-	-	-	-
---- Geneva, NY, Glenwood Cemetary -----		Applied 8/4/88,			Rated 9/30/88,		Replications - 4,			80 GPA	
Clopyralid + triclopyr	.141/.422	95	100	-	-	84	-	-	100	-	-
2,4-D + triclopyr	1.04/.401	91	99	-	-	98	-	-	100	-	-
2,4-D + MCPP + dicamba	.761/.405/.079	95	100	-	-	100	-	-	100	-	-
---- Ithaca, NY, Turf Research Farm ----		Applied 5/7/88,			Rated 7/27/88,		Replications - 4,			50 GPA	
Clopyralid + triclopyr	.141/.422	75	100	-	81	-	-	-	-	-	-
Clopyralid + triclopyr	.188/.563	97	100	-	95	-	-	-	-	-	-
2,4-D + triclopyr	1.08/.414	85	95	-	92	-	-	-	-	-	-
2,4-D + triclopyr (ester)	1.00/.500	97	100	-	97	-	-	-	-	-	-
---- Ithaca, NY, Turf Research Farm ----		Applied 7/5/88,			Rated 8/11/88,		Replications - 3,			50 GPA	
Clopyralid + triclopyr	.141/.422	80	-	-	-	-	-	25	-	-	-
Clopyralid + triclopyr	.188/.563	95	-	-	-	-	-	18	-	-	-
2,4-D + triclopyr	1.08/.414	88	-	-	-	-	-	68	-	-	-
2,4-D + MCPP + dicamba	1.02/.540/.105	93	-	-	-	-	-	53	-	-	-
---- Silver Spring, MD ----------		Applied 5/21/88,			Rated 7/11/88[c],		Replications - 3,			50 GPA	
Clopyralid + triclopyr	.141/.422	100	100	-	-	-	-	-	-	80	23
Clopyralid + triclopyr	.188/.563	100	100	-	-	-	-	-	-	80	62
2,4-D + triclopyr	1.04/.401	100	100	-	-	-	-	-	-	80	0
2,4-D + MCPP + dicamba	.837/.446/.087	100	80	-	-	-	-	-	-	20	8
---- Woodbine, MD ----------		Applied 4/30/88,			Rated 6/5/88[c],		Replications - 3,			50 GPA	
Clopyralid + triclopyr	.141/.422	-	-	88	-	-	-	-	-	-	83
Clopyralid + triclopyr	.188/.563	-	-	97	-	-	-	-	-	-	87
2,4-D + triclopyr	1.04/.401	-	-	97	-	-	-	-	-	-	80
2,4-D + MCPP + dicamba	.837/.446/.087	-	-	97	-	-	-	-	-	-	90
---- Kingston, RI, Turf Research Farm[d]		Applied 6/11/88,			Rated 8/17/88,		Replications - 3,			50 GPA	
Clopyralid + triclopyr	.125/.374	90	100	-	99	-	73	-	99	-	-
2,4-D + triclopyr	1.04/.401	83	99	-	94	-	-	-	100	-	-
2,4-D + triclopyr (ester)	.750/.375	96	99	-	95	-	62	-	-	-	-
2,4-D + MCPP + dicamba	.761/.405/.079	91	99	-	97	-	-	-	-	-	-

[a] All treatment formulations are amines unless noted.

[b] TAROF = dandelion, TRFRE = white clover, PLALA = buckhorn plantain, PLAMA = broadleaf plantain, PRUVU = healall, VIOAR = wild violet, VERSE = thymeleaf speedwell, GLEHE = ground ivy, OXAST = yellow woodsorrel, and RUMAC = red sorrel.

[c] Plots were rated as percent cover and then converted to percent control.

[d] Three separate sites contained the following weeds. Site A; TRFRE, TAROF, and PLAMA. Site B; VIOAR. Site C; GLEHE.

HERBICIDE TOLERANCE AND WEED CONTROL IN SEVERAL CONTAINER GROWN ORNAMENTALS

Andrew F. Senesac[1/] and Joseph C. Neal[2/]

ABSTRACT

Studies were conducted in 1987 and 1988 at the Long Island Horticultural Research Laboratory to examine the tolerance of six container-grown woody ornamental species to several preemergence herbicides. The plant material consisted of rooted cuttings or one year old plants of the following species: Rhododendron 'Roseum Elegans', Azalea 'Coral Bells', Potentilla fructosa 'Tangerine', Cotoneaster horizontalis 'Rockspray', Forsythia intermedia, Juniperus chinensis var procumbens 'Nana'(1987), and Juniperus chinensis var media 'Old Gold' (1988). In late May, single plants were transplanted into 3.8 liter containers filled with a soilless media composed of leaf mulch, pine bark and sand (1:1:1). The plots were treated immediately after planting and irrigated with 1.25 cm of water within 24 hours. Each species was replicated three times within a plot and each block replicated four times in a Randomized Complete Block design. The plants were visually evaluated twice during the growing season and fresh weight of each plant was measured at the end of each growing season. None of the herbicide treatments which were common to both studies significantly reduced the vigor or fresh weight of any the six species. These included pendimethalin (2.2 and 4.5 kg ai/ha), prodiamine (2.2 and 4.5 kg ai/ha), oryzalin (4.5 kg ai/ha), napropamide (4.5 kg ai/ha), metolachlor (2.2 and 4.5 kg ai/ha), oxyfluorfen+pendimethalin (2.2+1.1 kg ai/ha), isoxaben (0.56 and 1.1 kg ai/ha) alone or in combination with oryzalin.

A companion study conducted in 1988 examined the efficacy of several granular preemergence herbicides in controlling six seedling winter annual weed species commonly found infesting containerized ornamentals. Of particular interest were materials which could combine with or replace oxadiazon for improved control of common chickweed (Stellaria media). The results indicate that very good to excellent control (80-100%) can be attained when oxidiazon is combined with one of the following: diflufenicam at 0.45 kg ai/ha, chloramben at 3.4 kg ai/ha, or napropamide at 3.4 kg ai/ha. Excellent common chickweed control was also attained with isoxaben at 0.56 and 1.1 kg ai/ha, oxyfluorfen+oryzalin at 2.2+1.1 kg ai/ha and oryzalin+benefin at 1.1+1.1 kg ai/ha.

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CONTROL OF BIRD VETCH IN CHRISTMAS TREES

J.F. Ahrens[1]/

ABSTRACT

Bird vetch (Vicia cracca L.) is a twining perennial that disfigures Christmas trees. It is resistant to most herbicides used in Christmas trees including glyphosate. In experiments conducted from 1984 to 1988 several herbicides with known activity in controlling legumes were evaluated for selectivity in conifers at varying times and growth stages. Herbicides were applied with hand-held booms, calibrated to deliver 16 gal/A with fan nozzles for over-the-top sprays or 30 gal/A with off-center nozzles for semi-directed sprays where only the lower 12 to 15 inches of conifer foliage was contacted.

Triclopyr butoxy ester at 0.5 lb/A and clopyralid at 0.133 or 0.266 lb/A gave good to excellent control of bird vetch with little or no injury to Colorado spruce (Picea pungens) sprayed over-the-top from mid-June to mid-August. Triclopyr at 1 lb/A caused excessive contact injury. Clopyralid at 0.266 lb/A was the most consistently effective treatment, giving over 95% control of bird vetch the following year.

White pine (Pinus strobus L.) Douglas-fir (Pseudotsuga menziesii), fraser fir (Abies fraseri) and balsam fir (Abies balsamea) were uninjured by two or three annual applications of clopyralid at 0.133 or 0.266 lb/A in June, July or August. In one experiment clopyralid at 0.5 lb/A on white pine in September caused moderate needle twisting and loss of terminal dominance on new growth the following year, whereas clopyralid at 0.25 lb/A caused only slight needle distortion following three annual applications in September.

Semi-directed sprays of triclopyr at 0.5 or 1.0 lb/A injured sprayed foliage of white pine, fraser fir and Douglas-fir during the summer without systemic injury or effects on terminal growth. Injury to sprayed foliage decreased from June through September and was minor at 0.5 lb/A in fraser fir and white pine sprayed in August and Douglas-fir sprayed in September. Over-the-top sprays of triclopyr at 0.5 lb/A in late July or mid-August caused no injury to balsam fir, whereas sprays at 1 lb/A caused moderate shedding of needles in late July.

Clopyralid offers the greatest promise for selective control of bird vetch in Christmas trees because it can be safely used on several conifers during the summer before bird vetch has severely damaged young trees.

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HERBICIDE PROGRAMS FOR YELLOW NUTSEDGE CONTROL IN GLADIOLUS PRODUCTION

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ABSTRACT

A field study was conducted in 1988 to examine the tolerance of gladiolus (Gladiolus x hortulanus) to herbicides successfully used on other crops to control yellow nutsedge(Cyperus esculentus). Many growers express a willingness to tolerate slightly lower corm yields in order to avoid costly and inefficient removal of this weed by mechanical means. Because yellow nutsedge tubers are very similar in size and shape to small gladiolus corms they are often harvested and replanted with the crop the following year.

A split plot Randomized Complete Block design with 6 replications was utilized. The main plots were herbicide rates and timings and subplots consisted of two corm sizes. Large corms (size#5 (1.25 cm)) and small cormels of the cv. 'Shiloh' were planted on June 8, 1988. Preemergence treatments were applied the following day and delayed preemergence treatments on June 17 for corms and July 27 for the later emerging cormels.

Bentazon, at 1.1 and 2.2 kg ai/ha, and acifluorfen at 0.56 kg ai/ha applied either post over the top or directed to the base of the plants seriously reduced the yield of cut flowers, corms and cormels. Both of these compounds appear unsafe for gladiolus production.

Metolachlor, at 2.2 and 4.5 kg ai/ha, when applied preemergence reduced cut flower yield and corms produced from the smaller cormels. The larger corms appeared to tolerate metolachlor marginally when applied at this time (i.e. one day post plant). However, if the application of metolachlor was delayed until just prior to gladiolus shoot emergence and combined with diquat (2.2 kg ai/ha) for burn down of the emerged weeds, then flower production and large corm yield were not adversely affected, but small cormel yield was reduced. These results confirm previous reports that metolachlor has a potential for safe nutsedge control in this crop, but that application timing and propagule size are critical to insure safety.

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PRE- AND POSTEMERGENCE SMOOTH CRABGRASS CONTROL WITH MON-15151 IN COOL-SEASON TURFGRASS

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ABSTRACT

Three field experiments were conducted at the University of Massachusetts Turfgrass Research Center, South Deerfield. The objectives were to i) evaluate preemergence activity of Mon 15151 (Monsanto), ii) determine the optimum growth stage of smooth crabgrass [Digitaria ischaemum (Schreb. ex Schweig.)Schreb. ex Muhl.], for postemergence activity, and iii) determine, if any, turf injury. Experiments were conducted on an established perennial ryegrass (Lolium perenne L.) turf maintained at a height of 5 cm under low fertility. Treatments were applied to 1 by 3 m plots with a CO_2 backpack sprayer at a pressure of 152 kPa in 675 L/ha. The preemergence treatments were applied on April 27, 1988. The postemergence treatments were applied on June 10 and July 7, 1988 when the smooth crabgrasses were at the one- to four-leaf stage and three- to five-tiller stage, respectively. In a 'Penncross' creeping bentgrass (Agrostis palustris Huds.) experiment, postemergence treatments were applied on August 1988. Weed control was rated on July 26 and August 26, 1988.

In the preemergence trial, Mon-15151 (1EC) and Mon-15179 (0.5G) at 0.28 kg/ha controlled smooth crabgrass effectively (95% or better) throughout the growing season without any injury to perennial ryegrass. However, slight injury (10 to 20%) was noted with the highest rate (1.1 kg/ha). Pendimethalin at 1.5 kg/ha gave similar crabgrass control without any turf injury.

In the postemergence trial, Mon 15151 at 0.28 kg/ha and higher rates applied at the one- to four-leaf stage controlled smooth crabgrass effectively (90% or better). Late application of Mon 15151 at 0.28 kg/ha provided 75% crabgrass control, while the 0.84 kg/ha rate resulted in 94% control. The 0.38 and 0.56 kg/ha rates resulted in 87 and 85% control, respectively, 3 WAT. At 8 WAT, smooth crabgrass control dropped to 64% at the 0.84 kg/ha rate. Similar decline in smooth crabgrass control was observed with fenoxaprop at 0.20 kg/ha.

In a bentgrass green trial, 'Penncross' bentgrass was tolerant to Mon 15151 up to 1.1 kg/ha. A slight injury (13%) was noted with Mon 15151 at 1.68 k/ha and 22% at 2.2 kg/ha. Bentgrass color or quality was not affected with postemergence treatments of Mon 15151.

The excellent preemergence activity of Mon 15151 in controlling smooth crabgrass over the entire season indicates its potential for use on commercial and home lawns. In addition, postemergence activity of this material will be an additional factor in acceptance of this material.

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PREEMERGENCE CONTROL OF SMOOTH CRABGRASS IN A MIXED COOL SEASON TURF IN 1988

T. L. Watschke, G. Hamilton, and S. Harrison[1/]

ABSTRACT

An experiment was conducted during 1988 to evaluate several herbicides and herbicide combinations for their efficacy on smooth crabgrass (Digitaria ischaemum) (Schreb.) Michx. in a mixed stand of cool season turfgrasses. Control ratings of 85 percent or higher were considered to be commercially acceptable.

Of the commercially available materials, the wettable and granular formulations of DCPA provided acceptable control, but the flowable formulation did not (80%). The granular formulation of oxadiazon provided acceptable control at 2.24 kg ai/ha, but comparable rates of the ME formulation did not. The wettable formulation of oxadiazon only provided acceptable control at the highest rate (2.24 kg ai/ha). Pendimethalin, formulated on fertilizer and as a water dispersed granule, provided excellent control, although control was somewhat better when sprayed. Granular benefin provided acceptable control at the recommended rate. An experimental dry flowable formulation also provided acceptable control, but the rate tested was 2.69 kg ai/ha (equivalent to a 1.2X rate). Excellent control was obtained from the benefin-trifluralin combination regardless of whether it was formulated on fertilizer or another granular carrier. E1-107 combined with either benefin alone or with benefin-trifluralin provided very good control.

Of the experimental materials tested, prodiamine provided excellent control at both rates used. CGA-41065 at the low rate did not provide acceptable control, but at the high rate control was excellent (94%). Cinmethylin did not provide acceptable control at either rate tested. Both formulations of the MON experimental product provided excellent control at the higher rates tested. The granular formulation appeared to be more active at lower rates than when the compound was sprayed.

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Table 1. Preemergence control of smooth crabgrass in a mixed stand of cool season turfgrasses from the application of several herbicides and herbicide combinations on April 28, 1988. Ratings were made on August 16, 1988.

Treatment	Rate (kg ai/ha)	Crabgrass Control (%)
Cinmethylin 7EC	1.68	48
Cinmethylin 7EC	2.24	67
DCPA 75W	11.76	93
DCPA 6F	11.76	80
DCPA 5G	11.76	87
Pendimethalin 60WDG	1.68	94
Pendimethalin F	1.68	88
EL-107 + Benefin	0.67 + 2.69	88
Benefin 60DF	2.69	85
Benefin 2.5G	2.24	87
Benefin + Trifluralin	1.49 + 0.75	92
Benefin + Trifluralin (F)	1.49 + 0.75	96
EL-107 + Benefin + Trifluralin	0.56 + 1.49 + 0.75	96
CGA-41065 1.2EC	1.12	82
CGA-41065 1.2EC	2.24	94
Prodiamine 65WDG	0.56	94
Prodiamine 65WDG	0.84	95
Oxadiazon 50W	0.56	63
Oxadiazon 50W	0.84	50
Oxadiazon 50W	1.12	67
Oxadiazon 50W	2.24	85
Oxadiazon 2ME	1.12	55
Oxadiazon 2ME	2.24	68
Oxadiazon 2G	2.24	88
MON 15151 IEC	0.14	73
MON 15151 IEC	0.28	92
MON 15151 IEC	0.56	95
MON 15151 IEC	1.12	97
MON 15177 0.25G	0.14	92
MON 15177 0.25G	0.28	93
MON 15177 0.25G	0.56	97
MON 15177 0.25G	0.84	94
MON 15177 0.25G	1.12	97

PERFORMANCE OF MON-15100 AS A PREEMERGENCE AND POSTEMERGENCE CRABGRASS HERBICIDE IN COOL AND WARM SEASON TURF

D. C. Riego

ABSTRACT

MON-15100 is a new turf herbicide being evaluated for control of annual grasses and broadleaf weeds in turfgrasses. Field trials conducted throughout the United States in 1987 and 1988 show preemergent and early postemergent applications of MON-15100 control crabgrass [*Digitaria spp.*] and control or suppress many summer annual broadleaf weeds found in cool and warm season turfgrasses. Various formulations including emulsifiable concentrates, granules, and fertilizer granules were evaluated with good control of crabgrass following preemergent and postemergent applications.

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SMOOTH CRABGRASS CONTROL IN KENTUCKY BLUEGRASS TURF WITH TRIDIPHANE ALONE AND IN MIXTURES WITH BENSULIDE

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ABSTRACT

Studies were conducted on an irrigated, thatch-free Kentucky bluegrass (Poa pratensis L.) turf growing on a Blount clay loam soil in Delaware, OH, to determine the activity of tridiphane alone and in combination with bensulide for control of smooth crabgrass (Digitaria ischaemum Schreb.). In a three-year study (1985 to 1987) tridiphane at 1.1, 1.6, and 2.2 kg ha^{-1} was applied on five equally spaced dates between April 1 and June 15 to compare its soil residual activity to bensulide at 8.4 kg ha^{-1}. Treatments were replicated three times in a split-plot, randomized block design, with application dates as whole plots. In another three-year study (1984 to 1986) tank mixtures of tridiphane at 0.6 to 2.2 kg ha^{-1} plus bensulide at 2.1 to 6.2 kg ha^{-1} were applied postemergent to determine the effects of rates and application dates on control of crabgrass in turfs treated preemergent with reduced rates of bensulide (2.2 to 9.0 kg ha^{-1}). The experimental design was a split-plot, randomized block with three replicates. Whole plots were preemergent treatments applied in early April while postemergent treatments were applied as subplots in either late May or late June. Chemical treatments were in a factorial arrangement using a central composite design. All chemical treatments were applied at 1627 L ha^{-1} to 1.2 by 2.4 m plots. Adjacent to each plot was a 0.6 by 2.4 m untreated check strip. Crabgrass groundcover was determined in late August or early September.

Tridiphane effectively suppressed crabgrass on three of five application dates in 1985, on two dates in 1986, and on one date in 1987. In general, preemergent applications or late postemergent applications failed to suppress weeds season-long. Tridiphane rate response differences were not evident preemergent but were for early postemergent applications.

In the factorial study, preemergent bensulide (B) treatments and tridiphane (T) treatments were highly significant for all years evaluated, while postemergent bensulide (Bp) treatments were only significant in 1986. Dates (D) of posttreatment applications were not significant in any year. The interaction B x D was significant in 1984 and 1986, but not in 1985. In 1984 the only other significant interaction was T x Bp. There were no significant interactions in 1985. In 1986 there were several significant interactions including: T x D, B x T, Bp x D, B x Bp, and B x T x Bp.

The variation in year to year results for both studies may reflect differences in crabgrass phenology in each year. In 1984 and 1985 crabgrass emerged as a single flush in mid-to-late April, with little or no second flush of weed emergence. In 1986 and 1987 crabgrass emergence was delayed 3 weeks and a second flush was observed in late June each year. These results suggest tridiphane has very little preemergent soil residual activity and that postemergence treatments must be timed correctly. If applied too early in years where subsequent seed emergence occurs, a tank mixture with a soil residual herbicide is warranted.

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THE INFLUENCE OF GROUND COVER MANAGEMENT SYSTEMS AND STRESS COMPONENTS ON GROWTH OF WOODY ORNAMENTALS

Colleen M. Kearns, Joseph C. Neal, Thomas H. Whitlow,[1] and Andrew F. Senesac[2]

ABSTRACT

In field production of woody ornamentals, weed control is essential in any manangement system. The most direct method of weed control is maintenance of a bareground, weed-free environment. This regime, although optimal for plant growth, will increase production costs and soil erosion. The following study was initiated to examine the potential benefits of maintaining a permanent or semipermanent ground cover of weeds and/or cover crops without adversely affecting plant growth.

A three year field study was estasblished in 1986 to evaluate the impact of 14 ground cover management systems on the growth of woody ornamentals. The associated stress components were also investigated. The treatments included broadleaf weeds, grassy weeds, and tall fescue (Festuca arundinacea 'K31'), as influenced by mowing, cultivation, and percent ground cover. The species studied were: taxus (Taxus media), white pine (Pinus strobus), cherry (Prunus sp. 'Emla Colt'), and green ash (Fraxinus pennsylvanica). Directed applications of paraquat were used to maintain the 2 meter in-row weed free strips in the 50 percent ground cover regimes.

The bare in-row strip treatments produced growth equal to or greater than the cultivated treatments. Mowing weeds did not suppress the competitive effects of a weed cover. There were no differences in growth of ornamentals between the mowed and unmowed weed covers. The untreated plots were more competitive than the annual weed cover, the 100 percent grass treatment, or the 100 percent broadleaf treatment. No differences in weed competition between grassy and broadleaf weeds were observed. With a 2 meter weed free strip, the between row vegetation had no effect on growth of green ash, white pine, or taxus. However, mowed weeds were less competitive than mowed K31 fescue in one year out of three for cherry.

The plant water status of green ash and available soil moisture were recorded periodically, including times of severe drought conditions. When available soil water was limiting, the 100 percent broadleaf cover, mowed and unmowed annual covers produced the most negative pre-dawn and midday leaf water potentials. Soil analysis showed no differences between treatments in P, K, or micronutrients. Nitrogen analyses are incomplete at this point.

Weeds, whether grasses, broadleaves, mowed or unmowed, interfere with woody ornamental growth in the first three years of production. Bare in row strips with vegetation between, is a viable alternative to 100% bare ground and may offer advantages of reduced soil and wind erosion.

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GROWTH INHIBITION OF SHADE TREES BY ROOT COLLAR DRENCHES OF UNICONAZOLE

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ABSTRACT

Root collars of 11-yr-old black walnut (Juglans nigra L.) and 7-yr-old yellow-poplar (Liriodendron tulipifera L.) were drenched in early May 1986 with 2 or 4 g a.i. uniconazole [(E)-1-(4-chlorophenyl)-4,4,-dimethyl-2-(1,2,4-triazole-yl)-1-penten-3-ol] in methanol to determine growth inhibition response. Growth inhibition became evident in 1987 and was significantly less than controls (23% to 34% inhibition) by July of the 1988 growing season. Shoot growth was uniformly inhibited and except for shorter shoots and smaller, dark green leaves no visible phytotoxicity was evident. Root collar drench with uniconazole should be an effective approach in controlling the growth of young trees that may grow into utility lines.

INTRODUCTION

Utility foresters are investigating the use of growth inhibitors to lower the high cost of mechanical tree trimming. Uniconazole is one of a group of gibberellin biosynthesis inhibitors in which the reduced gibberellin level results in inhibition of shoot internodal growth (2, 3, 5). These chemicals offer the potential for use as tree growth inhibitors because they are not phytotoxic to woody plants and may be applied to roots, buds, or vascular systems (1, 4, 7, 8, 10). Trunk injection of growth inhibitors is the most common method of application, but response of plant parts some distance from the injection site may be erratic and injury from drilled injection holes is sometimes a problem if proper technique is not used (6, 12). Flurprimidol {α-(1-methylethyl)-α-[4-(trifluoromethoxy) phenyl]-5-pyrimidine-methanol}, a related compound, was found to suppress growth uniformly without injury when applied as a root collar drench to several species of shade trees (9, 11). The objective of this experiment was to determine if uniconazole would also effectively inhibit the growth of shade trees when applied as a root collar drench.

MATERIALS AND METHODS

Eleven-year-old black walnut and 7-year-old yellow-poplar saplings (both species 7 cm dbh) were grown in Duffield silt loam in Frederick, MD. In early May 1986, the root collar zones of these trees were treated with uniconazole by removing soil at ground line to expose root collar bark for a depth of 3 cm and wetting the exposed bark with 250 ml of a methanol formulation containing 2 or 4 g a.i. uniconazole. Before treatment, each tree was pruned to three branches about 2 meters above ground. Shoot growth from these three branches was measured during the 1986, 1987, and 1988 growing seasons. Treatments were replicated five times in a randomized complete block design.

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RESULTS AND DISCUSSION

The effect of uniconazole root collar drenches applied in May 1986 was not evident on black walnut or yellow-poplar until 1987 and shoot growth inhibition was significantly different from controls late in the 1988 growing season (Figure 1). Two g/tree of uniconazole was as effective as 4 g/tree. Uptake of uniconazole through the root collar zone and older root bark was much slower than direct injection into the trunk xylem. In an earlier study yellow-poplar and American sycamore (Platanus occidentalis L.) were inhibited by injections of uniconazole during the first growing season (10). Slow response to root collar drench was also true for flurprimidol (9, 11); however, flurprimidol inhibited growth faster than uniconazole -- by the end of the second growing season after treatment. Except for shorter shoots and smaller, dark green leaves, no visible phytotoxicity was evident.

The root collar drench treatment with uniconazole should be an effective approach in controlling the growth of young trees that may grow into utility lines. Consistent uniform inhibition of shoot growth is obtained. Although new shoot growth was not inhibited until the third growing season after treatment, the root collar drench method has several advantages over other methods --- no injection-type injury occurs (bark splitting or decay); root collar zones of city trees are usually accessible whereas fibrous roots (targets for the soil injection technique) that extend beyond the foliage canopy may be unavailable; e.g., covered with concrete and macadam; and confining uniconazole to the root collar zone reduces the possibility of contacting nontarget plants. In another study with flurprimidol, which is about ten times more soluble in water than uniconazole, activity (using a bioassay technique) was confined laterally within 10 cm of the treated root collar 1 1/2 years after drenching the trunk base (9).

Before uniconazole can be registered for root collar drench use, more information is needed regarding effective doses for large trees and for a variety of other species. Also, information is needed regarding longevity and movement of uniconazole residues in various soil types.

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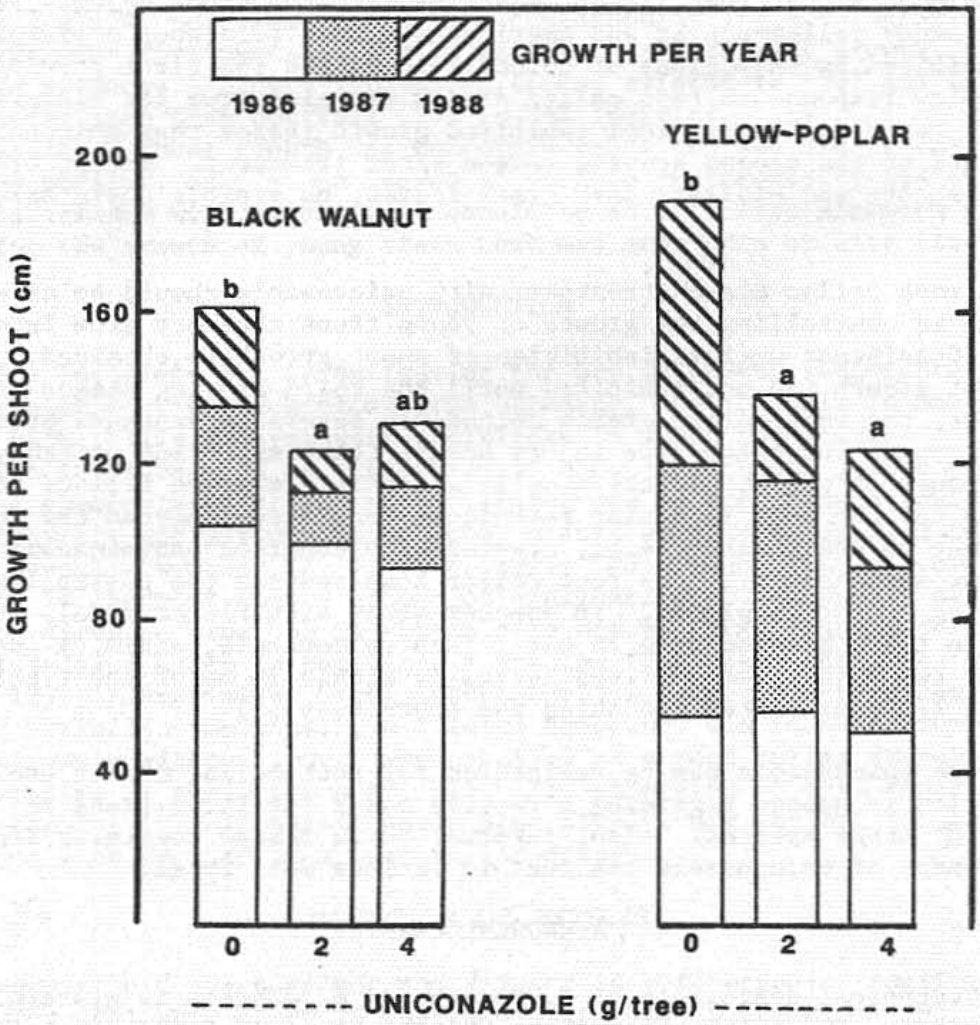

Fig. 1. Shoot growth at the end of the first, second, and third growing seasons following root collar drenches with uniconazole in May 1986. Total growth (May 1986 to July 1988) comparisons due to treatment were performed with Duncan's multiple range test. Bars topped with the same letter, within species, do not differ at the 5% level.

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HERBICIDE - LIVING MULCH IN SWEET CORN[1]

A.J. Enache, R.D. Ilnicki, and F.E. Katz[2]

A field study was conducted at the Soils and Crops Research Center, Adelphia, N.J. in 1988 to evaluate the combined and individual effects of subterranean clover (Trifolium subterraneum L.) used as living mulch and herbicide treatments on weed control and yield of several sweet corn (Zea mays saccharata L.) varieties.

The experimental design was split-split plot with three replications. Subterranean clover, mowed or unmowed before sweet corn planting, was the whole plot. Within each whole plot, three sweet corn varieties - Seneca Paleface, Biqueen, Crossword - were used as subplots, and then, in the subplots three preemergence herbicide treatments applied in a band over the row served as the sub-subplots.

Subterranean clover was planted on September 3, 1987 in a Freehold sandy loam with 2.1% organic matter and pH 6.4; sweet corn was planted on June 10 using a no-till planter. Cyanazine alone and atrazine and cyanazine in combination with metolachlor were applied preemergence. Weeds on the site included yellow nutsedge (Cyperus esculentus L.), and a mixture of fall panicum (Panicum dichotomiflorum Michx.), large crabgrass (Digitaria sanguinalis L.), and barnyardgrass (Echinochloa crus-galli (l.)Beauv.). Untreated and treated checks with atrazine + metolachlor in conventional tillage were also used.

Results indicated that subterranean clover used as a living mulch provided excellent weed control. Mowed clover resulted in better weed control and higher yields than unmowed clover. Both, weed control and yield were highest in Biqueen plots. Cyanazine applied alone slightly injured the crops. The control achieved was poor also. Regardless of sweet corn variety and/or subterranean clover cutting status, this negative effect was further reflected in the yield. All other herbicide treatments resulted in better weed control with consistently high yields.

Compared to the sweet corn planted in conventional tillage, all yields were either equal or slightly lower than the yield of treated check but higher than those of untreated checks.

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[1] New Jersey Agr. Expt. Station Publication No.J-15274-1-88

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Susceptibility of Atrazine-resistant Cauliflower to Other Photosynthetic Inhibiting Herbicides

R.W. Wallace, R.R. Bellinder, and D.T. Warholic[1]

Two lines (designated R4290 and R4291) of atrazine-resistant (AT^r) cauliflower (Brassica oleracea ssp botrytis) and a susceptible parent (AT^s) were field tested to determine if the presence of atrazine resistance also conferred resistance to other photosystem II inhibiting herbicides. The herbicides atrazine (s-triazine), metribuzin (as-triazine), linuron (substituted urea), and terbacil (uracil) were applied either preplant incorporated (atrazine) or preemergence (all others) at 0.5 and 1.0X rates one day prior to transplanting (July 28). Early injury ratings (August 5) showed that foliar chlorosis was greatest in the AT^s cauliflower treated with both 0.5 and 1.0X rates of atrazine, metribuzin and terbacil. The response to linuron was less severe. Very little chlorosis was observed in R4290 and R4291 plants in plots treated with atrazine. However, rate dependent chlorosis was observed in the resistant lines when treated with the other 3 herbicides. Although of similar parentage R4290 was somewhat more tolerant to the herbicides than was R4291. By September 15, with the exception of the 0.5X rate of linuron, greater than 70% injury (stunting and/or death) occurred to the AT^s cauliflower in all treatments (Table 1). Plant survival was variable for both AT^r and AT^s cauliflower, however, no AT^s plants survived treatments of metribuzin and terbacil. Analysis of average plant weight showed that biomass decreased as each treatment was increased from 0.5 to the 1.0X rate for both AT^s and AT^r cauliflower plants (Table 1).

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Table 1. The effect of photosynthetic-inhibiting herbicides on triazine-resistant and susceptible cauliflower.

		R4290		R4291		AT[s1]	
TREATMENT	RATE (Kg/ha)	INJURY[2]	YIELD (gm/plt)	INJURY	YIELD (gm/plt)	INJURY	YIELD (gm/plt)
Untreated	----	0.0	584.3	0.0	407.3	0.0	1018.8
Atrazine	0.56	0.3	674.8	0.5	509.3	7.3	263.5
	1.12	0.8	578.5	0.3	600.5	8.3	366.5
Metribuzin	0.28	2.8	478.8	2.3	478.0	10.0	0.0
	0.56	3.3	565.3	5.5	203.5	10.0	0.0
linuron	0.56	2.5	478.5	5.3	248.5	5.3	489.75
	1.12	7.5	299.3	9.3	212.5	9.3	233.25
terbacil	0.22	0.8	624.3	2.0	472.3	10.0	0.0
	0.45	2.5	482.5	4.5	203.0	10.0	0.0

[1]Atrazine susceptible parent

[2]Injury 0 = no injury, 10 = 100% injury

LSD (0.05) for injury = 1.56

LSD (0.05) for yield = 242.26

VARIOUS SCHEDULES OF HERBICIDE APPLICATION IN TRANSPLANTED COLE CROPS[1]

A.J. Enache, R.D. Ilnicki, and F.E. Katz[2]

A field study was conducted at the Soils and Crops Research Center, Adelphia, N.J. in 1988 to evaluate the effects of oxyfluorfen alone and in combination with trifluralin, pyridate, clopyralid, or cinmethylin at different rates and times of application in transplanted cabbage (Brassica oleracea capitata L.), broccoli (Brassica oleracea botrytis L.), and cauliflower (Brassica oleracea italica L.). Preplant incorporated and preemergence applications were made on July 25, and the following day the cole crops were transplanted. Early and late postemergence treatments were applied on August 10 and 26, respectively. Crop injury and weed control ratings were recorded on September 1. Weeds present on the site included redroot pigweed (Amaranthus retroflexus L.), common lambsquarters (Chenopodium album L.), fall panicum (Panicum dichotomiflorum Michx.), and giant foxtail (Setaria faberi Hermm.).

Results indicated that following preplant incorporation of oxyfluorfen alone or in combination with trifluralin injury to cauliflower resulted. Crop injury following early and late postemergence application of clopyralid and pyridate alone and in combination with oxyfluorfen on cauliflower was also recorded. This crop injury was further reflected by in yield. All other treatments did not injure the crops, or the injury was not significant at the 5% probability level.

Oxyfluorfen alone or in combination with trifluralin applied preplant incorporated provided excellent weed control of the four weed species. Oxyfluorfen applied preemergence followed by early postemergence application of clopyralid and late postemergence application of pyridate provided excellent weed control on cabbage and broccoli and good control on cauliflower.

Oxyfluorfen applied preemergence followed by an early postemergence application of cinmethylin resulted in the highest yield of cabbage and broccoli. The second best treatments were oxyfluorfen applied preemergence followed by clopyralid applied early postemergence on cabbage and preplant incorporated trifluralin followed by oxyfluorfen preemergence application on broccoli.

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[1] New Jersey Agr. Expt. Station Publication No. J-15472-2-88

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ACTIVITY OF RE-40885 IN POTATOES

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

ABSTRACT

Field studies were conducted for 3 yr to investigate the efficacy of and potato (Solanum tuberosum L. 'Superior') response to RE-40885. All naturally occurring weed species were present for a minimum of 2 yr. Common lambsquarters (Chenopodium album L.) and common ragweed (Ambrosia artemisiifolia L.) control exceeded 90% from 0.4 to 0.6 lb ai/A RE-40885 at 4 WAT and generally remained near those levels throughout the growing season. Jimsonweed (Datura stramonium L.) control varied with year but averaged between 70 and 85% from these rates of RE-40885 and was comparable to control from 0.5 lb ai/A metribuzin. Yellow nutsedge (Cyperus esculentus L.) and large crabgrass (Digitaria sanguinalis L.) control was satisfactory from RE-40885 only when the herbicide was combined with metolachlor. Potato injury from RE-40885 was manifested as bleaching with occasional expression of purple discoloration and leaf necrosis. Potatoes always recovered from initial injury to produce normal yields but the initial response was sufficient to preclude use of RE-40885 in this crop.

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SNAP BEAN TOLERANCE TO IMAZETHAPYR

C. E. Beste[1]

ABSTRACT

Imazethapyr was evaluated in 1987 and 1988 for efficacy with snap beans (Phaseolus vulgaris L. 'GV-66') in a Norfolk loamy sand (0.9% O.M.) pH 5.9. In 1987, the snap beans were planted on August 19 and the herbicide treatments were applied preplant incorporated (ppi) on August 18 and preemergence (pre) on August 19 and postemergence (post) on September 11. In 1988, the planting date was June 24 and ppi on June 23, pre on June 24 and post on July 19. A rotatiller was used to incorporate at a 3 inch depth. Irrigation was applied as needed in both years. Imazethapyr rates were 0.032, 0.047, 0.063 and 0.094 lb ai/A. All treatments were cultivated once. In 1987, no difference in snap bean phytotoxicity of imazethapyr as a pre vs ppi treatment occurred; however, in 1988 ppi was more injurious than pre. Pendimethalin in tank mixtures with imazethapyr, ppi, appeared to be slightly more injurious than either herbicide used alone in both years. Metolachlor as a ppi tank mix with imazethapyr in 1987 did not appear to enhance phytotoxicity nor did EPTC. Metolachlor as a pre tank-mix with imazethapyr did not indicate any interaction to enhance snap bean injury. Post imazethapyr with 0.25% v/v non-ionic surfactant caused unacceptable injury to snap beans. Imazethapyr incorportion was necessary for ivyleaf morningglory (Ipomoea hederacea (L.) Jacq.) and entireleaf morningglory (Ipomoea hederacea var. integriuscula Gray). Common purslane (Portulaca oleracea L.) control appeared weak with imazethapyr at 0.032 and 0.047 lb ai/A. Imazethapyr appears acceptable for snap beans at 0.032 lb ai/A ppi or pre; however, although higher rates were more phytotoxic, snap bean yields were seldom significantly reduced but a trend for reduced yields was apparent.

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IMAZETHAPYR, CLOMAZONE AND OTHER HERBICIDE COMPOUNDS FOR PEAS, SNAP BENS, AND LIMA BEANS

Ed Kee, Lori Rider, & Tracy Wheedleton[1]

ABSTRACT

Experiments were conducted in 1988 to evaluate the efficacy, phytotoxicity, and residual carryover risk to successive crops of imazethapyr, clomazone, and other herbicide compounds on peas (Pisum sativum 'Early Freezer 680'), snap beans (Phaseolus vulgaris 'Cascade' and 'Provider'), and lima beans (Phaseolus lunatus '8-78'). This work is a continuation of field research that was initiated in 1986.

Peas were planted in the same manner as commercial plantings for processing use. They were planted in 7 inch rows on March 25. Yields of shelled peas and the number of pods were higher in the untreated check than any other treatment. No visual symptoms were evident of injury. Imazethapyr gave acceptable weed control, although weed pressure was light. In a commercial experiment, 14% of the acreage treated with metolachlor exhibited injury. Bentazon is performing well in commercial situations.

The snap beans were planted on May 3. Imazethapyr caused significant injury after the first 30 days from planting. Plant weights of both varieties were lower in the imazethapyr treatments than the untreated check or EPTC treatments. EPTC gave good control and adequate crop safety.

Lima beans exhibited excellent tolerance to several rates of imazethapyr, whether applied pre-plant incorporated, pre-emergence, or post-emergence. Clomazone provided excellent grass control, good crop safety, but poor control of red root pigweed (Amaranthus retroflexes).

Bioassay studies planted after the peas were harvested indicate that broccoli (Brassica oleracea 'Premium Crop'), pickling cucumbers (Cucumis sativus 'Regal') and grain sorghum (Sorghum vulgara 'DK 42Y') are sensitive to imazethapyr.

Bioassay studies of wheat (Triticum aestivum), rye (Secale cereale), and barley (Hordeum vulgare) showed no yield loss at harvest. Barley did exhibit some visual symptoms in the fall where imazethapyr had been applied at 6 ounces per acre pre-plant incorporated on lima beans and the ground had been only disked after lima bean harvest.

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INFLUENCE OF POSTEMERGENCE GRAMINICIDES ON THE GROWTH OF CHINESE CRUCIFERS

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ABSTRACT

Three field studies were conducted in 1988 to determine the degree of tolerance of three chinese crucifer species to postemergence applications of sethoxydim and fluazifop-P. Chinese broccoli (Brassica alboglabra), Chinese mustard (Brassica juncea var *rugosa*) and Chinese cabbage (Brassica campestris, Chinensis group *pak choi*) were direct seeded in three row raised beds in Riverhead sandy loam on June 14, 1988. The plants were thinned to a stand and postemergence applications were applied 24 days after planting. Both sethoxydim and fluazifop-P were applied at the usage rates, 0.34 kg ai/ha and 0.28 kg ai/ha respectively, as well as at twice and four times these rates. The adjuvant Dash was included in all treatments and was also applied alone.

Injury symptoms were observed 24 hours after application. Injury was evident on all three species at the low rates of both herbicides. Symptoms were relatively minor at these rates, but was greatly increased in severity at the higher rates. Sethoxydim injury appeared as discrete, light brown necrotic spots, randomly distributed throughout the treated leaf area, whereas fuazifop-P caused a more subtle bronzing effect accompanied by minute dimpling over the treated leaves. In each case, the injury was topical and subsequent evaluations indicate that no systemic injury was occurring. The plots were harvested 18 days after treatment. Upon analysis of the data, it did not appear that any of the treatments caused a significant reduction in yield.

A followup greenhouse study was conducted to examine the degree to which technical sethoxydim and/or components of the commercial formulation may contribute to the injury. Injury was observed within 24 hours of application of the technical material, the formulation blanks and the commercially formulated herbicide. These preliminary results suggest that both the active ingredient and at least some of the formulation components are contributing to the injury.

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CLOPYRALID FOR POSTEMERGENCE BROADLEAF WEED CONTROL IN SEEDED OR TRANSPLANTED COLE CROPS

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

ABSTRACT

Clopyralid was applied postemergence, following preemergence applications of 8.4 kg ai/ha DCPA to seeded cabbage in 1987 and 1988, and to transplanted cauliflower in 1988. Rates between 0.11 kg ae/ha to 0.42 kg ae/ha were evaluated for efficacy, phytotoxicity, and yield. In addition, clopyralid was evaluated in an established weed nursery for efficacy on summer annual broadleaf weeds common in New Jersey. Common cocklebur (**Xanthium strumarium** L.), hairy galinsoga (**Galinsoga ciliata** (Raf.) Blake), and common ragweed (**Ambrosia artemisiifolia** L.) were effectively controlled. Smooth pigweed (**Amaranthus hybridus** L.), velvetleaf (**Abutilion theophrasti** Medik.), common purslane (**Portulaca oleracea** L.), common chickweed (**Stellaria media** (L.) Vill.), and shepherdspurse (**Capsella bursa-pastoris** (L.) Medik.) were not controlled by clopyralid. Common lambsquarter (**Chenopodium album** L.) was suppressed or controlled by higher rates of clopyralid, at or above 0.28 kg ae/ha, but was not affected by lower rates. No phytotoxicity was observed on either crop at any rate evaluated. Yield for all clopyralid treatments were equal to the hand weeded check, and equal to or higher than treatments of DCPA applied preemergence.

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SOIL APPLIED VERSUS PLASTIC APPLIED HERBICIDES FOR WEED CONTROL UNDER CLEAR PLASTIC MULCH

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

ABSTRACT

Soil applied and plastic applied herbicide treatments were evaluated for crop safety and weed control in cantaloupe (**Cucumis melo** L.) in 1986 through 1988. Field experiments consisted of cantaloupes grown on clear plastic mulch and in clear plastic row covers. Greenhouse experiments consisted of barnyardgrass (**Echinochloa crus-galli** (L.) Beauv.), velvetleaf (**Abutilon theophrasti** Medik.), and smooth pigweed (**Amaranthus hybridus** L.) sown into styrofoam flats.

Oxyfluorfen at 0.45, 0.90, and 1.80 kg ai/ha applied alone or at 0.45 and 0.90 kg ai/ha in combination with bensulide at 5.6 kg ai/ha applied to the soil surface prior to laying plastic mulch controlled large crabgrass (**Digitaria sanguinalis** (L.) Scop.), common purslane (**Portulaca oleracea** L.), and carpetweed (**Mollugo verticillata** L.). Weed control was generally less effective when herbicides were applied to the undersurface of the plastic mulch. However bensulide at 5.6 kg ai/ha applied in combination with oxyfluorfen at 0.90 kg ai/ha to the undersurface of the plastic mulch controlled large crabgrass and carpetweed in 1988. Bifenox at 4.5 kg ai/ha applied alone to the undersurface of the plastic mulch controlled large crabgrass and common purslane in 1987. Acifluorfen at 1.12 kg ai/ha, lactofen at 0.56 and 1.12 kg ai/ha, and fomesafen at 1.12 kg ai/ha applied alone to either the soil surface or the undersurface of the plastic mulch resulted in unacceptable crop injury and weed control.

Greenhouse experiments were conducted to evaluate the effect of spraying the soil surface compared with spraying the plastic, and the effect of elevating the plastic above the soil surface to simulate a rough or uneven soil surface. Generally herbicide applications to the undersurface of the plastic mulch or elevation of the plastic mulch above the soil and the combination of both these conditions reduced effectiveness of herbicide treatments. Oxyfluorfen was primarily dependent on soil applications for effective weed control and was not substantially affected by soil to plastic mulch contact. Bifenox controlled weeds when applied to either the soil surface or the plastic mulch, but was affected by contact of plastic mulch with the soil surface. Elevation of the plastic mulch reduced effectiveness of bifenox regardless of the spray surface. Oxyfluorfen and bifenox were equally effective in controlling velvetleaf and smooth pigweed. However, oxyfluorfen was more effective in controlling barnyardgrass.

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Bio & Photodegradable Mulches and Weed Control Programs for Mulched Cantaloupes in Delaware

Tracy Wheedleton and Ed Kee[1]

Abstract

Although plastic mulches have provided growers in Delaware with many benefits, the problems of weed control between rows, weed control in openings made for plants, and removal and disposal of the mulch at the end of the season still exist. For these reasons, the Bio & Photodegradable Mulch Trial and the Cantaloupe Herbicide Trial were conducted in 1988.

Mulches for the bio & photodegradable study were laid with a Mechanical Transplanter Plastic Layer on April 26, 1988 at the University of Delaware Research and Education Center, Georgetown, Delaware. All mulches were in 4 foot widths. Cantaloupes (Cucumis melo 'Superstar') were transplanted May 9, 1988; peppers (Capsicum annuum - hot cherry) were transplanted on May 16, 1988. Fertilizer and cultural practices were carried out according to the University of Delaware recommendations. Periodic evaluations for percent decomposition were made throughout the summer and will be made into 1989. The plastics used in the trial were as follows:

1. Standard 1 and 1/4 mil embossed.
2. PC 6105 (BLACK)
3. PC 6107 (BLACK)
4. PC 6108 (BLACK)
5. PC 6109 (CLEAR)
6. 54-3203 (BLACK - 90 DAY)
7. 54-3202 (BLACK - 60 DAY)

Plastics for the Herbicide Study were laid May 5, 1988. Both standard, embossed clear and black plastics - 1 and 1/4 mil were used. The herbicide treatments were applied to bare ground before the plastic was laid. The treatments were not incorporated. Cantaloupe transplants were planted May 9, 1988. Periodic evaluations for phytotoxicity and weed control efficacy were made. The herbicide treatments used included: Oxyflourfen (Goal) 1.6 lbs. a.i./acre; 1.25 pints/acre, Diclofop ethyl (Hoelon) 3 lbs. a.i./acre; 4 pints/acre, Oxyflourfen (Goal) 1.6 lbs. a.i./acre; 1.25 pints/acre plus Diclofop ethyl (Hoelon) 3 lbs. a.i./acre; 4 pints/acre.

All bio & photodegradable mulches, except PC 6109, appear to have the durability for one season's growth. All herbicide treatments gave acceptable early season control. However, unacceptable weed control resulted late in the season. Although unacceptable control resulted, it was late enough that the harvest of the crop should be nearing completion.

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OXYFLUORFEN FOR WEED CONTROL IN VEGETABLES GROWN WITH CLEAR PLASTIC MULCH

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

ABSTRACT

Oxyfluorfen alone and in combination with standard labelled herbicide treatments was evaluated for crop safety and weed control in cantaloupe (**Cucumis melo** L.) in 1984 through 1988, in eggplant (**Solanum melongena** var. esculentum) in 1986, and in tomato (**Lycopersicon esculentum** Mill.) in 1985. All crops were grown on clear plastic mulch and in clear plastic tunnels except for eggplant which was not covered with clear plastic tunnels.

No crop injury resulted to any crop in any year when 0.45 kg ai/ha or 0.90 kg ai/ha oxyfluorfen were applied to the soil prior to laying the clear plastic mulch.

Oxyfluorfen at 0.45 kg ai/ha and 0.90 kg ai/ha applied alone and at 0.45 kg ai/ha in combination with bensulide at 5.6 kg ai/ha, in cantaloupes, resulted in more effective control of common lambsquarters (**Chenopodium album** L.), large crabgrass (**Digitaria sanguinalis** (L.) Scop.), and common purslane (**Portulaca oleracea** L.) than bensulide applied alone at 5.6 kg ai/ha.

Oxyfluorfen at 0.90 kg ai/ha applied alone and at 0.45 kg ai/ha in combination with napropamide at 1.12 kg ai/ha, in eggplants, resulted in more effective control of large crabgrass than napropamide at 1.12 kg ai/ha applied alone. Both the 0.45 and 0.90 kg ai/ha rates of oxyfluorfen and the combination of oxyfluorfen (0.45 kg ai/ha) and napropamide (1.12 kg ai/ha) resulted in more effective control of common purslane than napropamide applied alone at 1.12 kg ai/ha.

Oxyfluorfen at 0.45 kg ai/ha and 0.90 kg ai/ha applied alone and at 0.45 kg ai/ha applied in combination with napropamide at 1.12 kg ai/ha, in tomatoes, resulted in more effective control of large crabgrass than napropamide at 1.12 kg ai/ha applied alone. Metribuzin at 0.28 kg ai/ha applied alone or in combination with napropamide at 1.12 kg ai/ha resulted in large crabgrass control that was as effective as oxyfluorfen applied alone and oxyfluorfen in combination with napropamide.

The use of oxyfluorfen in combination with standard labelled herbicide treatments can result in broad spectrum weed control for cantaloupes, eggplants, and tomatoes grown with clear plastic mulch.

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EVALUATION OF HERBICIDE PROGRAMS FOR HIGH DENSITY PICKLING CUCUMBERS

Ed Kee, Lori Rider, & Tracy Wheedleton[1]

ABSTRACT

Pickling cucumbers (Cucumis satisvus) that are mechanically harvested in a once-over destructive harvest is a major processing crop in Delaware. Gynoecious hybrids with a male pollinator variety blended in are planted in 18 to 22 inch rows at population densities of 50 to 75,000 plants per acre. Weed control is essential for good yields and to facilitate harvest.

An experiment was planted on May 27, 1988 to evaluate the efficacy and phytotoxicity of bensulide (6 qts/A), bensulide and naptalam (4 qts & 4 qts/A),
clomazone (1.5 pts/A), clomazone (0.5 pts/A), diclofop ethyl (2 qts/A) and diclofop ethyl (2 qts/A applied post-emergence).

Treatments of bensulide alone and in combination with naptalam provided the best control. Some early injury was evident from both treatments of clomazone, although the pickles recovered fully. Weed competition reduced yields in all plots as compared to the bensulide and naptalam treatments. Red root pigweed (Amaranthus retroflexes) control was extremely poor in the clomazone treatments.

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VIRGINIA CREEPER RESPONSE FROM SYSTEMIC HERBICIDES

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ABSTRACT

A field study initiated in 1983 evaluated the efficacy of glyphosate, sulfosate, triclopyr and 2,4-D alone and in combinations on Virginia creeper [Parthenocissus quinquefolia (L.) Planch, PRTQU]. Depending upon the herbicide, rates of application varied from 0.28 to 4.48 kg ai/ha. Spray volumes applied varied from 11 to 1402 L/ha. Single applications were made in June, July, August or September in severely infested apples (Malus domestica Bork 'Starkrimson') planted in 1963 and peaches [Prunus persica (L.)'Loring'] planted in 1967. Even though some treatments were very effective as a contact spray, translocation to the non-sprayed vine in the tree canopy or on the ground was ineffective as complete reinfestation occurred within a four year period. Glyphosate, sulfosate and triclopyr killed spray contacted creeper vine.

INTRODUCTION

Virginia creeper [Parthenocissus quinquefolia (L.) Planch, PRTQU] is a vigorously growing woody vine capable of making a solid ground cover encompassing as much as a 22 m^2 area with a non-mowed depth of 38 cm under the canopy of orchard trees. The long (15m) multi-branched horizontal stems growing on the ground are able to vegetatively propagate from nodes in contact with the upper soil surface. It also has the capability of climbing the tree trunk and enveloping the entire tree canopy. Abundant flowers and fruits develop only after the vine becomes pendant. Crop productivity may be greatly reduced.

The use of the postemergence herbicides triclopyr ester or amine and glyphosate, used alone and in combination with 2,4-D, have been reported to control Virginia creeper (1,4,6,7). The absorption or translocation of triclopyr was not enhanced with the use of several plant growth regulators (2). Triclopyr movement to the root did occur (3).

Even though a decrease in shoot and leaf growth was associated with an 8-hour photoperiod compared to a 16-hour period, the rate of triclopyr absorption and movement was not altered(5).

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MATERIALS AND METHODS

Field studies were conducted from 1983 to 1988 in orchards of apple (Malus domestica Bork 'Starkrimson') planted 6.7 by 7.6 m in 1963 and peach [Prunus persica (L.)'Loring'] planted 6.7 by 7.6 m in 1967. The orchard floor management usually consisted of: one sickle-bar mowing under the tree canopy and three rotary mowings in the middles per year, and a 2.6 m wide band of a residual herbicide applied in the tree row with or without paraquat. The residual herbicide treated area was prone to have sections with 100% of the ground covered with creeper which extending into the non-herbicide area of the row middle. By June, the vigorous creeper had grown to a depth of 30 to 38 cm in the sickle-bar mowed area of the apple orchard but less in the peach orchard where higher light intenisty was available under the tree canopy. By 1982 many trees had sufficient creeper growing in the top of the crown to shade out the crop foliage and bend the tree limbs down. A single tree could have several vines with stem diameters of 0.5 to 1.0 cm growing up the tree trunk into the tree canopy

Sites selected for treatment consisted of four trees having 90 to 100% of adjacent ground surface covered with creeper. The treated plot areas were 2.4 by 26.8 m. A boom with two or three flat fan nozzles was used annually to apply the basic carrier volume of 280 L/ha at 276 kPa. However, during 1983 to 1986 different carrier volumes were compared: (a) 51.4 to 280 L/ha with flat fan nozzles (b) 935 to 1402.5 L/ha with floodjet nozzles at 138 to 276 kPa and (c) 11.2 L/ha with the Herbi Micron applicator. At some time during the study the following herbicides were applied individually: glyphosate {isopropylamine salt of [N-(phosphonomethyl)glycine]} at 1.12, 2.24, 3.36 and 4.48 kg ai/ha; SC0224/ICI-A0224 (sulfosate) {trimethylsulfonium salt of [N-(phosphono-methyl)glycine]} at 1.12, 2.24 and 4.48 kg ai/ha; ester and amine formulations of triclopyr {[(3,5,6-tricloro-2-pyridinyl)oxy] acetic acid} at 0.28, 0.43 0.56, and 0.9 kg ai/ha; and three orchard registered amine formulation of 2,4-D [(2,4-dichlorophenoxy)acetic acid] at 2.24 and 3.36 kg ai/ha. Herbicide combinations applied were: ester formulations of triclopyr + 2,4-D (Crossbow, a 1:2 ratio) at 1.68 and 2.8 kg ai/ha; amine formulations of triclopyr + 2,4-D (a 1:2 ratio) (a) tank mixed at 2.24, 2.69 and 3.36 kg ai/ha and (b) the product Turflon II at 1.34, 1.61 and 2.15 kg ai/ha; triclopyr (amine) + glyphosate at 0.43 + 0.56, 0.84 + 1.12 and 1.68 + 1.12 kg ai/ha; triclopyr (amine) + sulfosate at 0.84 + 1.12 and 1.68 + 1.12 kg ai/ha; triclopyr (amine) + 2,4-D (amine) at 0.84 + 2.24 kg ai/ai/ha; and glyphosate + 2,4-D (amine) a 1:1 ratio at 2.24 and 4.48 kg ai/ha. All triclopyr treatments had the adjuvant XRM 4823 added at the rate of 0.08 ml/ml of triclopyr. The adjuvants used with 1.12 and 2.24 kg ai/ha glyphosate or sulfosate in 1985 and 1986 were 0.79 kg/L fatty amine ethoxylate (Frigate), 98.5% Polymerized pinene, saturated naphthenes, paraffins (Exhalt 800), and 90% Alkylarylpolyoxyethylene, glycols,free fatty acids, isopropanol

(X-77). Single foliar treatments were applied during the months of June, July, August or September from 1985 to 1988. Single dormant applications were made in February or early April 1988 using diesel fuel as the carrier for glyphosate at 4.48 kg ai/ha, triclopyr at 0.96, 1.9 and 3.81 kg ai/ha and 2,4-D at 3.36 kg ai/ha. Data collected was based upon the percent of the ground free of green creeper foliage within the treated area as observed in late September of the year of application to as long as 38 months posttreatment.

RESULTS AND DISCUSSION

Although control was excellent in treated areas, reinfestation occurred in all situations from: (a) seedling growth, (b) new growth originating from treated nodes on the horizontal stems on the ground, (c) encroachment from the vine growing on the tree trunk and in the tree canopy and (d) vine encroachment from outside of the treated area.

Glyphosate, triclopyr and 2,4-D failed to show any efficacy against Virginia creeper when applied with diesel fuel as a dormant application.

Herbicide applied June, July or August contacting the lower portion (25 cm) of current season creeper vine climbing on the tree trunk was translocated enough to kill that portion of the vine not sprayed in the tree canopy. Older vines were not so effected.

Water carrier volumes of 11.2 L/ha to 280 L/ha resulted in considerably more herbicidal effectiveness in reducing live creeper foliage and stems than volumes of 935 to 1402.5 L/ha. The single application at 1402.5 L/ha made 25 May or 13 June 1983 had visible foliage injury for only three weeks. Foliar treatments at carrier volumes of 11.2 to 280 L/ha defoliated the creeper vine and killed stem tissues only within the spray contacted area. Upon considering carrier volume effectiveness and ease of application, the better volume is considered to be 280 L/ha. This was achieved with the use of an OC08 plus two 11008 flat fan nozzles at 276 kPa.

The single applications made during the months of June, July, August or September 1985 to 1988 were inconsistent in kill of creeper stems. The same carrier volume and rate of glyphosate or triclopyr applied each month resulted in: (a) an excellent response, 80 to 100% control for a two year posttreatment period, and (b) a poor response, control lasting less than a month of the growing season, during the application period of 1985 to 1988. In certain instances, all compounds used alone - except 2,4-D - and all combinations, 80 to 100 % defoliation resulted in effective control for 3 to 18 months. Inconsistencies which occurred may be attributed, in part, to: (a) rainfall following treatment, (b) poor coverage associated with wind or a layer of of

vegetation above the creeper foliage and (c) possible strain variation since time of first bloom and fruiting is very variable between plants.

Areas treated with either 4.48 kg ai/ha glyphosate or 0.9 kg ai/ha triclopyr in June 1984 had 99% kill of foliage and stems at 13 weeks posttreatment (September). The plots had an average of 4.3 seedling plants per two square meters. The seedlings had up to 30 cm long horizontal stems. A replication in one glyphosate plot had regrowth present from three nodes on the horizontal treated stems. At 16 months posttreatment the seedling plants had two meter long horizontal stems, two meters of new vine growth extending from the trunk of trees having creeper in the tree canopy, and one meter or less vine encroachment from outside the treated area. At 38 months posttreatment, 100% of the treated area of both treatments was covered by creeper of the density as when first treated in 1984.

The three 2,4-D amine formulations registered for peach and apple, when used alone at 3.36 kg ai/ha, did not control the horizontal stems as effectively as glyphosate, sulfosate, or triclopyr.

This study has revealed that: (a) effective control of creeper is lacking with less than 3.36 kg ai/ha glyphosate plus an additional adjuvant, except when applied with the Herbi micron applicator, (b) triclopyr provides effective control at all rates used, (c) sulfosate is similar in efficacy to glyphosate, (d) the addition of the adjuvant to 1.12 or 2.24 kg ai/ha glyphosate or sulfosate did not make the materials as effective as when used at 3.36 kg ai/ha without an added adjuvant, and (e) none of the herbicides were translocated to the growing points enough to show responses except for treatment on current season growth.

Due to the seriousness of the creeper infestation in the orchards in this study, vines growing on the tree trunk into the tree canopy and vines in the grass middles, a large source is available for reinfestation of treated plots even when the treatments have given 100% control at three to six months posttreatment (Table 1).

The horizontal creeper stems on the ground may have terminal growths of 1.5 to 3.0 m in a single growing season. Within a 45 day posttreatment period, treated areas where all the creeper foliage had been destroyed in June 1988 have one meter encroachment of horizontal vine growth from the adjacent non-sprayed grass median. Complete reinfestation has occurred within three years for treatments with a 90% control rating at one year posttreatment.

This study reveals that Virginia creeper may be easily controlled with glyphosate, sulfosate, triclopyr, by themselves or in combination with 2,4-D, provided all creeper foliage is contacted with the spray.

Table 1. Average percent creeper control and foliage density 14 months posttreatment for applications made August 14, 1987.

Treatment	Rate kg ai/ha	Control %	Density cm
Glyphosate	3.36	80.0	8.8
Glyphosate + 2,4-D	2.24+2.24	0.0	16.5
2,4-D	3.36	0.0	16.5
Triclopyr/2,4-D (1:2)	3.36	30.0	16.5
Control	0.00	0.0	31.7

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EFFECTS OF RATE AND TIME OF TRICLOPYR APPLICATION ON VIRGINIA CREEPER MANAGEMENT IN A WEST VIRGINIA PEACH ORCHARD

T. J. Tworkoski[1/] and R. S. Young[2/]

ABSTRACT

Virginia creeper (Parthenocissus quinquefolia) is a fast-growing perennial vine that can aggressively proliferate in tree crowns and cause significant damage to fruit trees by shading and limb breakage. It is difficult to manage because herbicides do not easily reach underground stems and because it propagates from seed and vegetative buds. Previously we found that triclopyr was effective in controlling Virginia creeper without causing noticable damage to apple trees. In this experiment our objectives were to determine the effect of triclopyr rate and time of application on Virginia creeper control. We also investigated the effect of repeated triclopyr applications.

Butoxyethyl ester of triclopyr was applied to 30 m^2 plots beneath the canopy of peach trees near Kearneysville, WV. Applications were made with a carrier volume of 280 L/ha using a spray boom equipped with 11008 and 0C08 TeeJet nozzles. Each plot received 0, 0.1, 0.3, 0.6, or 1.1 kg ae/ha in August or September 1986; or in July or August, or September 1987. One set of plots received a repeat treatment of the 1986 treatments in 1987. Each rate/time treatment was replicated four times and percent ground area covered by Virginia creeper was evaluated at the end of the 1986, 1987, and 1988 growing seasons.

Triclopyr controlled Virginia creeper the season following treatment; but by the end of the second season, Virginia creeper reestablished its dominance. The best single applications of triclopyr were 1 kg/ha in August 1986 (35% ground cover compared to 90% in control site, evaluated in September 1987) and 1 kg/ha in September 1987 (39% ground coverage compared to 53% in control site, evaluated in September 1988). A single application of tricloyr was insufficient for long-term Virginia creeper control. The most effective control was obtained by repeated 1 kg/ha triclopyr applications made in September 1986 and September 1987; by the end of the 1988 growing season, Virginia creeper covered only 8% of the ground area compared to 75% in control plots. Repeat triclopyr applications were necessary because a few missed or newly germinated plants grew rapidly to dominate a site. Virginia creeper rooted near a tree trunk was particularly difficult to control since its foliage was protected from the herbicide by the tree crown. In general, triclopyr applications were equally effective in July, or August, or September.

Based on this and previous work, it appears that managing heavy infestations of Virginia creeper requires at least two annual applications of triclopyr at 0.6 to 1.12 kg/ha. Vines of plants rooted near trunks that grow into crowns should be sheared and additional "spot" applications may be required. Applications can be made from July through September provided plants are not stressed or senescent.

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CLOPYRALID FOR MUGWORT AND CANADA THISTLE CONTROL IN TREE FRUIT

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ABSTRACT

Clopyralid was evaluated for efficacy and phytotoxicity to peaches (**Prunis persica** L.) at 0.28 to 0.37 kg ae/ha alone or in combination with 2,4-D at 1.12 kg ae/ha or triclopyr at 0.56 kg ae/ha. Canada thistle (**Cirsium arvense** (L.) Scop.) control experiments were established in 1987 and in 1988. Treatments applied in May, when the thistle was 15 cm to 45 cm tall, but before bloom effectively controlled the weed throughout the growing season. Canada thistle control one year after application was good at the site treated in 1987. Applications of 2,4-D and triclopyr, alone or in combination, controlled thistle shoots present at the time of treatment but did not prevent regrowth. Glyphosate applied at 2.24 or 4.48 kg ai/ha suppressed Canada thistle regrowth, but was not as effective as clopyralid. Mugwort (**Artemisia vulgaris** L.) shoots sprayed were controlled by 2,4-D, triclopyr, or clopyralid, but regrowth was evident within 2 months of all the herbicides when applied alone. Only the tank-mix of 2,4-D and clopyralid controlled mugwort regrowth through the growing season. No phytotoxicity has been observed when clopyralid has been sprayed under peaches to control broadleaf weeds. Applications of a 0.25% solution the 350 g/l amine formulation of clopyralid to one scaffold limb of a peach tree in the third leaf were less injurious than 2,4-D, triclopyr, or glyphosate. Some epinastic response was observed to treated leaves, but no translocation from the treated limb was observed and no defoliation occurred.

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RESULTS OF CHEMICAL SUCKERING TRIALS IN 'CONCORD' GRAPEVINES

R. M. Dunst[1], M. J. Mahoney[2], and R. M. Pool[3]

ABSTRACT

The reduced availability and increased cost of hand labor has led many growers of grapes (*Vitis labruscana*, Bailey) to examine alternatives to traditional viticultural practices, including manual suckering. We conducted two grapevine suckering experiments in a commercial 'Concord' vineyard near Fredonia, NY, in 1988. The vineyard has a history of unusually prolific sucker growth. Both experiments utilized a RCB design with three replicate vines in four blocks. The first compared one or two applications of three rates of HOE-00661 (proposed name glufosinate), two rates of paraquat, one rate of ammonium nitrate, and hand suckering. The second compared two applications of 1 lb. ai/A HOE-00661 in five application volumes. First applications were made on May 27, when the longest suckers were about 20 cm., the second on June 14, when sucker regrowth on vines hand suckered at time 1 was about 20 cm. Vines were sprayed to a height of 30 cm.

Results of the first experiment are summarized in Table 1. Because sucker number or length at harvest was not reduced on vines receiving only a single application of any treatment, the data for time 1 application only treatments are not shown. Two applications of 1.0 and 1.5 lb. ai/A HOE-00661, or of 0.56 and 0.94 lb. ai/A paraquat generally reduced sucker number and significantly reduced total and average sucker length at harvest (October 21), as compared to not suckered control vines. These reductions were similar to values obtained on vines receiving two hand suckerings. Two applications of 0.75 lb. ai/A HOE-00661 or 200 lb./A ammonium nitrate did not provide similar reductions.

Results of the second trial are summarized in Table 2. Two applications of 1.0 lb. ai/A HOE-00661 were made in 10, 25, 50, 100, and 200 gallons per acre (gpa). All treatments provided similar reductions in the total and average length of suckers at harvest. However, measurements taken 17 days following the second application showed that 1.0 lb. ai/a HOE-00661 applied in 200 gpa produced less sucker kill than did the same amount applied in 10 to 100 gpa.

Sucker control provided by HOE-00661 or paraquat was incomplete for three reasons. First, regardless of concentration, herbicides did not kill all foliage contacted at the first application date. Second, some completely defoliated suckers produced new growth from forced lateral buds, and third, new suckers arose from the base of vines after the second application date. Although no chemical treatment eliminated all sucker growth, two applications of 1.0 or 1.5 lb ai/A HOE-00661 or of 0.54 or 0.96 lb. ai/A paraquat provided control similar to that obtained by two hand suckerings, which would be more thorough than is typical for commercial vineyards.

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Table 1. Control of 'Concord' suckers resulting from two applications of HOE-00661, paraquat (lb. ai/A), ammonium nitrate (lb./A), or hand suckering.

	no. of suckers per vine at 1st application date	no. of suckers per vine at 2nd application date	% change in no. of suckers from 1st to 2nd date	no. of dead suckers after 2nd application	no. of injured suckers w/ new lateral growth
Control	14.0 a	17.8 ab	+34 a	0.2 e	3.4 bcd
0.75 HOE-00661	16.8 a	17.8 ab	+8 ab	4.4 d	5.3 b
1.0 HOE-00661	16.5 a	16.2 abc	+8 ab	10.3 b	2.3 cde
1.5 HOE-00661	14.4 a	16.3 abc	+23 ab	13.4 a	1.8 cde
0.56 paraquat	14.3 a	14.0 abc	-1 ab	7.3 c	4.1 bc
0.94 paraquat	13.8 a	12.1 abc	-2 abc	10.9 ab	2.1 cde
Hand sucker	12.7 a	9.2 c	-16 bc	0.0 e	0.0 e
200 lb. am. nit.	16.7 a	19.1 a	+15 ab	1.8 de	8.7 a

	total no. of live suckers after 2nd application	% change in no. of suckers after 2nd application	total no. of suckers at harvest	total length of suckers at harvest (cm.)	ave. length of suckers at harvest (cm.)
Control	18.8 a	+5 ab	15.7 a	1295 a	75.2 a
0.75 HOE-00661	12.2 abcde	-23 bcd	15.4 a	905 abcd	60.0 abcd
1.0 HOE-00661	6.5 def	-61 ef	7.8 bcd	391 cde	37.0 bcde
1.5 HOE-00661	4.5 f	-77 f	9.3 abcd	468 cde	39.5 bcde
0.56 paraquat	8.8 cdef	-37 cde	8.5 bcd	369 cde	30.6 de
0.94 paraquat	5.8 ef	-45 de	4.9 d	143 e	24.0 e
Hand sucker	9.7 cdef	+1 ab	6.1 cd	196 e	23.0 e
200 lb. am. nit.	17.3 ab	-2 ab	13.5 ab	962 abc	67.7 ab

Table 2. Control of 'Concord' suckers resulting from two applications of 1.0 lb. ai/A HOE-00661 applied in five gallonages.

	no. of suckers per vine at 1st application date	no. of suckers per vine at 2nd application date	% inc. in no. of suckers from 1st to 2nd date	no. of dead suckers after 2nd application	no. of injured suckers w/ new lateral growth
Control	10.7 ab	13.0 ab	+33 a	0.3 c	1.4 c
10 gpa	9.3 ab	10.8 ab	+31 a	5.4 ab	1.8 bc
25 gpa	6.7 b	9.8 b	+117 a	5.7 ab	1.7 bc
50 gpa	12.6 a	16.8 a	+41 a	7.2 a	3.5 abc
100 gpa	12.4 a	14.6 ab	+27 a	4.1 b	4.1 ab
200 gpa	9.1 ab	13.2 ab	+71 a	1.5 c	5.2 a

	total no. of live suckers after 2nd application	% change in no. of suckers after 2nd application	total no. of suckers at harvest	total length of suckers at harvest (cm.)	ave. length of suckers at harvest (cm.)
Control	13.0 a	+2 a	10.8 a	1036 a	89.8 a
10 gpa	6.7 b	-32 bc	7.4 ab	280 b	30.9 b
25 gpa	4.6 b	-56 c	4.4 b	258 b	44.4 b
50 gpa	9.0 ab	-50 bc	10.1 a	474 b	41.7 b
100 gpa	10.3 ab	-33 bc	8.6 ab	527 b	59.3 b
200 gpa	9.6 ab	-23 ab	9.5 a	535 b	53.0 b

EVALUATION OF SULFONYL UREA AND IMIDAZOLINE COMPOUNDS FOR BUNCHBERRY CONTROL IN LOWBUSH BLUEBERRY FIELDS

David E. Yarborough and Prasanta C. Bhowmik 1/

ABSTRACT

The imidazoline compounds did not provide selective control of the bunchberry (Cornus canadensis L.) and resulted in unacceptable injury to the lowbush blueberry (Vaccinium angustifolium Ait.). In one experiment the sulfonyl urea, chlorimuron reduced bunchberry stems and increased blueberry stems but in another it did not reduce bunchberry stems but reduced blueberry yield. An increase in the number of blueberry buds with the low rates of chlorimuron was seen in both experments. Further research on timing and rates are needed to determine if the sulfonyl urea herbicides will provide consistent suppression of bunchberry in lowbush blueberry fields.

INTRODUCTION

Lowbush blueberries are produced in Maine and the Maritime Provinces of Canada and Quebec through the management of wild stands. Weed management consists of biannual pruning, preemergence applications of hexazinone [3-cyclohexyl-6-(dimethyl-amino)-1-methyl-1,3, triazine-(2,4(1H, 3H)-dione] (6) and selective wiper applications of 2,4-D [(2,4 dichlorophenoxy)acetic acid] or glyphosate [N-(phosphonomethyl) glycine (7). However, not all species are controlled by these treatments.

Hall and Sibley (1) reported that bunchberry was a prominent weed in Nova Scotia before the use of hexazinone. In a recent survey, McCully (2) indicated bunchberry was the most prevalent species on fields which had been treated by hexazinone. In Maine, bunchberry has increased in frequency and cover with hexazinone treatments (5). Dichlobenil (2,6-Dichlorobenzonitrile) which is used to control bunchberry in highbush blueberries (V. corymbosum L.) and cranberry (V. macrocarpon Ait.) did not adequately suppress the bunchberry in lowbush blueberry fields (4). Since the bunchberry has a rhizomatous growth habit similar to the lowbush blueberry (1), it grows in areas between and among the blueberry clones, making it difficult to apply non-selective treatments. A selective herbicide is needed to limit the growth and spread of the bunchberry in lowbush blueberry fields.

The objective of these studies was to investigate the rates and timing of three sulfonyl urea and two imidazoline herbicides for selective suppression of bunchberry in lowbush blueberry fields and to evaluate their effect on blueberry growth and yield.

1/ Massachusetts Agricultural Experiment Station Journal Article No. 2905.
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MATERIALS AND METHODS

In the first experiment, two sulfonyl urea herbicides, chlorimuron [2-[[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino]carbonyl]amino] sulfonyl] benzoic acid], thiameturon [3-[[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino]carbonyl]amino] sulfonyl] -2-thiophenecarboxylic acid], and three imidazoline herbicides, imazapyr [(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid], imazaquin [2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-quinolinecarboxylic acid] and imazethapyr [(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridine carboxylic acid], were included to determine the efficacy for bunchberry control and phytotoxicity to lowbush blueberries. Experimental plots established on Blueberry Hill farm and treated preemergence at 0, 35 and 70 g ai/ha for chlorimuron, 0, 22 and 44 g ai/ha for thiameturon, and 0, 23, and 46 g ai/ha for imazapyr, imazaquin, and imazethapyr on May 20, 1987. Postemergence treatments were at 0, 18 and 35 gm ai /ha for chlorimuron, 0, 11 and 22 g ai/ha for thiameturon, and 0, 12, and 23 g ai/ha for imazapyr, imazaquin, and imazethapyr on July 16, 1986. All treatments were applied by a Co_2 backpack sprayer at 207 kPa in 187 L/ha water. Experimental design was a split-block with six replications of five herbicides applied at three rates on two dates. Plot size was 1.5 by 3 m with 0.5 by 3 m alleyways. Ratings, where 0 = no effect and 10 = complete control or injury, were made on blueberry and bunchberry stand in August 1986 and 1987. Two, 0.05 m^2 subsamples were cut from each plot in October and the number of stems were counted and measurements were made on blueberry stem length and number of flower buds. Yields were obtained by mechanically harvesting the plots in August of 1987.

In a second study, plots were established at Blueberry Hill Farm in an area with a heavy bunchberry population in May 1987. Chlorimuron was applied with a Co_2 backpack sprayer at 0, 18, 35, 70 and 140 g ai/ha with 0.5% nonionic surfactant in 187 L/ha water on May 11, after bunchberry were fully emerged, and at blueberry tip dieback, on July 9, 1987. The experimental design is a randomized complete block with five replications of five rates applied at two times. Plot size was 1 by 3 m with a 1 by 3 m alleyway. Bunchberry plants were counted from two, 0.1 m^2 subplots in May 1987 and recounted from the same quadrats in 1988 to get an accurate effect of chlorimuron on stand. A visual rating (0 to 10 scale) of efficacy on bunchberry and injury to blueberry was made in August 1987. Blueberry stems were cut from two, 0.05 m^2 subplots in September 1987 to assess the effects of treatments on stand density and blueberry growth and development. Plots were mechanically harvested in August 1988 to determine the effect on blueberry yield.

In both experiments, data were analyzed by analysis of variance using the GLM procedure of SAS (3). Significant interactions were partitioned and orthogonal contrasts were used to determine the trends among the rates.

RESULTS

In the first experiment, preemergence applications of the sulfonyl urea herbicides had no effect on either the blueberry or bunchberry (Table 1). Preemergence applications of the imadazoline herbicides injured both blueberry and bunchberry and resulted in reduced stem numbers in all cases

except for imazethapyr which did not reduce bunchberry stem numbers. Injury observed for the untreated imazapyr and imazethapyr were due to drift on to the control plots. Postemergence application of thiameturon had no significant effect but the chlorimuron treatments resulted in an increase in blueberry stems and a decrease in bunchberry stems (Table 1). Postemergence applications of the imadazoline herbicides resulted in less injury and control than the preemergent applications but did not affect blueberry or bunchberry stand with the exception of a stimulation of blueberry stems at the 12 g/ha rate of imazapyr.

Carryover ratings on the blueberry or bunchberry and measurements on the blueberry for the preemergence applications of the sulfonyl urea herbicides chlorimuron and thiameturon indicated no effect, but blueberry yield was reduced by the latter herbicide (Table 2). Postemergence applications of the imadazoline herbicides resulted in sustained injury of both blueberry and bunchberry and resulted in reduced stem length and buds as well as a decrease in yield in all cases except for imazapyr. Injury observed for the untreated imazapyr was due to drift on to the control plots which resulted in no yield on half of the plots, which is the reason for the lack of significance.

Postemergence applications of thiameturon had no significant effect but the chlorimuron treatments resulted in an increase in blueberry stem length and buds but did not increase yield (Table 2). Postemergence applications of the imadazoline herbicides resulted in less injury and control than the preemergent applications but either produced no effect or resulted a reduction of blueberry growth and yield.

In the second study, the rating data indicate that both blueberries and bunchberries were injured by increasing rates of chlorimuron applied either at emergence in May or at tip dieback in July (Table 3). More injury was observed with the treatments applied at emergence. Injury consisted of a red colorations on the leaves and an appearance of shorter plants but no tissue death was seen. Although total stems and total length were not reduced, total and average buds were reduced with the higher rates of chlorimuron (Table 3). Average stem length was reduced by the chlorimuron treatments at emergence but not by the later treatments. The 18 and 35 g ai/ha rate increased total and average buds at emergence and average buds at tip die-back.

Chlorimuron did not reduce the number of bunchberry stems but the treatment at emergence resulted in a decline in blueberry yield as the chlorimuron rate was increased (Table 4).

DISCUSSION

The imadazoline compounds did not provide selective control of the bunchberry. Of the sulfonyl urea compounds chlorimuron showed initial promise in the first experiment by reducing the number of bunchberry stems while at the same time increasing the number of blueberry stems. These results were not duplicated in the second experiment. Blueberry flower buds were stimulated by the postemergence treatment of chlorimuron in the first study and by the emergence treatment in the second experiment. In the second study, blueberry injury was observed with the chlroimuron treatments and blueberry yield was depressed by the higher rates of chlorimuron at emergence. The addition of a surfactant and the higher rates of chlorimuron did not increase efficacy on the bunchberry but resulted in increased injury to the blueberry.

McCully (2) reported that another sulfonyl urea herbicide, sulfometuron [2-[[[[[(2,6-dimethyl-2-pyrimidinyl)amino]carbonyl]amino] sulfonyl]benzoic acid] applied in the fall at 150 to 200 g/ha was the most effective herbicide in reducing bunchberry in lowbush blueberry fields. Phytotoxicity to the blueberries was noted but it was comparable to hexazinone. Results from several experiments were variable and further studies are needed before any conclusions are made.

Under the current management practices, bunchberry is increasing in Maine (5) and Canada (2). Further research on timing and rates are needed to determine if the sulfonyl urea herbicides will provide consistent suppression of bunchberry in lowbush blueberry fields.

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Table 1. Effect of herbicides on blueberry and bunchberry, Jonesboro 1986.

Herbicide	Rate g ai/ha	Blueberry	Bunchberry	Blueberry	Bunchberry
		1986 Rating (0-10)		Stems (0.1m)	
Preemergence treatments					
Chlorimuron	0	0	0	60	76
	35	3.0	2.2	44	51
	70	1.5	0.9	90	45
Significance		NS	NS	NS	NS
Thiameturon	0	0	0	78	32
	22	1.5	0.7	90	35
	44	1.4	0.7	62	51
Significance		NS	NS	NS	NS
Imazapyr	0	4.7	3.8	17	71
	23	10	9.8	0	2
	46	9.3	9.3	0	0
Significance		Q*	Q*	L**	Q**
Imazaquin	0	0	0	73	48
	23	6.0	3.8	19	48
	46	7.6	5.3	26	47
Significance		Q**	L*	Q**	NS
Imazethapyr	0	3.0	2.5	76	42
	23	9.3	9.3	2	8
	46	9.7	9.5	0	2
Significance		Q**	Q**	Q**	Q*
Postemergence treatments					
Chlorimuron	0	0	0	39	59
	18	0.5	0.2	50	41
	35	1.6	1.2	84	32
Significance		NS	L*	L*	L*
Thiameturon	0	0	0	64	51
	11	0.8	0	78	34
	22	2.0	0.4	71	43
Significance		NS	NS	NS	NS
Imazapyr	0	0	3.8	76	51
	12	5	2.7	122	26
	23	5.4	3.4	56	47
Significance		Q**	L**	Q**	NS
Imazaquin	0	1.3	0.8	65	43
	12	1.0	0.3	112	22
	23	0.8	0.8	94	46
Significance		NS	NS	NS	NS
Imazethapyr	0	0	0.8	86	33
	12	0.7	0.3	81	48
	23	1.2	0.8	91	46
Significance		L**	L**	NS	NS

*=5%, **=10%, L = linear trend, Q = quadratic trend, NS = nonsignificant

Table 2. Effect of herbicides on blueberry and bunchberry, Jonesboro 1986.

Herbicide	Rate g ai/ha	Blueberry	Bunchberry	Blueberry		
		1987 Carryover rating (0-10)		Length (cm)	Buds (0.1m)	Yield kg/ha
Preemergence treatments						
Chlorimuron	0	0	0	204	59	2939
	35	1.0	0.8	150	70	1975
	70	1.5	0	278	66	2630
Significance		NS	NS	NS	NS	NS
Thiameturon	0	0	0	313	90	5651
	22	0.8	0.2	259	95	2675
	44	0.2	0	209	71	1629
Significance		NS	NS	NS	NS	L**
Imazapyr	0	5.5	2.2	103	11	628
	23	10	9.2	0	0	0
	46	10	9.3	0	0	0
Significance		L**	L**	L*	NS	NS
Imazaquin	0	0	0	329	70	2275
	23	3.4	2.0	50	10	459
	46	4.2	0.3	62	2	146
Significance		L**	NS	L**	L**	L**
Imazethapyr	0	1.2	0	279	131	1320
	23	9.2	7.8	6	0	0
	46	10	8.8	0	0	0
Significance		L**	L**	L**	L*	L**
Postemergence treatments						
Chlorimuron	0	0	0	196	54	5151
	18	0	0	269	91	3413
	35	0.7	0.2	380	107	3540
Significance		NS	NS	L*	L*	NS
Thiameturon	0	0	0	282	77	3567
	11	0	0	270	80	3121
	22	0.3	0	397	141	2030
Significance		NS	NS	NS	NS	NS
Imazapyr	0	2.0	0	345	101	4359
	12	9.8	4.5	474	9	0
	23	8.4	4.0	255	5	1048
Significance		L**	L**	Q*	L*	L*
Imazaquin	0	1.5	0.3	310	58	3103
	12	0.6	0	465	108	2285
	23	0.5	0.2	387	66	2566
Significance		NS	NS	NS	NS	Q**
Imazethapyr	0	0	0	397	114	4995
	12	3.0	0.5	343	51	428
	23	5.0	0.3	437	38	209
Significance		L**	L**	NS	NS	Q**

*=5%, **=1%, L = linear trend, Q = quadratic trend, NS = nonsignificant

Table 3. Effect of timing of chlorimuron on blueberry and bunchberry, Jonesboro 1987.

Timing	Rate g ai/ha	Blueberry	Bunchberry	Blueberry Total			Blueberry Average	
		Rating (0-10)[a]		Number (0.1m)	Legnth (cm)	Buds (0.1m)	Legnth (cm)	Buds (stem)
Emergence - May								
	0	0	0	54	454	122	8.8	2.8
	18	2.6	1.4	63	362	188	6.0	3.1
	35	2.4	0.8	61	316	167	5.5	3.5
	70	5.2	4.0	51	254	144	4.6	3.2
	140	5.8	4.2	65	320	81	4.9	1.3
Significance		L**	L**	NS	NS	Q**	Q**	Q*
Top dieback -July								
	0	0	0	59	424	112	7.2	1.9
	18	1.4	1.0	43	332	87	7.7	2.6
	35	1.2	0.8	48	408	82	8.5	1.9
	70	2.2	2.0	37	276	44	6.5	1.1
	140	1.4	1.4	62	425	23	6.8	0.3
Significance		L**	L**	NS	NS	L**	NS	L**

a Rating 0 = no effect, 10 = complete kill, ** = 1% level, L =linear trend Q = quadratic trend

Table 4. Effect of timing of chlorimuron on bunchberry stand and blueberry yield, Jonesboro 1988.

Timing	Rate g ai/ha	Bunchberry / 0.1m 1987	1988	Change	Blueberry Yield kg/ha
Emergence - May					
	0	21	27	6	8560
	18	28	22	-6	8053
	35	28	17	-1	7022
	70	26	33	7	4182
	140	30	20	-10	3617
Significance		NS	NS	NS	L*
Tip dieback - July					
	0	13	18	5	5640
	18	21	35	14	4844
	35	19	29	10	5524
	70	26	30	4	3311
	140	11	10	-1	3876
Significance		NS	NS	NS	NS

* = 5% level, L = linear trend NS = nonsignificant.

CONTROL OF FIELD VIOLET IN STRAWBERRY PLANTINGS

J.F. Ahrens[1/]

ABSTRACT

Experiments were conducted during 1987 and 1988 to determine the effect of fall applications of oxyfluorfen on control of field violet (Viola arvensis Murr.) and yield of 'Raritan' and 'Kent' strawberries (Frageria x ananassa Duch.) and to further evaluate effects of registered strawberry herbicides for control of field violet.

Replicated experiments were established on a sandy loam soil of 2.8% OM, both on a first year strawberry planting and on bare ground in the fall of 1987 and on bare ground in April, 1988. Field violet was seeded over the strawberry plants or freshly prepared seedbed on bare ground. Herbicides were applied with a hand-held boom calibrated to deliver 30 gal/A, after seeding, (preemergence, Sept. 10 or March 30), at the one- to two-leaf stage of field violet (early post, Oct. 1) or at the three- to eight-leaf stage (late post, Nov. 2).

Terbacil plus napropamide at 0.5 plus 4 lb/A, a standard herbicide treatment in early November in commercial strawberry fields, gave no control of field violet. Oxyfluorfen at 0.25 or 0.5 lb/A applied from Oct. 1 to Nov. 2, alone or with terbacil and napropamide gave complete control of field violet and injured strawberry leaves in October but had no effect on strawberry yield. Oxyfluorfen alone or with napropamide gave poor control of horseweed (Conyza canadensis (L.) Cronq.) whereas terbacil gave good to excellent control.

The bare ground experiments showed that terbacil at 0.25 to 0.5 lb/A gave erratic preemergence control of field violet, excellent early postemergence control and no late postemergence control. Oxyfluorfen at 0.25 lb/A controlled field violet at all growth stages. Diphenamid or chloroxuron at 4 lb/A gave poor preemergence control of field violet whereas napropamide at 4 lb/A or DCPA at 10.5 lb/A gave good to excellent preemergence control. Knowledge of these responses of field violet to current herbicides will aid in developing alternative control strategies.

Oxyfluorfen would be a welcome addition to the currently small arsenal of herbicides registered for strawberries because it would allow control of field violet at any growth stage in the fall.

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CAN COVER CROP RESIDUES CONTROL WEEDS IN VEGETABLE CROPS?

E.T. Maynard and R.R. Bellinder[1]

ABSTRACT

Growing interest in reduced herbicide rates, minimum tillage vegetable production, and weed suppression by cover crop residues motivated this study. Five cover crops were screened for use in minimum tillage tomato (Lycopersicon esculentum Mill.) and cauliflower (Brassica oleracea L. var. botrytis L.) production with standard and reduced herbicide rates. Cover crops were evaluated for their effect on weed control and crop performance.

Hairy vetch (Vicia villosa Roth), red fescue (Festuca rubra L.), winter rye (Secale cereale L.), and annual ryegrass (Lolium multiflorum Lam.) were seeded in late August, 1987, when bare ground control plots were also established, and oats (Avena sativa L.) were seeded in early Spring 1988. All plots were treated with glyphosate at 1.1 kg ai/ha on May 27, 1988. Fescue and vetch were not controlled by this treatment and so were mowed to 15 cm on June 2. Each plot was divided into two subplots, where trifluralin at 0.56 and 0.84 kg ai/ha (tomatoes and cauliflower) and oxyfluorfen at 0.28 and 0.43 kg ai/ha (cauliflower) were applied and irrigated in prior to transplanting. Tomatoes or cauliflower were transplanted into a 25 cm wide tilled strip on June 2. Each cover crop X herbicide rate combination was replicated three times with both crops.

At transplant time, vetch residue covered greater than 95% of the ground, fescue 73%, winter rye 52%, oats 38%, and ryegrass 28%, compared to the control with less than 5% ground cover.

Weed control was evaluated by determining dry weight of weeds in one 0.25 m^2 quadrat per plot in mid-August. Weed control varied from excellent in fescue plots (18 g/m^2 and 2 g/m^2 in tomato and cauliflower, respectively) to poor in vetch plots (348 g/m^2 and 298 g/m^2). In between were winter rye (55 g/m^2, 15 g/m^2), bare ground (157 g/m^2, 26 g/m^2), ryegrass (230 g/m^2, 63 g/m^2), and oats (265 g/m^2, 37 g/m^2). Reduced herbicide rates controlled weeds as well as standard rates in all plots, suggesting that lower rates may be effective with or without cover crop residue.

Yield of red and green tomatoes was reduced by 47% in vetch and 26% in fescue plots compared to control plots. Yield of red fruit alone was reduced by 59% in vetch, 47% in fescue, and 38% in winter rye plots. Ryegrass and oats reduced total yields and red fruit yields by up to 15%, but the reductions were not significant. Total fresh weight of cauliflower plants was reduced by 22% in vetch plots and 39% in fescue plots, compared to the control. Curd yield and average weight per curd were reduced by 53% in fescue plots compared to control plots.

Winter rye, annual ryegrass, and oats resulted in weed control and crop performance close enough to the bare ground plots to warrant further investigation. Vetch resulted in very poor weed control and decreased yields, especially for tomatoes; perhaps the thick residue layer prevented herbicide incorporation. Fescue controlled weeds well, but reduced yields considerably because it remained alive all season. If it could be killed before transplanting, it would be worthwhile to try it again.

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Postemergence Applications of Oxyfluorfen, Pyridate and BAS 514 in Direct-Seeded Broccoli

Kathleen A. Herbst and Jeffrey F. Derr[1]

ABSTRACT

In 1980, nitrofen was removed from the market creating a need for selective broadleaf weed control in cole crops. The currently registered herbicides, trifluralin, DCPA, and napropamide are effective on annual grasses but ineffective on many problem broadleaf weeds such as common ragweed, common lambsquarters, and redroot pigweed. Studies were conducted in the spring and fall of 1987 to evaluate the effects of herbicides on broadleaf weeds without decreasing crop stand or yield of direct-seeded broccoli.

Postemergence applications of oxyfluorfen at 0.07, 0.14, and 0.28 kg/ha caused white chlorotic speckling on broccoli. Injury decreased with time and plants treated with 0.07 kg/ha oxyfluorfen produced yields similar to the cultivated check. Pyridate at 4.03 kg/ha caused yellow lesions on broccoli foliage. Total broccoli yields from plots treated with pyridate at 0.28 and 0.50 kg/ha were not significantly different from the cultivated check. Postemergence applications of BAS 514 at 0.14, 0.28, 0.56 kg/ha caused no visible crop injury other than moderate growth stunting. Injury increased with time at some locations. Plots treated with 0.28 and 0.56 kg/ha BAS 514 had reduced broccoli weight. Treatments of BAS 514 (0.07, 0.14, 0.28, 0.56 kg/ha) in combination with the adjuvant BAS 090 caused foliar veinal chlorosis, deformed broccoli heads and decreased yield. Little or no stand reduction or delay in harvest was observed with any herbicide treatment.

Weed control studies conducted in the greenhouse indicated that postemergence applications of oxyfluorfen at 0.28 kg/ha provided >90% common ragweed and common lambsquarters control, and 77% redroot pigweed control. Pyridate at 2.02 kg/ha provided complete control of horseweed and >70% control of prickly sida, redroot pigweed, common ragweed and common lambsquarters. BAS 514 applied postemergence at 0.14, 0.28 and 0.56 kg/ha provided good to excellent control of horseweed and common ragweed. Greater than 90% control of large crabgrass was observed with BAS 514 (0.28 kg/ha) plus BAS 090.

Nomenclature: oxyfluorfen, 2-chloro-1-(3-ethoxy-4-nitro-phenoxy) -4-(trifluoromethyl) benzene; pyridate, 6-chloro-3-phenyl-pyridazine-4-yl-S-octyl carbonothionate; BAS 514, quinclorac, 3,7-dichloro-8-quinoline-carboxylic acid; broccoli *Brassica oleracea* L. var. *botrytis*; common ragweed *Ambrosia artemisifolia* L.; redroot pigweed *Amaranthus retroflexus* L.; common lambsquarters *Chenopodium album* L.; prickly sida *Sida spinosa* L.; horseweed *Conyza canadensis* L.; large crabgrass *Digitaria sanguinalis* L.;
Additional index words. quinclorac, BAS 090, *Brassica oleracea* L. *botrytis*.

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EVALUATION OF PREEMERGENCE HERBICIDES FOR GRASS SUPPRESSION IN LOWBUSH BLUEBERRY FIELDS

David E. Yarborough 1/

ABSTRACT

Hexazinone provided the best poverty oatgrass (Danthonia spicata) suppression followed by terbacil and atrazine. The 4.4 kg/ha rate of hexazinone reduced little bluestem (Andropogon scoparis) vigor and height and increased blueberry (Vaccinium angustifolium) yield. Terbacil or atrazine could be used in rotation with hexazinone for oatgrass suppression. Additional postemergence grass treatments may be needed to control little bluestem.

INTRODUCTION

Before the use of preemergence grass herbicides, grasses were a major factor in limiting lowbush blueberry production in Maine (2). Terbacil [5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H, 3H)- primidinedione], which was registered for use in 1975, suppressed most grasses and increased yields (1, 2) but also produced an increase in composite weeds. Hexazinone will suppress most grasses and also control many herbaceous and woody weeds (6). Hexazinone [3-cyclohexyl-6-(dimethyl- amino)-1-methyl-1,3, triazine-(2,4(1H, 3H)-dione] will suppress the most prevalent grass, poverty oatgrass (5) but is not effective on little bluestem. Little bluestem is found in the southern and western parts of the state but is increasing in the major blueberry producing eastern region. Postemergence grass herbicides did not give lasting control of little bluestem (3).

Other preemergence herbicides need to be evaluated to be used in rotation with hexazinone for grass control and to determine if they will suppress little bluestem. The objective of this experiment is to test several preemergence herbicides to determine the most effective material and rate for suppression of poverty oatgrass and little bluestem.

MATERIALS AND METHODS

Experimental sites were established on fields in Deblois, ME with a large poverty oatgrass population and in Bucksport on a field with extensive little bluestem cover in November 1986. The experimental design is a split-block with 6 replicates. Plot size was 1.5 by 10 m with 1.5 by 10 m alleyways. Pronomide [3,5-dichloro(N-1,1-dimethyl-2-propynyl)benzamide], hexazinone, and terbacil were applied at 0, 1.1, 2.2, and 4.4 kg/ha while simazine [6-chloro-N,N- diethyl-1,3,5-triazine-2,4-diamine] and atrazine [6-chloro-N-ethyl-N-(1 -methylethyl)-1,3,5-triazine-2,4-diamine] were applied

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at 0, 4.4, 8.8, and 17.6 kg/ha. Pronomide was applied in November 1986, all other herbicides were applied preemergence, after pruning in May 1987. Ratings of grass, where 0 = no effect and 10 = complete control, and the height of five grass clumps in each plot were made in September 1987 and July 1988. Yields were estimated by mechanically harvesting the plots in August 1988. Data were analyzed by analysis of variance and orthogonal contrasts were used to determine the trends among the rates.

RESULTS

All herbicides, except pronomade, produced a significant reduction in grass vigor and height of the oatgrass in 1987 but only hexazinone and terbacil produced a reduction in height in 1988 (Table 1). Hexazinone produced the greatest suppression at the lowest rate but terbacil and atrazine provided comparable results. No increase in blueberry yield was obtained with the use of any of the herbicides on the oatgrass.

Hexazinone provided the greatest suppression and reduction in height of little bluestem and increased blueberry yield at the 4.4 kg/ha rate (Table 2). Terbacil provided some suppression of little bluestem but the other herbicides were ineffective.

CONCLUSION

Hexazinone provided the best suppression of either grass, but terbacil and atrazine also provided control of oatgrass. Yield increases have been obtained with terbacil (2) and atrazine (4) in earlier studies so the lack of response may be because of the density of the grass in the field. Little bluestem was suppressed best by the 4.4 kg/ha rate of hexazinone, but control not complete. The lack of activity of the fall application of pronomide on either grass may have been due to the high levels of organic mater (> 10%) found in the fields.

Terbacil could be used in rotation with hexazinone to suppress oatgrass but not little bluestem. Atrazine provided good suppression of oatgrass, but is not registered for use in lowbush blueberries in Maine. A preemergence application of a high rate of hexazinone combined with a postemergence herbicide may be required to adequately control little bluestem.

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Table 1. Effect of preemergence herbicide applications on poverty oatgrass vigor and blueberry yield, Deblois 1987-1988.

Herbicide	Rate Kg/ha	Grass rating 1987	Grass rating 1988	Blueberry Yield kg/ha	Grass height(cm) 1987	Grass height(cm) 1988
Pronamide	0	0	0	2057	61	53
	1.1	0.6	0	1724	55	54
	2.2	1.6	0	1391	54	51
	4.4	2.6	0.4	2502	51	59
Significance		NS	NS	NS	NS	NS
Hexazinone	0	0	0	2531	55	58
	1.1	8.3	6	2758	39	49
	2.2	8.5	8.5	4018	17	29
	4.4	9.8	9.7	1615	2	6
Significance		L**	L**	NS	L**	L**
Terbacil	0	0	0	1593	53	55
	1.1	8.2	7.3	2953	23	22
	2.2	9.0	8.5	1682	15	19
	4.4	9.6	9.2	2553	4	9
Significance		L**	L**	NS	L**	L**
Simazine	0	0.8	0	1323	52	52
	4.4	2.9	0.3	1079	53	53
	8.8	3.6	0.7	1607	47	57
	17.6	6.6	2.1	1665	36	49
Significance		L**	L**	NS	L**	NS
Atrazine	0	2.0	0	1610	50	55
	4.4	7.0	5.3	2797	36	46
	8.8	8.5	7.7	2631	25	39
	17.6	9.3	9.0	2597	11	15
Significance		L**	L**	NS	L**	L**

Rating 0 = no effect, 10 = complete kill,
NS = nonsignificant, * = 5%, ** = 1% level

Table 2. Effect of preemergence herbicide applications on little bluestem vigor and blueberry yield, Bucksport 1987-1988.

Herbicide	Rate Kg/ha	Grass rating 1987	Grass rating 1988	Blueberry Yield kg/ha	Grass height(cm) 1987	Grass height(cm) 1988
Pronamide	0	0	0	1177	56	28
	1.1	0	0	999	52	29
	2.2	0	0	899	59	28
	4.4	0	0	688	59	27
Significance		NS	NS	NS	NS	NS
Hexazinone	0	0	0	722	59	30
	1.1	0.3	0.4	729	54	30
	2.2	2.7	1.9	594	51	31
	4.4	6.8	5.7	1621	38	32
Significance		L**	L**	L*	L**	NS
Terbacil	0	0	0	816	54	30
	1.1	0.5	0.2	1005	51	28
	2.2	0.8	0.5	799	50	28
	4.4	3.5	1.9	1465	41	33
Significance		L**	L**	NS	L*	NS
Simazine	0	0.5	0	1465	53	28
	4.4	0.0	0	577	55	30
	8.8	0.1	0	804	56	34
	17.6	1.5	0.6	937	48	26
Significance		NS	NS	NS	L*	Q*
Atrazine	0	0	0	649	52	27
	4.4	0.2	0	760	59	26
	8.8	0.4	0.4	1310	58	29
	17.6	1.4	0.4	370	62	32
Significance		NS	NS	NS	L*	NS

Rating 0 = no effect, 10 = complete kill,
NS = nonsignificant, * = 5%, ** = 1% level

ABSTRACT

Water Conservation in the Orchard Environment Through Management

William V. Welker, Jr., and D. Michael Glenn[1/]

The capture of rainfall and the conservation of soil water are major factors in maximizing the productivity of an orchard. Economics require the efficient use of natural resources. The management of both the grassed alleyway and the herbicide strip of the orchard floor can greatly affect rainfall capture and water availability to the fruit tree. Rainfall infiltration was found to be greatest with a sod or killed sod mulch surface, and least with a bare soil herbicide-treated surface. Water use of a Kentucky 31 tall fescue sod in the grassed alleyway was measured with a neutron moisture probe and an infrared thermometer. Water use of the K-31 was reduced with either the application of a low rate (0.14 kg/ha) of paraquat or by mowing. The application of maleic hydrazide (9 kg/ha) retarded grass growth. However, it had little effect on water use. The soil moisture content in the bare soil area immediately adjacent to the treated sod was unaffected by any of the treatments.

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THE EFFECT OF FOUR GRAMINICIDES ON CRANBERRY FRUIT QUALITY[1]

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

ABSTRACT

Four postemergence graminicides were tested on cranberry bogs for their affect on the quality of cranberry fruit. The fruit volume, acidity, percent soluble solids, anthocyanin content and flavonol content were determined and compared with untreated berries. Aside from a slight effect of sethoxydim on acidity and haloxyfop on percent soluble solids, the herbicides had no affect on cranberry fruit quality.

INTRODUCTION

Grasses are important problem weeds in cranberry bogs of southeastern Massachusetts. Growers achieve adequate control of these weeds with the use of preemergence herbicides such as dichlobenil (2,6-dichlorobenzonitrile), napropamide [2-(α-naphthoxy)-N,N-diethylpropionamide], and norflurazon [4-chloro-5-(methylamino)-2-(α,α,α-trifluro-m-tolyl)-3(2H)-pyridazinone]. However, the authors have found that the more recently developed postemergence graminicides give better control, are more selective, and can be applied where the weed is, not where it might be.

In anticipation of their possible future use on cranberry bogs four postemergence graminicides were tested for their effect on the growth and development of the cranberry fruit. The four herbicides tested were fluazifop [(±)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid], sethoxydim [2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one], haloxyfop [2-[4-[[3-chloro-5-(trifluoromethy)-2-pyridinyl]oxy]phenoxy]propanoic acid], and SC-1084 [methyl-3-hydroxy-4-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]-pentanoic acid]. Their effect on cranberry (*Vaccinium macrocarpon* cv 'Early Black') fruit volume, acidity, soluble solids, total flavonols, and anthocyanin development was studied.

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METHODS AND MATERIALS

A section of cranberry bog free of weeds and having a relatively consistent number of uprights over a large area was chosen for treatment. All herbicides were applied in mid-July as an aqueous spray to plots 6 m^2 in area, each treatment being replicated four times. Applications were made with a hand held knapsack sprayer as a fine mist at the rate of 750 l/ha. At harvest berries were hand scooped and berry volume determined. A sub-sample was taken from each plot and frozen for chemical analysis at a later date.

After 30 days the frozen berries were removed from the freezer and their acidity, soluble solids, anthocyanin content, and total flavonols determined. Standard methods for determining acidity and soluble solids were employed. Anthocyanins were determined according to the methods of Deubert (1) and flavonols according to the methods of Lees and Francis (2). The data were subjected to analysis of variance.

RESULTS AND DISCUSSION

Postemergence applications of fluazifop, sethoxydim, haloxyfop and SC-1084 for control of grasses on cranberry bogs does not affect the quality of the cranberry fruit (Tables 1-4). A slight, but significant, difference in acidity was observed in berries treated with 1.68 kg/ha sethoxydim (Table 2). A higher berry volume was noted in cranberries treated with 0.56 kg/ha haloxyfop (Table 3)

Table 1. The effect of fluazifop on cranberry fruit quality. Acidity is in ml 0.1 N NaOH/100g of berries.

Fluazifop (kg/ha)	Vol (ml)	Acidity (ml)	Sol. Solids (%)	Anthocyonin (mg/100g)	Total Flavonols (mg/100g)
0	1.46	215.5	7.39	30.5	29.2
0.56	1.47	213.6	7.46	33.8	31.2
1.12	1.45	220.5	7.35	30.8	27.4
1.68	1.34	222.7	7.65	33.5	29.0
LSD 5%	0.21	8.5	0.38	8.0	6.1
1%	0.28	11.9	0.53	11.3	8.5

Perhaps the most important of the parameters measured in this study is the effect of the graminicides on cranberry pigment content. Much of the commercial value of the cranberry is due to its attractive red color. This color is mainly due to the four red anthocyanin pigments, peonidin-3-arabinoside, cyanidin-3-arabinoside, peonidin-3-galactoside and cyanindin-3-galactoside, and to some extent to the yellow flavonol pigments, myricetin-3 arabinoside, myricetin-3-digalactoside, quercetin-3-

galactoside, quercetin-3-arabinoside, and quercetin-3-rhamnoside (2). As shown in Tables 1-4 cranberry pigment content was not affected by the herbicide treatments.

Table 2. The effect of sethoxydim on cranberry fruit quality. Acidity is in ml of 0.1 N NaOH/100g of berries.

Sethoxydim (kg/ha)	Vol (ml)	Acidity (ml)	Sol. Solids (%)	Anthocyanin (mg/100g)	Total Flavonols (mg/100g)
0	1.46	215.5	7.39	30.5	29.2
0.56	1.40	210.6	7.46	27.6	27.4
1.12	1.38	210.6	7.39	35.8	32.7
1.68	1.33	207.6	7.61	34.7	31.7
LSD 5%	0.21	7.6	0.35	8.3	7.6
1%	0.28	10.6	0.49	11.6	10.7

Table 3. The effect of haloxyfop on cranberry fruit quality. Acidity is in ml of 0.1N NaOH/100g of berries.

Haloxyfop (kg/ha)	Vol (ml)	Acidity (ml)	Sol. Solids (%)	Anthocyanin (mg/100g)	Total Flavonals (mg/100g)
0	1.46	215.5	7.39	30.5	29.2
0.56	1.28	218.2	7.80	33.7	30.8
1.12	1.38	218.2	7.50	30.2	27.1
1.68	1.26	221.2	7.50	33.7	30.9
LSD 5%	0.21	13.2	0.27	10.8	7.7
1%	0.28	18.5	0.37	15.1	10.8

Table 4. The effect of SC-1084 on cranberry fruit quality. Acidity is in ml of 0.1 N NaOH/100g of berries.

SC-1084 (kg/ha)	Vol (ml)	Acidity (ml)	Sol. Solids (%)	Anthocyanin (mg/100g)	Total Flavonols (mg/100g)
0	1.46	215.5	7.39	30.5	29.2
0.56	1.41	217.4	7.35	32.0	32.3
1.12	1.40	221.2	7.50	29.5	28.0
1.68	1.50	218.2	7.31	32.6	28.7
LSD 5%	0.21	15.1	0.19	7.7	7.4
1%	0.28	21.1	0.26	10.8	10.3

It is apparent that the four graminicides described in this study are safe to use on cranberry bogs. Since numerous studies have shown that these herbicides have excellent post emergence activity on grasses, federal clearance of anyone of the herbicides for cranberries would prove to be very useful.

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AN INTEGRATED WEED MANAGEMENT PROGRAM FOR SWEET CORN

Richard A. Ashley[1]

ABSTRACT

An Integrated Weed Management (IWM) program for sweet corn (Zea mays var. rugosa L.) was developed based on critical period and weed interference data generated at the University of Connecticut. The program combined preplant or preemergence herbicides carefully matched to identified weed problems with cultural practices and measured response to weed escapes in an effort to optimize weed control while minimizing the number and amount of herbicides applied. IWM was effective in its first year at improving weed control but did not generally result in a reduction in herbicide use.

INTRODUCTION

Integrated Pest Management (IPM) programs have been very successful in the Northeast in improving the control of European corn borer, corn earworm and fall armyworm while reducing the number of sprays applied. The Integrated Weed Management (IWM) program draws on the same principles proven effective by IPM to improve the effectiveness of weed control programs while minimizing the number and quantity of herbicides applied.

METHODS

The IWM program involves three separate steps. First, the use of herbicides best suited to the weed problem. I call this "prescription weed control". Second, don't control weeds that don't need controlling. This is the "critical period" for weed control. Finally, use cultural practices that favor the growth of the crop and minimize the competitiveness of the weeds.

Prescription weed control requires that you know which weeds need to be controlled. This involves scouting. Unlike the IPM program where scouting takes place while the crop is growing, the IWM scouting must start before the crop is planted. The most effective way to scout is to have growers leave an untreated strip the year before the field will enter the IWM program. Growers have proven willing to do this and after assessment I hand spray with a postemergence herbicide to prevent weeds from producing seed. If a grower decides to enter the program too late to leave an untreated area a reasonable assessment can be made by interviewing the grower and walking the field near the end of the season to identify weeds present. With this information, herbicides can be selected specifically to control the weeds identified in the field. To help select effective herbicides, tables have been prepared that list the herbicides labelled for use on sweet corn and rate them for effectiveness in controlling the major weeds found in New England.

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The critical period for weed control results from the fact that the effects of weed competition are not uniform throughout the season. Rather yield reduction occurs only during certain - frequently brief - stages of crop growth. This period when crop yield reduction occurs as a result of weed competition is the critical period. Weeds must be controlled during this time. Critical periods for sweet corn cultivars of various maturities have been determined experimentally at the University of Connecticut and other locations. IWM participating growers are instructed to walk their fields prior to the critical period for their sweet corn maturity group. If weeds are present they notify IWM personnel.

The competitive effect of mixed and single species weed populations on sweet corn has been determined experimentally at the Univeristy of Connecticut. The experimental data relates yield reduction to weed biomass. The observed yield of corn from two sites and several years of trials was plotted against weed biomass. Instead of fitting a curve to the data in the conventional manner a "worst case" senario was used. This was done to assure initial success of the program. As field experience is gained and grower confidence in the IWM program increases this action threshold will be raised to more accurately reflect the research data.

For extension purposes the weed biomass is represented by a rating illustrated by silhouette drawings. Postemergence herbicides, cultivation or other weed control measures are recommended only when yield reductions are projected to occur and the value of the yield increment lost exceeds the cost of control measures.

Finally, cultural practices such as increased crop density, fertilizer banding and nitrogen sidedressing are encouraged as production practices that maximize productivity, minimize potential for groundwater contamination and result in the crop being a better competitor relative to the weeds.

RESULTS AND DISCUSSION

Based on one year's experience, the growers who enter the IWM program tend to do so because they have a weed problem. For this reason, the number or amount of preplant or preemergence herbicide used is frequently not reduced. However, the effectiveness of weed control programs has been greatly increased and reductions in rescue treatments such as cultivation or multiple postemergence herbicide applications has been observed.